Purpose of and Need for Action

CHAPTER 1: PURPOSE OF AND NEED FOR ACTION

INTRODUCTION

Wind Cave National Park is proposing to manage the elk population that uses the park to prevent impacts to other natural resources, which would occur as the herd size increases. Previously, translocation of elk had been the principal tool used to keep population numbers in line with its historic management goals. However, with the concurrent discovery of CWD in elk wintering in the park and a 2002 National Park Service (NPS) Director's memo (NPS 2002b) preventing movement of live animals when the population is known to be infected with CWD, translocation was no longer an option. Because the natural suite of elk predators has long been absent from South Dakota, the population would continue to grow to a size where it would harm other park resources. Therefore, this planning process was needed to examine alternatives to translocation to maintain the elk population at a size where vegetation, other ungulates and wildlife, park neighbors and other park resources would not experience adverse effects.

Located in the southeastern Black Hills of South Dakota, Wind Cave National Park (also referred to as Wind Cave or the park) consists of 28,295 acres of mixed–grass prairie grasslands and ponderosa pine (*Pinus ponderosa*) forest (figure 1). The park is home to a variety of native wildlife besides elk (*Cervus elaphus nelsoni*), including bison (*Bison bison*), pronghorn antelope (*Antilocapra americana*), deer (*Odocoileus* spp.), coyotes (*Canis latrans*) and black-tailed prairie dogs (*Cynomys ludovicianus*). It is surrounded by a combination of 33 miles of seven-foot-high and four miles of four- to five-foot-high woven wire fence intended to contain bison and deter the movement of elk and other ungulates (figure 2).

Wind Cave National Park is proposing to manage the elk population that uses the park to prevent impacts to other resources.

Prior to the establishment of Wind Cave National Park (1903), elk had been extirpated from the area. Elk were reintroduced to the park between 1914 and 1916. Recent annual winter estimates of elk using the park are well over the historic management goal of 350 to 400 animals. Historically, management goals were set for biological, social and economic reasons, including ecological balance and impacts to nearby private landowners.

Chronic wasting disease was identified in elk and deer utilizing the park in 2002, resulting in the loss of the primary means of population control—transport of live elk out of the park (NPS 2002b). While hunting is not allowed in the park, it currently occurs in Custer State Park (immediately to the north) and on state and federally managed lands and private lands surrounding the park (see the "History of Elk Management in Wind Cave National Park and Surrounding Areas" section in this chapter for more detail).

The management of elk utilizing the park is an important component of the regional management of elk in the southern Black Hills. Park counts are taken in the winter, as this is when the maximum number of elk occupy habitat inside Wind Cave National Park. During the winter of 2003–2004 it was estimated that 700 elk were present in the park. In 2003, elk using the park comprised an estimated 36% of the elk population in the southern Black Hills (including state-managed hunting units H3 and H4, Custer State Park, and the park) and 11% of the entire Black Hills population (figures 1 and 2).

In the spring, many elk exit to calve and feed before re-entering the park in the late summer/early fall at the onset of the hunting season. Although earlier information suggested most of the elk leaving the park were females, more recent research indicates nearly the same percentage (37–38%) of bull and cow elk emigrate (Sargeant et al. 2008). The majority of elk summering outside the park make use of the lowered fence on the park's southwest corner to leave. Sargeant et al. (2008) found that although the majority of cow elk leaving the park stayed within a 5.4 mile (9 kilometer) radius west of the park and south of Pringle, S.D., bulls ranged over a larger area within 16 miles (27 kilometers) of the park. Bulls also ventured over a broader area further north, south and west of the park boundary than cows.

Elk in Wind Cave National Park

The park is partnering in this elk management planning effort with the South Dakota Department of Game, Fish and Parks (SDGFP). The park and the SDGFP have entered into a Memorandum of Understanding (appendix A) that establishes the standards, terms, conditions, roles, and responsibilities in the project planning and National Environmental Policy Act (NEPA) process for development of an elk management plan that is consistent with the state's larger southern Black Hills Plan (in progress). A separate CWD management plan has been developed by the SDGFP. Specifically, under the Memorandum of Understanding, the NPS agrees to:

- Be responsible as lead agency for the preparation, publication, and distribution of the elk and CWD management plan(s), and associated EISs and Record(s) of Decision for the park;
- Have sole approval authority and responsibility for proposed actions within Wind Cave National Park; and
- Act as a cooperator on the state's plans.

Under the Memorandum of Understanding the State of South Dakota agrees to:

- Be responsible as lead agency for the updating and maintenance of a Black Hills elk and a statewide CWD management plan(s) along with their associated research, management and public relations involvement strategies; and
- Act as a cooperator and consultant in the preparation of the Wind Cave National Park elk and CWD management plan(s) and EISs.

Under the Memorandum of Understanding the NPS and the State of South Dakota agree to:

- Meet regularly and draft the plan and environmental documents;
- Designate staff representatives to form a core planning team;
- Fund their individual participation in this process;
- Have a representative participate at public meetings relating to the issues covered by this Agreement; and
- Fully inform each other of and coordinate, to the best of their ability, all management planning efforts.

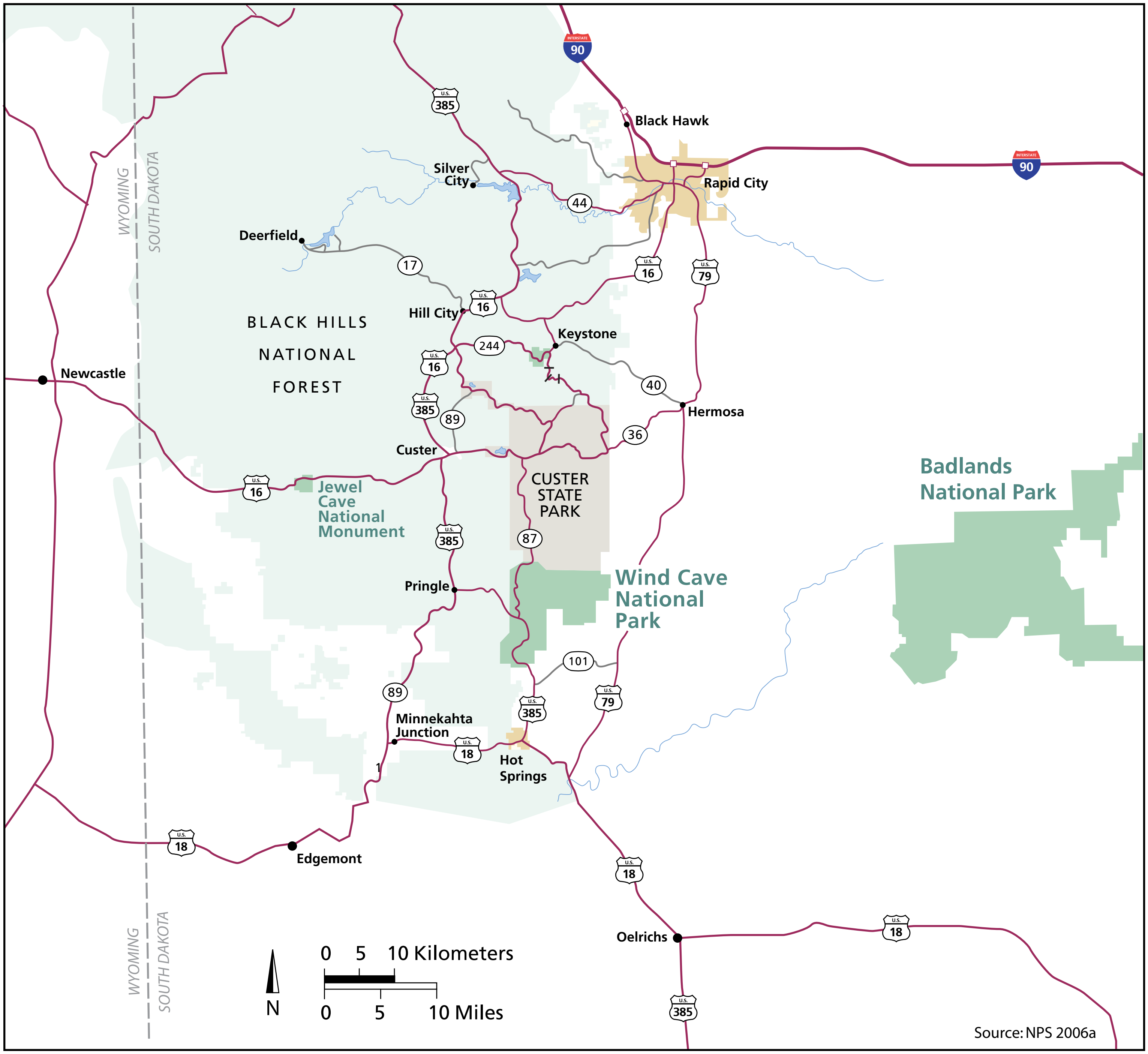


Figure 1. Vicinity Map with Wind Cave National Park, Black Hills National Forest and General Region Indicated

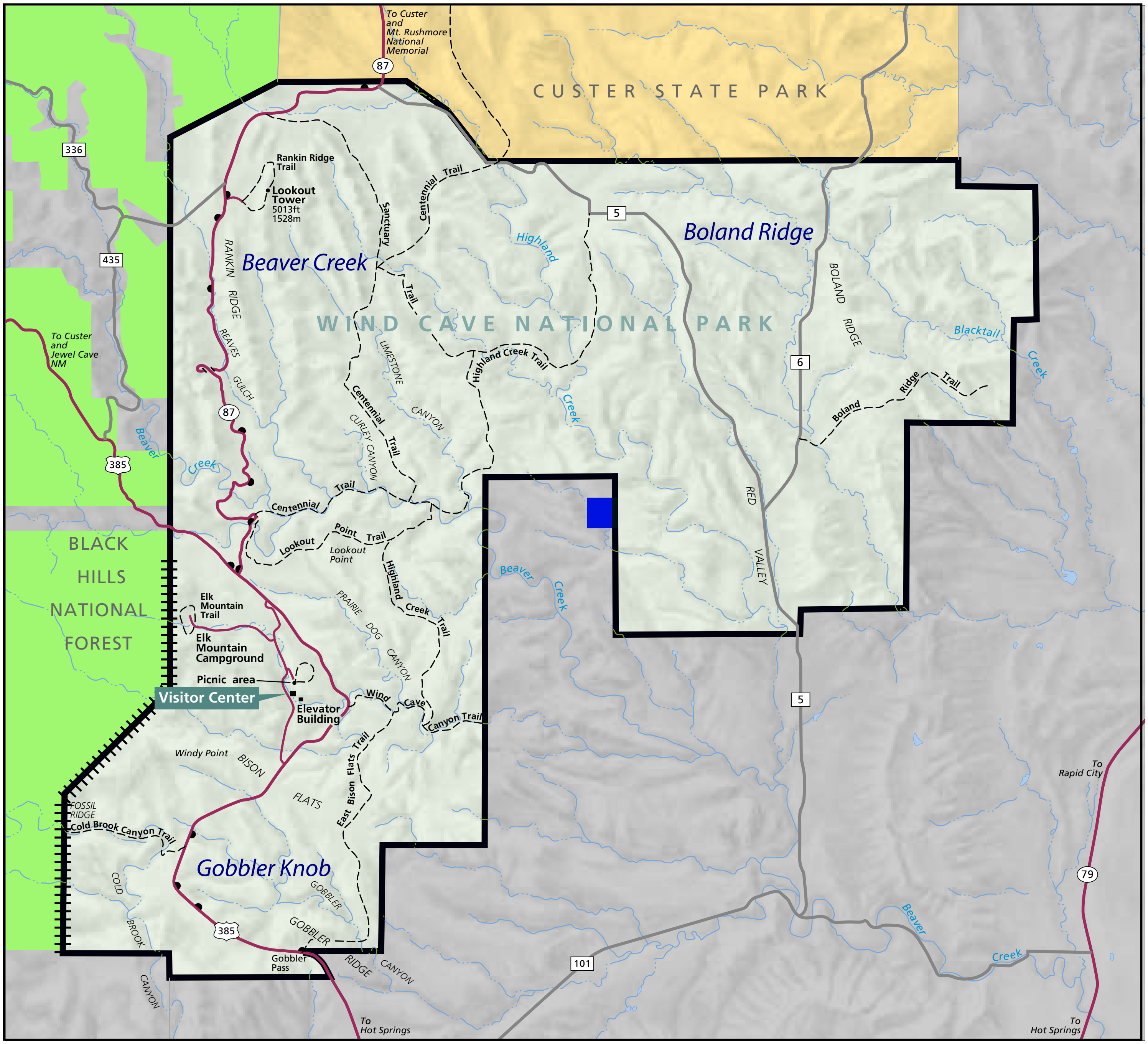


Figure 2. Wind Cave National Park Map with General Subherd Areas, State Hunting Units, Adjacent Land Owners, Fencing Indicated

Legend

- Roads / Highways
- Pullout
- Unpaved Road
- Trails
- Streams
- Fence 7 ft.
- BLM
- Forest Service
- State, Private or County
- State Park
- Fence 4 ft.

N

0 1 2 Kilometers

0 1 2 Miles

PURPOSE OF AND NEED FOR THE PLAN

Need is defined as a "discussion of existing conditions that need to be changed, problems that need to be remedied, decisions that need to be made, and policies or mandates that need to be implemented" (NPS 2001a:16). In other words, need is a discussion of why action is being proposed or taken at this time.

An elk management plan is needed at Wind Cave National Park because the population is not regulated by natural ecosystem processes. This may result in adverse effects on:

- neighboring land uses
- other wildlife species
- native vegetation
- wildlife habitat
- wildlife health

Wind Cave National Park Visitor Center Entrance

Additional detail on these impacts and on the need for action is available by reading the history of elk management and the summary of research sections in this chapter, as well as the impact analysis of the "no-action" alternative (continuation of current management) in the "Environmental Consequences" chapter.

Purpose is a broad goal statement that NPS intends to fulfill by taking action. Objectives are more specific statements of purpose, that is, what must be accomplished in large part for the action to be considered a success (NPS 2001a).

The purpose of this elk management plan and EIS is to identify elk management strategies for Wind Cave National Park that establish elk population levels that are in balance with natural system functions and native wildlife and vegetation communities in the park.

Alternatives selected for a detailed analysis must meet the plan's stated objectives to a large degree, and resolve purpose and need for action. Objectives identified for the elk management plan include the following:

1. Retain the ability to manage the elk populations to meet biological objectives where wildlife health issues are present or emerge
2. Incorporate latitude for management strategies as information is obtained from relevant research.
3. Consider the varied concerns of interested parties.
4. Coordinate with other agencies responsible for elk management in order to achieve management goals and objectives.
5. Identify thresholds that will trigger elk population management actions, considering all relevant biological factors.

BACKGROUND

ADMINISTRATIVE HISTORY OF THE PARK

Wind Cave National Park (initially 10,532 acres) was established by the act of January 9, 1903 (32 Stat. 765-766, 16 USC 141-146) to

> (reserve) from settlement, entry, sale, or other disposal and set apart as a park all those (lands) in the State of South Dakota as follows…That said, park shall be known as the Wind Cave National Park and shall be (controlled) by the Secretary of the Interior.

It was the eighth national park and the first created to protect a cave. Subsequent legislation influenced and altered the size and purpose of the park to include surface resources.

The act of August 10, 1912, (37 Stat. 293) established the Wind Cave National Game Preserve on the land included within the boundaries of Wind Cave National Park under the jurisdiction of what was then the Bureau of Biological Survey of the U.S. Department of Agriculture. This act established

> . . . a permanent national range for a herd of buffalo to be presented to the United States by the American Bison Society, and for such other Native American game animals as may be placed therein.

Section 601 of Public Law 148 (6/15/35; 49 Stat. 383, USC 141b) stated that "effective July 1, 1935, the Wind Cave National Game Preserve in the State of South Dakota" was to be abolished, and all property transferred to and made part of the Wind Cave National Park, which would be subject to all applicable laws and regulations for the purposes expressed in the act of August 10, 1912, establishing the game preserve.

In 1946, the park boundary was expanded from 11,718 to 28,059 acres to provide enough land to maintain viable populations of big game animals, especially pronghorn antelope (Public Law 708 [60 Stat. 970, 16 USC 141a]). In 1978, approximately 230 acres were added to the southern end of the park (Public Law 95-625 [92 Stat. 3475]).

PURPOSE AND SIGNIFICANCE OF WIND CAVE NATIONAL PARK

Wind Cave National Park was the seventh national park and the first created to protect a cave.

The park's purpose (as identified in the general management plan [1994b]) is to:

- Protect Wind Cave;
- Provide habitat for bison and other native game animals;
- Preserve and protect surface and subsurface resources;
- Preserve the flora, fauna, and natural processes of the mixed–grass prairie ecosystem; and
- Provide services and facilities necessary and appropriate for public enjoyment and appreciation of the park's resources.

Wind Cave National Park is significant for the following reasons:

- It is among the world's longest, oldest, and most three-dimensionally complex cave systems containing the world's largest concentration of boxwork. It provides a valuable opportunity to explore an underground frontier to study, observe, and interpret cave resources and processes.
- It was one of the earliest (1903) national parks and the first established to protect a cave (32 Stat. 765-766, 16 USC 141-146).
- It provides a valuable opportunity for visitors to view a mixture of equally significant cave resources and prairie ecosystems, and to appreciate the connection between the surface and subsurface ecosystems.
- It is a designated Class I air quality area (*Clean Air Act*).
- It is an important part of the region's tourism.

Wind Cave Room – Snow Drift Avenue

- It contains a slice of relatively undisturbed mixed–grass prairie ecosystem. Its location at the juncture of eastern grasslands/western forest results in a diversity of species easily accessed by visitors and researchers.
- It is a large area in the southern Black Hills managed primarily for natural processes. The Black Hill Community Inventory is a classification and description of vegetation of the Black Hills designed to identify high quality examples of plant communities. Exemplary sites contain multiple plant community types in landscapes that are relatively intact over large areas and where natural ecological processes are allowed to function. Wind Cave National Park is considered one of eight exemplary sites in the Black Hills (Marriott et al. 1999). Ten of the 16 plant community types with the highest rankings in the Black Hills occur in the park.
- It is one of the earliest (1912) park areas to be designated a game preserve for the reestablishment of the American bison (37 Stat. 293) and at present is the home to one of the nation's most genetically diverse bison herds and has no detected cattle gene introgression (NPS 2006b).
- It provides habitat for a wide variety of wildlife representative of a mixed–grass prairie ecosystem, including elk, bison, pronghorn, deer, prairie dogs, etc.

MISSION STATEMENT

The mission statement for Wind Cave National Park states: Wind Cave National Park is dedicated to preserving and protecting an internationally significant cave, a mixed–grass prairie ecosystem, bison, and other native wildlife for the enjoyment, education, and inspiration of this and future generations (NPS 2002a: 2).

HISTORY OF ELK MANAGEMENT IN WIND CAVE NATIONAL PARK AND SURROUNDING AREAS

With the historic extirpation or near-extirpation of their major natural predators, such as wolves and bears, elk populations in North America have increased greatly in the past 100 years, reaching an estimated 1.2 million animals in 2000 (Toweill and Thomas 2002). With growing elk numbers in the United States, several national parks are now encountering over-population problems and are developing elk management plans. At Rocky Mountain National Park, high browse pressure from elk is altering aspen and willow habitats and nutrient cycling (Singer and Zeigenfuss 2002). Rocky Mountain National Park is currently conducting lethal removal of elk to reduce the impacts of elk on vegetation, reduce conflicts between people and elk, and restore the natural range of variability in both the elk population and affected plant communities to the extent possible (NPS 2006c). Rocky Mountain National Park staff continue to monitor the population each year to determine the number of female elk to be culled; in 2009 the park estimates 30 to 40 should be removed (http://www.nps.gov/romo/parkmgmt/elkveg_fact_sheet.htm). Rocky Mountain National Park faces a situation similar to Wind Cave National Park in that CWD is also present in elk, precluding translocation of live elk from the park. As is true for alternatives in this plan/EIS, Rocky staff test all culled elk for the presence of CWD. Theodore Roosevelt National Park (North Dakota) is also in the process of developing an elk management plan, although CWD has not been found in elk in that park.

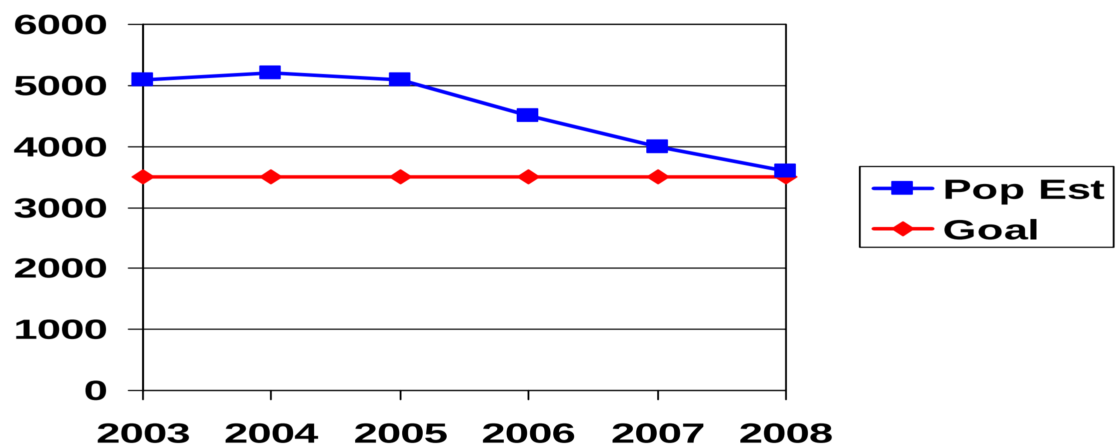

Bull Elk in Wind Cave National Park

Elk are native to Wind Cave National Park, but prior to establishment of the park in 1903, had been extirpated from the area. In 1912, the Wind Cave National Game Preserve was established, encompassing approximately 4,000 acres of Wind Cave National Park. Rocky Mountain elk were reintroduced into the preserve between 1914 and 1916 (Bauman 1997). Bison and pronghorn were also reintroduced to the preserve in 1913 and 1914. The game preserve was managed by the Bureau of Biological Survey, under the U.S. Department of Agriculture until 1935 when the preserve was abolished and management was transferred to the NPS under the Department of the Interior. At that time, a fence was constructed around the entire 11,723 acres of Wind Cave National Park to contain the growing bison herd. Today Wind Cave National Park includes 28,295 acres that are fenced with 33 miles of seven-foot-high fence and four miles of four- to five-foot-high fence. Elk are able to enter and exit the park over all fenced areas, but move more freely over the lower segment of fence located in the southwest corner (figure 2).

Several accounts of the history of animal and/or elk management in the park have been compiled (Lovaas 1973a; Mogen 1977; Bauman 1997; NPS n.d.a). Over time, managers have used several approaches to reduce elk numbers within the park, including butchering elk and selling or donating the meat; chasing elk into adjacent Custer State Park; culling elk through shooting; allowing egress of animals over the low segment of fence; and capturing and shipping elk to other national parks, federal lands, American Indian Tribes, State, or private organizations (Lovaas 1973a, b). Shooting elk as a control method was discontinued in 1957. As a result of the varied historic management techniques, the population of elk wintering in the park varied dramatically over the years (Bauman 1997).

In recent years, the park has been operating under a 1980 Elk Surplus Program Plan / Environmental Assessment (NPS 1980) and a 1994 Elk Management Strategy (NPS 1994a), both of which call for live trapping and relocation of elk to maintain the population between 350–400 animals. Until 1994 (the date of the last elk roundup conducted in the park), the park conducted a roundup once every few years when the elk population began to exceed the 350–400 head level. Census counts were conducted each year, and park staff was able to maintain desired sex/age ratios, protect lead cows to maintain herd memory, and not remove large numbers of elk from any one location in the park (NPS 1994a). This management approach was working well until 1997 when CWD was identified in a captive herd adjacent to the park. On July 26, 2002 the NPS director issued a memo stating “deer or elk will not be translocated from areas where CWD is known to occur” (NPS 2002b; appendix B). In November 2002, CWD was documented in a cow elk in Wind Cave National Park. This eliminated trapping and relocating elk as a management option. Since the 2002 memo, counts of the elk population wintering in the park has varied annually from an estimated 525 to more than 800, a range considerably higher than the historic management goal of 350–400 animals. On average, the elk herd is believed to increase annually by approximately 10–12% (NPS 2006g).

The number of elk in the Black Hills population has also been larger than the target set by SDFGP until recently. The number of elk in the Black Hills population exceeded the SDFGP objective of 3,500 +/- 200 (figure 3) until recently, but in 2008 had declined to be within the range set by the state (Kanta 2008).



Source: Kanta 2008

FIGURE 3. ESTIMATED NUMBER OF ELK ON NATIONAL FOREST AND PRIVATE LANDS IN THE BLACK HILLS, 2003 TO 2008

RESEARCH

Herd Organization/Movement

Surplus elk from Wind Cave National Park have been used to supplement and establish elk populations in many areas, including the Black Hills. Between 1980 and 1986 elk were transplanted from the park into several areas in the southern Black Hills (Rice 1988). A few elk transplanted into Custer State Park returned to Wind Cave National Park, but those taken farther away established new home ranges.

Elk herd organization in the park was studied from 1973–1975 (Varland 1976; Varland et al. 1978). Researchers believed that elk in the park formed three general cow-calf subherds: Gobbler Knob in the southwest portion of the park, Beaver Creek (also referred to as Rankin) in the northwest, and Boland Ridge in the east (figure 2). This assumption is currently under investigation (see discussion of U.S. Geological Survey and NPS study below), and preliminary results indicate a much wider range of movement for most elk and no particular fidelity to a given "subherd." Generally, elk use was concentrated in the forested areas of the park during the spring and summer, whereas grasslands were utilized during fall and winter (Varland et al. 1978). A portion of the elk in the Gobbler Knob area was found to spend some of the spring and summer west of the park on U.S. Forest Service (USFS) and private land.


NPS and USGS Representatives Examine Elk Radio-collar

Bauman (1998) further researched elk herd organization and movements from 1996–1997, including movements of wintering elk out of the park by studying a small sample of radio-collared animals (20 animals). The data showed that maximum animal crossings occurred in the spring (out of the park) and fall (into the park) and bulls crossed the park boundary most frequently in the fall (Bauman et al. 1999). This same study tested whether the use of one-way gates to allow elk out of the park would be workable as a possible means for elk population control. Researchers found that some elk would use the one-way gates to leave the park after being baited through the gates with salt licks. For the control method to work, the low segment of fence along the southwestern boundary of the park would have to be raised to discourage elk from re-entering. Elk radio telemetry location data from the Bauman (1998) study were also analyzed to determine elk use of edge habitat within the park (Lagueux 2002). Elk in the park showed preference for the suitable cover-forage edge and also for areas with a high degree of edge complexity.

In January, 2005, the U.S. Geological Survey and the National Park Service began a cooperative investigation of elk movements, distribution, and population dynamics. This project involved fitting about 100 elk with Global Positioning System radio receivers, which yield detailed accounts of elk movements within the park and across the park boundary. Preliminary results show that bull elk inside the park use a significantly larger (54% of the park) area than females (34% of the park), and are more uniformly distributed throughout the park, especially in the northeast part of Wind Cave (Sargeant et al. 2008). The number of elk leaving the park in the spring and summer was very close to equal; 38% of the 61 females and 37% of the 38 males monitored did exit the park for some period of time. Of elk leaving or entering the park, most were considered non-residents during the late spring and summer and residents during October to March. However, some who spent most of their time inside the park during the spring and summer did leave for short periods of time. The same study found that 80% of collared female elk leaving the park stayed within a 5.6-mile area on the west side of the park, where 80% of collared males roamed further north, south and west within a 16.8-mile area. Additional data is needed before any firm conclusions can be drawn regarding the degree to which elk wintering in the park are distributed outside the park in the warmer months (Sargeant et al. 2008).

Elk Food Habits

Several elk food diet studies were conducted in the park in the late 1970s (Wydeven 1979). Graminoids were the major forage class eaten in the spring and summer, while forbs were more important in the fall and winter (Wydeven and Dahlgren 1983). Wydeven and Dahlgren (1985) reported that elk and mule deer (*Odocoileus hemionus*) used habitats dominated by warm-season grasses, while bison and pronghorn used sites dominated by cool-season grasses. Competition between elk and bison appeared to be low due to low distributional overlap and food habit differences.

Elk Browsing Impacts

Elk in Wind Cave National Park

Although it is known that elk contribute to impacts on shrubs and young trees, the actual extent of their impact in the park is less well known. Singer and Zeigenfuss (1998) theorized that fire suppression, which leads to encroachment by ponderosa pine in Wind Cave National Park, and heavy utilization of shrubs by herbivores, including deer and elk, were likely contributing to the decline of shrubs and wooded riparian areas in the park. A much earlier report from 1924 when elk and other ungulates were confined to a fenced area of about 4,000 acres, also noted the role of elk stating that, as a result of elk browsing pressure, “skunk brush, buck brush, ground mahogany, plum, choke cherry, and every small shrub is practically extinct” (Bauman 1997). Singer and Zeigenfuss suggested that fall burns could be used to improve shrub regeneration in riparian areas of the park if browsing intensity was kept low following burning.

In addition to the decline of shrub and riparian habitat, elk have contributed to the decline of aspen, cottonwoods and bur oak through browsing. Aspen and other hardwoods are limited in their extent in the park, and this limited food source is heavily used by elk during some portions of the year. This heavy use prevents young plants from growing to maturity. To address elk impacts upon aspen regeneration, an exclosure of approximately 40 acres was constructed in the northwestern corner of the park, along with several smaller exclosures in other areas of the park. The habitat within these exclosures contains numerous young aspen that will be able to grow to maturity in the absence of elk browsing pressure.

Herd Size

The management goal of 350–400 elk (and a minimum of 400 bison) is a number based on range and forage conditions documented through a series of vegetation surveys conducted in the late 1950s and early 1960s. Despite some reduction efforts in the 1940s and early 1950s, the elk population had increased to an estimated 1,200 head in the park by 1953 and surveys confirmed the range was in poor condition as a result (NPS 1994a; Bauman 1997). Maximum numbers for both elk and bison and surplus disposal programs to maintain population levels were established to allow vegetation to recover. These numbers were formalized in the 1980 “Elk Surplus Disposal Program for Wind Cave National Park” environmental assessment (NPS 1980).

Effects of Overpopulation

In addition to impacts to rangelands, elk browsing can have substantial localized impacts on some vegetative communities such as those described above (shrublands, hardwoods, and riparian areas) and prevent regeneration. Larger elk numbers than those prescribed in park management plans (Elk Management Strategy [NPS 1994a], General Management Plan [NPS 1994b], and Resource Management Plan [NPS 1994c]) make it difficult for the park to balance the competing interests of elk and other ungulates. For example, Wydeven and Dahlgren (1985) considered competitive exclusion to be a likely explanation for the limited distribution of mule deer in the park when elk numbers reached 450–500 in 1976. They also noted the potential for competition between elk and pronghorn at this same time, and concluded that "[Elk] populations should not be allowed to expand greatly over [these] levels."

High elk densities also impact area landowners, who believe the park serves as a haven for elk that damage private property (e.g., crop depredation) at certain times of the year. Stakeholders have also expressed concern over the possibility that high elk densities would contribute to the spread of CWD among elk and deer within the park, which would then serve as a source of contamination for elk and deer managed at lower densities outside the park. Density of elk inside the park in 2007 as of the latest ground census was about 15 elk per square mile while densities in adjacent Custer State Park and state-managed hunting units (H3 and H4) south and west of the park are presumed to be much lower. In 2002, elk densities in Custer State Park averaged 9.6 elk per square mile and the hunting units averaged 1.4 elk per square mile (figure 2). Year 2002 estimates for elk wintering in the park were about 14 elk per square mile (Sargeant and Roddy 2002). These figures assume all habitat within Wind Cave, Custer State Park or hunting units H-3 and H-4 was used by elk. Park managers estimated that actual elk densities inside Wind Cave in 2002 may have ranged from 19 elk per square mile in the southwest part of the park to as high as 30 elk per square mile in the west-central Beaver Ridge area. Densities for the northeast part of the park at Boland Ridge were not estimated.

The elk population wintering in the park and in the vicinity outside the park contributes to property damage problems. The SDGFP pays for projects to mitigate or decrease property damage caused by elk on lands other than those managed by the NPS or U.S. Fish and Wildlife Service. In 2005, the SDGFP spent approximately $87,000 in mitigation and preventive measures designed to decrease property damage (e.g., crop depredation, fence damage), a figure which has more than doubled since 1999 (SDGFP 2003b). In 2003 a group of landowners concerned about increasing elk depredation formed the Fair Deal Coalition to meet with wildlife management agency staff to voice their concerns and help to create solutions. As a result of the Coalition's request for amendments in the elk harvest plan for the hunting units in their area, the SDGFP responded with science-based modifications including an increase in the numbers of cow elk tags for 2002 and 2003 hunting seasons (see SDGFP 2003a, b). The SDGFP has increased funding for elk depredation-related projects and hunter access within the elk emphasis area (SDGFP 2003b). The projects are evaluated and reviewed annually by the Coalition.

Chronic Wasting Disease

Chronic wasting disease is a member of the transmissible spongiform encephalopathy (TSE) family of diseases that are presumably caused by abnormal prion proteins. Chronic wasting disease is both infectious and contagious (Williams et al. 2002). Chronic wasting disease has been identified in Rocky Mountain elk, mule deer and white-tailed deer (*Odocoileus virginianus*), and moose (*Alces alces*). The dynamics of this disease in deer and elk populations are poorly understood, as is the exact mode of disease transmission. Scientists hypothesize that excreta such as urine, feces and saliva are potential means of transmission in free-ranging animals (Miller et al. 1998, 2004), and blood and saliva from infected animals is known to transmit the disease under experimental conditions. In captive penned studies, it has been shown that environmental contamination (e.g., contamination of soils and vegetation) with prion containing carcasses or excreta can transmit the disease to healthy individuals (Miller et al. 2004). Therefore, increasing concentrations of deer and elk may increase the chance of disease spread through direct contact among animals or indirect contact with environmental contamination (Samuel et al. 2002).

Wind Cave National Park biologists currently use detailed on-the-ground surveillance of the elk herds to identify animals exhibiting clinical signs of CWD. Under a NEPA categorical exclusion, the park can remove animals that exhibit clinical signs of CWD. The park also tests some deer for research purposes. As of September 2006, 181 deer and elk (45 elk, 109 mule deer and 27 white-tailed deer) had been killed and/or tested, with eleven elk and eight deer testing positive for CWD. It is important to note that this targeted killing and testing done by the park cannot be used to determine prevalence rate, as it is not systematic or random but rather deliberately picks out sick animals. No systematic study of elk has been conducted at Wind Cave to determine statistically valid prevalence rates because this would involve killing a large percentage of the population to obtain test results. However, results from testing elk heads from those killed by hunters immediately outside the park has provided 643 data points, with prevalence averaging 0.6% (SDGFP 2007).

PARK PLANNING DOCUMENTS RELEVANT TO ELK MANAGEMENT

The following is a summary of Wind Cave National Park planning documents related to elk management.

Elk Surplus Disposal Program / Environmental Assessment (NPS 1980). This document identifies the managed capacity of the park being between 350 and 400 elk. Of the seven alternatives analyzed, the alternative chosen was live trapping and relocation of elk, the same management strategy that had been in place for the previous 10 years and the one the park believed to be most efficient and effective in maintaining elk at a level that other resources are not adversely affected.

Elk Management Strategy (NPS 1994a). This document recommends maintaining an elk population in the range of 350–400 elk by live trapping and removing elk from the park.

Wind Cave National Park General Management Plan and Environmental Impact Statement (NPS 1994b). The purpose of this plan is to guide visitor use, natural (including large mammals) and cultural resource management, and general development within the park for the subsequent 10 to 15 years (NPS 1994b:iii). The plan's objectives include the following:

- To preserve the surface and subsurface resources and protect them from threats originating within and outside the park boundary.
- To increase public awareness of natural systems (e.g., elk management needs).
- To conduct and encourage scientific study.
- To regulate and facilitate visitor access to Wind Cave National Park to protect the cave and the surface resources.
- To maintain credibility and active working relationships with neighboring agencies, communities, and special interest groups.
- To provide appropriate facilities to support visitor use and resource management.

Other park planning documents that could influence or have relevance to elk management include the following:

- *Backcountry Management Plan* (NPS 2000a). This plan summarizes the park's backcountry use (patterns of use, actual use, regulation, administrative policies, patrol and management, trails management, recommendations and management).
- *Boundary Expansion Environmental Assessment* (NPS 2002a). This environmental assessment analyzes a proposed park boundary expansion, which would add 5,675 acres to the park; congressional action to expand the boundary took place in September 2005, however provisions for funding the purchase of the land have not occurred. These additional lands would increase the amount of habitat available to the elk herd, possibly resulting in reduced elk density in the park. However, the SDGFP has indicated these lands are already at or above the state's management goal. In addition, half of the property was depopulated because of CWD contamination.
- *Fire Management Plan* (NPS 2005a). This plan provides specific guidance and direction for use of fire to restore and perpetuate natural processes in the park. Plan objectives include those addressing safety of facilities and resources and the minimization of adverse environmental effects to them. The park plans to treat up to 4,000 acres per year, with each area being treated at a maximum of 15 years to replicate the natural fire frequency of 5 to 20 years.
- *Bison Management Plan* (NPS 2006b). The plan establishes the size of the park's bison population and provides direction for the distribution of forage among grazers.
- *Resource Management Plan* (NPS 1994c). This document outlines the direction for proposed actions for the protection of park resources and the enhancement of visitor experiences at the park. An update to the plan is currently in preparation.
- *Black-tailed Prairie Dog Management Plan and Environmental Assessment* (NPS 2006a). This document is designed to update management strategies that are consistent with the current resource objectives and policies of the NPS. The plan's goals include approaches for sustaining a long-term population of prairie dogs that meet other park objectives; conservation of natural processes and conditions; identification of tools to manage the black-tailed prairie dog population; management of resources in accordance with the park's general management plan, resource management plan, and NPS *Management Policies 2006* (NPS 2006d); and to protect public health, safety, and welfare.
- *Vegetation Management Plan and Environmental Assessment* (NPS 2006e). This draft plan would establish direction for the future management of native and non-native vegetation in the park. This could have effects on the amounts of available forage, as well as determine potential vegetation management activities.
- *Wind Cave National Park Black-footed Ferret Reintroduction Plan and Environmental Assessment* (NPS 2006f, Finding of No Significant Impact dated March 2007). This plan outlines goals for reintroduction and sustaining a long-term population of black-footed ferrets within the park and the conservation of natural processes and conditions. Wind Cave National Park could potentially receive approximately 20 to 25 animals per year for three to five years.
- *Statement for Management, Wind Cave National Park* (NPS 1994d). This document is designed to guide decision making and direct future planning and study efforts within the park.

OTHER AGENCY ELK MANAGEMENT RESEARCH/PLANNING EFFORTS AND ACTIONS

The South Dakota Department of Game, Fish and Parks. The SDGFP is responsible for management of the southern Black Hills elk population outside the park boundaries (figure 1). The SDGFP goal for elk management in the southern Black Hills is to optimize consumptive and non-consumptive elk uses while providing for the long-term conservation, management and enhancement of elk populations within the southern Black Hills ecosystem in a manner that is consistent with ecological, social, aesthetic and economic values of the people of South Dakota. The SDGFP sets population objectives for herd units based upon public desires and institutes hunting seasons at levels geared to maintain herds at objective levels.

In addition, as of 2008, the SDGFP is managing elk in the larger southern Black Hills to stabilize the elk population in hunting units H3 and H4 (those units surrounding Wind Cave National Park, see figure 2) to balance hunter satisfaction and elk-related property damage (SDGFP n.d.).

USFS Black Hills National Forest (BHNF). Most lands west of Wind Cave National Park are under BHNF management. Elk using the park during a portion of the year utilize these lands as well (figure 2). While the BHNF does not manage wildlife populations on forest land (this is the purview of the SDGFP), the BHNF does manage wildlife habitats, and in that respect, BHNF management actions could impact elk populations. The BHNF amended in 2005 its Land and Resource Management Plan, a document that directs management of forest lands in the southern Black Hills. The primary issues related to the elk population on the BHNF are potential impacts to vegetation and forage allocation (allocation of forage resources between wildlife and livestock). The Land and Resource Management Plan of 1997 set a goal of 3,800 elk for the BHNF.

RELATIONSHIP OF THE PARK'S PLANNING EFFORTS TO OTHER REGULATIONS, PLANS AND POLICIES

The NPS is governed by a variety of laws, regulations, and policies which apply to any management action addressed in this EIS. A brief discussion of those relevant to elk management in the park follows (additional resource-specific laws, regulations, and policies are discussed in the "Environmental Consequences" chapter.)

Federal Laws, Regulations and Policies

Organic Act and NPS Management Policies 2006. By enacting the NPS *Organic Act* of 1916 (*Organic Act*), Congress directed the U.S. Department of Interior and the NPS to manage units "to conserve the scenery and the natural and historic objects and wild life therein and to provide for the enjoyment of the same in such a manner and by such a means as will leave them unimpaired for the enjoyment of future generations" (16 USC 1). Congress reiterated this mandate in the Redwood National Park Expansion Act of 1978 by stating that NPS must conduct its actions in a manner that will ensure no "derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress" (16 USC 1a-1).

Despite these mandates, The *Organic Act* and its amendments afford the NPS latitude when making resource decisions that balance visitor recreation and resource preservation. By these acts Congress "empowered [the NPS] with the authority to determine what uses of park resources are proper and what proportion of the parks resources are available for each use" (Bicycle Trails Council of Marin v. Babbitt, 82 F.3d 1445, 1453 [9th Cir. 1996]).

Because conservation remains its predominant mandate, the NPS seeks to avoid or to minimize adverse impacts on park resources and values. Yet, the NPS has discretion to allow negative impacts when necessary (NPS *Management Policies 2006*, sec. 1.4.3 [NPS 2006d]). While some actions and activities cause impacts, the NPS cannot allow an adverse impact that constitutes resource impairment (NPS *Management Policies 2006*, sec. 1.4.3 [NPS 2006d]). The *Organic Act* prohibits actions that permanently impair park resources unless a law directly and specifically allows for those acts (16 USC 1a-1). An action constitutes an impairment when its impacts “harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values” (NPS *Management Policies 2006*, sec. 1.4.5 [NPS 2006d]). To determine impairment, the NPS must evaluate “the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts” (NPS *Management Policies 2006*, sec. 1.4.5 [NPS 2006d]). The NPS *Management Policies 2006* require that these determinations, and all NPS planning decisions, be based on current scientific and scholarly understanding of park resources and ecosystems (NPS 2006d, sec. 2.3.1.5).

Park units vary in their enabling legislation, natural and cultural resources, and missions. Management activities appropriate for each park unit vary as well. An action appropriate in one park could impair resources in another park. Thus, this EIS analyzes the context, duration, and intensity of impacts related to elk management within Wind Cave National Park, as well as the potential for resource impairment.

National Environmental Policy Act, 1969, as Amended. NEPA is implemented through regulations of the Council on Environmental Quality (CEQ) (40 Code of Federal Regulations [CFR] 1500–1508). The NPS has in turn adopted procedures to comply with the act and the CEQ regulations, as found in *Director’s Order 12: Conservation Planning, Environmental Impact Analysis, and Decision Making,* and its accompanying handbook (NPS 2001a). Section 102(2) (c) of this act requires that an EIS be prepared for proposed major federal actions that may significantly affect the quality of the human environment.

National Parks Omnibus Management Act of 1998 (NPOMA).NPOMA (16 USC 5901 et seq.) underscores NEPA in that both are fundamental to NPS park management decisions. Both acts provide direction for articulating and connecting the ultimate resource management decision to the analysis of impacts, using appropriate technical and scientific information. Both also recognize that such data may not be readily available and provide options for resource impact analysis should this be the case.

NPOMA directs the NPS to obtain scientific and technical information for analysis. The NPS handbook for Director’s Order 12 states that if “such information cannot be obtained due to excessive cost or technical impossibility, the proposed alternative for decision will be modified to eliminate the action causing the unknown or uncertain impact or other alternatives will be selected” (NPS 2001a, sec. 4.4).

Code of Federal Regulations, Title 43. Title 43 of the Code of Federal Regulations, part 24, describes the four major systems of Federal lands administered by the Department of the Interior. Section 24.4(f) states that “Units of the National Park System contain natural, recreation, historic, and cultural values of national significance as designated by Executive and Congressional action.” In describing appropriate activities, it states that “[a]s a general rule, consumptive resource utilization is prohibited.”

In addition, section 24.4 (i) instructs all Federal agencies of the Department of the Interior, among other things, to “[p]repare fish and wildlife management plans in cooperation with State fish and wildlife agencies and other Federal (non-Interior) agencies where appropriate.” It also directs agencies to “[c]onsult with the States and comply with State permit requirements … except in instances where the Secretary of the Interior determines that such compliance would prevent him from carrying out his statutory responsibilities.”

Endangered Species Act of 1973, as Amended. This act requires all federal agencies to consult with the Secretary of the Interior on all projects and proposals having potential impact on federally endangered and threatened plants and animals.

Natural Resources Management Guideline, NPS-77, 1991. This document provides guidance to park managers for all planned and ongoing natural resource management activities. Managers must follow all federal laws, regulations, and policies. This document provides the guidance for park management to design, implement and evaluate a comprehensive natural resource management program.

Director's Order 12 and Handbook: Conservation Planning, Environmental Impact Analysis, and Decision-Making. This document, based on NEPA regulations, lays the foundation for how the NPS complies with NEPA by setting forth a planning process for incorporating scientific and technical information and establishing a solid administrative record for NPS projects. Director's Order 12 requires that impacts on park resources be analyzed in terms of their context, duration, and intensity. It is crucial for the public and decision-makers to understand the implications of those impacts based on an understanding and interpretation by resource professionals and specialists. The document also requires that an analysis of impairment to park resources and values be part of the impact analysis.

State and Local Laws, Regulations and Policies

Hunting Laws and Regulations, State of South Dakota Department of Game, Fish and Parks (applicable to lands adjacent to Wind Cave National Park). On public and private (where applicable) lands adjacent to Wind Cave National Park, the SDGFP manages all aspects of elk hunting (e.g., seasons, permitting, herd maintenance, CWD testing protocols, etc.) (see Administration Rule 41.06; http://legis.state.sd.us/rules/DisplayRule.aspx?Rule=41:06). These state-managed areas include hunting units H3 and H4 located immediately adjacent to the park (figure 2).

SCOPING PROCESS AND PUBLIC PARTICIPATION

Scoping is an early and open outreach process designed to identify environmental issues and alternatives to be addressed in an EIS.

Scoping is an early and open outreach process designed to identify environmental issues and alternatives to be addressed in an EIS. Both internal and public scoping efforts have been conducted by Wind Cave National Park for the elk management planning process.

Internal scoping, conducted in the summer of 2004, included discussions with park staff, the SDGFP, and other interested public agencies to define the purpose, need and objectives of the elk management plan, as well as to identify preliminary action alternatives and associated issues and impact topics.

Public scoping was initiated with a notice of intent to prepare an EIS published in the Federal Register on December 17, 2004. During the week of August 22–26, 2005, five public scoping meetings (open houses) were conducted in Sioux Falls, Pierre, Rapid City, Hot Springs and Custer, South Dakota. These meetings were designed to receive input regarding the draft purpose, need and objectives of the plan; the preliminary action alternatives; and issues of concern to the public related to the elk management planning effort. Comments focused on a variety of control management options, elk depredation issues, and concerns related to the "wasting of resources" (elk carcasses, etc.). This latter concern—"wasting of resources"—was raised by numerous commenters with suggestions that the meat of elk killed be used (e.g., donated to charities). Where the park was able to meet NPS public health guidelines and its own management policies for natural resources, and where it was legally feasible, donation of meat from elk was integrated into alternatives.

The draft EIS was released for public review June 20, 2008. Public meetings to receive comments and answer questions on the draft took place during the week of July 21-24, 2008. Four meetings, in Sioux Falls, Pierre, Hot Springs and Custer were conducted, with several park specialists and EIS contractors on hand to address concerns. A short presentation summarizing elk management at the park preceded the public comment input process. Participants who wished their comments to be on record were encouraged to provide them in writing on comment sheets provided at the workshop, or to verbally dictate them to a recorder at each of the public input sessions. In addition, electronic comments could be submitted to the park's website or to the NPS Planning, Environment and Public Comment (PEPC) website or be submitted by mail or fax. The public review period for the draft EIS closed August 18, 2008. The park received 33 pieces of correspondence which contained 167 comments on various topics. These were divided into "substantive" and "non-substantive" comments as prescribed by the Council on Environmental Quality NEPA regulations. Non-substantive comments are those that do not question facts or propose changes to alternatives, but rather indicate agreement with decisions or facts or simply show a preference for one alternative over another. Substantive comments are addressed in this final EIS in "Appendix N: Comment Response Report."

A more detailed description of public scoping activities is presented in the "Consultation and Coordination" chapter. Consultation with the U.S. Fish and Wildlife Service, the State Historic Preservation Officer, the USFS, and Custer State Park, and numerous tribal entities has also occurred (see the "Consultation and Coordination" chapter).

ISSUES AND IMPACT TOPICS

Environmental issues are statements of problems or opportunities that might occur if the actions identified in the alternatives were implemented. The degree to which these become problems or advantages is analyzed as a set of impact topics in the "Environmental Consequences" chapter.

Input from NPS specialists; other federal, state, and local agencies; non-governmental organizations; and the general public resulted in the identification of the following issues and impact topics. Issues listed here have the potential to result in more than negligible changes to the resource.

Natural Resources

Elk

Several behavioral and physiological changes may occur when ungulate populations such as elk reach high densities. These include possible changes in reproduction, sex and age ratios, and health and body condition. Elk may also occupy habitat that is not preferred or that is already occupied by other ungulates. This would increase competition for limited forage and habitat, as well as energy expended in obtaining forage, and could decrease survivability, particularly in harsh winters. At high densities, the risk of transmitting CWD would likely increase. Elk that would normally winter in the park may leave to find habitat where densities are lower. These types of impacts are likely to occur as elk using Wind Cave increase in numbers under the no-action alternative. Management activities can also increase energy expenditures, increase injuries and separation from calves and herdmates, and cause physiological changes from stress that could result in illness or death.

Soils and Water Quality

Elk management activities may cause trampling and loss of vegetation, with resulting increases in soil erosion along stream banks. Management activities (roundup, euthanasia activities, etc.) could also result in trampling, and erosion. If erosion occurs along stream banks or springs, erosion would result in increased sedimentation of these water resources. If elk are killed in the corral area, mitigation would be required to ensure blood, cleaning products, or other fluids do not contaminate the neighboring stream.

Vegetation

At high population levels, elk browsing and grazing activities may adversely affect the general native plant communities and the natural species composition. Considered one of eight exemplary sites in the Nature Conservancy's plant community inventory for the southern Black Hills (Marriott et al. 1999), high levels of elk use could deteriorate the high quality plant communities located within the park. In addition, concentrations of browsing elk have contributed to the reduction of the already limited extent of hardwood (e.g., aspen, cottonwood, etc.) and shrub regeneration in the park, impacting the natural composition of plant species. These hardwood and shrub species serve as a food source for elk and are heavily used during some portions of the year, resulting in limited growth, seed production, and regeneration. High levels of elk grazing/browsing in and trampling of riparian areas can adversely impact the health of these plant communities throughout the park through loss of species diversity, erosion of soils, reduced reproduction, and increases in exotic plant species. Constant heavy grazing of grasslands can also result in reductions of palatable species, encroachment of weedy invasive species, or reduced productivity. Under certain management actions (e.g., roundup), vegetation trampling is likely to occur in limited locations such as the park corrals or en route to corrals.

Other Wildlife

At high levels, elk populations have the potential to affect other wildlife (bison, pronghorn, prairie dogs, ground nesting birds, etc.) and/or habitat by impacting habitat diversity through browsing or grazing. The loss of hardwood, riparian and shrubland habitat due to elk browsing activities has the potential to eliminate or degrade habitat used by other species, such as small mammals and breeding birds. In addition, high numbers of elk could increase the risk of amplifying CWD or the potential for the spread of other diseases (bovine tuberculosis, bovine brucellosis, etc.) if they were to be found among ungulates. Other than the identification of CWD in elk and deer, there is no evidence that these other diseases exist in South Dakota. Lower elk densities may have a positive effect on CWD prevalence and disease spread.

Special Status Species

Black-footed ferrets are the subject of a reintroduction effort at the park. Ferrets rely on prairie dogs as their primary source of prey, and may be temporarily disturbed by elk grazing at prairie dog colonies.

The park is in the historic range of the federally endangered American burying beetle (*Nicrophorus americanus*) (federal endangered), but no documented sightings have taken place closer than 150 miles to the east. It is not covered in this document.

The American peregrine falcon (*Falco peregrinus*), a state endangered species, is also a rare seasonal migrant through the park, but no discernable effect from any activities associated with elk management are anticipated and it is not covered in this document.

Air Quality

Air quality could be affected by emissions related to diesel-powered incineration operations (elk carcasses), as well as the presence of smoke and odors related to disposal of elk carcasses.

Cultural Resources

Archeological Resources

Archeological sites could incur impacts as a result of erosion, trampling caused by elk browsing activities, as well as elk management actions (e.g., hazing elk outside of park, roundup, dragging carcasses).

Ethnographic resources

Elk management activities may be of interest from an ethnographic resource perspective to tribes affiliated with Wind Cave National Park.

Visitor Experience

Elk management activities could reduce elk as a recreational resource for some visitors (e.g., wildlife viewing opportunities, chance sightings, and elk "bugling" in the fall). Management actions may include use of such things as helicopters and firearms which can alter perceptions, disturb the natural soundscape, redistribute elk away from the park, or make it difficult to hear elk "bugling." Under certain management actions (sharpshooting, roundup), backcountry permits (overnight camping) would not be issued and certain park trails and areas would be closed to visitors.

Socioeconomics

The movement of elk in and out of Wind Cave National Park onto adjacent private or federal leased grazing lands may contribute to property damage (e.g., crop depredation, fencing) or loss of forage otherwise available for cattle. The SDGFP could experience effects to its hunting license revenue sources as a result of elk management strategies within the park (e.g., hunting outside the park and increases in hunting licenses; then a decrease as initial reduction is complete). Elk management strategies also have the potential to affect socioeconomic conditions of gateway communities related to hunting and tourism in the general area (e.g., revenues from lodging, restaurants, guide and other recreational services, etc.).

Park Operations

Elk management activities have the potential to impact park operations, as the efforts of several park divisions would be necessary to undertake elk management strategies. These divisions include Interpretation, Resource Management, Maintenance, Resource and Visitor Protection, and Administration (including contracting).

Human Health and Safety

Depending on the alternative, certain aspects of elk management strategies could potentially affect health and safety of park staff, visitor contractors, recipients of donated meat, etc. These include, among other things, activities involved in roundup, euthanasia, contraception, sharpshooting, and use of aircraft.

ISSUES ELIMINATED FROM FURTHER CONSIDERATION

The following impact topics and/or issues from a standardized list of potential issues were eliminated from further discussion and analysis because proposed elk management actions are not believed to have the potential to affect them:

- **Geohazards**. There are no known geohazards in the park that would be affected by elk management actions.
- **Water Quantity**. No impacts to water quantity are anticipated as a result of elk management activities.
- **Streamflow Characteristics**. No impacts to streamflow characteristics are anticipated as a result of elk management activities.
- **Marine or Estuarine Resources**. No marine or estuarine resources are located in this inland park.
- **Unique or Important Fish or Fish Habitat**. No known unique fish or fish habitat are known within the park.
- **Energy Resources and Conservation Potential**. The implementation of the elk management plan is not anticipated to impact energy resources or resource conservation potential within the park.
- **Wetlands and Floodplains**. There are no designated wetlands located within the park. No actions taken under any of the alternatives would directly affect floodplains within the park. Effects on park waters resulting from elk management efforts are addressed in the “Soils and Water Quality” section in the “Environmental Consequences” chapter.
- **Cultural Landscapes, Historic Structures and Museum Collections (Cultural Resources)**. Management actions are not believed to have the potential to affect cultural landscapes, historic structures or museum collections.
- **Prime and Unique Agricultural Lands**. No such lands are located within the park.
- **Wilderness**. Wind Cave National Park does not contain nor is it adjacent to any designated or proposed wilderness areas.
- **Indian Trust Resources**. No identified Indian Trust Resources exist within the park.
- **Adjacent Land Use**. Issues related to this topic are covered under Socioeconomics.

Alternatives

CHAPTER 2: ALTERNATIVES

The *National Environmental Policy Act* (NEPA) requires that federal agencies explore a range of reasonable alternatives and provide analysis of what effects those alternatives could have on the natural and human environment. As required under Council on Environmental Quality (CEQ) regulations 40 CFR 1502.14(d) the analysis in an environmental impact statement (EIS) must "include the alternative of no action." The no-action alternative in this plan/EIS is the continuation of current elk management strategies with no major changes. Action alternatives selected for detailed analysis must resolve purpose and need for action and, to a large degree, meet the plan's stated objectives. This chapter describes and analyzes the no-action alternative and five action alternatives, including the environmentally preferred alternative for elk management within Wind Cave National Park.

ALTERNATIVE DEVELOPMENT PROCESS

The formulation of alternatives began with feasibility discussions among members of a Science Team, which was comprised of government scientists and technical experts. This team convened for four months as part of the planning effort to develop goals for the management plan and to provide an initial assessment of the viability of various means of accomplishing those goals. The team addressed topics including range management within the park, elk population goals, reduction and maintenance methods, monitoring, action thresholds, and adaptive management.

The Science Team was tasked with determining the appropriate size of the elk population utilizing the park. To do so, the team looked at all wildlife species that use the same food and habitat as elk and prioritized them. For example, bison are considered the top priority species at the park. This is because preservation of the bison herd is mandated in the Wind Cave National Park enabling legislation. In addition, recent findings indicate that the bison herd appears to be highly unique genetically and free of cattle gene introgression. Prairie dogs are an important keystone species (e.g., many other species depend on their presence and ecological health) in the park's prairie ecosystem and were considered by the park and the Science Team to have higher priority than elk (but lower than bison). Elk and pronghorn antelope are also mentioned in the park legislation.


Beaver Creek in Wind Cave National Park

The park elected to use standardized forage allocation methodology whereby approximately 25% of the available forage is assumed to be consumed by the major grazing species (i.e., bison and elk), 25% of the forage is allocated to other grazers, insects, trampling and other natural causes, and the remaining 50% set aside for vegetation growth, recovery and for soil cover (Hanselka, White and Holechek 2001). This is similar to the historic approach used by the park in the 1960s and 1970s to establish bison and elk populations based on forage availability (NPS 1980). Because weather conditions might change substantially during a given year or period of years, the park developed a range of conditions and of forage required for bison and elk. The acceptable size limits of the elk population were established within this framework—a high end for when environmental conditions and forage availability are better than average and a low end for periods when drought or other weather-related factors are worse than normal conditions. After running the forage allocation model, the park recommended a target range of 232 to 475 elk (NPS 2006g). This target range also represents consideration of earlier management data (NPS 1980, 1994a), as well as the recommended populations of bison and prairie dog colonies, although it reflects a more refined and accurate estimate of the manageable elk population in the park and provides a slightly wider range than did the earlier studies. If monitoring data related to cumulative impacts indicate continued adverse impacts to forage and browse species from the elk population in this range, the park may consider managing elk populations at even lower numbers.

The park also recommended that an annual determination of what would be an appropriate size for the elk herd within this range based on a number of factors, including precipitation, the condition and abundance of forage, bison population and health, prairie dog acreage, recruitment rates for elk and bison, and the impact of wildlife diseases such as CWD for that year be made. Because these factors would change each year, the alternatives incorporate flexibility, or the ability to apply "adaptive management" principles. Action thresholds — defined as indicators that determine when elk management action should be taken based on the goals and objectives of the park (NPS 2006g) — would be more fully incorporated into the selected alternative in the form of a "Monitoring and Adaptive Management Plan" element of the plan (refer to appendix C for a complete explanation). The Science Team also recommended that the information gathered each year on the condition and availability of forage, climate and wildlife population variables be designed primarily to support the management of a predetermined bison population and prairie dog acreage and, secondly, elk and other species on an annual basis (NPS 2006g).

After the Science Team determined an appropriate population range for the elk herd, elk management options were addressed. The park staff and contractors then met with cooperating and interested agencies in late February of 2006 to further develop the options into full-fledged alternatives.

Three of the action alternatives include tools for both initial reduction and maintenance; two action alternatives are maintenance options only.

This effort also included the consideration of comments received during public scoping in August of 2005. These comments primarily focused on differing reduction techniques, elk depredation, and the issue of "wasting of resources." On this latter issue, many commenters believed strongly that meat from elk carcasses should be utilized and not destroyed (see the "Consultation and Coordination" chapter).

As a result of this concern, Wind Cave National Park determined that it would attempt to donate meat if alternatives or portions thereof could satisfy specific conditions. In addition, the park must adhere to NPS Public Health Program guidance (NPS 2006h) on the donation of elk meat from areas affected by CWD. Given these constraints, the park may be able to donate meat under alternative C if conditions as described below are met. However, it could not donate meat under alternative D, sharpshooting, due to logistical and public health issues related to maintaining the sanitary conditions of the meat while transporting carcasses from the field to a processor. Carcasses would need to remain in the field for several hours awaiting pick-up by helicopters or vehicles. In addition, carcasses would be exposed to dirt, bacterial decomposition and possible predation, making them a potential public health risk. Although many members of the public might be willing to accept the risk related to meat quality, the park is not willing to assume this level of risk on behalf of the ultimate consumer or the potential liability that may stem from it. In addition, leaving carcasses in the field, as alternative D would do, would serve several wildlife species and add nutrients to soils, benefits to the park's natural resources that better fulfill the NPS *Management Policies 2006* mandate to "manage and preserve fundamental physical and biological processes as well as individual species, features and plant and animal communities" (NPS 2006, sec. 4.1).

The alternatives are designed to show the full spectrum of options for managing elk as required by NEPA. Alternatives B–D are “full-fledged” alternatives and include tools for both initial reduction and maintenance of the herd. The other two alternatives (E and F) are maintenance options only, as the scientific, technological and economic challenges inherent in either prevent their use as initial reduction tools.

Alternatives B–D include components that would reduce the population initially, maintain it over the lifetime of the plan, manage diseases such as CWD, and mitigate impacts. A final selected alternative may incorporate features from more than one of these approaches if the impacts of this combined alternative are not different from those analyzed in the EIS. Adaptive management measures as described in appendix C would also apply. If for some unknown reason a combination of alternatives is ultimately selected, and the tools (hunting, sharpshooting, etc.) in this combination alternative are analyzed in the EIS, no additional analysis is anticipated unless synergistic or interactive impacts resulting from the combination itself would take place.

ALTERNATIVE A—NO ACTION

As required under CEQ regulations 40 CFR 1502.14(d) the alternatives analysis in an EIS must “include the alternative of no action.” According to the CEQ, if an agency is preparing or updating a plan, the no-action alternative is

> …“no change” from current management direction or level of management intensity. To construct an alternative that is based on no management at all would be a useless academic exercise. Therefore, the “no-action” alternative may be thought of in terms of continuing with the present course of action until that action is changed (CEQ 1978, sec. 1502.14[d]).

As a mandated alternative, no action “sets a baseline of existing impacts continued into the future against which to compare impacts of action alternatives” (Director’s Order 12 [NPS 2001a, sec. 2.7]). Under the no-action alternative, no new management actions beyond those available as of the starting point of the EIS analysis would be undertaken to manage elk populations or their impacts to resources within Wind Cave National Park.

Action alternatives are compared to current elk management and monitoring activities, or the “no-action” alternative.

Current park resource management goals for elk are outlined in the Elk Management Strategy document (NPS 1994a) and the environmental assessment for the Elk Surplus Disposal Program (NPS 1980). The latter document addressed elk in two of the three geographic areas at the park, e.g. those at Beaver Creek and Boland Ridge. Those in the Gobbler Knob area were not included in the analysis as this group remained consistently at approximately 60 animals. Population control of elk in the Gobbler Knob area was accomplished through hunting outside the park of elk that naturally migrated out of the park.

These park documents recommend maintenance of the elk herd at a level of approximately 350–400 elk. The strategy to maintain elk numbers at the population level under these plans was to trap and relocate live elk. Animals were captured in the corrals, separated by age and sex, tested for brucellosis and/or tuberculosis, and then shipped to willing recipients. This trapping/translocating occurred approximately every few years (NPS 1994a). State and federal agencies and American Indian tribes were the typical recipients of the translocated elk.

This strategy became untenable with the discovery of CWD in the park and the prohibition by the NPS on translocating live animals from a CWD-affected area as directed by the NPS CWD memorandum (NPS 2002b). Because CWD was of limited distribution and relatively unknown, neither Wind Cave nor any other unit of the NPS anticipated it in their wildlife management strategies, and so the park was left, in effect, without the ability to control the population.

Now, and under the no-action alternative, monitoring efforts such as estimating seasonal elk population numbers and the amount of forage produced within the park would continue. Population estimates may include aerial surveys (winter) and informal, opportunistic counts throughout the year. In addition, the park would continue to conduct targeted surveillance surveys in an attempt to identify and remove elk exhibiting clinical signs of CWD (year round). All of these activities are dependent on the continuation of current funding.

Action alternatives are compared to current elk management and monitoring activities (the no-action alternative) in Wind Cave National Park in the "Environmental Consequences" chapter.

ELEMENTS COMMON TO ALL ACTION ALTERNATIVES

The following actions would be common to all action alternatives.

- The best available science will be used to determine appropriate management actions.
- The management plan would be adaptive, allowing for incorporation of new information over time to affect management actions. An adaptive management plan would describe the potential changes in management as a result of population and vegetation monitoring (appendix C). Potential changes in management would likely be small increases or decreases in target elk populations and are not likely to have impacts notably different than those described elsewhere in the EIS. Changes in management would be adapted to meet the plan's goals, and no change in management would be recommended if the plans goals were being met (refer to the "Adaptive Management Methods Included in the Alternatives" section at the end of this chapter and appendix C).

Bison in Wind Cave National Park

- Monitoring of the elk population size and impacts to vegetation would continue. The data would be evaluated to determine the success of the plan and the need for any changes each year after its implementation (appendix C).
- Monitoring and evaluation of the range forage, bison and elk population, and prairie dog acreage or trends in the populations of these species would be used to adjust management actions in any of the action alternatives (appendix C).
- Addressing elk management would be a cooperative regional approach involving the South Dakota Department of Game, Fish and Parks (SDGFP), a cooperating party to the park's planning efforts as outlined in a Memorandum of Understanding signed by the two agencies in 2003 (appendix A). Other agencies and entities with interest and expertise include Custer State Park and the USFS.

- In order to inform and educate the public about elk management actions, educational and interpretive measures would be implemented, including such tools as brochures/publications, inclusion of elk management information on the park website, exhibits at the visitor center, etc.
- Management actions would be designed to contribute to research on diseases such as CWD and would address actions to prevent or limit their spread. If in the future, disease testing of animals removed from the park no longer contributes in a meaningful way to research or management efforts, testing protocols would be reviewed, modified, or suspended.
- Post-planning communication with park neighbors would be designed to inform them of specific management actions, report on the success of the plan, and to foster two-way communication.
- Target elk population goals would be based on results from the Science Team Report which has set a target range of 232 to 475 elk (NPS 2006g; see the "Alternatives Development Process" section in this chapter). At the same time, and as monitoring data related to cumulative impacts indicate, management to numbers lower than this range may be considered if extreme environmental conditions (drought, for example), disease, concentrated and reversible impacts (to shrubs or riparian vegetation for example) or other unforeseeable factors lead park managers to believe this is warranted.
- All elk management activities would be conducted in accordance with American Veterinary Medical Association (AVMA) procedures (AVMA 2007).
- All elk management activities would be conducted in a manner which ensures human health and safety of staff and contractors (e.g., specific task-related safety protocols, additional staff training).
- For purposes of the action alternatives in this plan, "authorized agents" could include professional staff from other federal, state or local agencies or tribes; contractors; or skilled volunteers. A contractor would be a fully insured business entity, nonprofit group, or other entity engaged in wildlife management activities. Depending on their proposed involvement, skilled volunteers would have to possess a demonstrated level of proficiency as identified through an NPS-developed system. Skilled volunteers could be used for a variety of elk management activities including, but not limited to hazing, fence maintenance, field dressing and hauling of carcasses, sharpshooting and assisting with taking biological samples (e.g., for CWD testing). Those skilled volunteers that qualify for participation would become part of a pool of available personnel that may supplement elk management teams. All skilled volunteers would be directly supervised in the field by NPS personnel during any elk management actions and require an approved background check. Cost, efficiency, and effectiveness are among the factors that would be considered when determining whether authorized agents, including skilled volunteers, would be recruited and/or utilized.
- Known cultural resources would be avoided, whenever possible, during elk management activities. For those identified resources that cannot be avoided, effects would be evaluated in accordance with Section 106 of the *National Historic Preservation Act* to ensure that management actions would not adversely affect resources eligible for the National Register of Historic Places. In areas that have not been inventoried, particularly for archeological resources, ground-disturbing activities would be preceded by appropriate surveys and Section 106 (*National Historic Preservation Act*) compliance.
- Backcountry areas being used for management actions would be closed to the public to ensure their safety and to mitigate effects to their experience.

ALTERNATIVE B—HUNTING OUTSIDE THE PARK

Alternative B is both the park's preferred alternative and its environmentally preferable alternative (see the end of this chapter). The emphasis of this alternative is to make maximum use of hunting on public and private lands outside the park to reduce and maintain the population of elk utilizing the park. This would be accomplished cooperatively with the SDGFP-managed annual public hunt on lands surrounding Wind Cave National Park. Initial reduction activities are expected to occur over a period of one to five years, with annual maintenance activities conducted thereafter. Because this and other methods described in this document may not be sufficient to reduce elk population parkwide, backup strategies for reducing and maintaining the elk herd are also described. If hunting outside the park does not fully accomplish initial reduction goals, roundup and live shipping to a slaughterhouse or other reduction methods may be used to reach the target population range (see discussion of other options below). The same would be true for maintenance.

INITIAL REDUCTION PHASE

Elk are currently able to enter and exit the park in a variety of locations, but in particular over a section of low fence that lies along the park's southwestern boundary. Through the initial use of this area of low-lying fence and the installation of additional moveable sections of fence panels (bison-proof gates; referred to hereafter as "gates"), the park would allow elk to leave the park in the spring, but discourage their return in the late summer / early fall. Many elk leave the park in the spring in a natural movement process. This is particularly true for elk in the Gobbler Knob area (figure 2). Preliminary results from a recent study (Sargeant et al. 2008) indicate that egress rates of elk in the southwest are high, with 17 of 20 collared females and 6 of 6 collared males in this region exiting the park in 2005 and 2006. Although the exact number of elk leaving the park on average each spring is unknown, estimates range from about one-third to one-half. Of the 104 collared elk studied by Sargeant et al. (2008), 37–38% left the park during the warmer months for at least some period of time. Elk normally return to the park in August and September in conjunction with increased human activity associated with the hunting beyond park boundaries. The raised gates makes re-entry into the park highly unlikely with the result that more elk become available as part of the huntable population outside park boundaries.

Under alternative B, the South Dakota Department of Game, Fish and Parks would administer annual public hunts on lands surrounding Wind Cave National Park.

The SDGFP would administer the hunt according to its current regulatory authority granted in SDCL 41-2-18. The park area is flanked by two existing state hunting units (H3 and H4) (figure 2). The SDGFP would issue all hunting permits and retain all hunting fees.

The section of lower fence at Wind Cave National Park (figure 2) is approximately four miles of four-foot-high fencing (there are some portions that are five-foot-high resulting from strands of barbed wire on the top), with the remainder of the park surrounded by seven-foot-high fence. Elk have been observed crossing fences in both the high and low portions but substantially more cross at the lowered section. Because most elk leave the park through this lowered section of fence, it is possible that the majority of the initial reduction effort could be accomplished by simply raising the lowered section after the elk have left the park in the spring (the first year of management actions). However, recent observations indicate fewer elk than originally thought may leave the park, and of these some stay outside the park for only short periods of time rather than the entire spring and summer (Sargeant et al. 2008). This natural movement out may also substantially decrease elk that prefer the Gobbler Knob area as this is the portion of the elk using the park that cross the lowered fence for exiting each year. Therefore, this alternative assumes the insertion of additional spans of movable gates along the western and, to the extent possible, eastern boundaries of the park, with landowner consent. These gates would provide opportunities for movement out of the park by elk from the other geographic areas (figure 2). Hazing elk out of the park either in the spring and summer, or during the fall hunt if too few elk have left "voluntarily," is also a likely part of alternative B.

The gates would be approximately 10–12 feet in width with movable top portions that would either swing open or slide up and down to aid elk movement. When open, the gates would maintain a fence height of four to five feet and would be specifically designed to encourage elk movement out of the park, while still keeping bison in the park.

The number and the locations of gates would be determined by identifying areas where elk are known to congregate or where elk most likely would leave the park considering terrain and natural barriers. All gates would be installed in areas where adjacent owners have given their approval. Because the current four-foot fence along the southwestern boundary would be raised to seven feet, similar gates would be installed along this section of fence.

No gates would be installed along the north fence where the park shares a boundary with Custer State Park as there is no desire from Custer State Park for additional elk. In addition, no gates would be installed along the boundary fence adjacent to private property (south-central park boundary) where CWD was found in a captive elk herd.

The initial reduction would presumably result in several hundred additional elk being available for hunting outside the park (table 1 in the "Numbers of Elk Removed, by Year" section). During what may be a multi-year initial reduction, as well as during the maintenance phase, the park would estimate the number of elk in the park in the winter (January) to help decide how many need encouragement or hazing to leave the park in the spring and summer. By February, this information would be communicated to the SDGFP for its use in determining the number of additional hunting tags issued for the upcoming fall elk hunt(s). Whenever possible, elk estimates would be determined by aerial survey. Remote video cameras may be used at the lowered gate areas to estimate the number of elk leaving the park during the spring. A ground count of elk during the fall hunting season (October) would also help park staff decide whether some of the gates would need to be removed to haze additional animals out of the park.

Boland Ridge Fence Crushed from Elk Crossing

If so, hazing may be required during hunting season. Gates would be lowered and helicopters or other means of hazing elk (humans on foot, etc.) would be used to encourage the appropriate number to exit. If hazing is unsuccessful or reduction efforts require only a few elk be removed, sharpshooting in the park may be used (see discussion below). When the required number of elk leave the park, whether it be in spring, summer or, if needed, during the fall hunt, gates would be raised and the fence secured at seven feet until the hunting season is over for the year.

Preliminary estimates indicate that initial reduction could take four years to complete and that the majority of elk would likely come from the Gobbler Knob / Rankin Ridge area. This estimate is based on a series of assumptions regarding elk behavior that may prove to be different than actual behavior, especially given the stress of hazing or hunting elk.

During initial reduction efforts, the park would manage toward the lower end of the target population range (232–475) so the park could evaluate the effect of population reduction on elk redistribution (see discussion on population goals in the “Alternatives Development Process” section). As noted above, the majority of natural elk movement out of the park currently involves those from the southwest part of the park (Gobbler Knob area), and, to a lesser extent, those from the central Rankin Ridge/Beaver Creek area. Although earlier studies (Baumann 1998, for example) indicated that bulls do not migrate out as readily as cows, a recent analysis (Sargeant et al. 2008) suggests that equal percentages of bulls do and cows may leave the park in the spring. This study did not analyze equal numbers of male and female elk (61 female and 38 male) but did find about 37% of each spent some time outside the park in the summer. If bull elk prove to be less likely to leave the park than cows, different or additional reduction methods (i.e., sharpshooting—see discussion below) to maintain sex ratios may be required, especially for long-term maintenance. Sex ratios may become important when the population is being managed near the low end of population goals.

Despite the cost of the additional fence work, this method may provide a relatively efficient manner of reducing elk in the park. It is also possible that this method would work well for the first year, but may be substantially less effective in following years as elk with the tendency to move out of the park are hunted. Monitoring of elk numbers and movements is key to evaluating the success of this option (NPS 2006g). As noted below in the discussion of the number of animals removed each year, if in two years of operation the wintering population of elk in the park remains within ±5% of 482 animals, roundup and/or sharpshooting would be pursued.

Increased hunter access to private lands surrounding the park would help make this alternative feasible, particularly during the initial reduction phase when numbers of elk would be elevated over prior years. The SDGFP would work with neighboring landowners to facilitate this increased access. However, prior to meeting elk population goals within the park, there would also be the potential for increased crop depredation on private lands adjacent to or near the park boundary if this alternative was implemented.

CARCASS DISPOSITION / CWD TESTING

Individual hunters outside the park would be responsible for elk carcasses reduced to possession as they currently are under SDGFP hunting regulations. Currently the SDGFP administers a voluntary CWD testing program which would continue under this alternative. For the years of 2005 and 2006, an average of approximately 57% of elk was tested for CWD within hunting unit H3 (west of the park). For the same years, an average of approximately 64% of elk harvest within hunting unit H4 (south and east of the park) were tested for CWD. These voluntary testing rates are considered by the SDGFP to be statistically sound samples for an accurate measurement of CWD prevalence/distribution within these two hunting areas (Kintigh 2007). These voluntary testing rates are expected to remain stable under this alternative.

MAINTENANCE PHASE

For maintenance, as with initial reduction, the park would encourage animals to leave the park as often as every year through the open gates (described above). If the population is well within threshold levels based on forage availability and other factors described above, no removal or the removal of only a few animals may be needed in a given year. Annual or frequent maintenance is preferred because it is likely to minimize the impact to park operations, SDGFP operations, and neighboring lands. If culling of only a few animals is required, the park could consider using selective sharpshooting (see below).

As with the initial reduction, gates would be raised at the appropriate time of year to discourage elk from re-entering to the maximum extent possible, making them available for hunting outside the park. Winter counts and results of monitoring information described in the “Elements Common to All Action

Alternatives" section would be used to determine the number of elk that need to leave the park or be removed each time maintenance actions are taken. Fall camera and ground counts would aid in determining if the target number of elk remained in the park. If more elk than the target number remained, appropriate gates would be opened and hazing with helicopters, people on foot, dogs or other means would be used to encourage additional animals to leave. Coordination with the SDGFP regarding the issuance of additional elk tags would be required.

Numbers of Elk Removed, by Year

Scenarios for the approximate number of elk removed over the initial reduction phase of the alternatives assume starting population levels at or around 2008 predicted levels of 728 elk.

1. The population of the Gobbler Knob and Rankin Ridge area is approximately 66% and the population of the Boland Ridge area is 33% of the population using the park;

2. Animals from Gobbler Knob / Rankin Ridge leaving the park would all move to the west and animals from the Boland Ridge area leaving the park would all move to the east (assuming landowner consent);

3. Sex ratios are those approximated at the time of the Science Team report ("An initial estimate of approximately 120 cows and calves [including spike bulls] for each of the Boland Ridge and Rankin Ridge herds, 60 cows and calves in the Gobbler Knob herd, and approximately 60 adult bulls throughout the park [which usually reside in the central and northern portion of the park] would result in 360 elk within the park" (NPS 2006g:22)) which would equate to a ratio of 55 bulls to 100 cows;

4. The annual population growth rate of the elk using the park is 12%;

5. The hunter harvest success ratios for hunting unit H3 would be 55% of the bulls and 30% of the cows and hunting unit H4 would be 30% of the bulls and 25% of the cows (Kanta 2007); and

6. 75% of the elk using the park were excluded from the park during the hunting seasons (either moving out on their own or through hazing).

By the time of implementation, the population of elk using the park would be approximately 815, based on the current numbers of about 650 (table 1). With the above assumptions, it would take four years to reach the range of 232–475 animals using the park and six years to reduce the population of elk using the park to the target of 232 (low end of the range) and allow the population to begin fluctuating on its own. If after the second year of management actions, the park's elk population is not within 5% of the high end of the range (about 482 animals), the population would not be reducing at a rate fast enough to reach planned population goals. Therefore, park management may move to alternative C for population reduction.

At the low end of the range, the maximum number of animals that would need to be removed in a year is 28 to maintain the population at 232 (the same for maintenance actions under alternatives C and D).

Annual elk population surveys would be used to refine the actual number of elk using the park to be removed during initial reduction and maintenance efforts (see the "Elements Common to All Action Alternatives" section).

TABLE 1. ESTIMATES OF NUMBERS OF ELK TO BE REMOVED, BY YEAR, UNDER ALTERNATIVE B

Year	Elk Population	Increase Number	Year End Population	Gobbler/ Rankin Number Leaving	Cow Take	Bull Take	Boland Number Leaving	Cow Take	Bull Take	Total Take	Elk Left in Park
2007	650										
2008	650	78	728								728
2009	728	87	815	404	142	44	139	22	15	223	593
2010	593	71	664	329	116	35	113	18	12	181	482
2011	482	58	540	267	94	29	92	15	10	148	393
2012	393	47	440	218	77	24	75	12	8	120	320
2013	320	38	358	177	62	19	61	10	7	98	260
2014	260	31	291	144	51	16	50	8	5	80	212
2015	212	25	237								

ESTIMATED COST

Park staff estimated the cost of initial reduction and maintenance using the methods described above based on a series of assumptions. These include the number of elk exiting the park, either voluntarily or with the help of hazing; hunter harvest success ratios in hunting units H3 and H4 for bulls and cows, annual population growth for the herd and the geographical distribution of elk exiting the park (see appendix D). Given the assumptions, initial reduction costs would be about $175,000 and maintenance would cost about $3000 per year (refer to table 3). (The park is considering replacing sections of the fence in an unrelated project; the estimates provided here are to raise the now four-foot section of fence and install gates periodically along this same stretch of fence.)

ALTERNATIVE C—ROUNDUP AND LIVE SHIPMENT OR EUTHANASIA

The focus of this alternative is the movement of elk with helicopters or other methods into the existing corral facility within the park. From there, they may be live shipped to a slaughterhouse and processing facility where meat would be packaged and made available for donation, or killed at the corral site and their carcasses incinerated. Live shipment and donation of processed meat would be dependent on the park finding a partner(s) to be responsible for transport of live elk, processing, and distribution of meat. Should no partner be found, elk would be killed at the corral site in the most humane method possible (AVMA 2007), which could include captive bolt, exsanguination (cutting jugular, bleeding out), shooting, and/or chemical euthanasia. Carcasses would be incinerated. It is the commitment of the NPS should this alternative be used as a means of initially reducing the number of elk, or as an adaptive management tool to reduce elk numbers, that incineration by means of an air-curtain incinerator will be used to dispose of all carcasses of elk destroyed during the implementation of the alternative or those that die from stress. An appropriately-sized incinerator will be acquired at the point at which the need arises. This commitment applies to other alternatives which result in carcasses needing disposal, with the exception of alternatives A (no action) and B (hunting outside the park). The park will retain the option of landfilling some carcasses in all alternatives, consistent with the current method used to dispose of incidental animals that die due to other than direct management techniques, and/or test positive for CWD.

Incineration is the park's preferred method of carcass disposal, because incineration reduces the potential for environmental contamination. Disposal of carcasses in landfills was also evaluated, however due to environmental concerns and long-term availability of acceptable landfills their use will be limited.

Each of these options is considered acceptable for initial reduction and subsequent maintenance efforts. Initial reduction efforts likely could be completed in two years, although up to five years may be needed. The frequency and size of maintenance efforts would be determined by elk survey results and the information collected in the "Elements Common to All Action Alternatives" section in this chapter, and could involve other reduction methods (e.g., sharpshooting—see the following discussion).

INITIAL REDUCTION PHASE

The following discussion assumes that the park is working cooperatively with a partner(s) who would be responsible for transport of live elk to a slaughterhouse, killing, offal disposal, packaging/storage of meat, meat donation/distribution, and necessary record-keeping (e.g., CWD test tracking, informed consent requirements).

Initial reduction efforts are anticipated to involve hundreds of animals, on the order of 300 elk per year for two years. To the extent possible, roundup of elk would occur by geographic area, with capture and live transport taking from three to five days per area. Timing would vary with the size of the group occupying each area of the park. Roundup would be accomplished with the aid of a helicopter contractor in January or February following surveys in early January (see discussion of January survey in the "Alternative B—Hunting Outside the Park" section). Elk would be herded into the existing corral facility (figure 2) using helicopters and park staff. Some elk may be released from the corrals to ensure the park is able to maintain sex ratios, age classes and the number of elk in each area of the park. Only elk held 48 hours or less would be released to minimize the impact of concentrating animals on the prevalence of CWD in the herd.

The focus of alternative C is moving elk to corrals at the park. The park would seek partners to assist with the costs of processing and donating elk meat. If no partner is obtained for shipment and meat distribution, the elk would be euthanized and incinerated.

Elk from the Gobbler Knob area may be the most difficult to round up because of the distance and terrain required to move the animals to the corral site in the north-central area of the park. Consequently, sharpshooting or hazing of elk out of the park to be hunted as described above may also be needed to effectively reduce the size of the group.

In general, bulls are more difficult to haze as they tend to remain in small groups or in solitary situations. This means the initial reduction effort, as well as maintenance removals, could result in unnatural or distorted sex ratios over time and sharpshooting of bulls in the park may be required.

As the large rack size of some bulls makes their live transport difficult, corralled bulls may be brought into squeeze chutes and their antlers removed (sawed off) prior to shipping. It is possible that some large antlered bulls may be shot in the outer pastures or separated into alternative corrals and shot or anesthetized by dart and chemically euthanized to avoid having to handle these potentially dangerous animals. With the exception of large bulls that may be euthanized, all live elk, including older calves weighing at least 100 pounds, would be transported to a processing plant where they would be killed, samples removed by a qualified technician for CWD testing, and the meat processed for donation in accordance with NPS Public Health Program guidelines (NPS 2006h; appendix E). It is estimated that approximately 100–110 cows or 60–80 bulls could be transported in one truck to a processing facility. A waiver from the NPS policy prohibiting transport of live elk from an area in which CWD has been identified would be required (NPS 2002b).

Meat processors stated that calves weighing less than 100 pounds provide limited meat for donation and should not be processed. Therefore, these few smaller corralled animals may be euthanized (chemical injection, exsanguination, shooting—see the "Contingency Plan for Elk Reduction" section below for discussion of lethal method options). It is also possible a small number of elk would die from the stress of the hazing/corralling activities. In any case, CWD samples would be obtained from all animals. Carcasses from animals euthanized or dying from stress would be incinerated.

Facility (corral) modifications may include the construction of an additional squeeze chute (or modification of existing chute) to make antler removal safe and efficient. In addition, some modifications may be required for efficient and safe removal of carcasses of euthanized elk (see the "Contingency Plan for Elk Reduction" section below for more detail).

Issues of human health and safety under this option include risks associated with aircraft use, roundup and confinement of animals, antler removal, and euthanasia of a small number of calves. Protocols for personal protective equipment, clean up operations, etc., would be determined prior to plan implementation.

Some back roads would be closed to visitors during management actions. The public would be prohibited from accessing the corral areas during management actions for safety reasons.

Animal Handling, Meat Processing and CWD Testing

Corralled elk would be marked and shipped live to a predetermined slaughterhouse and processing plant that is approved by the state / U.S. Department of Agriculture. Shipping would be accomplished by use of tractor-trailers capable of holding all animal waste for the duration of the trip so as to minimize the potential spread of disease. The trailer would be sealed and a shooter would be on board in case of an accidental release during transport (Foster 2007). In case of accidental release, escaping animals would be killed to mitigate the potential for disease spread.

It is estimated that approximately 160–180 elk a week could be slaughtered and processed. Test samples for CWD would be taken from all slaughtered animals by qualified technicians; all carcasses would be tagged with a unique identifying mark to facilitate tracking of test results. To maximize efficiency, elk may be killed and processed in identified lots (e.g., 10 elk per lot). Slaughtering and processing areas and tools would be decontaminated between lots to prevent potential CWD contamination among lots. If a particular carcass(s) is identified as CWD positive, the entire lot to which it belongs would be destroyed and disposed of in an approved manner.

Chronic wasting disease prions are not known to be transferable to humans. However, the park would take every precaution to ensure those to whom the meat is distributed are aware of the fact that the elk was once part of a herd where CWD was present. No processed meat would be distributed to the public prior to CWD test results being received. As noted above, CWD positive carcasses and all elk processed in the same batch as a CWD positive animal would be destroyed. All donations of CWD-negative meat to the public would comply with NPS Public Health Program guidelines (NPS 2006h) which require that those consuming the meat be fully informed and take full responsibility for any long-term unanticipated effects of eating meat from animals coming from a CWD-affected area. Because of these same guidelines, processed meat would be donated only to individuals. Donations to shelters or food banks where informed consent for consumption by the end user cannot be controlled would be precluded.

As CWD testing is not considered a "food safety test," a negative test result does not guarantee that the animal is CWD free. Consequently, prior to donation, recipients would be required to sign informed consent forms that, at a minimum, would include the following information:

- Information regarding CWD, its distribution, and its prevalence,
- Information about CWD testing that has occurred and the determination that the disease was not detected in the carcass, and
- Information about any potential human health risks as it is understood by current science (NPS 2006c).

The following is a general list of responsibilities associated with this option. All of the following activities would be conducted in coordination with a partner(s). Specific responsibilities would be clearly defined in a written agreement prior to commencement of management actions involving meat donations.

Park staff responsibilities related to elk management activities under this option include the following:

- Roundup/corralling of elk into the existing corral facility.
- Possible aid in loading elk onto transport vehicles.
- Incineration of carcasses of those elk that die or are killed in the corral.
- Supervision/oversight of helicopter use: the helicopter pilot would be responsible, under the direction of the park helicopter manager and resource staff, for the hazing/herding of elk into existing corral facility. Pilots must be ACETA (Aerial Capture, Eradication and Tagging of Animals) certified (USDI 2006).
- CWD testing—coordination with slaughterhouse and laboratory for CWD testing; record keeping for all test sample results.

Partner responsibilities include the following:

- Transporter. The animal transportation contractor would be responsible for the elk from the time they are loaded onto the transport trucks to the time they are delivered to the predetermined meat processing contractor.
- Meat processor. The meat processing contractor would be responsible for the elk from the time they are delivered live to the facility to the point where the meat is distributed to the public. This effort would include
    - Holding animals in a humane manner at the processing facility until they are dispatched.
    - Humane killing of elk.
    - Assignment of unique identification marking for each elk carcass; designation/tracking of lots (as described above).
    - Collection/tracking of CWD test samples by qualified technicians (in coordination with the park).
    - Disinfection of tools/processing areas between processing of predefined lots.
    - Processing/packaging of meat.
    - Disposal of offal/bones in landfill.
    - Safe storage of processed meat until CWD results available.
    - Proper destruction of lots from which any samples test positive for CWD.
- Distribution (donation) to public of meat testing negative for CWD, including processing of informed consent forms. Signed forms would be returned to the park by the partner.

Contingency Plan if No Partner Obtained

If partners willing to be responsible for live shipping, processing, and donation of meat (described above) cannot be identified, elk would be euthanized within the park's corral facility and incinerated. Roundup efforts would be similar to those described above. Corralled elk would be killed in the most humane method possible, which could include captive bolt, exsanguination, shooting, and/or chemical euthanasia.

Under the captive bolt method, NPS staff and/or contractors would be responsible for moving the animals through chutes, rendering them unconscious (captive bolt), killing them (exsanguination, shooting, intravenous potassium chloride, etc.), and collecting samples for CWD testing. Due to antler size and difficulty of moving them through chutes, it may be necessary to shoot or inject captured bulls. If it is necessary to keep animals overnight, NPS staff would be responsible for caring for and feeding captured animals. Under this method, modifications to the existing corral facility could include those necessary for the effective and safe removal of carcasses and for the containment of blood and other waste. Measures (e.g., cover) would be taken to prevent scavenging of euthanized animals prior to incineration.

If the chemical injection method is used to kill elk, the use of sodium pentobarbital (barbiturate) may be preferable due to its fast-acting properties (animals simply lie down and die). This is the most commonly used euthanasia method for house pets. If sodium pentobarbital is used for euthanasia, the park would incinerate all carcasses immediately to prevent scavengers from feeding on contaminated carcasses. The use of potassium chloride requires the animal be rendered unconscious (anesthetics or captive bolt) prior to administering the drug.

Both methods require that a veterinarian administer or supervise the administration of the drugs. It is estimated that approximately 50–75 elk per day (10 minutes per animal) could be euthanized using either method. The use of chemical euthanasia could require modifications to the existing corral facility to allow for efficient removal of the animals from the drug administration pen (NPS 2006i).

Tissue samples for CWD testing would be collected from all elk carcasses by qualified technicians. No identification tagging would be necessary, as carcasses would be incinerated. Field protocols for animal and carcass handling would be established prior to plan implementation and would be designed primarily to protect staff and contractors.

Two methods of incineration are possible, both involving the principle of an "air-curtain incinerator." Controlled high velocity air is introduced across the upper portion of the combustion chamber into which fuel/carcasses are loaded. The curtain of air created in this process traps unburned particles under the curtain in the high temperature zone where temperatures can reach 1,832°F (1,000°C) (temperatures must be maintained above 850°F to denature the CWD prion). The increased combustion time and turbulence results in re-burning and more complete combustion of the loaded waste. Ash from incineration would be disposed of in a preapproved off-site landfill (NPS 2006i).

Assumptions used to determine the number of days needed to incinerate carcasses are described in detail in the methodology section for the air quality analysis in the "Environmental Consequences" chapter and are summarized here. The incinerator is assumed to burn about three tons of wood per hour, and given a 1:1 wood to carcass ratio, could burn up to three tons of elk carcasses as well. Accounting for time to move wood and carcasses in, and an average weight of 0.3-0.7 tons per elk, the analysis assumed 4-6 elk per hour could be incinerated. Assuming 40 hours/week of operation, about 160-240 elk/week could be incinerated (NPS 2006i).

Box and trench incineration methods are the types of air-curtain incinerators. Box incineration consists of a box placed on ground surface into which carcasses and fuel are placed. Trench incineration requires the digging of a trench into which carcasses and fuel are placed. The incinerator blows heat into the trench, thereby incinerating the carcasses as described above. However, due to potential impacts to park resources (e.g., caves, geology, hydrology, etc.) from required excavations, trench incineration is not feasible within park boundaries. Open burning for solid waste disposal is not permitted in parks except in the very limited circumstances (NPS 2006d, sec. 9.1.6.1). If a willing partner/landowner can be identified, there may be possible sites outside the park that fit requirements of incineration without impacting other park resources (NPS 2006i). Should incineration activities occur on lands outside the park, the NPS would ensure compliance with all applicable legislation (e.g., *National Historic Preservation Act*, *Endangered Species Act*, *Clean Air Act*, etc.).

Park staff would conduct incineration operations, including loading wood and carcasses, and ensuring the fire is adequately maintained. An excavator with a grapple would be needed for loading carcasses and fuel. Wood waste from ongoing fuel reduction efforts within the park may be adequate for fuel needs. Once a determination is made that an incinerator would be used, the park could begin stockpiling wood for this use (NPS 2006i).

Health and safety issues associated with incineration include those associated with equipment operation and air quality. Safety protocols (e.g., personal protective equipment, clean up operations, etc.) would be determined prior to plan implementation.

MAINTENANCE PHASE

The same types of activities as those described above would also apply for the maintenance phase. Hazing would be used to herd elk toward the corral. Because many fewer elk would be removed during the maintenance phase, a greater number are likely to escape capture before reaching the corral. More precise hazing methods such as dogs, gunshots/noisemakers (e.g., to scare animals into moving ahead), horseback riders, etc., might be used instead of aircraft if only a few elk are rounded up in a given year. Sharpshooting may be employed as an alternate maintenance method in years when only a few elk are targeted for removal (see discussion below). As is true in the initial reduction phase, the park would require a partner to be responsible for shipment of elk, meat processing and coordinating donations.

Numbers of Elk Removed, by Year

Based on experience of wildlife roundup within the park, approximately 300 elk could be captured and processed per year. If the park chose the low end of the desired range, approximately 232 elk would remain in the park after two years. This work would take a minimum of three days and possibly up to five days for each roundup. However, if after the second year of management actions it appears unlikely that the park's elk population would be sufficiently reduced to make target goals during the initial reduction period, other management actions could be considered (alternatives B or D).

To maintain the population at the low end of the range (232 animals), the maximum number of animals that would need to be removed in a year is 28 (the same for maintenance actions under alternatives B and D).

Estimated Cost

As noted above, if the park finds a partner to be responsible for transporting live elk and processing the meat, meat would be donated. Assuming this is the case, the cost to the park of initial reduction is estimated at $235,000. If no partner steps forward, the cost of initial reduction assuming carcasses are incinerated is estimated at $315,000. Incineration is the park's preferred method of carcass disposal, because incineration reduces the long-term reliance on acceptable landfills and environmental impact. Costs for landfill disposal are presented for comparison purposes only and are estimated for initial reduction to be $210,000 (refer to table 3). Maintenance costs to the park are approximately $100,000 per year regardless of whether elk are transported to a processing facility and donated with the help of a partner, or carcasses are incinerated without a park partner (see appendix D).

ALTERNATIVE D—SHARPSHOOTING

The focus of this alternative would be to maximize the use of sharpshooters inside the park to reduce and maintain the herd. Initial reduction efforts are anticipated to take several months spread over a four-year period. If sharpshooting does not accomplish initial reduction population goals, other techniques such as roundup and either live shipping to a slaughterhouse, or killing by way of exsanguination, shooting, intravenous potassium chloride, or sodium pentobarbital may be used. For initial reduction efforts, carcasses would be incinerated as described above under alternative C. Once initial reduction goals are met, maintenance activities in subsequent years would occur during the winter for the life of the plan. For the most part, carcasses would be sling-loaded by helicopter from the park's backcountry to a central loading area where they would be incinerated. Up to 25 animals per day could be removed by one helicopter supporting a team of shooters and assistants. Some carcasses may be left in place if they are very difficult to remove or if wildlife managers believe their natural breakdown is environmentally preferred or acceptable. About one carcass per square mile could be left in the field. The location of carcasses left in the field would be mapped to allow park staff to return to the site and retrieve CWD samples. Samples for CWD testing would be taken from all animals.

It is the commitment of the NPS should this alternative be used as a means of initially reducing the number of elk, or as an adaptive management tool to reduce elk numbers, that incineration by means of an air-curtain incinerator will be used to dispose of all carcasses of elk destroyed during the implementation of the alternative or those that die from stress. An appropriately-sized incinerator will be acquired at the point at which the need arises. This commitment applies to other alternatives which result in carcasses needing disposal, with the exception of alternatives A (no action) and B (hunting outside the park). The park will retain the option of landfilling some carcasses in all alternatives, consistent with the current method used to dispose of incidental animals that die due to other than direct management techniques, and/or test positive for CWD.

Under alternative D, sharpshooters inside the park would reduce and maintain the herd.

Incineration is the park's preferred method of carcass disposal, because incineration reduces the potential for environmental contamination. Disposal of carcasses in landfills was also evaluated, however due to environmental concerns and long-term availability of acceptable landfills their use will be limited.

INITIAL REDUCTION PHASE

Under alternative D, initial reduction would be accomplished via direct reduction with firearms, using qualified federal employees and/or authorized agents (state and tribal personnel, contractors, or skilled volunteers). Personnel engaged in direct reduction of elk for this plan would have the appropriate skills and proficiencies in the use of firearms and protecting public safety. In addition, these personnel would have experience in the use of firearms for the removal of wildlife. For the purposes of this plan, a contractor would be a fully insured business entity, nonprofit group, or other entity engaged in wildlife management activities that include the lethal removal through sharpshooting. The contractor would possess all necessary permits. Skilled volunteers would need to achieve a level of firearm proficiency established by the park prior to assisting with elk removal actions. Those skilled volunteers that qualify for participation would become part of a pool of available personnel to be used to supplement elk management teams. In addition, all skilled volunteers would need to be directly supervised by NPS personnel during elk management actions.

Compliance with all relevant NPS directives related to firearms use in parks, as well as federal firearm laws administered by the Bureau of Alcohol, Tobacco, and Firearms would be required. The park would develop very specific guidelines for firearms use.

Sharpshooters may use suppressors to help in both minimizing the stress to and scattering of elk, and to improve efficiency in reducing elk numbers. Noise suppressors would also minimize disturbance to the public.

Aerial or ground surveys in the winter would aid in determining the number of elk requiring lethal removal. Reduction efforts would most likely occur in the fall and winter, coinciding with the time of lowest visitation rates to the park. However, reduction efforts could occur anywhere between August 1 and March 1. Areas undergoing elk reduction management activities would be closed to the public.

Sharpshooting would allow the park to finely tune reduction efforts so that specific sex and/or area targets could be achieved. Although the ability to be more sex- or gender-specific in removal actions would be used in the maintenance phase, culling during the initial reduction would focus on efficiency rather than specific targets. It is expected that sharpshooters would typically dispatch an animal with one shot.

Carcass Disposition / CWD Testing

In the initial reduction phase, it is likely that the majority of carcasses would be removed from the park's backcountry. The park would not donate meat under this alternative due to logistical issues related to maintaining the sanitary conditions of the meat while transporting carcasses from the field to a processor. Instead, elk carcasses would be sling-loaded via helicopter to designated locations along roads where carcasses would be stored in the short term until they could be transported to an incinerator site. It is estimated that approximately 20 elk carcasses could be removed in a day using one helicopter.

Samples for CWD testing would be taken from all carcasses, with the majority of this effort occurring at the central site into which carcasses are sling-loaded. Locations of elk carcasses not brought to the central site (i.e., left in the field) would be mapped and a follow up visit conducted by field personnel to obtain CWD test samples as soon as possible. In compliance with State Historic Preservation Officer guidance, dragging of carcasses across the landscape would occur only when the ground was dry or frozen and no known cultural sites existed in the area.

A certain number of carcasses would be left in the field, primarily for ecological reasons as several species of wildlife and soil nutrients would benefit. The park staff would consider the ability of current predators and scavengers to benefit from carcass distribution without bringing in new animals or creating a glut in deciding the number of elk left during initial reduction efforts. By doing so, management would best create natural conditions and be in line with NPS *Management Policies 2006* that direct park units to preserve fundamental biological processes in their natural condition (NPS 2006, sec. 4.1). Logistics and minimizing any potential for environmental contamination would also be considered. With the park's 44 square mile area, it is estimated that up to 60 carcasses could be left in the field per year (NPS 2006i). It may be desirable to leave all calf carcasses in the field as CWD has not been detected in free-ranging elk less than 6 months old (NPS 2006c); however, this could affect the visitor experience to a greater degree than leaving only adult elk carcasses.

Mitigation Measures

- Sharpshooting activities would typically be planned for the fall and winter, coinciding with times of lowest visitor use.
- All areas required for management activities would be closed to the public.
- Where appropriate, firearms would be suppressed to minimize noise impacts to elk and to visitors, and to maximize the efficiency of removal efforts.
- Dragging of carcasses would be confined to a period when the ground was either dry or frozen to minimize adverse effects to natural and cultural resources.

MAINTENANCE PHASE

The same techniques described above for initial reduction would be used to maintain the population. Qualified federal employees and/or authorized agents would conduct maintenance sharpshooting operations. It is anticipated that selective removal of elk by park staff during the three months of winter when the most elk are in the park would be adequate to keep the population within the target range. Additional elk could be hazed out of the park during the hunting season using unsilenced gunshots or other noisemakers if needed, although lethal removal inside the park may continue to utilize noise suppressors to maximize efficiency, unsilenced weapons may aid in redistributing the population away from selected areas.

Numbers of Elk Removed, by Year

Assuming approximately 25 elk could be shot and sling loaded from the park per day, it would take eight days to remove 200 elk from the park for the first three years and the fourth year only 52 elk would need to be taken in two days to bring the population to 232. Using this alternative, it would take four years to reduce the population from 728 to 232 using the park. As with any alternative, if park managers believe the tools in this alternative are not as efficient or effective as initially believed (e.g., the number of elk removed is much lower than anticipated), the Record of Decision could be amended to select another alternative.

To maintain the population at the low end of the range (232 considered), the maximum number of animals that would need to be removed in a year is 28 (the same for maintenance actions under alternatives B and C).

ESTIMATED COST

The cost of initial reduction with the use of sharpshooting is approximately $470,000. The cost of maintenance is about $11,000 per year and assumes carcasses would remain in the field (refer to table 3).

ALTERNATIVE E—CONTRACEPTION (STERILIZATION) (MAINTENANCE ONLY)

Alternative E is analyzed solely for maintenance of the elk population after initial reduction. At this time, sterilization has not been proven through science to effectively manage wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be an effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

The focus of this alternative is the use of permanent sterilization to maintain target elk population size. Because this option is unlikely to result in adequate initial reduction of the elk population within the lifetime of the plan, it is proposed here only for use as a population maintenance tool following initial reduction efforts by other means (see alternatives B–D above). Any of the methods described in alternatives B–D could be used to initially reduce the elk population size.

MAINTENANCE PHASE

This alternative would probably rely on surgical sterilization of reproductive females to reduce recruitment and growth of the herd, although if a safe and effective multi-year chemical contraceptive becomes available during the life of this plan, it might be used instead of or in addition to surgical sterilization (see alternative F). Under this alternative, enough reproductive females would be left untreated (unsterilized) so that some calves would be born, otherwise the population would reach senescence and death nearly simultaneously, an undesirable situation. Elk population management through surgical sterilization would include considerations of sex, age, recruitment, and natural mortality. Because the fence around the park allows movement in and out of the park, recruitment rates would include immigration (elk entering the park) and emigration (elk leaving the park), as well as birth rate. This option may be more practical for elk in the Boland Ridge area as these animals appear more likely to remain within the park year round.

Modeling would be required to determine the number of cows each year that required sterilization (NPS 2004a; appendix F). Sterilized cows would need to be permanently marked (ear tag, freeze branding, etc.) so that hunters could recognize them (and either not shoot treated elk or be fully informed that the cow had been treated) and to prevent their recapture for sterilization inside the park. Because elk in the Gobbler Knob region regularly move over the approximately four-foot-high section of fence in the southwestern area of the park, they may not be acceptable candidates for sterilization because they would be susceptible to hunting outside the park. In other words if the elk is killed by a hunter, the expense of sterilization would be wasted.

Alternative E is a maintenance phase that would focus on permanent sterilization of elk.

Surgical sterilization procedures addressed here (tubal ligations, ovariectomies) are time consuming, highly invasive, and stressful to the animal and could result in moderate mortality rates that may approach 5%–20% (Powers 2006). There can be dramatic differences in terms of risk to the animal and time involved in the two sterilization methods. Neither of the two procedures addressed here have been used on elk. NPS or contract veterinarians would perform all surgical procedures.

Tubal ligation would allow the animal to continue their breeding cycle and go through the rut, but it may artificially extend the rut (i.e., bulls would want to breed longer). Approximately four elk per day could be treated with this method (Powers 2006). Ovariectomy would stop hormone production and would likely affect normal breeding behavior. This procedure is a relatively quick one allowing for the treatment of approximately 10–30 elk per day. For either method (tubal ligations or ovariectomies), a 24-hour observation period is recommended to identify animals with excessive bleeding or other post-surgical complications (Powers 2006).

As these techniques have not been used on elk, future scientific studies would need to occur, particularly for the ovariectomy method in standing elk. Biologically, it may be better to perform such procedures in August but it is also very hot and quite stressful to animals at this time. It would be ideal to if these studies were conducted in January to mimic the actual time that the park may be implementing such actions. In addition, studies should include monitoring of mortality and success rates before these techniques would be used on a wide-scale basis.

In general, treatment would be performed during periods when animals are not cycling and are not pregnant or are in very early pregnancy (e.g., the summer months or early winter). Performing an ovariectomy on pregnant elk would result in abortion, likely within one to two weeks post-treatment (Powers 2006).

A single dose of antibiotics and an anti-inflammatory would be appropriate for treated elk (Powers 2006). Withdrawal times for these drugs of 30 to 45 days would restrict human consumption of treated elk meat though this would likely not be an issue if treatment occurs during a time when hunting/human consumption is not a possibility. Given all constraints imposed by timing, January is likely to be the best time to roundup or otherwise capture elk for sterilization. Because the logistics of treatment include capture and marking of a large portion of the female population, backup sharpshooting inside the park or other lethal means (roundup/euthanasia) of removal may be necessary to ensure the proper number of reproductive animals is removed each year.

If future scientific studies prove sterilization effective in elk population control and the preferred alternative and adaptive management efforts failed to maintain elk population, sterilization may be used for population maintenance. Capture of females could be accomplished by helicopter roundup or other hazing methods and corrals could be used to hold elk for sterilization to maximize efficiency. In a roundup situation, squeeze chutes would be used to immobilize the cows and an epidural and a local anesthetic would be administered to each animal. The elk would also be marked at this time with paint, collars or other means so that the mark is long-lasting and also obvious from the air. Markings would include information on pharmaceutical withdrawal times.

Issues of health and safety of staff and contractors under this option would include exposure to elk while they are being anaesthetized, tools used in sterilization procedures, animals being rounded up / confined, and the proximity of aircraft.

Carcass Disposal / CWD Testing

Surgical sterilization is not expected to result in a substantial number of elk carcasses though the procedures' mortality rates are unknown (initial estimates range from 5% to 20%). Any animals that are lost as a result of the procedure would be tested for CWD and, if positive, disposed of through incineration (if available) or in an off-site landfill. Otherwise, carcasses may be placed in the backcountry.

Mitigation Measures

- Experimental study of a small number of elk using both described procedures in January to mimic the actual time that the park may be implementing such actions. Monitoring of mortality and recovery rates would be completed before using these techniques on a wide-scale basis.
- Observation of treated elk for at least 24 hours after procedure to ensure safe recovery.
- Monitoring of mortality rates resulting from procedure to inform future management decisions.

NUMBERS OF ELK TREATED, BY YEAR

The park could treat up to 20 cows and/or female calves each year of maintenance or elect to treat a larger number in the first year of maintenance (up to 103 cows and/or female calves). Modeling would help in determining the ideal treatment scenario. If a large number of cows were treated the first year of maintenance, a very small number of calves moving into the breeding age, on the order of one per year, would require sterilization thereafter. If after the second year of maintenance activities it appears unlikely that the park's elk population would be sufficiently maintained at target goals, other maintenance actions could be considered (alternatives B, C, D, or F).

Estimated Cost

The estimated cost of sterilizing a single female elk is approximately $10,000 (Powers 2007). This includes monitoring, care following surgery, and radio-collaring treated animals. Many assumptions were needed to estimate costs for this alternative, including treatment of 90% of female cows in one year and treatment of only half the females coming into breeding age from then on. Although it is likely that fewer cows would be sterilized in the first year, for cost purposes this alternative assumes about 150 cows would be sterilized in the 20 years of maintenance, or an average of 7–8 per year. Including costs of roundups over this same period, the average cost of sterilizing as a maintenance tool is about $120,000 per year (refer to table 3).

ALTERNATIVE F—FERTILITY CONTROL AGENT (MAINTENANCE ONLY)

Alternative F is analyzed solely for maintenance of the elk population after initial reduction. At this time, fertility control agents have not been effective in controlling population growth in large free-ranging wildlife populations. The park will not use this alternative unless future scientific studies prove fertility control agents to be an effective and efficient means of elk population control at Wind Cave National Park and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Under alternative F, a maintenance phase, cow elk would be treated with chemical fertility control agents.

This alternative would focus on treating cow elk with chemical fertility control agents to maintain target elk population size. Because this option is unlikely to result in adequate initial reduction elk population within the lifetime of the plan, it is proposed here only for use as a population maintenance tool following initial reduction efforts by other means (see alternatives B–D above). Any of the methods described in alternatives B–D could be used to initially reduce the elk population size.

Under alternative F, a maintenance phase, cow elk would be treated with chemical fertility control agents.

This alternative would reduce the number of calves born each year, slowly contributing to the decline of the elk population. Because this option is not likely to accomplish initial elk reduction goals quickly (in less than five years), it is better suited as a maintenance tool. The use of other lethal options for initial reduction would be necessary (see alternatives B–D).

A helicopter would be used to round up elk into the wildlife corral for treatment. In order to minimize the potential for overheating animals during capture, and to treat when the greatest number of elk are within the park, the best time for treatment would be during the winter. However, most contraceptives need to be applied during or just prior to breeding season (fall), with the exception of contragestives, which are administered during pregnancy (NPS 2006g).

Animals would be treated by hand injection and would be marked with the date of administration of the agent and the agent's withdrawal date (the time after which human consumption is considered safe). Every effort to minimize the time elk are concentrated in the corrals would be made to reduce the possibility of spreading CWD.

The current pattern of movement of elk into and out of the park presents a challenge to using this technique because hundreds of cow elk may be out of the park during the treatment period (depending on the agent used). Treated elk may also leave the park exposing them to hunting, nullifying the expense and effort of contraception. Because of these limitations, treatment may be most effective for elk in the Boland Ridge area or the non-migratory element of the group that stays in the Beaver Creek area.

MAINTENANCE PHASE

While no chemical contraceptive meeting the needs of the park is currently available, several that might be effective are in development and future agents may become available. Appendix F provides information on the status of elk fertility control.

If future scientific studies prove fertility control agents effective in free-ranging elk population control and the preferred alternative and adaptive management efforts failed to maintain elk population, fertility control agents may be used for population maintenance. To be considered feasible for the park's use as an elk management option, fertility control agents would need to meet the following criteria, much of which is referenced from the Rocky Mountain National Park Draft EIS, Elk and Vegetation Plan (NPS 2006c:65–67).

- **Effective with a single treatment**. The agent would effectively control fertility for the specific duration with a single dose. A single dose treatment is required because the percentage of animals requiring treatment would be very high (in the 90% range) to maintain population levels, and treatments requiring multiple doses require animals to be handled multiple times. A mobile elk population like that utilizing park lands further decreases the chances of capturing and later recapturing the same animals and, from a population dynamics perspective, becomes increasingly less effective. In addition, capturing animals is potentially dangerous and stressful to both animals and humans. While tule elk (*Cervus elaphus nannodes*) at Point Reyes National Seashore (NPS 2004a) are treated with a chemical (porcine zona pellucida [PZP]) requiring both an initial treatment and a booster dose three weeks later, this was facilitated by the fact that the herd was confined to a small area in the park. Similar treatment would be much more difficult over the 44 square mile area of Wind Cave National Park.
- **At least 85% effective**. Ideally, a fertility control agent would be effective in every treated animal. Considering the variability in biological response and the difficulty and expense of applying a chemical contraceptive to a free-roaming wildlife population, the lowest acceptable level of effectiveness that would enable the park to reach the target elk numbers would be 85%.
- **Appropriate approvals and certifications**. Ideally, the agent would have regulatory approval for use in elk and would require no withdrawal period. Less optimally, it would be approved for use in an alternate species as an extra-label drug or approved for investigational purposes and would require no withdrawal period. If the agent was used for investigational purposes, the NPS

or researcher would be required to obtain an investigational exemption from the appropriate regulatory agency. This exemption requires specialized authorizations under a drug research project. All agents would need to be certified as safe for use in elk by the prescribing veterinarian. If the drug used has a required drug withdrawal period or used in an investigational manner, all animals treated would be permanently marked.

- **Safe for treated animals**. The agent would have no long-term effects on treated elk other than effective fertility control. This would include the absence of toxic, short-term reactions or debilitating long-term effects that would increase morbidity or mortality in the population. It also would not result in any genetic mutations that would be passed on to subsequent generations of elk if the fertility control was not successful.
- **No recognizable behavioral effects**. The fertility control agent would not result in recognizable behavioral effects such as the following:
  - **Reduced courtship, rutting, and breeding behavior**. Watching and listening to bull elk during the fall breeding season is an important component of the visitor experience at Wind Cave National Park. It is the park's goal to avoid noticeable reduction in bulls' "bugling," pursuing and herding cows, or challenges which would adversely affect wildlife behavior or visitor experience.
  - **Increased courtship, rutting, and breeding behavior**. PZP vaccine, although an effective contraceptive because it prevents pregnancy, also caused prolonged rutting and breeding behavior in tule elk at Point Reyes National Seashore in California (NPS 2004a). This behavior would be physically draining for the bulls, could increase elk–human conflicts (e.g., collisions with vehicle), and would clearly be a recognizable behavioral change from natural current conditions.
- **Safe for non-target animals**. Elk carcasses often serve as a food source for many other animals in the park. A fertility control agent should have no adverse effects on non-target animals that consume elk. Examples of possible effects include toxicity, changes in fertility, and genetic mutations that would interfere with life cycles or be passed on to subsequent generations. The long-term effects of fertility control agents on non-target animals are unknown at this time. Based on an adaptive management approach (appendix C), if additional information becomes available indicating that an agent has adverse effects on non-target animals, the use of the agent would stop or be modified to eliminate risks.
- **Multi-year effectiveness**. Given the expense of treating animals, it is necessary that a chemical agent would need to be effective (at least 85%) for more than a single season.

Potential agents for future fertility control use include a longer-lasting form of Leuprolide acetate (Leuprolide). Leuprolide currently exists as a single-breeding season agent which acts to suppress the secretion of a reproductive hormone (luteinizing hormone [LH]). It is approved for therapeutic use in humans and has been shown to successfully suppress ovulation and pregnancy in cow elk for one breeding season (Baker et al. 2002). Its use would require a prescription by a veterinarian who would also be responsible for establishing the withdrawal period. Marking to prevent human consumption prior to the passage of the withdrawal time would also be required. It is typically administered between mid-July and early-September so as to prevent conception during the fall breeding season (NPS 2006c:67). Treatment can be accomplished by hand injection and would require the use of a capture facility. Treatment with Leuprolide or similar pharmaceuticals would likely require permanent marking of each animal to aid in identifying them in subsequent years and to inform hunters of the chemical treatment and the withdrawal date after which human consumption would be considered safe.

GonaCon™, an immunocontraceptive vaccine, is a potential multi-year (possibly up to three years) agent which works by producing antibodies that attack proteins related to fertility (gonadotropin releasing hormone [GnRH]), rendering the animal infertile. It has been shown to be effective in various wildlife species with one dose. Clinical trials using GonaCon™ in elk are currently underway. All treated cow elk would require long-term marking (ear tags, freeze branding, collars, etc.) as this agent is not yet approved for use in any wildlife species. Treatment typically occurs at least four to eight weeks prior to the breeding season to allow the agent to be effective during the breeding season. The use of a capture facility may be necessary.

One of the constraints of the use of fertility control agents for elk reduction is the fact that there is ongoing movement of elk into and out of the park, depending on the time of year. There are many hundreds of elk outside the park that are unavailable for capture or treatment during the spring and summer, for example. Treated elk may also leave the park and be hunted, nullifying the expense and effort the park would put into contraception.

Carcass Disposal / CWD Testing

As with surgical sterilization, fertility control is not expected to result in a substantial number of elk carcasses though the procedures' mortality rates are unknown (initial estimates range from 5% to 20%). Any animals that are lost as a result of the procedure would be tested for CWD and, if positive, disposed of through incineration (if available) or in an off-site landfill. Otherwise, carcasses may be placed in the backcountry.

NUMBERS OF ELK TREATED, BY YEAR

As explained in the Science Team Report (NPS 2006g),

> In order for fertility control agents to effectively reduce population size, treatment with an agent must decrease the reproductive rate to less than the mortality rate. In urban deer populations, mortality rates are generally very low (approximately 10%); therefore, it would be necessary to treat 70–90% of the female deer to effectively reduce or halt population growth (Rudolph et al. 2000). Additionally, significant amounts of population data are necessary to effectively monitor the effects of long-term population changes due to the use of contraceptives (Rudolph et al. 2000; Hobbs et al. 2000; Porter et al. 2004).
>
> Fertility control agents generally decrease population levels slowly. At best, with 90% of the female deer treated, a 5% decline in the population would likely be expected after several years of treatment. Hobbs et al. (2000) described a model that suggests deer density will remain constant if 90% of the initial females are treated with a long-term fertility control agent. Subsequently, 90% of female fawns would require treatment. This would stabilize the population if the average mortality rate is 10%. However, this result does not hold for short-duration agents (one year duration). In this case, the 90% of reproductively mature females would require treatment each year in order to maintain constant herd numbers (Hobbs et al. 2000). Fertility control techniques are best suited to localized populations where the number of breeding females to be treated is small (e.g., less than 100 deer) and managers are trying to maintain the population between 30% and 70% of carrying capacity (Rudolph et al. 2000).

Assuming sex ratios similar to those at the beginning of the planning process (a bull to cow ratio of 1:1.8), a 35% calving rate, calves born at the bull to cow ratio of 1:1.8, an annual population growth of 12% and the need to treat 90% of the breeding female population, a population of 232 elk would contain approximately 114 breeding cows and 34 female calves. Table 2 shows that, with these assumptions, in the first year 103 cows would need to be treated. This treatment is assumed to require repeated application every year (as a worst case scenario). Because the calves in the beginning population would become breeders in the second year, the number needing treatment in subsequent years would increase. At these assumptions, the number to be treated would slowly increase over time by about one cow every 5-10 years. If after the second year of maintenance activities it appears unlikely that the park's elk population would be sufficiently maintained at target goals, other maintenance actions could be considered (alternatives B–E).

TABLE 2. ESTIMATED NUMBERS OF ELK TO BE TREATED, BY YEAR, UNDER ALTERNATIVE F

Year	Beginning Cow/Calf Population	Number of Calves	Number of Cows	Number of Cows Treated	Number of Breeding Cows	Number of new births	Number of new females	Cow Population after Mortality of 10%
1	148	34	114	103	11	1	1	148
2	148	2	146	131	15	2	1	148
3	148	2	146	132	15	2	1	148
4	148	2	146	132	15	2	1	148
5	148	2	146	132	15	2	1	149
6	149	2	147	132	15	2	1	149
7	149	2	147	132	15	2	1	149
8	149	2	147	132	15	2	1	149
9	149	2	147	132	15	2	1	149
10	149	2	147	132	15	2	1	149

These assumptions do not take into account recruitment or immigration of animals into the population, and have not been field tested or validated with field data.

Estimated Cost

Currently, no multi-year contraceptives are available for use, and so cost figures for annual treatment with Leuprolide were used to estimate costs. If elk were treated by NPS veterinarians, maintenance would consist only of the cost of the contraceptives and roundup. The cost of the chemicals is relatively low, on the order of $200 per elk. However, models of other elk populations indicate that 90% of the female breeding population, or about 125 elk if the population remains at the low end of the management target, would require treatment each year (appendix F). With the cost of roundup, this translates to about $57,000 per year. As noted above, one of the conditions for using chemical contraception is that the treatment be effective for more than one year. Since this would mean fewer roundups and fewer doses administered, actual annual costs would likely be less than $57,000. Table 3 provides a cost comparison of the action alternatives.

TABLE 3. ESTIMATED COST COMPARISON OF ACTION ALTERNATIVES

	Alternative B—Hunting Outside the Park	Alternative C—Roundup and Live Shipment or Euthanasia	Alternative D—Sharpshooting [b]	Alternative E—Contraception (Sterilization) (maintenance only)	Alternative F—Fertility Control (maintenance only)
Initial Reduction	$175,000	$210–$235k[a]	$470,000		
Annual Maintenance	$ 3,000	$100,000	$ 11,000	$105,000	$57,000
Total Maintenance	$48,000	$1.8 million	$176,000	$2.1 million	$1.1 million
Total Cost	$223,000	$2 million	$646,000	$1.5 million + initial reduction costs	$935,000 + initial reduction costs

[a] This assumes no park partner; partner costs (if found) would be up to $315,000, + $100,000 per year maintenance cost.
[b] Five to six teams (spotter and shooter)

ADAPTIVE MANAGEMENT METHODS INCLUDED IN THE ALTERNATIVES

The Department of the Interior requires that its agencies “use adaptive management to fully comply” with CEQ guidance that requires “a monitoring and enforcement program to be adopted….where applicable, for any mitigation” (516 DM 1.3 D (7); 40 CFR 1505.2). Adaptive management is based on the assumption that current resources and scientific knowledge are limited. Nevertheless, adaptive management attempts to apply available resources and knowledge and adjusts management techniques as new information becomes available (NPS n.d.:71).

Adaptive management incorporates scientific experimental methods into the management process while providing flexibility to adjust to changes in the natural environment. It is based on a continuing, iterative process of:

- applying management actions,
- monitoring consequences,
- evaluating monitoring results against plan objectives,
- adjusting management, and
- using feedback to make future management decisions (appendix C).

All action alternatives incorporate adaptive management techniques designed to aid in meeting plan objectives. Each action alternative includes a specific management action, an estimate of numbers of animals that would need to be removed/treated, and a period of monitoring to evaluate the success of the action. Integrating these issues into decision-making for future actions would allow the park to change timing, intensity, or type of management actions to better meet the goals of the plan.

The monitoring and adaptive management plan (appendix C) describes the potential changes in elk management strategies which could occur as a result of monitoring activities findings. Under this plan, key monitoring data which could influence management actions are those related to range forage and wildlife (elk, bison, and prairie dogs). The number of elk to be removed annually would be adjusted based on the results of the success of the previous year’s removal effort, the monitoring of the park’s forage, elk population surveys, and growth projections. Action thresholds — indicators that determine when elk management action should be taken based on the goals and objectives of the park (NPS 2006g) — would be incorporated into plan implementation.

ALTERNATIVES CONSIDERED BUT DISMISSED

HUNTING INSIDE THE PARK

A “hunting inside the park” option was considered as a preliminary alternative to accomplish direct reduction of the elk population within Wind Cave National Park. However, it was not carried forward for further analysis for the following reasons:

- It is inconsistent with existing laws, policies, regulations, and case law regarding public hunts in units of the National Park System and the likelihood of this changing is remote and speculative. See Natural Resources Defense Council, Inc. v. Morton, 458 F.2d 827 [D.C.C. 1972]; National Rifle Association v. Potter, 628 F. Supp. 903 [1986]; NPS 2001a:50; Headwaters, Inc. v. Bureau of Land Management, 914 F.2d 1174, 1181 [9th Cir. 1990]; Seattle Audubon Society v. Moseley, 80 F.3d 1401, 1404 [9th Cir. 1996]; Kootenai Tribe of Idaho v. Veneman, 313 F.3d 1094 [9th Cir. 2002]).
- Other direct removal alternatives (e.g., sharpshooting) could be implemented without changing current laws and policies; would better meet the purpose, need, and objectives of the plan; and would have substantially the same environmental effects as hunting in the park.

Throughout the years, the NPS has consistently maintained a strict policy of not allowing hunting in national parks. Hunting within national parks is viewed as contrary to NPS philosophy of preserving, protecting and providing visitor opportunities to see natural conditions. In the 1970s Congress passed the General Authorities Act and the “Redwood Amendment” which clarified and reiterated that the primary purpose of the Organic Act is conservation. While the Organic Act gave the Secretary of the Interior the authority to destroy plants or animals for the purposes of preventing detriment to park resources, it did not give the Secretary authority to permit the destruction of animals for recreational purposes. In 1984, after careful consideration of Congressional intent with respect to hunting in national parks, NPS promulgated a rule (36 CFR 2.2) that allows public hunting in national park areas only where “specifically mandated by Federal statutory law.” NPS has recently reaffirmed this approach in the NPS *Management Policies 2006* (NPS 2006d).

Enabling legislation creating Wind Cave National Park was signed in 1903; in 1908 general rules and regulations were established which specifically stated “Hunting or killing, wounding or capturing any bird or wild animal on the park lands… is prohibited” (NPS 1908). In 1912, Wind Cave National Game Preserve was established within the current park boundaries specifically “for a permanent national range for a herd of buffalo” (NPS 1994d). When the national game preserve was abolished in 1935 and authority over those lands was transferred to Wind Cave National Park, these lands were subject “to all laws and regulations applicable” to the park (49 Stat. 383, USC 141b). As hunting within the park was not addressed in its enabling legislation, it has never been considered a legal activity.

Congressional action would be required to change existing legislation to allow hunting in the park and it is believed there is little chance this would occur. Some hunting activities are currently allowed within certain national recreation areas and seashores through their enabling legislation, but this is not the case for the vast majority of NPS units. Proposing such a legislative change would also require approval from the NPS directorate, which has indicated it would not provide that approval.

In addition to these legal, regulatory and policy reasons for not considering hunting in the park, hunting would be duplicative of other alternatives and would not outweigh the advantages of those alternatives. Alternatives in an EIS are to be reasonable, but offer a full spectrum. Therefore if one alternative offers technical, economic or other advantages over another and environmental consequences are the same between the two, only one should be carried forward for analysis.

When reviewing the options of hunting in the park and sharpshooting (alternative D), it is believed that sharpshooting offers technical, legal and policy advantages over hunting inside the park. While hunting inside the park might offer a beneficial impact to one segment of visitor use, it has the potential to adversely affect visitor use by other segments of the public (e.g., associated park area closures for special hunts, knowledge of visitors/public that hunting is taking place in a national park). Sharpshooting would result in less noticeable impacts to visitors through the use of rifle noise suppressors, the potential of shooting at night, and the ability to have a few sharpshooters work over a longer period than that of a special hunt, etc.

To summarize, the alternative of hunting elk in the park to reduce their numbers is legally infeasible and duplicates other options which offer relative advantages. For these reasons, it was dismissed from further analysis.

TRANSLOCATION OF ELK

Prior to 1994, the park managed elk populations through the use of roundup and translocation activities conducted every few years. This approach worked well until 1997 when CWD was identified in a captive herd adjacent to the park. In July 2002, the NPS director issued a memo stating “deer or elk will not be translocated from areas where CWD is known to occur” (see appendix B). In the same year, CWD was documented in a cow elk in the park. The prohibition on the translocation of elk to other locations outside park boundaries is still in effect. Targeted surveillance to detect sick elk and CWD testing of elk that have died are ongoing management activities within the park. As of May 2006, testing has resulted in eleven positives in elk and eight positives in deer.

There is some possibility that the NPS policy precluding translocation would change in the future if CWD is found nationwide in all park and non-park ungulate populations. At that time live translocation would presumably not be a problem unless it is occurring from an area where prevalence is much higher to one where it is lower. This is considered too speculative a possibility to keep the alternative of live translocation as a reasonable alternative.

It was decided that this management option should be eliminated from further consideration given the current constraints. It can be reviewed at a later time under supplemental NEPA compliance if translocation becomes viable in the future.

HABITAT ALTERATION

Some members of the public indicated that the park should improve habitat either inside or outside the park so the land could carry more elk and fewer reductions would be needed. Ultimately, however, altering habitat to support additional elk would not provide a long-term solution to the needs identified in this planning process. Even if the park did employ ideas mentioned by the public, such as prescribed burning for example to create additional elk habitat, the herd would presumably grow in response, occupy this new habitat and continue to grow in size to have the same impacts it has now. In other words, this alternative would just delay the problems the park is currently experiencing with elk. In addition, it is not clear whether burning would create additional elk habitat, and other ideas such as providing additional sources of water or supplemental feeding were either unnecessary (e.g., water is adequate) or conflict with

NPS *Management Policies 2006* and wildlife management policies of other agencies (supplemental feeding with hay or growing additional forage crops).

FENCING IN ELK

The option of fencing elk in within park boundaries was dismissed for the following reasons: (1) it is inconsistent with the project's purpose (…establish elk population levels that are in balance with natural system functions…) by discouraging natural movement of elk and other animals, potentially creating a "captive herd" situation and (2) it is contrary to NPS *Management Policies 2006* (sec. 4.4.1.1) which direct that park actions maintain natural migratory animal behavior in populations in the park (NPS 2006d). While the park is already completely fenced to impede bison escaping, this does not result in a captive elk herd as there is predictable and observable movement of elk into and out of the park over these fences throughout the year.

AERIAL SHARPSHOOTING

Aerial sharpshooting for reduction activities was discussed and dismissed. The reasons include public perception, impacts on visitor experience and safety if a visitor happened to be in backcountry and was not aware the area was closed, the fact that highway 385 cannot be closed, and the considerable expense involved.

PREDATOR REINTRODUCTION

The reintroduction of wolves to accomplish population goals was discussed in detail and dismissed. The gray wolf is currently listed as "endangered" in western South Dakota under the *Endangered Species Act*. The focus of this alternative would have been the experimental use of wolves confined to the park to control elk numbers under as natural conditions as possible.

Depending on the number of wolves released into the park, this option could have functioned as both an initial reduction and a maintenance tool. The small size of the park would limit a wolf pack size to less than ten animals for elk population reduction and less than five animals for elk population maintenance. In Yellowstone National Park, a pack of 10 wolves kills approximately 150 elk/year (Smith 2006); five to six wolves would likely take 60 to 75 per year. As noted above, maintaining the elk population at Wind Cave National Park at the lowest end of the acceptable range would require removal of a maximum of 28 animals per year.

Two methods to keep wolves from leaving the park were examined, including exclusionary fencing and shock collars. Exclusionary fencing that precluded wolves from digging under or climbing over would create unacceptable environmental impacts to other park resources. Shock collars appeared to be feasible as a method to keep wolves within the park, however would create a need for constant wolf handling for collar maintenance (for example battery replacement). Recent research indicates conditioning (and hence the ability to remove the collar once a wolf has learned to stay away from the fence) is not clearly demonstrated in wolves fitted with shock collars as a means to keep them away from livestock (Hawley et al. 2009).

In addition, the small number of wolves needed to reduce and maintain the elk population would create a breeding population in which pups must be removed on a continual basis, necessitating additional wolf handling. To eliminate this need, sterilized or fertility controlled wolves were examined.

Issues related to wolf reintroduction include public opinion/perception (including park neighbors), lack of SDGFP support for the either natural migration or translocation of wolves, and the gray wolf's current listing as endangered under the *Endangered Species Act* requiring formal consultation with the U.S. Fish and Wildlife Service.

The primary reason for the dismissal of this option is that it is infeasible from a regulatory perspective. The use of sterilized wolves for elk management within the park is considered a "take" under the *Endangered Species Act* (Larson 2006a) and would have required formal consultation with and a permit from the U.S. Fish and Wildlife Service. A "take" is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (*Endangered Species Act of 1973*). This may include significant habitat modification or degradation if it kills or injures wildlife by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering (USFWS 2006). The U.S. Fish and Wildlife Service has stated that it would not expend limited resources on the establishment of a population of wolves that would not contribute to the recovery goals of the species, would not contribute to the breeding population, and whose focus for reintroduction would be maintenance of elk populations (Larson 2006b) (appendix G).

In addition, it is possible that the gray wolf would be delisted by the U.S. Fish and Wildlife Service in the future, at which time management of the species would revert to the State of South Dakota for lands outside Wind Cave National Park. If the wolf is delisted, the state of South Dakota could possibly adopt a zero-tolerance policy. South Dakota Game, Fish and Parks, a cooperating agency for the park's elk management plan, strongly opposes the reintroduction of predators as an elk management tool and requested that the option be removed from consideration (SDGFP 2006a) (appendix H).

In response to public comments asking for additional detail regarding the reasons for dismissing reintroducing wolves as an alternative, information taken from discussion with the USFWS (Bangs 2006; Larsen 2006b) and Yellowstone National Park (D. Smith, YNP Wolf Project Leader) has been added. The following summarizes relevant points from conversations with these experts:

1. The amount of space in Wind Cave (44 square miles) is much too small for an average wolf pack, which uses between 200 and 500 square miles of territory.

2. If the park introduced a small fertile pack, and the alpha female or male died, no breeding would take place as breeders come from adjacent packs. Packs studied in Europe indicate that those without contiguous packs become "sick" with adverse effects on breeding, feeding, and social behavior.

3. Any pups that are born to the pack would attempt to leave seeking mates from other packs. This means they would be using all means to try to exit the park, even if they were shocked from electric collars. They would also never attempt to return if shocked on their way out of the park.

4. The collars would also be problematic according to Bangs, as the batteries would be unreliable and it would be very difficult to design a fence system where the current was not broken by animals shoving against the fence, chewing on wires, trying to escape, etc. The thickness of wolf fur would change seasonally, and contact with the skin would be less likely in the winter. Without this contact, wolves would be more likely to escape; in addition, park staff would need to handle wolves and wolf pups frequently to ensure contact (3–4 times per year to change batteries, ensure prongs are the correct length, etc., [Smith 2006]). Doug Smith, from Yellowstone National Park indicated that shock collars may not keep wolves inside Wind Cave National Park, and that tracking would need to be added to the collars to retrieve wolves that do escape. As noted above, recent research indicates it is unlikely that wolves would become conditioned to collars, allowing

the park to remove them. Therefore continued handling to ensure contact, functionality, etc., would be required.

5. It is possible that wolves would affect elk distribution so that most would leave the park and not return; this in turn would mean the wolves would predate non-target species such as deer or antelope.

6. As noted in the EIS, the USFWS would not be willing to either grant permission to “take” fertile wolves from another U.S. population to seed a non-fertile pack at Wind Cave National Park and would be unwilling to expend financial and staff resources to grant “10(J)” status unless the Wind Cave pack was contributing to reintroduction efforts (e.g., was fertile and allowed to exit the park naturally). The USFWS also is only willing to consider a 10(J) status when there is state support. Fertile wolves exiting the park either because they are allowed to do so to meet recovery efforts, or simply because the fence cannot hold them (experts unanimously agreed it would be extremely difficult for any fence to keep all wolves penned in and cited holding pens in Yellowstone prior to wolf release where wolves escaped as an example) is absolutely untenable for the South Dakota Game Fish and Parks, as noted in the letter included as appendix H of this plan/EIS. Gray wolves remain a listed species in western South Dakota, and without special status conferred by 10(J), could not be shot or harassed in any way should they leave the park, leaving the state or landowners with no management options.

NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

The CEQ regulations for implementing NEPA (1502.14[e]) require that an agency identify its preferred alternative or alternatives in draft and final EIS documents. The preferred alternative is that alternative “which the agency believes would fulfill its statutory mission and responsibilities, giving consideration to economic, environmental, technical and other factors” (Q4a).

Alternative B (Hunting Outside the Park) is the preferred alternative because it most fully meets the plan’s objectives and it would be easier to implement than the other alternatives.

In the fall of 2007, after completion of the analysis of environmental consequences of the alternatives, preliminary cost information, logistics and other information, the park undertook a series of discussions and exercises designed to identify the “preferred alternative.” These efforts included evaluation of how well alternatives met the stated objectives of the plan (see table 5 at the end of this chapter), the level of ease/difficulty of implementation of each alternative, costs, and the environmental benefits and adverse impacts for each. Collectively, these factors were evaluated to arrive at the park’s preferred alternative.

Alternative B, which makes use of drop down (e.g., lowered) segments of fence and hazing to encourage elk out of the park for public hunting, was identified as the preferred alternative for both initial reduction and maintenance phases (refer to table 3 and the “Alternative B—Hunting Outside the Park” section in this chapter for more specific alternative information).

Regarding Objective 1, alternative B better integrates concerns of a wide range of parties (land management agencies, tribes, and private entities) interested in addressing elk over-population issues. Under this alternative, hunters would utilize carcasses / elk meat versus the “wasting of resources” possible under alternative C and certain under alternative D. The “wasting of resources” was a primary concern expressed by many members of the public during scoping for the project in 2005.

Regarding Objective 2, alternative B fully meets the objective of coordinating with other agencies involved in elk management in order to achieve multiple goals and objectives when compared to other action alternatives (the SDGFP manages hunts; the park coordinates with the SDGFP on elk population numbers, hunting tags, etc.). Coordination with other agencies regarding elk management in the Black Hills currently occurs in a less formal manner and would likely continue under other action alternatives. However, it would be enhanced in alternative B beyond other alternatives, as all aspects of the hunt as well as planning and management activities would require full coordination with the SDGFP.

Regarding Objective 3, alternative B fully identifies specific management action thresholds based on elk population numbers and condition of forage, as do all action alternatives. This information would guide the park as to when specific elk management actions should occur to avoid unwanted impacts to park resources. The use of tools in alternatives B, C, and D for maintenance efforts are particularly effective when compared to alternatives E and F where action thresholds would likely be more difficult to assess in a timely manner.

Regarding Objective 4, alternatives B, C, and D fully meet the objective of incorporating latitude into management strategies through the use of their adaptive management approach. The adaptive management process would include evaluating the effects of management actions on other resources within and, where necessary, outside the park to identify whether and how elk management actions or thresholds may need to be modified to meet the objectives of the plan. It should also be noted that alternative B (as well as alternatives C and D) would allow for a more efficient assessment of a management strategy's success when compared to alternatives E and F where evaluation of effectiveness may require a considerably longer period of time.

Regarding Objective 5, alternatives B, C, and D also fully meet the objective of managing present and future wildlife health issues. While it is anticipated under alternative B that approximately 60% of harvested elk carcasses would be tested for CWD (versus the 100% of carcasses under alternatives C and D), this approach is believed to provide a sound statistical sample from which accurate measurements of prevalence/distribution of disease rates can be determined in an area where CWD is known to exist (Powers 2007; Kintigh 2007). In addition, alternative B would not involve the corralling of live animals (and the possibility of disease transfer) as would alternatives C, E, and F, under which some or all animals would be ultimately released back into the park. As noted, alternatives C and D also meet this objective well and would allow for the possibility of more specific biological research/data collection due to the park-directed handling of individual carcasses not possible under alternative B.

In summary, alternatives B, C, and D would all largely meet objectives 3, 4 and 5, but alternative B would meet objectives 1 and 2 to a larger degree than all other alternatives. Alternatives E and F, even in combination with other initial reduction tools, would not meet objectives to the same degree as alternatives B, C, or D.

The park also believed that alternative B would be more easily implemented than other action alternatives. Alternative B is considered environmentally superior (see discussion of environmentally preferable alternative below) and preliminary estimates show it would be less expensive (refer to table 3). Alternative B would be easier to implement than other alternatives because it would require no modification of the park corral, roundups, or handling and care of live animals as would alternative C, E or F. In addition, it does not require carcass removal or disposal of hundreds of animals, a considerable task possible under alternative C and certain under alternative D. As noted above, concerns over sanitary conditions of elk meat while it remains in the field awaiting transport by helicopter and during transport itself, as well as liability concerns prevent the park from considering donating carcasses in alternative D. At the same time, it is possible that some adjacent landowners may be concerned about the numbers of elk on their lands if elk are not removed through hunting as anticipated under this alternative. Resolution of such issues would be part of the adaptive management strategy.

AN ADAPTIVE APPROACH FOR THE PREFERRED ALTERNATIVE

Adaptive management incorporates scientific experimental method in the management process while remaining flexible to adjust to changes in the natural world, as well as the policy that governs it. Implementation of an adaptive management approach requires constant evaluation and includes managing under a certain level of uncertainty. It integrates setting quantitative objectives, exploring alternative management strategies, monitoring progress, and evaluating performance in terms of risks and benefits (Goodman and Sojda 2004). For information on adaptive management, see appendix C.

Implementation of the preferred alternative has an inherent amount of uncertainty in being able to meet the plan's elk population objectives. Factors such as elk dispersing to areas outside the park and hunter participation and success outside the park would greatly impact the effectiveness of the alternative. Given this uncertainty, the park would implement an adaptive management approach that seeks to provide for the most effective management technique. In addition, the park has also developed an adaptive approach for adjusting elk population sizes and forage allocations. For more information on this aspect of the plan, see appendix C.

In terms of assessing the effectiveness of the preferred alternative, the park would work closely with the state of South Dakota to collect specific elk population information. If the data suggests that the plan's population objectives during the initial reduction phase would not be met, then the park would initiate actions described in alternative C. Once the initial population objective is met then the park would shift back to the actions described in alternative B (the preferred alternative) for long-term maintenance. If, however, maintenance efforts under alternative B cannot stabilize the elk population meeting the plan's objectives, then the park would initiate maintenance actions described in alternative D. The impacts of alternative C and D are described in the "Environmental Consequences" chapter and there would not be any synergistic effects from switching management techniques.

To assess the effectiveness of the preferred alternative, the park would collect annual elk population estimates inside the park as described in appendix C. In addition, the state would provide data related to hunter numbers and hunter success. If the population estimates and hunter success rates show that initial reduction or maintenance actions under the preferred alternative would not likely meet population objectives, then the park would adjust its actions as described above. This assessment would take place after a period of two years from implementation of each phase to account for factors such as weather conditions, logistical issues with implementation, state license availability and participation, among others.

If the preferred alternative is implemented in the fall of 2009, the population of elk using the park could be approximately 815, based on the current numbers of about 650. Assuming actions in the preferred alternative are as effective as expected, it would take four years to get into the range of 232–475 animals wintering in the park and six years to achieve the low end of this range. If the elk are not wintering in the park and the population is still within ±5% of 482 animals following two years of implementing of the alternative, the park would assume the tools are not effective enough to reach planned population goals, and would begin to implement alternative C (roundup and live shipment or euthanasia). Sharpshooting (alternative D) would be used if the population number is lower than this, but still not within the 232–475 range after two years. Sharpshooting (alternative D) may also be used periodically and sparingly during the implementation of the preferred alternative if needed to balance elk from different geographical areas of the park, displace elk, achieve more desirable sex or age ratios, etc.

CONSISTENCY WITH PURPOSES OF THE NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act requires an analysis of how each alternative meets or achieves the purposes of the act, as stated in section 101(b). The following purpose statements make up section 101(b):

Alternative B, the environmentally preferable alternative, would effectively reduce and maintain the herd size to target population goals while preserving the current natural distribution/ movement of elk into and out of the park.

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
- Assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings.
- Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences.
- Preserve important historical, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment that supports diversity and variety of individual choice.
- Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities.
- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.
- The following sections discuss each of these purposes and the degree to which each of the action alternatives meet them:

Alternative B, the environmentally preferable alternative, would effectively reduce and maintain the herd size to target population goals while preserving the current natural distribution/ movement of elk into and out of the park.

Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations. As noted in the analysis, alternatives B, C, or D include both initial reduction and maintenance phases, whereas alternatives E and F are only envisioned as maintenance strategies and would require pairing with the initial reduction tools in alternative B, C, or D. Alternatives B, C, or D would fulfill responsibilities of each generation as trustee of the environment for succeeding generations by, in the long-term, contributing to a more natural park ecosystem characterized by an environmentally sustainable number of elk using the park. Because they are only maintenance options, alternatives E or F would only preserve the population at these levels, rather than create them and so would not meet the intent of this criterion as well. The positive effects of creating an environmentally sustainable elk population would be particularly evident for the herd itself, as well as for vegetation (promotion of healthy plant communities, minimization of loss of species diversity/reduced reproduction) and wildlife (improved habitat/reduced competition) resources.

Assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings. Alternative B may be more "productive" or "aesthetically pleasing" in that excess elk would be put to what some members of the public may describe as a useful purpose (hunting/consumption of meat). This is in contrast to the potential public perception of the "wasting of resources" related to incineration of elk carcasses under alternatives C and D, the choice to minimize reproduction in alternatives E and F, and leaving carcasses in the field in alternative D.

Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences. Alternative B would attain a wide range of beneficial uses of the environment without degradation or other undesirable and unintended consequences by reducing the elk population so that it minimizes adverse impacts on other resources to a slightly larger degree than would alternatives C or D. Alternative B would perform better than other alternatives, including E and F, in protecting the health and safety of park staff and contractors, as each of these requires dangerous tasks such as herding elk into squeeze chutes (alternatives C, E, and F), removing antlers (alternative C), euthanizing or loading live animals onto trucks (alternative C), shooting elk in close quarters with other sharpshooters (alternative D), carcass handling and removal (alternatives C and D), etc. In addition, the resource would be put to a useful purpose (consumption of meat by hunters) under alternative B (not true for alternatives C and D). Alternative B would not include the potential disease transmission risk from elk being corralled and closely held, an unintended consequence possible under alternatives C, E, and F. However, hunter safety would be more compromised in this alternative than others due to their anticipated increased numbers in hunting units adjacent to the park.

Preserve important historical, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment that supports diversity and variety of individual choice. Alternatives B, C, and D each meet this criterion in that they create an elk population to minimize impacts on the ecosystem at the park, which will preserve natural aspects, such as the bison herd and prairie dog colonies, in a healthy state well into the future. Because the bulk of elk management efforts would occur outside park boundaries under alternative B, it would minimize impacts to these resources, considered part of the national heritage of this national park unit. At the same time, analysis of non-park resources outside the park (e.g., cultural resources) indicates only negligible adverse impacts. Alternative B may also increase choice on the park of the public by providing hunting opportunities that are not available under other alternatives.

Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities. Alternative B would also provide for a balance between population and resource use by its promotion of the continued public enjoyment of the park and adjacent lands, its socioeconomic contributions, and its promotion of a healthy park ecosystem (also aspects of alternatives C and D). Hunting outside the park under alternative B would further contribute to the wide sharing of life's amenities, particularly in that the resource (elk) would be put to a consumptive use and not "wasted" (incinerated) as is proposed under alternative C and possibly alternatives D, E or F. This issue is considered a notably positive characteristic of alternative B.

Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources. This criterion is less relevant to the elk management plan, as it is geared toward discussion of "green" building or management practices.

ENVIRONMENTALLY PREFERABLE ALTERNATIVE

The NPS is required to identify the environmentally preferable alternative in its NEPA documents for public review and comment. The environmentally preferable alternative is defined by CEQ NEPA regulations as the alternative that "causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves and enhances historic, cultural and natural resources (40 CFR 1500–1508).” (See the “Environmental Consequences” chapter for detail on environmental effects of each alternative.) The CEQ NEPA regulations also indicate that the environmentally preferable alternative is the one that “will promote the national environmental policy as expressed in NEPA Section 101 (Forty Most Asked Questions Concerning CEQ’s National Environmental Policy Act Regulations 40 CFR 1500 – 1508; Question 6a).

In the fall of 2007, after completion of the environmental consequences analysis of the alternatives, the park undertook a series of discussions and exercises designed to identify the environmentally preferable alternative. These efforts included discussion of how well alternatives met the CEQ interpretations of the Section 101 criteria, as well as the review and comparison of specific environmental effects to natural and cultural resources provided in this document (see table 6 at the end of this chapter). Collectively, these factors were evaluated to arrive at the environmentally preferable alternative.

In many respects, alternatives B, C, and D are quite similar to one another in effects to natural and cultural resources. Effects which differ notably among them relate to such things as beneficial impacts to the elk herd from restoring greater migratory movement under alternative B; reduced negligible adverse effects to individual elk realized by reduced stress under alternative D; increased vegetation trampling outside the park and along the fence line expected under alternative B; and adverse effects to prairie dogs and black-footed ferrets from trampling during roundup under alternatives C, E, and F (see table 6 at the end of this chapter).

After careful consideration of all factors involved, alternative B (Hunting Outside the Park) was selected as the environmentally preferable alternative. The fact that alternative B would effectively reduce and maintain the elk within target population goals while preserving the current natural distribution/movement of elk into and out of the park were prime contributors to its selection.

The park has identified alternative B as best meeting the CEQ definition of environmentally preferable alternative, because it:

- Accomplishes the goal of reducing herd size to the target population goals.
- Preserves to a large degree the natural elk distribution patterns/movements into and out of the park.
- Does not require carcass disposal (hunters would presumably consume elk meat from harvested animals), thereby minimizing impacts to air quality and soils expected under alternative D and possible under alternative C.
- Provides better utilization of meat from killed elk, an important issue for many commenters (not an option under alternative D and only a possibility under alternative C).
- Requires no modification to the park corral (alternative C, and possibly alternatives E and F do require modifications), or potential contamination of soils and water quality from exsanguination (more likely to occur in alternative C).
- Does not increase the chance of elk to elk contact or contamination of the corral by CWD infected elk (as do alternatives C, E, and F).
- Minimizes the adverse effect on visitor experience because carcasses would not be left in the field (as would alternative D).
- Provides hunting opportunities for the public with a state-managed (SDGFP) infrastructure that is already in place (e.g., hunting licenses, CWD testing etc., already in place).

HOW ALTERNATIVES MEET PLAN OBJECTIVES

As stated in the “Purpose of and Need for Action” chapter, action alternatives selected for analysis must meet all objectives to a large degree. Action alternatives must also address the stated purpose of taking action and resolve the need for action. Alternatives that did not meet the plan objectives were dismissed from further analysis (see the “Alternatives Considered but Dismissed” section above).

Table 4 summarizes the elements of the alternatives analyzed within this EIS. Table 5 summarizes the degree to which each of the analyzed alternatives meets the stated objectives of the plan/EIS (the list of plan objectives are presented in the “Purpose of and Need for Action” chapter). Table 6 presents a summary of environmental effects to park resources, by alternative (see the “Environmental Consequences” chapter for detailed resource analysis).

TABLE 4. SUMMARY OF ALTERNATIVE ELEMENTS

Element	Alternative A—No Action (Continuation of Current Management)	Alternative B—Hunting Outside the Park	Alternative C—Roundup and Live Shipment or Euthanasia	Alternative D—Sharpshooting	Alternative E—Contraception (Sterilization) (maintenance only)	Alternative F—Fertility Control (maintenance only)
Primary initial reduction method used to bring population levels to target goal within first five years of plan implementation	Continuing monitoring to estimate seasonal elk population numbers and amount of forage available. Surveillance surveys to identify and remove elk exhibiting clinical signs of CWD continue. No direct elk reduction activities.	Natural (and possibly hazed) elk movement through gates in park fence boundary to facilitate hunting of elk outside the park; possible use of other lethal method for those elk that do not typically leave the park.	*With partner*: roundup/live shipment and donation of meat. *Without partner*: roundup and euthanasia; carcasses incinerated. Other lethal methods may be necessary for those elk difficult to roundup.	Use of ground-based qualified federal employees and/or authorized agents. Use of other lethal methods may be necessary to meet reduction goals.	N/A—no initial reduction using this methods (see maintenance discussion below).	N/A—no initial reduction using this methods (see maintenance discussion below).
Timing of initial reduction efforts	No specific reduction efforts planned.	Anticipated that many elk will leave park naturally in spring/summer; hazing could occur in fall to push more out. Public hunt outside park in fall (designated hunting seasons).	Winter (January/ February).	August 1 to March 1.	Variable, most likely January.	Variable (dependent on agent).
Maintenance of population through the life of the project (15–20 years) (after initial reduction phase)	No maintenance efforts planned.	Same as initial reduction but on smaller scale, possibly coupled with other options for hard to haze elk or for elk that do not move freely through gates.	Same as initial reduction, possibly on smaller scale, possibly coupled with another lethal option depending on numbers of elk that need to be removed during maintenance efforts.	Same as initial reduction, possibly on smaller scale.	Maintenance of reduced population numbers by surgical sterilization of a number of reproductive females designed to reduce recruitment/ herd growth.	Maintenance of reduced population numbers by treating cow elk with chemical fertility control agents that will gradually contribute to the decline of the elk population.

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Element	Alternative A—No Action (Continuation of Current Management)	Alternative B—Hunting Outside the Park	Alternative C—Roundup and Live Shipment or Euthanasia	Alternative D—Sharpshooting	Alternative E—Contraception (Sterilization) (maintenance only)	Alternative F—Fertility Control (maintenance only)
Carcass disposition	Existing management—as elk die, carcasses left in field or landfilled (if CWD positive).	Elk carcasses taken by hunters outside the park.	*With partner*: elk live-shipped, killed, processed, meat donated to public, offal/bones disposed of in acceptable manner. *Without partner*: elk dispatched in park corrals and carcasses disposed of by incineration.	Sling-load carcasses from the park's backcountry to central point in park; incinerated. Some may be left in the field if environmentally preferred or difficult to remove.	Few carcasses expected; those elk that do die as a result of the procedure would be disposed of by incineration or if CWD positive in a landfill.	Same as alternative E.
Resource monitoring	Annual estimates of seasonal elk population numbers (aerial and ground surveys) and forage produced within the park would continue. Targeted surveillance surveys to identify/remove elk exhibiting clinical signs of CWD.	Annual monitoring of range forage, bison and elk population, and prairie dog acreage or trends in the populations of these species would be used to adjust management actions.	Same as alternative B.	Same as alternative B.	Same as alternative B.	Same as alternative B.

TABLE 4. SUMMARY OF ALTERNATIVE ELEMENTS

Element	Alternative A—No Action (Continuation of Current Management)	Alternative B—Hunting Outside the Park	Alternative C—Roundup and Live Shipment or Euthanasia	Alternative D—Sharpshooting	Alternative E—Contraception (Sterilization) (maintenance only)	Alternative F—Fertility Control (maintenance only)
Adaptive management	N/A	Incorporation of new information (e.g., range and forage condition, elk numbers) would be used to adjust management actions in order to reach plan goals (target elk populations). This could include implementing other action alternative techniques.	Same as alternative B.	Same as alternative B.	Same as alternative B.	Same as alternative B.
Other entity/ agency coordination	Continuation of current informal communications between the park and the SDGFP regarding elk populations.	SDGFP/state-managed hunting outside the park (the park and the SDGFP coordinate). Potential contract coordination if hazing additional elk out of the park is required.	*With partner*: coordinate specifics of shipping / meat processing / donation, CWD testing. Helicopter contractor. *Without partner*: contract for veterinarian services for chemical euthanasia. Helicopter contractor.	Contract with qualified federal employees and/or authorized agents for sharpshooting services (if park staff not used). Helicopter contractor.	Contract for veterinarian services for surgical sterilization procedures.	If necessary, contract for veterinarian services for fertility control agent prescription/ administration.

TABLE 5. HOW ALTERNATIVES MEET OBJECTIVES

Objective	Alternative A—No Action (Continuation of Current Management)	Alternative B—Hunting Outside the Park	Alternative C—Roundup and Live Shipment or Euthanasia	Alternative D—Sharpshooting	Alternative E—Contraception (Sterilization) (maintenance only)	Alternative F—Fertility Control (maintenance only)
Consider the varied concerns of interested parties.	Does not meet objective, particularly related to elk over-population concerns of the SDGFP, USFS, and adjacent land owners.	Fully meets objective—various entities (land management agencies, tribes, private entities) involved in addressing over-population issue/ solutions. Carcasses/elk meat would be kept by hunters. No meat would be "wasted."	Roundup/live shipping/donation: same as alternative B. Euthanasia in the park: partially meets objective. Contributes to efforts of other agencies regarding elk management; perception of resource waste by tribes, hunters and other public related to incinerating carcasses.	Partially meets objective. Contributes to efforts of other agencies regarding elk management; perception of resource waste by tribes, hunters and other public related to incinerating carcasses (same as alternative C).	Partially meets objective—this method may not ultimately maintain herds at target levels which will be of concern to other land management agencies and private entities.	Same as alternative E.
Coordinate with other agencies responsible for elk management in order to achieve management goals and objectives.	Does not fully meet objective, but continues current informal communications between the park and the SDGFP regarding elk populations.	Fully meets objective. The SDGFP would manage hunts outside the park. Ongoing coordination between the park and the SDGFP regarding management goals, elk population size, and numbers of elk tags issued annually. Potential coordination with the SDGFP of hazing if needed.	Partially meets objective. Although extent of required coordination with the SDGFP is not as great as under alternative B, it would still occur in a more informal manner regarding elk population size and CWD testing.	Partially meets objective. Contract with qualified federal employees and/or authorized agents. Ongoing, informal coordination with the SDGFP regarding elk population size and CWD testing would continue.	Partially meets objective. Contract with agency veterinarians services for surgical sterilization. The park and the SDGFP would continue informal coordination regarding elk population size.	Partially meets objective. Contract with agency veterinarians services for treatment, prescriptions. The park and the SDGFP would continue informal coordination regarding elk population size.

TABLE 5. HOW ALTERNATIVES MEET OBJECTIVES

Objective	Alternative A—No Action (Continuation of Current Management)	Alternative B—Hunting Outside the Park	Alternative C—Roundup and Live Shipment or Euthanasia	Alternative D—Sharpshooting	Alternative E—Contraception (Sterilization) (maintenance only)	Alternative F—Fertility Control (maintenance only)
Identify thresholds that will trigger elk population management actions, considering all relevant research.	Does not meet objective—no-action thresholds (no elk management plan).	Fully meets objective—action thresholds integrated into plan.	Same as alternative B.	Same as alternative B.	Partially meets objective. Action thresholds will be in place but will likely be more difficult to assess in timely manner.	Same as alternative E.
Incorporate latitude for management strategies as information is obtained from relevant research.	Does not meet objective—no management strategy proposed.	Fully meets objective—adaptive management strategies incorporated into proposed management plan.	Same as alternative B.	Same as alternative B.	Partially meets objective—more difficult to monitor effectiveness of elk management actions and identify necessary shifts in actions in a timely manner as this option relies on the use of untested modeling projections. In addition, evaluating effectiveness will be made more difficult as it will involve monitoring of some elk that move in and out of the park.	Same as alternative E.
Retain the ability to manage the elk populations to meet biological objectives where wildlife health issues are present or emerge.	Does not meet objective—lack of management plan; ad-hoc management of wildlife diseases.	Fully meets objective—plan would result in comprehensive data base related to wildlife disease.	Same as alternative B.	Same as alternative B.	Partially meets objective—wildlife disease research similar to that included in alternatives B–D would not occur in any systematic, large-scale manner (e.g., CWD testing).	Same as alternative E.

TABLE 6. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

	Alternative A—No Action (Continuation of Current Management)	Alternative B—Hunting Outside the Park	Alternative C—Roundup and Live Shipment or Euthanasia	Alternative D—Sharpshooting	Alternative E—Contraception (Sterilization) (maintenance only)	Alternative F—Fertility Control (maintenance only)
NATURAL RESOURCES						
ELK						
Population size and structure						
To herd density	Moderate adverse impacts as density dependent factors begin.	Benefits from reducing density and numbers.	Benefits from reducing density and numbers.	Benefits from reducing density and numbers.	Additional benefit from reduced density during maintenance for non-migratory elk as these are likely candidates for sterilization.	Same as alternative E.
Age/sex structure	Possible indirect beneficial impact from removal of older elk during extreme weather.	Hunting may remove a larger portion of reproductive females, a negligible to moderate adverse effect on age/sex structure.	Ability to selectively remove age or sex classes benefits age/sex structure.	Ability to selectively remove age or sex classes benefits age/sex structure.		
Calf:cow ratio	Reduced calf:cow ratio over time; minor to moderate adverse impact.	Increase calf:cow ratio over time beneficial impact	Same as alternative B.	Same as alternative B.	Benefits from increased calf:cow ratio, but lower ratio than with other action alternatives.	Same as alternative E.
Bull:cow ratio	Increase in bull:cow ratio; negligible to minor impact.	Selective removal of bulls negligible to minor impact to bull:cow ratio.	Increase in bull:cow ratio; negligible to minor impact.	Selective removal of bulls negligible to minor impact to bull:cow ratio.	Higher bull:cow ratio with negligible to minor impacts.	Same as alternative E.

TABLE 6. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

	Alternative A—No Action (Continuation of Current Management)	Alternative B—Hunting Outside the Park	Alternative C—Roundup and Live Shipment or Euthanasia	Alternative D—Sharpshooting	Alternative E—Contraception (Sterilization) (maintenance only)	Alternative F—Fertility Control (maintenance only)
Health, survival, and mortality						
Impact of management to individual elk	No management tools used in this alternative.	Moderate to major adverse impacts to individuals from hunting, injury or separation.	Moderate to major adverse impacts to individuals from injury, stress, separation during roundup, transport, euthanization.	Negligible adverse impacts to individuals from stress as noise suppressed rifles would be used.	Moderate to major adverse short-term impacts to captured and treated animals from stress.	Same as alternative E.
Calf survival and recruitment	Moderate to major, long-term, adverse from reduced calf survival and recruitment.	Beneficial impacts from increased calf survival and recruitment.	Same as alternative B.	Same as alternative B.	Would continue benefits from increased calf survival and recruitment.	Same as alternative E.
Adult survival	Negligible to minor adverse impacts from reduced adult survival.	Benefits from increased adult survival.	Same as alternative B.	Same as alternative B.	Minor to moderate adverse impacts to cow survivability from procedure.	Same as alternative E; possible benefit from increased survival rate of treated cows.
Body condition of females, older adults and calves	Minor to moderate adverse impact to females, older elk, calves from reduced body fat, poorer body condition and reduced survivability in harsh winters.	Benefit to females, older elk and calves from improved body condition.	Same as alternative B.	Same as alternative B.	Would continue benefits to females, older elk and calves from improved body condition.	Same as alternative E.
Competition	Moderate adverse impacts from increased energy to find food, competition between elk.	Beneficial impact from reduced competition for forage.	Same as alternative B.	Same as alternative B.	May provide particular benefits in reducing numbers for non-migratory elk as these are best candidates for treatment.	Same as alternative E.

TABLE 6. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

	Alternative A— No Action (Continuation of Current Management)	Alternative B— Hunting Outside the Park	Alternative C— Roundup and Live Shipment or Euthanasia	Alternative D— Sharpshooting	Alternative E— Contraception (Sterilization) (maintenance only)	Alternative F— Fertility Control (maintenance only)
Elk behavior, distribution, and movement						
Impact of management activities	No management actions	Installing gates, using helicopters minor to moderate adverse impact through disturbance.	Minor to moderate adverse impacts from energy expenditure, panic during roundup.	Minor adverse impact from helicopters used to remove carcasses.	Negligible to minor additional impacts to herd, elk in vicinity from helicopters, roundup activities.	Same as alternative E.
Natural wariness, disturbance	Elk forced to occupy less desirable habitat, including near roads with adverse impact to natural wariness.	Benefit from reducing population and allowing elk to resume natural wariness.	Same as alternative B.	Same as alternative B.	Would continue benefits from reduced population size.	Would continue benefits from reduced population size. Repeated handling of cow elk may increase wariness; beneficial impacts.
Migration	Natural migration may be somewhat barred by high fence	Minor to moderate long-term impacts to migration from installing fence (adverse) and gates (beneficial).	Same as alternative A.	Same as alternative A.	Same as alternative A.	Same as alternative A.
Cow or Bull behavior	N/A	Minor adverse impact from reduction in bugling.	Same as alternative B.	Same as alternative B.	Bugling same as alternative B. May eliminate cow breeding behavior; minor adverse impact.	Bugling same as alternative B.

TABLE 6. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

	Alternative A— No Action (Continuation of Current Management)	Alternative B— Hunting Outside the Park	Alternative C— Roundup and Live Shipment or Euthanasia	Alternative D— Sharpshooting	Alternative E— Contraception (Sterilization) (maintenance only)	Alternative F— Fertility Control (maintenance only)
Chronic wasting disease						
Impacts from management activities	Park kills elk with obvious symptoms	No impact to CWD levels from management activities.	Concentrating in corral may have minor to moderate adverse impacts by contaminating soil or increasing transmission between elk. Possible benefit in testing and removal if future live test developed.	Minimizing the number of carcasses remaining in the field would keep potential for contamination negligible.	Same as alternative C.	Same as alternative C.
Impacts from increased risk of transmission	Moderate, long-term adverse from increased risk of transmission between elk and environmental contamination.	Long-term benefits from reducing the risk of transmission and density of elk (chance of environmental contamination).	Same as alternative B.	Same as alternative B.	Continue benefits of initial reduction.	Same as alternative E.
SOILS AND WATER QUALITY						
Impact of Management Actions	No management actions affect soil/water	Negligible short term adverse impacts to soils and water quality from compaction/ erosion related to installing fence, hunting activities.	Short term minor, localized impact to soils and water quality from increased trampling and erosion at or near corral site.	Negligible increase in erosion and sedimentation from sharpshooters possible.	Short term negligible, localized impact to soils and water quality from increased trampling and erosion at or near corral site.	Same as alternative E.
Bulk density and erosion	Minor to moderate, adverse, localized impacts on bulk density and erosion when large number of elk concentrates. Negligible impacts parkwide.	Localized, long-term benefits from decreases in bulk density and threat of erosion compared to no action; negligible adverse impacts could remain.	Same as alternative B.	Same as alternative B.	Negligible adverse impacts from trampling and vegetation loss to bulk density and erosion could remain.	Same as alternative E.

TABLE 6. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

	Alternative A—No Action (Continuation of Current Management)	Alternative B—Hunting Outside the Park	Alternative C—Roundup and Live Shipment or Euthanasia	Alternative D—Sharpshooting	Alternative E—Contraception (Sterilization) (maintenance only)	Alternative F—Fertility Control (maintenance only)
Soil nutrients	Long-term benefits from increased grazing soil nutrients. (particularly nitrogen).	Possible long-term moderate adverse impacts to soil nutrients from decreased available nitrogen.	Same as alternative B.	Same as alternative B in the long term. Possible localized benefits to soil nutrients from carcasses left in the field.	Same as alternative B	Same as alternative B.
Water quality	Localized negligible or minor increases in suspended sediments, nutrient levels and bacteria from increased size of elk population.	Localized benefits to suspended sediment and nutrient levels from reduced elk population size.	Same as alternative B	Same as alternative B	Same as alternative B	Same as alternative B
CWD contamination to soil or water	Elk with CWD may contaminate soil in the park through shedding	No concentration of elk, incineration ash or landfilling of carcasses, so no change in impact from shedding compared to no action expected.	Localized minor impacts from elk shedding on corral soils during the time they are captured. Possible increase in contamination at capture facility/corral site or adjacent Highland Creek from accidental release during exsanguination if needed; minor to moderate adverse impact. Site specific negligible to minor impacts from ash or carcass disposal to soils or groundwater possible.	Possible negligible to minor site-specific impact to soils where incineration occurs or to groundwater surrounding landfill sites from CWD infected carcasses.	Continued negligible adverse impact at capture facility/corral site from concentrated animals during capture possible.	Same as alternative E.

TABLE 6. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

	Alternative A— No Action (Continuation of Current Management)	Alternative B— Hunting Outside the Park	Alternative C— Roundup and Live Shipment or Euthanasia	Alternative D— Sharpshooting	Alternative E— Contraception (Sterilization) (maintenance only)	Alternative F— Fertility Control (maintenance only)
VEGETATION						
Impacts from management actions	No impact from current management	Minor to moderate adverse localized impacts from trampling to vegetation near gates and from hunters during season.	Negligible to minor short term impacts to vegetation along route to corral and localized impacts in and near corral from concentrated elk while captured.	Negligible to minor localized impacts to vegetation from sharpshooting.	Continued impacts as described for alternative C.	Same as alternative E.
Hardwoods	Major adverse impacts to aspen and other hardwoods would continue or worsen.	Possible benefits to aspen from reduced browsing on hardwoods. No beneficial impact to other hardwoods as cumulative impacts would continue.	Same as alternative B.	Same as alternative B.	No additional impacts beyond those associated with initial reduction.	Same as alternative E.
Shrublands	Moderate, adverse, long-term impacts from elk browsing would continue or worsen.	Benefits from reduced browsing.	Same as alternative B.	Same as alternative B.	No additional impacts beyond those associated with initial reduction.	Same as alternative E.
Riparian areas	Moderate, adverse, long-term impacts to meadow riparian would continue or worsen.	Minor to moderate from reduced browsing.	Same as alternative B.	Same as alternative B.	No additional impacts beyond those associated with initial reduction.	Same as alternative E.
Grasslands	Moderate to major adverse effects to grasslands loss of biomass, productivity and species changes. Beneficial impacts from nutrient increases.	Benefits from reduced loss of biomass, reduced invasive nonnative species. Minor adverse impact from loss of nutrient inputs.	Same as alternative B.	Same as alternative B.	No additional impacts beyond those associated with initial reduction.	Same as alternative E.

TABLE 6. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

	Alternative A— No Action (Continuation of Current Management)	**Alternative B— Hunting Outside the Park**	**Alternative C— Roundup and Live Shipment or Euthanasia**	**Alternative D— Sharpshooting**	**Alternative E— Contraception (Sterilization) (maintenance only)**	**Alternative F— Fertility Control (maintenance only)**
OTHER WILDLIFE						
Impacts of management actions	No impact from current management actions.	Installing and operating gates, hunting activities and hazing would disturb and temporarily displace animals, a short-term minor impact to nearby wildlife.	Roundup would have short term minor to moderate adverse impacts from disturbance. Minor localized adverse impacts to prairie dogs near the corral are possible.	Negligible to minor adverse impacts from disturbance by sharpshooters; minor short term impacts from use of helicopters to sling load carcasses; short term benefits to predators and scavengers from carcasses left in field.	Negligible to minor disturbance from helicopters, roundup activities would continue during maintenance; possible habitat changes or trampling near corral. Possible temporary benefit from increases in aborted fetuses possible.	Same as alternative E.
Long-term impacts of elk reduction						
Wildlife habitat	Moderate to major adverse impact on biodiversity from degradation of shrubs, hardwoods, riparian habitat when elk are at high numbers.	Beneficial impact by increasing biodiversity in shrubs, hardwoods, riparian habitat; possible benefit for grassland species.	Same as alternative B.	Same as alternative B.	Continued benefits from reduction in elk numbers.	Same as alternative E.

TABLE 6. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

	Alternative A— No Action (Continuation of Current Management)	Alternative B— Hunting Outside the Park	Alternative C— Roundup and Live Shipment or Euthanasia	Alternative D— Sharpshooting	Alternative E— Contraception (Sterilization) (maintenance only)	Alternative F— Fertility Control (maintenance only)
Bison and prairie dogs	Short term benefit for prairie dogs from increased habitat related to elk grazing. Minor to moderate long-term adverse impacts to both from increased competition for forage. Additional moderate to major adverse impacts to prairie dogs possible if park is forced to manage populations to low end of acceptable range in absence of elk removal tools.	Temporary minor adverse impact relative to no action from less grazing, creating prairie dog habitat. Long-term benefits for prairie dogs from reduced elk foraging; long-term benefits for bison from reduced competition.	Same as alternative B.	Same as alternative B.	Continued benefits from reduction in elk numbers.	Same as alternative E.
Other ungulates	Minor to major, adverse impacts to other ungulates (mule deer, pronghorn, and white-tailed deer) from competition for forage. Possible competitive exclusion impact on mule deer.	Beneficial impacts for most ungulates from reduced competition for forage, especially pronghorn antelope. Additional benefits from reduced possibility of competitive exclusion with mule deer.	Same as alternative B.	Same as alternative B.	Continued benefits from reduction in elk numbers.	Same as alternative E.
Small mammals	Minor to moderate adverse impacts to small mammals from loss of cover/increased competition; possible benefit to those associated with early seral stages.	Benefits to small mammals in shrublands, riparian areas; more extensive benefits to grasslands mammals from reduced browsing.	Same as alternative B.	Same as alternative B.	Continued benefits from reduction in elk numbers.	Same as alternative E.

TABLE 6. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

	Alternative A—No Action (Continuation of Current Management)	Alternative B—Hunting Outside the Park	Alternative C—Roundup and Live Shipment or Euthanasia	Alternative D—Sharpshooting	Alternative E—Contraception (Sterilization) (maintenance only)	Alternative F—Fertility Control (maintenance only)
Meadow jumping mouse/least shrew	Minor adverse to rare meadow jumping mouse and least shrew from loss of cover.	Benefits for meadow jumping mouse; more extensive benefits for least shrew from increase in cover.	Same as alternative B.	Same as alternative B.	Continued benefits from reduction in elk numbers.	Same as alternative E.
Scavengers and predators	Benefits to predators and scavengers (increase in calves/other prey).	Negligible to minor adverse for predators/scavengers from reduced numbers of elk calves; indirect benefits from increase in prey (small mammals or birds) or ungulates now competing with elk.	Same as alternative B.	Same as alternative B.	Continued benefits from reduction in elk numbers.	Same as alternative E.
Birds	Moderate to major adverse impacts to birds that occupy hardwood habitats; moderate adverse impacts to those in riparian and shrubland habitat from elk browsing. Minor to moderate beneficial and adverse to grassland dependent birds—benefits for species diversity and many grassland early seral species when grazing remains light or moderate; change to minor or moderate adverse when grazing is heavy, or to grassland birds requiring cover for breeding or habitat.	Benefits to small birds in shrublands, riparian areas; grassland birds that require cover to breed. Minor adverse long term impacts on early seral grassland birds, and possibly to overall grassland bird diversity and abundance.	Same as alternative B.	Same as alternative B.	Continued benefits and/or adverse impacts as noted in alternative B from reduction in elk numbers.	Same as alternative E.

TABLE 6. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

	Alternative A— No Action (Continuation of Current Management)	Alternative B— Hunting Outside the Park	Alternative C— Roundup and Live Shipment or Euthanasia	Alternative D— Sharpshooting	Alternative E— Contraception (Sterilization) (maintenance only)	Alternative F— Fertility Control (maintenance only)
Rare butterflies	Moderate adverse to rare butterflies dependent on mixed-grass prairie grasslands from loss of cover, trampling host plants.	Long-term benefits to rare butterflies dependent on mixed-grass prairies from reduced trampling of host plants, elk grazing.	Same as alternative B.	Same as alternative B.	Continued benefits from reduction in elk numbers.	Same as alternative E.
SPECIAL STATUS SPECIES						
Impacts from management actions	No impact from current management activities	Negligible to minor adverse effects to bald eagle from disturbance related to hunters, hazing.	Negligible to minor adverse effects to bald eagles from disturbance related to helicopters. Unlikely but possible negligible to minor short-term localized impact from loss of prairie dog habitat, individual prairie dogs (primary prey for ferrets) near corrals from trampling.	Negligible to minor adverse effects to eagles from disturbance related to sharpshooters.	Continued negligible to minor adverse effects to eagles from disturbance related to helicopters. Continued localized negligible adverse impacts to ferrets from trampling, loss of prairie dog prey possible.	Same as alternative E.

TABLE 6. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

	Alternative A—No Action (Continuation of Current Management)	Alternative B—Hunting Outside the Park	Alternative C—Roundup and Live Shipment or Euthanasia	Alternative D—Sharpshooting	Alternative E—Contraception (Sterilization) (maintenance only)	Alternative F—Fertility Control (maintenance only)
Long-term impacts to black-footed ferret (federal endangered species)	Temporary benefit related to prairie dog expansion until 3,000 acre-target reached. Minor adverse impact from increased competition with primary prey for ferrets, prairie dogs.	Temporary negligible to minor adverse impact from loss of elk grazing and related expansion of prairie dog habitat. Long-term benefits from reduction in competition for forage with prairie dogs.	Same as alternative B.	Same as alternative B.	Continued benefits from reduced elk numbers.	Same as alternative E.
	Moderate or even major adverse impacts to ferrets possible if park is forced to manage primary prey populations of prairie dogs to low end of acceptable range in absence of elk removal tools. Possible "adverse effect" requiring formal consultation under *Endangered Species Act*.	Possible benefit to future ferret population from allowing park to continue to manage prairie dogs at upper end of the range.	Same as alternative B.	Same as alternative B.		
Long-term impacts to bald eagle (state threatened species)	Minor, indirect, adverse from loss of small mammal and bird habitat and reduced prey.	Benefits from reductions in elk numbers and return of small mammal/bird habitat, including prairie dog numbers.	Same as alternative B.	Same as alternative B.	Benefits continued through maintenance of population size.	Same as alternative E.
	Managing toward low end of prairie dog range may also have negative effects on abundance of eagle prey.	Indirect benefit to eagles from managing prairie dogs at upper end of range.	Same as alternative B.	Same as alternative B.	Benefits continued through maintenance of population size.	Same as alternative E.

TABLE 6. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

	Alternative A—No Action (Continuation of Current Management)	Alternative B—Hunting Outside the Park	Alternative C—Roundup and Live Shipment or Euthanasia	Alternative D—Sharpshooting	Alternative E—Contraception (Sterilization) (maintenance only)	Alternative F—Fertility Control (maintenance only)
AIR QUALITY						
Impact of management actions	No impact to park air quality from current elk management activities.	Negligible, short-term, adverse effects from hunter vehicle emissions.	Negligible, short-term effects from use of helicopter during roundup; Negligible to minor short-term adverse effects from operation of incinerator if needed.	Same as alternative C for both helicopter emissions and use of incinerator.	Negligible, short-term effects from use of helicopter during roundup for maintenance operations.	Same as alternative E.
CULTURAL RESOURCES						
Archeological resources	No impact from current management.	Minor, long-term, site-specific adverse (ground disturbance).	Same as alternative B.	No effect.	No effect.	No effect.
Ethnographic resources	Minor, long-term, adverse (elk-related impacts to natural resources considered important ethnographically).	Within the park—localized benefits (decreased detrimental effects of overgrazing). Adjacent to park—negligible, site-specific, long-term adverse (potential overgrazing), and localized long-term benefits (decreased detrimental effects of overgrazing).	Same as alternative B (within the park).	Same as alternative B (within the park).	Same as alternative B (within the park).	Same as alternative B (within the park).

TABLE 6. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

	Alternative A—No Action (Continuation of Current Management)	Alternative B—Hunting Outside the Park	Alternative C—Roundup and Live Shipment or Euthanasia	Alternative D—Sharpshooting	Alternative E—Contraception (Sterilization) (maintenance only)	Alternative F—Fertility Control (maintenance only)
VISITOR EXPERIENCE						
Elk management actions	No impact to visitor experience from current elk management activities.	Negligible to minor short-term adverse impacts possible for most visitors that object to hunting, hazing or witness shooting; occasional moderate or even major short or long-term adverse impact to a visitor's experience possible.	Negligible or minor short term adverse impacts possible for most visitors that object to roundup, killing elk; possible moderate or major short or long-term adverse impacts to some visitor's experience.	Negligible or minor short term impacts possible for visitors that object to shooting elk; remote possibility of moderate or major adverse impact from an occasional visitor who objects and/or witnesses an elk shot.	Similar to alternative C although different visitors may object to sterilization than those that object to killing elk.	Similar to alternative C although different visitors may object to sterilization than those that object to killing elk.
Wildlife viewing opportunities	Localized benefits (continued enhanced wildlife viewing opportunities).	Minor to moderate, long-term, localized, adverse (reduced wildlife viewing opportunities).	Minor to moderate, long-term, localized, adverse (reduced wildlife viewing opportunities).	Same as alternative C.	Negligible, long-term, localized, adverse (stabilized wildlife viewing opportunities).	Same as alternative E (stabilized wildlife viewing opportunities).
Soundscape	Negligible, long-term, localized and site-specific, adverse (aircraft/firearms noise).	Negligible to minor, long-term, localized, adverse (aircraft noise).	Same as alternative B.	Negligible to minor, long-term, localized, adverse (aircraft/ firearms noise).	Same as alternative B.	Same as alternative B for winter treatment; minor, long-term, localized adverse for summer treatment (aircraft noise).
	Long-term benefits (possibly increase in elk "bugling").	Minor, long-term adverse (reduction in elk "bugling").	Same as alternative B.	Same as alternative B.	No effect.	No effect.

TABLE 6. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

	Alternative A— No Action (Continuation of Current Management)	Alternative B— Hunting Outside the Park	Alternative C— Roundup and Live Shipment or Euthanasia	Alternative D— Sharpshooting	Alternative E— Contraception (Sterilization) (maintenance only)	Alternative F— Fertility Control (maintenance only)
Backcountry access restrictions	No effect.	Minor, long-term, localized, adverse (backcountry closures).	Negligible, long-term, localized, adverse (backcountry closures).	Negligible to minor, localized, long-term adverse (October – March). Moderate, localized, long-term adverse (August, September) (backcountry closures).	Negligible, long-term, localized, adverse (backcountry closures).	Same as alternative C during winter months. Minor to moderate, long-term, localized adverse during summer months (backcountry closures).
Carcasses left in field	No effect from current management.	No effect.	No effect.	Long-term, site-specific, benefits and adverse (presence of elk carcasses).	No effect.	No effect.
SOCIOECONOMICS						
Tourism/ recreation	Short- and long-term benefits (tourism/ recreation-related expenditures remain similar to current situation).	Minor to moderate, short-term, adverse during initial reduction (negative public perception and possible visitor or spending reductions); negligible long-term effects during maintenance.	Same as alternative B.	Same as alternative B.	Negligible adverse effects may continue during maintenance.	Same as alternative E.
Hunting	Beneficial impacts as hunting-related expenditures remain similar to current situation.	Benefits during initial reduction (increase in hunting-related expenditures) moderate long-term adverse impacts as elk population reduced.	Moderate, long-term adverse effects from reduced elk herd.	Same as alternative C.	Continued adverse impact to hunting revenues.	Same as alternative E.

TABLE 6. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

	Alternative A—No Action (Continuation of Current Management)	Alternative B—Hunting Outside the Park	Alternative C—Roundup and Live Shipment or Euthanasia	Alternative D—Sharpshooting	Alternative E—Contraception (Sterilization) (maintenance only)	Alternative F—Fertility Control (maintenance only)
State programs and elk impacts on private lands or leased grazing lands	Moderate, short- and long-term adverse (elk depredation-related impact expenditures remain similar to current situation).	Minor to moderate, short-term adverse effects during initial reduction; possible benefits as elk herd and depredation are reduced.	Beneficial impact as elk herd and depredation are reduced.	Same as alternative C.	Continued benefits from reduction in depredation.	Same as alternative E.
PARK OPERATIONS						
Resource Management Division	Negligible to minor, long-term, adverse (monitoring/mitigation efforts; coordination with other land management agencies).	Minor, long-term, adverse (monitoring, contract coordination/ oversight).	Negligible to possibly moderate, long-term adverse (monitoring, contract coordination/ oversight; euthanasia activities).	Minor, long-term, adverse (monitoring, contract coordination/ oversight; carcass handling/disposal).	Minor to possibly moderate, long-term, adverse (monitoring, contract coordination/ oversight; surgical procedures).	Minor to moderate, long-term, adverse (monitoring, contract coordination/ oversight; fertility control administration).
Interpretation Division	Negligible, long-term, adverse (continuation of public information regarding elk).	Negligible to minor, long-term, adverse (additional public educational information regarding elk management).	Same as alternative B.	Same as alternative B.	Same as alternative B.	Same as alternative B.
Resource and Visitor Protection Division	Negligible, long-term adverse (dispatching of sick animals).	Negligible to minor, long-term, adverse (backcountry closures; dispatching of sick animals).	Minor to moderate, long-term, adverse (backcountry closures, euthanasia activities, dispatching of sick animals).	Minor, long-term, adverse (backcountry closures, dispatching of sick animals).	Negligible to minor, long-term, adverse (backcountry closures; dispatching of sick animals).	Minor, long-term, adverse (backcountry closures; dispatching of sick animals).
Maintenance Division	No effect from current management.	Minor to moderate, short- and long-term, adverse (fence / gate construction / manipulation).	Minor to moderate, long-term, adverse (corral modifications; carcass disposition).	Minor, long-term, adverse (carcass handling/disposal).	Minor to moderate, long-term, adverse (corralling and care of animals, assistance with sterilization procedures).	Minor, long-term, adverse (corralling and care of animals, assistance with procedures).

TABLE 6. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

	Alternative A—No Action (Continuation of Current Management)	Alternative B—Hunting Outside the Park	Alternative C—Roundup and Live Shipment or Euthanasia	Alternative D—Sharpshooting	Alternative E—Contraception (Sterilization) (maintenance only)	Alternative F—Fertility Control (maintenance only)
Administration Division	No effect from current management.	Negligible, long-term adverse (contract management/ oversight).	Minor, long-term adverse (contract management/ oversight).	Same as alternative C.	Negligible, long-term, adverse (contract management/ oversight).	Same as alternative E.
HUMAN HEALTH AND SAFETY						
Aircraft use	Negligible to minor, long-term, adverse (aerial monitoring).	Same as alternative A (aerial monitoring, hazing).	Same as alternative A (aerial monitoring, roundup).	Same as alternative A (aerial monitoring, sling-loading).	Same as alternative A (aerial monitoring, roundup).	Same as alternative A (aerial monitoring, roundup).
	Negligible, short-term, adverse (noise generated from aircraft).	Negligible to minor, short-term, adverse (noise generated from aircraft).	Same as alternative B.	Same as alternative B.	Same as alternative B.	Same as alternative B.
CWD-related work (targeted surveillance)	Minor, long-term, adverse (use of firearms, knives).	Same as alternative A.	Same as alternative A.	Same as alternative A.	Same as alternative A.	Same as alternative A.
Hazing (by any means other than aircraft)	No effect under current management (no hazing)	Negligible to minor, long-term, adverse (possible exposure to hunting activities).	No effect (no hazing)	No effect (no hazing)	No effect (no hazing)	No effect (no hazing)
Facility modifications	No effect under current management (no facility modifications)	Negligible to minor, short-term, adverse (use of hand/power tools, handling heavy materials for fence modifications).	Negligible to minor, short-term, adverse (use of hand/power tools, handling heavy materials for corral modifications).	No effect (no facility modifications).	No effect (no facility modifications).	No effect (no facility modifications).
Human consumption of elk meat	No effect under current management	Negligible, long-term, adverse (consumption of elk meat in area in which CWD has been identified).	Negligible, long-term, adverse (consumption of elk meat which has tested negative for CWD).	No effect (no human consumption)	Negligible, short-term, adverse (consumption of elk meat treated with antibiotics and anti-inflammatories).	Negligible to moderate, long-term, adverse (consumption of elk meat treated with fertility control agent).

TABLE 6. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

	Alternative A—No Action (Continuation of Current Management)	Alternative B—Hunting Outside the Park	Alternative C—Roundup and Live Shipment or Euthanasia	Alternative D—Sharpshooting	Alternative E—Contraception (Sterilization) (maintenance only)	Alternative F—Fertility Control (maintenance only)
Increased hunting adjacent to the park	No effect under current management.	Negligible to minor, long-term, adverse (potential for increased numbers of hunters/ hunting related risks).	No effect.	No effect.	No effect.	No effect.
Handling of live elk	No effect under current management.	No effect.	Minor, long-term, adverse (exposure to corralled wildlife, use of knives/firearms).	No effect.	Minor to moderate, long-term, adverse (use of surgical instruments, syringes; exposure to corralled wildlife).	Minor, long-term, adverse (exposure to corralled wildlife, treatment of individual animals).
Euthanasia activities	No effect under current management.	No effect.	Minor to possibly moderate, long-term adverse (exposure to firearms, knives/ sharp instruments).	Negligible to moderate, long-term, adverse (exposure to firearms).	See "handling of carcasses" below.	No effect.
Handling of carcasses	No effect under current management.	No effect.	Minor, long-term, adverse (CWD testing; carcass disposal; exposure to potentially infectious materials).	Minor to possibly moderate, long-term, adverse (CWD testing, carcass disposal).	Minor, long-term, adverse (CWD testing, carcass disposal).	No effect.
Administration of pharmaceuticals	No effect under current management.	No effect	Minor, long-term, adverse (administration of drugs potentially dangerous to humans).	No effect	Negligible to minor, long-term, adverse (administration of/exposure to antibiotics/ anti-inflammatories).	Negligible to moderate, long-term, adverse (potential accidental injection; exposure to drug potentially dangerous to humans).

Affected Environment

CHAPTER 3: AFFECTED ENVIRONMENT

The "Affected Environment" describes existing conditions for those elements of the natural and cultural resources that would be affected by the implementation of the actions considered in this environmental impact statement. The natural resource components addressed include elk, soils and water quality, vegetation, other wildlife, special status species, and air quality. The cultural resource components include archeological resources and ethnographic resources. Visitor experience, socioeconomics, park operations, and human health and safety are also addressed. Impacts for each of these topics are then analyzed in the "Environmental Consequences" chapter.

ELK

POPULATION HISTORY, SIZE, AND TREND

Elk are native to the Black Hills of South Dakota, including the area now known as Wind Cave National Park. However, prior to establishment of the park in 1903, elk had been extirpated from the area due to unregulated hunting.

In 1912, the 4,160-acre Wind Cave National Game Preserve was established within Wind Cave National Park to provide suitable habitat for a bison herd (Lovaas 1973). Forty-six Rocky Mountain elk, 21 from Jackson Hole, WY and 25 from the Yellowstone National Park area were transplanted to the preserve in 1914 and 1916, respectively (Lovaas 1973). In 1935, the preserve was abolished and the entire 11,723 acre park was fenced to contain the growing bison herd. Today Wind Cave National Park includes 28,295 acres that are fenced with 33 miles of seven-foot-high fence and four miles of four- to five-foot-high fence. Elk are able to enter and leave the park over all fenced areas, but move more freely over the lower segment of fence located in the southwest corner.

The elk population using Wind Cave flourished following their re-introduction (Bauman 1997). Although accurate census data are not available for the 1920s–1950s, park records show that the elk herd periodically grew to exceed the desired number and had to be reduced. In addition, new lands were added to the park in 1946, bringing the total acreage to 28,059. This addition to the park contributed to a dramatic increase in the elk population both by incorporating those elk residing on the acquired lands and by providing habitat to support a much larger herd.

Wind Cave has not conducted systematic elk surveys in all years. However, general estimates of the elk population are available since 1995 (table 7; Roddy 2006). Between 1995 and 2005, the estimated population increased from 250–300 to 800–850. That number fell to between 525 and 550 in 2006, possibly from changes in survey technique, emigration, hunter disturbance of elk outside the park boundaries, or new food or water sources. A ground census in 2007 indicated the population was about 600 to 650 animals (Foster 2007a).

The current population target range of 232–475 (mid-range of 354) was established by a Science Team comprised of park staff and other technical experts (NPS 2006g). The range was based on potential forage available within the park and bison and elk forage allocations adjusted for prairie dog colony acreages under normal weather conditions. Drought and other environmental factors would also be considered in establishing the precise number of elk within the range that would be supportable in a given year. The Science Team recommended flexibility in the elk management plan, and cautioned against managing elk to a specific number. Adaptive management thresholds were set at a given percentage, plus or minus from the mid-range goal (350).

TABLE 7. ESTIMATED ELK POPULATION SIZE IN WINTER, 1995–2007, WIND CAVE NATIONAL PARK

Survey Year	Estimated Population
1995	250–300
1996	300
1997	443
1998	250–300
1999	No Estimate
2000	No Estimate
2001	350
2002	No Estimate
2003	650
2004	657–700
2005	800–850
2006	525–550
2007	600–650

POPULATION MANAGEMENT AND CONTROL

Throughout the years, as elk numbers fluctuated, managers used numerous techniques to reduce them, including: harvesting and butchering elk and selling or donating the meat; hazing elk onto adjacent Custer State Park; culling elk through shooting; allowing egress of animals over a low segment of fence; and capturing and shipping live elk to other national parks, other federal lands, American Indian Tribes, states, and/or to private organizations (Lovaas 1973). Shooting elk as a control method was discontinued in 1957.

Despite periodic reduction efforts through the early 1950s, the elk herd in the park had increased to an estimated 1,200 (as possibly as high as 1,500) head by 1953, and surveys confirmed the range was in poor condition as a result (NPS 1994a; Bauman 1997). The park established a management goal of 350–400 elk based on range and forage conditions documented through a series of vegetation surveys conducted in the late 1950s and early 1960s. This management goal was formalized in the 1980 *Elk Surplus Disposal Program for Wind Cave National Park* environmental assessment (NPS 1980).

Until 1994, the park conducted a roundup once every few years when the elk population began to exceed the 350–400 head level. Census counts were conducted each year, and park staff were careful to maintain desired sex/age ratios, protect lead cows to maintain herd memory, and not remove large numbers of elk from any area of the park (NPS 1994a). Surplus elk removed from Wind Cave National Park between 1980 and 1986 were used to supplement and establish new herds of elk throughout the Black Hills.

This approach worked well until CWD was discovered on private land adjacent to the park in 1997, and then in the park in 2002. On July 26, 2002 the NPS director issued a memo stating “deer or elk will not be translocated from areas where CWD is known to occur” (NPS 2002b). This policy meant the park could no longer trap and relocate elk to manage the population.

As noted above, the size of the elk population wintering in the park fluctuates for a variety of reasons, including survey techniques and other unknown factors (hunter success, emigration, food or water resources, etc.). Although it was estimated to range between 600 and 650 in 2007 (Foster 2007a), it was believed to be 800–850 in 2005. At that time, the Science Team for the Wind Cave National Park Elk Management Plan estimated that without removals the elk population could increase to 1,200 within three years (NPS 2006g). This assumed an annual increase of 10%–12%. Using 2007 figures and assuming no substantial emigration or slowing of the growth rate, elk numbers inside the park would reach 1,200 in six to seven years (see table 8). However, as noted in the "Environmental Consequences" chapter discussion of the no-action alternative (continuing current management) on elk, the growth rate would slow as elk numbers reached the ecological or food-based carrying capacity of the habitat in the park.

TABLE 8. ESTIMATED ELK POPULATION SIZE ASSUMING NO EMIGRATION OR CHANGE IN GROWTH RATES OVER 10 YEARS, WIND CAVE NATIONAL PARK

Year	Size assuming 10% growth	Size assuming 12% growth
2007	650	650
2008	715	728
2009	786	815
2010	865	913
2011	951	1022
2012	1046	1145
2013	1151	1282
2014	1266	1435
2015	1393	1608
2016	1533	1801
2017	1685	2017

SEX AND AGE COMPOSITION

Precise calf:cow and bull:cow ratios for elk wintering in the park are unknown and variable estimates exist. In the mid-1990s, one researcher estimated the calf:cow ratio to be between 51 and 55 calves to every 100 cows. The population of elk at this time was estimated at about 300 (Bauman 1998). Earlier estimates put the calf:cow ratio at 34:100 in 1973 and 43:100 in 1974. Wydeven (1977) also reported calf:cow ratios ranging from 50:100 to 64:100 during autumn inside the park. A ratio of 51–55:100 is similar to that experienced in the Estes Park population of elk shortly after elk "discovered" the town in 1978 and began to winter there (Lubow et al. 2002). However, by 2001, the Estes Park population had declined to about 30:100, indicating a population experiencing density dependent feedback as it approached ecological carrying capacity. This appears to be the case for elk wintering in the Wind Cave, although environmental factors such as drought may also be playing a role. In 2005, park staff estimated about 40 to 45 calves per 100 cows on average for elk inside the park. Even more recent ground estimates (2007) indicate this has dropped to an average of 30-35 calves:100 cows across the park, with the Boland Ridge (northeast part of the park) yielding fewer than 20 calves:100 cows (Weber 2007). As noted above, the elk herd size in 2007 was estimated at about 600 to 650 animals.

Bull:cow ratios in the park are also unknown, and estimates have varied over the years. The bull:cow ratio was estimated by Bauman to be 75:100 or higher in the mid-1990s compared to 45:100 in the Black Hills (SDGFP n.d.; Bauman 1998). However, this was following a removal of 71 adult cows and 19 adult bulls in 1994 and may be skewed toward high bull numbers because of the removal. More recent estimates indicate a lower bull:cow ratio, on the order of 55:100 (NPS 2006g). In the Madison River drainage of Yellowstone National Park, the bull:cow ratio is 25:100, and in Rocky Mountain National Park, the ratio is 22:100 inside the park and 6:100 in neighboring Estes Park (Bauman 1998; NPS 2006c). The higher ratio of bulls to cows in Wind Cave may be the result of several factors, including adequate forage, no hunting, and the use of roundup for the last several decades to remove elk because this method is more efficient at rounding up cow elk than bulls (NPS 1980).

The elk population in Wind Cave is believed to have an older age structure than animals in hunted populations outside the park (NPS 2006g).

ELK DENSITIES

Wind Cave National Park occupies 28,295 acres, approximately 44 square miles. Elk occupy all park lands seasonally, although they use about half the park as primary habitat in the winter (Varland et al. 1978). Assuming they occupy the entire park, densities have ranged from 12 to 19 per square mile over the past two years. Densities would be higher in their primary range, on the order of twice that over the entire park, or about 24 to 38 per square mile. The current management goal of 225–475 elk implies a density range of 5.1 to 10.8 elk per square mile. Research in Rocky Mountain National Park indicated that impacts to vegetation from high densities in specific areas (on the order of 200 elk per square mile and higher) are as important as the total population size (NPS 2006c).

DISTRIBUTION AND MOVEMENTS

Whereas recent research shows home ranges of bull elk are distributed throughout the park, cows and their calves wintering in Wind Cave may be more likely to stay in a given region of the park. Early research indicated fidelity to a given area to such an extent that elk were regarded as subherds in one of three distinct geographic areas: Gobbler Knob in the southwest portion of the park, Beaver Creek in the northwest, and Boland Ridge in the east (figure 2) (Varland 1976 and Varland et al. 1978), although even early studies found some movement back and forth between these areas. Elk in the Boland Ridge area appear to be most likely to remain in that area. Females here are relatively isolated from other female elk (Sargeant et al. 2008). Several years of monitoring data for 104 radio-collared elk found that the average home range for female elk was 14 square miles and 22 square miles for male elk.

A portion of the elk wintering in the park jump the four to five foot high segment of fence in the southwest corner of the park to spend part of the spring and summer on federal and private land. These animals typically return to the park in late summer when increased human activity associated with the hunting season begins. Recent research supports earlier observations that a greater percentage of those in the southwest part of the park in the Gobbler Knob region, and to a lesser extent those from the central part of the park exit the park than those from Boland Ridge. Sargeant et al. (2008) found that only 2 of the 31 eastern-most females and 1 of the 18 eastern most males exited the park, whereas 23 of the total 61 females and 14 of the total 38 males radio-collared spent some time outside the park. Egress rates of both sexes were very high for elk in the southwest, with 17 of 20 radio-collared females and 6 of 6 radio-collared males from this area exiting the park.

Some elk that leave the park stay within close proximity, while others range broadly. Eighty percent of the collared females in the 2008 USGS and NPS study (Sargeant et al. 2008) leaving the park stayed within 5.4 miles (9 km) of its boundary, and concentrated west and southwest of the park. However, males ranged further north, south and west than females, and 80% of those radio-collared stayed in an area nearly three times further from the park fence (16.8 miles (27 km)) than females.

Although Bauman found that the highest frequency of animals crossing the fence occurs in spring and fall, bulls appear to cross the park boundary most frequently in fall (Bauman et al. 1999). In 1999, Bauman and others tested the feasibility of one-way gates as a potential means of elk population control.

They found that some elk would use the one-way gates after being baited across with salt licks. However, for the control method to work, the low segment of fence along the southwestern boundary of the park would have to be raised to discourage elk from re-entering (as it is in alternative B). Totally fencing in elk as a management tool could interfere with natural system functions by restricting migration.

HABITAT USE

In general, observations of marked elk indicate a preference for forested areas for bedding and grasslands for feeding (Varland et al. 1978). However, elk in the Boland Ridge area, in areas further from public roads, or in areas seldom disturbed by park visitors seem to make greater use of grasslands for bedding.

Overall, elk use is great in the forested areas of the park during the summer and winter, whereas grasslands were most heavily used during spring and fall (Varland et al. 1978). Elk in the park consistently show a preference for cover-forage edge habitat, and for areas with a high degree of edge complexity (Varland et al. 1978; Lagueux 2002).

FOOD HABITS

Elk are very adaptable and can utilize a wide variety of forage species. Therefore, they can occupy and exploit a wide variety of habitats. Forage preferences change by season and depend on forage availability. Elk spend approximately equal amounts of time feeding and bedding, and therefore benefit from a diverse landscape with high interspersion of forage and cover. At Wind Cave, elk use habitats dominated by warm-season grasses (Wydeven and Dahlgren 1985).

Elk consume a wide variety of forage species in all seasons. A 1979 study showed that graminoids comprised 87% of the summer diet, and declined to 24% in winter (Wydeven 1979). The same study found that, in late summer, elk preferred big bluestem (*Andropogon gerardii*), bluegrasses (*Poa* spp.), skunkbush sumac (*Rhus trilobata*) and leadplant (*Amorpha canescens*) (Wydeven 1979). In fall and winter, use of perennial forbs, especially of Louisiana sagewort (*Atremisia ludoviciana*), fringed sagewort (*Artemisia frigida*) and heath aster (*Aster earicoides*), increased (Wydeven and Dahlgren 1983). Use of browse was light throughout the year. Lead plant was the only browse species to receive substantial use, which occurs during the during the summer months (Wydeven 1977).

At Wind Cave, elk use habitats dominated by warm-season grasses.

REPRODUCTION

The elk breeding season begins in mid-August and extends through November with a peak of activity in late-September. Cow elk may become sexually mature as yearlings, although the proportion that successfully breeds varies. Yearling pregnancy rates are affected by nutritional and environmental factors. Breeding age cow elk are the major contributors to the elk population (Raedeke et al. 2002).

Elk are polygamous with dominant herd bulls gathering harems of cows. Although yearling bulls are capable of breeding, they are rarely involved in breeding because of behavioral interactions with older bulls. Younger aged bulls (2.5 to 3.5) are rarely able to gather and hold a harem of cows. During the breeding season or rut, bulls bugle both to warn other males and to attract females.

A recent study of elk in the park (Sargeant et al. 2008) indicates that pregnancy rates for adult females average 73% and 12% for subadults. A total of 98 females over three years were tested.

Calf elk are born in late-May to early-June. Calving typically occurs on the upper portions of the winter range or on transitional ranges between winter and summer range, much of it outside the park. Cow elk separate from herds and seek solitude in forest or shrubland areas. Calves are mobile within days after birth and are often stashed in heavy cover for extended periods of time while the cow feeds or beds. As the calf grows, cows gradually return to the herds. Calves are weaned in late summer. If something happens to the cow in late summer, the calf is often able to survive as part of the larger herd.

SURVIVAL AND MORTALITY

Natural mortality, including predation, of elk in Wind Cave National Park is limited (Andrew 1974). Although mortality figures for elk wintering in the park were unknown until recently, Sargeant et al. (2008) preliminary figures indicate natural mortality (e.g. without hunting or poaching) for elk wintering in the park averages 6% and is not statistically different between male and female elk. When considering hunting and poaching, the mortality rate averaged 14% and was higher for female elk (Sargeant et al. 2008). Typically elk are vulnerable to natural mortality during the first few weeks as calves and during the winter throughout their lives.

The major sources of mortality for calf elk typically are malnutrition and predation. Malnutrition occurs when the cow is in poor condition due to weather or resource limitations. The three primary large predators in the park are mountain lion, coyote and bobcat. Although all three could take healthy calves, elk are not their primary prey.

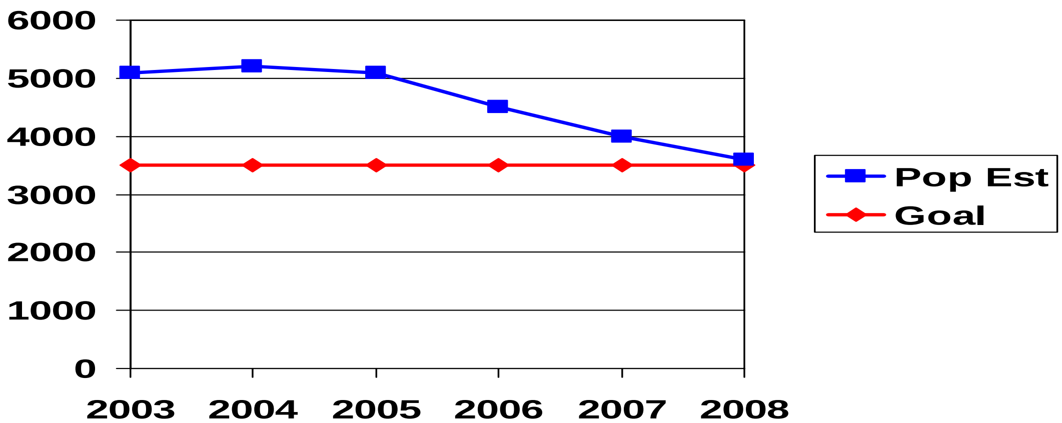
Winters at Wind Cave are generally pleasant with extended periods of little or no snow and temperatures above 0°F. Under these conditions winter mortality related to weather would be light and generally limited to old and infirm animals.

RELATIONSHIP TO BLACK HILLS ELK MANAGEMENT

The Black Hills Elk herd is comprised of three major units: elk on National Forest and private lands, Custer State Park, and Wind Cave National Park. These three units are managed separately. The South Dakota Department of Game, Fish and Parks (SDGFP) managed elk on National Forest and private lands. Custer State Park manages its primarily resident elk separately.

The number of elk in the Black Hills population has also been larger than the target set by SDFGP until recently. The number of elk in the Black Hills population exceeded the SDFGP objective of 3,500 +/- 200 (figure 4) until recently, but in 2008 had declined to be within the range set by the state (Kanta 2008).

The elk population is causing substantial damage on private lands throughout the Black Hills, especially in the southern Black Hills, as wildlife damage costs associated with elk have more than doubled since 1999 (SDGFP 2003c).



Source: Kanta 2008

FIGURE 4. ESTIMATED NUMBER OF ELK ON NATIONAL FOREST AND PRIVATE LANDS IN THE BLACK HILLS, 2003 TO 2008

Wind Cave National Park has taken steps to partner with other agencies in the development of a Black Hills Elk conservation and management plan. The park and the SDGFP have entered into a Memorandum of Understanding that lays the groundwork for cooperation in the development of the elk management plan for Wind Cave National Park and the southern Black Hills (NPS and SDGFP 2003). The objective of the Memorandum of Understanding is to establish the standards, terms, conditions, roles, and responsibilities in the project planning and National Environmental Policy Act (NEPA) process for development of an elk management plan for Wind Cave National Park so that it is consistent with the larger southern Black Hills Plan.

Chronic Wasting Disease is the only known wildlife disease of significance in Wind Cave National Park. It is an infectious neurologic disease that affects mule deer, white-tailed deer, elk, and moose.

DISEASE

Chronic wasting disease is the only known wildlife disease of significance in Wind Cave National Park. It is an infectious neurologic disease that affects mule deer, white-tailed deer, elk, and moose. Chronic wasting disease belongs to the family of transmissible spongiform encephalopathies (TSEs), which includes scrapie in sheep and goats, bovine spongiform encephalopathy (BSE) in cattle, and Creutzfeld-Jakob disease (CJD and vCJD) in humans, among others. Abnormal accumulation of protease-resistant prion protein in neural and lymphoid tissues are characteristics of TSEs (Prusiner 1999). Prions are infectious proteins without associated nucleic acids. Although there is still debate about the possible infectious agents causing TSEs, the leading theory is that abnormal prions themselves are responsible. According to the protein-only hypothesis, these abnormal proteins act as templates, causing normal prion proteins in animal tissues to change shape. This process starts a cascade that results in persistent prion accumulations that can no longer be recycled by the body. These accumulations cause structural and functional changes in the brain, leading to cell death, loss of neuron function, and death of the animal. Chronic wasting disease is the only TSE found in free-ranging wildlife (Williams et al. 2002).

Chronic wasting disease was first described in a Colorado deer research facility in 1967 (Williams and Young 1980) and has since been found (in August 2006) in free-ranging or captive cervids in 14 states and two Canadian provinces (figure 5). Chronic wasting disease is endemic in northeastern Colorado, southeastern Wyoming, and in the southwest corner of the Nebraska panhandle (Williams et al. 2002). Currently at least two national parks — Rocky Mountain in Colorado and Wind Cave in South Dakota — are inhabited by CWD-infected cervids. Elk in Wind Cave were first diagnosed with CWD in 2002, and since then, eleven infected elk and eight mule deer have been identified and removed from the park. As noted in other sections of this elk management plan and environmental impact statement (EIS), the emergence of CWD at Wind Cave has resulted in the loss of the primary means of elk population control, i.e. trapping and transport to other sites. The recent expansion of CWD into states and provinces outside the endemic area is probably a function of real distributional changes as well as increased surveillance for the disease.

Signs of CWD are progressive and subtle in early stages (Williams et al. 2002). In captive herds, CWD-infected cervids often become isolated or aggressive toward herdmates. While they continue to eat and drink, they gradually lose weight and become emaciated. Other signs can include carrying the head lowered, increased drinking and urination, drooling, wide-based stance, and gait abnormalities. The incubation period of CWD in nature probably depends on the exposure dose, and is generally about 12 to 17 months as suggested by surveillance and experimental studies. Most captive animals survive a few weeks to several months after signs first appear. Free-ranging deer and elk probably don’t live as long since they are more vulnerable to malnutrition and predation.

Although it is unknown exactly how CWD spreads, it is likely that cervids acquire infections through oral ingestion of contaminated secretions from infected animals or from the environment (Miller et al. 1998; Williams and Miller 2002; Miller and Williams 2003; Miller et al. 2004). The high prevalence of CWD in some captive cervid herds indicates that the infection spreads readily among animals that are concentrated. Shedding of infectious particles probably precedes clinical disease in both elk and deer. There is no evidence that CWD is transmitted naturally to cattle, despite instances of extended contact with infected deer or elk (Gould et al. 2003; Belay et al. 2004). Molecular differences in the normal prion protein may limit the susceptibility of cattle, humans and sheep to CWD (Raymond et al. 2000).

The social behavior of elk and deer, coupled with environmental persistence and indirect transmission of the CWD agent, is hampering efforts to control this disease in free-ranging cervids (Miller et al. 2004). Where early detection is possible, it may be feasible to stamp out small isolated outbreaks of infection. On the other hand, containment and reduction are more practical goals in CWD endemic regions (Williams et al. 2002). Affected jurisdictions have adopted several disease mitigation strategies, including bans on artificial feeding and translocation of animals from affected populations. Limited applications of selective culling and localized density reductions in endemic areas are being applied, with final results not yet available. Recent development of the tonsil biopsy as a live test in deer could help control CWD where populations are accessible and lethal sampling is not an option (Wolfe et al. 2002). Likewise, the rectal mucosal biopsy, which has been described as a preclinical diagnostic test for scrapie in sheep, may be suitable as a live-animal diagnostic test for CWD in elk (Spraker et al. 2006).

Prevalence rates of CWD for elk that use the park are unknown, as park staff only selectively remove animals that appear sick, which is not a random sample. However, results from testing elk heads from those killed by hunters immediately outside the park has provided 643 data points, with prevalence averaging 0.6%. The data showed no CWD in 83 tested elk in hunting unit H4, 2 positives in 345 samples in hunting unit H3, and 2 positives in 215 samples from Custer State Park have been found as of December 2007 (SDGFP 2007).

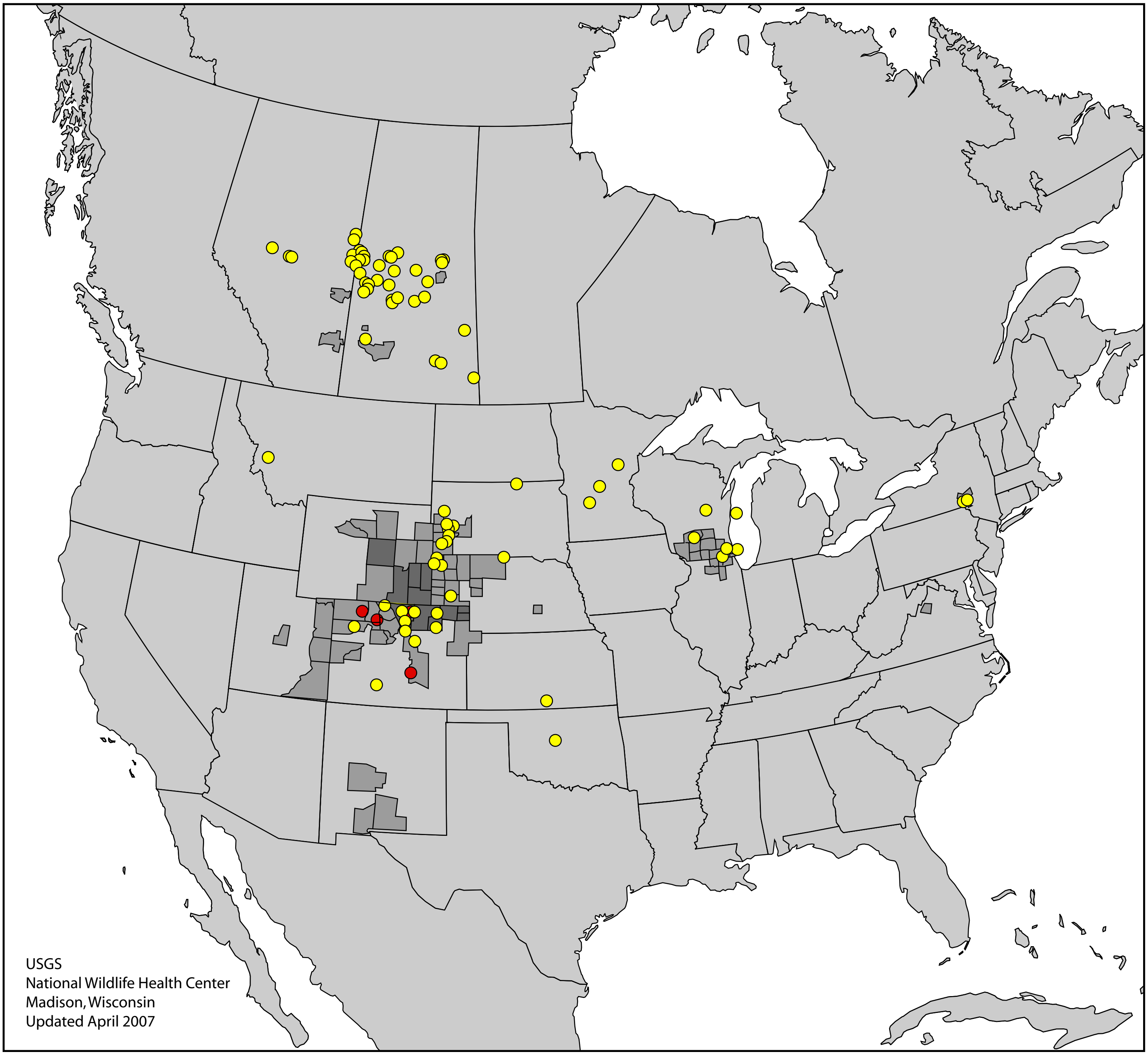


Figure 5. Reported Distribution of Chronic Wasting Disease in North America

Legend

- CWD in free-ranging populations
- Known distribution prior to 2000 (free-ranging)
- CWD in captive facilities (depopulated)
- CWD in captive facilities (current)

NOTE: All locations are approximations based on best-available information

SOILS AND WATER QUALITY

SOILS

Elk management activities may directly or indirectly (through loss of vegetation) result in increases in soil erosion, which in turn could increase sedimentation in streams in the park.

All of the major geomorphic subdivisions for the Black Hills are found in the park. An area of dramatic topographic relief and rugged slopes characterize the highest part of the park in the west. East of this zone is an area underlain by limestone and sandstone where terraces grade into the Minnelusa Foothills region. In the southwest corner of the park, steep dips of the rock strata occur in the Madison and Englewood formations. Elevations continue to drop through the Minnelusa Foothills east to the Red Valley in the eastern part of the park. The Red Valley is underlain by red, iron-rich Spearfish formation which is exposed as red badlands. The easternmost geomorphic subdivision is the Dakota Hogback, which is represented by the Boland Ridge near the east park boundary (NPS 2006e).

Four of the eight major soil associations found in the southern Black Hills occur in the park (NPS 2006a). These are called the Canyon-Rockoa-Rock outcrop, the Nevee-Gypnevee-Reikop, the Vanocker-Sawdust-Paunsaugunt and the Buska-Mocmont-Rock outcrop. These are gray, brown or reddish silts and loams formed from underlying bedrock of limestone, siltstone, shale, sandstone and other formations exposed in the area. Nearly all are well-drained and many are shallow with intermittent rock outcrops. A gray loam (Cordeston) soil is found in swales and other wetter areas in the northern part of the park (appendix I in NPS 2006e).

Using the U.S. Department of Agriculture Natural Resources Conservation Service “web survey” tool (http://soilsurvey.nrcs.usda.gov/app/), soils in the vicinity of Gobbler Knob, Beaver Creek, and Boland Ridge were investigated for erodibility. The tool considers soil type and slope in its calculations. Soils in the southwest corner of the park, where Gobbler Knob is located, are primarily of moderate erodibility, and include the Vocker–Citadel, Sawdust–Vanocker–Paunsaugunt and Hilger–Metre Complex. About 70% of soils in this region are of moderate erodibility, and only about 10% are considered severely erodible. In the northeast corner of the park, where Boland Ridge is located, soils are more erodible. About 40% of soils in this area are considered severe, including the Canyon–Rockoa–Rock outcrop and Butche–Rock outcrop series. About half the remaining soils in this area (or 30% of the total) are moderately erodible and the other half are considered slightly erodible. In the north and central western half of the park, where the Beaver Creek area is centered, about 60% of soils are moderately erodible, 25% slightly erodible and the remainder severely erodible. Soils in the moderately erodible Sawdust–Vanocker–Paunsaugunt series and slightly erodible Paunsaugunt–Gurney series make up about one-third of the area in this part of the park.

WATER QUALITY

Wind Cave National Park lies within the Cheyenne River Basin, which is part of the greater Missouri River watershed. Flow generally moves to the southeast from higher to lower elevations in the park. Average precipitation is 18.6 inches, with late spring and early summer rain making up about half that amount. Flows decrease as temperature increases, and can be quite low in late summer months (NPS 2006e). Precipitation in the winter can be scarce. Three perennial streams flow in Wind Cave National Park: Beaver Creek, Highland Creek and Cold Springs Creek. All three streams have their headwaters in bedrock dominated by igneous and metamorphic rocks and two, Beaver and Highland Creek, continue to flow southeast across the Minnelusa Foothills and Madison Limestone outcrop formations in the park. Here, flow is captured beneath the surface as the water dissolves limestone and runs in subsurface channels. Cold Spring Creek joins Beaver Creek before it crosses the Madison formation, and only flows above ground.

The park also contains several seeps and springs used by elk and other wildlife. Inventories conducted on water sources in Wind Cave in 2000 and 2002 identified over 90 natural springs in the park that provide beneficial uses to wildlife (NPS 2006e).

For the past several years, most of western South Dakota has experienced persistent drought conditions (Curtin 2007a). Hydrologic conditions for 2001–2003 were much different than the wetter conditions experienced in the 1990s, and streamflow levels have generally been well below normal for this period, while many natural springs have been dry.

In addition to increased erosion and suspended sediment levels, elk management activities could affect nutrients and dissolved oxygen levels in water. Because temperature can affect the concentration of dissolved oxygen and have synergistic impacts on aquatic life, it is included in this discussion of water quality.

The temperature of water is affected by air temperature, humidity, shading, turbidity, flow and the temperature of incoming groundwater and/or precipitation. Water temperature is particularly sensitive to changes in air temperature when streamflow volume is low. The degree of shading provided by trees and brush in the riparian zone may be an important factor in determining water temperatures. In small streams, variation in temperature between can be as much as 10°C (50°F).

Suspended sediment concentration varies with season, and water generally has higher sediment concentrations when flows are high. Total suspended solid concentrations below 5 mg/L are considered undetectable and those greater than 53 mg/L are out of compliance with the South Dakota state standard for a single sample.

Dissolved oxygen in water is important for the health of aquatic life, including fish and insects. Most fish are detectably affected by a lack of oxygen when dissolved oxygen levels drop below 2 mg/L. Dissolved oxygen levels of 4–7 mg/L are acceptable for most stream biota and more than 6–7 mg/L is needed to support a permanent coldwater fisheries population. With ample dissolved oxygen, fish are often able to survive other environmental threats such as high ammonia or suspended solids levels that would otherwise kill them (Horne and Goldman 1994 in Cooprider 2004).

Nitrogen and phosphorus are nutrients that occur naturally in soils and therefore in surface waters. Decomposing plants and wildlife waste are other natural sources. However, sewage, fertilizers, and livestock waste are human-caused additions which, at high levels, can be toxic to aquatic life and exceed water quality standards. One problem caused by excess levels of either of these nutrients is eutrophication, where algae and other plants experience explosive growth in the form of “blooms.” When these plants die, bacterial decomposition strips the water of oxygen and results in the death of aquatic organisms. Nitrogen can form nitrate when dissolved oxygen levels are high, but is not toxic. Ammonia, which forms in the presence of lower oxygen levels, is directly toxic to fish. The EPA recommended total phosphorus criteria is 0.02 mg/L in streams, and 0.017 in lakes or reservoirs.

Fecal contamination can come from leaking septic systems, untreated wastewater, animal wastes, and livestock operations. Fecal contamination can also lead to or be associated with low dissolved oxygen, excess ammonia, total nitrogen and phosphorus, as well as pathogenic organisms. USGS reports (Heakin 2004) that the range of fecal coliform found in uncontaminated surface waters ranges from less than 1 to 5,000 cfu/100 ml (“cfu” means “colony forming units”) and in fecal-contaminated surface waters ranges from 200 to less than 2,000,000 cfu/100 ml.

Water quality in the three perennial streams at Wind Cave National Park is generally high, as indicated by a 2002–2003 sampling effort conducted cooperatively by the NPS and U.S. Geological Survey (Heakin 2004). Some samples taken during this study did exceed criteria established for fisheries or other beneficial uses, but none exceeded primary Environmental Protection Agency drinking water standards (Heakin 2004). The pH values for several samples did exceed the secondary maximum contaminant level (a guideline related to the esthetic quality of water) for pH of 8.5.

Several samples from Highland and Beaver Creeks had higher temperatures and pH than those considered the maximum able to support coldwater permanent fisheries (Heakin 2004). Almost all of the samples that exceeded water temperature criteria were collected during July, indicating that temperature may stress fish during unusually warm summer periods with lower flows. Sampling showed Beaver Creek to be higher in nutrients and fecal coliform than the other streams, and lower in benthic macroinvertebrate diversity, which investigators indicated was likely due to human activities outside the park.

Temperatures in samples taken from the three streams averaged between 7.5°C (45°F) and 12.1°C (54°F). The maximum temperature reading in Cold Spring was 21.5°C (71°F); in Beaver Creek 21°C (70°F) and in Highland Creek 14°C (57°F) during the 2002–2003 sampling period. Although the mean temperatures do not exceed any water quality standards, the maximums in both Beaver and Cold Spring Creek are higher than those set by South Dakota Department of Environment and Natural Resources (state) of 18.3°C (52°F) for permanent coldwater fisheries.

Suspended sediment approached but did not exceed the standard for state daily maximum concentrations of 53 mg/L, and ranged from 1.5 mg/L to nearly 50 mg/L in samples collected at the three perennial streams during different times of the year. In Cold Spring Creek, they ranged from a low of 4.5 mg/L in September 2002 to a high of 49.7 mg/L in July 2003. Suspended sediment concentrations were generally lower in Beaver Creek, and varied from 2.4 mg/L (September 2002) to 32.7 mg/L (January 2002). They were lower yet in Highland Creek above the limestone outcrop, where they ranged from 1.5 mg/L (September 2002) to a high of 9.4 mg/L (July 2003). Heakin (2004) reported that it is likely that suspended sediment concentrations were lower than on average during the period collections took place (2002–2003) because of the lower flow conditions related to drought.

Average dissolved oxygen concentrations varied between 8.5 and 12.2 mg/L in the park’s three perennial streams. The minimum dissolved oxygen concentration in any of the samples was 7.5 mg/L, collected at the upland Beaver Creek site. Even this minimum concentration is high enough to support a permanent spawning coldwater fishery and should assist aquatic organisms in withstanding higher concentrations of nutrients or other pollutants.

The upland sampling station for Beaver Creek on the park’s west side was higher in nutrients and coliform than the downstream location. Nutrient levels are measured forms of nitrogen and phosphorus and include nitrates, nitrites, ammonia, and phosphate (including orthophosphate). None of the nutrient concentrations sampled exceeded any EPA drinking water standards. However, average ammonia concentrations did approach the state maximum allowable levels for coldwater permanent fisheries of 0.02 mg/L in Beaver Creek, and the maximum concentrations in Coldwater (0.23 mg/L) and Beaver Creek (0.053 mg/L) exceeded the standard. Dissolved phosphorus exceeded the EPA recommendation of 0.02 mg/L in streams in all three perennial streams in the park. The average reported for Cold Spring ranged from 0.003 mg/L to 0.05 mg/L; for Beaver Creek 0.005 to 0.038 mg/L; and for Highland Creek 0.008 to 0.05 mg/L. Other nutrient concentrations did not approach or exceed the standard (nitrite, nitrate plus nitrite).

The upland location for Beaver Creek also had the highest concentrations of fecal coliform bacteria of those tested. Samples ranged from 32 to 220 colony-forming units per 100 milliliters; all were below the state standard for single sample fecal coliform limits in immersion waters of 400 colony-forming units per 100 milliliters.

VEGETATION

The description of resources in this "Affected Environment" chapter and subsequent impact analysis focus on the following vegetative types, as these vegetation communities are particularly prone to overgrazing by elk and could also be impacted by management actions:

- Hardwood forests;
- Riparian areas;
- Shrublands; and
- Mixed–grass prairie.

Wind Cave National Park is considered one of eight exemplary sites in the Black Hills (Marriott et al. 1999). Exemplary sites contain multiple plant community types in landscapes that are relatively intact over large areas and where natural ecological processes are allowed to function. Ten of the 16 plant community types with the highest rankings in the Black Hills occur in the park (appendix I).

Wind Cave National Park Mixed-grass Prairie and Ponderosa Pine Forest

High levels of elk use could adversely affect native plant communities and alter the natural species composition. Anecdotal evidence from the 1950s, when the elk population was over 1,200 animals, indicates that the range condition improved following the major herd reductions of the mid-1950s (Bauman 1997). Other accounts from the 1960s indicated browse plants were over utilized and dying and the damage was most likely being caused by elk (Lovaas 1973). Smith (1978) reported that red osier dogwood (*Cornus stolonifera*), serviceberry (*Amelanchier* spp.) and sapling aspen were found only in secluded or inaccessible areas. In addition, fence-line differences in buffaloberry (*Shepherdia canadensis*) and bearberry (*Arctostaphylos uva-ursi*) numbers suggested that browse utilization was intense. The species listed above are those most affected by elk herbivory, and can be expected to be most affected by the proposed management actions.

The current and desired acreages of primary vegetation types at Wind Cave are given in table 9 (NPS 2006e). Because coniferous forest and open water habitat types at Wind Cave are not expected to be affected by the actions proposed to manage the elk population, they are not discussed in detail in this document.

TABLE 9. VEGETATION TYPES, WIND CAVE NATIONAL PARK, SOUTH DAKOTA

Vegetation Type	Acres	Percent of total area of Wind Cave	Acreage Goal from Draft Vegetation Management Plan (NPS 2006e)
Mixed-grass Prairie	17,681	62.6 %	16,975–19,804 acres (60–70%)
Coniferous Forest	8,122	28.8 %	4,244–5,658 acres (15–20%)
Shrubland	2,142	7.2 %	1,415–2,829 acres (5–10%)
Hardwood Forest/Woodland	87	0.3 %	383–1,415 acres (0.5–1.5%)
Riparian/Wet Meadow	29	0.1 %	283 acres (0.5–1%)
Open Water	4	0.01 %	4 acres (0.01%)

Source: NPS 2006e

HARDWOOD FOREST

Hardwood forests and woodlands occupy 87 acres, approximately 0.3% of park vegetation. The preferred alternative of the Draft Vegetation Management Plan sets the goal of increasing hardwood forests to a range of 383–1,415 acres (0.5–1.5% of park lands) (table 9; NPS 2006e).

Hardwood forest stands occur along streams and in floodplains, drainage bottoms and toeslopes. The most common deciduous tree species are boxelder (*Acer negundo*) and American elm (*Ulmus americana*). Other species are less abundant, such as green ash (*Fraxinus pennsylvanica*), bur oak (*Quercus macrocarpa*), plains cottonwood (*Populus deltoides*), lanceleaf cottonwood (*Populus acuminata*), hackberry (*Celtis occidentalis*) and peachleaf willow (*Salix amygdaloides*). Aspen (*Populus tremuloides*) and paper birch (*Betula papyriferia*) occur as scattered small patches or individual trees (Cogan et al. 1999).

Aspen is a keystone species in the Western United States and one of the best indicators of overall ecosystem health. Where aspen communities occur in the Western United States, they are second only to riparian areas in species diversity and abundance (Bartos and Campbell 1998). Park staff believe that elk browsing has contributed to the decline of aspen because this limited food source is heavily used by elk during some portions of the year (NPS 2005b). Heavy use by elk is believed to prevent young plants from growing to maturity.

Aspen stands are present in historical locations, but are diminished in size primarily due to high grazing pressure from ungulates (NPS 2006e). Many of these stands are decadent with no significant recruitment. Unprotected clones receive heavy browse pressure and have retreated to grow only in those areas that function as natural refugia (e.g., a talus slope or a narrow ledge on a cliff face). These aspen clones continue to sucker. However, any suckers outside the area of refuge are quickly browsed, resulting in little or no increase in the number of overall trees (Curtin 2006). Eighty-one percent of aspen sprouts sampled outside the exclosure had been grazed during the last year (Ripple and Beschta 2006).

Climate does not appear to be a factor in the condition or decline of aspen at the park; aspen protected from ungulates, especially elk, are doing well. Deer are assumed to impact aspen, but only to a small degree; aspen occurring in areas frequented by deer, but where elk are never seen (Historic Housing Area, park road right-of-ways), are doing fairly well (Curtin 2006).

Survival and recruitment of hardwoods outside of exclosures or small refugia has been essentially non-existent at Wind Cave since the advent of livestock grazing in the 1880s (Ripple and Beschta 2006). Ripple and Beschta's data confirm that recruitment of plains cottonwood and bur oak peaked in the 1870s, and that no recruitment of lance leaf cottonwood has occurred since the 1920s.

The lack of recruitment is continuing today during a period of grazing by wild ungulates. Plains and lance leaf cottonwood occur at several locations at the park, but the only location where regeneration isn't heavily browsed is inside a five-acre cottonwood exclosure created in 1991. Outside the exclosure, 86% of plains cottonwood root sprouts and 68% of lance leaf cottonwood sprouts had been grazed in the year the study occurred (Ripple and Beschta 2006). Bur oak occurs at two locations at the park, but the only location where seedlings survive is within a 1/2 acre oak exclosure created in 1977. Seedlings of hackberry and peach leaf willow are heavily browsed (Curtin 2006). Without new recruitment, certain hardwood species, especially plains cottonwood, aspen and bur oak, may be extirpated in the park except for within fenced exclosures (Ripple and Beschta 2006).

RIPARIAN COMMUNITIES

Riparian herbaceous vegetation communities occupy only 29 acres, 0.1% of park lands, and include the Western Great Plains Streamside Vegetation type, prairie cordgrass (*Spartina pectinata*), sedge wet meadows (*Carex* spp.), and creeping spikerush (*Eleocharis palustris*) wet meadows (Cogan et al. 1999). The preferred alternative of the Draft Vegetation Management Plan calls for increasing riparian communities from 29 acres to 283 acres, 0.5 to 1.0% of park lands (table 9; NPS 2006e). Other vegetative types such as mixed-grass prairie, ponderosa pine forest, deciduous shrublands and deciduous woodlands occur in riparian areas as scattered patches. Most riparian areas exhibit stable hydrologic function and condition.

SHRUBLAND

Shrublands occur in a variety of dry sites including side slopes, lower slopes, and drainage bottoms on approximately 7.6% of the park area. Shrublands occur in conjunction with mixed-grass prairie, ponderosa pine forest, and deciduous woodlands. The preferred alternative of the Draft Vegetation Management Plan sets the goal of maintaining shrublands at approximately the current level, within a range of 1,415 to 2,829 acres, or 5% to 10% of park lands (table 9; NPS 2006e). Key species include mountain mahogany (*Cercocarpus montanus*), Western snowberry (*Symphoricarpos occidentalis*), chokecherry (*Prunus virginiana*) and three-leaved (*skunkbush*) sumac (*Rhus trilobata*) (Cogan et al. 1999). While some shrub species within the park appear to be healthy, others appear to be negatively impacted by current levels of herbivore browsing. The degree to which elk browsing is responsible for these impacts (as opposed to mule deer, for example) is unknown.

MIXED-GRASS PRAIRIE

The mixed-grass prairie vegetative community includes seven upland herbaceous community types and occupies 62.6% of the park (Cogan et al. 1999). The preferred alternative of the Draft Vegetation Management Plan indicates mixed-grass prairie habitats should be maintained within a range of 16,975 to 19,804 acres, or 60 to 70% of park lands (table 9; NPS 2006e). The exemplary sites identified within the park (Marriott et al. 1999; appendix I) included undisturbed, mixed-grass prairie ecosystems. The dominant grass species are big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), western wheatgrass (*Agropyron smithii*), green needlegrass (*Nassella viridula*), grama grass (*Bouteloua gracilis* and *B. curtipendula*) and threadleaf sedge (*Carex filifolia*). This type also supports a variety of forbs and shrubs including Yucca (*Yucca glauca*), prairie clover (*Dalea purpurea*), prickly pear (*Opuntia polyacantha*), black-eyed Susan (*Rudbeckia hirta*), and cinquefoil (*Potentilla* sp.) (NPS 1994b). Exotic species such as smooth brome (*Bromus inermis*), Kentucky bluegrass (*Poa pratensis*), and cheatgrass (*Bromus tectorum*) have been introduced but have not significantly altered the natural function of the prairie. The mixed-grass prairie type occurs in a mosaic with other communities, including ponderosa pine, shrubland, riparian and woodland communities.

Historic grazing and fire suppression have altered species composition and the extent of mixed–grass prairie in the park. Livestock and wildlife grazing have caused cool-season exotic species such as smooth brome and Kentucky bluegrass to increase in dominance and fire suppression has allowed the encroachment of exotic plants, shrub species, and the establishment of ponderosa pine. Conifers in the park are expanding not only their external extent, but crowding out small prairie grassland islands within the forest. Although exotic plants are mixed into native grasses in the park, they have not significantly altered the ecology of the prairie (NPS 2006e).

The percentage of forage consumed has increased to a rate considered unsustainable over the long term.

Wind Cave monitors range production and condition within the park using Natural Resource Conservation Service methodology (Cosgrove et al. 2001). Data collected by park staff during 2004 indicate that range conditions in the park were, on average, “good,” with some areas being “fair” as characterized by the Natural Resource Conservation Service rating system for rangelands (Curtin 2005 in NPS 2005b). However, in more recent years, a combination of grazing, drought, trampling, and other forces have resulted in an increase in the percentage of forage utilized so that in 2006–2007, between 50% and 60% (on average) of the forage had been consumed (Curtin 2007b), a rate considered unsustainable over the long term (Singer et al. 2002).

OTHER WILDLIFE

Wind Cave provides habitat for approximately 200 bird, 48 mammal, 11 reptile and 6 amphibian species (Uhler 2002). Two federally listed wildlife species—black-footed ferret and American burying beetle—have potential habitat in Wind Cave National Park and are discussed in the “Special Status Species” section. Rare, unlisted species, including the Bear Lodge meadow jumping mouse (*Zapus hudsonius campestris*), least shrew (*Cryptotis parva*), and several butterflies are described below.

The impact analysis in this elk management plan and EIS focuses on the following wildlife species or groups that are most likely to be affected either directly or indirectly by actions taken to manage the elk populations:

- Key management species for Wind Cave: bison and black-tailed prairie dog;
- Other ungulates: pronghorn antelope, mule deer, white-tailed deer;
- Small mammals, including the Bear Lodge meadow jumping mouse and the least shrew both of which are South Dakota species of concern;
- Breeding and migratory birds; and
- Several rare butterflies, including regal fritillary (*Speyeria idalia*) and arogos skipper (*Atrytone arogos iowa*).

The actions proposed to manage the elk population are not expected to have more than negligible impacts on non-breeding birds, or on amphibians or reptiles, and so these groups of wildlife are not discussed further.

KEY MANAGEMENT SPECIES

Several keystone species are found at Wind Cave National Park. A keystone species is defined as one whose ecological effect is disproportionate to its abundance. A decline in a keystone species’ population may initiate changes in ecosystem structure and a decline in overall species diversity (USFWS 2000).

Bison

Bison were reintroduced into the park in 1913 (Lovaas 1973a). Bison are the primary management species for Wind Cave National Park (Public Law 148). This is the only herd under federal management with no indication of cattle gene and that is also free of the disease brucellosis.

A bison management plan was completed by the park in 2006. The plan includes a summary of research indicating the herd is best managed in a range of 400–500 animals, which is large enough to preserve the unique genetics of the herd. As of October 2006, the bison herd numbered about 400 animals (NPS 2006g).

Bison tend to segregate into mixed herds and bull groups. Mixed herds include cows, calves and yearling bulls. Bulls tend to separate from cows and calves except during the rut forming loose groupings. There is a high degree of similarity in range use by mixed herds and bull groups in mixed prairie ecosystems at Wind Cave (Popp 1981).


Bison: A Keystone Species

Bison food habits reflect seasonal habitat use (Popp 1981). Cool season graminoids (grasses), such as bluegrass, sedges and western wheatgrass usually dominate bison diets, but the proportion of warm season grasses, such as grama-like short grasses, buffalo grass (*Buchloe dactyloides*) and blue stems increase during the summer. Threadleaf sedge is a key forage species for bull groups. Forbs and browse are minor portions of bison diets. There is a high degree of similarity between seasonal diets of mixed bison herds, calves, and bull groups. Kentucky bluegrass, blue grama and bluestem are key forage species for all bison.

In general, both mixed herds and bull groups prefer sites with cool season species and avoided those dominated by warm season grasses for all of their activities throughout the year. Peak bison use of prairie dog towns occurs in the late summer when towns are often used for rutting activity, wallowing and loafing (Wydeven and Dahlgren 1985).

Black-tailed Prairie Dog

Although the black-tailed prairie dog is not specifically identified as a resource to be protected in the establishing legislation or its expansions, the prairie dog is an integral element of the mixed–grass prairie habitat and surface ecosystems that the park is mandated to protect. The best available information indicates that the species has been present in the area for thousands of years (Carlson 1986; White 1986). As of early 2007, Wind Cave National Park had approximately 16 colonies occupying about 2,800 acres, or 9.9% of the present park area (figure 6) and has approximately 8,566 acres of potential habitat (Muenchau 2007). Grasses comprise up to 80% or more of the black-tailed prairie dog’s diet in northern mixed-grass prairie, especially in spring and summer (NPS 2006a). Preferred grasses include big bluestem, little bluestem, grama (*Bouteloua* spp.), buffalo grass, western wheatgrass and sedges. During the fall, broadleaf plants are especially important; any available vegetation could be eaten in winter (ibid).

The black-tailed prairie dog is regarded as a keystone species (Kotliar in Hoogland 2005). Burrowing and foraging activities of black-tailed prairie dogs affect a number of ecosystem processes including vegetation structure, plant composition, soil nutrients, soil turnover, soil chemistry, energy flow, plant nutrient quality and plant succulence that in turn affect many prairie-dwelling species (USFWS 2004a). At least 9 species depend to some extent directly on prairie dogs or their activities, and another 137 species are associated opportunistically (USFWS 2000).

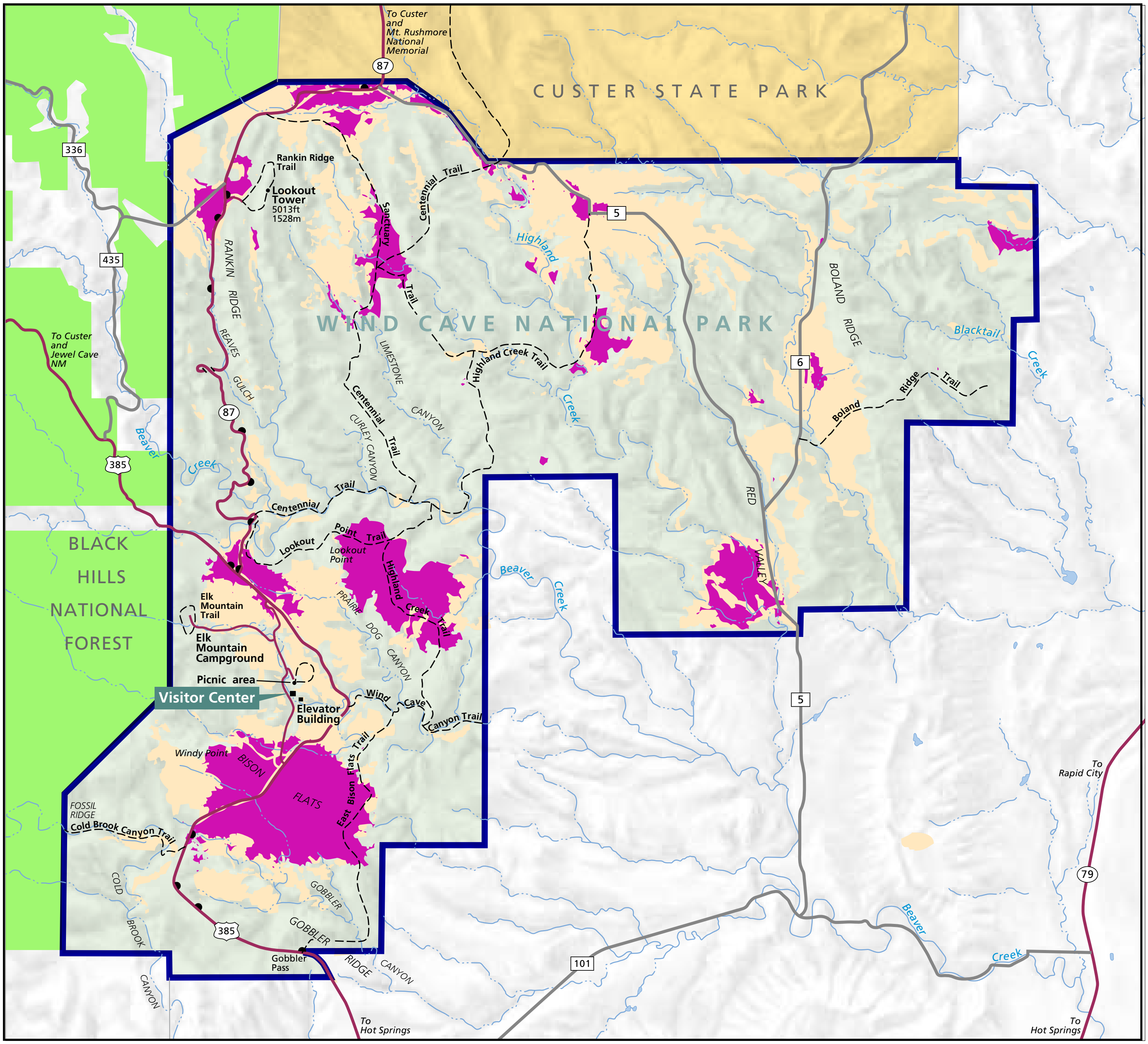


Figure 6. Black-tailed Prairie Dog Colonies in Wind Cave National Park

Legend

- Roads / Highways
- Pullout
- Unpaved Road
- Trails
- Streams
- Prarie Dog Colony
- Suitable Habitat

N

0 1 2 Kilometers

0 1 2 Miles

At Wind Cave, these species include: burrowing owl (*Athene cunicularia*), ferruginous hawk (*Buteo regalis*), bobcat (*Lynx rufus*), coyote and rattlesnake (NRCS 2001).

Bison, and perhaps elk, may have a symbiotic relationship with black-tailed prairie dogs, although findings are mixed. Continual clipping of vegetation by prairie dogs initially improves the palatability of some grasses (those more resistant to loss from grazing) by keeping them in an early growth stage, as does grazing by bison. A study at the park found that mean leaf nitrogen of grasses where prairie dogs or bison had been removed was significantly lower than when either had grazed an area (Cid et al. 1999). This is particularly true of newer prairie dogs colonies or the edges of older colonies, as long term clipping by prairie dogs results in more forbs in the center of the colony, vegetation that is less attractive to most ungulates at the park (Long and Truett 2006).

Limited research at the park (Wydeven and Dahlgren 1985) on the use of prairie dog towns by ungulates found that only pronghorn preferentially used dog towns throughout the year. The estimated percentage of time pronghorn grazed at prairie dog colonies ranged from 10 to 25% and depended on the plants present. Both this study and another (Coppock et al. 1983) found bison selectively grazed parts of prairie dog towns at the park during the summer. Coppock and others found very high selection by bison (nearly 90% of all habitat use and feeding time) during the summer for prairie dog towns. The newer part of the colony was used for feeding and the interior for resting. Use of prairie dog colonies by bison during the remainder of the year was low.

Wydeven and Dahlgren also examined whether elk selected prairie dog towns for grazing, and found that elk used the towns primarily for rutting activities rather than foraging (also Vermeire et al. 2004). Elk did occupy this habitat during the autumn, but generally did not in the winter and spring. In fact, Wydeven and Dahlgren (1985) found the major food species at the park consumed by elk (and bison) were more abundant in locations other than prairie dog towns. In analyzing Wydeven and Dahlgren's data further, Vermeire and others (2004) noted that the percentage of elk observations on prairie dog colonies was "less than or similar to the percentage of open prairie sites colonies (i.e., neutral or negative selection)."

While it is sometimes debated whether or the extent to which prairie dogs positively coexist or influence grazing ungulates, authors generally agree that at least moderate ungulate grazing benefits prairie dogs. Grazing and trampling by bison and cattle (a domesticated ungulate) in mixed-prairie grasslands assists prairie dogs by reducing the height of vegetation and allowing them to better monitor for predators (Licht and Sanchez 1993; Miller et al. 2007; Derner et al. 2006; Cable and Timm 1987; Vermeire et al. 2004). In fact, removing cattle from rangelands is sometimes used as a tool to keep prairie dogs from expanding. Particularly in areas of high rainfall or during wet years, deferred grazing (until the end of the grass growing season) has been found to be effective (Cable and Timm 1987). Conversely, heavy grazing, dry weather, human disturbance, or low plant biomass productivity can also result in shorter or more sparse vegetation and expansion of prairie dog colonies (Miller et al. 2007). Studies comparing the rate of prairie dog expansion in taller mixed grass prairie as opposed to short-grass steppe found an increase of 27% on average in the fastest growing dog towns in the former and between 100% and 200% per year in short-grass steppe (Dalsted et al. 1981 and Antolin et al. 2006 as cited in Derner et al. 2006).

The park recently completed a *Black-Tailed Prairie Dog Management Plan/EA* (NPS 2006a). Under the park's preferred alternative (alternative C), the size of prairie dog colonies in the park will be maintained at a sustainable level between 1,000 and 3,000 acres for both the long-term viability of the prairie dog population and the availability of forage and habitat for other species within the park. The park has also completed a plan (NPS 2006f, FONSI dated March 2007) to reintroduce the prairie dogs' primary predator, the endangered black-footed ferret, and the first ferrets were released in the park during the summer and fall of 2007 (Foster 2007b).

OTHER UNGULATES

The park supports populations of a variety of ungulates whose habitats could be adversely affected by over-use by elk, including bison, pronghorn, mule deer and white-tailed deer. Bison, a key park species, are discussed above.

Elk numbers higher than those proposed in the park management plans (Elk Management Strategy [NPS 1994a], General Management Plan [NPS 1994b]), Resource Management Plan [NPS 1994c]) may prevent NPS from balancing the competing interests of elk and other ungulates. For example, Wydeven and Dahlgren (1985) considered competitive exclusion to be a likely explanation for the limited distribution of mule deer in the park when elk numbers reached 450–500 in 1976. They also noted the potential for competition between elk and pronghorn at this same time, and concluded that "[Elk] populations should not be allowed to expand greatly over [these] levels."

Pronghorn Antelope

Pronghorn antelope are native to the area now known as Wind Cave National Park, but had been extirpated by the time the park was established. Twenty-three pronghorn antelope were reintroduced into the park between 1914 and 1924 (NPS 2006j). Since then, the population has fluctuated reaching a low of 20–25 animals in 2001–2002 with a population in September 2006 of 90–100 animals (Roddy 2007). These animals have historically been able to move into and out of the park by way of crawl holes primarily in the northern fence. Although recent maintenance of the fence has occurred to prevent bison from moving into Custer State Park, pronghorn antelope movement has not been deterred (Roddy 2007).

Pronghorn Antelope

Pronghorn antelope bucks are polygamous and territorial. Bucks establish breeding territories as the rut approaches, and exclude other bucks while attempting to keep does within their territory. Does often breed as fawns and have a single fawn the first year and twins thereafter. Breeding occurs from August to September, and fawns are born in late May to early June. Fawns remain inactive for the first week after which they are able to travel with the doe (Yoakum in Schmidt and Gilbert 1978).

Pronghorn antelope use non-timbered habitats yearlong. At Wind Cave, pronghorn antelope and bison exhibit very similar habitat use during all seasons (Wydeven and Dahlgren 1985). Elk and pronghorn antelope have less habitat overlap. The greatest probability of direct competition between elk and pronghorn antelope would occur in winter when both species forage heavily on Louisiana sagewort (*Artemisia ludoviciana*); however they generally do not occupy the same areas (Wydeven and Dahlgren 1985).

Mule Deer

Mule deer are common in ponderosa pine and shrubby draws at Wind Cave (Wydeven 1977). As of early 2007, the population is estimated to be approximately 200–225 individuals (Roddy 2006). They are distinguished from white-tailed deer by their grayish color, white rope-like tail, large mule-type ears and bounding gait, and tend to occupy rough terrain and shrubland habitats.

Mule deer bucks are polygamous and form harems, which they defend from subordinate bucks. Breeding may occur from October to December with a peak in early November. Does generally do not breed as fawns. Yearling does may have a single fawn with twins more common thereafter. Fawns are born in early June and weaned in late summer.

Although mule deer utilize habitats similar to elk, especially in summer, their diets do differ (Wydeven and Dahlgren 1985). In winter when competition could be greatest, mule deer and elk usually occupy different areas of the park (Wydeven and Dahlgren 1985).

White-tailed Deer

White-tailed deer occupy riparian and forest habitats in the park. The current population is about 60 animals (Roddy 2006). Beyond that, little is known of their movements, distribution or habitat use in the park.

White-tailed deer bucks are territorial and polygamous. Does can breed as fawns, but generally do not breed until yearlings. The rut extends from October through December with peak breeding in mid-November. Fawns are born in late May or early June, and weaned in late summer (Halls in Schmidt and Gilbert 1978).

White-tailed deer eat browse and forbs, and may overlap with elk during the summer when elk use riparian corridors for shade, food, and traveling.

OTHER WILDLIFE

Small Mammals

Small mammals are important to the ecology of Wind Cave for several reasons. They are an important prey base for predators, consume insects and play a role in seed and spore dispersal (Duckwitz 2001). In grasslands, prairie voles (*Microtus ochrogaster*) are a common prey item consumed by predators such as coyotes and red fox (*Vulpes vulpes*). Red squirrels (*Tamiasciurus hudsonicus*) are considered the most effective forest dwelling seed forager, and can remove up to 82% of a ponderosa pine seed crop in a year. Deer mice (*Peromyscus maniculatus*) are also excellent seed foragers in shrub and grassland habitats. Although these species remove some of the seed crop, they also help those that remain to grow by reducing competition for nutrients. Seeds are moved through feces and fur, as are spores of fungi. In addition, seed-caching behavior of many small mammals increases seed dispersal when unused or forgotten caches germinate. Small mammals, particularly shrews (*Sorex* spp.) and deer mice, are considered important insect predators. Because they often consume the most numerous and dominant insects, biodiversity of the insect population increases. Small mammals may also be an important form of natural biological control of invertebrate pests (Duckwitz 2001).

Wind Cave provides habitat for approximately 26 native species of non-predatory small mammals (appendix J). Seventeen species occur in habitats likely to be affected by actions proposed in this elk management plan and EIS. Fifteen of these are considered common. The distribution of small mammals within the park varies by species, season and habitat. Monitoring data are not available for this group, although a study of relative abundance was conducted in 1999 and 2000 (Duckwitz 2001).

This study found that the most common small mammals captured in the park were deer mice and white-footed mice (*Peromyscus leucopus*), least chipmunk (*Tamias minimus*) and southern red-backed vole (*Clethrionomys gapperi*). The hispid pocket mouse (*Chaetodipus hispidus*) and least shrew were least common. Riparian shrublands had the highest diversity of small mammals captured, including white-footed mice, meadow voles (*Microtus pennsylvanicus*) and Hayden's shrews (*Sorex haydeni*). Meadow jumping mice and southern red-backed voles were closely associated with birch/aspen forests. Nuttall's cottontail rabbits (*Sylvilagus nuttalli*) and bushy-tailed woodrats (*Neotoma cinerea*) were associated with shrublands, including mountain mahogany and riparian areas. Deer mice were also found in shrublands, but more so with leadplant vegetation alliances and young ponderosa pine forests. Species that occupy mixed-grass prairie habitats include cottontail (*Sylvilagus floridanus*), prairie dog, deer mice, pocket gopher (*Thomomys talpoides*) and prairie vole.

Two species, the Bear Lodge meadow jumping mouse and the least shrew, are addressed individually. These species are listed by South Dakota Natural Heritage Foundation as S-3: Rare and local throughout its range or found locally (even abundantly in some portions of the range) in a restricted range or vulnerable to extinction throughout its range because of other factors.

Bear Lodge Meadow Jumping Mouse

The Bear Lodge meadow jumping mouse is the more common subspecies to the Preble's meadow jumping mouse, which has been the center of controversy regarding its status as a federally listed species. It is considered uncommon in moist draws and riparian areas in the park. It feeds primarily on insects, seeds and fruits especially grass seeds. Population maintenance requires adequate herbaceous ground cover (Whitaker 1972).

Least Shrew

The least shrew is a relatively rare species that lives in grasslands at the park. It occurs primarily in the eastern half of the United States from central New York to central South Dakota, but its range also extends into Mexico and Central America (Fox 1999). In the United States, it prefers grassy, weedy or brushy fields and unlike most shrews is a social species. Least shrews may be active at any hour, but the peak of activity is at night. It eats insects and other small animals such as snails or earthworms (Whitaker 1974).

Predators and Scavengers

Three species of predatory mammals that may prey on elk and other ungulates occur in the park; they are mountain lion (*Felis concolor*), coyote, and bobcat. Predator populations are not controlled within the park, and currently coyotes are common and mountain lion populations are increasing (Muenchau as cited in Ripple and Beschta 2006). Predators could be affected by changes in elk and other ungulate population levels as a result of actions proposed to manage the elk population.

Mountain lions are occasionally seen in the park and can move freely in and out of the park at any location. Lions are associated with broken habitats with adequate vegetation, shrubs or trees, to provide stalking cover. Lions are opportunistic feeders capable of killing healthy adult elk, but more typically prey on deer, elk calves and small mammals.

Coyotes are common in the park, and function as both predators and scavengers. Their prey typically consists of small mammals although they are very adaptable. In years when small mammal populations are low, they can be effective predators of deer fawns (Riley 1982). They are opportunistic and take advantage of carrion when it is available.

Bobcats are uncommon in the park. They generally occupy shrublands, riparian areas, forest edge habitats and prairie dog colonies. They typically prey on rabbits and hares, other small mammals, birds and prairie dogs.

Birds

Approximately 200 species of birds have been identified at Wind Cave, including 123 breeding species (table 10). Of those, 41 are considered common and the remainder are considered uncommon or rare. Hardwood forest, including aspen, shrublands, riparian areas and mixed-grass prairies are key foraging habitats for elk. These habitat types have a very limited distribution in the park, and would be expected to be impacted by increased herbivory by an unregulated elk population. Many of the breeding bird species that utilize aspen and other hardwood forests, shrublands and riparian areas are considered uncommon or rare in the park. The distribution of breeding birds within the park varies widely by season and habitat. Monitoring data are not available for this group of species.

In 1995, Turchi et al. found bird species richness to be significantly higher in aspen than conifer habitat, and that the percentage of shrub cover in aspen stands was the most important predictor for bird species richness in Rocky Mountain National Park. Cavity nesting species such as woodpeckers, swallows, bluebirds, chickadees and nuthatches use live and standing dead trees, including aspen, as roosting and nesting sites. Data from Rocky Mountain National Park suggest that live aspen are more important to cavity nesting species than standing dead trees, and that different species use different sizes and densities of aspen (Zaninelli and Leuckering 1998; Duberstein 2001)

Riparian habitats are the rarest upland habitat in Wind Cave. These habitats potentially support the highest bird diversity of any western habitat type. Bluebirds, thrushes, vireos, warblers, towhees, sparrows and juncos use riparian habitats. Shrublands provide valuable food and cover for many avian species, including warblers, sparrows, towhees, wrens, thrashers, and certain sparrows. Elk herbivory may reduce habitat available for use in both of these vegetative types.

TABLE 10. NUMBER AND RELATIVE ABUNDANCE* OF SPECIES OF BREEDING BIRDS ASSOCIATED WITH KEY HABITATS AT WIND CAVE NATIONAL PARK

Habitat	Breeding birds	Common	Uncommon	Rare
Hardwood Forest	12	1	5	6
Shrublands	19	5	10	4
Riparian Areas	18	4	5	9
Mixed-grass Prairie	19	8	7	4
Coniferous Forest	40	18	11	12

* Relative abundance was determined from information provided on the Wind Cave Website (NPS 2006j).

Rare Butterflies

The park provides habitat for a number of rare butterfly species as indicated by the South Dakota Natural Heritage Program. These include the regal fritillary, Atlantis fritillary, ottoe skipper (*Hersperia ottoe*), Iowa skipper, and the uncas skipper (*Hersperia uncas*).

Regal Fritillary

The regal butterfly is a rare butterfly species currently monitored under the South Dakota Natural Heritage Program. Regals can be found in ever decreasing prairie habitats from North Dakota and Colorado east to Virginia and Maine. They feed on species such as milkweed (*Asciepias* sp.) or thistle (*Cirsium* sp.). Females aestivate in August, only to emerge late in the summer and walk along the ground laying eggs singly in the debris on the prairie floor. After roughly 10 days the eggs will hatch and the tiny caterpillar, roughly one millimeter in length, will over-winter. In the spring the caterpillars will emerge to feed on their host plants, presumably North American violets (*Viola* spp.) (Williams 1999). High levels of elk grazing may reduce the quality of mixed-grass prairie habitat for the regal fritillary.

Atlantis Fritillary

The Atlantis fritillary, subspecies pahasapa, is a recently described subspecies thus far restricted to the Black Hills in Custer, Lawrence, Meade, and Pennington counties in South Dakota and Crook County, Wyoming. This species prefers wet meadows, moist canyons, and boggy areas near springs and headwaters of small streams. The flight period is primarily in July, but extends from June 27 to August 9. Males can be found in open areas and along streams in search of females. They have one brood which overwinters as unfed caterpillars. The larval host plants are violets, including northern bog violet, meadow violet, and Canada violet. The adult energy source is nectar from a variety of flowers, including coneflowers, alfalfa, wild bergamot, ox-eye daisy, black-eyed Susan, and wild spiraea (Marrone 2002; Marrone 2005). Though the Atlantis fritillary is considered secure globally, the subspecies pahasapa found in the Black Hills is more rare and is considered vulnerable to extinction by the state throughout its range in South Dakota. Twelve new sites were located for the species in 2006, including a southernmost record at Wind Cave National Park (Marrone 2006).

Ottoe Skipper (*Hesperia ottoe*)

The ottoe skipper is one of many butterflies that are restricted to relatively undisturbed, mixed-grass to tall-grass prairie habitats and now depend on scattered remnants for their survival. This skipper is usually found in small numbers not far from big bluestem, the favored host plant for the larvae. Other larval host plants include little bluestem, sideoats grama and other native prairie grasses. Flight period extends from late June to August, with peak flight in mid-July. Males can be seen perched on tall flowers such as purple coneflowers and thistles to watch for females. Adults feed on the nectar from many flowers, but especially those of coneflowers, gayfeathers, asters, milkweeds, alfalfa, leadplant, black-eyed Susan, and sunflowers. This species overwinters as a partially grown caterpillar in a leaf shelter. Distribution is very local and generally uncommon to rare throughout South Dakota and its entire range (Marrone 2002; Marrone 2005). The ottoe skipper is considered secure globally, but is rare in parts of its range, especially in the periphery. The State has ranked the ottoe skipper as “imperiled” or “vulnerable to extinction” throughout its range. Three new sites, all within Wind Cave National Park, were found for the ottoe skipper during a 2006 survey. Native prairie sites with abundant nectar sources are very important in order for this species to survive (Marrone 2006).

Arogos Skipper

This skipper is found locally throughout South Dakota and also requires relatively undisturbed prairies and grasslands. In western South Dakota, populations of this butterfly are generally found near patches of big bluestem on south facing slopes of rolling hills. Big bluestem and little bluestem are the larval host plants, while adults feed primarily on purple coneflower, prairie coneflower blackeyed Susan, and thistles. The flight period extends from late June to Late July, with peak flights in July. Males perch near host plants in mid-afternoon to watch for females. This species has one brood, and overwinters as a partially grown caterpillar in a leaf cocoon about three feet above the ground. On emergence, caterpillars feed on leaves and live in nests constructed of two leaves sewn together with silk (Marrone 2002; Marrone 2005). As with the ottoe skipper, this species is secure globally, but is "imperiled" or "vulnerable to extinction" in the State. The species can be occasionally common in some areas, as was found in 2006 at one site in Wind Cave National Park (Marrone 2006).

Uncus Skipper

Populations of this prairie butterfly seem to be on the decline due to loss of habitat (Marrone 2006), and although it is not yet monitored by the South Dakota Natural Heritage Program or listed as rare by the State of South Dakota, it is considered sensitive in the park. This species prefers short-grass and mixed grass prairie sites, especially along foothills of the Black Hills, badlands buttes, and rocky ridges of the glacial lakes region. The larval host plant species in South Dakota is blue gramma, while adults feed on nectar from flowers, including coneflowers and gayfeather. Flight periods extend from early June to early September. This species has two broods and probably overwinters as a caterpillar (Marrone 2002). A noteworthy find during the 2006 survey was the capture of two uncas skippers (one male and one female) in Wind Cave National Park.

SPECIAL STATUS SPECIES

Two federally listed wildlife species—black-footed ferret and American burying beetle—have potential habitat in Wind Cave National Park. Black-footed ferrets are the subject of a reintroduction effort to the park, and were reintroduced to the park as an endangered species with special take provisions in 2007. The bald eagle (*Haliaeetus leucocephalus*), a state threatened species, currently is known to use the park, and the state-endangered peregrine falcon occasionally pass through during migration.

BLACK-FOOTED FERRET

Black-Footed Ferret

The federally endangered black-footed ferret, which was extirpated from the park (the last known siting was in 1977 [NPS 2006a]) is the subject of an ongoing reintroduction effort. Ferrets were reintroduced into the park in 2007 and an additional 20–25 ferrets will be released each year for the next three to five years. The ferrets were reintroduced as endangered and authorized under a 10(a)(1)(A) scientific experimental/recovery permit issued under the Endangered Species Act. This permit allows experimental reintroductions to occur within park boundaries and provide mechanisms to ensure that private property interests outside the park are not impacted.

Black-footed ferrets are one of the rarest animals in the world, and were believed to be extinct until a small population was discovered in Wyoming in 1981. A captive breeding program brought this species back from the brink of extinction, and there are now over 600 individuals in the wild as a result of the program (NPS 2006f, FONSI dated March 2007). The factors contributing to the species' decline include loss of habitat, loss of prey and disease. The primary prey of black-footed ferrets are prairie dogs, which have been reduced in numbers from loss of habitat, disease, and large-scale poisoning. It is estimated that a ferret "family" (mother and young) require a minimum of 50 acres of prairie dog colonies to survive without depleting the prey resource. Ferrets can travel long distances, and are known to move up to five miles in one night. Juveniles disperse up to nine miles when leaving their families.

AMERICAN BURYING BEETLE

The federally endangered American burying beetle (federal endangered) is known to occur in South Dakota, but no documented sightings have taken place closer than 150 miles to the east and so it is not analyzed in this document.

BALD EAGLE

In South Dakota, the bald eagle is primarily a migrant and wintering species. Eagles are listed by South Dakota as a threatened species. In the park they are seen during both fall and spring migrations in open valleys and roost during the winter in large trees (NPS 2003a). No nesting sites are known to occur in the park. The nearest regular bald eagle concentration occurs during the winter at Angostura Reservoir, about 12 miles south of the park (NPS 2006a).

AMERICAN PEREGRINE FALCON

The American peregrine falcon, a state endangered species, is also a rare seasonal migrant through the park, but no discernable effect from any activities associated with elk management are likely to occur. No additional analysis of this species is included in this document.

AIR QUALITY

Incineration of elk carcasses could result in emissions related to operation of a diesel generator creating an air-curtain and/or odors and smoke.

Wind Cave National Park is a designated Class I airshed under the Clean Air Act, which requires the highest level of air quality protection. The most comprehensive study of Wind Cave air quality comes from a 2000 inventory completed by consultants (EA Engineering, Science and Technology, Inc.) to the Washington office of the NPS.

Emissions of criteria pollutants (those for which primary standards have been established) are relatively low in the immediate vicinity of the park. The closest urban area is Rapid City, where there is light industry. In addition, strip mining, oil development, coal-bed methane production and coal-fired power plants in eastern Wyoming and Montana upwind of the park pose threats to air quality in the Black Hills area and region. Nonetheless, visibility in the park is considered to be excellent (Peterson et al. 1998).

Local pollution comes from a variety of sources including sawmills, feldspar and other rock quarries and vehicles and woodstoves.

Stationary sources of emissions in the park include propane, fuel oil and pellet stove heating units, a generator and fuel storage tanks. Campfires, prescribed burning and wildfires also contribute to stationary sources of air emissions. Visitor and NPS vehicles, as well as movers, tractors and other maintenance equipment contribute to mobile sources of air emissions.

Table 11 summarizes estimated annual emissions in Wind Cave National Park. Emissions were calculated for the following criteria pollutants: particulate matter (PM_{10}), sulfur dioxide (SO_2), nitrogen oxides (NOx), carbon monoxide (CO), and volatile organic compounds (VOC). Prescribed burning or wildfires could also release smaller particulates (2.5 microns or smaller) and carbon monoxide. Mobile emissions were based on vehicle counts in 2001 (about 289,000).

Regional emissions for Custer County (which include those for the park) are provided below for comparison (table 12). Beyond the same type of sources described above for the park, regional air quality can be affected by oil and gas development and industrial sources in Rapid City, South Dakota.

TABLE 11. SUMMARY OF ESTIMATED ANNUAL EMISSIONS IN WIND CAVE NATIONAL PARK

(all emissions shown in tons)

Source	PM_{10}	SO_2	NOx	CO	VOC
Stationary Point Sources					
Heating Equipment	0.02	0.21	0.16	0.13	<0.01
Generators	0.02	<0.01	0.07	0.02	0.01
Gasoline Storage Tanks	–	–	–	–	0.27
Subtotal	0.02	0.21	0.23	0.15	0.27
Stationary Area Sources					
Campfires	0.06	<0.01	<0.01	0.46	0.42
Prescribed Burning	39.15	–	–	417.95	19.55*
Subtotal	39.21	<0.01	<0.01	418.41	19.97
Mobile Sources					
Road Vehicles	2.23	–	22.06	38.61	2.15
Nonroad Vehicles	0.11	–	0.17	0.16	0.67
Subtotal	2.34	–	11.23	38.77	2.82
TOTAL	**41.47**	**0.21**	**11.46**	**457.33**	**23.06**

Note: * As methane

TABLE 12. REGIONAL EMISSIONS FOR CUSTER COUNTY

(all emissions shown in tons)

	PM_{10}	SO_2	NOx	CO	VOC
Stationary Sources					
Wind Cave National Park	39.23	0.22	0.24	418.56	20.24
Custer County	1996	85	259	7698	938
Mobile Sources					
Wind Cave National Park	2.34	–	11.23	38.77	2.82
Custer County	1320	33	473	1829	199

CULTURAL RESOURCES

Management actions have the potential to result in impacts to both archeological resources (ground disturbance) and ethnographic resources (modification of resources and access to them).

ARCHEOLOGICAL RESOURCES

Archeological resources are described as any material remains or physical evidence of past human life or activities, including the record of the effects of human activities on the environment (NPS 1998). The Black Hills region is located between the Middle Missouri River Valley culture area to the east and the High and Northern Plains culture area to the west. Prehistoric users of the Black Hills and Wind Cave National Park areas were likely attracted to the region because of good hunting opportunities, the presence of good quality stone for tools, and the winter shelter and relatively cool summers it offered. Archeological remains indicate that American Indian use of the area began approximately 11,500 years ago (NPS 2005a).

Less than 20% of the park has been inventoried for archeological resources (Farrell 2006). Seventy-six archeological sites have been identified and mapped within the park including lithic and artifact scatters, tipi rings, quarries, historic farmsteads and wooden remnants. The majority of recorded prehistoric sites are associated with prehistoric subsistence activities (hunting, food preparation, lithic tool production, and camping). Of the 76 recorded sites, four (two bridges, an historic district, and a rock shelter) are listed in the National Register of Historic Places, 13 have been determined eligible (yet to be listed), 38 are potentially eligible, 13 have been determined ineligible, six have not been evaluated, and two have been destroyed (NPS 2004b).

ETHNOGRAPHIC RESOURCES

Ethnographic resources are defined as objects and places, including sites, structures, landscapes, and natural resources, with traditional cultural meaning and value to associated peoples (NPS 1998). Various natural resources within the park were valued historically by tribes affiliated with the park, and continue to occupy a special place within their belief systems and cultural traditions. These include a variety of plants and animals used for subsistence, medicinal and spiritual purposes.

Tipi Ring

A number of American Indian tribes have aboriginal, historical, and cultural ties to the land within the Black Hills, including the Wind Cave National Park area. The Lakotas and Cheyennes have the most well-documented and uninterrupted historical and legal relationship to the Black Hills over the past two centuries. The Arapaho were also connected to the Black Hills under U.S. treaty. Tribes and tribal entities with ties to the park include: Crow Creek Sioux Tribal Council, Ponca Tribe of Oklahoma, Apache Tribe of Oklahoma, Rosebud Sioux Tribal Council, Cheyenne River Sioux Tribe, Three Affiliated Tribes Business Council, Arapaho Business Committee, Lower Brule Sioux Tribal Council, Fort Peck Tribal Executive Board, Standing Rock Sioux Tribal Council, Ponca Tribe of Nebraska, Northern Cheyenne Tribal Council, Cheyenne-Arapaho Tribes of Oklahoma, Santee Sioux Tribal Council, Oglala Sioux Tribal Council, Flandreau Santee Sioux Executive Committee, Kiowa Tribe of Oklahoma, Lower Sioux Indian

Community, Fort Belknap Community Council, Yankton Sioux Tribal Business & Claims Commission, and Sisseton-Wahpeton Sioux Tribal Council (NPS 2005a).

The Black Hills occupy a special place in the history, creation stories, and religious beliefs of many of these groups. American Indian stories tell of a “hole that breathes cool air” near the Buffalo Gap (LaPointe 1976). This “wind” cave was regarded by some as the site of origin, and there are many stories about the role the cave played in American Indian culture. Many common tribal names for the area describe the landscape or special activities associated with the area (Hall 1985; DeMaille 1984; LaPointe 1976).

The area was viewed as a significant resource procurement area. At various times in history, the tribes have referred to the Black Hills euphemistically as a “meat pack” (Hassrick 1964; Utley 1993), “a safe” (Allison 1875), or a “supermarket” (Kadlecek and Kadlecek 1981), as it is a place that contained all of the resources necessary for the life they once depended on. A variety of plant species (such as junipers, sumac, groundcherry, field mint) were important to the inhabitants of the Black Hills area and were used for food, ceremonial/religious, and medicinal purposes (Evans 2005). Bison were considered of exceptional spiritual importance (Parlow 1983; Hall 1997; Walker 1980; Brown 1971; Goodman 1992; Grinnell 1972). Elk meat was an important food for tribes, procured by stalking and surrounding on foot, capturing in rawhide snares, or driving them over cliffs and banks. Elk and other game animals that inhabit the park are seen by some tribes as particularly significant because they live in proximity to their underworld spiritual homes and because they feed on the grounds where the Great Race took place and where their ancestors first emerged on the earth’s surface. Many American Indian stories about the park area involve hunting of large game, primarily in the winter or fall (Kadlecek and Kadlecek 1981; Brown and Willards 1924; Vestal 1934; Hassrick 1964; Grinnell 1972).

Elk hides were highly valued and were often tanned to make moccasins, breechclouts, shirts, leggings, belts, saddle skirts, shield covers, and gowns for everyday wear as well as garments worn on ceremonial occasions. The two ivory canine teeth of the elk were highly prized as they were believed to symbolize longevity (Densmore 1948). Elk horn was used by different tribes for making fleshers to scrape hides (Grinnell 1972; Standing Bear 1975), for flintknapping tools (Curtis 1907-30), and for bows (Grinnell 1972; Marquis and Limbaugh 1973).

Some admired the male elk for its strength, endurance, and courage, but especially for its ability to attract and protect members of the opposite sex. Some tribes associated the elk with manhood and it was a favorite animal for young men to emulate (Wissler 1905; Fire and Erdoes 1972; Walking Bull 1980; Standing Bear 1988; Brown 1992; St. Pierre and Long Soldier 1995; Walking Bull 1980). Many men found spiritual gifts of elk to be of great assistance after dreaming of them (Grinnell 1972) and some performed elk ceremonies of various symbolisms (Wissler 1912; Hoebel 1960).

To some tribes, elk were seen as a strong embodiment of both good and evil, greatly admired for their ability to endure and escape capture; their antlers were considered highly sacred (Grinnell 1972; Whiteman in Schwartz 1988). Antlers were used to create sounds that would transmit over long distances, and were also used as a way to attract game to camp (Dorsey 1905). Special ceremonies, impersonating elk were performed and dances were conducted where elk played an important role (Grinnell 1972; Hoebel 1960).

In addition to elk, ethnographic resources previously identified within the park include those associated with forms of religious practices, including several plant species important to the Cheyenne and Lakota (Evans 2005). In the recent past, certain areas of the park have been used for ceremonial purposes (Farrell 2006).

VISITOR EXPERIENCE

Elk management actions have the potential to affect the visitor experience within the park by way of altering wildlife viewing opportunities and the park's soundscape. In addition, the restriction of backcountry access and leaving elk carcasses in the backcountry may also impact a visitor's park experience.

Wind Cave National Park provides one of numerous recreational opportunities located within the Black Hills of South Dakota, including those available in the Black Hills National Forest immediately to the west and Custer State Park immediately to the north (figure 1). Most visitors to the park are en route to other destinations in the area (NPS 2000a).

Approximately 615,000 recreational visits to Wind Cave National Park occurred in 2005. Recreational visitation rates for 2005 were at their highest (56% of annual visitation) between June and August (average of 116,500 monthly visits) and at their lowest (9% of annual visitation) between November and February (average of 13,100 monthly visits) (table 13).

The park provides a variety of activities for visitors including cave tours, the visitor center/bookstore, hiking, wildlife viewing opportunities, camping, picnicking, scenic driving and interpretive tours/programs (figure 7). Park cave resources include over 127 miles of known cave passages and are the primary reason for park visitation. Depending on the time of year, visitors can choose from one to five cave tours (Garden of Eden, Natural Entrance, Fairgrounds, Candlelight, and Wild). Repeat visitors to the park tend to spend their time enjoying the park's surface features (NPS 2006a).

TABLE 13. WIND CAVE NATIONAL PARK 2005 RECREATIONAL VISITATION NUMBERS BY MONTH

Month	Recreational Visits	NPS Campground Use	Backcountry Use
January	12,430	0	0
February	12,910	3	0
March	20,656	0	0
April	38,703	45	15
May	58,520	440	19
June	92,423	1,225	59
July	135,615	1,708	25
August	121,524	1,553	30
September	69,053	758	42
October	25,951	211	9
November	14,275	20	2
December	12,727	3	0
TOTAL	**614,787**	**5966**	**201**

Visitor opportunities related to elk include short programs offered three nights a week in September. As part of these programs, the ranger leads visitors into the park and listens for "bugling" elk. The visitor center also provides information to visitors regarding optimal places within the park to view/hear elk "bugling" (Farrell 2006).

The park's frontcountry area (visitor center, cave access, campground, and picnic area) comprises about 3.5% of the park area and experiences the highest visitation. Interpretive programs offered include nature walks focused on the natural resources and history of the park. Visitors enjoy wildlife viewing opportunities, particularly those for bison, elk, pronghorn, deer, coyotes and prairie dogs (NPS 2006a). Other activities which visitors mentioned as important to their experience at the park include picnicking and hiking (NPS 1992). Most visitors remain in the park for less than half a day (NPS 1992).

The Elk Mountain Campground contains 75 campsites and sees its highest use during the summer months (figure 7; table 13). Less than 1% of visitors (approximately 6000) stayed overnight in the frontcountry campground in 2005 (table 13).

Park Ranger Interacting with Young Visitors

The park trail system consists of eleven designated trails encompassing about 30 miles, much of which falls within established backcountry (NPS 2000a) (figure 7). Fifty-five percent of survey respondents said that trails and hiking opportunities were "moderately" or "very" important to them (NPS 1992:84).

Visitor use of the park's backcountry area, located in the northwest portion of the park (figure 7), is considerably lower than that of the developed frontcountry (table 13). The majority of backcountry use occurs between June and September of each year. Primary backcountry activities include hiking, cross-country skiing, and horseback riding (permit required). "Dispersed camping" (no formal campsites) in the backcountry is allowed and requires a free permit. In general, the park's goal is to limit backcountry campers to two per square mile per day (26 per day) to minimize encounters between visitors and wildlife. Backcountry camping is limited to a total of seven days for any one park visit (NPS 2000a). Approximately 175 visitors engaged in backcountry camping during 2005. While some winter day use (e.g., hiking) occurs in the backcountry, no overnight use was recorded between December and March of 2005 (table 13).

The park also receives significant non-recreational users (commuters) due to the fact that two major transportation routes (US 385 and SD 87) are partially located within its boundaries (figure 7). Other non-recreational users include those using easements within the park to access their private property outside the park, people operating businesses within the park, those attending public meetings and other incidental uses (NPS 1994b).

The natural soundscape of a park, and visitors' appreciation of it, is addressed here as a component of the general visitor experience. Natural soundscapes include all natural sounds that occur within and beyond the range of sounds that humans can perceive. The NPS strives to preserve, to the greatest extent possible, the natural soundscapes of parks (NPS 2006d, sec. 4.9). Components of natural soundscape include such things as sounds produced by animals (birds, frogs, prairie dogs, elk, bison, bats, deer, etc.) and those produced by physical process (wind, water, etc.). The natural soundscape is considered the baseline condition against which current conditions are measured and evaluated.

While no studies specific to the park's natural soundscape are available, a 1992 survey indicated that 74% of respondents believed the park was a place where natural systems should be allowed to exist without the interference of humans (NPS 1992:63). Known sources of human-produced noise which can intrude on the park's natural soundscape include vehicular noise on adjacent lands and along road corridors located within the park (such as US 385, SD 87, and NPS access roads); firearms use related to annual (fall) state-managed hunts on lands surrounding the park; air traffic related to park ungulate (elk, bison) management activities (e.g., wildlife surveys and roundups) and fire management activities; use of the park's firing range (located approximately one mile east of the park headquarters/visitor center, in Wind Cave Canyon), and private/commercial aircraft overflights. When compared to the backcountry, the park's developed area (visitor center, cave access, staff offices/residences, etc. [figure 7]) experiences higher noise levels as a result of, among other things, the elevated/concentrated human activity, and the concentrated vehicular traffic and mechanized noise associated with visitation and park operations (maintenance, visitor services, etc.).

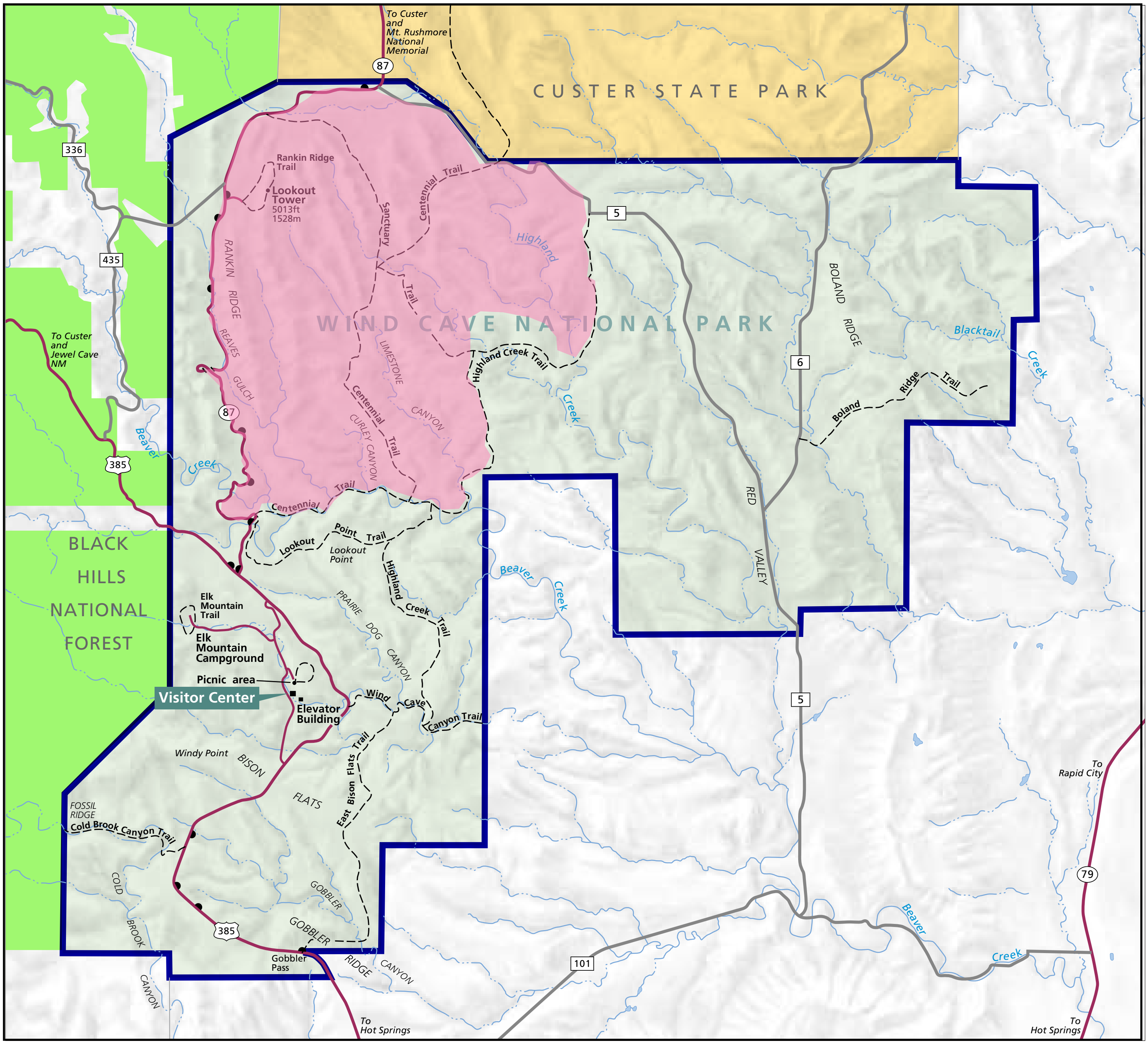


Figure 7. Wind Cave National Park Map Indicating Backcountry Areas (overnight camping)

Legend

Roads / Highways	Park Boundary
Pullout	Overnight Camping
Unpaved Road	State Park
Trails	Forest Service
Streams	

N

0 1 2 Kilometers

0 1 2 Miles

SOCIOECONOMICS

The socioeconomics analysis examines the social and economic factors that impact the broader region surrounding the Wind Cave National Park. This section focuses on the baseline indicators describing the affected socioeconomic environment.

Wind Cave National Park is located in southwestern South Dakota. This rural region features an abundance of outdoor attractions including Custer State Park, Black Hills National Forest, Mount Rushmore National Memorial, and Badlands National Park. Wind Cave National Park is located within the southern half of Custer County and is adjacent to Fall River County. The two principal gateway communities to the park are Hot Springs (Fall River County) located six miles south and the town of Custer (Custer County) about 20 miles to the north (figure 1).

Elk management policies at Wind Cave National Park could change the elk migration and population inside and outside the park boundaries. These changes could impact tourism and recreation, hunting, and state run programs addressing elk impacts on private land in the region. This information is provided as background for the analysis of potential impacts in the context of the two county regions of Custer and Fall River.

This section begins with an overview of the demographic and economic characteristics of the two counties. This summary examines the key drivers of employment and income in these counties, and evaluates the special role of tourism and recreation, hunting, and state programs to address wildlife depredation impacts.

DEMOGRAPHIC AND ECONOMIC OVERVIEW

The current populations in Custer County and Fall River County are similar in size with 7,904 and 7,355 people, respectively (table 14). Over the past 15 years Custer County population has grown 27.9% from 1990 to 2005, while the population in Fall River County has remained nearly constant over the same period. By comparison, the population growth from 1990 to 2005 in South Dakota and the United States was 11.5% and 19.2%, respectively (U.S. Census Bureau 2006).

The largest communities in Custer County are the towns of Custer and Hermosa with populations of 1,860 and 315, respectively. In Fall River County, the largest towns are Hot Springs and Edgemont with 4,129 and 867 residents, respectively (U.S. Census 2000).

Custer County and Fall River County have relatively older populations than South Dakota or the United States. The median age in Custer County is 43.2 years and the Fall River County median age is 45.5 years. The median age for South Dakota and the United States is 35.6 years and 35.3 years, respectively.

The racial makeup in both Custer County and Fall River County is over 90% white, 3%–6% American Indian, and a smaller percentage of Hispanic, Black and Asian. Educational attainment for the two counties is on par with South Dakota and national rates for high school graduates and college graduates. Median household income for Custer County is $39,743, or about 30% higher than the $30,248 median household income in Fall River County. South Dakota’s median household income is $38,008 (U.S. Census 2000).

TABLE 14. DEMOGRAPHIC AND ECONOMIC PROFILE

	Custer County	Fall River County	South Dakota	United States
Population, 2005 estimate	7,904	7,355	775,933	296,410,404
Population, 2000	7,275	7,453	754,844	281,421,906
Population, 1990	6,179	7,353	696,004	248,709,873
Population, % change, 1990 to 2005	27.9%	0.0%	11.5%	19.2%
Population, % change, 2000 to 2005	8.6%	-1.3%	2.8%	5.3%
Population, % change, 1990 to 2000	17.7%	1.4%	8.5%	13.2%
Median Age, 2000	43.2	45.5	35.6	35.3
Persons under 5 years old, %, 2004	4.40%	4.3%	6.7%	6.8%
Persons under 18 years old, %, 2004	20.00%	19.8%	24.8%	25.0%
Persons 65 years old and over, %, 2004	16.80%	23.7%	14.2%	12.4%
White, %, 2004	94.9%	91.1%	88.7%	80.4%
American Indian and Alaskan Native, %, 2004	3.2%	5.9%	8.6%	1.0%
Hispanic or Latino origin, %, 2004	1.5%	2.0%	2.0%	14.1%
Black, %, 2004	0.2%	0.4%	0.8%	12.8%
Asian, %, 2004	0.1%	0.3%	0.7%	4.2%
High school graduates, % persons age 25+, 2000	88.9%	82.5%	84.6%	80.4%
Bachelor’s degree, % persons age 25+, 2000	24.4%	19.2%	21.5%	24.4%
Households, 2000	2,970	3,127	290,245	105,480,101
Persons per household, 2000	2.35	2.23	2.50	2.59
Median household income, 2003	$39,743	$30,248	$38,008	$43,318
Persons below poverty, %, 2003	9.9%	14.1%	12.4%	12.5%
Housing units, 2004	3,985	3,930	342,620	122,671,734
Homeownership rate, 2000	77.0%	69.7%	68.2%	66.2%
Housing units in multi-unit structures, %, 2000	7.2%	14.9%	18.9%	26.4%
Median value of owner-occupied housing units, 2000	$89,100	$54,300	$79,600	$199,600

Source: U.S. Census Bureau 2006

INCOME AND EMPLOYMENT

In 2004, per capita personal income in Custer County and Fall River County was $26,840 and $24,938, respectively. The corresponding level in South Dakota is $30,209 and for the nation it is $33,050 (table 15) (Bureau of Economic Analysis 2006).

Personal income consists of work income and non-work income (retirement income, dividends, interest, rent). Non-work income accounts for about 45% of the personal income in the two counties. In Custer and Fall River Counties, income from work accounts for just over half of total personal income.

Average annual earnings per job are considerably higher in Fall River County at $33,649 compared to average earnings in Custer County at $19,297. The annual unemployment rate over the past five years has ranged from 3.3% to 3.9% in Custer County and 3.5% to 4.5% in Fall River County.

Employment and income by industry sector at the county level are presented in table 16. The tourism-based sector of the economy is derived by aggregating three distinct sectors in which data is available: retail trade; arts, entertainment and recreation; and accommodation and food services. The Custer County tourism-based sector provides 1,446 jobs which amounts to 27.4% of total employment in the county. The Fall River tourism-based sector generates 839 jobs which accounts for 15.9% of total employment in that county.

TABLE 15. INCOME PROFILE, 2004

	Custer County		Fall River County		South Dakota		United States	
	Number	%	Number	%	Number	%	Number	%
Per capita personal income	26,840	100.0%	24,938	100.0%	30,209	100.0%	33,050	100.0%
Per capita net earnings	15,225	56.7%	13,281	53.3%	19,662	65.1%	22,978	69.5%
Per capita transfer receipts:	4,521	16.8%	6,308	25.3%	4,331	14.3%	4,863	14.7%
Income maintenance	265	1.0%	372	1.5%	342	1.1%	482	1.5%
Unemployment insurance	72	0.3%	50	0.2%	43	0.1%	126	0.4%
Retirement and Other	4,185	15.6%	5,887	23.6%	3,947	13.1%	4,255	12.9%
Per capita dividends, interest, and rent	7,094	26.4%	5,348	21.4%	6,215	20.6%	5,209	15.8%

Source: Bureau of Economic Analysis 2006

TABLE 16. EMPLOYMENT BY INDUSTRY, 2004

Employment by Industry, 2004				
	Custer County		Fall River County	
	Number	%	Number	%
Agriculture, forestry, fishing	465	8.8%	360	10.2%
Mining	64	1.2%	21	0.6%
Construction	434	8.2%	137	3.9%
Manufacturing	115	2.2%	39	1.1%

Employment by Industry, 2004				
	Custer County		Fall River County	
	Number	%	Number	%
Retail trade	594	11.3%	404	11.4%
Transportation and warehousing	122	2.3%	231	6.5%
Finance and insurance	91	1.7%	61	1.7%
Real estate and rental and leasing	262	5.0%	35	1.0%
Administrative and waste services	197	3.7%	78	2.2%
Arts, entertainment, and recreation	180	3.4%	89	2.5%
Accommodation and food services	672	12.7%	346	9.8%
Sectors not disclosed and other**	1,235	23.4%	637	18.0%
Government	840	15.9%	1,101	31.1%
Total	**5,271**	**100.0%**	**3,539**	**100.0%**
Tourism-related sector*	1,446	27.4%	839	15.9%
Income by Industry, 2004				
	Custer County		Fall River County	
	($1000)	Percent	($1000)	Percent
Agriculture, forestry, fishing	963	1.2%	1,781	1.7%
Mining	1,381	1.7%	322	0.3%
Construction	3,950	4.9%	2,332	2.2%
Manufacturing	576	0.7%	822	0.8%
Retail trade	6,040	7.5%	6,648	6.3%
Transportation and warehousing	593	0.7%	17,570	16.6%
Finance and insurance	1,520	1.9%	1,828	1.7%
Real estate and rental and leasing	216	0.3%	227	0.2%
Administrative and waste services	1,192	1.5%	796	0.8%
Arts, entertainment, and recreation	1,587	2.0%	1,120	1.1%
Accommodation and food services	7,372	9.2%	3,358	3.2%
Sectors not disclosed and other**	16,714	20.9%	13,911	13.1%
Government	37,982	47.4%	55,196	52.1%
Total	**80,086**	**100.0%**	**105,911**	**100.0%**
Tourism-related sector*	14,999	18.7%	11,126	13.9%

Notes:

*Tourism-related sector includes three areas: retail trade; arts, entertainment, and recreation; and accommodation and food services.

** Sectors not disclosed because of confidential information restrictions are: utilities; whole sale trade; information; professional and technical services; management of companies and enterprises; educational services; health care and social assistance; other services.

Source: Bureau of Economic Analysis 2006, U.S. Department of Commerce, Regional Economic Accounts, Local Area Personal Income, CA25 Total full-time and part-time employment by industry, Custer, SD and Fall River, SD, 2006. http://www.bea.gov/bea/regional/reis/

Table 16 also displays the contributions to income by industry sector. In Custer County, the tourism based-sector generates nearly $15 million of income which accounts for 18.7% of total income in the county. In Fall River County, the tourism-based sector produces over $11 million of income and that equates to 13.9% of the total income in the county.

Government is another important sector in the regional economy. The combined federal, state and local government contributes about 15% to 30% of the jobs and about 50% of the income to the economies of Custer County and Fall River County.

Table 17 presents the top ten employers for Custer County and Fall River County.

TABLE 17. LEADING EMPLOYERS BY COUNTY

Leading Employers by County				
	Company	Sector	Employees	City/Town
	Custer County			
1	Black Hills National Forest	Government-Federal	583	Custer
2	Custer School District	Government-Local	183	Custer
3	Custer Regional Hospital	Health Care	116	Custer
4	Custer Regional Senior Care	Health Care	100	Custer
5	Custer County	Government-Local	74	Custer
6	Crazy Horse Memorial	Entertainment	60	Custer
7	Lynn's Dakota Mart	Retail	35	Custer
8	Jorgensen Log Homes	Construction	34	Custer
9	Pacer Corporation	Mining	33	Custer
10	Custer State Park	Government-State	30	Custer
	Fall River County			
1	VA Medical Center	Health Care	402	Hot Springs
2	Castle Manor Nursing Home	Health Care	140	Hot Springs
3	Hot Springs School	Government-Local	125	Hot Springs
4	State Veterans Home	Health Care	106	Hot Springs
5	Wind Cave Park*	Government-Federal	100	Hot Springs
6	Edgemont School District	Government-Local	47	Edgemont
7	Lynn's Dakota Mart	Retail	43	Hot Springs
8	Black Hills Special Services	Service	36	Hot Springs
9	Pamida	Retail	35	Hot Springs
10	Maverick Junction	Retail	33	Hot Springs

Source: South Dakota County Profiles, Custer County, Fall River County, 2009.
http://www.sdreadytowork.com/CountyProfileReport/Profiles.aspx
*Although Wind Cave National Park is located in Custer County, its mailing address is in Hot Springs, hence its listing in Fall River County.

CONTRIBUTION OF WIND CAVE NATIONAL PARK TO THE LOCAL ECONOMY

Wind Cave National Park contributes to the local economy by providing jobs to park employees who live in the area and through visitor spending in the local economy. The economic impact of the NPS payroll is a function of the number of jobs, salaries and benefits associated with the park employees. Additionally, Wind Cave National Park attracts thousands of visitors every year to the region who make expenditures in retail stores, restaurants, hotels and other businesses. The economic impact of visitor spending on the local economy depends on the number of visitors and the spending characteristics of those visitors.

This analysis draws upon a comprehensive assessment of payroll impacts and visitor spending at 360 national park system units in a report by Daniel J. Stynes of Michigan State University for the NPS Social Science Program (Stynes 2006). Stynes and other economic researchers used the Money Generation Model version 2 (MGM2) to derive visitor spending impacts at national park system units. (The Money Generation Model (MGM) was originally developed by Ken Hornback. In 2001, Daniel Stynes and Dennis Propst of Michigan State University created a revised version of the model called MGM2. The MGM2 uses a set of Microsoft Excel workbooks to estimate the economic impacts of visitation on local economies located near national parks.)

The MGM2 model provides estimates of visitor spending based upon surveys of visitors that are disaggregated into distinct categories (local day trips, non-local day trips, motel visitors, and camping visitors) and the spending habits of visitors in each category. These surveys provide information on average spending per visit on categories of spending such as motels, camping fees, restaurants, groceries, gasoline and other items. The detailed information about total visits, visitor profiles, and spending habits provides the basis to calculate total spending by visitors to a given national park system units. Spending levels will vary among the different national park system units based on the variation of visitor profiles and spending characteristics of those visitors. For national park system units that do not have detailed visitor spending information, the MGM2 model relies upon averages that are adjusted to capture differences among different types of units (e.g., parks, parkways, recreation areas, historic sites and monuments), different regions with high or low spending characteristics, and certain unique spending factors.

For a given level of visitor spending, the MGM2 model derives the direct and secondary economic impacts on jobs, personal income, and value added. Jobs are defined as including full-time and part-time jobs. The seasonal part-time jobs are converted to an annual basis. Value added is defined by the sum of personal income, profits, rents, and indirect business taxes.

The economic impacts of visitor spending and park payrolls are derived from multiplier mechanisms in the local economy around a park. The specific multiplier parameters used in the MGM2 model were estimated with the IMPLAN regional model for four regions that vary by population size and economic development. The local region in the MGM2 model is generically defined as a 50-mile radius around a park. The 50-mile radius represents a general average of the primary impact region surrounding most parks.

National Park Service Payroll Impacts

The NPS is one of the leading employers in the local economy surrounding Wind Cave National Park. In fiscal year 2005, the NPS provided 61 jobs at Wind Cave National Park. The total park payroll amounted to $2.36 million in salary and $661,000 in benefits.

The NPS employees from Wind Cave National Park spend a portion of their earnings on goods and services within the local economy that induces subsequent rounds of additional spending, income and jobs in the region. The NPS payroll earnings provide an injection to the local economy that has a multiplier effect on overall economic activity in the region. The estimated impact of the NPS payroll from the 61 jobs at Wind Cave National Park adds 28 additional induced jobs for a total of 89 jobs in the local economy. The impact of the NPS payroll raises personal income by $3.71 million and contributes $4.19 million of value added to the local economy.

Visitor Spending Impacts

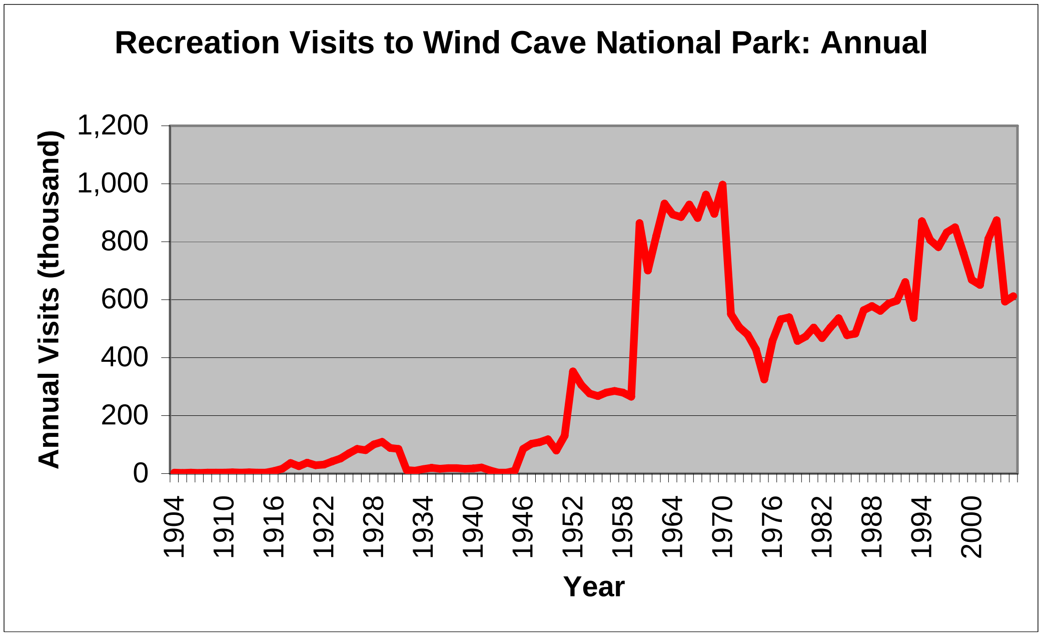
Over the past 10 years, the number of recreation visits to Wind Cave National Park has fluctuated between 600,000 to 800,000 visitors each year. See figure 8 for annual recreation visits from 1904 to 2005. During the 1960s, recreation visits reached an all time high near one million. After a drop in the mid-1970s, annual visits have grown over time to the current range of visits today.

Recreation visits to the park exhibit a fairly consistent seasonal fluctuation as depicted in figure 9. Recreation visits peak in mid-summer to about 150,000 to 200,000 visitors per month, and then taper off in the fall. Visits reach their lowest level during the winter around 10,000 per month and then begin to pick up again in the spring.

The economic impacts of visitor spending linked to Wind Cave National Park were evaluated using the MGM2 model for the year 2005. Public use data shows that there were 615,757 recreation visits in 2005. Of the total visits, 6,019 consisted of overnight visits.

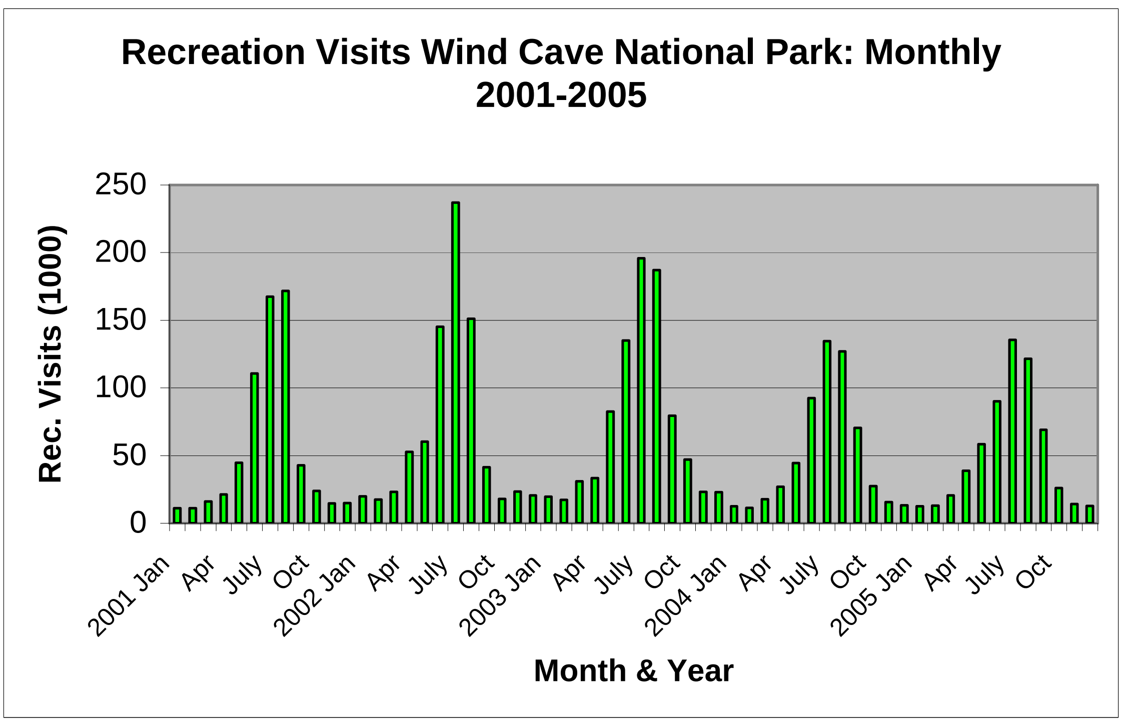
For 2005, the MGM2 model estimates that recreation visits to Wind Cave National Park generated $39.8 million of spending from non-local visitors in the local economy.

The MGM2 model uses a county-based economic model to estimate the direct and secondary impacts of visitor spending in the local economy. Visitor spending has multiplier effects that generate additional spending in the local economy. In 2005, visitor spending from Wind Cave National Park contributed nearly $16.5 million in personal income, $26.1 million in value added, and 894 jobs to the local economy.



Source: NPS 2006k

FIGURE 8. RECREATION VISITS TO WIND CAVE NATIONAL PARK: ANNUAL



Source: NPS 2006k

FIGURE 9. RECREATION VISITS, WIND CAVE NATIONAL PARK: MONTHLY 2001 – 2005

HUNTING AND WILDLIFE-WATCHING IMPACTS ON THE LOCAL ECONOMY

Hunting and wildlife-watching activities are popular activities in South Dakota with important economic impacts. Recreational uses of lands adjacent to the park are interspersed with agricultural interests. In particular, these lands are heavily used for hunting and wildlife viewing activities. Wildlife viewing is of particular interest during the rut (typically from mid-August to November) when bull elk are "bugling."

In 2004, the South Dakota had 128,000 resident licensed hunters or about 20% of the state population aged 12 years and older (SDGFP 2006c). Hunting expenditures in South Dakota by residents and nonresidents in this same year were estimated to be $275 million. Approximately 360,000 residents and nonresidents participate in wildlife-watching activities in South Dakota and spend an estimated $92 million annually (based on a 2001 survey; USFWS 2003).

Elk hunting is one of the premier big game activities in South Dakota. South Dakota's wild elk herds are located in the Black Hills region and on the prairie in the counties of Butte, Bennett and Gregory. The SDGFP manages all elk hunting within the state in accordance with the habitat capacity and landowner tolerance. Elk hunting is restricted to state residents and all tags available are sold in any given year (SDGFP 2006d). Table 18 summarizes the amount of elk hunting applications, licenses, harvests and average days hunted in these regions and across the state for 2005.

TABLE 18. ELK HUNTING IN SOUTH DAKOTA, 2005

	Applications	Licenses	Harvests	Average Days Hunted
Archery Elk	2,844	267	56	10.10
Black Hills - Firearms	14,687	2,670	1,395	6.04
Prairie - Firearms	1,432	89	42	6.20
Custer State Park - Firearms	15,021	188	129	3.21
Custer State Park - Archery	3,964	57	9	8.63
Total	**35,104**	**3,004**	**1,575**	

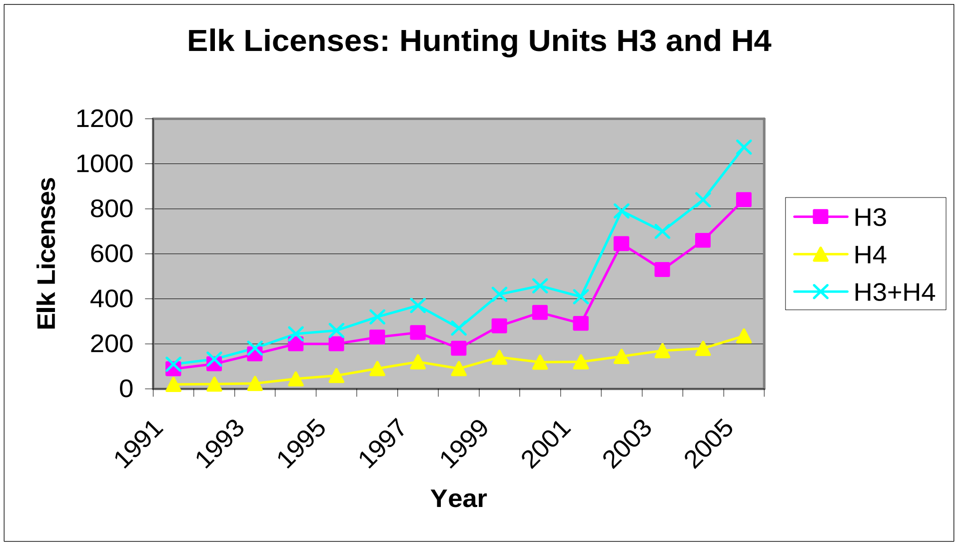
Source: SDGFP 2005

National Park Service policy prohibits hunting within Wind Cave National Park. The elk using Wind Cave, however, may move outside the park boundaries and become hunted during elk season. Elk moving out of Wind Cave National Park to the west and southwest enter state hunting unit H3. Elk migrating to the east and southeast enter state hunting unit H4. Elk exiting Wind Cave National Park and moving to the north enter Custer State Park. In 2005, hunting activity in Custer State Park featured 245 total elk licenses issued (firearm and archery) and 138 total elk harvested.

Elk hunting in units H3 and H4 represents a significant portion of total elk hunting in the Black Hills region and the state. In 2005, the South Dakota Game Fish and Parks reported 426 elk harvests from hunting units H3 and H4. Given a total state harvest of 1,575 elk, the combined harvests of hunting units H3 and H4 account for more than a quarter of the total state harvest.

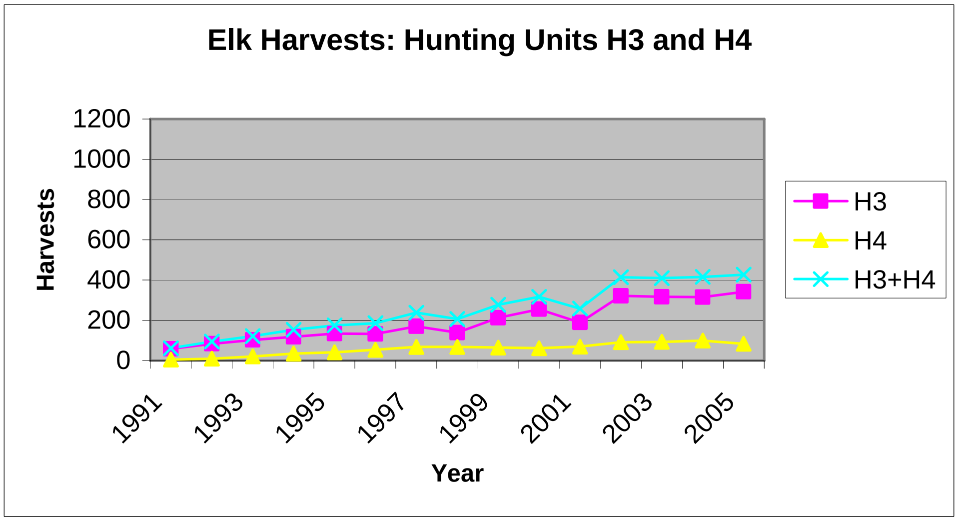
Hunting activity has increased over the past 15 years in hunting units H3 and H4. The number of elk licenses issued in the two units increased from 109 in 1991 to 1,075 in 2005 (figure 10). Total elk harvests in hunting units H3 and H4 increased from 62 in 1991 to 426 in 2005 (figure 11).

The local impacts of hunting in units H3 and H4 are significant. In 2005, approximately 1,075 hunters spent an average of 6.08 days hunting in units H3 and H4, for a total of 6,532 total hunting days (SDGFP 2005). Given average trip expenditure per hunter day in South Dakota is $47, the total trip expenditures for elk hunting in units H3 and H4 was $307,004 in 2005.



Source: data from Halseth 2006

FIGURE 10. ELK LICENSES: HUNTING UNITS H3 AND H4



Source: data from Halseth 2006

FIGURE 11. ELK HARVESTS: HUNTING UNITS H3 AND H4

STATE PROGRAMS TO ADDRESS ELK IMPACTS ON PRIVATE LAND

Wildlife impacts on private lands have become a growing issue in South Dakota over the past decade. The SDGFP responded with a series of programs that attempt to address wildlife depredation on private land throughout the state. These new programs have been funded from hunting license revenue and a five-dollar surcharge on big game license applications.

In 2003, complaints about elk impacts (damage to fencing, agricultural crops, etc.) to private land near Wind Cave National Park prompted the SDGFP to increase funding to programs in the designated area called the elk emphasis area. In figure 12, the red line denotes the elk emphasis area (EEA) boundary.

The vast majority of private land east, west, and south of the park is in agricultural use. In addition, some private inholdings within USFS land west of the park are also used for agricultural purposes. The primary crops on these agricultural lands are grass or hayed grass (cultivated and/or native). Other crops include alfalfa and, to a smaller degree, small grains such as oats, millet and sorghum (Kintigh 2007). Some private landowners involved in agriculture are eligible for state wildlife depredation programs.

The SDGFP coordinates program implementation with the Southern Hills Elk Partnership Committee, which includes private landowners, Custer State Park, Wind Cave National Park, USFS, Rocky Mountain Elk Foundation, Natural Resource Conservation Service, and South Dakota Resource Conservation and Forestry.

In 2006, the SDGFP operated five distinct programs to mitigate or offset the adverse impacts in the elk emphasis area. Elk hunting access agreements enable private landowners to lease their land for elk hunting purposes. In 2006, the SDGFP contracted with nine landowners for elk hunting access agreements that covered 18,480 acres of land in the elk emphasis area. Elk harvests on these leased private lands were 92 in 2005, and 299 since 2003 (Mann 2006).

Hayland contracts are designed to mitigate damages to hay fields used by elk. Most of this hay is harvested by the contracted landowners for winter feed or cow and calf operations. The SDGFP entered into seven hayland contracts in 2006 that covered 783 acres in the elk emphasis area (Mann 2006).

Food plot contracts serve to compensate landowners for elk grazing and destruction of crops such as alfalfa and hay during the summer season. On lands in the Black Hills and outside the elk emphasis area, the SDGFP contracts to pay landowners up to 33% of the cropland area up to a maximum of $3,000 per landowner. For food plot contracts in the elk emphasis area, landowners can receive up to 50% compensation on the contracted acres up to a maximum of $5,000 per landowner. In 2006, there were 13 food plot contracts in the elk emphasis area extending over 1,485 acres (Mann 2006).

Cable contracts help protect fences on private lands. The SDGFP pays landowners to install cable on the top of a fence to protect the lower areas of a fence. In 2006, two cable contracts enable 5,280 feet of cable to be installed on fences in the elk emphasis area. Stackyard contracts create protected storage area for feed. The SDGFP entered a stackyard agreement with one landowner for 2006 (Mann 2006).

In total for 2006, the SDGFP entered into 32 contracts that encompass over 20,000 acres in the elk emphasis area. Total cost for these five programs in 2006 was $72,886. Table 19 summarizes the types and costs of elk depredation projects in the elk emphasis area.

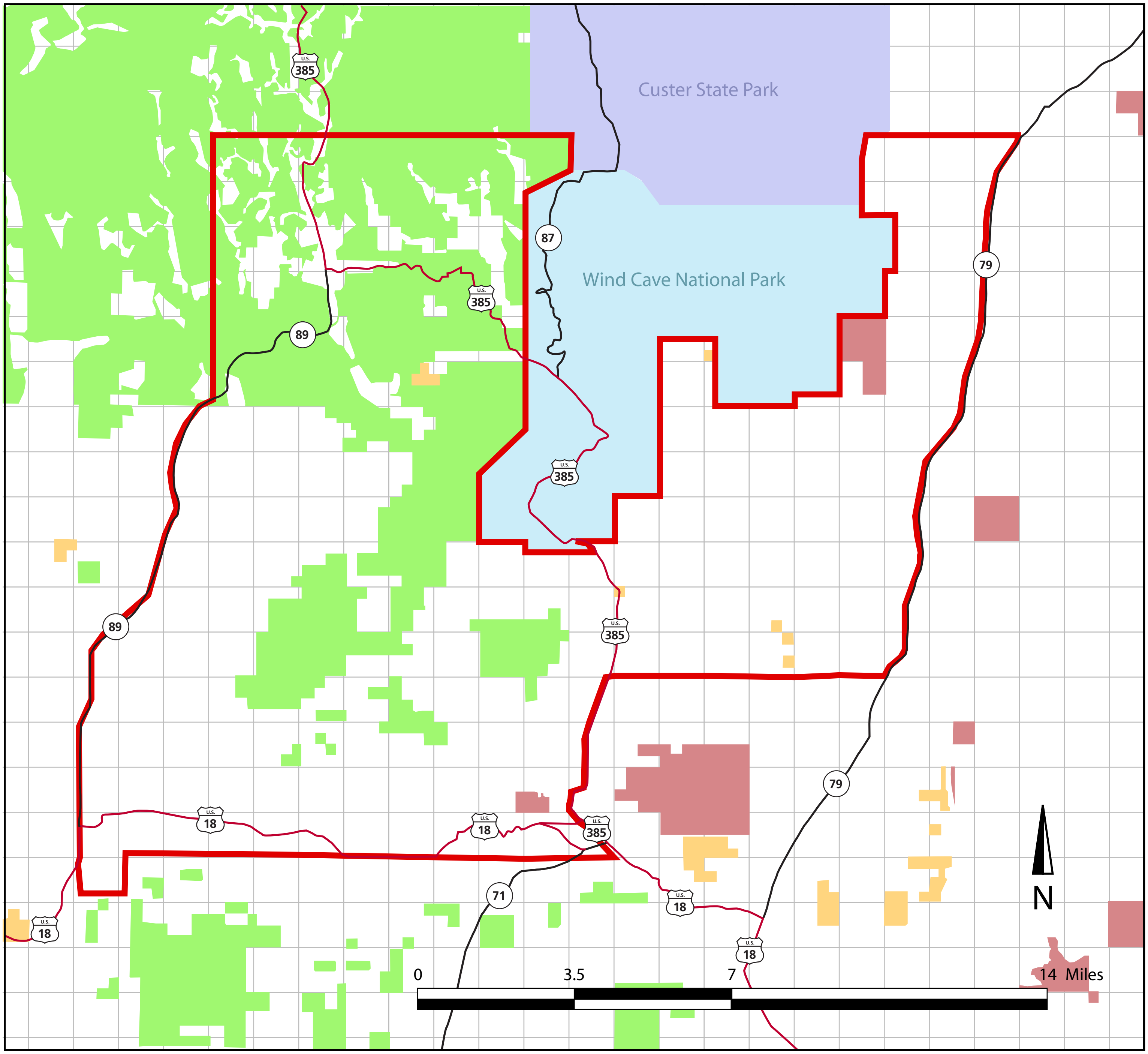


Figure 12. South Dakota Department of Game, Fish and Parks Elk Emphasis Areas

Legend

Elk Management Emphasis Unit	State Lands
Bureau of Land Management	Other
National Park Service	U.S. Highway
U.S. Forest Service	State Highway
State Park	

TABLE 19. SOUTH DAKOTA DEPARTMENT OF GAME, FISH AND PARKS LANDOWNER PROGRAMS, 2006

	Number of contracts	Contract coverage	units	Cost
Elk Hunting Access Agreements	9	18,480	acres	$20,947
Hayland Contracts	7	783	acres	$7,090
Food Plot Contracts	13	1,485	acres	$40,701
Cable Contracts	2	5,280	feet	$1,848
Stackyards	1			$2,300
Total	**32**			**$72,886**

Source: Mann 2006

PARK OPERATIONS

“Park operations” refers to the ability of the park to adequately protect and preserve important park resources given current funding/staffing levels. Its focus is the provision of an effective visitor experience. The park currently has 41 full-time and a variable number of part-time, seasonal employees. Five staffing divisions work to accomplish management goals within the park, including Resource Management, Maintenance/Facilities, Administration, Interpretation, and Law Enforcement. All divisions could be affected by proposed elk management actions.

The Division of Resource Management includes eight full-time and a variety of seasonal employees responsible for, among other things, general wildlife management activities; biological monitoring; vegetation management; and coordination with the SDGFP and USFS regarding elk management and CWD issues. The division currently conducts annual elk population counts (ground and aerial surveys) and targeted surveillance to identify/remove animals that exhibit clinical signs of CWD. The division is also responsible for research activities (e.g., maintenance/monitoring of vegetation exclosures, elk GPS tracking efforts, etc.) which may or may not continue, depending on funding. The division would be involved in the coordination and management of all elk management actions.

The Division of Interpretation included three full-time and 18 seasonal positions in 2005. Several volunteers and interns are also utilized. Division employees are responsible for, among other things, public outreach/education, park resource interpretive materials and programs, the park newspaper published each spring, park website management, media relations, cultural resource management, and volunteer coordination. The division regularly provides educational information on elk and their management including a 20-minute talk and an evening program during the summer of 2006. Each September, the division provides a short program on elk three nights a week, prior to leading visitors into the park to view and listen for elk “bugling”. Information on best places to hear elk “bugling” is provided at the visitor center and elk management issues are covered in the park newspaper and on the park website. This division could be involved in a variety of elk management efforts, including education and interpretive efforts related to elk management activities.

The Division of Resource and Visitor Protection includes five full-time and eight seasonal employees and is responsible for, among other things, the protection of park visitors and resources (including dispatching of elk which exhibit clinical signs of CWD); management of backcountry use, frontcountry roads, and campgrounds; physical security of all facilities; structural and wildland fire protection; search and rescue; and emergency medical services. Law enforcement rangers working within this division are commissioned officers who police the park and could be involved in a variety of elk management efforts, including firearms use, backcountry closures, etc.

The Division of Maintenance includes eight full-time and approximately five part-time employees responsible for, among other things, the maintenance of park facilities (plumbing, painting, carpentry, and electrical), vehicles and roads; snow removal within the park's developed area and along US 385 and SD 87; maintenance of park structures (residential and public) and campgrounds; maintenance of utility systems; maintenance and repair of the park wildlife handling facility and wildlife boundary fence; and trail maintenance and construction. The division is also responsible for coordination of all new development and construction within the park. This division could potentially be involved in several elk management actions (e.g., increase in fence height, installation of gates, corral modifications, carcass disposal).

The Division of Administration is comprised of one contracting officer who is responsible for all aspects of contracting for the park. Because much of the contracting effort occurs within the Resource Management division, the Administration division has ultimate oversight for contract management.

HUMAN HEALTH AND SAFETY

The health and safety of visitors and park staff, volunteers, and partners is of paramount concern to the NPS. The NPS *Management Policies 2006* summarize the commitment of the NPS to provide a safe working environment for employees by safeguarding human life and ensuring that all employees are trained and informed on how to do their jobs safely (NPS 2006d, sec. 1.9.1.4).

In fiscal year 2007, the park staff experienced a total of 11 employee-related incidents, three of which resulted in no lost time or medical expenses. Types of incidents vary by occupation with fire and maintenance activities tending to have higher rates of incidents. Injuries/accidents are typically not serious or life-threatening. In 2006, incidents included a tick bite, an eye abrasion, foreign object (slag) in eye, a cut cheek, two ankle sprains, a foot strain, a crushed hand, an aggravated knee injury, and punctured fingers (Stewart 2007).

The park experienced two helicopter accidents in the 1980s, both of which were associated with bison roundup activities. The first accident (early to mid-1980s) occurred in the general vicinity of the wildlife corral area in the northern extent of the park. As the contractor pilot maneuvered bison into the corral, the helicopter made contact with corral fence posts, knocking the cap off the main rotor of the helicopter. The pilot was able to safely set the helicopter down, make a field repair, and return to his headquarters. No staff or contractors were injured (Dahlberg 2007).

In the late 1980s, a second accident involving a contractor's helicopter occurred, again in the general vicinity of the wildlife corral. The helicopter malfunctioned as it lifted off with the contractor pilot and a staff member, ultimately coming to rest on its side on the ground. The park staff member sustained permanent injuries to his leg/hip; the pilot was not injured. The accident was deemed a result of the manufacturer's error in the rebuilding of the helicopter's main rotor (Dahlberg 2007).

Environmental Consequences

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

The National Environmental Policy Act requires the disclosure of environmental effects of proposed federal actions and any adverse environmental effects that cannot be avoided should the preferred alternative be implemented. This chapter analyzes both beneficial and adverse impacts that would result from implementing any of the six alternatives described in this plan/EIS. In addition, this chapter includes a summary of laws and policies relevant to each impact topic, definitions of impact “thresholds” (negligible, minor, moderate, major), methods used to analyze impacts, and the analysis methods used for determining cumulative effects. As required by the CEQ regulations implementing NEPA, a summary of the environmental consequences for each alternative is provided in table 6 (see the “Alternatives” chapter). The resource topics presented in this chapter and the organization of the topics correspond to those presented in the “Affected Environment” chapter.

SUMMARY OF LAWS AND POLICIES

Three overarching environmental protection policy and laws guide the actions of the NPS in the management of the parks and their resources—the NPS *Organic Act*; the *National Environmental Policy Act*, and its implementing regulations; and the *National Parks Omnibus Management Act*. These statutes are described in brief below. These statutes are described briefly below.

The NPS *Organic Act of 1916* (16 USC 1) commits the NPS to making informed decisions that perpetuate the conservation and protection of park resources unimpaired for the benefit and enjoyment of future generations. The *National Environmental Policy Act of 1969* is implemented through regulations of the Council on Environmental Quality (CEQ) (40 CFR 1500–1508). The NPS has, in turn, adopted procedures to comply with NEPA and CEQ regulations as found in *Director’s Order 12: Conservation Planning, Environmental Impact Analysis, and Decision-making* (NPS 2001a), and its accompanying handbook. The *National Parks Omnibus Management Act* (Omnibus Act, 16 USC 5901 et seq.) underscores the *National Environmental Policy Act* in that both are fundamental to park management decisions. Both acts provide direction for connecting resource management decisions to the analysis of impacts, and communicating the impacts of these decisions to the public through the use of appropriate technical and scientific information. Collectively, these guiding laws provide a framework and process for evaluating the impacts of the proposed alternatives for elk management actions within Wind Cave National Park.

GENERAL METHODOLOGY FOR RESOURCE IMPACT ANALYSIS

The general approach for analysis of effects to affected park resources includes the following, described further below:

- general descriptions of the analysis methods as described in guiding regulations for specific resources,
- clarification of basic assumptions used to formulate the specific methods used in this analysis,
- definitions of thresholds used to define the level of impact resulting from alternatives,
- definitions of methods used to evaluate the cumulative effects of each alternative in combination with unrelated factors or actions affecting park resources, and
- definitions of methods and thresholds used to determine if impairment of specific resources would occur under any alternative.

GENERAL ANALYSIS METHODS

The analysis of impacts follows CEQ guidelines and Director's Order 12 procedures. This includes the application of results of scientific research related to elk management which has been conducted in Wind Cave National Park. It also includes the use of other best available scientific literature applicable to the region and setting, the resources being evaluated, and the actions being considered in the alternatives. Substantial elk management research has been conducted in the park and Black Hills region designed to answer many of the key questions of impacts on the park's (and region's) resources and how best to address them (see history of elk management section in the "Purpose of and Need for Action" chapter).

As part of the impact analysis, the park created an interdisciplinary Science Team comprised of representatives from the park, regional and Washington D.C. NPS offices, other interested federal agencies (USFS, USGS), the State of South Dakota (SDGFP, Custer State Park), and contractors (Total Quality NEPA, URS) to assist the park with collection, evaluation and interpretation of fundamental scientific data. The Science Team convened for four months to develop goals for the management plan and to provide initial assessments of the viability of various means of accomplishing those goals. Topics addressed by the team included elk population goals, reduction and maintenance methods, monitoring, action thresholds, and adaptive management (refer to the "Alternatives Development Process" section in the "Alternatives" chapter). The core team of park and contracted staff met periodically throughout the process to discuss the scope of the analysis, to review thresholds and methodologies, to refine alternatives, to conduct and review the analysis of impacts, and to complete the preparation of this document. More resource-specific analysis methods are discussed below, by topic.

ASSUMPTIONS

Several guiding assumptions were made to provide context for this analysis, including:

Analysis Period

This plan/EIS establishes goals, objectives, and specific implementation actions needed to manage the elk population over the next 20 years; therefore, the analysis period used for assessing impacts is 20 years.

Geographic Analysis Area

Unless otherwise noted, the geographic study area for analysis for this plan/EIS includes the lands that fall within the boundaries of Wind Cave National Park (see figure 2 in the "Purpose of and Need for Action" chapter).

Potential Combined Uses of Initial Reduction Techniques

The analysis of initial reduction efforts (alternatives B–D) are analyzed separately. However, if a particular alternative does not fully accomplish the initial reduction goal, or if a small number of elk need to be removed, it is assumed that tools analyzed as part of another reduction alternative may be used to reach the target population range. This strategy is described as part of the preferred alternative, alternative B, and is further detailed in appendix C. The detailed impacts of employing these "backup" tools are not analyzed within each specific alternative, but rather in the alternative that focuses on that particular tool. For example, as shown in the "An Adaptive Approach for the Preferred Alternative" section in the "Alternatives" chapter, the park would first test whether a significant number of elk leave the park during spring and summer on their own before hazing is used. If the combination of hazing and egress through gates still does not move enough elk outside the park and make them available to hunting, roundup may be used to help complete initial reduction. The impact of roundup is not analyzed under alternative B as a backup strategy, but rather is discussed in detail in alternative C.

Initial Reduction Actions versus Maintenance Actions

This document includes analysis of three action alternatives (B–D) proposed for initial reduction activities, which could also be used as maintenance tools. In addition, two alternatives (E and F) are analyzed for use as maintenance tools only (for use after initial reduction), as it is believed that either alternative would not likely accomplish initial elk reduction goals quickly (less than five years). To clarify for the reader, these latter two alternatives (E and F) have been clearly noted in the analysis as "maintenance only". At this time, the use of sterilization or contraceptives has not been proven through science to effectively manage wildlife populations. The park will not use either of these alternatives unless future scientific studies prove these methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Duration and Type of Impacts

Unless otherwise noted, this EIS considers and defines "short-term" and "long-term" effects to each resource as:

Short-term impacts: Those occurring from elk management actions for a duration of one year or less.

Long-term impacts: Those occurring from elk management actions for a duration of greater than one year.

Impact Thresholds

Determining impact thresholds is a key component of the NPS *Management Policies 2006* (NPS 2006d) and Director's Order 12 (NPS 2001a). Clearly defining these thresholds provides the reader with an idea of the intensity of a given impact on a specific resource. Among other things, impact thresholds commonly take into consideration standards that are relevant from state or federal regulations or scientific research. Because definitions of intensity vary by resource, intensity definitions are provided separately for each impact topic analyzed in this document. The following general intensity levels are used in describing adverse effects throughout the analysis: negligible, minor, moderate and major. Beneficial impacts are those that result in general positive effects to the park's resources and functioning.

Where appropriate, effect assessments may also include geographic contexts. For example, an effect may be site-specific, local or regional in nature. Definitions of these context descriptions vary by resource and, if utilized, are defined within specific resource topics.

Cumulative Effects Analysis Method

CEQ regulations for the implementation of NEPA require the assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impacts on the environment which result from the incremental impact of the action when added to other past, present, and reason ably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are addressed for all alternatives, including the no-action alternative.

Black-Tailed Prairie Dog

Cumulative impacts were determined by combining the impacts of the alternative being considered with other past, present, and reasonably foreseeable future actions. Actions included in the analysis of cumulative impacts are not restricted by land ownership. Identification of cumulative effects is often resource-specific and is discussed in greater detail in each impact topic and each alternative (but primarily under the "no-action" analysis). In general, known actions that have, will or may contribute to cumulative impacts affecting resources of the park and surrounding areas include those related to the following:

- Continuation of wildlife monitoring activities (e.g., aerial and ground surveys).
- Continuation of state-managed public hunting adjacent to the park.
- Continuation of elk management efforts by cooperating land management agencies in the larger Black Hills region.
- Continuation of elk and deer surveillance to detect and remove CWD-infected animals (includes CWD testing).
- Continuation of infrastructure and maintenance projects (e.g., road resurfacing; parking lot/structure replacements; maintenance of fences, campgrounds, utilities [relocation of wastewater treatment lagoons, repair of Elk Mountain water system], etc.).
- Implementation of the park's Fire Management Plan (NPS 2005a) including vegetation removal operations, prescribed burning and wildland fire suppression actions.
- Implementation of the park's *Black-Tailed Prairie Dog Management Plan/EA* (NPS 2006a) including population control (lethal and non-lethal) and habitat management actions.
- Continuation of annual bison roundups with associated effects (use of aircraft, closure of certain park areas, etc.).
- Reintroduction of the black-footed ferret to the park (NPS 2006f; FONSI dated March 2007).
- Continued prohibition on translocation of elk from the park due to identification of CWD (NPS 2002b).
- Implementation of an updated park vegetation management plan is anticipated in the near future (NPS 2006e).
- Fire Management Plan. Wind Cave National Park recently completed a Fire Management Plan (2005a).

In forest habitats, the program will reduce heavy fuel loading, reduce canopy closure, reduce stand density, reduce forest encroachment into grassland and provide for grassland restoration. The goal is to achieve conifer stands that are widely spaced with varied size/age class distributions with a ponderosa pine savannah appearance. This program will help to achieve the reduction in overall coniferous forest habitat desired in table 9 in the "Affected Environment" chapter.

In grassland units, this program will enhance grassland resources as a forage base for wildlife populations and woody draws would be protected.

Impairment Analysis Method

The NPS is required to evaluate the potential effects of proposals as to the likelihood they would cause "impairment" of park resources and/or values. An action results in impairment when its impacts "harm the *integrity* of park resources or values" (NPS 2006d, secs. 1.4..4 and 1.4.5). "Whether an impact meets this definition depends on the particular resources and values affected; the severity, duration and timing of the impact; the direct and indirect effects; and the cumulative effects of the impact in question and other impacts" (sec. 1.4.5).

Established by the 1916 Organic Act, one of the primary purposes of the national park system is the mandated conservation of park resources and values. NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adversely impacting park resources and values. Although the NPS has the discretion to allow certain impacts within parks, that discretion is limited by the statutory requirement that park resources and values remain unimpaired unless a specific law directly provides otherwise. An impact to any park resource or value may constitute impairment, but an impact would be more likely to constitute impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park,
- key to the natural or cultural integrity of the park, or
- identified as a goal in the park's General Management Plan or other relevant NPS planning documents.

The following process was used to determine whether the analyzed alternatives had the potential to impair park resources and values:

- Review of the park's enabling legislation, General Management Plan (NPS 1994b), Resource Management Plan (NPS 1994c), Statement for Management (NPS 1994d), Draft Resource Management Plan (NPS 2003) and various other relevant planning documents to ascertain the park's purpose and significance, resource values, and resource management goals or desired future conditions.
- Thresholds were established for each resource of concern to determine the context, intensity, and duration of impacts, as defined in the "Impact Thresholds" section above in this chapter.
- An analysis was conducted to determine if the magnitude of impact to any resource would reach the level of "impairment," as defined by NPS *Management Policies 2006* (NPS 2006d).

An analysis of the potential for resource and/or value impairment has been included for the following topics: elk, soils and water quality, vegetation, other wildlife, special status species, air quality, and cultural resources. Visitor experience, socioeconomics, park operations, and human health and safety issues are not considered park resources or values and, therefore, no impairment statements are provided for those topics.

ELK

GUIDING REGULATIONS AND POLICIES

Units of the NPS are obligated to restore, to the extent possible, natural functions and processes in park units. The NPS *Management Policies 2006* (NPS 2006d) direct parks to strive to maintain components and processes of naturally evolving park ecosystems. NPS *Management Policies 2006* also recognize that intervention may be necessary to “restore natural ecosystem functions that have been disrupted by past or ongoing human activities” (NPS 2006d, sec. 4.1). The following are excerpts from the NPS *Management Policies 2006*:

Biological or physical processes altered in the past by human activities may need to be actively managed to restore them to a natural condition or to maintain the closest approximation of the natural condition when a truly natural system is no longer attainable. Prescribed burning and the control of ungulates when predators have been extirpated are two examples (sec. 4.1).

The Service will reestablish natural functions and processes in parks unless otherwise directed by Congress (sec. 4.1.5).

The Service will successfully maintain native plants and animals by preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur (sec. 4.4.1).

Extirpation — The localized extinction of a species.

Whenever possible, natural processes will be relied upon to maintain native plant and animal species and influence natural fluctuations in populations of these species. For example, management may be necessary because a population occurs in an unnaturally high or low concentration as a result of human influences (such as loss of seasonal habitat, the extirpation of predators, the creation of highly productive habitat through agriculture or urban landscapes) and it is not possible to mitigate the effects of the human influences (sec. 4.4.2).

NPS *Director’s Order 77-4: Use of Pharmaceuticals for Wildlife*. This director’s order and accompanying Reference Manual 77-4 establish NPS operational policies and procedures for compliance with existing federal laws, regulations and guidelines governing the use of pharmaceutical agents for wildlife in the National Park System. NPS policy is to administer pharmaceuticals in a manner that is safe for humans and animals, adheres to humane standards and is in accordance with NPS wildlife management philosophy.

Wind Cave National Park Documents

Guiding park planning documents that may have relevance for elk management include the following:

- Wind Cave National Park General Management Plan and Environmental Impact Statement, 1994 which guides visitor use, natural and cultural resource management, and general development within the park (NPS 1994b).
- Elk Management Strategy (NPS 1994a) which directed the maintenance of the park’s elk herd between 350 and 400 elk by live trapping and removing elk from the park.
- Environmental Assessment and Review of the Elk Surplus Disposal Program (NPS 1980), which established the herd size objective at between 350 and 400 elk, and identified a mechanism to manage the herd.

METHODOLOGIES AND ASSUMPTIONS FOR ANALYSIS OF IMPACTS

Geographic Area Evaluated for Impacts

The geographic area evaluated for impacts on the elk population includes the entire park and the area outside the park within the 6 mile area generally used by migratory elk. Local effects are those that occur within specific geographic areas of the park (e.g. Gobbler Knob, Boland Ridge). Park-wide effects occur within the park and the 6-mile general migratory perimeter. Cumulative effects that would occur both within and outside of these areas were evaluated using the methods described in the "Cumulative Effects Analysis Method" section.

Issues

Issues that were identified during public and internal scoping regarding the elk population include

- Management activities could disturb or displace elk.
- In the long term, a large elk herd would damage other resources including vegetation and wildlife, and would result in an unnatural and unhealthy elk herd.
- Management activities could temporarily concentrate elk and increase the risk of CWD transmission, but in the long term would reduce this risk parkwide.

Assumptions

The following assumptions were used to analyze the effects of elk management actions on the elk population:

- The elk population in the park is increasing by 10–12% per year, but growth will slow as the population nears ecological carrying capacity.
- The South Dakota Game, Fish and Parks elk management program would continue to direct elk management outside the park.
- Elk would increase inside the park to carrying capacity before permanent emigration significantly reduces numbers.

Assessment Methods

Primary steps for assessing impacts include identifying (1) the elk herds likely to be affected by the proposed alternatives; and (2) potential changes in the elk population, habitat or behavior caused by current and future elk population management actions.

To understand the effects of elk management methods on the elk population, park resource inventories and management plans, NPS and other agency specialists, scientific literature and published technical data were consulted to identify the information contained in this analysis.

The potential incremental effects of each of the action alternatives on elk were compared to the effects of alternative A, which would continue current management practices. The following steps were used to perform the analysis:

- Identify the issues associated with possible elk population management approaches.
- Establish a series of impact threshold definitions and conditions that would determine if and when a change to the current management practices occur and the magnitude of that change.
- Estimate or determine the changes in the elk population that would occur relative to the issues and as a result of implementing the different alternative actions.
- Compare the changes identified for each action alternative to what the conditions would be under current management practices and assign appropriate intensity levels based on the impact threshold definitions.

Impact Threshold Definitions

Negligible: Impacts would be so slight that they would not be of any measurable or perceptible consequence to the elk population and well within natural fluctuations. Elk behavior changes would not be detectable.

Minor: Foraging choices, distribution, shyness, etc. or other behavioral aspects may change for individual or small groups of elk, but these would remain within the natural range of variability. Population level changes, including age and sex ratios, genetic variability, reproductive and recruitment rate, etc. would not be detectable.

Moderate: Foraging choices, distribution, shyness, etc. or other behavioral aspects for individual or small groups of elk would be apparent, and these changes may occasionally exceed those considered to be within natural range of variability. Population level changes, including age and sex ratios, genetic variability, reproductive and recruitment rate, etc., may be detectable.

Elk may be disturbed during particularly vulnerable life-stages, such as breeding, late stages of pregnancy or juvenile stages or severe winter; occasional mortality or interference with activities necessary for survival could be expected, but is not expected to threaten the continued existence of elk in the park.

Major: Distinct changes in foraging choices, distribution, shyness, etc. or other behavioral aspects for individual or small groups of elk considered to be outside the natural range of variability could occur. Population level changes, including age and sex ratios, genetic variability, reproductive and recruitment rate, etc. would occur and may be large-scale enough to affect regional populations.

Elk may be disturbed during particularly vulnerable life-stages, such as breeding, late stages of pregnancy or juvenile stages or severe winter; mortality or interference with activities necessary for survival could be expected, although the population would be able to recover, possibly from immigration.

Impairment: Some of the major impacts described above might be an impairment of elk if their severity, duration, and timing resulted in the elimination or significant alteration of the elk population. In addition, these adverse, major impacts to park resources and values would:

- contribute to deterioration of the park’s elk resource and values to the extent that the park’s purpose could not be fulfilled;
- affect resources key to the park’s natural or cultural integrity or opportunities for enjoyment; or
- affect a resource whose conservation is identified as a goal in the park’s general management plan or other park planning documents.

Duration of Impact

Short-term: Those impacts occurring from elk management actions in the immediate future (usually 1 to 6 months).

Long-term: Those impacts occurring from elk management actions over a period of 6 months or longer.

ALTERNATIVE A—NO ACTION

Elk herd size at Wind Cave National Park is no longer subject to control by natural predators.

Under the no-action alternative, existing elk management actions (monitoring and targeted surveillance) would continue with no additional efforts implemented to address the size of the elk population and its effect on park resources.

Population Size and Density

Under alternative A, the elk population would continue to increase. In February 2007, the elk population in the park numbered approximately 650. This is larger than in 2006, when the population dropped from 800 in 2005 to 550. The reason behind the reduction in 2006 is unknown, but may have resulted from changes in survey techniques. This drop in elk numbers was unexpected, and the degree to which survey techniques or other factors (emigration, hunter success, etc.) would affect the size of the herd that winters in the park in future years remains unknown. Although there are sometimes large-scale fluctuations such as those in 2005 and 2006, park staff estimate the population continues to expand on average by about 10 to 12% per year (Roddy 2007; NPS 2006g).

Natural regulation of ungulates relies on predator or food limitation. Although predators influence the size and distribution of ungulate population, the degree of limitation in pre-European systems is a matter of debate (Lubow et al. 2002). The southern Black Hills did have wolves when Wind Cave National Park was established, but both they and coyotes were extensively hunted in the early 1900s. Because records of the number of elk have only been kept post European settlement and include many removals and alterations of elk habitat (including cattle grazing, fencing and removal of predators), the degree to which wolves influenced elk numbers in the park is not known. However, other researchers (including Garton et al. 1990; Boyce 1993; and Mac and Singer 1993 as cited in Zeigenfuss and Singer 2002) suggest primary predators, including wolves and bears, reduced elk numbers by 10–20% in the Yellowstone basin. This has been further substantiated 10 years into the reintroduction (e.g., in 2005) effort by 15 North American wolf experts recently predicting that even 100 wolves inside the park would result in no more than a 20% reduction in elk (NPS website, Dec 2007).

Regardless, the herd size in the park is no longer subject to significant control by predators. Some hunting of elk that leave the park each spring reduces numbers, as does emigration. Mountain lions or coyotes may take an occasional elk. Although mortality rates of elk wintering in the park are unknown, recent research suggests those not related to hunting or poaching are in the 5-6% range (Sargeant et al. 2008).

For purposes of analysis, the elk population is assumed to continue to grow if no reduction activities take place. This is because elk predators are largely absent, no hunting is allowed inside the park, and the park is unable to translocate elk. At higher numbers, when competition between elk, and between elk and other herbivores begins to limit forage, food availability would play an increasingly large role in determining herd size of elk wintering in the park. In the 1970s and 1980s, when the herd size averaged around 350–400, little competition was noted in studies of food and habitat overlap among ungulates in the park. Authors generally concluded that competition among ungulates, especially at lower numbers, was low, and "appeared to be minimized by differential habitat selection and forage utilization" (Wydeven 1977).

However, even in recent years (2005–2007) at a population of 550–850 elk, early signs are appearing that grasslands are grazed at unsustainable rates. This is at least in part due also to decreases in forage production related to drought during these same years (Curtin 2007).

Eventually, the elk population inside the park would likely expand to fluctuate around its "food-based carrying capacity." The food-based or food-limited carrying capacity is the maximum dynamic capacity of the habitat, forage and climate of an area to sustain elk (Zeigenfuss et al. 2002). Traditionally, populations approach this level at a progressively slower pace over time. In other words, the rate of increase, which is currently estimated at 10%–12%, would fall as the population numbers rise. Eventually, it would be at or close to zero and the population would fluctuate around the carrying capacity through a balance of births, deaths (natural and predation), immigration and emigration.

Elk populations at food-based carrying capacity are not necessarily in balance with their environment or within the natural range of variation, as the reduction and redistribution functions predators historically played are absent. For example, the population of elk in Rocky Mountain National Park is considered to be at carrying capacity, but densities in some parts of the park can exceed 260 elk per square mile, the highest concentrations ever documented for a free-ranging population in the Rocky Mountains (NPS 2006c). Severe degradation to riparian areas, in aspen forests and other vegetative communities as well as the wildlife that depend on them has resulted from these very high densities. Historically, predation from wolves and grizzly bears (both extirpated from the area) likely kept the population in Rocky Mountain National Park from 15% to 40% lower than it is now, and prevented elk from congregating in any one spot. Although elk numbers are high, the concentration of elk in some parts of the core winter range (Moraine Park, for example) has been at least equally important in causing severe vegetation damage in the park (NPS 2006c). Predators were believed to be effective through both redistribution and reducing numbers in keeping elk from overgrazing vegetation at Rocky Mountain National Park.

Currently, systems like Rocky Mountain National Park have no significant remaining natural predators of elk and wildlife managers often elect to manage elk and herbivores at a level similar to that if predators were part of the system, in the range of 55 to 60% of the food-based carrying capacity (e.g., 40 to 45% lower than food-based carrying capacity), to mimic a predator-based carrying capacity and a more historically natural system. Doing so may also prevent damage to vegetation from concentrated grazing (Zeigenfuss et al. 2002). In Rocky Mountain National Park, managers would reduce the size of the herd to between 60 and 68% of carrying capacity. In the case of areas where sport hunting is the method used to maintain deer or elk at a number, the huntable number of animals is referred to as the maximum sustained yield.

Assuming that elk using Wind Cave National Park would reach food-based carrying capacity sometime in the 20-year lifetime of this plan if no park management were to take place, an important piece of the impact analysis for the no-action or "no management" alternative is the prediction of the number of elk occupying habitat inside the park when this capacity is reached. However, although clues exist as to what this number might be, the actual number is unknown. Predicting the ultimate number of elk wintering in the park is further complicated by the management goals for bison and prairie dogs, drought and weather, other ungulates in the park, movement of elk in and out of the park, and hunting success of elk moving outside the park.

Historic counts of elk occupying habitat in the park show that around 1953, the herd had grown to at least 1,200 and perhaps as many as 1,500 (Bauman 1998). Assuming elk occupy the entire park, this translates to a density of 27–34 elk per square mile. Impacts to vegetation were noted at this time, and a large scale removal (about 1,000 elk were removed over the next two years) along with seeding and gully erosion control was successful in "rehabilitating range lands" in the park (Bauman 1997). Obvious adverse effects to shrubs ("elk are nearly eliminating shrubs such as skunk brush, buck brush, ground mahogany, plum, choke cherry….") are also recorded as occurring in 1924 when 250 elk were confined to a 4,000 acre game preserve in the park at a density of 40 elk per square mile.

The Science Team for this project used a range management model to determine the ideal number of elk in the park. This model assumed only 25% of the forage at the park at various seral stages would be available to the park's major grazers—bison and elk—and was adjusted to compensate for prairie dog colony acreages. Another 25% was allocated to other herbivores (including mule deer, white-tailed deer and pronghorn) and to accommodate damage from events such as storms, severe winters, and trampling. Fifty percent was allocated for vegetation regeneration. Using this method, the Science Team calculated the number of animal unit months (AUMs) available to bison, elk and prairie dogs in an average year. This approach indicated that an average elk population of about 350 (and ranging from 230–475) could be accommodated without impact to the park's forage base or other herbivores. However, an unmanaged elk population would likely grow well beyond this number, initially foraging on the 50% of vegetation set aside for forage and regeneration and then competing with other herbivores for the remainder.

The ultimate size of an unmanaged elk population predicted by the range management modeling approach is unknown, although it is possible that 1,800 or more elk (assuming 20,000 to 30,000 AUMs park-wide, a minimum 400 bison and 2,800 acres of prairie dogs) could potentially exist at the park for a short period of time before forage set aside for regeneration would be consumed and the population would begin to decrease. As noted above, park vegetation specialists are already estimating that grazing animals in Wind Cave remove 50–60% of the annual forage production. This includes all park grazers, is during a multi-year period of drought, and is based on range forage production monitoring, but may be an early indicator that, even at the 550–800 elk population size, forage utilization rates are not sustainable in the long term if drought conditions continue.

At its current rate of increase, and assuming no significant immigration or emigration and the ability of forage to sustain the herds, the population of elk in Wind Cave (currently about 650) would reach 1,200 animals in about 6–7 years, 1,500 in 8–9 years and 1,900 in 10–12 years (see table 8 in the "Affected Environment" chapter). These are major increases of 200% to 300% in the wintering population of elk in the park, with potential impacts to reproduction, health, and survival discussed below.

Because the fence is lowered over several miles of the park, some elk would undoubtedly leave as forage becomes less available. This is particularly true since densities outside the park are low, on the order of one to two elk per square mile on national forest lands (SDGFP n.d.). However, because the park offers a respite from hunting, elk may "choose" to compete with each other as well other ungulates for habitat and forage in the park to the maximum extent possible rather than cross into National Forest lands. The safe zone offered by the park may be especially preferred during mild weather conditions and when forage production is high.

Although it is unknown when elk would leave the safety of the park in large numbers to take advantage of low densities and available forage, evidence from the elk population using Rocky Mountain National Park indicates that it may be later rather than sooner. Two large subpopulations of elk winter in the area of Rocky Mountain National Park—one inside the park and the other in the town of Estes Park. Elk wintering in the park did not "discover" the town of Estes Park, another "safe zone" from hunters, until the mid to late 1970s, coincident with the time period when the park population reached carrying capacity. In other words, emigration from the park apparently did not occur until the carrying capacity of the park was reached. The population of elk wintering in town is still growing, not primarily from immigration from the park herd, but rather from higher calf survival rates. Researchers (Lubow et al. 2002) predict that movements between the town and park population would become nearly equal when both are at carrying capacity. Applying this same philosophy to Wind Cave, the population inside the park is more likely to increase to carrying capacity, which may be a very high average level, before significant emigration begins.

Because it is unknown how elk would behave, this analysis assumes the population wintering in the park would increase to around 1,200 before elk begin to leave the park or other density dependent factors (see Survival and Mortality below) act to stop population growth. As noted above, this appears to be a level elk have approached in the park in the past, but may be too low, particularly if forage conditions improve. As noted above, the elk population wintering in the park may have even grown to 1,500 or higher before removals lowered numbers. Conversely, multi-year drought, forage removal percentages, and decreasing calf:cow ratios (either birth rates or calf survival rates or both to account for this decrease) (Weber 2007) observed in parts of the herd now suggest even at 650–850 elk the population may be struggling and its growth is at least temporarily slowing. An EIS predicts a "reasonable worst case" future or upper-end estimate of the size of the elk population and damage it might cause to park resources. Therefore, given existing or planned populations of other grazers and average forage production, the carrying capacity for elk is assumed to be approximately 1,200 elk for analysis purposes.

Population Sex and Age Ratios

Several aspects of the elk population using Wind Cave indicate it has been in the recent past unlimited by forage or habitat, although this may be changing at least in the short term in response to known and unknown factors, including a multi-year drought, reduced forage production, the inability to remove elk through translocation, stabilized populations of other managed grazing animals, and other unknown factors. For example, the calf:cow ratio in the mid-1990s as reported by Bauman (1998) was quite high—in the range of 51 to 55:100. This ratio is similar to that experienced in the Estes Park population of elk shortly after elk "discovered" the town in 1978 and began to winter there (Lubow et al 2002), i.e., when forage per elk was plentiful. However, by 2001, the Estes Park calf:cow ratio had declined to about 30:100, indicating a population experiencing density dependent feedback as it approaches carrying capacity. This feedback is mediated through nutrition, and affects physiological dynamics such as fecundity and survival rates. A study (Stewart et al. 2005) comparing two populations of elk, one at lower density (12 elk per square mile) and another at a higher density (60 elk per square mile) found several density dependent changes, including a lower proportion of pregnant females as density increased. This was particularly true for primed-aged (ages 4–9) elk.

Given the growth scenario assumed for this alternative (e.g., as many as 1,200 elk wintering in the park), the same type of density dependent changes to the herd would be very likely to occur in the population using Wind Cave. As noted in other sections of this EIS, although the calf:cow ratio was estimated by park managers at about 45 calves per 100 cows as late as 2005, it dropped to 30–35 calves in 2007 (Weber 2007). Pregnancy rate of 98 adult female elk tested in 2005-07 was 73%, suggesting calf mortality is high or recruitment low. The reasons for this drop in calf:cow ratio are unknown, although drought and decreased forage production and the same nutrition feedback loop noted by Stewart et al. (2005) are at least partially responsible. An aging cow population and higher bull:cow ratio than other areas are also possible contributing factors. Since drought may be reversed in future years, the calf:cow ratio is also likely to fluctuate for a time before the population stabilizes. However, ultimately the long-term calf:cow ratio and all of the factors that contribute to this ratio, such as pregnancy rates, live birth rates, and calf survival or recruitment rates, would drop from those in the 1990s and early 2000s, a potential moderate adverse impact to the population structure.

The elk population in Wind Cave has an older age structure than animals in hunted populations outside the park (NPS 2006g). This would be even more pronounced as the population remains unmanaged but continues to grow. Extreme winters have a proportionately greater effect on young, old and infirm animals. Should a severe winter occur, higher mortality may result than if the population were more balanced. Although the herd would then lose some important behaviors and knowledge (such as that of lead cows or migratory individuals), this kind of stochastic event would also reduce the elk population and restore a more natural age structure which, on balance, would result in a beneficial effect.

Bull:cow ratios in the park are also unknown, but are likely on the order of 55:100 on average (NPS 2006g). On average, bull:cow ratios are lower than this in the neighboring Black Hills lands outside the park, where they average 45:100 (SDGFP n.d.; Bauman 1998). In the Madison River drainage of Yellowstone National Park, the bull:cow ratio is 25:100, and in Rocky Mountain National Park, the ratio is 22:100 inside the park and 6:100 in neighboring Estes Park (Bauman 1998, NPS 2006c). The higher ratio of bulls to cows in Wind Cave may be the result of several factors, including no hunting and the use of roundup for the last several decades to remove elk. Roundup and trapping is considered to be more efficient at rounding up cow elk than bulls (NPS 1980). It is unknown whether the ratio would change with increasing population size. Bulls may be less likely to migrate from the park than cows. Also, it is possible that the proportion of female calves recruited to the population would decrease as density increases, as it appears to have done in Rocky Mountain National Park (Lubow et al. 2002). Both of these factors indicate the bull:cow ratio would actually increase beyond its already high level as density increases. The change is not likely to have more than a negligible or minor effect on the sex structure of the population wintering in the park.

Health, Survival, and Mortality

Density dependent factors for populations fluctuating at or around carrying capacity also include changes to calf survival, calf recruitment and body condition. A study of the park and town subpopulation of elk at Rocky Mountain National Park/Estes Park found lower calf survival (calves are considered to be 6 months or less) and recruitment rates (survival of elk to between 6 and 18 months of age) in the park population, which has been at carrying capacity for several years. Calf recruitment for the population of elk inside the park averaged 0.349 (e.g., about 35% of calves born remain alive at 18 months), and was 2.5 times higher (0.878) in the growing population at Estes Park. These mechanisms were also observed in the elk population within Yellowstone National Park (Lubow et al. 2002). Should this shift occur in an expanding population wintering in Wind Cave National Park, the impact on elk would be adverse, long term and moderate to major in intensity.

The study comparing high and low density populations of elk (Stewart et al. 2005) found reduced body condition measured as amount of rumpfat of adult and yearling females to be lower in the higher density population of elk. Elk are adapted to survive severe winters and can sustain energetic debt and weight loss of up to 25% during more severe winters (Wisdom and Cook 2002 as cited in USFWS 2004b). Other known adaptations in ungulates include thick winter fur, metabolism reduction by nearly one-third, behavioral adaptations (bedding down for long periods during severe weather), and great reliance on stored body fat (Mitchell et al. 1976; Mautz 1978 as cited in USFWS 2004b). In particular, summer nutrition may be important, as energy stores for the winter are determined by the quality of the summer range, while depletion is a function of winter range quality and the length of winter (Stewart et al. 2005).

Additional evidence that density does not play a large role in adult survival comes from comparing town and park populations of elk at Rocky Mountain National Park. Both the town and park population survival rate for elk older than 18 months is 0.913, despite one having been at carrying capacity for several years and one continuing to grow. In Wind Cave National Park, the current survival rate is unknown, but estimated to be in the 0.94 to 0.95 range (Sargeant et al. 2008.).

Given these factors, the impact of the no-action alternative on adult survival may be no more than minor. Additional elk may move out of the park to summer range where elk densities are low and food is available. This may enable them to survive even moderately harsh winters inside the park. Older elk and/or female calves in particular may be susceptible to severe winters, and impact on survival in these sectors if such a winter occurs may be moderate.

Elk mortality from human related sources such as vehicle crashes would increase as elk occupied roadside habitats and became more habituated to human activity.

Elk Behavior, Distribution, and Movement

Information on behavior, distribution, and movement of elk wintering in the park comes from older studies and is currently being updated through a joint study by the US Geological Survey and NPS (Sargeant et al. 2008). Preliminary information from the USGS/NPS study was used in the analysis.

Elk and other ungulates in the park most likely avoid competition through spatial distribution. Early research found that elk spent most of their time during the winter was spent in relatively discrete areas totaling about 22 square miles (Varland et al. 1978). During most of the day, elk appeared to be distributed within these areas based on their foraging preferences. At night and during midday, they rested in edge habitat or forested areas.

Varland et al. (1978) indicated that the herd wintering in the park is unusual in that the total area occupied is small, yet female elk appeared to maintain distinct subherds. Although only a small amount of intermingling by cows and calves between subherds appeared to occur, bulls appeared to move easily from one bull herd to the other (Sargeant et al. 2008, Varland et al. 1978). Bauman (1998) found that calving and breeding seasons represented two periods during which more social flux occurred. Over time, group composition and distribution have changed, both from year to year and in response to human activity. For example, cows and calves in the Beaver Creek area stopped grazing in the vicinity of the corral when the park began using helicopters to trap elk in 1970.

A more recent ongoing study by USGS and NPS (Sargeant et al. 2008) using a significantly larger sample size has expanded knowledge and changed early ideas about herd movements in the park. Mapping of nearly 100,000 locations of 104 radio-collared elk from 2005-06 did indicate that female elk tended to cluster in the northeast (Boland Ridge), central (Beaver Creek) and southwest (Gobbler Knob) parts of the park, although elk moved between these areas (Sargeant et al. 2008). Subsequent findings indicate even wider ranging movements and less fidelity for animals on the west side of the park, although cow elk in the Boland Ridge area appear to be more likely to stay in this area and were relatively isolated from other females. Male elk were less concentrated, and were spread out over the entire north area and less frequently in the central and southern end of the park. Because recent research indicates elk move more freely and are wider ranging than originally thought, the notion of discrete subherds has been abandoned.

As the herd increases in size, patterns the elk use now to maintain separation from each other but still meet nutritional and other needs would likely continue in the short term. The migratory segment of the herd would continue to leave the park in the spring and would experience some mortality from hunting outside the park. As the herd expands, a greater number would leave the park seasonally, but it is unknown whether a larger proportion would permanently emigrate before significant increase in the size of the herd takes place. As noted above under the discussion of population changes, it is possible that eventually both the number immigrating into and emigrating out of the park each year would stabilize.

As the population in the park continues to expand, elk would exploit all available habitats. Elk are opportunistic feeders and adapt to variable types of foraging options (Lagueux 2002). Therefore, secondary habitats used less frequently by elk now could become important feeding and resting spots, with possible effects on other smaller ungulates that are unable to successfully compete with elk. Areas largely unused by elk now would be occupied if they provide forage or cover. Although bison are able to keep elk from occupying an area, other smaller ungulates would not be as successful and shrublands, woody draws, riparian areas, grasslands and other habitat now used by pronghorn and deer would likely become elk habitat. In addition, competition between elk would increase, with moderate long-term adverse effects on the behavior and health of the population as a result. As elk from the migratory segments of the population leave the park, those less likely to leave the park in the spring or summer would likely disperse to fill "vacant" habitat over time.

As the population increases, elk would come into more frequent contact with park visitors. As elk use habitats closer to roads and park facilities, they may become more habituated and less wary of people, although currently this population is shy and avoids people, human activities and roads (Rumble 2001). Impacts are not likely to be more than minor.

With an increase in herd size, the number of both mature bull elk and reproductively mature females would increase. The incidents of elk breeding behavior, including "bugling," sparring and courting, would also increase inside the park as a result. Impacts to elk behavior and the population from these changes are not likely to be more than minor.

Chronic Wasting Disease

In the absence of population reduction measures for elk, the prevalence of CWD may increase. The elk population would continue to grow, albeit at a declining rate over time, and the higher density of elk may increase contact between animals and lead to higher levels of soil contamination with CWD infectious material. Chronic wasting disease spreads readily among animals that are concentrated, as shown in studies of some captive cervid herds (Miller and Williams 2003, Miller et al. 2004). And, although elk in the park are free-ranging, their density could become high enough that it would increase the incidence of CWD in the herd. It is plausible that CWD-infected elk are more vulnerable to predation, but the absence of a full suite of large predators such as wolves and bears in the park suggests that predation would continue to play a relatively minor role in mitigating the effects of CWD in the herd.

Chronic Wasting Disease spreads readily among animals that are concentrated in an area.

Under this alternative, the continued increase in elk numbers may result in greater risk of CWD transmission among elk, and possibly, higher prevalence of CWD in elk and deer. Because elk seasonally leave the park, impacts would extend beyond park boundaries. Effects on elk herd health would be adverse, moderate and long term inside the park, and adverse, minor and short term outside the park.

Cumulative Impacts

Vegetation management activities in the park could temporarily displace elk, but are likely to offer benefits in the long run. Prescribed burns to restore natural ecological processes and to restore the vigor of mixed-grass prairies would improve forage for elk and other ungulates. Prescribed burning of ponderosa pine forests to restore natural density and spacing of trees and to restore fire as a natural ecosystem process would improve forage but decrease hiding cover for elk. Thinning of conifer stands, to create appropriate conditions for restoring the natural role of fire would temporarily displace elk during project activities, improve forage conditions and reduce hiding cover in the long term in the areas treated. Vegetation exclosures to exclude grazing wildlife would adversely affect elk by preventing them from grazing areas that could be important winter food sources of shrubs and hardwood trees.

The current pattern of park fencing has a long-term adverse effect on elk populations by disrupting natural migratory patterns and providing refuge from hunting outside the park.

The two highways that transect the park would continue to be a potential source of mortality for elk, a long-term, local, minor adverse impact. Elk also avoid land where roads exist.

Predator reduction and elimination efforts in the past have had a long-term impact on ungulates, including elk at the park. In addition to keeping overall numbers down and individual nutrition per elk up, predation tends to remove the young, old and the weak animals in a population benefiting herd health.

Herbivore management also affects elk. The newly released bison management plan (NPS 2006b) calls for maintaining the herd at a minimum of 400 animals. Although rounding up and removal of bison in the fall would have short-term adverse effects on elk, in the long term elk would benefit from reduced grazing pressure on mixed-grass prairies. In the spring of 2006 the park had approximately 16 prairie dog colonies on 2,800 acres. The park's *Black-Tailed Prairie Dog Management Plan/EA* (NPS 2006a) established a goal of maintaining 1,000–3,000 acres of prairie dog towns, which would not have a measurable effect on the elk population.

Hunting outside the park would continue to be managed by the SDGFP to control the elk population and maintain habitat conditions outside the park. To the extent that this keeps numbers of elk wintering inside the park down, it is a benefit to habitat and the herd. It is an adverse effect to those elk shot.

Overall, the natural condition and behavior of the elk population is probably affected more by existing fencing and past predator elimination than by habitat enhancement efforts, hunting or herbivore management, with long-term, park-wide, minor to moderate and adverse cumulative impacts to elk on balance.

The elk from a game ranch adjacent to Wind Cave National Park were depopulated when CWD was discovered there in 1997. This site continues to be a potential source of CWD environmental contamination for elk and deer in the southern Black Hills, including elk inhabiting the park. However, because CWD is now found regionally, the future site-specific impact of this material on elk herd health may be negligible to adverse and minor. Elk have traditionally used the park as a refuge from hunting, and their movements have been constrained by the perimeter fence, leading to increases in elk density and possibly in the risk of CWD transmission in the park. To the extent that current hunter harvests reduce the elk population outside the park, they may have a beneficial, long-term effect on elk herd health by removing some animals infected with CWD. Cumulative negligible beneficial impacts to the prevalence of CWD in elk in the park may occur from increased vehicle collisions with infected animals (Krumm et al. 2005).

Conclusion

Under alternative A, the elk population would continue to increase. Because the ecological or food-based carrying capacity is unknown, this analysis assumes the population of elk wintering in the park would increase to around 1,200 before emigration and density dependent processes act to stop net population growth. Changes in the population structure are likely to occur, including lower calf:cow ratios with noticeable or moderate impacts to the population. An increasingly older average population may mean high losses during severe weather, a beneficial impact since a more natural age structure and lower numbers would result. Changes in bull:cow ratios may also occur, but only negligible or minor adverse impacts to the population would be expected as a result. Reductions in calf survival and recruitment are a likely response to increased density, with possible long-term moderate or major adverse impacts to the herd. Adult survival is not expected to experience more than minor adverse impacts on average, although the survival of older elk or calves may be affected more severely, e.g., moderate adverse impacts. Elk would likely expand to exploit all available habitats, with increased competition and energy expenditures in finding food. Moderate long-term adverse effects on the population are possible as a result. Minor adverse impacts from decreased wariness and increased energy expended in rut are also possible. Increased density may result in increased transmission of CWD, a moderate adverse impact to elk inside the park and minor adverse impact to those in the Black Hills. Fencing and past predator elimination have changed distribution and herd size with adverse cumulative effects. Additional adverse cumulative effects from the former elk ranch adjacent to the park and its role as a source of CWD in the region may have occurred; if so, these could have been offset somewhat by depopulation of the infected herd and by hunter harvest. Beneficial cumulative impacts include habitat enhancement, hunting and herbivore management.

No impairment to park resources or values from impacts to the elk population would result from implementing alternative A.

ALTERNATIVE B—HUNTING OUTSIDE THE PARK

Alternative B emphasizes maximum use of hunting elk on public and private lands outside the park to reduce and maintain the park's elk population at target goals.

To facilitate this alternative, the now four foot high section of fence would be raised to seven feet, and moveable sections of fence (gates) installed here and at other locations along the west and east sides (assuming landowner permission) of the park to encourage elk to leave in the spring. Hazing elk out through the gates during the hunting season with noisemakers, guns, helicopters, etc. would occur if additional removals are required.

Population Size and Density

Depending on a number of factors when removal efforts begin, including the size of the population inside the park, the success of encouraging elk to leave the park and the rate at which the herd is increasing, the initial reduction could take several years. Currently, several hundred elk leave the park each spring (Roddy 2006) . Most of these are cows, many of whom are pregnant. Calf elk are born in late-May to early-June. They are mobile within days after birth and are often stashed in heavy cover for extended periods of time while the cow feeds or beds. Calves are weaned in late summer, and if the cow does not survive after this period, the calf is often able to survive as part of the larger herd.

It is possible that much of the increase in huntable elk outside the park during the initial reduction under alternative B would be composed of these cows and their calves. Eliminating or significantly reducing this segment of the population could mean the loss of seasonal migrating behavior from the herd. Therefore, careful monitoring and control of the numbers from each subpopulation available for hunting during the late summer and early fall would be important to the continued success of this alternative. Also, as noted in the "Alternatives" chapter, moveable gates along the west and possibly east sides of the park would be installed and elk from the element of this herd that does not normally migrate would also be encouraged to exit the park in spring and summer.

Despite these efforts, it is likely that more elk that tend to winter in the Gobbler Knob and Beaver Creek region would be removed through hunting, and the benefits to elk in these areas related to a smaller herd would be greater than for those in areas where elk are not as likely to migrate. Compared to the no-action scenario when the herd inside the park may have reached well over 1,000 animals in a few years, the relative benefit of alternative B to the portion of elk where many have migrated in the form of reproduction, survival, and reduced competition, would be temporary but noticeable.

Elk in the Boland Ridge area tend to winter here year-round, and would likely be less affected as fewer are likely to leave in the spring. Although hazing may increase the number of elk from this area using gates to leave the park, they are more likely to remain and this portion of the herd grow in place.

Although the herd would benefit from reduced competition and improved access to quality forage, removal efforts would have adverse effects on individual elk, from killing by hunting, a calf's loss of a cow during a potentially vulnerable time for a calf (immediately after weaning), injury, or separation. These effects would not jeopardize the existence of the herd, but could be moderate or even major in intensity for some individuals.

The effectiveness of hazing may decline through time as elk learn that they can remain in cover, frustrating hazing efforts. Some elk would also learn the location of the corral trap and avoid it. Sharpshooting may be required to remove small numbers of elk during the maintenance phase. The effects of either hazing toward the existing corral or sharpshooting would be the same as described in alternatives C (roundup) or D (sharpshooting).

Population Sex and Age Ratios

Maintaining a viable population of elk between 232 and 475 animals may necessitate close monitoring on sex and age ratios, however age and sex ratios will adjust over time to allow the population to remain viable.

As noted above, mixed herds of cows, calves and yearlings appear more likely to migrate out of the park than adult bulls, so hunting outside the park may cause an unwanted increase in bull:cow ratios in the park. If sufficient numbers of adult bull elk do not naturally migrate through the new gates, hazing may be needed to move additional elk out of the park. If this also does not work, selective sharpshooting inside the park to manage bull:cow ratio would be used. Assuming the successful use of hazing or sharpshooting if the gates do not work, no impact to the bull:cow ratio would occur. If the park is not concerned about the number of bulls, the ratio would continue to increase. As bull:cow ratios increase, harem size generally decreases. Smaller harems would require less energy expenditure by bulls, which in turn would lead to better body condition in bulls and the ability to withstand harsh winter conditions (NPS 2006c).

Carrying capacity is the maximum number of organisms that can be supported in a given area or habitat.

The average age of cow elk migrating out of the park is unknown, but because many appear to be pregnant it may be that they are mostly of prime reproductive age. If so, hunting may alter the age structure of the herd, leaving older and younger females, and removing a disproportionate number of breeding age cows. Although this may be beneficial in lowering the rate at which the population increases, it would have a negligible to moderate adverse effect on the age and sex structure of the population.

As noted above, under the no-action scenario calf:cow ratios are likely to decrease over time as the population approaches carrying capacity. Density dependent physiological changes in the herd, such as reductions in pregnancy, calf survival and recruitment are also likely to occur under the no-action alternative. However, reducing the herd size to around 350 under alternative B and all other action alternatives should maintain these features of the population as they were in the recent past. In other words, the calf:cow ratio, calf survivability and relative survivability of female calves should all increase substantially over what they would be under the no-action alternative, particularly in the later years of that alternative as the herd approaches carrying capacity. These changes would result in beneficial impacts relative to the no-action alternative to the herd occupying the park.

Health, Survival, and Mortality

This alternative would result in hunting outside the park of many of the elk that normally winter inside Wind Cave National Park. Hunting would likely make elk more secretive, and they would travel more extensively to avoid hunters. This may mean they would occupy less than preferred habitat and experience greater expenditure of energy at the same time their available nutrition falls. Elk may also be separated from calves, or cows shot and calves left to fend for themselves. These changes to elk health and survival would be minor to moderate, adverse, and may be long term.

Long-term survival and mortality changes in this alternative would be directly related to the age and sex of elk that migrate out of the park. As noted above, cows, calves and yearlings are more likely to migrate than bulls and possibly than older cows. A greater number of these elk would be lost to hunting. However, hazing may also increase the number of bulls lost to hunting and sharpshooting and would remove some bulls that do not typically leave the park.

For those elk that remain in the park, beneficial increases in calf survival and recruitment compared to the no-action alternative would occur. Adult survival may also increase--a benefit)--but the increase would not be as noticeable. This would be sustained over the life of the plan and beyond.

Cow elk and female calves, which lose body fat in high-density herds, may experience improvement in body condition. Ultimately, this could mean an increase in their ability to survive a harsh winter, should one occur, a benefit. Older elk and calves, which are particularly susceptible to the effects of harsh winters, may experience a benefit relative to the no-action alternative from increased forage and improved body condition.

Elk Behavior, Movements, and Distribution

This alternative involves both raising the now lowered section of fence in the park and installing gates along long sections of fence on the west and possibly east sides of the park. The gates would be installed where elk now appear to congregate, and may allow more natural migration patterns to redevelop, a long-term benefit for the entire herd and particularly for elk in the Boland Ridge area that to date have been less likely to leave the park. However, removing a higher proportion of elk that migrate now or raising the fence to seven feet along the now four-foot section of fence may also have minor adverse effects on the natural migration of elk in other parts of the park.

For those elk that are exposed to hunting and survive, activity may tend to increase during dawn and dusk and decrease during daylight. Elk may also occupy forested areas during resting or bedding. This behavior is true of the portion of elk in the park that migrate now (Varland et al. 1978), but is not true of elk in the Boland Ridge area, which tend to rest in open areas during mid-day.

They would also continue to avoid areas of concentrated human activity and open habitats, especially near roads, as they do now. Under the no-action alternative, elk may be more likely to occupy all available habitat, including that near roads if it is available and not associated with hunters or other danger. This is the case in Estes Park near Rocky Mountain National Park, where elk commonly graze along roadsides, on golf courses and park lawns, and in gardens (NPS 2006c). If this occurred under the no-action alternative in Wind Cave, implementing an alternative like alternative B where populations are kept under control would be a long-term benefit by returning elk behavior to a more natural state where roads and humans are avoided (Rumble 2001).

Archery hunting occurs during the elk breeding season (rut) and archers often attempt to imitate elk “bugling” and cow calls to lure animals within the range of archery equipment, about 40 yards. Bull elk exposed to excessive “bugling” by archery hunters often tend to reduce their own “bugling” activity especially during daylight hours. Therefore, in the long term, bull elk that return to the park may display a reduced level of “bugling” activity, especially during daylight hours, a minor effect on elk behavior, but a negligible effect on the elk population.

In the long term, the comparative beneficial effects of reducing the herd could be moderate as forage would become accessible and elk would expend less energy in forage competition. Elk would likely return to current conditions where they reduce or eliminate competition with other elk and with other ungulate species through the use of spatial separation or forage choices.

Chronic Wasting Disease

The prevalence of CWD in elk wintering in the park may decrease following the reduction of the herd through hunting. While a natural predator may preferentially remove sick animals from the population, human hunters would not intentionally do so. Therefore, hunting as a tool would not result in disproportionately lower prevalence rates of disease; rather, reductions in CWD would come simply from decreases in the number of infected elk and the density of the herd. Although the mechanism of transmission between elk is not fully understood, CWD behaves as a contagious disease (Miller et al. 2003) which indicates “horizontal” or animal to animal transmission is important. Lowering the density of elk in the park may decrease the risk of contact between animals, which in turn would lower risk of transmission and overall prevalence of CWD in the herd. In addition, lowering the number of elk in the park would also decrease the number of infected animals that may be shedding CWD prions into the environment. As noted in the “Affected Environment” chapter, prions in the environment appear to be very long lasting and a source of potential infection for cervids.

Hunting does offer some advantages over the other alternatives. There would be no requirement to capture and concentrate large numbers of elk, an action that would increase exposure of healthy elk to animals infected with CWD. This alternative would also eliminate any need to decontaminate capture and handling facilities and to dispose of potentially infected carcasses.

The intensity of beneficial impacts of hunting, reduced numbers and density on the risk of transmission of CWD and its prevalence in elk wintering in the park could be difficult to detect given the low rate of CWD currently found in elk within the Black Hills elk. However, the degree of impact could also be evident if the sample size is large enough to detect the change, as it would be during initial reduction. Therefore, when compared to the no-action alternative, impacts to elk herd health from reducing the risk of transmission of CWD and environmental contamination would be beneficial and long term. Less obvious benefits may occur in the Black Hills elk population through reductions in emigration of sick animals that would take place relative to the no-action alternative.

Cumulative Impacts

Cumulative impacts would be the same as those described for alternative A.

Conclusion

The impacts of increased hunting to elk health and survival would be minor to moderate, adverse, and could be long term. Compared to the no-action alternative, long-term benefits for the elk population wintering in the park from decreases in numbers and density would occur. In addition, benefits for the migratory portion of the herd as compared to later years of no action are likely. Individual elk would experience moderate or major adverse impacts from removal from killing by hunting, injury or separation during hazing, and from loss of a cow during a vulnerable time for calves. Hunting may remove a larger proportion of breeding age females than any other group, with negligible to moderate adverse effects on the age and sex structure of the population. Increases in calf:cow ratios compared to no action would be beneficial. Because sharpshooting would remove excess bulls inside the park, no impact to the bull:cow ratio is expected. For elk that remain in the park, beneficial increases in calf survival and recruitment compared to no action would occur. Beneficial increases in overall adult survival and in the survival of older or younger elk may also occur. Female elk may experience benefits from improved body condition and overall health. Installing gates in areas where the fence is seven feet high may restore more natural migration patterns, a long-term benefit especially for elk in the Boland Ridge areas, although raising the now four-foot high section of fence may have minor adverse impacts on these same patterns for elk in the southwestern part of the park where migration is ongoing. Reductions in competition from other elk or other ungulates compared to no action would increase access to forage and minimize energy expenditures--a benefit. Whereas the no-action alternative may cause elk to expand into spaces closer to roads and humans, implementing alternative B would return behavior to current natural conditions, perhaps particularly for elk in the Boland Ridge area, a long-term benefit. Minor effects on elk behavior and negligible effects on elk population resulting from a reduction in “bugling” may occur. A beneficial and long-term effect on elk health from reductions in density and the possibility of transmitting CWD would occur for elk in the park, and a similar benefit for elk outside the park.

Fencing and past predator elimination have changed distribution and herd size with adverse cumulative effects. Additional adverse cumulative effects from CWD on the former elk ranch adjacent to the park may have occurred; if so, these could have been offset somewhat by depopulation of the infected herd and by hunter harvest. Beneficial cumulative impacts include habitat enhancement, hunting and herbivore management.

Using the criteria presented in this chapter, there would be no impairment from impacts to the elk population as a result of implementing alternative B.

ALTERNATIVE C—ROUNDUP AND LIVE SHIPMENT OR EUTHANASIA

The focus of this alternative is the reduction and maintenance of the elk population through roundup and live shipment/donation or euthanasia.

Population Size and Density

The number and density of elk in the park would be reduced as in alternative B, but impacts from the roundup itself would be different than those from hunting. Elk would be chased sometimes long distances by helicopter over a three- to five-day period during initial removal. Separate roundups would be held for each region of the park allowing park officials to maintain the desired distribution.

There may be differences in the impacts to elk that prefer to occupy certain areas of the park (particularly females, and particularly in the northeastern part of the park) if roundup is the only method used. For example, the capture facility lies along the park’s northern border and so is much further from the Gobbler Knob area than either Beaver Creek or Boland Ridge. Therefore, reductions from these two northern areas may be somewhat larger with benefits to health, survivability, and reproduction, as described below.

Population Sex and Age Ratios

Using roundup, especially over a series of several days, may allow the park to selectively remove elk of various age classes to maintain a prescribed balance. Although generally all members of a group of elk would be rounded up at once, some would be allowed out of the corral facility to preserve this balance and to maintain desired distribution to the extent possible. Lead cows, migratory behavior and other desirable herd characteristics could also be preserved using this method. However, bull elk are more difficult to herd, and additional removals through sharpshooting inside the park are necessary (NPS 1980). Park managers have conducted elk roundups in the past when live shipment was an option, and have found them to be "an efficient and effective method with few drawbacks" (NPS 1980). The major drawback identified is the inability to consistently herd bulls. As with alternative B, where bulls are less likely to leave the park or respond to hazing, careful monitoring of the herds would be needed to ensure a particular balance of numbers and age and sex ratios in the herd. The bull:cow ratio is likely to increase over that in the no-action alternative under this alternative without selective removal of bulls by sharpshooters. As noted in alternative B, this could lead to more manageable harem sizes for bulls and better body condition.

Elk Capture Operation in Wind Cave National Park
Photo provided by U.S. Geological Survey

Reducing the density of elk in the park compared to no action would likely result in calf:cow ratios higher than the current 30-35:100. Under the no-action alternative, the calf:cow ratio and reproductive features that contribute to it such as pregnancy, calf survival and recruitment, would drop as the population approaches carrying capacity. Restoring them to a higher rate is a beneficial impact.

Whereas alternative B may inadvertently result in a disproportionate reduction in the number of breeding cows removed through hunting, alternative C would allow park managers to more selectively remove particular age classes. The removals would be done in a way that creates as natural of an age and sex structure as possible for the herd wintering in the park. Compared to no action, this may be a beneficial impact to the population structure.

Health, Survival, and Mortality

Roundup would push elk from their wintering grounds into the capture facility and would involve running several miles in some cases. During the roundup, elk may be panicked, or may trip or be otherwise injured. Herdmates could be separated, as could calves from cows. This would result in short-term minor to moderate adverse impacts.

As in alternative B, decreasing the number and density of elk in the park compared to no action would result in beneficial increases in calf survival and recruitment. Adult survival may also increase—a benefit--but the increase would not be as noticeable. This would be sustained over the life of the plan and beyond.

Cow elk and calves, which lose body fat in high-density herds, may experience improvement in body condition. Ultimately, this could mean an increase in their ability to survive a harsh winter, should one occur, a benefit. Older elk and calves, which are particularly susceptible to the effects of harsh winters, may experience a benefit relative to no action from increased forage and improved body condition.

Selective removals by park managers of elk captured during roundup may also alter the overall survival rate in the herd. For example, removing higher numbers of breeding age animals could reduce the overall survivability rate of the herd, as it would be composed of older and younger animals that are naturally more susceptible to natural causes of death. Conversely, they could increase the overall survival rate from what is discussed under the no-action alternative by selectively removing older animals and promoting a younger aged herd capable of surviving even very harsh winters. Impacts of this selective removal could range from negligible to moderate.

Elk Behavior, Movements, and Distribution

The short-term impacts of roundup would likely result in panic and injury for many of the elk corralled or transported live to a slaughterhouse. Those killed at the park by captive bolt would first need to be pushed into and immobilized by a narrow or squeeze chute. Bulls would likely have their antlers sawed off, although it is possible that because of the logistic difficulty of achieving this task, bull elk would be separated into different holding areas and shot with noise-suppressed rifles or would be shot by sharpshooters as they are being herded by wing fences into the corral area. These activities, including herding, corralling, pushing into chutes, removing antlers, as well as the captive bolt and exsanguination process itself would cause physiological and behavioral stress for virtually all captured elk. Reactions would include elevated heart rate, production of stress hormones and metabolism. Some elk would attempt to escape by scaling the chute walls, and some would be injured. Although antlers would be sawed off bulls before they enter the final chute, some injuries to other elk from antler wounds are likely. During roundup, elk may be driven by helicopter over long distances, with increased energy expenditure, exhaustion and separation from herdmates and/or calves occurring. These are short-term impacts, but may be moderate or major for individual elk.

In the long term, removing elk from the very large herd that would occur under the alternative C could have benefits as forage would become accessible and elk would expend less energy in forage competition. Elk would reduce or eliminate competition with other elk and with other ungulate species through the use of spatial separation or forage choices.

Chronic Wasting Disease

Resumption of roundups, coupled with euthanasia or shipment of elk to slaughter plants, could be an effective means of rapidly lowering the elk population. As the population density and numbers decrease, reductions in the risk of transmission between elk, or of contamination of the environment with CWD may also be reduced.

Advantages of this alternative include the ability to remove obviously ill animals, and to apply a live test when it becomes available. Such a test, the rectal biopsy, is currently under study. This would allow the park to remove infected animals and reduce the prevalence of CWD in the herd over time. Elk could also be tested for other diseases, such as brucellosis, and removed if found to be infected.

Elk that are not released at the corral site would either be shipped live to a slaughterhouse and processing facility where meat would be packaged and made available for donation, or they would be killed on site and the carcasses incinerated. Animals euthanized on site would be killed by shooting, or by captive bolt pistol followed by exsanguination or lethal injection. Modifications to the corral facility would be needed for safe and effective chemical euthanasia, handling and removal of carcasses, and for temporary containment of blood and other wastes that would be generated at the corral. Animal and carcass handling protocols would be established prior to field activities. Tractor-trailers would be capable of holding all animal waste and would be decontaminated according to standard protocols after delivery of animals to minimize risk of spreading CWD. These measures would minimize the risk of environmental contamination or CWD transfer to healthy elk.

Concentrating and stressing elk at capture facilities would increase exposure of healthy animals to CWD. Some of these may be among those elk released back into the park. In addition, concentrating animals in a small geographic area may increase the potential for contamination of the corral. This impact is likely to be minor and no more than moderate adverse if elk are not concentrated for longer than 48 hours (Powers 2007). Prescribed operating procedures would be needed for animal handling, decontamination, and carcass disposal to minimize risk of exposure.

Although selective removal does offer some advantages over alternative B, the benefits of alternative C are primarily related to the same reduction in density that alternative B would achieve. Therefore, similar to alternative B, long-term beneficial impacts to elk herd health in the park from lowered risk of transmission of CWD, and similar beneficial, short-term impacts on elk health outside the park would result.

Cumulative Effects

Cumulative impacts would be the same as those described for alternative A.

Conclusion

Under alternative C, long-term benefits relative to no action to elk from reductions in numbers and density would occur. Benefits from increases in the calf:cow ratio would occur, and increases in the bull:cow ratio are possible without careful monitoring or sharpshooting to remove bulls. Selective removals may return a natural age and sex structure--a benefit. Beneficial impacts from increased calf survival and recruitment, and from increased adult survival relative to alternative A would occur. Older elk and calves may experience a benefit from improved body condition and ability to withstand harsh winters. Benefits to specific age or sex classes could occur from selective removals. Short-term, minor to moderate adverse impacts from injury, energy expenditure, separation, and stress during the rounding up process, and additional moderate to major adverse impacts to elk from these same factors during the captive bolting process or transport to a processing facility would occur. Long-term reductions in density and numbers would have beneficial impacts for remaining elk by reducing competition and energy expenditure for forage. Short-term concentration of elk at capture facilities and exsanguination at the corral site would increase the possibility of CWD contamination, a minor to moderate adverse impact, but would also offer the opportunity for selective removal of animals exhibiting clinical signs of CWD and applying a live test, should one be developed. Reductions in density may, like alternative B, result in beneficial impacts on elk herd health both in and outside the park by reducing the likelihood of CWD transmission.

Fencing and past predator elimination have changed distribution and herd size with adverse cumulative effects. Additional adverse cumulative effects from CWD infected animals and soils at the former elk ranch adjacent to the park may have occurred; if so, these could have been offset somewhat by depopulation of the infected herd and by hunter harvest. Beneficial cumulative impacts include habitat enhancement, hunting and herbivore management.

Using the criteria presented in this chapter, there would be no impairment from impacts to the elk population as a result of implementing alternative C.

ALTERNATIVE D—SHARPSHOOTING

Under this alternative, sharpshooting within the park would be used to reduce and maintain the elk herd at target population levels.

Population Size and Density

Initial reduction efforts under this alternative would be spread out over several months for up to five years. This is because only about 25 elk can be shot and sling loaded to a central location on average per day. This means population reduction would be less extreme than in alternatives B or C, and the benefits of lowered numbers and density would likely not take place until year four. However, alternatives B and C may also require several years for the initial reduction phase, and so impacts between the alternatives to the population are not noticeably different.

Currently, elk in the Boland Ridge area behave as if they are unhunted; that is, they spend time bedded down in more open grassland areas and do not make as much use of forested or forest-edge habitats as do elk in the rest of the park during the winter, when sharpshooting would likely take place (Varland et al. 1978). Female elk also have been shown to be more likely to feed in open grasslands and stray from forested edge habitat (Lagueux 2002). It is possible that these easier targets would be more likely to be removed by sharpshooters, especially during initial reduction when efficiency would determine which elk are shot. This may mean that the long-term effects of reducing the number and density of elk compared to no action would be unevenly distributed, with elk from the Boland Ridge area experiencing more noticeable beneficial impacts from reduction in the size of the population. As maintenance sharpshooting would be more selective, these benefits should even out across the herd after a few years.

Population Sex and Age Ratios

Sharpshooters would target animals opportunistically in the initial reduction phase. Since cows and cows with calves are more likely to feed in the open than bulls, the sex ratio may change to favor bulls in the first few years compared to the no-action alternative. However, as sharpshooters become more selective in the maintenance phase, the bull:cow ratio would be maintained at whatever level park managers believe is most natural or desirable, a possible benefit to the herd structure.

Initial reductions and maintenance may also target calves, initially because calves would be in the open feeding with their mothers, and in the maintenance phase because it may be desirable to leave calf carcasses in the environment. This alternative calls for leaving up to 40–60 elk carcasses in the field each year. Leaving calf carcasses may be the safest option since CWD has not yet been found in elk calves less than about 6 months old (R. O’Sullivan 2007).

Compared to no action where density dependent changes to pregnancy (as well as calf survival and calf recruitment) could occur in later years, alternative D would result in a comparative increase in reproductive success and a concomitant increase in the calf:cow ratio--a beneficial impact to herd structure.

During the maintenance phase, alternative D would allow park managers to selectively remove not only bulls or cows, but particular age classes. The removals would be done in a way that creates as natural or desirable an age structure as possible for the herd wintering in the park. Compared to no action, this may be a beneficial impact to the population structure.

Health, Survival, and Mortality

As with other action alternatives, decreasing the number and density of elk in the park compared to no action would result in long-term beneficial increases in calf survival and recruitment. Adult survival may also increase—a benefit—but the increase would not be as noticeable. This would be sustained over the life of the plan and beyond.

Cow elk and calves, which lose body fat in high-density herds, may experience improvement in body condition and overall health. Ultimately, this could mean an increase in their ability to survive a harsh winter, should one occur, a benefit. Older elk and calves, which are particularly susceptible to the effects of harsh winters, may experience a benefit relative to no action from increased forage and improved body condition.

Selective removals by agency sharpshooters may also alter the overall survival rate in the herd. For example, removing higher numbers of breeding age animals could reduce the overall survivability rate of the herd, as it would be composed of older and younger animals that are naturally more susceptible to natural causes of death. Conversely, selectively removing older animals and promoting a younger aged herd capable of surviving harsh winters would improve overall survival rates in the herd. Impacts of this selective removal could range from negligible to moderate adverse to beneficial.

Elk Behavior, Movements, and Distribution

Sharpshooters would likely use noise-suppressed rifles to kill elk. This would minimize disturbance of elk in a group and help to maximize efficiency. It is possible that elk even nearby those that are shot would remain in the area, as sharpshooters would attempt to kill elk from as far away as the rifle remains accurate and so human scent or activity would be undetectable. Sharpshooting with suppressed rifles would also potentially minimize stress-related impacts described above for alternative C, however there may be times when unsilenced shooting may aid in redistributing the population away from selected areas.

Because initial reductions would be geared to maximize removals, elk that forage in the open during winter months are more likely to be shot. This is likely to result in an increase in wariness and perhaps greater use of forested areas. If elk are aware of sharpshooters they may also become more difficult to find. Although this would make removals more difficult, wariness and avoidance of people is natural elk behavior, and a beneficial impact of this alternative compared to no action.

Helicopters used to remove carcasses would also cause temporary disturbance of remaining elk in the vicinity, a short-term, minor adverse impact.

In the long term, removing elk from the very large herd that would occur under the no-action alternative could have benefits as forage would become accessible and elk would expend less energy in forage competition. Elk would likely return to current conditions where they reduce or eliminate competition with other elk and with other ungulate species through the use of spatial separation or forage choices.

Chronic Wasting Disease

In the long term, alternative D may reduce the risk of CWD transmission between elk through a reduction in density, and the likelihood of environmental contamination from a reduction in numbers. Sharpshooting has the advantage of selective removal of elk, allowing some control over the health status of the population. Culling elk by sharpshooters would not be quite as selective as roundups, since animals are shot from a distance rather than being handled.

A potential disadvantage of sharpshooting is the need to dispose of a large number of elk carcasses. Some of these carcasses could be infected with CWD, posing a potential risk to deer and elk herd health if they are left in the field. However, as long as too many carcasses are not left at one time, animals such as coyotes, crows, magpies, and other scavengers would quickly remove most CWD-contaminated tissues. The park estimates that up to 40–60 carcasses could be left annually without attracting too many scavengers, excessively concentrating CWD infectious material, or causing aesthetic concerns. This number is less than the projected annual population growth of 10%–12% for an elk herd of 350, and greater than negligible impacts to elk health from leaving carcasses in the field during maintenance phases are not expected. Also, as noted above, if all or the majority of carcasses remaining in the field are younger calves, the potential for CWD contamination would be reduced. Removal of excess elk carcasses from the park would require handling and disposal of carcasses potentially infected with CWD but would mitigate the risk of contaminating the environment with infectious material as incineration would be an effective means of disabling prions if temperatures are high enough (see the "Air Quality" section in this chapter).

If sharpshooting were used as the sole means of elk population reduction and maintenance, there would be no requirement to capture and concentrate elk or modify capture and handling facilities. This would also apply if sharpshooting were used in combination with hunting outside the park. Both scenarios would eliminate capture stress to elk, as well as the potential for transmission of CWD to healthy elk exposed to infected animals at handling facilities.

Overall, this alternative would result in beneficial, long-term impacts on elk herd health within the park, and beneficial, short-term impacts on elk health outside the park.

Cumulative Effects

Cumulative effects of this alternative would be the same as described for alternative A.

Conclusion

The long-term benefits of reducing the population of elk would be similar to other action alternatives. The Boland Ridge may experience more noticeable benefits from initial reduction. As with other alternatives, benefits to the population structure compared to no action from reductions in density dependent physiological changes and increased calf:cow ratio would occur. Selective shooting during maintenance would also allow park managers to attain the most natural bull:cow ratio and age distribution, a benefit to herd structure. Long-term beneficial increases in calf survival and recruitment and in increases in adult survival relative to no action would occur from reducing herd numbers and density. Improved body condition and survivability for cow elk, calves and older elk are possible, resulting in beneficial effects. Selective removals during maintenance could also affect age and sex structure and survival rate herd-wide, with negligible to moderate, adverse or beneficial impacts. The use of noise-suppressed rifles would eliminate or limit stress-related behavior or changes in movements and distribution. If changes do occur, they would be in keeping with natural elk behavior, a beneficial change relative to no action. Helicopters would result in short-term minor adverse impacts to elk distribution and behavior. In the long term, reductions in density would improve access to forage and lower energy used to compete for it, a benefit for elk health and survivability. Benefits to elk health inside and outside the park from reductions in the risk of transmitting CWD would occur relative to no action.

Fencing and past predator elimination have changed distribution and herd size with adverse cumulative effects. Additional adverse cumulative effects from CWD on the former elk ranch adjacent to the park may have occurred; if so, they could be offset somewhat by depopulation of the infected herd and by hunter harvest. Beneficial cumulative impacts include habitat enhancement, hunting and herbivore management.

Using the criteria presented in this chapter, there would be no impairment from impacts to the elk population as a result of implementing alternative D.

ALTERNATIVE E—CONTRACEPTION (STERILIZATION) (MAINTENANCE ONLY)

This alternative would be implemented solely to maintain elk at target population goals after initial reduction (alternatives B–D) through permanent sterilization of a predetermined number of the park's reproductive female elk population. At this time, sterilization has not been proven through science to effectively manage wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Population Size

The beneficial effects of initial reduction would be those described above for alternatives B, C, or D.

Elk that prefer to winter in the Boland Ridge area appear to be non-migratory and the majority of cows remain in the park in the summer. Because they are not susceptible to hunting outside the park (where the expense of sterilization could be wasted if the elk is taken), members of this group of elk may be the best candidates for sterilization. This may be especially true of the first few years of maintenance, when sterilization would be considered experimental. Maintaining the number of elk wintering at Boland Ridge may offer beneficial impacts relative to the remainder of the herd (which would continue to grow and compete for resources) in this alternative.

The number of elk each year that require sterilization would vary depending on the initial size of the herd, number of reproductively aged females, recruitment (including through migration) and rate of increase per year. Modeling to determine the number of elk treated each year would be an important step in preventing the herd from growing beyond the objectives established by the Science Team while ensuring it persists. Modeling for a similar alternative to maintain fallow deer populations at Point Reyes National Seashore at 350 animals using permanent chemical contraception found that about 20 animals per year would need to be treated. Doing so at Wind Cave would remove nearly all females born to a population of 350 elk (assuming an 11% increase per year), and would eventually result in the extirpation of the herd. Therefore it is likely that fewer than 20 elk would require treatment each year, or that treatment would be needed less frequently than each year. The park may elect to sterilize a larger number in the early years of maintenance rather than treat them annually.

A potential disadvantage to this approach and to all action alternatives that maintain the population at a relatively static level is that, under natural conditions, the population fluctuates in size. Even when it has reached or is approaching the carrying capacity, under natural conditions winter or predator kill would remove many animals in a single year and the herd would increase pregnancy rates, calf survival and recruitment over the next few seasons to increase beyond the carrying capacity. Keeping the herd “trimmed” of too many reproductively aged females or calves would remove this natural fluctuation and be outside the natural range of variability typical of ungulate herds. However, this effect could be mitigated by allowing the herd size to increase naturally over a few years beyond the average 350 and then using sterilization (or sharpshooting in alternative D, for example) to reduce it size to a level nearer to 275. This is the intent of the Science Team and the park, and so no impact to this natural cycle is expected.

Population Sex and Age Ratios

Surgical sterilization would only be used on breeding age cows. Surgical sterilization procedures addressed here (tubal ligations, ovariectomies) are highly invasive and stressful to the animal and could result in moderate mortality rates that may approach 5%–20% (Powers 2006). This could result in a higher bull:cow ratio than under the no-action alternative, and could skew the age ratio to favor older and younger aged females not subject to the procedure

Because fewer cows would be reproductively capable, the calf:cow ratio herd-wide would be lower than it is now, but higher than under the no-action alternative. Because the herd would likely be allowed to increase in size and then be reduced every few years, the beneficial effect of this reduction would not be readily apparent compared to no action.

Health, Survival, and Mortality

As noted, surgical sterilization is invasive and stressful for elk, and can result in abortions in pregnant elk as well as a moderate number of deaths. Two methods to sterilize elk are possible, with relative benefits and costs to the animals.

The first method involves a tubal ligation, leaving the ovaries. This allows the animal to continue their breeding cycle and go through the rut, but it may artificially extend the rut (i.e., bulls would want to breed longer). Because this is an invasive abdominal procedure, animals would be placed under anesthesia. Sutures related to flank incision procedures take approximately two weeks to heal. Risk of infection to the animal is elevated over that associated with ovariectomies (see below). It is projected that about four elk per day, per veterinarian could be treated with this method (Powers 2006).

The second method, an ovariectomy, would stop hormone production and normal breeding behavior. There is a possibility that some of the bowel may be caught in the procedure which would be fatal for the animal. This procedure may require anesthesia, however this is unknown as ovariectomies have not been performed on standing elk. This method is relatively quick, allowing for the treatment of approximately 10–30 elk a day. As noted above, it is likely that fewer than 20 elk per year would require treatment.

For either method (tubal ligations or ovariectomies), a 24-hour observation period is recommended to identify animals with excessive bleeding or other post-surgical complications (Powers 2006).

As these techniques have not been used on elk, experimentation on a small sample of animals would likely occur in the first few years, particularly for the ovariectomy method in standing elk. Sterilization would likely take place in January to minimize heat stress, although either technique would result in abortion if females are pregnant (Powers 2006).

Capture of females could be accomplished by helicopter roundup. Squeeze chutes would be used to immobilize the cows and an epidural and a local anesthetic would be administered to each animal.

The use of sterilization on cow elk would result in some deaths, a moderate adverse herd-wide impact. In addition, the use of roundup, corrals, squeeze chutes and the procedure itself are all activities that are stressful for elk. These impacts are adverse, short term, and can be minor to moderate in intensity.

Back-up sharpshooting may also be required to ensure the proper number of reproductive animals are removed each year. If so, selective removals by agency sharpshooters may also alter the overall survival rate in the herd. For example, removing higher numbers of breeding age animals could reduce the overall survivability rate of the herd, as it would be composed of older and younger animals that are naturally more susceptible to natural causes of death. This is a negligible to minor adverse impact to the overall survival rate of the herd.

As with other action alternatives, maintaining the lowered numbers and density of the herd would result in continued benefits in herd health and survivability brought about by the initial reduction. Adult and calf survival may experience continued benefits from maintenance.

Elk Behavior, Movements, and Distribution

The short-term impacts of roundup as well as the sterilization procedure itself would likely result in panic and stress for captured elk. These activities, including herding, corralling, squeezing into chutes, medicating and sterilization would cause physiological and behavioral stress including elevated heart rate, production of stress hormones and elevated metabolism. Some elk may attempt to escape by scaling the chute walls, and some would be injured. During roundup, elk may be driven by helicopter over long distances, with increased energy expenditure, exhaustion and separation from herdmates and/or calves occurring. These are short-term impacts and have negligible impacts herd-wide, but may be moderate or major for individual elk.

The long-term benefits from increasing access to forage and reducing competition that would allow elk to maintain separation from other ungulates through spatial means would be true of this alternative as well. Instead of roundup, hunting or sharpshooting, reducing the number of live births would be the means to do so.

Use of helicopters to capture cows to be sterilized would cause a minor, short-term disturbance to other elk in the area. Surgical sterilization by ovariectomy, but not tubal ligation, would eliminate cow elk breeding behavior, but would not affect movements or distribution. Overall, this alternative would have a minor, long-term adverse effect on behavior, but negligible effects on elk movements and distribution.

Chronic Wasting Disease

As with alternative C, elk would be temporarily concentrated in the capture facilities in alternative E, increasing the potential for CWD exposure and contamination of the corral. This is likely to be a minor and no more than moderate adverse impact if elk are not concentrated for longer than 48 hours (Powers 2007). Using sterilization to keep herd numbers low would result in benefits to herd health from decreased density and reductions in the risk of transmitting CWD for elk inside and outside the park.

Cumulative Effects

Cumulative impacts would be the same as described in alternative A.

Conclusion

The beneficial effects of initial reduction would depend on the method used. Because elk in the Boland Ridge area are less migratory and better candidates for sterilization, benefits from reductions during maintenance for elk in this location are possible. Because only females of reproductive age would be sterilized, the bull:cow ratio could be higher than under the no-action alternative. Although the calf:cow ratio would be higher than under no action, it would not be as high as it is currently. This is a benefit relative to no action. Minor to moderate adverse impacts to cow survivability from the procedure itself are possible, although moderate to major short-term adverse effects to the individual health of treated cows from stress related to roundup and treatment are also possible. Removal of breeding age cows may lower the overall survival rate of the herd by leaving older and younger animals, both of whom are more susceptible to natural causes of death, a negligible to minor adverse impact. Minor short-term adverse effects on elk movement and distribution from the use of helicopters during roundup are possible. Over the long term, this alternative would continue benefits to the elk population and herd health from reducing densities and increasing available forage relative to no action. The risks of contaminating the corral and of CWD transmission to healthy elk while they are in the capture facility during and following treatment would increase, a minor to moderate adverse impact. Alternative E would also continue benefits for elk health from reducing the risk of transmitting chronic waste disease for elk inside the park and in the region.

Using the criteria presented in this chapter, there would be no impairment from impacts to the elk population as a result of implementing alternative E.

ALTERNATIVE F—FERTILITY CONTROL AGENT (MAINTENANCE ONLY)

Under this alternative, cow elk would be treated with chemical fertility control agents solely to maintain the elk population at target goals once initial reduction efforts (alternatives B–D) are completed. At this time, fertility control agents have not been effective in controlling population growth in large free-ranging populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Population Size

The beneficial effects of initial reduction would be those described above for alternatives B, C, or D.

Chemical contraception would target animals that are most likely to remain in the park year-round to minimize the chance of them being hunted outside the park. As noted above, these are elk in the Boland Ridge area. As a result, elk in this area are more likely to experience more consistent reductions and continued benefits to the population as a result of reductions.

The number of cows each year that require treatment would vary depending on the size of the herd, number of reproductively aged females, recruitment (including through migration), effectiveness of the contraceptive method used, and rate of increase in the population per year. Modeling to determine this number would be an important step in managing the herd size. Modeling for a similar alternative to maintain fallow deer populations at Point Reyes National Seashore at 350 animals using chemical contraception effective for four years found that about 25% of fertile females would need to be treated at each application to maintain the herd size (NPS 2006l). Using figures from Bauman (1997), about 43% of the population at Wind Cave are cows. Assuming 75% of these cows are of breeding age and a population of 350, 25–30 cows would need to be treated every four years. The long-term effect of this treatment on the population would be to continue the benefits described above resulting from initial reduction.

Although one criterion of using any chemical contraceptive is that it must have multi-year effectiveness, no such product is currently available. Therefore, for "reasonable worst-case scenario" costing purposes, the "Alternatives" chapter describes the number of annual elk requiring treatment if the fertility control agent is only effective for a single year. Should the park decide to use a single-year agent, about 125 cows would require treatment every year.

Population Sex and Age Ratios

As in alternative E, the calf:cow ratio would be reduced through the use of chemical contraceptives. Effective treatment could mean the ratio would drop to levels lower than are currently the case (35:100) and similar to those that might occur in the later years of the no-action alternative as density dependent factors keep the population from growing. This is a benefit from maintaining population size through chemical contraception.

The age structure of the population would also shift to older adults as fewer calves each year would be born.

Health, Survival, and Mortality

Potential agents for future fertility control use include a longer-lasting form of Leuprolide acetate (Leuprolide). Leuprolide currently exists as a single-breeding season agent which acts to suppress the secretion of a reproductive hormone (lutienizing hormone - LH). It is approved for therapeutic use in humans and has been shown to successfully suppress ovulation and pregnancy in cow elk for one breeding season (Baker, et al. 2002). Treatment can be accomplished by hand injection and would likely require the use of a capture facility. Treatment with leuprolide or similar pharmaceuticals would likely require permanent marking of each animal to aid in identifying them in subsequent years and to inform hunters of the chemical treatment and the withdrawal date after which human consumption would be considered safe.

GonaCon™, an immunocontraceptive vaccine, is a potential multi-year (possibly up to three years) agent which works by producing antibodies that attack proteins related to fertility (gonadotropin releasing hormone - GnRH), rendering the animal infertile. It has been shown to be effective in various wildlife species, with one dose. Clinical trials are currently underway in elk. All treated cow elk would require long-term marking (ear tags, freeze branding, passive transponders, etc.) as this agent is not yet approved for use in any wildlife species. Treatment can take place throughout the year (Powers 2007). The use of a capture facility would be necessary.

Because a condition of their use is that they be safe for target and non-target animals, no impact to elk health is anticipated from application of either these or any other agent. It is possible that the body condition and ability to withstand harsh winters would improve in cow elk overall, as fewer would expend energy in caring for and nursing calves. This is a benefit to this segment of the population. If elk are pregnant when a chemical contraceptive is applied, abortion would very likely result.

As with other action alternatives, maintaining the lowered numbers and density of the herd would result in continued benefits in herd health and survivability brought about by the initial reduction. Adult and calf survival may experience continued benefits from maintenance.

Elk Behavior, Movements, and Distribution

The stress, exhaustion, injury and separation from herdmates and calves associated with the use of roundup would occur under this alternative and would have minor to moderate short-term, adverse effects on the health of captured animals.

The long-term benefits from increasing access to forage and reducing competition that would allow elk to maintain separation from other ungulates through spatial means would be true of this alternative as well. Instead of roundup, hunting or sharpshooting, reducing the number of live births would be the means of do so.

Use of helicopters to round up cows would cause a minor, short-term disturbance to other elk in the area. Overall, this alternative would have a minor, long-term adverse effect on behavior, but negligible effects on elk movements and distribution. Repeated handling of some cow elk every few years may result in increases in wariness, a beneficial effect in restoring more natural elk behavior.

Chronic Wasting Disease

The effect of chemical contraception on the incidence of CWD in the elk herd would be incremental, and would depend on the degree to which this method is responsible for maintaining the elk population within the range of management objectives. Overall, it is likely to provide the same continuation of benefits to elk inside and outside the park by reducing the numbers and density of elk in the herd. These benefits may be most obvious to elk in the Boland Ridge area. Concentrating animals in the capture corral may also increase the chance of exposure to sick animals and environmental contamination of the corral. Impacts are likely to be minor but not more than moderate and adverse if elk are not kept corralled for longer than 48 hours (Powers 2007).

Cumulative Effects

Cumulative effects would be the same as described in alternative A.

Conclusion

The beneficial effects of initial reduction would be those described above for alternatives B, C, or D. Larger scale continued benefits would likely be experienced by elk that tend to stay in the park year-round, such as at Boland Ridge. Benefits relative to no action from an increased calf:cow ratio would occur. Because contraceptives would need to be safe for target and non-target animals, no impact from their application to herd health is expected, although cow elk may on average experience slight improvement in health and survival rates, a benefit. Adult and calf survival may experience continued benefits from maintenance through contraception. Minor to moderate short-term adverse effects to individual elk from roundup would occur; helicopter noise is expected to result in minor adverse effects to elk in the vicinity of roundup operations. Over the long term, this alternative would continue benefits to the elk population and herd health from reducing densities and increasing available forage. Maintenance through contraception would continue benefits to elk health from reducing the risk of transmitting chronic waste disease. Concentrating elk in the capture facility may increase the risk of transmission, both through the release of treated elk and contamination of the corral itself. The impact is likely to be no more than moderate if elk are kept no longer than 48 hours.

Using the criteria presented in this chapter, there would be no impairment from impacts to the elk population as a result of implementing alternative F.

SOILS AND WATER QUALITY

GUIDING REGULATIONS AND POLICIES

NPS *Management Policies 2006*. Soils are fundamental natural resource components whose integrity is addressed within the scope of numerous NPS policies and guidelines, specifically Chapter 4, Natural Resource Management, Sections 4.6 (Water) and 4.8 (Soils) in NPS *Management Policies 2006* (NPS 2006d). Section 4.8.2.4 states "Management action will be taken by Superintendents to prevent or at least minimize adverse, potentially irreversible impacts on soils." The policies specifically direct parks to prevent the "unnatural erosion, physical removal, or contamination of the soil or its contamination of other resources" (sec. 4.8.2.4).

NPS Management Policies direct the protection of soils and water quality.

The protection of water quality is addressed in section 4.6.3 of the NPS *Management Policies 2006*, as well as the federal Clean Water Act. Section 4.6.3 of the Policies states that park units will "take all necessary actions to maintain or restore the quality of surface waters and ground waters within the parks consistent with the *Clean Water Act* and all other applicable federal, state and local laws and regulations." Enforcement of the *Clean Water Act* is taken on by states following the approval by the Environmental Protection Agency of an implementation plan and occurs by establishing standards to protect public health and safety, as well as for the benefit of fish and wildlife.

METHODOLOGIES AND ASSUMPTIONS FOR ANALYZING IMPACTS

Geographic Area Evaluated for Impacts

The geographic area evaluated for impacts to soils is the park. The geographic area evaluated for water quality includes three above ground streams that flow inside park boundaries. The impacts of activities outside the park along the stream corridors were included in the discussion of cumulative impacts.

Issues

- Vehicles used in elk management, or elk themselves can compact soils and increase bulk density, increasing the potential for erosion
- Elk can add nutrients to soils and change their chemical makeup
- Elk grazing can remove vegetation which holds soils in place and thereby increase erosion, with increases in suspended sediment resulting.
- Elk congregating in riparian areas may add nutrients to streams or stream banks

Assumptions

- Elk are distributed throughout the park, but prefer grassland areas
- Elk numbers may be very high under the no-action alternative, and elk may occupy less desirable sites in later years
- Elk would congregate along waterways in warm months.

Assessment Methods

Agency and NPS literature and reports were consulted to identify where aboveground streams in the park were located and the degree to which elk used them in the different seasons. These same sources, as well as the scientific literature, environmental assessments and the Natural Resources Conservation Service website were consulted for soil properties, erodibility and existing water quality. Thresholds were developed in consultation with contractors and the NPS, and applied to determine the extent of these impacts under each alternative scenario. Best professional judgment was used in assigning impacts.

Impact Threshold Definitions

Negligible: The physical or chemical property of soils or water quality would not be affected, or the effects would be at or below the levels of detection. There would be no discernable effect on the rate of soil erosion or the ability of the soil to support native vegetation. Chemical, physical, or biological changes would be well below water quality standards or criteria, and would be well within the historical or desired water quality conditions.

Minor: Changes in the physical or chemical property of soils or water quality would be detectable. There would be measurable effects on the rate of soil erosion or the ability of the soil to support native vegetation. Chemical, physical or biological changes would be well below water quality standards or criteria and within historical or desired water quality conditions.

Moderate: Changes in the physical or chemical property of soils would be readily apparent, and there would clearly be changes in the rate of soil erosion or the ability of the soil to support native vegetation. Chemical, physical or biological changes to water quality would be detectable but would be at or below standards or criteria; however, historical baseline or desired water quality conditions would be altered on a short-term basis.

Major: The physical or chemical property of soils would be substantially changed, and there would be clearly highly noticeable changes in the rate of soil erosion or the ability of the soil to support native vegetation. Chemical, physical or biological changes to water quality would be detectable, would be frequent and would be often altered from the historical baseline or desired water quality condition. Water quality standards or criteria may be slightly and singularly exceeded on a short-term basis.

Impairment: Chemical or physical changes to soils or the rate of erosion and threat of loss, or changes to the physical, chemical or biological properties of park water resources would be so adversely affected that the park purpose could not be fulfilled, or resources could not be experienced and enjoyed by future generations.

Duration of Impact

Short-term: Occurs only through the duration of treatment.

Long-term: Continues beyond the duration of the treatment.

ALTERNATIVE A—NO ACTION

Under the no-action alternative, existing elk management actions (monitoring, targeted surveillance) would continue with no additional efforts implemented to address the size of the elk population and its effect on park resources.

Soils

Soil characteristics include their physical properties, as well as their chemical and biological make-up. In high numbers, elk can potentially alter all three.

For example, heavy use of an area by ungulates can result in increased compaction of soils, increases in bulk density and loss of vegetation, which in turn can lead to bare ground, drier soils and erosion and loss (Singer et al. 2002). Ungulates can also change the chemical makeup of soils through the addition of waste products, and grazing can exert indirect and less understood changes in chemical and biological soil characteristics related to the physiological response of vegetation.

Climate and topography are major factors influencing soil moisture and temperature. The movements of wind and water along topographic gradients also help determine moisture, as well as texture and nutrient content. These influences on natural soil characteristics and distribution in turn can affect patterns of plant production, leaf chemistry and plant species distributions, which then influence nutrient levels of carbon and nitrogen in soils (Frank and Grossman 1998).

Soils in the project area are generally shallow, well-drained silts and loams, with some rock outcropping and some wetter areas in the northern part of the park. The smaller the particles making up the soil, the lower capacity it has for water infiltration and storage. Loams and silts, for example, are composed of small and/or medium sized particles (generally less than 20 μm in size).

Soil compaction may occur when large numbers of elk congregate in one area for long periods of time. Some ungulates including elk are known to occupy habitats, particularly riparian areas, for several weeks during the rut, and damage to soils and vegetation is evident in these locations, as is true for non-native deer in Point Reyes National Seashore (NPS 2006l). Studies of the relationship of elk to park resources in Rocky Mountain National Park did find increases in bulk density, the indicator of compaction, in both the uppermost 15 centimeters of soil and in the layer which lies between 15 and 30 cm (Binkley et al, 2002). Across all vegetation types studied, this difference was about 9% in the uppermost layer, and about 6% in the 15–30 cm stratum. Although an earlier study of elk and their impact on grassland soils in Yellowstone National Park (Frank and Grossman 1998) did not find any change in bulk density in the upper 10 centimeters, re-examination of the data with a focus on only the first five centimeters did show a 30% increase in grazed areas (Binkley et al. 2002). An increase in bulk density from compaction reduces infiltration rates, which in turn increases runoff during storm events and erosion of vulnerable soils.

Large concentrations of ungulates exacerbate this problem by trampling vegetation or removing it through grazing. Without the binding function roots serve, soils are no longer held in place and are more subject to erosion during precipitation events. In Point Reyes National Seashore, park biologists have observed more erosion along trails and in rutting areas where vegetation has been removed by deer trampling and antler thrashing (NPS 2006l). Rocky Mountain National Park researchers found 4.6% more bare ground on grazed sites than those that had been fenced following four years of protection (Singer et al. 2002). Once initiated, compaction and soil loss from erosion can last for a long period of time. This is because vegetation is less likely to grow in soil that has been compacted, or where top organic layers have been removed through erosion. This long-term cycle of erosion and vegetation loss occurs particularly when compaction and/or erosion are severe (NPS 2006l).

If elk are unregulated, their numbers would increase, perhaps dramatically, over the lifetime of this plan. Shrubs, including willows and other riparian vegetation, may become increasingly more favored by elk, and denudation of all vegetative types through trampling and grazing more common. Soils in the northern part of the park are on average more erodible than in other locations and may be particularly affected by a larger herd size. Even so, it is unlikely that any area, including riparian areas, would experience greater impacts to soil compaction or from erosion through the creating of bare ground than are currently experienced at Rocky Mountain National Park. At Rocky Mountain National Park, elk are at carrying capacity, and congregate at very high densities in riparian areas to browse willows. Yet, even in these most affected locales in the park, bulk densities are only slightly higher (1.7%) and area of bare ground only 4.6% higher in grazed than ungrazed similar spots (NPS 2006c). Therefore, although adverse impacts could be minor or perhaps even moderate in some isolated spots, on a park-wide basis, changes to physical properties of soils from elk grazing would be negligible under the no-action alternative.

Elk can change the chemical, and indirectly the biological, characteristics of soil as well. Both elk urine and feces contain high levels of nitrogen. Although nitrogen is returned to soils in the form of plant litter, mineralization or breakdown of this plant material and release of its nutrients, occurs over several months or even years in some ecosystems. However, nitrogen and other nutrients in elk waste products are immediately available to plants for uptake. Net nitrogen mineralization was higher in soils where elk grazed in Yellowstone National Park by up to 4.5 times those in ungrazed soils. Average net nitrogen mineralization was 3.8 grams of nitrogen/square meter per year on grazed plots compared to 1.9 g N/square meter per year on ungrazed plots, about double (Frank and Grossman 1998).

Researchers have traditionally concluded this increased nitrogen availability is a function of inputs from urine and feces. Nitrogen availability has been found to be a principal and limited resource in grasslands (Frank and Grossman 1998). For example, elk in Yellowstone migrate from low elevation winter range to high elevation summer range following young, nitrogen-rich forage (Hamilton and Frank 2001). Therefore, researchers have speculated that areas where elk graze would begin a cycle of increased future use, as uptake by grasses produces more nutritious forage, encourages additional elk grazing and waste deposition and again uses the labile nitrogen to produce richer food that is limited in this ecotype.

Although localized increases in nitrogen results from inputs from waste products, landscape scale nitrogen increases on grasslands result from elk grazing (Hamilton and Frank 2001). Because waste products are not deposited equally across the landscape, a wider-scale phenomenon associated with grazing in grasslands and responsible for nitrogen increases has been sought and found.

In addition to direct changes in soil nutrients, elk grazing can cause the initiation of processes that ultimately modify the amount of carbon and nitrogen available in soils. When a blade of grass or the leaves or shoots of shrubs or forbs are removed through grazing, the root of a plant re-allocates its energy toward regrowing these elements, without which photosynthesis cannot occur. Grazing grasses above ground is known to stimulate the exudation by roots of sugars, amino acids, organic acids and other products used readily by microbes which live in the plants rhizosphere, or space immediately adjacent to the root (Hamilton and Frank 2001). In the process of breaking down these products exuded by the root, microbes release additional soluble carbon and nitrogen, which is then available to the plant. The landscape scale increase in nitrogen in above ground shoots and grasses across an entire grazed area is consistent with this cycle, and is believed to explain how grazing increases the net mineralization of nitrogen and its availability to plants. Assuming elk numbers stabilize at a food based carrying capacity under this alternative, the addition of nitrogen and other nutrients from this process would result in a landscape scale beneficial impact to the chemical characteristics of soils in grassland areas of the park.

Water Quality

Two streams cut across Wind Cave National Park, Beaver Creek and Highland Creek (see figure 13). These are the primary sources of surface water in the park, although several seeps and springs are also used by elk and other wildlife. Cold Spring Creek joins Beaver Creek before it crosses the Madison Limestone outcrop in the west end of the park.

Elk can affect water quality indirectly through some of the changes described above for soils. Trampling of vegetation by elk can eventually result in its removal, and the soil-binding ability of its roots. Vegetation also reduces the force of rain (rainsplash) and can trap sediment. The combination of increased compaction and the loss of vegetation often results in increased bare ground and increased erosion of soils. Trampling by ungulates of the stream bank can also physically destabilize the bank itself, making it more susceptible to sloughing into streams and adding to sedimentation. In addition, bank vegetation helps keep water temperatures cool, and its loss can mean both an increase in temperature and a reduction in dissolved oxygen. Elk can also directly affect water quality from waste input.

As with soils, riparian areas are particularly vulnerable to water quality impacts, particularly during the summer when ungulates congregate in these areas to cool off and graze on vegetation that has retained more of its moisture (Hubert et al. 1992). Elk also may use riparian corridors for travel routes or resting in the fall, and bulls may use streams and streamside areas for wallowing during the rut. Because loosened soil or waste products in soils in a riparian corridor have only a short distance to travel before they become part of the water column, the congregation of elk in these habitats may result in particularly intense impacts to water quality.

Increases in suspended sediment can affect not only water quality, but its ability to sustain stream flora and fauna. Light is less able to penetrate turbid water, and this can reduce the photosynthetic ability of microscopic floating plants. Decreases in these “primary producers” can also influence secondary consumers, such as macroinvertebrates and fish. Increases in suspended sediment can directly and indirectly affect fish through reducing gill function and impairing the ability of visual feeders such as trout to locate prey.

Sediment can also settle out and cover gravel substrates, eggs or young fish and decrease the ability of fish to reproduce or to survive. Settled sediments can also act as a sink, carrying bacteria, nutrients and organic matter which often adhere to them, to the bottom of a stream. Storm events can cause re-suspension of these materials, with temporary adverse effects to aquatic organisms and water quality.

Elk can also deposit urine and feces into streams, or on soils adjacent to them or on open ground upland of streams. These waste products are washed into streams during rain events, and can result in increases in bacteria and nutrients, primarily phosphorus and nitrogen. In the extreme, such as where elk are highly concentrated and/or water is slow moving, eutrophication, or excess concentrations of algae and other single-celled plants, can result. Decomposition of these algae can result in reductions in dissolved oxygen. Toxic forms of nitrogen and sulfur, such as ammonia, form when inadequate oxygen is available.

Currently, water quality in park creeks is high, and no drinking water standards are exceeded (Heakin 2004). However, several samples from Beaver and Highland Creek had higher temperatures and pH values than those considered to be the maximum able to support coldwater permanent fisheries. Temperatures were exceeded in the summer, during warm days and low flow conditions. Beaver Creek was also found to be higher in nutrients and fecal coliform than Highland Creek. Average ammonia concentrations did approach the state maximum allowable levels for coldwater permanent fisheries in Beaver Creek, and maximum concentrations in Cold Spring and Beaver Creek exceeded the standard. Dissolved phosphorus also exceeded the EPA recommendation in all three streams.

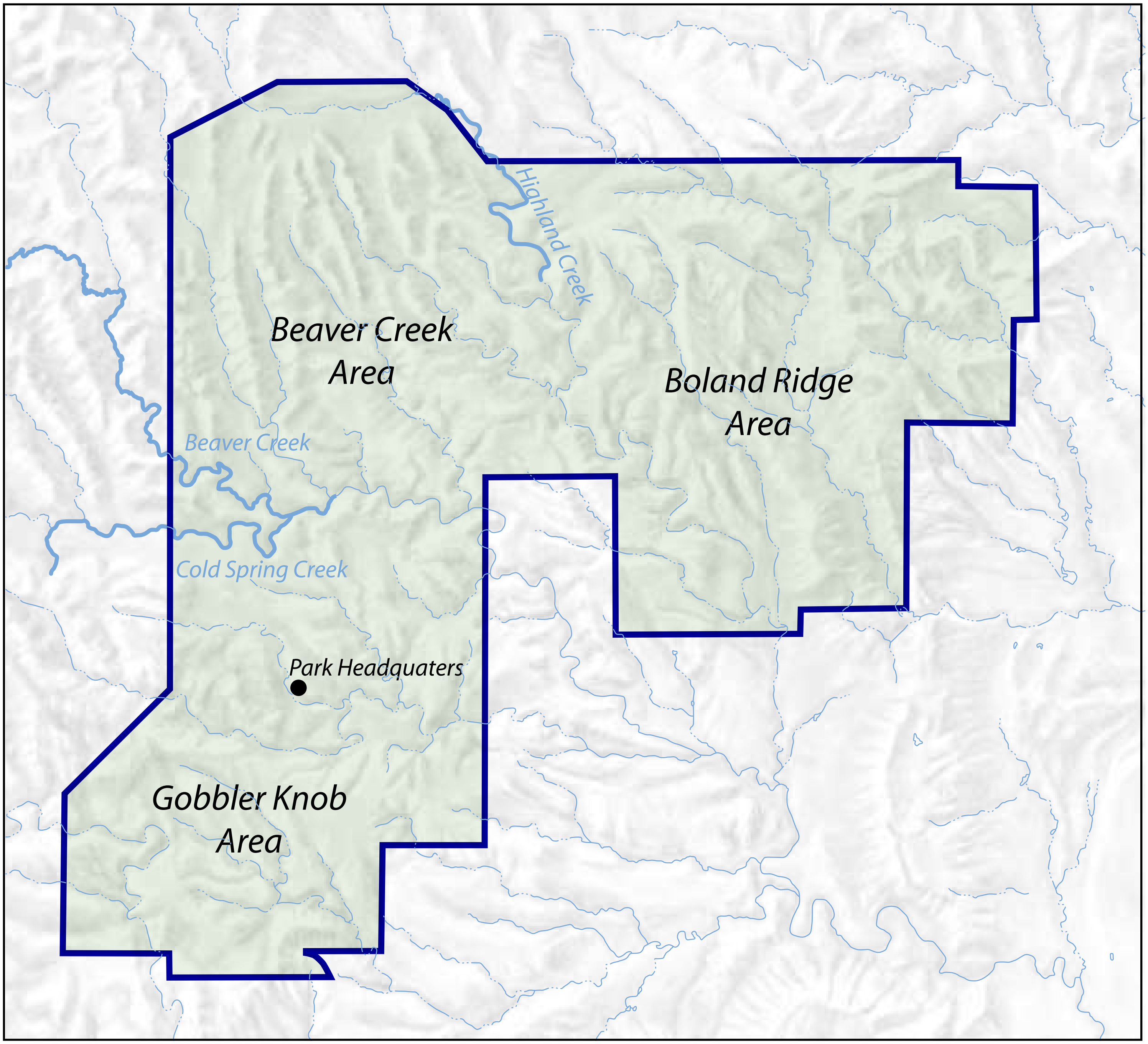


Figure 13. Wind Cave National Park Surface Water

Source: Varland et al. 1978

Fecal coliform concentrations were highest in the upland (nearest park border) location of Beaver Creek, but did not exceed any standards (Heakin 2004).

Suspended sediment did approach the standard for state daily maximum concentrations in Highland Creek, but was generally lower in Beaver and Cold Spring Creek. Average dissolved oxygen concentrations were high enough in all three streams to support a spawning coldwater fishery.

Although these water quality indicators are likely the result of upstream land management practices (including livestock grazing), wildlife do contribute impact in the forms described above. At its current size, the elk population likely has no more than a negligible adverse impact on any aspect of water quality. However, if the population continues to grow at its current rate or to reach what could be a very high carrying capacity, the impacts described above, including increases in suspended sediments, nutrients and bacteria, and reductions in dissolved oxygen, could be detectable.

Elk numbers have stabilized at carrying capacity in Rocky Mountain National Park, and this population concentrates during winter in riparian areas to browse on willow and aspen. Yet, a recent environmental impact statement evaluating the impacts of current conditions on water quality in the park indicated that the impact of elk from increased sedimentation due to bank destabilization even in the most concentrated area would be minor and adverse. Impacts to water temperature, or from contaminants from waste products (bacteria, ammonia, nitrates, and phosphorus) would be no more than negligible. These minimal impacts would occur despite concentrations of elk in these locations among the highest ever known to occur (up to 285 elk per square mile). Elk concentrations in Wind Cave are currently about 12–14 per square mile, and at 1,200 elk would be 27 per square mile. Although elk may begin to increasingly occupy riparian or woodland areas to browse willows and other shrubs and trees if numbers get this high, impacts are not likely to be greater than those in Rocky Mountain National Park. Therefore, impacts to water quality from continuing current elk management practices at Wind Cave over the life of this plan (e.g., implementing the no-action alternative) and would most likely be no more than minor. Because elk numbers could persist indefinitely, impacts could be long term.

Cumulative Impacts

Actions which may have additive effects on soils and water quality inside the park include development, paving and road building, logging activities in the headwaters of Highland Creek (Custer State Park), grazing by cattle and other wildlife, prescribed burning and other vegetation management and bison roundup in the vicinity of Highland Creek. Development and road building have covered soils and reduces infiltration rates, which leads to increased runoff and the potential for erosion. Logging creates bare soils, which are also then vulnerable to erosion and contribute sedimentation. Grazing by cattle and wildlife causes the effects described above, and would have cumulative adverse impacts on bulk density and erosion (through vegetation trampling and loss) and cumulative beneficial impacts on soil nitrogen. Bison roundup would cause additional negligible trampling, soil loss and sedimentation, particularly at the capture facility, which is adjacent to Highland Creek. As noted above, sampling in 2002 and 2003 indicated that suspended sediment levels in Highland Creek were quite low. Although the author (Heakin 2004) indicated this may have been due to low water levels during drought years, prescribed burning and other vegetation management activities could have offset impacts of logging and bison roundup by stimulating grasses and forest understory growth. Beaver Creek was particularly high in fecal coliform bacteria. Although the origin of the bacteria was not indicated, it is possible that upstream livestock operations or leaking septic systems from recent development were at fault. Prescribed burning may increase the vigor and growth rate of grasses and other vegetation, and may keep encroachment of ponderosa pine onto prairie grasslands from continuing (NPS 2006e). Either of these results could mean a cumulative beneficial impact to soil nutrients, and an offsetting beneficial impact to erosion by promoting growth of vegetation and the soil binding properties of its roots.

Conclusion

Localized minor to moderate adverse impacts to bulk density from compaction and to loss from erosion are possible in isolated spots where elk congregate. However, on a park-wide basis, changes to physical properties of soils from elk grazing would be negligible under the no-action alternative. Assuming elk numbers stabilize at a food based carrying capacity under this alternative, increased grazing would result in a beneficial impact to the chemical characteristics of soils related to underground microbial production of nutrients.

Even at herd densities known to have historically occurred in the park, adverse impacts from elk to the physical or chemical properties of water, including suspended sediments, nutrient levels and bacteria, would be localized and negligible or minor in intensity.

Cumulative benefits to soil chemical make-up from wildlife and prescribed burning are possible, and cumulative adverse impacts to the physical properties of soils from development, other ungulates and bison roundups are likely to occur. Logging and wildlife management activities may have increased sedimentation in Highland Creek, which may be offset by prescribed burning in the park. Upstream livestock ranching or faulty septic systems may be responsible for increased fecal coliform bacteria in Beaver Creek.

No impairment to park resources or values from impacts to soils and water quality would occur if alternative A were implemented.

ALTERNATIVE B—HUNTING OUTSIDE THE PARK

The emphasis of this alternative is the reduction and maintenance of the park's elk population via the state-managed public hunt on lands outside the park.

Soils

Some localized negligible impacts to soils from vegetation trampling and loss, and/or from compaction would occur under alternative B from the installation of fence, the placement and removal of gates, and from the activity of hunters outside the park fence. In addition, elk would congregate around gates both on the inside and outside of the park. Installing and removing gates and the activity of elk would probably disturb small areas, on the order of 100 square feet. Otherwise, impacts to soils would be related to reductions in elk numbers.

Although elk do not appear to spend inordinate amounts of time in riparian or other woody or shrubby areas, research indicates that they do occupy areas adjacent to creeks more intensively in the summer (Varland et al 1978) and appear to "group up" into large cow calf herds in grassland areas in the winter more than any other season. Because vegetation in the winter is more likely to be either senescent or covered by snow, impacts to soils from the loss of vegetation during this season would likely be negligible at an elk population of around 350–400 animals.

As noted above for alternative A, impacts to the physical characteristics of soils in Rocky Mountain National Park at elk densities of 32 elk per square kilometer in willow habitat were still quite small, on the order of 1.7% increase in bulk density and 4.6% increase in bare ground. At 400 elk, average elk density in Wind Cave National Park would be about 3 elk per square kilometer. Therefore, impacts to the physical characteristics of soils in riparian or other woody or shrubby areas from elk would be negligible, a beneficial localized impact compared to no action.

The beneficial impacts ungulate grazers can have on the chemical characteristics of grassland soils would be reduced from those described above under no action. Elk population numbers would be lower than they are now, and the contribution of nitrogen these animals make in urine and feces would be less available to vegetation. In addition, the landscape scale increase in nitrogen and soluble carbon from increased microbial activity over ungrazed grasslands would be reduced. These are relative moderate adverse effects compared to the no-action alternative.

Water Quality

No direct impacts to water quality inside the park are expected from activities needed to implement this alternative. However, it is likely that what could be hundreds of elk normally able to jump the lower fence in the park's southwest corner during hunting season would congregate along the fence line. As noted above, this activity may result in trampled vegetation and negligible short-term localized increases in erosion and suspended sediments in any surface water sources in the vicinity. Hunters scouting for elk may also increase compaction of sediments and increases in turbidity in any surface water in the vicinity. This may be most likely to occur in Beaver Creek and/or Cold Spring Creek, as these enter the park along its western boundary.

Reductions in the size of the elk herd may result in negligible changes to water quality compared to the no-action alternative. As noted above, even at very high densities it is difficult to detect any water quality impact from elk grazing. At lower densities, elk would be more likely to continue their existing behavior of eating primarily grasses rather than browse, and maintaining small cow/calf or bull groups during most of the year. Elk at Wind Cave do travel in larger herds in the winter, but usually do so out in the open on prairie habitat rather than in forested stream corridors. Any impacts to water quality relative to no action would be beneficial but likely not detectable.

Cumulative Impacts

The same actions as described above for alternative A would contribute impact in this alternative. These include cumulative adverse impacts from grazing by cattle, logging and other wildlife on bulk density, erosion (through vegetation trampling and loss) sedimentation and nutrient levels of streams, as well as cumulative beneficial impacts on soil nitrogen from grazing and increased growth related to prescribed burning.

Conclusion

Beneficial localized impacts to bulk density and the threat of erosion compared to no action would occur in the long term. Reductions in elk herd numbers compared to no action would result in relative moderate adverse impacts to soil chemical characteristics, particularly in available nitrogen. Negligible short-term impacts to suspended sediment levels are possible outside the park from congregating elk and hunters during the late summer and fall. Long-term beneficial impacts to suspended sediment, nutrients and bacterial from a reduced elk herd may also occur. Cumulative benefits to soil chemical make-up from wildlife and prescribed burning are possible, and cumulative adverse impacts to its physical properties from development, other ungulates and bison roundups likely occur. Logging and wildlife management activities may have increased sedimentation in Highland Creek, which may be offset by prescribed burning in the park. Upstream livestock ranching or faulty septic systems may be responsible for increased fecal coliform bacteria in Beaver Creek.

No impairment to park resources or values from impacts to soils and water quality would occur if alternative B were implemented.

ALTERNATIVE C—ROUNDUP AND LIVE SHIPMENT OR EUTHANASIA

The focus of this alternative is the reduction and maintenance of the elk population through roundup and live shipment/donation or euthanasia.

Soils

Some impact to the physical properties of soils, including through compaction to bulk density, and from increased bare ground associated with trampling and loss of vegetation, would occur from roundup of elk, both during initial reduction efforts and maintenance. Given the acreage over which the elk would be driven during roundup, and the fact that they would be unlikely to remain in any given spot for more than a few minutes, the impacts to soil are likely to be short term and negligible. If high numbers of elk are held in pastures at the corral site for longer than 48 hours, substantial trampling, grazing and loss of vegetation with resulting increased potential for erosion may occur. Infected elk may also shed CWD prions onto corral soil. These are localized minor impacts, which may be short or long term.

Other sources of impact to soils particular to this alternative include the possibility of contamination by CWD-infected animals during exsanguination and disposal of carcasses if needed. The potential for these impacts to park soils would only occur if a partner to be responsible for transporting live elk to a processing facility is not found, as this would require park staff to corral and kill elk in the park capture facility, and to incinerate carcasses. Burial of ashes from incineration would occur in an off-site, privately run landfill.

Modifications to the corral would be required to capture all waste from exsanguination if this is required. These materials would also require disposal in an off-site landfill approved for the acceptance of potentially CWD-infected fluids. Although every effort to contain contamination at the capture facility would be made, it is possible that some spatter or accidental release of fluids could occur. Because CWD prevalence in the southern Black Hills population is very low, and because CWD primarily infects the brain and nerves, the chance of contaminating soils with CWD prions is highly unlikely. If it occurs, it would be localized and minor, but potentially long term.

Air-curtain incinerators, which are the technology the park would use to dispose of carcasses inside the park, reportedly achieve higher temperatures than open-air burning, and may reach 870º C (1,600º F). Although it is unknown whether these temperatures would destroy the prion responsible for CWD, two European scientific advisory committees (UK Spongiform Encephalopathy Advisory Committee and the European Commission Scientific Steering Committee) both identified this temperature as a standard for disposing of TSE (transmissible spongiform encephalopathies) -infected material, such as cattle infected with mad cow disease, scrapie-infected sheep or CWD-infected deer or elk (Kastner and Phebus 2004). The conclusion that this temperature would reduce or eliminate the infectivity of prions is based on at least one study where scrapie (a disease caused by a prion similar to CWD) was subjected to temperatures of 590ºC (1,100ºF) and 980ºC (1,800ºF). Temperatures of 590ºC completely ashed the samples, but some small traces of infectivity remained. Only at 980ºC were all carbon residues eliminated. No samples were exposed to an intermediate temperature. The Steering Committee indicated that increasing the temperature to 870ºC for at least two seconds should destroy the remaining infectivity, e.g., that the risk of infection from ash "would be extremely small" (Woodward 2004).

However, prions are notoriously resistant to inactivation. They are not destroyed by conventional inactivation procedures including irradiation, boiling, dry heat or chemicals. In fact, drying out prions can stabilize them so they are even more resistant to inactivation. This resistance to normal inactivation techniques, and the residual infectivity of ash at 590º C led the Steering Committee to add that: "the possibility that incineration might not be completely effective is clearly being considered."

Wind Cave would clean out ash from the air-curtain incinerator under this alternative, and would dispose of the ash in off-site landfills approved for the acceptance of CWD-contamination waste. These landfills would be lined with clay, plastic, or other waterproofing material to minimize leaking into neighboring soils. If CWD positive carcasses are landfilled, this same lining would minimize impacts to adjacent soil and groundwater as well. Although some very small residual amount of ash may seep into soils at the incineration site in the park, the adverse impact is likely to remain site-specific and be negligible or minor, as the carcasses would have been burned at very high temperatures and the prion would likely be destroyed. If any CWD prions do remain in the ash, and not all ash is removed, this highly site-specific and low-level contamination of soils would be long term.

Other than this impact to soils from incineration and physical effects from rounding up elk, the same long-term impacts associated with a reduced elk herd described above in alternative B would be true of this alternative as well. These include beneficial localized impacts to soil bulk density from fewer animals and adverse impacts to soil chemical characteristics.

Water Quality

Short-term impacts to water quality associated with implementing this alternative would come from incidental increases in erosion from vegetation trampling and changes to the physical characteristics of soil along the roundup route. These would be so small as to be below the limits of detection, and would only last until the following spring green-up. Ash or CWD positive carcasses would be disposed of in landfills structured so as to minimize any leaking into surrounding soils, groundwater aquifers or surface water, so no or only negligible impact to water quality is expected.

As noted above, if elk were euthanized in the park at the corral facility, modifications to contain blood and byproducts would be part of a required retrofit. Even so, the corral is located near Highland Creek and it is remotely possible that spatter or accidental release of contaminated material could be washed into it during a storm. Underground drains and tanks or similar additions to the corral facility to capture these potential contaminants would generally prevent impacts to water quality from being more than negligible; however an accidental release would result in a short-term minor or moderate impact.

Long-term benefits to suspended sediment, nutrient and bacteria concentrations in surface waters would be the same as described above for alternative B.

Cumulative Impacts

The same actions as described above for alternative A would contribute impact in this alternative. These include cumulative adverse impacts from grazing by cattle, logging and other wildlife on bulk density, erosion (through vegetation trampling and loss) sedimentation and nutrient levels of streams, as well as cumulative beneficial impacts on soil nitrogen from grazing and increased growth related to prescribed burning.

Conclusion

A short-term adverse minor and localized impact from increased erosion associated with trampling and potential long-term CWD contamination in and near the corral may occur. Contamination of corral soils or adjacent Highland Creek with CWD-infected blood may occur during an accidental release if elk are killed at the park capture facility, a long-term, localized minor to moderate adverse impact. Site specific minor impacts from ash or carcass disposal to soils or groundwater if CWD prions remain are possible. Beneficial benefits to water quality and to soil bulk density and moderate adverse impacts to soil chemical characteristics from fewer animals would also occur.

Cumulative benefits to soil chemical make-up from wildlife and prescribed burning are possible, and cumulative adverse impacts to its physical properties from development, other ungulates and bison roundups likely occur. Logging and wildlife management activities may have increased sedimentation in Highland Creek, which may be offset by prescribed burning in the park. Upstream livestock ranching or faulty septic systems may be responsible for increased fecal coliform bacteria in Beaver Creek.

No impairment to park resources or values from impacts to soils and water quality would occur if alternative C were implemented.

ALTERNATIVE D—SHARPSHOOTING

Under this alternative, sharpshooting within the park would be used to reduce and maintain the elk herd at target population levels.

Soils

Impacts to soils from this alternative would come from carcasses left in the field, or the landfilling of either ash from incineration or of CWD positive carcasses. Trampling by sharpshooters may cause negligible increases in erosion. Long-term impacts from the reduction in elk numbers would be the same as identified for alternatives B and C.

The 40–60 elk carcasses left in the field would likely be partially or wholly consumed by scavengers in the park. Any remaining tissue or bone would deposit a concentrated pulse of nutrients in the soil. A 2000 study (Towne 2000) found that soil in the inner 25 inches of a site where an ungulate had died contained significantly higher concentrations of nitrogen than in the surrounding prairie. This difference resulted in low diversity of vegetative species for the first year, but much higher diversity in subsequent years. Even five years later, the sites remained vegetated with species that were different in composition and stature from the surrounding grasslands. These heterogeneous patches of soil nutrients and vegetative diversity would be localized beneficial impacts to soil chemical properties resulting from alternative D. Because maintenance activities would continue to leave carcasses in the field, the impact would continue for the duration of the plan.

If CWD positive carcasses are landfilled, the facility would need to be permitted to take hazardous waste and would be lined with clay, plastic or other waterproofing material to minimize leaking into neighboring soils. Therefore negligible or, at most, minor adverse impacts to soils from this activity is expected.

If carcasses are first incinerated and the ash disposed of in a landfill, negligible impacts to soils at the landfill site would occur, but negligible or minor localized impacts from not removing all ash at the incineration site are possible. These impacts are considered unlikely, but if they occur, would be adverse and long term.

Water Quality

The sources of impact to soils from management activities in this alternative, including trampling, CWD contamination, and carcass treatment, could also affect water quality.

Nitrogen pulses underlying areas where ungulate carcasses have been left in the field, as well as bacteria could be washed into nearby streams during storm events. It is unlikely but unknown whether these pulses would increase concentrations of either nutrients or bacteria beyond water quality standards; however given the usually high volume of streamflow during any storm event large enough to wash them into nearby creeks, concentrations would be diluted and would persist for only a very short time. Impacts may range from short term, localized and negligible to short term, localized and moderate. Within a short distance from the spot where any sheet wash carrying these contaminants enters the creek, impacts would be undetectable.

Ash from incineration or CWD positive carcasses that are landfilled may result in some leakage despite liners, with negligible to minor adverse impacts to surrounding groundwater possible, but unlikely.

Long-term beneficial impacts would be the same as those described above for alternatives B and C.

Cumulative Impacts

The same actions as described above for alternative A would contribute impact in this alternative. These include cumulative adverse impacts from grazing by cattle, logging and other wildlife on bulk density, erosion (through vegetation trampling and loss) sedimentation and nutrient levels of streams, as well as cumulative beneficial impacts on soil nitrogen from grazing and increased growth related to prescribed burning.

Conclusion

Beneficial impacts to soils for the duration of the plan from elevated nutrient levels associated with leaving carcasses in the field would occur. Washing these nutrients or bacteria into nearby streams would result in negligible to moderate, short-term localized adverse impacts to water quality. Negligible to minor impacts to soils and groundwater surrounding landfill sites where ash from incineration or CWD-positive carcasses would be disposed, as well as to soils inside the park where incineration takes place are possible. In the long term, reductions in elk numbers could have benefits to water quality and to physical properties of soils, as well as moderate adverse impacts to the chemical makeup of soil through lower nutrient levels.

Cumulative benefits to soil chemical make-up from wildlife and prescribed burning are possible, and cumulative adverse impacts to its physical properties from development, other ungulates and bison roundups likely occur. Logging and wildlife management activities may have increased sedimentation in Highland Creek, which may be offset by prescribed burning in the park. Upstream livestock ranching or faulty septic systems may be responsible for increased fecal coliform bacteria in Beaver Creek.

No impairment to park resources or values from impacts to soils and water quality would occur if alternative D were implemented.

ALTERNATIVE E—CONTRACEPTION (STERILIZATION) (MAINTENANCE ONLY)

This alternative would be implemented solely to maintain elk at target population goals after initial reduction (alternatives B–D) through permanent sterilization of a predetermined number of the park's reproductive female elk population. At this time, sterilization has not been proven through science to effectively manage wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Soils

The impacts to soils of initial reduction of the elk population would be as described above for alternatives B, C or D, depending on the method selected. Because roundup would be required during maintenance, continued negligible adverse impacts to the physical properties of soils would occur for the life of the plan from trampling, removing vegetation and subsequent increases in bulk density, runoff and erosion.

Long-term impacts from elk reduction would be the same as described above for other action alternatives.

Water Quality

As with soils, the impacts to water quality of initial reduction of the elk population would be as described above for alternatives B, C or D, depending on the method selected. Because roundup would be required during maintenance, continued negligible adverse impacts in the form of increased sedimentation in surface water in the park are possible.

Long-term impacts from elk reduction would be the same as described above for other action alternatives.

Cumulative Impacts

The same actions as described above for alternative A would contribute impact in this alternative. These include cumulative adverse impacts from grazing by cattle, logging and other wildlife on bulk density, erosion (through vegetation trampling and loss) sedimentation and nutrient levels of streams, as well as cumulative beneficial impacts on soil nitrogen from grazing and increased growth related to prescribed burning.

Conclusion

Impacts to soils or water quality from initial reduction would vary, depending on the method selected, but would be the same as those described for alternatives B, C or D. In the long term, reductions in elk numbers could have benefits to water quality and to physical properties of soils, as well as moderate adverse impacts to the chemical makeup of soil through lower nutrient levels. Negligible adverse impacts to the physical properties of soils and from sedimentation to water quality during maintenance would continue for the life of the plan. Cumulative benefits to soil chemical make-up from wildlife and prescribed burning are possible, and cumulative adverse impacts to its physical properties from development, other ungulates and bison roundups likely occur.

No impairment to park resources or values from impacts to soils and water quality would occur if alternative E were implemented.

ALTERNATIVE F—FERTILITY CONTROL AGENT (MAINTENANCE ONLY)

Under this alternative, cow elk would be treated with chemical fertility control agents solely to maintain the elk population at target goals once initial reduction efforts (alternatives B–D) are completed. At this time, fertility control agents have not been effective in controlling population growth in large free-ranging wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Soils

Although the method of delivery is unknown, impacts to soils are only likely if roundup is involved. Then, negligible adverse impacts to the physical properties of soils for the lifetime of the plan, similar to alternatives C and E, would occur.

The impacts of initial reduction would depend on the method chosen, and would be identical to those in alternative B, C or D. Long-term impacts to soils from reducing the size of the elk herd would be the same as those described above for these alternatives as well.

Water Quality

As with soils, impacts to water quality are only possible if roundup is involved. Then, negligible adverse impacts to suspended sediment concentrations are possible.

The impacts of initial reduction would depend on the method chosen, and would be identical to those in alternative B, C or D. Long-term impacts to water quality from reducing the size of the elk herd would be the same as those described above for these alternatives as well.

Cumulative Impacts

The same actions as described above for alternative A would contribute impact in this alternative. These include cumulative adverse impacts from grazing by cattle, logging and other wildlife on bulk density, erosion (through vegetation trampling and loss) sedimentation and nutrient levels of streams, as well as cumulative beneficial impacts on soil nitrogen from grazing and increased growth related to prescribed burning.

Conclusion

Impacts to soils or water quality from initial reduction would vary, depending on the method selected, but would be the same as those described for alternatives B, C or D. If roundup is required to deliver a chemical contraceptive, negligible adverse impacts to bulk density and erosion, as well as suspended sediment concentrations in water are possible. In the long term, reductions in elk numbers could have benefits to water quality and to physical properties of soils, as well as moderate adverse impacts to the chemical makeup of soil through lower nutrient levels. Cumulative benefits to soil chemical make-up from wildlife and prescribed burning are possible, and cumulative adverse impacts to its physical properties from development, other ungulates and bison roundups likely occur.

No impairment to park resources or values from impacts to soils and water quality would occur if alternative F were implemented.

VEGETATION

SUMMARY OF REGULATIONS AND POLICIES

NPS *Management Policies 2006* states that the "fundamental purpose" of the national parks begins with a mandate to conserve park resources and values and provide for the public enjoyment of the park resources and values to the extent that the resources would be left unimpaired for future generations. Section 1.4.6 identifies native vegetation as a park resource, and section 4.4.2 provides general principles for the maintenance of natural resources in the park by preserving and restoring natural abundances, diversities, dynamics distributions, habitats and behaviors of native species. Section 4.4.1 requires parks to minimize human impacts on native plants or the processes that sustain them (NPS 2006d).

METHODOLOGIES AND ASSUMPTIONS FOR ANALYZING IMPACTS

Geographic Area Evaluated for Impacts

Issues and concerns regarding vegetation degradation within the park generally focus on less common vegetation types. These key vegetation types are distributed throughout the park in small patches, so the area of analysis is either the local vegetative site or the entire park. The vegetation types that are analyzed include: hardwood forests, especially aspen, shrublands and riparian areas.

Issues

The following issues regarding the effects of elk herbivory or elk management activities on vegetation were identified through internal and public scoping:

- Elk browsing could reduce hardwood regeneration in the park, impacting the natural composition of tree species (e.g., aspen and other hardwoods).
- Elk browsing can limit growth and seed production of shrubs, limiting reproduction.
- High elk populations could have negative impacts on vegetation in riparian areas of the park (i.e., adverse impacts on health of plant communities through loss of species diversity, erosion and reduced reproduction).
- Vegetation trampling could occur during roundup activities.

Assumptions

The following general assumptions were used to analyze the effects of elk management actions on key vegetation types.

- Initial elk herd reduction would take 1–6 years; maintenance activities would occur during years 6–20.
- The impact of elk on vegetation in key vegetative types is a function of both the number of elk and the preference elk show for those vegetative types.
- If the elk population is allowed to remain at current levels or increase, the effects of elk browsing on aspen, other hardwood forests, shrublands and riparian areas would continue to prevent regeneration and recovery.

- A reduced elk population would continue to concentrate on these preferred sites. Therefore, reducing the number of elk may not adequately reduce elk herbivory to allow regeneration and recruitment. Fencing key sites may be required to allow vegetation in these vegetative types to recover.
- Grazing by an unregulated elk population would degrade mixed-grass prairies by reducing the vigor of individual plants and changing the species composition over time.

Assessment Methods

Information in the literature, as well as park reports, GIS information and professional judgment were used to analyze impacts. Inferences about the effects of elk browsing on hardwoods and shrubs are also based on observations of vegetation responses within exclosures which illustrate the potential growth of vegetation when ungulate herbivory is excluded.

Scientific information on the effects of elk browsing on key vegetative types within the park is somewhat limited. Based on direct observation and professional judgment, park staff believes that the vegetation in Wind Cave is currently adversely affected by the elk population (Curtin 2007). Smith (1978) documented the effects of ungulates on rare trees and shrubs within the park. Ripple and Beschta (2006) studied the long-term effect of elk on cottonwoods and bur oak in the park.

Studies of ungulate food habits and habitat relationships provided information on seasonal elk food and habitat preferences (Wydeven and Dahlgren 1983 and 1985).

These data were used to predict how key vegetative types might be affected by a reduced elk population. Where local data were not available, inferences about the change in vegetation over time as a function of changes in elk numbers and the management actions proposed were based on research and management in other areas.

Impact Threshold Definitions

Impacts are determined by examining the potential effects of the proposed activity on vegetation in key vegetative types. The following impact thresholds were established to describe the relative changes in vegetation under the various alternatives being considered:

Negligible: Impacts would have no measurable or perceptible changes in plant community size, integrity, or continuity.

Minor: Impacts would be measurable or perceptible but would be localized within a relatively small area. The overall viability of the plant community would not be affected and, if left alone, would recover.

Moderate: Impacts would cause a noticeable change in the plant community (e.g., abundance, distribution, quantity, or quality); however, the impact would remain localized within the park.

Major: Impacts to the plant community would be substantial, highly noticeable, permanent, and affect large areas in or outside the park.

Impairment: Impacts would contribute substantially to the deterioration of park vegetation to the extent that the park's vegetation would no longer function as a natural system. In addition, these adverse major impacts to park resources and values would contribute to deterioration of these resources to the extent that the park's purpose could not be fulfilled as established in its enabling legislation:

- affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or
- affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

Duration of Impact

Short-term: Those impacts occurring from (activity) in the immediate future (usually 1 to 6 months).

Long-term: Those impacts occurring from (activity) from 6 months through the next 10 years.

ALTERNATIVE A—NO ACTION

Under the no-action alternative, existing elk management actions (monitoring and targeted surveillance) would continue with no additional efforts implemented to address the size of the elk population and its effect on park resources.

Elk can cause a variety of impacts on vegetation. Foraging can result in changes to relative abundance, physical structure, structural diversity, species composition and productivity in plant communities, as well as weed and nutrient dispersal. Elk also trample vegetation, particularly when they congregate in large groups, or remain in an area for a long period of time. Elk can alter patterns of nutrient cycling both within plant communities and by transferring nutrients from one community to another, and can change the distribution of nutrients between plant shoot and root structures. Depending on the soil fertility, intensity of grazing and the vegetation being grazed, elk and other ungulates can stimulate or suppress vegetative productivity across a landscape.

An ecosystem is the interaction of living organisms and the nonliving environment producing an exchange of materials between the living and the nonliving.

Studies in the 1970s and 1980s of the diets of elk at Wind Cave found that elk relied mostly on grasses. Warm season grasses, especially big bluestem, were the mainstay in summer, although elk also made use of forbs and the leaves of shrubs such as leadplant and skunkbush. The rest of the year, they primarily consumed cool-season grasses, as well as forbs in the fall and winter. Browse was consumed occasionally in fall, winter and spring. This is different than other populations of Rocky Mountain elk, which eat more grass in fall and more browse in winter than the Wind Cave population (Wydeven and Dahlgren 1983).

In addition to the effects ungulates have on the physical structure, species diversity and composition of vegetative communities, they can act as forces in the distribution of seeds and nutrients. For example, consumption of non-native seeds in one area and migration and dispersal into an unaffected area can add to the spread of invasive plants. This is true for native plants as well. Grazers can also exert a large-scale effect on the nutrient levels in soils through their waste products. While the high nitrogen content of urine may damage some species, others grow more quickly in nitrogen enriched soil. Feces and urine can stimulate soil microbial activity as well, making additional nitrogen available to plant roots. This is taken up by plant shoots and becomes available to herbivores as more nutrient rich forage (Van derWal et al. 2004). The cycle of adding nutrients in the form of waste products and returning it in the form of more nutritious forage is one of the key mechanisms in which grazers manipulate their own food supply (Van derWal et al. 2004). It occurs readily in grassland ecosystems where overgrazing is not present and can lead to a proliferation of grasses preferred by some ungulates (Wardle and Bardgett 2004).

Hardwood Forests

Aspen and other hardwoods have a very limited distribution within the park, 87 acres or 0.3%. There are only 13 aspen stands in the park. These stands are present in historic locations, but are generally diminished in size due to browsing by elk (Curtin 2006). The gradual decline or loss of hardwood forest stands is undesirable because they support many bird, small mammal and plant species.

Aspen stands are particularly vulnerable to elk browsing, and this prevents young plants from growing to maturity. Evidence from exclosures in Rocky Mountain National Park indicates that all aspen less than eight feet tall are currently unable to escape elk herbivory (NPS 2006c). Aspen in the core elk winter range at Rocky Mountain National Park do not currently regenerate if elk numbers are higher than 600, and since the elk population has been at about 1,000 animals for several years, no aspen in the core elk range regenerate, and only about 20% of aspen parkwide regenerate. Elk densities in the core winter range at Rocky Mountain National Park currently exceed 260 elk per square mile, and modeling indicates densities would need to be below one-tenth of this number, or about 26 per square mile, for aspen regeneration. Densities in Wind Cave National Park are currently about 12.5 per square mile, but have been as high as 18 per square mile in the recent past (winter of 2005).

Despite lower elk densities than in Rocky Mountain National Park, very little regeneration of aspen currently occurs in Wind Cave. This may be because elk concentrate in pockets of aspen to browse new growth (Smith 1978) or because very little aspen normally grows at this elevation in mixed prairie habitat. Because aspen occupies only a small number of acres in the park, even limited browsing by a smaller population could reduce or eliminate regeneration. Smaller stands are browsed more heavily than larger stands. Stands located in developed areas or along roads are less affected because elk tend to avoid these areas (Curtin 2006).

To determine the impacts of elk on aspen regeneration, an exclosure surrounding approximately 45 acres was constructed in the northwestern corner of the park in 2004. Within this fenced area, relatively prolific aspen recruitment is occurring (Ripple and Beschta 2006). Outside this exclosure, only a few large-stem aspens are growing across the entire park. Although it is tempting to assume this results from a large herd size (around 800 in 2005), results of a recent study indicate that recruitment in aspen and other hardwoods has consistently failed not only when elk numbers are high, but since Wind Cave became a park and before (Ripple and Beschta 2006). This indicates that even low numbers of ungulates would continue to exert enough impact to reduce or eliminate regrowth in aspen. The observed effects are primarily attributed to elk because aspen in areas used by mule deer but not elk are doing fairly well (Curtin 2006). Eventually, it is likely that aspen accessible to elk would die out, resulting in a major localized long-term impact to this hardwood species.

Examples of this same effect on other hardwoods include cottonwood and bur oak. Recruitment of these two species peaked in the 1870's, diminished during the 1880's and, except for a small number of lance leaf cottonwoods which established in the 1920's, has not occurred since the 1890's (Ripple and Beschta 2006). Investigation of current conditions found that more than 80% of root sprouts of plains cottonwoods and 68% of lanceleaf cottonwood had been browsed within the prior year. Measurements of recruitment inside and outside a 5 acre cottonwood exclosure established in 1991 and a 0.5 acre bur oak exclosure established in 1977 found about 50 new bur oak trees established by 1999, and more than 70 lanceleaf cottonwoods by this same date. This is in contrast to no new cottonwood or bur oak establishing outside the exclosures during this same period. Although the authors (Ripple and Beschta) explored other possible explanations such as fire suppression and climate influences, the excellent recruitment inside the exclosures for all three hardwood species indicate at least an ongoing major impact to these species from ungulate herbivory. Park staff have noted heavy browsing of hackberry, peachleaf willow and paper birch as well (Curtin 2006).

These severe, localized impacts from elk browsing persist despite findings by other researchers (Wydeven and Dahlgren 1983, for example) that browse is a small part of their diet at Wind Cave and that effects occur almost regardless of the size of the population inside the park. However, as the population grows elk would likely occupy areas used by mule deer or pockets of hardwoods not currently affected by ungulates. Therefore, current localized, major adverse effects on hardwoods would continue and potentially worsen to extend over a larger part of the park as the herd grows under the no-action alternative.

Shrublands

Elk utilize shrubs in Wind Cave National Park during all seasons, but more so in the winter than other seasons (Wydeven and Dahlgren 1983). Preferred shrub species include leadplant in summer and mountain mahogany in winter during periods with heavy snow cover. Although elk forage on shrubs, they make up a relatively small portion of their diet. This is in contrast to other populations of elk, which tend to eat more grass in the fall and browse in the winter. This difference has been attributed to more mild winters in Wind Cave than across other elk ranges.

Despite several food habit studies that support the relatively high use of grass and low use of shrubs by elk in the park, there have been declines in shrub densities at Wind Cave attributed to elk herbivory. In 1924, an expanding population of 250–300 elk was confined in a 4,000 acre fenced area that preceded the establishing of Wind Cave National Park as it is today. At this very high density (about 48 per square mile), officials reported as a result of browsing pressure “skunk brush, buck brush, ground mahogany, plum, choke cherry, and every small shrub is practically extinct” (Bauman 1997). An intensive range and soil survey conducted by the U.S. Soil Conservation Service in the park in 1969 found grassland areas were in satisfactory condition, but browse was “overutilized and dying.” Lovaas (1973a) indicated that “the only browsing animals numerous enough and frequenting the overused areas enough to cause the damage were elk.” In a later study, Smith (1978) observed that red-osier dogwood, serviceberry, buffaloberry and bearberry were heavily utilized in the park. Kay (1995) found that browsing by high densities of ungulates, including elk, limited the growth and seed production of shrubs in the Greater Yellowstone Ecosystem. This heavy use prevented young plants from growing to maturity. Singer and Zeigenfuss (1998) theorized that utilization by elk at Wind Cave could be contributing to the decline of shrubs in woody draws in Wind Cave, but also noted that observed herbivory by elk of shrubs was low, and that drought and lowered water table could also have caused or contributed to the decline.

These studies seem to indicate that, like their impact on young hardwood sprouts, even lower numbers of elk can exert a disproportionate effect on relatively sparse populations of shrubs. Preferred shrubs species such as mountain mahogany and leadplant may be particularly hard hit as the elk population increases under the no-action alternative. In addition, although elk and mule deer currently occupy different geographic areas of the park, leaving deer to more frequently browse shrubs, elk are considered likely to displace deer if the two overlap. Elk are also dietary generalists, and although they preferentially eat grass at Wind Cave now, could easily switch to shrubs if needed. It is likely then that elk would both displace mule deer and more heavily browse on shrubs across the park as the size of the herd increases, resulting in a long-term, moderate adverse effect.

Riparian Areas

In the park, riparian areas (streamside vegetation and meadows in Wind Cave) account for only a small percentage (29 acres, 0.01% of the park) of lands used by elk. These are unique areas in the park, and offer habitat for a variety of wildlife species, including several species of birds and small mammals. Elk may spend much of the summer or early fall in the park in these streamside forests and shrublands as other vegetation dries. Other ungulates, such as white-tailed deer or exotic fallow and axis deer at Point Reyes National Seashore remain faithful to certain pastures and woods and return to them frequently year-round (NPS 2006l). Densities in riparian areas at the Seashore can be as high as 240 deer per square mile, several times the densities at which the effects of heavy grazing have been documented for white-tailed deer and other ungulates. The effects of so many ungulates in a sensitive streamside habitat can be locally severe, both from consumption of vegetation and trampling from hooves or from bedding.

At Rocky Mountain National Park, the severe impacts of elk browsing of the park's 1,200 acres of montane riparian willow on primary winter range are one of the primary reasons the park is conducting elk reduction operations. Experimental exclosures have been successful in allowing unbrowsed willows to regenerate in the park, as plots that did not experience elk grazing increased plant production by 98% after 35 years (Zeigenfuss et al. 2002). Study of herbaceous riparian vegetation in Rocky Mountain National Park found that no large-scale effects on plant species richness or biodiversity were evident from elk herbivory, although increases or decreases in the cover of some individual species did occur. In riparian areas, grazed sites had more goldenrod species and ungrazed sites had more bluebell (NPS 2006c). Ungulates in riparian areas at Point Reyes National Seashore have been associated with noticeably increased denudation of areas, soil erosion, compaction of soils and reduced the ability for vegetation to regrow. Extensive damage to willows at one riparian restoration area at the Seashore, where they were unable to keep deer from entering has also been noted (NPS 2006l).

Herbaceous plants — Non-woody plants; includes grasses, wildflowers, and sedges and rushes (grass-like plants).

The only studies of the condition of riparian vegetation at Wind Cave have examined shrubs and trees, and are described above under these sections. Although the generally degraded condition of shrubs in woody draws may have been attributed to elk, population size at the time was quite low (250), and the authors specifically note that drought or other environmental factors may have played a role (Singer and Zeigenfuss 1998). The recent study of hardwood trees, including two cottonwood species, found that ungulate herbivory was likely responsible for the continued lack of regeneration begun by livestock grazing in the late 1800s (Ripple and Beschta 2006). Elk at Wind Cave are also known to consume the meadow species threadleaf sedge in the spring and likely use a variety of streamside forbs at this time as well (Wydeven and Dahlgren 1983).

Indirect evidence of the impact of ungulate grazing in riparian areas in Wind Cave comes from known reductions in the number of beaver in the area that is now the park. It is possible that a contributing factor to this decline is the grazing by elk of riparian plants, including willow, that beaver would use for food (Ripple and Beschta 2006). These findings are consistent with a 90% reduction in the number of beaver at Rocky Mountain National Park and the conclusion that one reason may be ungulate grazing of foods normally used by beaver. Long-term climate changes and drought are also thought to play a part in this reduction.

Hubert et al (1992) generalized that elk would be more likely to move into riparian areas and moist meadows as vegetation becomes increasingly dry during the summer. Elk also may use riparian corridors for travel routes or resting and in the fall, bulls may use streams and streamside areas for wallowing during the rut. Observations of elk movement in the park indicate that at least those from one area (Boland Ridge) do move to the riparian vegetation along Highland Creek during the summer (Varland 1976). Elk are also known to consume meadow plants in the spring, and forbs throughout most of year, some of which may be understory plants from streamside shrublands and forests. These observations are consistent with the degraded condition of some riparian species.

Although research from other parks indicate that large-scale changes in riparian species richness or diversity would not occur, localized denuding and overutilization of some parts of riparian habitat would likely continue and worsen as the elk herd increases in size under the no-action alternative, a long-term, adverse, moderate impact.

Mixed Grass Prairie

Several researchers have demonstrated “grazing optimization,” where plant productivity increases in response to grazing. This has been particularly true of grasslands (Zeigenfuss et al. 2002, Frank and Grossman 1998, Hamilton and Frank 2001). Studies of African grasslands and native ungulates have found they share a long evolution and that vegetation supports chronic levels of intense herbivory that exceed that of other habitats. Even so, these vegetative communities are highly sustainable and support diverse food webs, in part because of the indirect positive effects herbivores have on ecosystem processes. These include stimulation of aboveground grassland production through increases in nutrients that would normally limit plant growth, such as nitrogen and reallocation of energy from roots to shoots (Hamilton and Frank 2001).

Growth of plants in grasslands in Yellowstone and elsewhere in the western United States has been found to be limited by nitrogen availability (Hamilton and Frank 2001). Nitrogen is returned over several months from decomposition of plant litter, but is more immediately available for plant uptake from elk urine and feces. Another indirect mechanism occurs from the release of sugars and other organic materials in solution from roots into the soils immediately adjacent following grazing. These chemicals are readily broken down by microbes that grow in close association with the root surfaces. The number of microbes increases, but then dies off as the exudates stop, releasing nitrogen and soluble carbon into the soil where it is taken up by the roots.

In Yellowstone, net nitrogen availability was higher in soils where elk grazed compared to that of ungrazed soils. Average net nitrogen mineralization was 3.8 g N/square meter per year on grazed plots compared to 1.9 g N/square meter per year on ungrazed plots, or about double (Frank and Grossman 1998). In Rocky Mountain National Park, grazed grassland sites had 15% higher nitrogen concentrations than ungrazed. Percent cover of grasses was greater in grazed sites as well (Zeigenfuss et al. 2002). The additions of nitrogen and other nutrients from urine, feces, and the nutrient feedback system described above for grassland grazers would provide benefits for mixed-grass prairie under the no-action alternative.

Overgrazing of grasslands may be an issue as the elk population increases, although overgrazing is a value-laden and controversial term (Zeigenfuss et al. 2002). The NPS began managing populations of ungulates in Yellowstone and Rocky Mountain National Park through natural regulation (e.g., no removals by humans) beginning in 1968. Although these populations reached food-limited carrying capacity and had the potential to cause shifts in plant species, plant productivity and geographical extent of vegetative communities, this was considered acceptable and not defined as overgrazing. Other researchers would define elk populations at food-based carrying capacity to by default be overgrazing forage, as historically elk and other large grazing animals were kept to 40–80% of this number by primary predators, such as wolves and bears (Zeigenfuss et al. 2002). State wildlife managers might define overgrazing as anything over the number of animals that limit the long-term maximum production of wildlife for sport hunting purposes. This "maximum sustained yield" for wild herbivores like elk is often in the range of 50–60% of ecological or food-based carrying capacity. As noted in other sections of this document, the Science Team advising on the number of elk Wind Cave National Park could accommodate has assumed only 50% of the annual forage production should be consumed by grazing animals, and that anything over this amount is unsustainable and therefore is considered overgrazing.

Both Rocky Mountain and Yellowstone National Parks have stabilized ungulate populations. Those at Yellowstone are likely lower density because of the presence of native predators, which limit the population of elk to 40%–50% of food based carrying capacity (Zeigenfuss and Singer 2002).

At Rocky Mountain National Park, elk numbers inside the park (a separate population occurs outside the park in the town of Estes Park and surrounding area) are at the ecological or food-limited carrying capacity of the park. This is defined as the maximum dynamic capacity of the habitat, forage and climate of the area to sustain the herbivore (Zeigenfuss and Singer 2002) and is about 1,000 elk at Rocky Mountain National Park. Yet, despite these relative high numbers, researchers have found few changes in grasslands. No differences in the number of species in or outside grassland exclosures were found, although the relative cover of some species did change. These include lichens, which are associated with drier sites in Montana grasslands, and timothy, an exotic grass (Zeigenfuss and Singer 2002; NPS 2006c).

Prairie in Wind Cave National Park

While additional criteria to decide whether overgrazing of grasslands is ongoing include percent of bare ground, sediment yields, and erosion, these have not been measured at Wind Cave National Park. However, managers are concerned about the increasing percentage of forage consumed and the increasing appearance of less palatable or exotic plant species noted by park vegetation specialists. The estimated forage utilization rates by all grazing animals in the years 2005–2007 averaged 50–60% (Curtin 2007). This is from a combination of factors, including management of bison and prairie dogs at high levels, drought, and increasing elk populations. While the literature indicates that moderate grazing pressure of 40–45% in mixed grass prairie appears sustainable and is not overgrazing, consumption rates of 60–80% generally are not considered sustainable (Singer et al. 2002). Impacts include decreases in available biomass, productivity, and the appearance of non-native species.

The park mixed-grass prairie does have non-native invasive cool season species such as Kentucky bluegrass, smooth brome, or cheatgrass, which are indicators of heavy grazing. Although the presence of these species is not only a result of present-day grazing by wildlife, but of historic livestock grazing, preliminary work in the Boland Ridge area indicates the encroachment of less palatable weedy forb species indicative of higher levels of disturbance in recent years (Curtin 2007).

As noted in the discussion of elk populations, the food-based carrying capacity of elk at Wind Cave is unknown, but the elk population appears to have reached 1,200 (and may have even gone to 1,500) for a short period of time before removals were conducted (Bauman 1997, 1998). This translates to a maximum density of about 27 elk per square mile, which is still substantially lower than maximum concentrations at Rocky Mountain National Park, but is nearly twice the number found in the February 2007 count at Wind Cave. At 1,200 elk, and assuming all other grazer numbers remain stable (400 bison, prairie dogs at 2,800 acres, stabilized populations of deer and pronghorn etc.), a population of 1,200 elk would push the total forage removed to about 70% of current annual grassland production rates (of about 31,000 AUMs). This is higher than that considered sustainable by researchers, and far exceeds the 50% management capacity for grazing animals developed by NRCS and the Science Team for this project.

Wind Cave National Park is considered significant as a unit of the NPS in part because of its mixed-grass prairie ecosystem, and has identified preservation of the flora, fauna, and natural processes of this unique ecosystem as one of its purposes (see the “Purpose and Significance of Wind Cave National Park” section in the “Purpose of and Need for Action” chapter for more information). The park has also identified an acreage goal of 60–70% of the park for this vegetative community. Consumption by ungulates at an unsustainable rate would likely result in a decrease in the geographic extent, health and vigor, or relatively pristine nature of this community. Instead of native grasses, the increased prevalence of cool-season non-native species, as well as forbs and other earlier seral stage plants would occur. Biomass available to other wildlife would also decrease, through these processes and from simple removal by an increasingly large population of elk. Given that mixed-grass prairies only occupy 62% of the geographic area of the park and are considered especially significant to the park purpose, losses and changes from an elk population at food-based carrying capacity would be a moderate to major adverse impact on this vegetative community.

Cumulative Impacts

Vegetation at Wind Cave has experienced impacts in the past that are independent of this elk management plan. These include prior livestock grazing, bison, and prairie dog and past elk management, wildfire suppression, prescribed fire, wildlife exclosures, drought, and roads. The type, duration and intensity of these disturbances before and after the park was established varied widely.

Livestock grazing began in the Black Hills in the 1870s, and primarily affected mixed-grass prairies, hardwood forests and shrublands. Prior to the establishment of the park, the land that would become Wind Cave National Park had been overgrazed by livestock. Livestock were allowed to graze within Wind Cave National Park until 1939 (Roddy 2006). Most grazing in that era was season long and continuous. Under that grazing regime, mixed-grass prairie range conditions generally declined with subsequent declines in the number of animals that could be supported. Because livestock grazing in the park was terminated more than 60 years ago, the residual effects of past livestock grazing on grasslands are no more than negligible.

Wildfire suppression and prescribed fires have impacted vegetation in the past.

Livestock grazing prevented normal hardwood generation since the 1890’s (Ripple and Beschta 2006). The recruitment of plains cottonwood and bur oak peaked in the 1870’s, diminished in the 1880’s and was essentially non-existent from the 1890’s. A small number of lanceleaf cottonwood trees established between 1900 and 1920 with no recruitment since the 1920’s (Ripple and Beschta 2006). Livestock grazing in the park ended in 1939, but the major adverse effects on hardwood forests continue due to elk browsing.

Livestock grazing influenced shrub vegetation within Wind Cave National Park. In 1874, an abundance of berry producing shrubs, including serviceberry, was observed (Krause and Olson 1974 in Ripple and Beschta 2006). Grinnell reported numerous beaver along many of the streams in the Black Hills (Ludlow 1875 in Ripple and Beschta 2006). By the mid-1880’s, the Black Hills contained 500,000 cattle and 85,000 sheep, and beaver had begun to disappear. Smith (1978) noted that many shrub species were heavily utilized and found only in inaccessible areas or ungulate exclosures. Initial impacts to shrubs were related to grazing by domestic livestock, but continued degradation is due to excessive grazing by ungulates.

Bison were introduced to the Wind Cave National Game Preserve in 1913. Prior to fencing the game preserve, the area had been heavily grazed by domestic livestock. Initially, bison were fed hay and alfalfa to allow the grasslands to recover. Since then, the herd has been periodically culled to remove excess bison. The current management goal, a minimum of 400 animals, is maintained by annual roundup and removal. The cumulative effect of past, present and future bison management on vegetation in the park is minor because numbers have been kept relatively low.

Black-tailed prairie dogs are native to the park and currently occupy 2,800 acres of a potential 8,566 acres of suitable habitat (NPS 2006a). The long-term goal is to maintain prairie dogs on 1,000–3,000 acres in the park. Prairie dogs tend to maintain vegetation in an early seral stage, and continued close cropping prevents normal plant succession. Prairie dogs have long-term, moderate, adverse effects on vegetation in local areas. However, prairie dogs are a native species and these effects are part of the normal range of variation for these habitats.

Wildfire suppression essentially eliminated the natural role of fire in ecosystem maintenance. From 1903 to 2002, 196 lightening and 118 other wildfires were suppressed in the park (NPS 2005a). Singer and Zeigenfuss (1998) theorized that fire suppression leads to encroachment by ponderosa pine into other vegetative types in Wind Cave National Park, and could be contributing to the decline of shrubs and wooded riparian areas in the park. Suppression of wildfire has had a long-term, moderate adverse impact on vegetation throughout the park.

The ecological role of wildfire has been replaced to some extent by prescribed fire. Since 1973, 62 prescribed fires have been conducted in the park for a variety of purposes including creating fire breaks, small plot burns, research burns and large scale vegetation improvement burns (NPS 2005a). The primary goal of using prescribed fire has been to restore natural vegetation communities partially offsetting the adverse effects of wildfire suppression and providing a long-term, local benefit.

Wildlife exclosures have been constructed in key habitats to allow natural vegetation to recover and to demonstrate the adverse effects of ungulate grazing. Exclosures have had long-term benefits to vegetation within the exclosures.

Drought and long-term climate change have likely altered vegetative communities in the park. In recent years, drought has been particularly severe and may have had moderate or even major adverse impacts on forage production and other vegetation in the park. The loss of beaver from the park ecosystem and degradation of woody draws may in part be a result of lowered water tables.

Roads and associated disturbed areas provide both an opportunity and suitable conditions for the spread and establishment of noxious weeds. Generally, weed infestations are restricted to local areas along roads and other disturbed areas, but in some situations weeds may escape these areas and invade other habitats. To date, the effects of weeds have been minor in local areas. Once established, the effects are long term.

Conclusion

Current localized, major adverse effects on hardwoods would continue and potentially worsen to extend over a larger part of the park as the herd grows under the no-action alternative. These effects were initiated by historic livestock grazing and are exacerbated by other ungulates and drought. Prescribed burning and wildlife exclosures have a cumulative beneficial effect on these plant communities.

Growth of the elk herd is likely to continue existing impacts on plant production in meadow riparian and shrubland areas in the park, and may worsen them, causing long-term, adverse and moderate impacts to these vegetative types.

Beneficial impacts to grasslands from grazing by elk and other ungulates in the form of increased nitrogen and other nutrients would occur, but moderate to major adverse impacts from losses in biomass, productivity, and species changes are also likely as the population approaches food-based carrying capacity.

ALTERNATIVE B—HUNTING OUTSIDE THE PARK

The emphasis of alternative B is the reduction and maintenance of the park's elk population via the state-managed public hunt on lands outside the park.

Effects of Specific Elk Management Actions

Management actions in this alternative, including the installation of gates and raising of the park's section of 4-foot-high fence or hazing activities, could have a variety of impacts to vegetation.

Vegetation in the immediate vicinity of the newly installed gates to accommodate ingress and egress in this alternative would be affected by trampling due to elk milling near and passing through the gate. In addition, elk on the outside of the park would likely crowd around the newly raised section of fence in the southwest portion of the park in the first year or two after it is installed. This alternative may also result in increased trampling of vegetation by hunters outside the park and their vehicles, especially during initial reduction. Localized minor or perhaps moderate impacts in these areas would result. It is possible that some of these trampling impacts would continue over the life of the elk management plan, as hunting would increase during maintenance as well.

If necessary to ensure that adequate numbers of elk leave the park, elk may be hazed or herded toward gates. That could be done by helicopter, horseback riders, noise makers or herding dogs. Herding would cause local impacts to vegetation due to trampling, but these would be negligible and short term. In most cases, the effects would be eliminated by the next growing season.

If horses are used to herd or haze elk in this or other alternatives, owners would be required to feed them weed-free hay for 2–3 days prior to their use for this purpose in the park. If dogs are used to herd or haze elk in this or other alternatives, owners would be required to brush and clean them immediately prior to their use for this purpose in the park. This would minimize the chance that seeds of exotic or invasive non-native plant species would be spread by way of horse droppings or fur. Some localized establishment of non-native species may occur as a result of horse use, however. This would be a minor, localized adverse impact.

Because adult bull elk have traditionally been less likely to leave the park in spring and summer, it may be necessary to remove surplus bull elk by sharpshooting. Sharpshooters would not be allowed to drive vehicles off of established roads or to drag carcasses of dead elk across the ground surface unless the ground is dry or frozen, thereby limiting the disturbance to vegetation. Because of the dispersed nature of this activity, the adverse impacts of sharpshooting on vegetation would be short term, localized and negligible under this alternative.

Effects of Elk Population Reduction (long term)

Hardwood Forests

Alternative B would result in a substantially reduced elk population, which theoretically could result in less grazing and more beneficial impacts to hardwood forests in the park. However, modeling results for elk management at Rocky Mountain National Park found that aspen did not increase in any elk reduction scenario, including one that took populations to as low as 200 elk (from the 1,000+ currently in the herd) (Coughenour 2002). Modeling also indicated that, although aspen increased when an area was fenced, they began to decline again when the fence was removed, regardless of the reduction scenario. Elk herbivory in Rocky Mountain National Park currently prevents regeneration in aspen suckers less than eight feet tall (Olmstead 1979 and 1997, Baker et al 1997 and Suzuki et al 1999). This suggests that aspen in Wind Cave National Park would remain unable to regenerate and eventually die off in areas where elk browse them now. As noted above, some aspen are not currently browsed by elk in the park, but may be less intensively grazed by deer. These patches may continue to regenerate in the park, as would those in exclosures. Otherwise current major adverse impacts to aspen now browsed by elk would likely continue. Aspen forests would decline, possibly at a slower pace than in alternative A. This is a beneficial impact of alternative B compared to no action.

Although the impact on other hardwood forest communities, such as oak and cottonwood has not been modeled, it is likely that the current adverse effects in preventing all regeneration in these forests would also continue, regardless of the reduction in herd size. Ripple and Beschta (2006) found through tree-ring surveys that no regeneration in either species had occurred since the 1880's, regardless of the size of the elk herd. Therefore, the reduced size of the elk herd under this alternative would likely have no beneficial or adverse effect relative to current conditions, e.g., ongoing major adverse effects would continue. Elk would continue to concentrate and forage in these stands limiting the survival of seedlings and preventing the recruitment of young trees. Without recruitment of younger individuals, older trees would not be replaced when they die and hardwood forests would gradually disappear from the landscape.

Shrublands

Under this alternative, the elk population would be reduced by 30%–50% over current numbers through the use of removable sections of fence. If elk numbers are reduced, it is possible that mule deer, whose ecological niche overlaps somewhat with elk, would increase in numbers. Mule deer consume proportionately more browse than elk.

As noted above in the discussion of impacts of alternative A, several studies of park vegetation have attributed declines in shrub densities at Wind Cave to elk herbivory. These declines have occurred across a range of elk herd sizes and densities, from a high of 48 per square mile in 1924 (Bauman 1997) to a low of 6 per square mile in 1994 (Singer and Zeigenfuss 1998). If the impacts to shrublands over this wide range of numbers and densities are truly from elk and not from drought, lowered water table or other ungulates, reducing the size of the elk population would have little overall impact on the condition of shrubs in the park. However, some improvements in the condition of shrub species preferred by elk, such as leadplant and mountain mahogany, as well as relative beneficial impacts in some geographic locations, are possible.

Because elk exert more pressure on preferred shrub species, seed production and reproduction in these species is at risk as the elk herd increases as it would under no action. Reducing browsing on these two species would likely have noticeable benefits in stabilizing or even increasing groundcover of both. Even if mule deer numbers increase as a result of lowered elk herd sizes, the localized impact on browse favored by elk could decrease.

In addition, some beneficial impacts relative to no action would likely occur for shrubs in the north and northeastern sides of the park. Shrubs are part of the elk diet in all seasons, but because many elk wintering in the west and southwest sides of the park leave the park in the spring and summer, browsing pressure in this part of the park is possibly lower than in the northeast portions. Therefore, a reduction in the size of these more stationary elk may have proportionately more beneficial impacts on shrubs than reducing the size of the more migratory element from Gobbler Knob for example.

Overall, compared to no action, the long-term impact of reducing the elk herd on shrubs in the park would be beneficial, in most of the park and for most species, including preferred shrubs and in areas of the park where elk currently exert year-round browsing pressure on shrubs.

Riparian Areas

In the long term, reductions in elk grazing in riparian areas could result in a slow increase in herbaceous biomass, as well as that of willows and shrubs, but is less likely to have any beneficial impact to streamside trees.

Investigation of the impact of reducing elk numbers at Rocky Mountain National Park indicated that the reduction would change the cover of individual species, but would not result in any large-scale effects on species abundance, biodiversity or composition in riparian herbaceous communities. Elk at Rocky Mountain currently eat about 55% of riparian herbaceous vegetation. Modeling indicated reducing elk numbers could increase riparian understory biomass by about 30%. If this is true in Wind Cave National Park, it would result in a beneficial impact for this element of riparian vegetation. Riparian sites used by elk for resting or traveling would still be adversely affected from trampling or bedding, although some small benefits are possible from fewer elk. Also, fewer elk would likely mean less grazing pressure on meadow species, including threadleaf sedge. The condition of this species in the park is unknown, but intense selective grazing often results in reduced reproduction and range over time. Therefore, fewer elk and less intense grazing are likely to mean beneficial increases in the reproduction and range of this and other meadow species.

Modeling also indicated that quick reduction of the elk herd size and management at lower elk densities would result in a greater proportion of willow to reach maturity, with resulting increases in reproduction and range expansion. Increases in willow were in turn expected to result in increased expansion by beaver into areas they had formerly colonized. Beaver would increase the amount of surface water on the elk range and improve groundwater recharge, which would provide additional habitat for willow establishment (NPS 2006c). Willow canopy volume, height and stem density increases of up to 100% over current levels are a predicted outcome of elk reductions. Increases in willow habitat and range are predicted to be between 25 and 40%. No information about decreases in willows in Wind Cave is available. However, given the absence of beaver in formerly colonized areas of the park, elk herbivory of food used by beaver may be a factor. If elk are reduced by 30 to 50% over their current levels and beaver are reintroduced, it is possible that the same cycle of increase in water levels and willow habitat could occur. The extent of such a beneficial impact is unknown.

As noted above in the discussions of shrubs and hardwood forests, even a small number of elk can have a disproportionately large impact, particularly on young shoots of aspen, cottonwood or oak. Cottonwood, which tends to grow in riparian areas, would continue to be subject to browsing by elk, even at reduced levels.

Mixed-grass Prairies

As noted above in the analysis of alternative A, ungulates have both adverse and beneficial impacts on grasslands. Grazing animals deposit nutrients in the form of feces and urine, and grazing itself stimulates the production of nutrients in the soils and of higher quality forage.

Overgrazing by elk at Wind Cave may or may not take place under the no-action alternative, as this is a value-laden term that differs depending on the philosophy, goals, and objectives of the group defining it. However, from an observable ecological perspective, reducing the number of elk from those predicted at carrying capacity under the no-action alternative may not have obvious large-scale adverse effects on grasslands. For example, even at higher densities than are currently at Wind Cave National Park, elk in Rocky Mountain National Park appeared to have a minimal adverse impact on biomass of grasslands, and primarily caused changes only in the range of certain species and soil moisture. Modeling the impact of reducing the Rocky Mountain elk herd by about 45% indicated that all upland herbaceous vegetation (grasses and forbs) would increase biomass by only 1 to 3% over the following 20 years (NPS 2006c). This is despite a current 60% offtake (e.g., consumption) of upland forb and grassland communities.

As noted in the analysis of alternative A, the combination of all grazers in the park and an elk herd at food-based carrying capacity (e.g., a number the herd would reach with no management by the park) may result in as much as 70% offtake. From a range or wildlife management perspective, 70% offtake is unsustainable and would likely result in changes to the range that would not produce maximum beef or huntable deer or elk numbers. From a park perspective, it would also produce adverse changes in vegetation.

At Wind Cave, the Science Team determined the size of the herd of elk wintering in the park should be in a range that would not result in any unwanted changes in a number of resources, among them the quality and quantity of grasslands. As noted in the analysis of alternative A, reductions in biomass, extent and quality of grasslands, change in seral stage, as well as the increasing dominance by non-native invasive species from existing levels of forage consumption by grazers are already occurring and would get worse if the elk herd nearly doubles in size to reach carrying capacity. These impacts are considered moderate or major and adverse by park vegetation specialists. Under alternative B, elk would be reduced to and maintained at a number within the range developed by the Science Team to prevent these types of impacts, as well as impacts to other park resources. This means elk and bison together would consume about 25% of upland forb and grassland communities in the park. Combined with other grazers, including deer, pronghorn, and prairie dogs, grazing offtake would be no greater than 50% of annual forage production if elk are within this stated range, precipitation is average, and numbers of other grazers do not change. Research indicates that total exclusion from herbivores for nine years or more may be required to increase forage production if the grasslands are severely overgrazed (in the 60 to 80% range). Therefore, although large-scale ecological benefits may not result and restoration of current grassland conditions may take several years, the eventual return of grasslands from reducing elk numbers would be a beneficial impact compared to no action.

The loss of nutrients and stimulation of nutrient production by grasslands from a reduced number of elk is not likely to be noticeable on a large scale, as grazing by other ungulates would continue at current levels. Park mixed-prairie grasslands may experience a minor adverse impact to nutrient levels from reductions in elk compared to no action.

Cumulative Impacts

The cumulative actions that affect vegetation would be the same as those described under alternative A.

Prescribed fire would stimulate re-sprouting of aspen, but elk would continue to consume most if not all of the reproduction preventing recruitment of young trees thereby negating that benefit. Stands would continue to age, a major, long-term adverse effect. Similarly, prescribed fire in shrublands would stimulate production, but in preferred feeding sites, elk herbivory would continue to impact preferred shrub species such as leadplant and mountain mahogany. In mixed-grass prairies, the cumulative effects of prescribed fire and population reduction would be long term and beneficial.

Conclusion

Minor to possibly moderate, adverse, localized impacts from trampling to localized vegetation near the newly installed gates and near the raised section of fence in the park would occur during installation, and from elk and hunters in the late summer and fall. Additional negligible impacts from hazing or sharpshooting, should they be needed, are possible.

Current major adverse impacts to aspen from elk browsing would continue, with possible benefits relative to no action from herd reductions in slowing the pace of their eventual disappearance from the park. No differences in impact relative to no action on impacts from elk on hardwood forests would occur, as regeneration in these species has not occurred in the park since 1880 regardless of the size of the elk herd. The long-term impact of reducing the elk herd on shrubs in the park would be beneficial compared to no action and would include areas of the park where elk exert year-round browsing pressure on shrubs now. Beneficial impacts to meadow or riparian herbaceous vegetation and willows from decreased grazing is likely. No change in impact to current adverse impacts to riparian trees is expected and impacts from trampling during travel or resting would be only minimally reduced from lowering elk numbers. Long-term benefits to grasslands in the form of reductions in biomass lost and prevalence of nonnative invasive species are possible. Minor adverse impacts to grassland production from a reduction in nutrients may also occur relative to no action.

ALTERNATIVE C—ROUNDUP AND LIVE SHIPMENT OR EUTHANASIA

The focus of this alternative is the reduction and maintenance of the elk population through roundup and live shipment/donation or euthanasia.

Effects of Specific Elk Management Actions

The impacts of rounding up elk would likely be negligible to minor during initial reduction, and then negligible to minor during annual maintenance operations. Vegetation around the capture facility consists of native mixed-grass prairie species. Prior to use for roundup of bison or other functions, the helicopter landing zone and parking area to the west of the cabin, as well as the area within 50 feet of the cabin, are mowed. This means the grasslands are quite disturbed and less subject to impact from trampling or other roundup activities. In addition, roundup would be conducted in January or February when vegetation is covered by snow or ice or senescent, preventing more serious trampling-related impacts. During the initial reduction phase, herding would be accomplished through the use of helicopters. Elk would be herded toward the existing corral where they would be handled, thus causing some trampling. Once the initial reduction has been accomplished and fewer elk need to be removed each year, herding could be done using horseback riders, noise makers or herding dogs. Because the roundup would occur in winter and vegetation would be dead or covered in snow for the most part, the adverse effects would be local, short term and negligible. Any visible sign to vegetation of trampling would typically be eliminated during the next growing season. Because this activity would be conducted only once a year in winter when the ground is frozen, it is unlikely that permanent trails would be created even if elk were herded through the same general area each year, therefore, trampling would cause short-term, negligible to minor impacts.

Similar to alternative B, it may be necessary to remove surplus bull elk by sharpshooting. Sharpshooters would not be allowed to drive vehicles off of established roads or to drag carcasses of dead elk across the ground surface. Because of the dispersed nature of this activity, the adverse impacts of sharpshooters trampling on vegetation would be short term, localized and negligible under this alternative.

Effects of Elk Population Reduction (long term)

The indirect and long-term effects of reduced elk herbivory, as a result of herd reduction through roundup and live shipment or euthanasia, on aspen and other hardwood forests, shrublands, riparian areas, and mixed-grass prairies would be very similar or identical to those described above for alternative B. (However, the direct impact of management actions would be somewhat different as noted in the subsections *Effects of Specific Management Actions*.)

Cumulative Impacts

The cumulative actions that affect vegetation would be the same as those described under alternative A.

The cumulative effects of alternative C added to past, present and future action impacts would be the same as those described for alternative B with the addition of minor, short-term impacts due to trampling during roundup activities.

Conclusion

Negligible to minor short-term impacts to vegetation from trampling during roundup would occur, and additional negligible to minor localized impacts from sharpshooting or hazing if needed are possible.

Current major adverse impacts to aspen from elk browsing would continue, with benefits relative to no action from herd reductions in slowing the pace of their eventual disappearance from the park. No differences in impact relative to no action on impacts from elk on hardwood forests would occur, as regeneration in these species has not occurred in the park since 1880 regardless of the size of the elk herd. The long-term impact of reducing the elk herd on shrubs in the park would be beneficial compared to no action and would include areas of the park where elk exert year-round browsing pressure on shrubs now. Beneficial impacts to meadow or riparian herbaceous vegetation and willows from decreased grazing is likely. No change in impact to current adverse impacts to riparian trees is expected and impacts from trampling during travel or resting would be only minimally reduced from lowering elk numbers. Long-term benefits to grasslands in the form of reductions in biomass lost and prevalence of nonnative invasive species are possible. Minor adverse impacts to grassland production from a reduction in nutrients may also occur relative to no action.

ALTERNATIVE D—SHARPSHOOTING

Under this alternative, sharpshooting within the park would be used to reduce and maintain the elk herd at target population levels.

Effects of Specific Elk Management Actions

Sharpshooting activities would be conducted during late summer, fall and winter, August 1 through March 1. For much of that period, vegetation is dormant and the ground is frozen. Because of the dispersed nature of this activity, the adverse impacts of sharpshooting on vegetation would be short term, localized and minor. Helicopters to sling load carcasses would also cause temporary disturbance and dispersion of elk, with some negligible adverse impacts from trampling. If sharpshooting does not accomplish the initial population reduction goal in the first 2–4 years, roundup would be required and the effects would be similar to those described under alternative C. However, if roundup is not required, the direct impacts of this alternative from trampling by elk and by humans would be less than in alternative C, as little running by large numbers of elk is anticipated. This is because sharpshooters would used suppressed rifles, and would take only a few elk at a time.

Effects of Elk Population Reduction (long term)

The effects of elk herd reduction on aspen and other hardwood forests, shrublands, riparian areas and mixed-grass prairies would be similar to those described above for alternative B, but could take slightly longer to occur because initial reduction via sharpshooting could take up to four years.

Cumulative Impacts

The cumulative actions that affect vegetation would be the same as those described under alternative A.

Conclusion

Impacts of management activities on vegetation would be minor, as sharpshooters would operate during winter when vegetation is covered in snow or senescent.

Current major adverse impacts to aspen from elk browsing would continue, with possible beneficial effects relative to no action from herd reductions in slowing the pace of their eventual disappearance from the park. No differences in impact relative to no action on impacts from elk on hardwood forests would occur, as regeneration in these species has not occurred in the park since 1880 regardless of the size of the elk herd. The long-term impact of reducing the elk herd on shrubs in the park would be beneficial compared to no action, and would include areas of the park where elk exert year-round browsing pressure on shrubs now. Beneficial impacts to meadow or riparian herbaceous vegetation and willows from decreased grazing is likely. No change in impact to current adverse impacts to riparian trees is expected and impacts from trampling during travel or resting would be only minimally reduced from lowering elk numbers. Long-term benefits to grasslands in the form of reductions in biomass lost and prevalence of nonnative invasive species are possible. Minor adverse impacts to grassland production from a reduction in nutrients may also occur relative to no action.

ALTERNATIVE E—CONTRACEPTION (STERILIZATION) (MAINTENANCE ONLY)

This alternative would be implemented solely to maintain elk at target population goals after initial reduction (alternatives B–D) through permanent sterilization of a predetermined number of the park's reproductive female elk population. At this time, sterilization has not been proven through science to effectively manage wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Effects of Specific Management Actions

Impacts of sterilization as a maintenance tool would be similar to those described for alternative C. This is because roundup would be required so elk could be observed and medicated for at least 24 hours following the sterilization procedure. Because sterilization would be done in January when vegetation is dormant and the ground is frozen, effects on vegetation would be short term, local and negligible. Any signs of trampling would be eliminated during the next growing season. Because the roundup would be conducted only once a year, it is unlikely that trails would be created even if elk are driven through the same general area each year, therefore, trampling would cause negligible adverse effects.

It may be necessary to use sharpshooters to achieve the desired bull: cow ratio or herd size. If so, the effects of sharpshooting under alternative E would be similar to those described above for alternative B, short term, local and negligible to minor trampling.

Effects of Elk Population Reduction (long term)

Long-term impacts to vegetation from reductions in the size of the herd would be the same as described in alternatives B–D.

Cumulative Impacts

The cumulative actions that affect vegetation would be the same as those described under alternative A.

Conclusion

Impacts of initial reduction activities and the long-term effects of removal would depend on the method used, but would be the same as described in alternative B, C or D. Impacts on vegetation of maintaining the elk herd through surgical sterilization would be negligible, as roundup would be conducted during the winter, when vegetation is covered in snow or ice and senescent.

ALTERNATIVE F—FERTILITY CONTROL AGENT (MAINTENANCE ONLY)

Under this alternative, cow elk would be treated with chemical fertility control agents solely to maintain the elk population at target goals once initial reduction efforts (alternatives B–D) are completed. At this time, fertility control agents have not been effective in controlling population growth in large free-ranging wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Effects of Specific Elk Management Actions

Impacts of contraception as a maintenance tool may be greater than described above for other alternatives because animals may be treated during any time of the year. Although cool temperatures are best, it is possible that fall or spring may be preferred to mid-winter. If so, vegetation would be actively growing and unprotected by snow or ice. The method of treatment is not known at this time, but would most likely involve a roundup. Impacts of roundup would likely be no more than short term and minor due to trampling. In most years, signs of trampling would be eliminated during the next growing season.

Effects of Elk Population Reduction

Long-term impacts to vegetation from reductions in the size of the herd would be the same as described in alternatives B–D.

Cumulative Impacts

The cumulative actions that affect vegetation would be the same as those described under alternative A.

Conclusion

Impacts of initial reduction activities and the long-term effects of removal would depend on the method used, but would be the same as described in alternative B, C or D. Impacts on vegetation of maintaining the elk herd through contraception would be short term, adverse and negligible or minor if roundup is required.

OTHER WILDLIFE

Wind Cave National Park is responsible for protecting wildlife, including fish, invertebrates and all native species, as a park resource. This section does not include elk, because they, as the primary resource addressed by this management plan, were discussed as an independent impact topic. Hardwood forests, especially aspen, shrublands, riparian areas and mixed-grass prairies are important wildlife habitats, and this section addresses these habitats in addition to particular groups of wildlife.

GUIDING REGULATIONS AND POLICIES

The *NPS Organic Act* (1916) and NPS *Management Policies 2006* (NPS 2006d) provide the basis for resource protection, conservation and management and are fully described in the "Purpose of and Need for Action" chapter. Specific sections of the NPS *Management Policies 2006* that are relevant to both the elk reduction effort and its impact on wildlife include the following:

- Sec. 4.4.2.1. Whenever the Service removes native plants or animals, or manages plant or animal populations to reduce their sizes…the Service will seek to ensure that such removals will not cause unacceptable impacts on native resources, natural processes or other park resources. In addition, the Service will manage such removals to prevent them from interfering broadly with
  - natural habitats, natural abundances and natural distributions of native species and natural processes
  - rare, threatened, and endangered plant of animal species or their critical habitats
  - opportunities to restore depressed populations of native species
  - breeding or spawning grounds of native species

Director's Order 77-4: Use of Pharmaceuticals for Wildlife. This director's order and accompanying Reference Manual 77-4 establish NPS operational policies and procedures for compliance with existing federal laws, regulations and guidelines governing the use of pharmaceutical agents for wildlife (such as in alternative F) in the National Park System. NPS policy is to administer pharmaceuticals in a manner that is safe for humans and animals, adheres to humane standards and is in accordance with NPS wildlife management philosophy.

METHODOLOGIES AND ASSUMPTIONS FOR ANALYZING IMPACTS

Geographic Area Evaluated for Impacts

The geographic area evaluated for impacts on wildlife includes sites occupied by individual vegetative communities that serve as wildlife habitat within Wind Cave and that may be affected by elk or management activities proposed in each alternative. The scope of the analysis may extend beyond the boundaries of the park, to ensure cumulative actions and impacts, indirect impacts and connected actions are all fully considered. Cumulative effects that would occur both inside and outside these areas were evaluated using the methods described in the "Cumulative Effects Analysis Method" section.

Issues

The following issues were identified during internal and public scoping regarding the potential effects of elk management activity on other wildlife:

- At very high population levels, elk may compete with prairie dogs, a keystone species for the park mixed-prairie ecosystem.
- Elk may compete with bison and other ungulates in the park for forage, especially at high elk numbers.
- High levels of elk grazing may reduce available habitat for several species of rare butterflies in the park.
- Meadow jumping mouse and least shrew, state species of concern, may be affected by increased elk browsing in their habitat.
- Browsing can eliminate or minimize hardwood, riparian, and shrubland habitat for small mammals and birds.
- Raising the fence (alternative B) could interfere with natural system functions (migration).

Impact Thresholds Definitions

Impact intensity level thresholds were defined and evaluated as follows:

Negligible: There would be no observable or measurable impacts to native species, their habitats, or the natural processes sustaining them. Impacts would be of short duration and well within natural fluctuations.

Minor: Impacts would be detectable, but they would not be expected to be outside the natural range of variability and would not be expected to have any long-term effects on native species, their habitats, or the natural processes sustaining them.

Population numbers, population structure, genetic variability, and other demographic factors for species might have small, short-term changes, but long-term characteristics would remain stable and viable. Occasional responses to disturbance by some individuals could be expected.

Key ecosystem processes might have short-term disruptions that would be within natural variation. Sufficient habitat would remain functional to maintain viability of all species. Impacts would be outside critical reproduction periods for sensitive native species.

Moderate: Impacts on native species, their habitats, or the natural processes sustaining them would be detectable, and they could be outside the natural range of variability for short periods of time.

Population numbers, population structure, genetic variability, and other demographic factors for species might have short-term changes, but would be expected to rebound to pre-impact numbers and to remain stable and viable in the long term. Frequent responses to disturbance by some individuals could be expected.

Key ecosystem processes might have short-term disruptions that would be outside natural variation (but would soon return to natural conditions). Sufficient habitat would remain functional to maintain viability of all native species. Some impacts might occur during critical periods of reproduction or in key habitat for sensitive native species.

Major: Impacts on native species, their habitats, or the natural processes sustaining them would be detectable, and they would be expected to be outside the natural range of variability for long periods of time.

Population numbers, population structure, genetic variability, and other demographic factors for species might have large, short-term declines, with long-term population numbers significantly depressed. Frequent responses to disturbance by some individuals would be expected, with negative impacts to feeding, reproduction, or other factors resulting in a long-term decrease in population levels. Breeding colonies of native species might relocate to other portions of the park.

Key ecosystem processes might be disrupted in the long term or permanently. Loss of habitat might affect the viability of at least some native species.

Impairment: Some of the major impacts described above might be an impairment of park resources if their severity, duration, and timing resulted in the elimination of a native species or significant population declines in a native species. In addition, these adverse, major impacts to park resources and values would

- contribute to deterioration of the park’s wildlife resources and values to the extent that the park’s purpose could not be fulfilled as established in its enabling legislation;
- affect resources key to the park’s natural or cultural integrity or opportunities for enjoyment; or
- affect the resource whose conservation is identified as a goal in the park’s general management plan or other park planning documents.

Duration of Impact

Short-term: Those impacts occurring from elk management activities in the immediate future (usually one to six months).

Long-term: Those impacts lasting longer than six months.

ALTERNATIVE A—NO ACTION

Under the no-action alternative, existing elk management actions (monitoring and targeted surveillance) would continue with no additional efforts implemented to address the size of the elk population and its effect on park resources.

Wildlife Habitat

Under alternative A, adverse effects of elk herbivory (as described in the “Vegetation” section in this chapter) would continue to increase in hardwood forests, shrublands, riparian areas and mixed-grass prairies. The increased herbivory would alter conditions for wildlife associated with these habitats in the park. This trend would continue until the elk population stabilized. Overall, herd numbers and impacts to wildlife wildlife species that rely on hardwood forest, shrubland or riparian vegetative types would continue as site conditions continued to decline.

As noted in the “Vegetation” section, elk browsing and grazing have prevented regeneration of some hardwood and riparian species, but may have encouraged the growth of nutritionally superior grasses. On a landscape scale, this can mean the extent of shrub, forest and riparian habitats decline whereas the disturbed or low seral stage vegetation that grasslands represent becomes relatively more abundant (Kay 1995). This overall trend would benefit wildlife that use this type of habitat, such as prairie dogs, burrowing owls, bobcats and ferruginous hawks. It would have adverse effects on those species that require vegetation in later seral stages, such as mature riparian forest, hardwood forest, ponderosa pine and shrublands. These include several species of songbirds and raptors.

In the extreme, preventing regeneration of some hardwood trees, browsing shrubs so intensely that seed production is curtailed or lost, or grazing and/or trampling the park’s limited willows and other riparian vegetation could also mean an overall decline in wildlife biodiversity in the park. Allowing the elk herd using the park to reach 1,200 could produce this reduction in biodiversity in the park, particularly if it persists for many years. If it occurs, it would be a moderate to major impact on wildlife habitat.

Currently, two fenced monitoring exclosures limit availability for ungulates of about 45 acres of aspen habitat. This represents a long-term, local, minor to moderate habitat loss for those species. Small mammals, breeding birds and other wildlife which can freely cross the fences are not affected.

Bison

Bison, the key management species for Wind Cave, have little seasonal variation in their habitat use. According to a 1980s study (Wydeven and Dahlgren 1985) bison graze on grasses year-round, cool-season species most of the year, and big bluestem in the early summer. A study in the late 1970s (Wydeven 1979) found that elk and bison spatial distribution overlapped about 43% of the time. Overlap appeared to be higher in the spring and summer. Moderate similarity also existed in bison and elk food habits, as both fed on cool-season grasses, big bluestem and threadleaf sage. Only elk and pronghorn shared a higher percentage of foods. Wydeven and Dahlgren (1985) noted that elk and bison did not seem to compete extensively in the park, and that competition was reduced by low distributional overlap. However, because both bison and elk depended on grasses in spring and summer, the potential for direct competition increases during these seasons. When the two cross paths, the literature suggests that bison would be dominant, and harassment, particularly of elk calves, may cause elk to avoid areas frequented by bison. This is particularly true during elk calving season (Shult 1972 and Mahan 1977 as cited in Wydeven and Dahlgren 1985).

Bison

If the elk herd expands to as many as 1,200 individuals, it is more likely that the geographic separation the two species are able to utilize to avoid direct competition may disappear and interactions would be more likely. Although bison are more aggressive and likely to prevail if competition increases, they would use energy reserves to do so. Body condition or reproductive rates may decline as a result, a minor to moderate long-term adverse effect on the bison herd.

The park's bison management plan calls for maintaining a viable population at a minimum of 400 animals through annual roundup and removal. With increasing competition from elk, and increased adverse impacts on mixed-prairie grasslands, the park would potentially be forced to manage bison at or near 400 animals to address overgrazing under the no-action alternative. Because this also reflects current conditions, it is not an adverse impact to the herd, but would prevent a potential benefit from increasing the number of bison in the park.

Black-Tailed Prairie Dog

The same study that investigated bison also examined the use of prairie dog towns in the park by other ungulates. It found that elk used prairie dog towns primarily during the fall rut and generally avoided them during the rest of the year (Wydeven and Dahlgren 1985). As noted in the "Affected Environment," Wydeven and Dahlgren (1985) found the major food species at the park consumed by elk (and even bison) were more abundant in locations other than prairie dog towns.

When grazing by elk and other ungulates is relatively light, competition and impact to grasslands, including of elk on prairie dogs and vice versa, is also quite light. For example, a study by Whicker and Detling (1998 as cited in Vermeire et al. 2004) during a time when the park was using live translocation of elk to keep the wintering population low compared live, dead and total herbage on grazed and ungrazed plots and found they had virtually the same cover values for all species. At the time, large herbivores only used 5 to 30% of the aboveground net primary production.

When grazing pressure increases, competition and impact to the grazing animals is also likely to increase. Whiles studies of the effect of increasing elk populations on prairie dog colonies have not been conducted, the literature is full of (often conflicting) information regarding the impact of prairie dog expansion on cattle weights. At least one study (Cable and Timm 1987) also examined the effect of removing cattle on prairie dogs. This study found that the ratio of prairie dog pups to adults and percent increase of animals in a colony both decreased on sites where grazing was deferred during the growing season, and increased along with colony density on grazed sites. In other words, within the light to moderate spectrum of cattle grazing examined by this study, moderate cattle grazing appeared to offer greater benefits to prairie dog colonies. As noted in the "Affected Environment," these benefits are likely related to the removal of high grasses and increased visibility for prairie dogs (and therefore the ability to detect predators), as well as the stimulation of nutrients in grasslands described in the "Vegetation" section.

The impact of very heavy grazing by cattle (and, since no elk-specific information is available, by proxy the impact of heavy grazing by elk) on prairie dogs has not been studied, but the reverse has. Derner and others (2006) re-examined past studies evaluating the impact of prairie dogs on weight gains in cattle (domesticated ungulates) and concluded that there was a relationship, for example, that the ability of cattle to gain weight while foraging in grasslands was related to the percentage of area occupied by prairie dogs. This team found the weight of cattle declined with increasing area occupied by prairie dogs, but at a rate proportionately lower than the increasing percentage of the pasture occupied by prairie dogs. For example, when prairie dogs occupied 20% of the pasture, cattle weight declined on average by 5.5%. When prairie dogs occupied 60% of the pasture, weights declined on average by 13.9%. Differences were particularly noticeable during drought years. Over all years and all areas, Derner and others found cattle grazing in areas without prairie dogs had 6% higher weight gains than those with prairie dogs, and that the mean area occupied by prairie dogs was 24%.

Although this and other studies examined the impact of prairie dogs on ungulates, there is no reason to believe the reverse is not true, for example, that at some point the density of ungulate grazing will adversely affect prairie dogs. Both elk and prairie dogs eat the same species of grasses, and light or moderate grazing by both increases nutrient levels and encourages regrowth of grazing resistant species as described above in the “Vegetation” section. However, at very high grazing pressures, biomass removal, shifts in seral stage and plant species to less palatable forbs and the spread of non-native species are likely. This combination of factors is likely to have overall adverse effects on prairie dogs in the long term under the no-action alternative. An expanding elk population would be expected to exploit all available forage resources, including those on prairie dog towns. However the relatively small acreage occupied by prairie dogs and feedback loops involving increased availability of nutrients (see the “Vegetation” section) are likely to keep impacts to prairie dogs in the park minor, with possible moderate localized impacts at particular colony locations. In the shorter term, increasing grazing by elk may have a positive effect on prairie dogs colonies, as additional vegetation around the colonies may be shortened or consumed (particularly in the fall, if the current trend of use by elk at the park continues), facilitating expansion by prairie dog colonies.

The longevity of these positive impacts and the degree of adverse impacts to prairie dogs related to a very dense elk population may be tempered by park management. For example, if under the no-action scenario elk truly do expand to occupy all available grassland habitat with adverse impacts to bison, other wildlife and other resources as described in this EIS, it is possible that the park may choose to reduce the prairie dog population to the lowest end of the range allowed for in its *Black-Tailed Prairie Dog Management Plan/EA* (NPS 2006a), a decrease from the current 2,800 acres to 1,000 acres. Because black-footed ferrets, an endangered species, depend on prairie dogs for prey, the park may be unable to reduce numbers of prairie dogs to this low number; however, to allow for maximum management flexibility, this EIS assumes the park is able to make such a reduction under the no-action alternative given the absence of any other elk management tool. Reducing the population to this extent would involve a 65% decrease, a moderate to major long-term adverse impact to the prairie dog population.

It is also likely that any positive impact from increased elk grazing would be very short-lived under this scenario, as currently prairie dog colonies occupy 2,800 acres of the maximum 3,000 acres the park’s plan allows.

Ungulates (other than bison)

Competition with elk for forage and space can restrict the population size and distribution of other ungulates at the park, i.e., pronghorn antelope, mule and white-tailed deer. However, little competition was noted in studies of food and habitat overlap among ungulates completed in the park during the 1970s and 1980s. Authors generally concluded that competition among ungulates was low, and “appeared to be minimized by differential habitat selection and forage utilization” (Wydeven 1977). This could change if the elk herd reaches high numbers.

Elk and pronghorn diets overlap, particularly during winter. Both eat similar forbs, especially Louisiana sagewort, and both use the same type of habitats, although authors of studies in the 1970s and 1980s noted they did so in different areas of the park (Wydeven and Dahlgren 1983 and 1985). Wydeven and Dahlgren (1985) studied relationships between ungulates at Wind Cave and found that pronghorn and elk had the highest “coefficient of competition,” a variable that includes habitat, spatial distribution and food preferences, although even this value was quite low (0.09). The authors noted that potential for serious direct competition between species occurs when the coefficient of competition values is near or greater than 0.30. If the number of elk increases, competition between these species would also increase as elk occupy habitats they do not currently use. It is likely that pronghorn would suffer under this scenario as elk are larger and more dominant. Impacts to pronghorn would be adverse, long term and moderate or perhaps even major in intensity.

Mule deer and elk prefer similar habitats at Wind Cave, but were found to occupy different areas of the park in winter when competition would be expected to be greatest (Wydeven and Dahlgren 1985). Mule deer and elk were found by Wydeven and Dahlgren (1985) to be most similar in distributional overlap in summer. Mule deer in the park generally eat forbs and browse. Elk were found to eat mostly grasses and forbs, but are known to utilize browse in harsh winters in the park. In other locations, Rocky Mountain elk depend heavily on browse. It is possible that as elk numbers increase in Wind Cave under alternative A, they would displace mule deer from portions of the park through aggressive behavior and competition for browse as they may have done in the past (Cliff 1939; DeNio 1938; Cowan 1947 in Thomas and Toweill 1982). Because elk would depend increasingly on browse and may expand into all geographic areas of the park at very high numbers, competitive exclusion of mule deer may have long-term moderate adverse impacts.

As of the fall of 2006, only about 60–80 white-tailed deer occur in the park, and little is known about this population (Roddy 2006). White-tailed deer occupy riparian areas and food includes browse and forbs in these habitats. As noted in the “Vegetation” analysis, elk can use riparian corridors for foraging, travel and resting, and may consume both herbaceous understory plants and shrubs and young tree shoots. Although competition between elk and white-tailed deer may not be extreme because of relatively low numbers and divergent food habits (Thomas and Toweill 1982), this could change as the number of elk increases. At very high numbers, elk may utilize forage in all accessible habitats, including the park’s limited riparian areas. Effects to white-tailed deer numbers could be noticeable, a minor to moderate, adverse and localized impact.

Small Mammals

An unregulated elk population under alternative A would affect the structure and function of habitats for small mammal populations. A 1992 study (Derting and Kruper) of small mammals at Wind Cave found that although species diversity was relatively high, density of at least two species of small mammals, white-footed mouse and prairie vole, was surprisingly low. In comparing abundance and diversity inside an existing four-acre elk exclosure and areas immediately outside the exclosure, the researchers found both abundance and diversity higher inside than outside. The difference was most highly correlated with reductions in vegetation height, presumably the result of grazing from elk and other ungulates. Although some of the compared sites outside the exclosure showed dramatic differences in mammal abundance and vegetation height, others where grass and brush cover was abundant found significantly higher numbers of voles and other small mammals. The study did not identify whether the grasses and shrubs that had been grazed on tracts outside the fenced area were grazed by bison, elk, or other ungulates.

Under the no-action alternative, the number of sites where vegetation height is unaffected would diminish, and the kinds of impacts noted in this study would begin to occur across a wider portion of the landscape. The effects on increased elk herbivory on small mammal species would vary depending on the individual habitat requirements of each species, although most of the small mammal species at the park would experience adverse effects from the loss of cover or from direct competition from elk consuming seeds of shrubs. Elk also trample vegetation, and have particularly intense impacts in areas where soils are moist or elk concentrate, such as riparian woodlands. Over time, grazing, browsing or trampling can change plant composition and lower habitat diversity for small mammals as it has likely already done in riparian, shrub and hardwood forests. An increasing elk herd is likely to add to current impacts, but because these habitats are already altered, the addition over current levels would be minor or moderate.

Not all species decline with increasing ungulate grazing pressure. Grazing at intermediate and low deer densities has been shown to increase or have no effect on some plant and animal species in Britain (Fuller and Gill 2001). At Point Reyes National Seashore, deer mice were found more often in pastures grazed by cattle than in pastures where cattle were excluded (Fellers and Pratt 2002). Deer mice, prairie dogs, cottontail rabbits, and northern pocket gophers are examples of other small mammals at Wind Cave that may benefit from elk grazing, as they are associated with early seral stages and disturbed habitats, and have low cover requirements. These beneficial impacts would increase as the elk herd increases.

The Bear lodge meadow jumping mouse, a species of state concern, lives in moist draws and permanent riparian areas in the park. Habitat for this species would be affected by increased browsing of riparian areas by an unregulated elk population (Hafner et al. 1998 in Duckwitz 2001). However, because these habitats are already affected by high use by elk, the adverse effects would be minor, but long term.

The least shrew occurs as a rare species in grasslands at Wind Cave. An unregulated elk herd would impact habitat for the least shrew by increased grazing which would reduce the amount of herbaceous cover in mixed-grass prairies in the park. However, because of the limited distribution of the least shrew in the park, the adverse effects would be minor.

Predators and Scavengers

The park is home to at least three mammalian species that could potentially take an occasional elk, especially calves, as prey. These are the mountain lion, coyote and bobcat.

Although mountain lions tend to selectively prey on deer, they do take elk calves and have taken occasional mature elk in the park. An expanded elk population would potentially offer benefits to mountain lions by producing more prey, especially calves. An indirect adverse effect to mountain lions could also occur if the larger elk population displaces some deer from the park. This would only be a minor effect though because lions can move freely into and out of the park to areas with higher deer populations.

Coyotes are usually not large enough to take elk as prey, and feed primarily on small mammals. However, an expanded elk population would provide more calves, and would also potentially lead to the weakening of some elk through progressively fewer food reserves. As noted in the “Impacts to the Elk Population” section, scarce forage would particularly affect those individuals that are not as able to compete, such as the older, calves and sick or weak elk. These individuals would be both more likely to be taken down by a coyote, and more subject to death from hard winters or disease. The availability of additional weakened live animals and calves, as well as the greater availability of elk carrion, would benefit coyotes. Coyotes would also experience an indirect benefit from any increases in small mammals associated with increasingly disturbed or early seral stage conditions.

Bobcats can also take an occasional elk calf. The increased elk population would provide a benefit for bobcats.

Breeding Birds

The impacts of grazing on breeding birds at the park would vary depending on the species’ habitat needs. For example, some grassland birds in the park prefer early successional stages and low cover; the no-action alternative would benefit these species. One study that included information on the impacts of light to moderate grazing by wildlife (in this case, prairie dogs) on western bird species (Agnew et al. 1986) found that grassland species horned larks, western meadowlarks, mourning doves, killdeer, barn swallows and burrowing owls were each more common on grazed grasslands than ungrazed. This same study found species diversity and bird abundance were each higher on the grazed areas than non-grazed. This was attributed to an increased in structural diversity of the vegetation and increased seed production by forbs. Grassland birds more common on ungrazed sites included red-winged blackbirds, lark bunting, upland sandpipers and grasshopper sparrows.

Heavy grazing such as that which may occur in the later stages of the no-action alternative would likely reduce patchiness and structural diversity of vegetation, and reduce litter and above ground biomass to the point that more adverse than beneficial impacts to nesting habitat for grassland birds is more likely. For example, in a study of cattle grazing and grassland bird abundance, research indicated that avian abundance and species richness in areas grazed by cattle had lower diversity, lower species richness and lower relative abundance of passerines (songbirds) and near-passerines (hummingbirds, woodpeckers and doves). Only one species, the savannah sparrow, was found in higher numbers in grazed grasslands (NPS 2004a). A long-term adverse impact of unknown intensity, likely to be minor to moderate, on grassland-dependent breeding birds is possible under the no-action alternative.

Deer exclosure studies in hardwood forests (Pennsylvania) indicate that high densities of white-tailed deer cause declines in intermediate canopy-nesting songbirds. This study showed complete absence of certain songbird species, including American robins, at deer densities over 75 deer per square mile (deCalesta 1994). These declines are thought to occur because high deer numbers alter the structure of woody and herbaceous vegetation at elevations of one to 20 feet above the ground (deCalesta 1994). Studies of fallow deer, roe deer and muntjac deer in British lowland forests suggested that some bird species, namely understory nesters, declined with high grazing pressure while other species, namely bark foragers, benefited from reductions in understory vegetation. Researchers in British lowland forests determined that "losers" substantially outnumbered "winners" and that breeding populations of migrant birds were especially vulnerable to adverse impacts from heavy deer grazing pressure (Fuller 2001).

In Wind Cave, a large elk population would be expected to cause severe impacts in aspen and other hardwood forests, and to a lesser degree in shrublands and riparian areas. In these habitats, increased elk herbivory would reduce the amount of nesting cover for many species of breeding birds. Continued overbrowsing of aspen and other hardwoods by elk would cause a reduction in structural diversity, aging and the eventual loss of aspen and other hardwood stands (Ripple and Beschta 2006), as well as a reduction in cavity and other nesting habitat. Most of the species associated with hardwood forests are considered uncommon or rare within the park (see table 10 in the "Affected Environment" chapter). Although browsing may have prevented regeneration in some hardwood species, aspen, oak and cottonwood still remain in the park. With continued elk herbivory these tree species would largely disappear from the park and the birds that depend on them as well. This is a localized moderate to major impact on these bird species.

Shrubland species would be affected by high levels of elk herbivory which reduces the size and vigor or individual plants, seed production and reproduction, particularly on preferred browse species. Fourteen of 19 breeding birds associated with shrublands are uncommon or rare (see table 10 in the "Affected Environment" chapter). As noted in the analysis of impacts to vegetation, increased herbivory by an increasing elk population could be expected to have moderate adverse effects on shrublands. These effects would in turn have long-term, moderate adverse impacts on breeding birds that occupy this habitat.

Rare Butterflies

Mixed grass prairie in the park provide habitat for several rare butterflies, most of which are monitored under the South Dakota Natural Heritage Program. These include the regal fritillary, ottoe skipper, arogos skipper, and uncus skipper. The Atlantis fritillary also occurs in the park, but prefers wet meadows and boggy areas. The skippers lay their eggs on big and little bluestem, and so are dependent on the abundance of these species for successful reproduction and continuation of the species. Regal fritillary lays its eggs in the debris of the prairie floor. The eggs overwinter and caterpillars hatch in the spring to feed. An increase in the number of elk feeding on bluestem and occupying prairie grasslands is likely to result in trampling, crushed eggs and loss of habitat for the skippers and regal fritillary butterflies. These impacts would result in a decline in numbers, a moderate, long-term, adverse effect.

Cumulative Impacts

Wind Cave anticipates conducting prescribed fires on up to 4,000 acres per year (NPS 2005a) to improve wildlife habitat conditions by restoring a natural ecological process and improving the vigor of park vegetation. There would be short-term, local, minor adverse disturbance impacts during and immediately following project implementation, but generally would benefit wildlife and would offset to some extent the adverse effects of increased elk herbivory.

Vegetation exclosures as described above to exclude grazing wildlife and protect aspen reproduction and recruitment would provide a local benefit for wildlife species that rely on aspen. Vegetation management, including thinning of conifer stands in preparation for prescribed fires described above, would temporarily displace wildlife during project activities, while restoring historic stand conditions in the areas treated. Short-term effects are adverse, local and minor while long-term effects are park-wide and beneficial.

The current pattern of park fencing has a negligible effect on most wildlife populations because mule and white-tailed deer, small mammals, breeding birds and other wildlife are able to move freely through the fences.

Previous predator reduction efforts (primarily from 1912 to 1935; Mogen 1977) had moderate short-term adverse effects on the affected species population. Prey species populations grew during this period, and continued unregulated growth of these populations has generally been an adverse effect on the health, population structure, and behavior of ungulates since predators were eliminated.

Park management plans for bison and prairie dogs benefit wildlife by maintaining or restoring sustainable habitat conditions for other wildlife species. The impacts of these plans would be long term and local to park-wide. Maintaining the parks current acreage of prairie dog colonies would maintain habitat for species of wildlife that are closely associated with prairie dog colonies.

Conclusion

A moderate to major adverse impact on wildlife biodiversity from degradation of shrubs, hardwoods, and riparian habitat may occur if the elk herd reaches carrying capacity at the park. Minor to moderate adverse impacts would occur to two important species in the park, bison and prairie dogs, from increased competition for forage as the elk population expands. Moderate to major adverse impacts to prairie dog populations from increased removals required by park managers if elk management tools remain unavailable would occur. Moderate to major impacts to pronghorn and moderate impacts to mule deer from interspecific competition for habitat and forage are likely as elk numbers increase. Minor to moderate adverse impact to white-tailed deer are also possible. The abundance and diversity of most small mammals in the park would likely decrease through loss of cover and direct competition related to elk grazing, a minor to moderate impact over current conditions. Some small mammals associated with early seral stages or disturbed habitat may experience beneficial impacts. Minor adverse impacts to two rare small mammals in the park, Bear lodge meadow jumping mouse, and least shrew from loss of cover are likely. Benefits to the park's predators and scavengers are likely from the higher number of calves and additional weakened elk. Moderate to major impacts to birds that breed in hardwood forests and moderate impacts to riparian and shrubland bird nesters are likely as the physical structure of vegetation in these habitats is altered by increased elk herbivory. Both beneficial and adverse impacts to grassland birds would occur. Minor to moderate adverse impacts to grassland-dependent birds and benefits to those bird species that prefer early successional stages and less cover would occur. Several species of rare butterflies would decline in numbers, a long-term moderate adverse effect. Cumulative effects from park management have generally been beneficial, including habitat management through mechanical means and prescribed fires and the implementation of species management plans. Previous predator control actions have had adverse impacts on the predators themselves and the populations they historically controlled.

No impairment to park resources would occur as a result of impacts to wildlife should alternative A be implemented.

ALTERNATIVE B—HUNT OUTSIDE THE PARK

The emphasis of this alternative is the reduction and maintenance of the park's elk population via the state-managed public hunt on lands outside the park.

Wildlife Habitat

Large scale reduction in the number of elk in the park would reduce grazing and browsing pressure on park vegetation. However, improvements in hardwood forests including aspen, shrublands and riparian areas would be limited because of the limited amount of these vegetative types available and the preference that elk show for them.

Aspen communities in particular would be over-utilized because elk concentrate in these stands. Reproduction and recruitment of young aspen would occur at a very low rate if at all. Other vegetation within this community would continue to be stressed because they would be heavily used by elk.

Grasslands are the most abundant vegetative type in the park and are well distributed, so the effects of reduced elk herbivory on this type would be beneficial and noticeable. Overall, beneficial impacts on wildlife habitat and biodiversity in hardwood forests, shrublands, and riparian areas would occur, with possible benefits in grasslands.

Bison

Increases in human activity associated with implementing this alternative would have short term effects on bison. Bison movements would not be directly affected by installing moveable gates in the fences because the remaining fence would be designed to keep bison in the park. Similarly, closing the gates or raising the fence in the fall would have a negligible effect on bison.

The number of bison in the park is regulated through annual roundup and removal. The roundup, which is accomplished by hazing with helicopters, is stressful and some injuries do occur (NPS 2006b). Hazing to move additional elk out of the park would have lesser effects on bison than the annual roundup because hazing would concentrate on moving elk not bison. However, some bison may inadvertently join in the hazing and be disturbed, displaced or run for long distances. Particularly because hazing would take place in the winter when nutrition is scarce, the loss of energy expended in an inadvertent run to avoid hazing could have adverse impacts to the health and survivability of bison. Calves and older bison would be particularly vulnerable to the impact of lost calories. In addition to energy expended from increased activity, the use of helicopters for hazing could have indirect effects from reducing the time spent in search of and consuming food. Stockwell and others (1991 as cited in Bowles 1995) found that bighorn sheep alerted more often when feeding if helicopters were flying in the vicinity. By counting the number of bites, the researchers found that food intake was affected, even when helicopters were as far as 500 meters away. The impact to bison of helicopters would be localized, short term, and minor to moderate.

Sharpshooting to remove surplus adult bull elk or for maintenance activities would have very localized, short-term minor to moderate adverse effects on bison, but long-term effects would be negligible. The effects would primarily be a result of increased human activity because sharpshooters' firearms would have noise suppressors attached. Carcasses of elk killed by sharpshooters would generally be moved by helicopter to a central loading area, causing a local displacement of bison with minor or moderate short-term effects as described above. In some cases, carcasses may be left in the field, with no effect on bison.

If hazing or sharpshooting is required, closing backcountry roads to visitors would reduce the amount of visitor travel but have no apparent benefit because most bison are habituated to human activity along roads. The benefits of limiting human disturbance along roads would be offset by the disturbance caused by the sharpshooters.

Long-term impacts associated with a reduced elk population would include less competition for habitat and forage, particularly grasses and forbs. Because competing with elk for food resources and habitat requires energy, reducing the size of the elk herd would offer benefits for bison relative to the no-action alternative.

Black-tailed Prairie Dog

No or negligible impacts from management activities in alternative B are expected to affect black-tailed prairie dogs. Human activity such as from hazing or sharpshooting may have short term negligible impacts on prairie dogs from disturbance.

Long-term impacts of alternative B would be both adverse and beneficial relative to no action. Because disturbed areas would increase under no action, prairie dog town habitat might increase temporarily. However, elk foraging on grasses and forbs used by prairie dogs would also increase, and the park may be forced in alternative A to manage prairie dogs to lower numbers in the absence of elk management tools. Both of these would be reversed under alternative B. Prairie dog expansion would be reduced as fewer ungulates would be available to eat tall grasses or otherwise create suitable habitat. This is a minor, but short lived adverse impact relative to alternative A. Because the park would be able to manage the wintering elk population, long-term competition for forage between elk and prairie dogs that would likely result under no action would not occur in any of the action alternatives, a potential benefit for prairie dogs. Particularly if no action would have eventually resulted in managing the prairie dog population to the lower end of the size allowed in its *Black-Tailed Prairie Dog Management Plan/EA* (NPS 2006a), action alternatives (including alternative B) would offer relative benefits by reducing the elk population instead.

Other Ungulates

Installing new gates in the fence and closing gates in the early fall would have a negligible adverse effect on mule deer and white-tailed deer because they are currently able to move freely into and out of the park through the existing seven-foot fences. Pronghorn antelope would also experience negligible impacts because they use holes in the fence and crawl underneath it. Hazing activities would temporarily displace ungulates in the local area where those activities occur. Since these activities would occur in the late fall or early winter, escaping from helicopters and a reduction in feeding opportunities may have particularly adverse effects on ungulate energy expenditure. Older and younger animals may be particularly vulnerable, and impacts may be minor or moderate, although they would be short term and localized. Similarly, sharpshooting would have a minor, local, short-term displacement effect, but no long-term adverse effects. Truck traffic and the presence of humans hunting elk outside the park may disturb and temporarily displace other ungulates on federal, state or private lands, a minor adverse impact. Closing roads to visitor use in areas where roundup or sharpshooting are occurring would reduce disturbance and provide a local, short-term benefit for ungulates.

The large-scale elk herd reductions proposed in alternative B would reduce competition for forage and space with all other ungulates in the park. Long-term changes could take several years to be realized.

As noted above, it does not appear that at current population levels, elk are impacting pronghorn antelope numbers. Direct competition between pronghorn antelope and elk is limited, and would be expected to decline under alternate B compared to the no-action alternative. Because the two occupy similar habitats types and eat similar grasses and forbs, greatly increasing the elk population could have moderate or even major impacts on pronghorn. Therefore, reducing the size of the herd would result in beneficial impacts on pronghorn.

Wydeven and Dahlgren (1985) speculated that competition between elk and mule deer might be more severe than casual observations indicate, and that the more dominant elk could be limiting the distribution of mule deer within the park even at current numbers. Alternative B would result in a population of elk of around 350. This is a 54% decrease over current conditions, but a potential decrease of 70% over what could occur under the no-action alternative. As noted under the analysis of no action, mule deer would likely be progressively outcompeted by elk, with potential herd-wide moderate adverse impacts. Implementing alternative B would eliminate this adverse impact, with comparative beneficial impacts to mule deer. In addition, since alternative B would further decrease the size of the elk herd, it may result in increases in the number and distribution of mule deer over what they are now. Although it may take several years for the mule deer population to increase and stabilize, this would be an additional beneficial impact for this species.

Elk foraging activity in riparian areas would decline under alternative B. Because of the very limited distribution (29 acres, 0.01% of park lands) and generally over-utilized condition of these areas (Curtin 2006), grazing by elk would continue to impact habitat for white-tailed deer, but less than alternative A. Compared to alternative A, beneficial impacts for white-tailed deer are likely to occur.

Small Mammals

The structure and function of vegetation would generally improve with a substantially reduced elk population. The effects on small mammal populations would vary due to their diverse habitat requirements. In general, grassland species would experience long-term, park-wide benefits. Benefits to wildlife species occupying aspen, shrublands and riparian areas relative to no action would also occur. However, because even a small population of elk exert a disproportionate effect on these habitat types, adverse effects to these wildlife species would continue.

Continued high levels of utilization by elk in aspen and riparian communities would prevent substantial habitat improvements for the Bear lodge jumping mouse, but localized beneficial effects could occur in natural refugia (Curtin 2006). Overall, the impacts of alternative B on the meadow jumping mouse would be long term, local and beneficial.

Beneficial impacts for the least shrew from a reduction in grazing by elk may occur, as grazing could reduce the amount of herbaceous cover in mixed-grass prairies used as habitat by this species. However, because of the limited distribution of the least shrew in the park, the benefits would be limited.

Predators and Scavengers

Coyotes and other scavengers would experience a short-term local benefit if a few carcasses of elk killed by sharpshooters are left in the field for scavengers. Leaving carcasses of elk killed by sharpshooters in the field would provide short-term, local benefits to scavenger bird species such as magpies and migratory bald eagles. However, in the long term a much smaller elk population would supply less carrion. Some of that shortfall could be compensated for by additional deer and pronghorn antelope carrion. Overall, the effect of elk reductions in alternative B on scavengers is likely to be adverse and negligible to minor.

Other activities associated with alternative B, (human activity and disturbance caused by hazing and sharpshooting) would have minor, localized, short-term, adverse effects on predators.

As with scavengers, the impact to predators in the park from a reduced elk herd would be mostly adverse as the number of vulnerable prey (such as calves and starving or diseased animals) decline. An increase in mule deer could help compensate for this loss, especially for mountain lions, whose preferred prey species is deer. The impact to mountain lions would likely be beneficial.

An increase in some of the small mammals in the park related to decreased grazing, particularly in grasslands, would increase available prey for bobcats and coyotes. As the deer and pronghorn antelope populations increase, fawns would be more abundant and provide a potential alternate prey base in years when small mammal populations are low (Riley 1982). An increase in the abundance of breeding bird populations would also provide prey for bobcats. These changes would result in beneficial impacts for the park's smaller predators.

Dogs, if allowed to run uncontrolled in the park and remain for hours, could have contact with wildlife and spread diseases either directly or through fecal matter. In particular, coyotes or foxes may be vulnerable. To prevent this, only highly trained dogs under demonstrated control of their owners would be used, and all dogs would be fully vaccinated. Given these conditions, the impact of using dogs would be negligible.

Breeding Birds

Hazing and sharpshooting activities would primarily occur during the fall and winter after the breeding season and after most migratory birds have left the park. Resident bird species would be temporarily displaced by these actions, but the effects would be very local, short term and minor.

The long-term effects of alternative B of reducing elk populations on breeding birds are related to changes in the structure and function of key habitats resulting from reduced herbivory. Changes in grasslands (i.e., increase in residual cover, above ground biomass and increased seed and insect production) would occur within one or a few growing seasons. Changes in other vegetative types, especially those with limited distribution, which are also preferred by elk (i.e., hardwood forest, especially aspen, shrublands and riparian areas), would take longer to occur or may not occur even with lowered levels of elk herbivory.

Breeding birds of late seral grasslands would benefit from improved nesting and foraging habitat that would occur under alternative B. Effects would be park-wide and long term. In contrast, adverse long-term effects on birds associated with early seral grasslands and grassland bird biodiversity during the growing season would occur. These are likely to be negligible or minor because grazing by elk and bison would continue to provide a diverse patchy landscape with areas of early seral vegetation suitable for these species.

Rare Butterflies

Grassland habitat conditions for the regal fritillary butterfly and skippers would improve with reduced elk herbivory under alternative B, a park-wide, long-term benefit.

Cumulative Impacts

The existing effects of other plans, projects and actions on wildlife would be the same as under alternative A.

Conclusion

A beneficial impact to biodiversity and wildlife habitat in most vegetative communities in the park, with possible benefits for grassland species, would occur from reductions in elk grazing. Implementation of alternative B would result in short-term minor to moderate adverse impacts to ungulates, predators, small mammals and breeding birds from disturbance, increased energy expenditure, and displacement associated with installing and raising the fences and gates, and from hunting outside the park, as well as hazing and sharpshooting should these tools be needed. If dogs are used to haze elk, vaccination and demonstrated control by pet managers would keep impacts to wildlife from occurring. Reductions in elk numbers would have generally beneficial effects on wildlife habitat and wildlife populations. Less competition for habitat and forage, with relative benefits for most ungulates, including bison and mule deer, would occur. Benefits for pronghorn and white-tailed deer from reducing elk numbers would be possible. Additional benefits from a reduction in competitive exclusion by elk and increase in population size for mule deer are likely. Localized beneficial impacts to prairie dogs from decreased elk foraging would occur. Continued high use by elk in hardwood, riparian and shrubland habitats would prevent substantial beneficial impacts to small mammals, birds and grassland species in these habitats. Benefits for the meadow jumping mouse and the least shrew would occur from increases in herbaceous cover. Predators and scavengers would experience negligible to minor adverse impacts from reduced numbers of calves and other vulnerable prey, although beneficial impacts to mountain lions from increased numbers of mule deer, and to coyotes and bobcats from increases in small mammal numbers are positive indirect impacts of reducing the elk herd. A long-term beneficial impact to rare butterflies from improved grassland habitat conditions is also possible. Cumulative effects from park management have generally been beneficial, including habitat management through mechanical means and prescribed fires and the implementation of species management plans. Previous predator control actions have had adverse impacts on the predators themselves and the populations they historically controlled.

No impairment to park resources would occur as a result of impacts to wildlife should alternative B be implemented.

ALTERNATIVE C—ROUNDUP AND LIVE SHIPMENT OR EUTHANASIA

The focus of this alternative is the reduction and maintenance of the elk population through roundup and live shipment/donation or euthanasia.

Wildlife Habitat

The effects of alternative C on the structure and function of vegetation would be similar to those described under alternative B. Elk herbivory would be reduced to the same extent because, while the methods to reduce the elk population have been changed, the elk population reduction target is the same.

Roundup activities would cause an increase in trampling effects on vegetation along the routes used to herd elk into the central corral. Any visible sign of effect would typically be gone by the next growing season. Because this activity would be conducted only once a year during winter when the ground is frozen, it is unlikely that trails would be created even if the same routes were used each year, therefore, trampling would cause short-term, minor adverse effects.

Wildlife Species

The effects of alternative C on wildlife would occur either as a result of direct reduction in the number of elk, changes in the structure and function of vegetation, or disturbance and temporary displacement of wildlife during project activities.

The adverse effects of disturbance in implementing alternative C would be somewhat greater than alternative B during the initial reduction phase, but similar during maintenance. During the initial reduction phase, hazing of elk using a helicopter in this alternative would occur over a longer time frame and across elk habitat in the park. Herding of elk into a corral, and other activities associated with either lethal removal or live shipping are expected to take 3 to 5 days for each of three geographic areas of the park, and would create more disturbance than alternative B. Hazing would occur in January and February when other ungulates tend to occupy winter ranges distinct from those used by elk (Wydeven and Dahlgren 1985). However, it is possible that elk may need to be herded across a long distance and through other ungulate herds, across prairie dog towns or small mammal or bird habitats. Individual animals, including predators and scavengers, small mammals and wintering birds, and other mobile wildlife are likely to be disturbed and to expend energetic resources in flight during herding operations. The expenditure of energy during flight or in avoidance behavior can be particularly adverse for older and younger animals. Ungulates are also known to feed less frequently when helicopters are in the vicinity, as more time is spent on alert. However, although impacts from disturbance and increased energy expenditures would be more severe than in alternative B, they would remain localized and sporadic and would not be more than moderate and short term. Trampling of small mammals, butterflies, or other less mobile wildlife would also increase in this alternative, with minor adverse effects.

Once the elk population is reduced to the target range and the maintenance phase begins, roundup or hazing activities would be substantially reduced, or more precise methods of hazing such as dogs, gunshots, horseback riders, or noisemakers might be used. The effects of these more precise and shorter lasting forms of hazing may be negligible or minor.

Sharpshooting may also be an alternate technique used in years when only a small number of elk need to be removed. In that case, the effects would be similar to those described under alternative B for sharpshooting, that is, short term, localized and minor.

Herding of elk through or near prairie dog towns could cause some localized disturbance. As planned, roundup and related management activities could occur over a period of up to 15 days during January and February. During this period of the year, prairie dog activity tends to be minimal; however, if the weather during roundup and associated activities were to be warm, prairie dogs would be active above ground. Because prairie dogs in the park are generally habituated to human activity, the effects of this disturbance would likely be local, short term and minor.

The long-term effects of alternative C on bison, pronghorn antelope, mule deer, white-tailed deer, mountain lion, bobcat, coyote, small mammals, meadow jumping mouse, least shrew, breeding birds and rare butterflies would be similar to alternative B because the overall objective of reducing the elk herd to within a certain range is the same.

Cumulative Impacts

The existing effects of other plans, projects and actions on wildlife would be the same as under alternative A.

Conclusion

Pronghorn Antelope

Trampling during roundup could cause minor adverse impacts to wildlife habitat. In the long term, beneficial impacts to biodiversity and wildlife habitat in most vegetative communities in the park, with possible benefits for grassland species, would occur from reductions in elk grazing. Implementation of alternative C would result in short-term minor to moderate adverse impacts greater than those in alternative B to ungulates, predators, small mammals, butterflies and birds from trampling, disturbance and displacement. Reductions in elk numbers would have generally beneficial effects on wildlife habitat and wildlife populations. Less competition for habitat and forage, with benefits for most ungulates, including bison and mule deer. Benefits for pronghorn and white-tailed deer from reducing elk numbers would be possible. Additional benefits from a reduction in competitive exclusion by elk and increase in population size for mule deer are likely. Localized beneficial impacts to prairie dogs from decreased elk foraging could occur. Continued high use by elk in hardwood, riparian and shrubland habitats would limit beneficial impacts to small mammals and birds in these habitats, although more noticeable benefits to grassland species are likely. Grassland birds dependent on open spaces would experience adverse impacts from a reduction in elk. Benefits for the meadow jumping mouse and the least shrew would occur from increases in herbaceous cover. Predators and scavengers would experience negligible to minor adverse impacts from reduced numbers of calves and other vulnerable prey, although beneficial impacts to mountain lions from increased numbers of mule deer, and to coyotes and bobcats from increases in small mammal numbers are possible and are indirectly related to reducing the elk herd. A long-term beneficial impact to rare butterflies from improved grassland habitat conditions is also possible. Cumulative effects from park management have generally been beneficial, including habitat management through mechanical means and prescribed fires and the implementation of species management plans. Previous predator control actions have had adverse impacts on the predators themselves and the populations they historically controlled.

No impairment to park resources would occur as a result of impacts to wildlife should alternative C be implemented.

ALTERNATIVE D—SHARPSHOOTING

Under this alternative, sharpshooting within the park would be used to reduce and maintain the elk herd at target population levels.

Wildlife Habitat

As with other action alternatives, a beneficial impact to biodiversity and wildlife habitat in most vegetative communities in the park, with possible benefits for grassland species, would occur from reductions in elk grazing.

Wildlife Species

The effects of alternative D on wildlife would occur either as a result of direct reduction in the number of elk, changes in the structure and function of vegetation, or disturbance and temporary displacement of wildlife during project activities.

Alternative D differs from alternatives B and C in that the initial reduction is expected to require more time each year to complete. Sharpshooting would be conducted between August 1 and March 1. Several teams each with one shooter and one assistant would work in a general area until their local goal was met or animals moved from the area. The amount and duration of short-term disturbance would be related to the length of time that teams of sharpshooters remain in a given area and the number of times they return to the same area to cull additional animals. Bison, other ungulates and predators could be displaced from the local area where project activities are occurring for a longer period of time, but the adverse effects would continue to be short term, local and minor. The disturbance for other wildlife would be negligible.

The short-term effects of implementing alternative D from the presence of humans on black-tailed prairie dog, small mammals, Bear Lodge meadow jumping mouse, least shrew, mountain lion, bobcat, coyote, breeding birds, and rare butterflies would be similar to those in alternative B. Some additional impacts to wildlife from the noise of helicopters would occur.

Alternative D differs from other alternatives in that some elk carcasses would be deliberately left in the field. Doing so would provide predators and scavengers with short-term increases in food resources, a beneficial effect for this group of wildlife. The extent of the impact depends on whether sharpshooters complete their initial reduction (estimated at 8 days per year for 3 to 4 years) during a consecutive period or over a several month span in the winter. If it is the former, up to 60 adult carcasses and an unknown number of calf carcasses could be spread over the park. This would likely bring in additional predators and scavengers from the area around the park until the increase in food is consumed, on the order of a few days to a few weeks. If sharpshooters instead culled the population over several months during each of the first 3 to 4 years, the existing predator and scavenger population in the park would be unlikely to change. In either case, temporary benefits from increases in nutrition during what can be severe winter months would occur for predators and scavengers in the park and perhaps on adjacent lands. Maintenance would also provide ongoing benefits for the park predator and scavenger population, but would likely be a low enough number that those outside the park would be largely unaffected.

Sharpshooting or roundup and removal of elk are intended to accomplish the initial reduction of the elk population to achieve the same management goal during the same general time frame as alternative B or C; therefore, long-term effects from elk reduction would be the same.

During the maintenance phase, management actions and their effects on wildlife would be similar to alternative B and C.

Cumulative Impacts

The existing effects of other plans, projects and actions on wildlife would be the same as under alternative A.

Conclusion

In the long-term beneficial impacts to biodiversity and wildlife habitat in most vegetative communities in the park, with possible additional benefits for grassland species, would occur from reductions in elk grazing. Implementation of alternative D would result in short-term minor adverse impacts to ungulates, predators, small mammals and breeding birds from disturbance and displacement from helicopters and from human activity. Impacts from these management activities would occur over a longer time each season during both initial reduction and maintenance phase than alternatives B or C. Short-term benefits to predators and scavengers from an increase in food following sharpshooting from leaving carcasses would occur. Reductions in elk numbers would have generally beneficial effects on wildlife habitat and wildlife populations. Less competition for habitat and forage, with benefits for most ungulates, including bison and mule deer, would occur. Benefits for pronghorn and white-tailed deer from reducing elk numbers would be possible. Additional benefits from a reduction in competitive exclusion by elk and increase in population size for mule deer are likely. Localized beneficial impacts to prairie dogs from decreased elk foraging would occur. Continued high use by elk in hardwood, riparian and shrubland habitats would limit beneficial impacts to small mammals and birds in these habitats, although more noticeable benefits to grassland species are likely. Grassland birds dependent on open spaces would experience negligible to minor adverse impacts from a controlled elk population. Benefits for the meadow jumping mouse and the least shrew would occur from increases in herbaceous cover. Predators and scavengers would experience negligible to minor adverse impacts from reduced numbers of calves and other vulnerable prey, although beneficial impacts to mountain lions from increased numbers of mule deer, and to coyotes and bobcats from increases in small mammal numbers are positive and related indirectly to reducing the elk herd. A long-term beneficial impact to rare butterflies from improved grassland habitat conditions is also possible. Cumulative effects from park management have generally been beneficial, including habitat management through mechanical means and prescribed fires and the implementation of species management plans. Previous predator control actions have had adverse impacts on the predators themselves and the populations they historically controlled.

No impairment to park resources would occur as a result of impacts to wildlife should alternative D be implemented.

ALTERNATIVE E—CONTRACEPTION (STERILIZATION) (MAINTENANCE ONLY)

This alternative would be implemented solely to maintain elk at target population goals after initial reduction (alternatives B–D) through permanent sterilization of a predetermined number of the park's reproductive female elk population. At this time, sterilization has not been proven through science to effectively manage wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Wildlife Habitat

The effects of alternative E on wildlife habitat would be similar to those described above for alternatives B, C or D depending on which technique is used to accomplish the initial reduction. Additional minor adverse impacts from roundup to capture elk for sterilization would also occur, although since roundup for maintenance would take less time, impacts would be less intense than those described for alternative C, for example.

Wildlife Species

The effects of the initial reduction on wildlife would be the same as alternative B, C or D depending on which method or combination of methods is used.

The impacts to wildlife of implementing this alternative would be primarily those associated with roundup. Incrementally fewer elk may need to be treated each year or two as sterilization efforts are begun, as less population growth in the herd is expected. Boland Ridge is closer to the corral than other locations, and so impacts of roundup of elk from this region (note in the analysis of impacts to the elk population that both chemical contraception and sterilization may be preferentially applied to elk in this area as they are less likely to migrate out of the park) would be slightly less, but similar to those described in alternative C. Specifically, these would include negligible to minor adverse effects to ungulates, predators, small mammals and breeding birds from disturbance related to roundup activities and minor to moderate adverse effects to prairie dogs in close proximity to the wildlife corrals.

Surgical sterilization would have no effect on non-target animals. However, sterilization may increase the availability of fetuses or afterbirth if elk abort in the field. Elk often eat afterbirth or even fetuses if they are small; however if they leave either, it may be a temporary increase in food and a beneficial impact for predators and scavengers.

Cumulative Impacts

The existing effects of other plans, projects and actions on wildlife would be the same as under alternative A.

Conclusion

Impacts of initial reduction would be the same as described for alternative B, C or D, depending on the method selected. The long-term effects of elk reduction would be the same as described for these alternatives.

Negligible to minor impacts to wildlife habitat from trampling during roundup would occur. Impacts on wildlife of maintaining the elk herd through surgical sterilization would primarily be related to rounding up elk. Roundup would result in short-term negligible to minor adverse impacts to ungulates, predators, small mammals and breeding birds from trampling, disturbance and displacement associated with herding elk across the park would occur. Benefits to predators and scavengers from a temporary increase in aborted fetuses or afterbirth could occur. Cumulative effects from park management have generally been beneficial, including habitat management through mechanical means and prescribed fires and the implementation of species management plans. Previous predator control actions have had adverse impacts on the predators themselves and the populations they historically controlled.

No impairment to park resources would occur as a result of impacts to wildlife should alternative E be implemented.

ALTERNATIVE F—FERTILITY CONTROL AGENT (MAINTENANCE ONLY)

Under this alternative, cow elk would be treated with chemical fertility control agents solely to maintain the elk population at target goals once initial reduction efforts (alternatives B–D) are completed. At this time, fertility control agents have not been effective in controlling population growth in large free-ranging wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Wildlife Habitat

The effects of alternative F on wildlife habitat would be similar to those described above for alternatives B, C, or D depending on which technique is used to accomplish the initial reduction. Additional minor adverse impacts from roundup to capture elk for sterilization would also occur, although since roundup for maintenance would take less time, impacts would be less intense than those described for alternative C, for example.

Wildlife Species

The effects of the initial reduction under alternative F on wildlife would be similar to those described above for alternatives B, C or D depending on which method or combination of methods is used. Impacts to predators and scavengers from consuming treated elk would be prevented by first testing any contraceptive on non-target species. As noted in the “Alternatives” chapter, any chemical contraceptive used on elk in the park would be safe, including for wildlife. Long-term effects related to elk reduction would also be the same as described above for other action alternatives.

During the early years of the maintenance phase, the effects of this alternative may be greater than those described for other alternatives if most animal capture and handling activities occur during spring or fall, rather than in winter. Roundup would be accomplished by hazing with helicopter, horseback riders, noise makers, dogs or other means. However, many species are raising young during the spring, and disturbance or displacement may have additional issues on reproductive success.

Ungulates, pronghorn, mule deer and white-tailed deer have dependent young during the spring, but the fawns are born in late-May early-June and would be able to travel with the doe by the time that roundup occurred. The effects of disturbance at that time would be short-term, minor adverse impacts.

Small mammals and breeding birds could be in various phases of nesting and rearing depending on the species. Because of the very short-term nature of roundup activities, impacts would be short term, local and minor.

As with alternative E, application of contraception on pregnant elk would result in increased abortion and availability of fetuses and afterbirth, a benefit for predators and scavengers.

It is possible that over time fewer elk would have to be handled during the maintenance phase of alternative F, but this may depend on the amount of time the contraceptive lasts and the amount of immigration the park experiences.

Cumulative Impacts

The existing effects of other plans, projects and actions on wildlife would be the same as under alternative A.

Conclusion

Relative to alternative A (no action), this alternative would have the following effects on wildlife resources.

Negligible to minor impacts to wildlife habitat from trampling during roundup would occur. The effects of alternative F on wildlife during the initial reduction phase would be similar to alternative B, C or D depending on which method or combination of methods is used to reduce the elk population. Ungulates, pronghorn, mule deer and white-tailed deer would experience short-term minor adverse effects related to disturbance from roundup activities. Small mammals and breeding birds in various stages of nesting and rearing would experience short-term minor adverse effects for similar reasons (roundup activities). Benefits to predators and scavengers from a temporary increase in aborted fetuses or afterbirth could occur. Cumulative effects from park management have generally been beneficial, including habitat management through mechanical means and prescribed fires and the implementation of species management plans. Previous predator control actions have had adverse impacts on the predators themselves and the populations they historically controlled.

No impairment to park resources would occur as a result of impacts to wildlife should alternative F be implemented.

SPECIAL STATUS SPECIES

GUIDING REGULATIONS AND POLICIES

The U.S. *Endangered Species Act* (16 USC §§ 1531 et seq.) mandates that all federal agencies consider the potential effects of their actions on species listed as threatened or endangered. If the NPS determines that an action may adversely affect a federally listed species, formal consultation with the USFWS is required to ensure that the action will not jeopardize the species' continued existence or result in the destruction or adverse modification of critical habitat. Listed species are identified through discussions with park staff and informal consultation with the USFWS. Formal consultation is initiated if the NPS determines that actions in the preferred alternative are likely to adversely affect one or more of the federally listed threatened or endangered species identified in the park.

NPS *Management Policies 2006* state that potential effects of agency actions will also be considered on state or locally listed species. The NPS is required to perpetuate the natural distribution and abundance of these species and the ecosystems upon which they depend.

The animal species that have the potential to be affected by the management alternatives include the federally endangered black-footed ferret and state threatened bald eagle.

METHODOLOGIES AND ASSUMPTIONS FOR ANALYZING IMPACTS

Geographic Area Evaluated for Impacts

The focus of this study is the park.

Issues

- Management actions may disturb wintering bald eagles.
- Elk browsing may indirectly affect eagles by removing habitat for prey.
- Large numbers of elk may compete with prairie dogs for forage; reductions in prairie dogs may in turn reduce black-footed ferret numbers.
- An unmanaged elk herd (no action) may require reductions in prairie dog populations to compensate, which means a reduction in ferret prey.

Assumptions

This analysis assumes the ongoing reintroduction of ferrets would be successful, and that the park would try to manage for the higher end of the range of prairie dogs defined in its *Black-Tailed Prairie Dog Management Plan/EA* (NPS 2006a) if possible (e.g., elk numbers are kept controlled).

This analysis assumes the park would reduce the size of acreage or numbers of competitive grazing animals (prairie dogs and bison) if the elk herd is unmanaged.

Assessment Methods

Primary steps in assessing impacts on listed species were as follows:

- The literature and park reports were used to determine whether listed species were in the park.
- An assessment based on literature and professional judgment was completed. The assessment determined whether the listed species or their habitats would be affected by each of the management actions and outcomes.
- Thresholds were established to evaluate the extent of such impact.
- Thresholds were applied to the actions in each of the alternatives.

Impact Threshold Definitions

USFWS guidance for implementing section 7 consultation under the *Endangered Species Act* defines the terminology used to assess impacts to federally listed species as follows:

No effect: The appropriate conclusion when the action agency determines its proposed action will not affect a listed species or designated critical habitat.

Is Not Likely to Adversely Effect: The appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial. **Beneficial effects** are contemporaneous positive effects without any adverse effects to the species. **Insignificant effects** relate to the size of the impact and should never reach the scale where take occurs. **Discountable effects** are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect or evaluate insignificant effects; or (2) expect discountable effects to occur.

Is Likely to Adversely Effect: The appropriate finding in a biological assessment (or conclusion during informal consultation) if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not: discountable, insignificant, or beneficial (see definition of "is not likely to adversely affect"). In the event the overall effect of the proposed action is beneficial to the listed species, but is also likely to cause some adverse effects, then the proposed action "is likely to adversely affect" the listed species. If incidental take is anticipated to occur as a result of the proposed action, an "is likely to adversely affect" determination should be made. An "is likely to adversely affect" determination requires the initiation of formal section 7 consultation.

The impact threshold definitions used in this environmental impact statement reference these *Endangered Species Act* terms, but apply to both federal and state listed species. They are as follows:

Negligible: There would be no observable or measurable impacts to federally listed or state-listed species, their habitats, or the natural processes sustaining them in the proposed project area. This impact intensity would equate to a determination of "no effect" under section 7 of the *Endangered Species Act*.

Minor: Individuals may temporarily avoid areas. Impacts would not affect critical periods (e.g., breeding, nesting, denning, feeding, resting) or habitat. This impact intensity would equate to a determination of "not likely to adversely affect" under section 7 of the *Endangered Species Act*.

Moderate: Individuals may be impacted by disturbances that interfere with critical periods (e.g., breeding, nesting, denning, feeding, resting) or habitat; however, the level of impact would not result in a physical injury, mortality, or extirpation from the park. This impact intensity would equate to a determination of "likely to adversely affect" under section 7 of the *Endangered Species Act*.

Major: Individuals may suffer physical injury or mortality or populations may be extirpated from the park. This impact intensity would equate to a determination of "likely to adversely affect" under section 7 of the *Endangered Species Act*.

Impairment: Some of the major impacts described above might be an impairment of park resources if their severity, duration, and timing resulted in the elimination or significant population declines in a species of concern. In addition, these adverse, major impacts to park resources and values would:

- contribute to deterioration of the park's wildlife resources and values to the extent that the park's purpose could not be fulfilled as established in its enabling legislation;
- affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or
- affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

Duration of Impact

Short-term: Those impacts occurring from management activities and lasting the duration of the activity (up to six months).

Long-term: Impacts lasting longer than six months.

ALTERNATIVE A—NO ACTION

Under the no-action alternative, existing elk management actions (monitoring and targeted surveillance) would continue with no additional efforts implemented to address the size of the elk population and its effect on park resources.

Bald Eagle. Bald eagles do use areas of the park for roosting and feeding in the winter. Migrating eagles have been observed in prairie dog towns and roost in large trees during winter months. They are considered transient and casual visitors to the park. Although no direct impact to eagles from an increasing elk herd would result from this alternative, elk may browse so heavily on shrubs, riparian and hardwood vegetation that small rodents or birds are displaced. Since these small animals are likely sources of prey for eagles in the winter, an indirect minor adverse impact from an increasing elk population is possible. In addition, as noted above in the discussion of impacts to wildlife, if the park is unable to manage elk, bison and/or prairie dogs may need to be kept at the lowest end of their allowable range, given the bison and prairie dog management plans. Because bald eagles do prey on prairie dogs, they may experience additional, localized minor adverse impacts from the reduction in prairie dog numbers.

Black-footed Ferret. As noted in the "Affected Environment" chapter, the park is in the process of reintroducing the federally endangered black-footed ferret into prairie dog towns inside Wind Cave. The black-footed ferrets feed almost exclusively on prairie dogs, live in prairie dog towns, and so would experience direct or indirect effects related to changes in prairie dog numbers of habitat. An expanding elk population would be expected to exploit all available forage resources, including those in prairie dog towns. Although an increase in the numbers of elk grazing vegetation near prairie dog towns would initially result in expansion of the prairie dog colony and beneficial impacts, the park would begin to manage colonies to reduce them shortly after this occurs. This is because prairie dogs currently occupy about 2,800 acres in the park and the *Black-Tailed Prairie Dog Management Plan/EA* (NPS 2006a) only allows for 3,000 acres of prairie dog colonies as a maximum. In addition, if the park is unable to manage elk (this is currently the case and is assumed to continue under no action), it may be forced to reduce the number of other grazers including bison and prairie dogs. The *Black-Tailed Prairie Dog Management Plan/EA* (NPS 2006a) theoretically allows a minimum of 1,000 acres of colonies; this kind of reduction would be a moderate or major adverse impact on prairie dogs as well as for black-footed ferrets. This translates to a finding of "likely to adversely affect" under the *Endangered Species Act* and means the park would require formal consultation with and permission from the USFWS to implement this level of prairie dog reduction. Practically, it is unlikely that the park would so substantially reduce the prairie dog colonies because of the impact on ferrets, but it is assumed to be a possibility in this EIS to give the park maximum management flexibility.

Cumulative Impacts

Both bald eagles and black-footed ferrets have experienced impacts throughout their range that have led to their status as threatened or endangered. For bald eagles, these have included habitat loss through development and toxic effects of pesticides. Black footed ferrets have been reduced in numbers due to loss of habitat, reductions in habitat for their primary prey, prairie dogs, and large-scale poisoning.

Conclusion

Reductions in habitat for prey animals related to overbrowsing by elk, and reductions in prairie dog numbers that may need to take place under this alternative would have minor adverse effects on bald eagles in the park.

Increases in elk numbers may initially provide prairie dogs and ferrets with beneficial impacts as tall grasses are removed and habitat improved, allowing expansion of the colonies. Management that could occur to offset long-term impacts of a greatly increased elk population may include reductions in prairie dog numbers, with resulting moderate or even major adverse impacts to ferrets, and may result in an adverse effect to this species as defined by the Endangered Species Act.

No impairment to park resources resulting from impacts to the bald eagle or black-footed ferret would occur if alternative A were implemented.

ALTERNATIVE B—HUNTING OUTSIDE THE PARK

The emphasis of this alternative is the reduction and maintenance of the park's elk population via the state-managed public hunt on lands outside the park.

Bald Eagle. An increase in the number of hunters outside the park, and associated noise from cars, trucks and guns, may temporarily disturb a resting bald eagle. Because the hunting season lasts several weeks, eagles may move to a different location, a short-term adverse minor impact. In the long term, reducing the number of elk would mean that shrublands, riparian areas and hardwood forests would recover compared to the scenario if no management takes place (no action). This would provide habitat for small rodents and birds, which are prey for bald eagles. An indirect benefit would result.

Black-footed Ferret. Reducing the number of elk compared to no action would also reduce the chance of loss in the prairie dog colonies from competition for forage. This is a relative benefit for prairie dogs and black-footed ferrets. However, the chances of elk creating new habitat for prairie dog occupation would be lower, a relative negligible or minor adverse impact on ferrets. In addition, the park would not be forced to manage other grazers, including prairie dogs, at the lower end of the range indicated in its *Black-Tailed Prairie Dog Management Plan/EA* (NPS 2006a), a benefit for ferrets compared to the possible long-term outcome under the no action alternative. On balance, the impact of elk reduction is likely to be long term, localized and beneficial with "no effect" or a finding of "not likely to adversely affect" under the Endangered Species Act.

Cumulative Impacts

Cumulative impacts would be the same as described above for alternative A.

Conclusion

Increases in hunters may have short-term, minor adverse effects on eagles from disturbance. Lowered elk numbers may have indirect beneficial impacts from the return of eagle prey.

Reductions in competition from a reduced elk herd would have an indirect benefit for black-footed ferrets, and would not be likely to adversely affect this species as defined by the Endangered Species Act. Additional indirect benefits compared to alternative A from managing prairie dogs at higher numbers are also possible.

No impairment to park resources resulting from impacts to the bald eagle or black-footed ferret would occur if alternative B were implemented.

ALTERNATIVE C—ROUNDUP AND LIVE SHIPMENT OR EUTHANASIA

The focus of this alternative is the reduction and maintenance of the elk population through roundup and live shipment/donation or euthanasia.

Bald Eagle. Management activities associated with roundup could temporarily disturb bald eagles. In particular, helicopters flying overhead for several days in the winter during initial reduction efforts are likely to result in the displacement of any roosting bald eagles along the route or within hearing range. Even during initial reduction, helicopters would not be likely to be used more than a total of 15 days. Displacement during this period of an occasional eagle would have no more than a minor adverse effect. The same benefits from a reduced elk population and increases in mammal and bird prey would result from this alternative.

Black-footed Ferret. Herding of elk through or near prairie dog towns is a possibility under alternative C, but is considered unlikely and impacts negligible or minor and localized should it occur. Roundup activities would be conducted during the day, and ferrets are nocturnal feeders, so direct impacts are unlikely. However, if elk roundup activities result in the loss of some prairie dogs, trampling of prairie dog forage, collapsed burrows, etc., indirect impacts to ferrets are possible. Given that ferrets are able to travel long distances quickly, it is likely they would find other habitat soon enough to avoid impact. Impacts to ferrets would not be more than minor or moderate, and "not likely to adverse affect" the population at the park.

Reducing the number of elk compared to no action would also reduce the chance of loss in the prairie dog colonies from competition for forage. This is a relative benefit for prairie dogs and black-footed ferrets. In addition, the park would not be forced to manage other grazers, including prairie dogs, at the lower end of the range indicated in its *Black-Tailed Prairie Dog Management Plan/EA* (NPS 2006a), a benefit for ferrets compared to the possible long-term outcome under the no-action alternative. However, the chances of elk creating new habitat for prairie dog occupation would be lower, a relative negligible or minor adverse impact on ferrets. On balance, the impact of elk reduction is likely to be long term, localized and beneficial with "no effect" or a finding of "not likely to adversely affect" under the Endangered Species Act.

Cumulative Impacts

Cumulative impacts would be the same as described above for alternative A.

Conclusion

Displacement of eagles by helicopters during roundup would have minor adverse effects, and reduction in elk numbers and resulting increase in eagle prey would have beneficial effects.

Reductions in competition from a reduced elk herd would have indirect benefits for ferrets. Additional indirect benefits compared to alternative A from managing prairie dogs at higher numbers are also possible. At the same time, negligible to minor short-term adverse effects to ferrets are possible and related to the reduced chance of elk producing new habitat that prairie dogs would inhabit. Alternative C would not be likely to adversely affect this species as defined by the Endangered Species Act.

No impairment to park resources resulting from impacts to the bald eagle or black-footed ferret would occur if alternative C were implemented.

ALTERNATIVE D—SHARPSHOOTING

Under this alternative, sharpshooters would be used to reduce and maintain herd numbers at target population levels.

Bald Eagle. Sharpshooting could displace some bald eagles, although because noise-suppressed rifles would be used, it is less likely than under alternative B, where hunting outside the park is used to remove elk. If roundup is required, impacts to eagles from helicopter noise and presence would be the same or less intense (because fewer days would be needed if sharpshooting had accomplished partial reduction) than in alternative C. These actions would have no more than short-term minor adverse effects to eagles. Reductions in elk numbers would provide benefits by restoring small mammal and bird habitat and providing additional prey for eagles. In addition, this alternative calls for leaving some elk carcasses in the field, another potential food source.

Black-footed Ferret. Sharpshooting is unlikely to affect black-footed ferrets except by reducing the number of elk with beneficial impacts in reducing competition between elk and prairie dogs for forage. In addition, the park would not be forced to manage other grazers, including prairie dogs, at the lower end of the range indicated in its *Black-Tailed Prairie Dog Management Plan/EA* (NPS 2006a), a benefit for ferrets compared to the possible long-term outcome under the no-action alternative. This alternative is not likely to adversely affect black-footed ferrets at the park.

Cumulative Impacts

Cumulative impacts would be the same as described above for alternative A.

Conclusion

Some negligible impacts to bald eagles from displacement related to sharpshooting is possible, and minor impacts from roundup related to helicopter noise if needed would occur. Reduction in elk numbers and resulting increase in eagle prey would have beneficial effects.

Sharpshooting would have no direct effect on black-footed ferrets, but reductions in competition from a reduced elk herd would have indirect benefits. Additional indirect benefits compared to alternative A from managing prairie dogs at higher numbers are also possible. Alternative D would not be likely to adversely affect this species as defined by the Endangered Species Act.

No impairment to park resources resulting from impacts to the bald eagle or black-footed ferret would occur if alternative D were implemented.

ALTERNATIVE E—CONTRACEPTION (STERILIZATION) (MAINTENANCE ONLY)

This alternative would be implemented solely to maintain elk at target population goals after initial reduction (alternatives B–D) through permanent sterilization of a predetermined number of the park’s reproductive female elk population. At this time, sterilization has not been proven through science to effectively manage wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Bald Eagle. Impacts to bald eagles under this alternative would be additive with those from the chosen initial reduction strategy, and would come from helicopters or other hazing needed to round up animals for treatment. Because this is a maintenance tool only, only a small number of elk would need to be herded each year or periodically when the park conducts a treatment operation. Impacts would be less intense than those reported above for alternative C, and would not be more than negligible or minor for bald eagles. Some benefits to eagles from a temporary increase in aborted fetuses or afterbirth are also possible.

Black-footed Ferret. Negligible impacts to ferrets from localized loss of prairie dogs at or near corrals during herding operations are possible. Impacts to ferrets under this alternative would be additive with those from the chosen initial reduction strategy. This alternative is "not likely to adversely affect" black-footed ferrets at the park.

Cumulative Impacts

Cumulative impacts would be the same as described above for alternative A.

Conclusion

Some negligible to minor adverse impacts to bald eagles from displacement related to helicopter use is possible. Beneficial impacts from increased fetuses or afterbirth are also possible.

Roundup activities could have localized adverse impacts on prairie dog colonies with possible short-term and negligible impacts to black-footed ferrets preying on these prairie dogs. Alternative E would not be likely to adversely affect this species as defined by the Endangered Species Act.

No impairment to park resources resulting from impacts to the bald eagle or black-footed ferret would occur if alternative E were implemented.

ALTERNATIVE F—FERTILITY CONTROL AGENT (MAINTENANCE ONLY)

Under this alternative, cow elk would be treated with chemical fertility control agents solely to maintain the elk population at target goals once initial reduction efforts (alternatives B–D) are completed. At this time, fertility control agents have not been effective in controlling population growth in large free-ranging wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Bald Eagle. The impacts of this alternative to bald eagles would be additive with those from the chosen initial reduction strategy, and would be similar to those described above for alternative E. Negligible to minor adverse impacts from disturbance, and benefits from a temporary increased availability of aborted fetuses or afterbirth are possible.

Additional effects to bald eagles from consumption of carrion of treated elk would be prevented by ensuring that any chemical contraceptive is safe for non-target species, a condition of its use in this plan.

Black-footed Ferret. The impacts of this alternative to ferrets would be additive with those from the chosen initial reduction strategy, and would be the same as those described for alternative E. Negligible short-term impacts are possible, but this alternative is "not likely to adversely affect" black-footed ferrets.

Cumulative Impacts

Cumulative impacts would be the same as described above for alternative A.

Conclusion

Some negligible to minor impacts to bald eagles from displacement related to helicopter use is possible as are temporary benefits from increased carrion in the form of aborted fetuses.

Roundup activities could have localized adverse impacts on prairie dog colonies with possible short-term and negligible impacts to black-footed ferrets preying on these prairie dogs. Alternative F would not be likely to adversely affect this species as defined by the Endangered Species Act.

No impairment to park resources resulting from impacts to the bald eagle or black-footed ferret would occur if alternative F were implemented.

AIR QUALITY

GUIDING REGULATIONS AND POLICIES

Clean Air Act. The *Clean Air Act* establishes national ambient air quality standards (NAAQS) to protect the public health and welfare from air pollution. The act also establishes the prevention of significant deterioration (PSD) of air quality program to protect the air in relatively clean areas. One purpose of this program is to preserve, protect, and enhance air quality in areas of special national or regional natural, recreational, scenic, or historic value (42 USC 7401 et seq.). The program also includes a classification approach for controlling air pollution.

Wind Cave National Park is designated a “mandatory Class I” area through specific visibility protection regulations under the Prevention of Significant Deterioration (PSD) provisions of the Clean Air Act. The PSD provisions protect visibility at Wind Cave National Park by requiring all major new and modified sources with the potential to affect the visibility of a “mandatory Class I” area to obtain a new source permit that assures no adverse impact on the Class I area's visibility.

NPS Organic Act and NPS Management Policies 2006. The *NPS Organic Act of 1916* (16 USC 1 et seq.) and the NPS *Management Policies 2006* guide the protection of park and wilderness areas. The general mandates of the *Organic Act* state that the NPS will

> promote and regulate the use of . . . national parks . . . by such means and measures as conform to the fundamental purpose of the said parks, . . . which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations (16 USC 1).

Under its NPS *Management Policies 2006*, the NPS will

> seek to perpetuate the best possible air quality in parks to (1) preserve natural resources and systems; (2) preserve cultural resources; and (3) sustain visitor enjoyment, human health, and scenic vistas (sec. 4.7.1) (NPS 2006d).

The NPS *Management Policies 2006* further state that the NPS will assume an aggressive role in promoting and pursuing measures to protect air quality related values from the adverse impacts of air pollution. In cases of doubt as to the impacts of existing or potential air pollution on park resources, the NPS "will err on the side of protecting air quality and related values for future generations" (NPS 2006d).

The *Organic Act* and the NPS *Management Policies 2006* apply equally to all areas of the national park system, regardless of *Clean Air Act* designations. Furthermore, the *NPS Organic Act* and NPS *Management Policies 2006* provide additional protection beyond that afforded by the Clean Air Act's national ambient air quality standards alone because the NPS has documented that specific park air quality related values can be adversely affected at levels below the national standards or by pollutants for which no standard exist.

METHODOLOGIES AND ASSUMPTIONS FOR ANALYZING IMPACTS

Geographic Area Evaluated for Analyzing Impacts

Although air emissions can travel long distances, in this case the analysis was confined to the park and area immediately outside. This is because emissions would result from only two sources, trucks/cars or helicopters to hunt and/or remove carcasses, and an incinerator located on park property. The incinerator would be controlled to minimize emissions. Neither of these sources is likely to contribute detectable emissions to the airshed further than a few hundred meters away. The specific area of analysis for this topic includes 1000 feet downwind from the incinerators. This is the distance at which emissions have found to be indistinguishable from ambient conditions.

Issues

- The incineration of carcasses would result in emissions from both the burning itself and the use of diesel engines to operate the air-curtain incinerator.
- Trucks and/or helicopters may emit pollutants related to internal combustion engines.

Assumptions

The assumptions regarding emissions from incineration include the following:

- An air-curtain incinerator system similar to Air Burners LLC model T-350, would be used rather than simple open air burning
- Wood is used inside the incinerator; diesel fuel is used to operate the air-curtain
- The incinerator would be started using diesel fuel.
- The incinerator would be able to handle 4–5 elk per hour; an upper limit of 180 elk per week and 40 hours per week of operation for 3 weeks was assumed for initial reduction.
- The incinerator would burn 3 tons per hour; the average weight of an elk is 0.75 ton.
- Tons of pollutants emitted during the 3-week period are calculated as follows: pound of pollutant per ton of carcass burned x 3 tons per hour x 120 hours x 0.0005 tons per pound. Emissions for burning carcasses and operating the diesel engine to run the air-curtain fan are added.

Assessment Methods

Air quality impacts were analyzed by reviewing current state and federal laws regarding air quality and previously completed environmental compliance documents for the park. Information about regional air quality was obtained from NPS reports and the literature. The most comprehensive study of Wind Cave National Park air quality comes from a 2000 inventory completed by consultants (EA Engineering, Science and Technology, Inc.) to the Washington office of the NPS (NPS 2003b). Incinerator emissions are estimated using emission factors from the literature, including reports from the Environmental Protection Agency (Ferguson et al 2006).

Emissions from cars and trucks were calculated using Bureau of Transportation statistics in grams per mile. Table 20 shows the average emissions in grams per mile of gasoline powered cars and trucks for 2005.

TABLE 20. AVERAGE EMISSIONS OF GASOLINE POWERED CARS AND TRUCKS, 2005

	Cars	Trucks
	(in grams per mile)	
Total Hydrocarbons	1.25	.54
Carbon monoxide	12.57	16.23
Nitrogen oxides	0.92	1.21

For alternative B, an average of 100 miles of driving per hunting trip (including scouting) in the vicinity of the park was assumed. Between 200 (for a five-year scenario) and 450 (for a one-year scenario) additional elk tags were assumed to be granted during the initial reduction phase, and an additional maximum of 150 per year for the maintenance phase. Each tag holder was assumed to drive his/her own vehicle; 75% of hunters were assumed to drive trucks.

For alternatives that involved the use of helicopters, helicopters were assumed to be single-engine, and to make mostly very short-term trips, either to herd elk into the corral facility, or to sling-load carcasses from where they are shot to a central park location. Emissions factors for helicopters were taken from USDOI Minerals Management Service 2004 and are 0.55 pounds of nitrogen oxides and 0.19 pounds of sulfur oxides per trip (averaging 15 minutes). Because these figures include a take-off and landing for each trip, they are conservative for use in a sling-load operation. A sling-load is assumed to be three elk.

Emissions of criteria pollutants are taken from Air Quality Permit #3292-00 to Montana Department of Livestock (2004).

Impact Threshold Definitions

Negligible: Changes in air quality would be below or at the level of detection, and if detected, would have effects that would be considered slight. Emissions would be less than 50 tons per year for each pollutant. There would be no potential for impact to air quality from odors associated with elk management activities.

Minor: Changes in air quality would be measurable, although the changes would be small and the effects would be localized. Emissions would be less than 100 tons per year for each pollutant. No air quality standards would be exceeded. Sensitive receptors may notice odors, but they would be barely detectable and not offensive.

Moderate: Changes in air quality would be measurable and would have consequences, although the effect would be relatively local. Emissions would be greater than or equal to 100 tons per year for each pollutant. Without mitigation, short-term air quality standards (8-hour or 24-hour, for example) standards may be exceeded occasionally. Sensitive receptors would notice odors and may find them objectionable.

Major: Changes in air quality would be measurable, would have substantial consequences, and be noticed regionally. Emissions would be greater than or equal to 250 tons per year for each pollutant. Air quality mitigation measures would be necessary to prevent exceeding short and/or long-term standards and the success of the measures could not be guaranteed. Visitors would nearly universally notice odors and find them objectionable.

Duration of Impact

Short-term: Occurs only through the duration of treatment.

Long-term: Continues beyond the duration of the treatment.

ALTERNATIVE A—NO ACTION

Under the no-action alternative, existing elk management actions (monitoring and targeted surveillance) would continue with no additional efforts implemented to address the size of the elk population and its effect on park resources.

As noted in the “Air Quality” section of the “Affected Environment” chapter, because Wind Cave National Park is a designated Class 1 area under the Clean Air Act, it requires the highest level of air quality protection.

Emissions of criteria pollutants (those for which primary standards have been established) are relatively low in the immediate vicinity of the park, although light industry, coal-fired power plants and oil and gas development in the region can pose a potential threat to the air quality at the park. Nonetheless, visibility in the park is considered to be excellent (Peterson et al 1998).

Local pollution comes from a variety of sources including sawmills, feldspar and other rock quarries and vehicles and woodstoves.

Stationary sources of emissions in the park include propane, fuel oil and pellet stove heating units, a generator and fuel storage tanks. Campfires, prescribed burning and wildfires also contribute to stationary sources of air emissions. Visitor and NPS vehicles, as well as movers, tractors and other maintenance equipment contribute to mobile sources of air emissions.

Table 12 in the “Affected Environment” chapter summarizes annual emissions in the park. The total emissions per year are: 457 tons of carbon monoxide, 41 tons of particulates, 23 tons of volatile organic compounds, 11 tons of nitrogen oxides and less than one ton of sulfur dioxide. These figures include both stationary and mobile sources.

Current elk management activities do not produce any air quality pollutants.

Cumulative Impacts

Regional emissions for Custer County include some of the same types of sources as those inside the park. Total emissions per year are: 7700 tons of carbon monoxide, 2000 tons of particulates, 940 tons of volatile organic compounds, 260 tons of nitrogen oxides and 85 tons of sulfur dioxide. Future oil and gas development or construction of additional coal-fired power plants in the region could reduce visibility from its current excellent condition over the planning horizon of this Elk Management Plan.

Conclusion

No impact to air quality from elk management is expected to occur under the no-action alternative. Ongoing sources of air pollution, including stationary and mobile sources inside and outside of the park in Custer County would continue. Visibility is excellent, but may be degraded by regional development of oil, gas or coal-fired power plants over time.

No impairment to park resources from impacts to air quality associated with implementing alternative A would occur.

ALTERNATIVE B—HUNTING OUTSIDE THE PARK

The emphasis of this alternative is the reduction and maintenance of the park's elk population via the state-managed public hunt on lands outside the park.

As noted above in the Methodology section, additional hunting permits or tags would be issued both during the initial reduction and maintenance phases of this alternative. Assuming a take of about 180–220 animals per year and a 40% success rate, about 500–600 additional elk tags would be issued in the initial reduction period, estimated to take four to five years. This could mean an addition 500–600 cars and trucks could be driving roads adjacent to or within a few miles of the park to scout the locations of elk and advantageous spots from which to hunt them for a short time over a 2–3 year period.

If the average number of miles hunters drive during this scouting and hunting exercise is 100, the additional emissions from mobile sources would still be less than a ton. Approximately 0.036 tons of hydrocarbons, 0.40 tons of carbon monoxide, and 0.027 tons of nitrogen oxides would be emitted. This would be a negligible short-term adverse impact to park and/or Custer County air quality. Emissions of less than one-tenth these associated with the initial reduction would occur annually during the life of the plan when maintenance hunts take place.

If helicopter hazing is required, this analysis assumes it would occur over a 3-day period and that helicopters would be active for 3 hours per day. Helicopters would emit about 6 pounds of nitrous oxides and 2 pounds of sulfur oxides. This is a negligible short-term impact.

Cumulative Impacts

Cumulative impacts in the vicinity of the park would be the same as those identified for alternative A, and would include cars and trucks, home heating, light industrial and energy development and power plant emissions in the region. Future oil and gas development or construction of additional coal-fired power plants in the region could reduce visibility from its current excellent condition over the planning horizon of this Elk Management Plan.

Conclusion

Negligible short-term adverse impacts to air quality from increased car and truck emissions and from helicopter hazing should it be needed would occur during the initial reduction and during maintenance hunts. Ongoing sources of air pollution, including stationary and mobile sources inside and outside of the park in Custer County would continue. Visibility is excellent, but may be degraded by regional development of oil, gas or coal-fired power plants over time. When compared to the no-action alternative, alternative B would result in additional negligible adverse effects to air quality.

No impairment to park resources from impacts to air quality associated with implementing alternative B would occur.

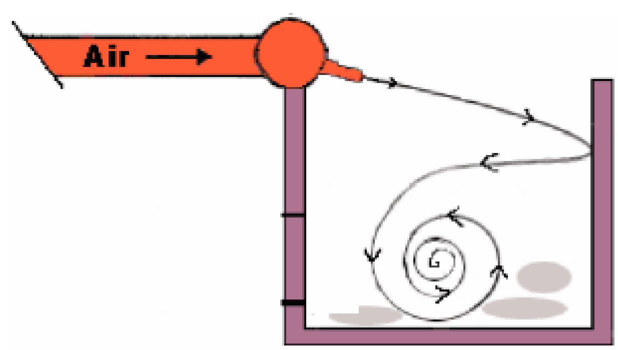
ALTERNATIVE C—ROUNDUP AND LIVE SHIPMENT OR EUTHANASIA

The focus of this alternative is the reduction and maintenance of the elk population through roundup and live shipment/donation or euthanasia.

The sources of air emissions in this alternative include the helicopter, and possibly the incinerator if no partner to be responsible for live shipment, meat processing, and distribution is obtained. The helicopter would emit the same type of pollutants as identified in alternative B for cars and trucks, with a resulting very short-term negligible impact to air quality. Assuming a maximum of 5 days per year for initial reduction and that a helicopter would operate for an 8-hour day during this period, annual emissions would be on the order of 90 pounds of nitrous oxides and 30 pounds of sulfurous oxides, a negligible adverse impact.

Air-curtain incineration involves a machine that fan-forces a mass of air through a manifold (figure 14), creating a turbulent environment in which incineration is greatly accelerated, up to six times faster than open-air burning. Air-curtain technology can be used for carcass incineration in either a burn pit or a refractory box (USDA APHIS 2004). Large-capacity fans are driven by diesel engines to deliver high-velocity air (up to about 165 miles per hour- USDA/Texas Animal Health Commission 1994) into the pit or refractory box. Air-curtain incinerators can be mobile or fixed.

The bed of the incinerator is lined with wood, which is soaked with diesel fuel. Wood continues to be added as additional carcasses are burned. As an example, an incident in 2001 where 500 adult swine were incinerated involved 30 cords of wood and 200 gallons of diesel fuel (USDA APHIS 2004). Ash is disposed of in landfills able to take potentially CWD infected carcasses.



Source: USDA APHIS 2004

FIGURE 14. DEPICTION OF AIR-CURTAIN INCINERATION TECHNOLOGY

Incinerators may emit smoke, odors, pollutants and noise. However, the blower cage is insulated and the diesel engine has a muffler that reduces noise levels. Smoke is also possible, especially upon start up. When the air-curtain fan speed is increased to about 1,500 rpm, smoke is no longer visible (USDA/Texas Animal Health Commission 1994). The air-curtain also minimizes odors, and a 3-day incineration of 500 head of swine carcasses, resulted in the detection of "very little if any carcass burning odor was detected during the incineration" (USDA/Texas Animal Health Commission 1994). If operations are placed 1,000 feet or more from trails, the visitor center, or other attractions, a three-week incineration period during initial reduction of the elk herd at Wind Cave would result in no more than short-term, negligible to minor adverse impacts to air quality from smoke and odors or from noise.

Assuming the incinerator would be operated for a total of 15 days to dispose of 450–550 carcasses during initial reduction, emissions of criteria pollutants are shown in table 21. Should incineration be used during the maintenance period, emissions would be less than one-tenth those in table 21.

HAP (Hazardous Air Pollutants) emissions include bromoform, carbon tetrachloride, chloroform, 1,2-Dicholoropropane, ethyl benzene, naphthalene, tetrachloroethylene, 1,1,2,2-tetrachloroethane, toluene, vinylidine chloride, and xylene. Before the Montana Air Resource Board issued a permit to operate an incinerator similar to the one being considered for use by Wind Cave National Park, they required an analysis of whether the hazardous air pollutants would pose any risk to human health.

TABLE 21. EXPECTED EMISSIONS RELATED TO AIR-CURTAIN INCINERATOR USE

Pollutant	Emission rate for incineration (from Montana Department of Livestock 2004)	Emission rate for diesel engine	Total emissions during initial reduction (15 day period)
Particulates (PM_{10})	1.5 pounds/ton incinerated	0.11 pounds/ton	0.29 tons
Nitrogen oxides	2.0 pounds/ton	1.6 pounds /ton	0.65 tons
Volatile organic compounds	3.8 pounds/ton	0.13 pound /ton	0.71 tons
Carbon monoxide	1.40 pounds/ton	0.34 pound/ton	0.31 tons
Sulfur oxides	0.10 pound/ton	0.11 pound/ton	0.04 tons
HAP emissions*	0.35 pound/ton	0.002 pound/ton	0.06 tons

The Board was considering a permit to operate an incinerator to burn livestock carcasses at 6 tons per hour for an entire year. This would produce 9.14 tons per year of hazardous air pollutants, more than 150 times the amount the park incinerator would emit. Even so, dispersion modeling indicated that at the concentrations this type of operation would produce, the "excess lifetime cancer risk" or ELCR to human health from any of the HAP substances was less than 0.0001% (1 in 1,000,000). The ELCR for the sum of all HAP from operating the incinerator for a year was less than 1 in 100,000. These risks were within the state standard and the board indicated they posed a negligible risk to human health.

The Board also required air dispersion modeling to analyze concentrations of particulates (PM10) assuming certain stack heights and terrain. While the modeling was for a different site and under different conditions, it again predicted that the worst-case concentration of particulates from the stack would be well below the 24 particulate standard of 150 $\mu g/m^3$ or the annual standard of 50 $\mu g/m^3$. In this case, the model predicted a maximum of 30 $\mu g/m^3$ over 24 hours and 3.65 $\mu g/m^3$ maximum concentration averaged over a year. Given that the incinerator modeled burned about twice as many carcasses per hour as the one the park would likely use, concentrations of particulates at Wind Cave should not be any higher than those modeled, regardless of minor terrain or weather differences.

Therefore, impacts to park and local air quality from emissions of criteria pollutants and of hazardous air pollutants from operation of an air-curtain incinerator, should it be required, would be short term, adverse, and negligible to minor.

Cumulative Impacts

Cumulative impacts in the vicinity of the park would be the same as those identified for alternative A, and would include cars and trucks, home heating, light industrial and energy development and power plant emissions in the region. Future oil and gas development or construction of additional coal-fired power plants in the region could reduce visibility from its current excellent condition over time of this Elk Management Plan.

Conclusion

Short-term negligible effects to air quality are expected as a result of helicopter use under this alternative. Negligible to minor short-term adverse impacts to air quality criteria pollutants and of hazardous air pollutants from operation of the air-curtain incinerator, should it be needed, would occur. Ongoing sources of air pollution, including stationary and mobile sources inside and outside of the park in Custer County would continue. Visibility is excellent, but may be degraded by regional development of oil, gas or coal-fired power plants over time. When compared to the no-action alternative, this alternative would result in additional negligible to minor adverse effects to air quality.

No impairment to park resources from impacts to air quality associated with implementing alternative C would occur.

ALTERNATIVE D—SHARPSHOOTING

Under this alternative, sharpshooting within the park would be used to reduce and maintain the elk herd at target population levels.

The sources of air emissions in this alternative include those from the helicopter used in sling-loading carcasses back to a central location for transport for incineration. Assuming 25 elk could be removed per day and that this would require 8 hours of helicopter time, it would take 8 days to remove 200 elk from the park each of the 3 to 4 years of initial reduction. This translates to 530 pounds (0.25 tons) of nitrous oxides and 180 pounds (0.09 tons) of sulfurous oxides. This is higher than any other alternative, but remains a negligible impact.

Incineration would be the other potential source of emissions. If incineration is used, emissions would be the same or less than those described above for alternative C depending on the number of elk sharpshooters are able to remove in a single year. It is estimated that sharpshooters could kill and helicopters could sling-load up to 20 carcasses per day. If the park incinerates carcasses as they arrive and following CWD testing, this is an approximate 5-hour per day operation. The emissions figures in alternative C assume a sustained 3-week period of 8-hour days of incinerating, and so although maximum concentration of emissions in alternative D may be the same, the total emissions per day would be less. Emissions from incineration may extend over a longer period of time as well, as initial reduction efforts may take several months and even maintenance efforts each year could require several days work. Impacts from incineration to air quality, including to criteria pollutants, odors, hazardous air pollutants and noise would range from negligible to minor in this alternative.

Cumulative Impacts

Cumulative impacts in the vicinity of the park would be the same as those identified for alternative A, and would include cars and trucks, home heating, light industrial and energy development and power plant emissions in the region. Future oil and gas development or construction of additional coal-fired power plants in the region could reduce visibility from its current excellent condition over the planning horizon of this Elk Management Plan.

Conclusion

Negligible to minor short-term adverse impacts to air quality criteria pollutants and of hazardous air pollutants from operation of the air-curtain incinerator, should it be needed, would occur. Additional short-term negligible impacts from the operation of the helicopter during sling-loading to remove carcasses during initial reduction would also occur. Ongoing sources of air pollution, including stationary and mobile sources inside and outside of the park in Custer County would continue. Visibility is excellent, but may be degraded by regional development of oil, gas or coal-fired power plants over time. When compared to the no-action alternative, this alternative would result in additional negligible to minor adverse effects to air quality.

No impairment to park resources from impacts to air quality associated with implementing alternative D would occur.

ALTERNATIVE E—CONTRACEPTION (STERILIZATION) (MAINTENANCE ONLY)

This alternative would be implemented solely to maintain elk at target population goals after initial reduction (alternatives B–D) through permanent sterilization of a predetermined number of the park's reproductive female elk population. At this time, sterilization has not been proven through science to effectively manage wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Impact to air quality from this alternative would come only from helicopter emissions, a negligible, short-term impact of less intensity than that reported for alternative C.

Cumulative Impacts

Cumulative impacts in the vicinity of the park would be the same as those identified for alternative A, and would include cars and trucks, home heating, light industrial and energy development and power plant emissions in the region. Future oil and gas development or construction of additional coal-fired power plants in the region could reduce visibility from its current excellent condition over the planning horizon of this Elk Management Plan.

Conclusion

Negligible short-term impacts to air quality from emissions of criteria pollutants from the operation of the helicopter during roundup would occur. Ongoing sources of air pollution, including stationary and mobile sources inside and outside of the park in Custer County would continue. Visibility is excellent, but may be degraded by regional development of oil, gas or coal-fired power plants over time. When compared to the no-action alternative, this alternative would result in a very slight increase in adverse effects to air quality.

No impairment to park resources from impacts to air quality associated with implementing alternative E would occur.

ALTERNATIVE F—FERTILITY CONTROL AGENT (MAINTENANCE ONLY)

Under this alternative, cow elk would be treated with chemical fertility control agents solely to maintain the elk population at target goals once initial reduction efforts (alternatives B–D) are completed. At this time, fertility control agents have not been effective in controlling population growth in large free-ranging wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Emissions similar to those described for alternatives D or E would affect air quality—negligible and short term. This would be related to the use of helicopters needed for herding and corralling of elk.

Cumulative Impacts

Cumulative impacts in the vicinity of the park would be the same as those identified for alternative A, and would include cars and trucks, home heating, light industrial and energy development and power plant emissions in the region. Future oil and gas development or construction of additional coal-fired power plants in the region could reduce visibility from its current excellent condition over the planning horizon of this Elk Management Plan.

Conclusion

Negligible short-term impacts to air quality from emissions of criteria pollutants from the operation of the helicopter during roundup are expected. Ongoing sources of air pollution, including stationary and mobile sources inside and outside of the park in Custer County would continue. Visibility is excellent, but may be degraded by regional development of oil, gas or coal-fired power plants over time. When compared to the no-action alternative, this alternative would result in a very slight increase in adverse effects to air quality.

No impairment to park resources from impacts to air quality associated with implementing alternative F would occur.

CULTURAL RESOURCES

GUIDING REGULATIONS AND POLICIES

The NPS is charged with management and protection of cultural resources through a variety of guidance documents and legislation in which NPS managers avoid, or minimize to the greatest degree practicable, adverse impacts on park resources and values. In addition, the park's draft Resource Management Plan includes a stated objective to "Inventory, evaluate, and manage prehistoric and historic resources to preserve their integrity as remnants of historical events and cultural dynamics" (NPS 2003:8).

The *National Historic Preservation Act* (NHPA), as amended, is the principal legislative authority for management of cultural resources located within national parks. It requires federal agencies to strive to minimize harm to historic properties that would be adversely affected by an undertaking. Section 106 of the NHPA requires all federal agencies to consider the effects of their actions on cultural resources determined eligible for inclusion in the National Register of Historic Places (NRHP) (see discussion below). Section 110 of the NHPA, among other things, charges federal agencies with the responsibility to establish preservation programs for identification, evaluation and nomination of cultural resources to the NRHP.

NPS-28: Cultural Resources Management Guidelines (NPS 1998) is the fundamental basis for managing cultural resources in the National Park System. It contains park management standards and other requirements for cultural resources, including archeological resources, historic and prehistoric structures, museum collections, cultural landscapes and ethnographic resources.

American Indian Religious Freedom Act of 1978 (AIRFA) outlines the U.S. policy of protection and preservation of the inherent right of American Indians, Eskimos, Aleuts, and Native Hawaiians to believe, express, and exercise their traditional religions. This includes, but is not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites. The act directs federal agencies to consult with native traditional religious leaders to ensure religious cultural rights and practices are protected and preserved.

Executive Order 13007 (Indian Sacred Sites, May 24, 1996) requires that each executive branch agency with statutory or administrative responsibility for the management of Federal lands shall, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and (2) avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies shall maintain the confidentiality of sacred sites.

Other cultural resource-related laws and regulations relevant to this analysis include:

- *Executive Order 13175* (Consultation and Coordination with Indian Tribal Governments, November 6, 2000)
- *Executive Order 11593* (Protection and Enhancement of the Cultural Environment, 1971)
- NPS *Management Policies 2006* (NPS 2006d)

Section 106 Compliance

This cultural resource analysis is intended to comply with the requirements of both NEPA and section 106 of the NHPA (36 CFR Part 800, Protection of Historic Properties). A section 106 statement follows the conclusion statement for each alternative.

Section 106 of the *National Historic Preservation Act* mandates that federal agencies take into account the effects of their actions on properties listed or eligible for listing in the National Register. Under the ACHP regulations, a determination of either adverse effect or no adverse effect must be made for affected NRHP-listed or eligible cultural resources. An adverse effect occurs whenever an impact alters, directly or indirectly, any characteristic of a cultural resource that qualifies it for inclusion in the NRHP. Adverse effects also include reasonably foreseeable effects caused by the proposal that would occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5, Assessment of Adverse Effects). The resolution of adverse effects can occur in a variety of ways, in accordance with 36 CFR 800.6 (Resolution of Adverse Effects). A determination of no adverse effect means there is an effect, but the effect would not diminish, in any way, the characteristics of the cultural resource that qualify it for inclusion in the NRHP. All effect determinations are made in consultation with the South Dakota SHPO and/or the appropriate Tribal Historic Preservation Officers (THPO).

The park has surveyed approximately 20% of its lands for cultural resources. Many (59 of 76) of the park's identified cultural resources have not been evaluated as to their eligibility for the NRHP. None of the resources determined eligible for the NRHP is expected to be affected by proposed management actions. However, in all cases where new cultural resources are identified as a result of management actions, or where it is discovered post-review that NRHP-eligible resources may be affected, potential adverse impacts to those NRHP-eligible resources will be coordinated by the park with the SHPO and/or THPO. For this reason, impact threshold definitions contain statements specifically related to adverse impacts as defined in 36 CFR 800.

METHODOLOGIES FOR ANALYSIS OF IMPACTS

The following discussion describes the methodology used to evaluate the impacts to cultural resources that could result from implementation of any of the proposed alternatives.

Geographic Area Evaluated for Impacts

Analysis of the effects to cultural resources from proposed management activities includes those resources located within park boundaries. In addition, under alternative B (Hunting Outside the Park), hazing of elk outside the park in the late summer/early fall would result in a greater number of elk on these lands, particularly in areas just west of the park (see figure 2 in the “Purpose of and Need for Action” chapter). Increased numbers of elk in these areas could elevate the risk to ethnographic resources, particularly vegetative resources. For purposes of section 106 (NHPA), the area of potential affect is considered the geographic area described above.

Issues

The following issues that could affect cultural resources have been compiled from both internal and public scoping efforts:

- Potential effects to archeological resources related to ground disturbance.
- Potential effects to elk and other ethnographic resources (e.g., plants, animals).

Impact Threshold Definitions

The following thresholds were used to determine the magnitude of impacts to cultural resources resulting from implementation of any of the alternatives. (Note: Cultural resources are nonrenewable resources and adverse effects to them generally consume, diminish, or destroy the original historic materials or form, resulting in a permanent loss in the integrity of the resource that can never be recovered. Therefore, although actions determined to have an adverse effect under section 106 may be mitigated, the effect remains adverse).

Archeological Resources

Beneficial effects to archeological resources could involve a range of preservation and stabilization actions, all of which would result in a determination of effect of *no adverse effect* for purposes of section 106.

Intensity definitions of adverse effects to archeological resources are described as follows:

Negligible: Impact is at the lowest levels of detection. For purposes of section 106, the determination of effect would be *no adverse effect*.

Minor: Disturbance of a site(s) results in little, if any, loss of integrity. For purposes of section 106, the determination of effect would be *no adverse effect*.

Moderate: Disturbance of a site(s) results in loss of integrity but not in a substantial loss of important data. For purposes of section 106, the determination of effect would be *adverse effect*. A memorandum of agreement is executed between the NPS and applicable State or Tribal Historic Preservation Officer and, if necessary, the ACHP in accordance with 36 CFR 800.6(b). Mitigation measures identified in the memorandum of agreement would reduce the intensity of impact under NEPA from moderate to minor.

Major: Disturbance of a site(s) results in loss of most or all of the site and its potential to yield important information. For purposes of section 106, the determination of effect would be *adverse effect*. The NPS and applicable State or Tribal Historic Preservation Officer are unable to negotiate and execute a memorandum of agreement in accordance with 36 CFR 800.6(b).

Impairment: A major adverse impact occurs to an archeological resource whose conservation is necessary to fulfill specific purposes identified in the park's enabling legislation, is key to the natural or cultural integrity of the park, or is identified as a goal in the park's general management plan (NPS 1994b) or other relevant NPS planning document.

Ethnographic Resources

Beneficial effects to ethnographic resources could involve the provision, facilitation and encouragement of access to traditional practices and beliefs, all of which would result in a determination of effect of *no adverse effect* for purposes of section 106.

Intensity definitions of adverse effects to ethnographic resources are described as follows:

Negligible: Impact would be barely perceptible and would neither alter resource conditions, such as traditional access or site preservation, nor alter the relationship between the resource and the affiliated group's body of practices and beliefs. For purposes of section 106, the determination of effect on traditional cultural properties would be *no adverse effect*.

Minor: Impact would be slight but noticeable but would neither appreciably alter resource conditions, such as traditional access or site preservation, nor alter the relationship between the resource and the affiliated group's body of practices and beliefs. For purposes of section 106, the determination of effect on traditional cultural properties would be *no adverse effect*.

Moderate: Impact would be apparent and would alter resource conditions. Interference occurs with traditional access, site preservation, or the relationship between the resource and the affiliated group's practices and beliefs, even though the group's practices and beliefs would survive. For purposes of section 106, the determination of effect on traditional cultural properties would be *adverse effect*.

Major: Impact would alter resource conditions. Traditional access, site preservation, or the relationship between the resource and the affiliated group's body of practices and beliefs are blocked or greatly affected, to the extent that the survival of a group's practices and/or beliefs would be jeopardized. For purposes of section 106, the determination of effect on traditional cultural properties would be *adverse effect*.

Impairment: A major adverse impact occurs to an ethnographic resource whose conservation is necessary to fulfill specific purposes identified in the park's enabling legislation, is key to the natural or cultural integrity of the park, or is identified as a goal in the park's general management plan (NPS 1994b) or other relevant NPS planning document.

Duration of Impacts

Short-term: Effects on ethnographic resources or access to them would persist for less than one year.

Long-term: Effects on ethnographic resources or access to them would persist for one year or more.

Context of Impacts

Site-specific: Effects confined to a specific site, in its immediate vicinity.

Localized: Effects confined within park boundaries, or areas larger than site-specific.

Regional: Effects may include larger areas, including areas outside park boundaries.

MITIGATION MEASURES

The following mitigation measures would be implemented to minimize or eliminate potential negative effects to cultural resources from proposed activities under all action alternatives, including:

- Known cultural resources would be avoided, whenever possible, during elk management activities.
- While this analysis does not involve impacts to cultural resources known to be eligible for or listed on the NRHP, in the event that future management activities are determined to affect such resources, they would be evaluated in accordance with section 106 of the NHPA.
- In areas that have not been inventoried, particularly for archeological resources, ground-disturbing activities would be preceded by appropriate studies/inventories and section 106 (NHPA) compliance. In areas that have been inventoried but new cultural resources are discovered during management actions, the park would ensure that the resource is protected pending the required 106 compliance.
- In compliance with State Historic Preservation Officer guidance, dragging of elk carcasses across the landscape would not occur unless the ground surface is dry or frozen.
- Work crews would be educated about the sensitivity and importance of cultural sites, and about the need to protect any cultural/archeological resources encountered and would be instructed of the illegality of collecting artifacts on federal lands.

The following mitigation measure applies only to alternative D (Sharpshooting):

- the park would verify the locations of known archeological sites in backcountry areas from which carcasses are removed and would clearly define these areas as sensitive resource areas off-limits for crew access (without calling attention to the presence of archeological resources).

ALTERNATIVE A—NO ACTION

Under the no-action alternative, existing elk management actions (monitoring and targeted surveillance) would continue.

Archeological Resources

No management actions proposed under the no-action alternative are believed to have the potential to affect archeological resources.

Ethnographic Resources

A variety of ethnographic resources considered important to certain tribes is present within the park and include both plant and animal resources (e.g., elk, bison, pronghorn, deer, specific vegetation species). Under the no-action alternative, the lack of an elk management plan and the prohibition of elk translocation would likely result in a much larger elk herd with the potential for harm to ethnographic resources. For instance, overgrazing by elk can result in increased competition among several animal species for similar forage, the decimation/degradation of certain vegetation communities, and, ultimately, the modification of conditions and availability of resources considered ethnographically important. As a result, the lack of a comprehensive elk management plan has the potential to result in minor, adverse, long-term effects to ethnographic resources.

Cumulative Impacts

As is true under all alternatives, a number of cultural resources, including ethnographic resources, have undoubtedly sustained repeated adverse impacts from natural and human forces over the lengthy period of human occupation of the Black Hills region. The majority (approximately 80%) of the park has not been formally inventoried for cultural resources making unidentified resources, especially those archeological resources exposed on or located near the surface, particularly vulnerable to human and natural disturbance.

Sources of cumulative effects to the park's archeological resources under the no-action alternative include past and present natural and human activities—erosion, park development and maintenance of infrastructure (e.g., visitor center, campgrounds, roadways), resource management (e.g., bison roundup, vegetation management, fire management), and others (vandalism, artifact collection). Many of these actions took place in the past when protection of cultural resources was not mandated (see the "Policies and Regulations" section) and most likely resulted in adverse impacts of unknown intensity to unidentified cultural resources within the park. However, in accordance with the NHPA and other relevant legislation, current and future projects are required to conduct cultural resource studies prior to ground disturbance to identify and mitigate impacts to the resources. This, coupled with the eventual completion of a park-wide cultural resource inventory designed to identify/protect historic properties, would provide long-term, cumulative benefits to cultural resources in the park and region.

A variety of plant and animal species, including elk, found in the Black Hills region are considered ethnographically important to certain tribes (Lakotas, Cheyenne, Arapaho) (Grinnell 1972; Densmore 1948; Hassrick 1964; Walker 1980). More specifically, elk populations in the region, including the park, have sustained considerable effects (changes in historic range, population fluctuations, extirpation in certain areas, and active population management by humans) over the past century due to non-Indian settlement patterns, farmland conversion, land and transportation development, etc. Over time, such activities are estimated to have resulted in moderate, adverse, cumulative effects to all ethnographic resources, including elk. Ongoing fire management actions within the park would have unknown effects on ethnographic resources. At the same time, past, current and future park planning and management efforts affecting natural resources (e.g., the *Black-Tailed Prairie Dog Management Plan/EA* [NPS 2006a], a bison management plan [NPS 2006b], the Draft Vegetation Management Plan [NPS 2006e]) provide cumulative benefits to these ethnographic resources by enhancing their protection and availability to tribes who value them.

Conclusions

None of the current actions which define the no-action alternative are believed to have the potential to affect archeological resources within the park. Under this alternative (e.g., the continued absence of elk management), ethnographic resources could experience minor, long-term, adverse effects resulting from potential modification of condition and availability of ethnographically important resources. Cumulative effects to archeological resources under this alternative include adverse impacts of unknown intensity resulting from prior development/land uses, as well as benefits resulting from compliance with current historic preservation legislation and the completion of a park-wide cultural resource inventory. Cumulative effects to ethnographic resources include moderate adverse impacts resulting from prior development/land use impacts, and benefits related to implementation of relevant park resource management plans which would enhance resources considered ethnographically important.

Implementation of the no-action alternative would not result in impairment of cultural resources within Wind Cave National Park.

For purposes of 106 of the NHPA, no identified cultural resources listed in or eligible for the NRHP are expected to be affected (no adverse effect) under this alternative.

ALTERNATIVE B—HUNTING OUTSIDE THE PARK

The emphasis of this alternative is the reduction and maintenance of the park’s elk population via the state-managed public hunt on lands outside the park.

Archeological Resources

The installation of gates within the park’s boundary fence line to encourage elk movement out of the park has the potential to affect archeological resources adversely by creating areas of concentrated ground disturbance, particularly if the elk were being hazed in large numbers through these small areas. The intensity of adverse effects would depend on the specific archeological resource impacted. However, as is true for all action alternatives (see the “Mitigation Measures” section) cultural resource inventories and NHPA compliance activities would occur in areas of all ground disturbances prior to plan implementation. Consequently, no greater than long-term, minor, site-specific, adverse effects to archeological resources are anticipated.

Ethnographic Resources

The health and sustainability of ethnographic resources (elk and numerous other plants and animals) are considered important to tribes in the area. This alternative would strive to manage the elk population within the park to numbers that would result in adequate and sustainable forage levels, primarily for bison, prairie dogs and elk (see the “Alternatives Development Process”). Simultaneously, it is expected that other ethnographic resources such as certain plant species, pronghorn, and deer would experience positive effects resulting from decreased grazing pressures by elk and the return to more sustainable natural conditions. Consequently, though elk may be encouraged/hazed out of the park annually at prescribed levels, the park’s other ethnographic resources, in general, would experience long-term, localized benefits as a result of the decreased detrimental effects of overgrazing elk.

Simultaneously, during the initial reduction phase (first five years), alternative B is expected to result in increased numbers of elk outside the park due to natural or hazed movement, creating the potential for impacts to ethnographic resources (plants and animals) on these neighboring lands, particularly those located to the west of the park. In general, the larger Black Hills region contains numerous resources ethnographically important to American Indians groups. As is true for resources within the park, overgrazing by elk can negatively affect ethnographically important resources outside park boundaries. While it is unknown as to how many additional elk may be using these lands outside the park under alternative B or the specific geographic extent of this use, it is possible to make some general assessment of impact to ethnographic resources. In the first few years of initial reduction when increased numbers (possibly 100s) of elk are denied re-entry to the park and are left on adjacent lands prior to being hunted, ethnographic resources could experience negligible, localized, adverse, long-term impacts related to potential overgrazing. After initial reduction and the elk population has been stabilized, impacts to ethnographic resources as a result of park management actions would result in long-term, localized benefits resulting from decreased detrimental effects of overgrazing elk, similar to those described for ethnographic resources within the park.

Cumulative Impacts

Cumulative impacts expected under alternative B are similar to those described under the no-action alternative.

Conclusions

Under this alternative, ground disturbance in the vicinity of gates installed within the park boundary fence would likely result in no greater than minor, site-specific, adverse effects to archeological resources. Ethnographic resources within the park are likely to experience long-term, localized benefits as a result of the decreased detrimental effects of overgrazing elk (similar effects for all action alternatives). These positive effects are similar under all action alternatives. When compared to the no-action alternative, alternative B would result in additional minor adverse effects to archeological resources and additional benefits to ethnographic resources. Cumulative effects expected under alternative B are similar to that described for the no-action alternative (adverse effects of unknown intensity to archeological resources; moderate adverse and beneficial effects to ethnographic resources).

Implementation of alternative B would not result in impairment of cultural resources within Wind Cave National Park.

For purposes of 106 of the NHPA, no identified cultural resources listed in or eligible for the NRHP are expected to be affected (no adverse effect) under this alternative.

ALTERNATIVE C—ROUNDUP AND LIVE SHIPMENT OR EUTHANASIA

The focus of this alternative is the reduction and maintenance of the elk population via roundup and live shipment/donation or euthanasia.

Archeological Resources

The wildlife corral facility into which elk would be herded under this alternative is an area that has been used for many years for the park's annual bison roundups and, consequently, is characterized by considerable ground disturbance. No archeological resources are known to exist in this area. However, as is true for all action alternatives (see the "Mitigation Measures" section) cultural resource inventories and NHPA compliance activities would occur in areas of all ground disturbances prior to plan implementation or if cultural resources are discovered during management activities. Consequently, no greater than long-term, minor, site-specific, adverse effects to archeological resources are anticipated.

Ethnographic Resources

Effects to the park's ethnographic resources under alternative C are similar to those described under alternative B—long-term, localized benefits—as a result of the decreased detrimental environmental effects of overgrazing elk.

Cumulative Impacts

Cumulative impacts expected under alternative C are similar to those described under the no-action alternative.

Conclusions

Alternative C would result in long-term benefits to ethnographic resources within the park, an additional positive effect when compared to the no-action alternative. Minor, long-term, adverse effects to archeological resources are possible but not expected (similar to alternative B). Cumulative effects expected under alternative C are similar to that described for the no-action alternative (adverse effects of unknown intensity to archeological resources; moderate adverse and beneficial effects to ethnographic resources).

Implementation of alternative C would not result in impairment of cultural resources within Wind Cave National Park.

For purposes of 106 of the NHPA, no identified cultural resources listed in or eligible for the NRHP are expected (no adverse effect) to be affected under this alternative.

ALTERNATIVE D—SHARPSHOOTING

Under this alternative, sharpshooters would be used within the park to reduce and maintain the elk herd at predetermined population levels.

Archeological Resources

No actions proposed under alternative D are expected to affect archeological resources.

Ethnographic Resources

Effects to the park's ethnographic resources under alternative D are similar to those described under alternative B—long-term, localized benefits—as a result of the decreased detrimental effects of overgrazing elk.

Cumulative Impacts

Cumulative impacts expected under alternative D are similar to those described under the no-action alternative.

Conclusions

Alternative D would result in long-term benefits to ethnographic resources within the park. These benefits result in an additional positive effect when compared to the no-action alternative. Cumulative effects expected under alternative D are similar to that described for the no-action alternative (adverse effects of unknown intensity to archeological resources; moderate adverse and beneficial effects to ethnographic resources).

Implementation of alternative D would not result in impairment of cultural resources within Wind Cave National Park.

For purposes of 106 of the NHPA, no identified cultural resources listed in or eligible for the NRHP are expected to be affected (no adverse effect) under this alternative.

ALTERNATIVE E—CONTRACEPTION (STERILIZATION) (MAINTENANCE ONLY)

This alternative would result in the permanent sterilization of a predetermined number of reproductive female elk in the park to maintain elk population goals after initial reduction efforts (alternatives B–D). At this time, sterilization has not been proven through science to effectively manage wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Archeological Resources

No actions proposed under alternative E are believed to have the potential to affect archeological resources, although impacts related to the choice of an initial reduction method would occur as described in alternatives B–D.

Ethnographic Resources

Effects to ethnographic resources under alternative E are similar to those described under alternative B—long-term, localized benefits—as a result of the decreased detrimental effects of overgrazing elk.

Cumulative Impacts

Cumulative impacts expected under alternative E are similar to those described under the no-action alternative.

Conclusions

Alternative E would result in long-term benefits to ethnographic resources within the park, an additional positive effect when compared to the no-action alternative. No impacts to archeological resources are anticipated (similar to the no-action alternative and alternatives C, E and F). Cumulative effects expected under alternative E are similar to that described for the no-action alternative (adverse effects of unknown intensity to archeological resources; moderate adverse and beneficial effects to ethnographic resources).

Implementation of alternative E would not result in impairment of cultural resources within Wind Cave National Park.

For purposes of 106 of the NHPA, no identified cultural resources listed in or eligible for the NRHP are expected to be affected (no adverse effect) under this alternative.

ALTERNATIVE F—FERTILITY CONTROL AGENT (MAINTENANCE ONLY)

This alternative focuses on treating cow elk with chemical fertility control agents solely to maintain elk population goals after initial reduction efforts (alternatives B–D). At this time, fertility control agents have not been effective in controlling population growth in large free-ranging wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Archeological Resources

The wildlife corral facility into which elk would be herded is an area that has been used for many years for the park's annual bison roundups and, consequently, is characterized by considerable ground disturbance. No archeological resources are known to exist in this area. No actions proposed under alternative F are believed to have the potential to affect archeological resources.

Ethnographic Resources

Effects to ethnographic resources under alternative F are similar to those described under alternative B—long-term, localized benefits—as a result of the decreased detrimental effects of overgrazing elk.

Cumulative Impacts

Cumulative impacts expected under alternative F are similar to those described under the no-action alternative.

Conclusions

Alternative F would result in long-term benefits to ethnographic resources within the park, an additional positive effect when compared to the no-action alternative. No impacts to archeological resources are anticipated (similar to the no-action alternative and alternatives C–E). Cumulative effects expected under alternative F are similar to that described for the no-action alternative (adverse effects of unknown intensity to archeological resources; moderate adverse and beneficial effects to ethnographic resources).

Implementation of alternative F would not result in impairment of cultural resources within Wind Cave National Park.

For purposes of 106 of the NHPA, no identified cultural resources listed in or eligible for the NRHP are expected to be affected (no adverse effect) under this alternative.

Section 106 Summary

This plan/EIS provides an analysis of impacts to cultural resources (archeological and ethnographic) of six alternatives (the no-action alternative, three initial reduction alternatives, and two maintenance alternatives). Effects to these resources were evaluated, by alternative, pursuant to 36 CFR Part 800.5 (implementing regulations of the *National Historic Preservation Act* addressing the criteria of effect and adverse effect). No cultural resources which are listed in or eligible for the NRHP are expected to be affected (no adverse effect) under the proposed alternatives. However, cultural resources not yet identified, as well as identified resources which have yet to be evaluated as to their NRHP eligibility, could potentially be affected. In this case, such resources would undergo review regarding potential adverse impacts in accordance with 36 CFR 800 (see the "Mitigation Measures" section).

VISITOR EXPERIENCE

GUIDING REGULATIONS AND POLICIES

The importance of and commitment to the visitor experience is affirmed in various NPS-wide and park-specific documents. The 1916 *Organic Act* requires the NPS to ensure its natural and cultural resources are not impaired, but it also requires parks "to provide for the enjoyment of" these resources. NPS *Management Policies 2006* (NPS 2006d) state that the enjoyment of park resources and values by the people of the United States is part of the fundamental purpose of all parks and that the NPS is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks. Because many forms of recreation can take place outside a national park setting, the NPS seeks to provide opportunities for forms of enjoyment that are uniquely suited and appropriate to the natural and cultural resources found in a particular unit, and defer to other agencies, private industry, and nongovernmental organizations to meet the broader spectrum of recreational needs and demands that are not dependent on a national park setting.

Park Ranger and Visitors in Elks Room

Park Ranger and Visitors at Natural Entrance

One of the park's purposes is the provision of services and facilities for public enjoyment and appreciation of the resources of Wind Cave National Park. The park's Backcountry Management Plan (NPS 2000a) identifies a management goal of ensuring that visitors safely enjoy and are satisfied with the availability, accessibility, diversity, and quality of park facilities, services, and appropriate recreation opportunities.

Park Ranger and Visitors at Natural Entrance

The visitor experience often involves enjoyment of a park's natural soundscape. The NPS *Management Policies 2006* (NPS 2006d) provides guidance to parks in managing natural sounds or soundscapes. "The natural ambient sound level—that is, the environment of sound that exists in the absence of human-caused noise—is the baseline condition, and the standard against which current conditions in a soundscape" should be measured and evaluated (NPS 2006d, sec. 8.2.3). The *Management Policies 2006* also indicate that NPS units must preserve "to the greatest extent possible, the natural soundscapes of parks" (NPS 2006d, sec. 4.9). In and adjacent to parks, effects of human activities that generate noise, including that caused by mechanical devices, must be evaluated as a part of the planning process. Parks are required to choose equipment "consistent with public and employee safety" that has the least potential for impact to the natural soundscape (NPS 2006d, sec. 8.2.3). The NPS is also required to "take all necessary steps to avoid or to mitigate adverse effects from aircraft," including from flights the park needs to function or manage its resources (NPS 2006d, sec. 8.4). In addition, *Director's Order 47: Soundscape Preservation and Noise Management*, articulates the NPS policies that address the protection, maintenance or restoration of the natural soundscape resource in a condition unimpaired by inappropriate or excessive noise sources (NPS 2000b).

Noise levels can vary significantly with distance from their source, weather conditions, terrain and vegetation. The introduction of new unwanted and unnatural noise into a quiet park setting has the potential to adversely influence the visitor experience. Analysis of the effects of noise on visitor experience in national parks involves a variety of factors, many of which are not easily quantifiable. These include, among other things, a visitor's expectation (e.g., presumptions of noise levels in developed vs. undeveloped/wilderness areas), a visitor's personal characteristics (the likelihood of being annoyed by noise), and the degree to which a quiet experience is desired (Gramann 1999).

The effect of noise on a community, particularly noise from aircraft, has been studied by various researchers (EPA 1974; American National Standards Institute [ANSI] 1980, 1988). Community annoyance regarding noise has been defined as "any negative subjective reaction on the part of an individual or group" and is measured by the "day-night average sound level" (DNL) by which the level of annoyance is quantified (FAA 2005). According to this research, it was found that, in general, approximately 10% of people are highly annoyed at noise levels greater than approximately 60 dB (urban areas), while approximately 75% are highly annoyed with DNL levels of 85 dB (under a flight path) (FAA 2005).

METHODOLOGIES AND ASSUMPTIONS FOR ANALYSIS OF IMPACTS

The following discussion describes the methodology used to evaluate the impacts to the visitor experience that could result from implementation of any of the proposed alternatives.

Issues

The following issues that relate to the visitor experience have been compiled from both internal and public scoping efforts and include the following potential effects related to:

- wildlife viewing opportunities
- soundscape (use of aircraft, firearms)
- backcountry access restrictions
- elk carcasses left in the backcountry
- seeing elk chased, captured or killed

Assumptions

- "Frontcountry" is used in this discussion to indicate the park's developed area (visitor center, cave tour access, campground, and picnic area) (see figure 2 in the "Purpose of and Need for Action" chapter).
- "Backcountry" is used in this discussion to indicate all those park areas not associated with frontcountry facilities and services. The park also includes designated backcountry areas in which permitted camping is allowed (see figure 7 in the "Affected Environment" chapter).
- Helicopters contracted for use by the park would fly out of Hot Springs or Custer, South Dakota. If landing (refueling) in the park is necessary, this would occur at a temporary helispot within the park. Temporary helispots would be closed off to the public. For this alternative, one helispot would likely be located in proximity to the existing wildlife corral area in an area cordoned off specifically for this activity (see figure 2 in the "Purpose of and Need for Action" chapter). Others may be established on a temporary basis as needed.

Impact Threshold Definitions

The following thresholds were used to determine the magnitude of impacts on the visitor experience.

Negligible: Visitors would not likely be aware of the effects associated with management actions.

Minor: Visitors would be aware of management activities but the effects would be slight. While noticeable, effects would not change the experience and enjoyment of the park's values and facilities.

Moderate: Visitors would be aware of the readily apparent effects associated with management actions. Detectable effects would change the visitor's ability to experience and enjoy the park's values and facilities within certain areas.

Major: Visitors would be highly aware of the effects associated with management actions and could prompt visitors to choose pursue their activity/experience in other areas outside the park.

Duration of Impacts

Short-term: Effects would be perceptible to visitors only temporarily and/or these management actions would persist for less than one year.

Long-term: Effects would be repeatedly perceptible to visitors, lasting for at least a year or more.

Context of Impacts

Site-specific: Effects to visitors are confined to a specific site.

Localized: Effects to visitors are confined to within park boundaries.

Regional: Effects to visitors may include larger areas which include the park and areas outside park boundaries.

MITIGATION MEASURES

The following mitigation measures would be implemented to minimize or eliminate potential negative effects to the visitor experience from proposed activities under all action alternatives, including:

- Whenever possible, management actions that could potentially affect the visitor experience would be scheduled during the time of lowest visitation (late fall/winter).
- Access to areas in which management action are occurring which could adversely affect the visitor experience would be restricted.
- Visitor information regarding elk management actions would be provided to enhance the public's understanding of the issue and to help them better plan their visits.

Actions Common to All Alternatives

Under all alternatives, aerial surveys to monitor elk population numbers would continue during the winter when snow cover helps observability and provides for a better chance of accuracy with population estimates. As these monitoring flights occur during the period of lowest visitation to the park, their effects to the park's natural soundscape would result in negligible, localized, adverse effects to the visitor experience.

ALTERNATIVE A—NO ACTION

Under the no-action alternative, existing elk management actions (monitoring and targeted surveillance) would continue.

Wildlife Viewing Opportunities

Under the no-action alternative, elk populations are expected to grow each year and ultimately to reach the ecological carrying capacity of the park (see the "Elk" section above). Those visiting the park in the fall often engage in elk-related activities (viewing, experiencing bugling), particularly in September. The presence of elk also contributes to the enjoyment of the backcountry (hiking, camping). These opportunities would likely increase without management actions, with resulting long-term, localized benefits to the visitor experience.

Soundscape

Occasionally, park staff must use firearms in the backcountry to dispatch individual elk that exhibit clinical signs of CWD. This can affect the park's soundscape, and thus, visitor experience, in negligible, site-specific, adverse ways.

As noted in the elk analysis section, the ratio of bull elk to cows in the park is already high, and would likely increase under the no-action alternative, as would the overall number of elk. The opportunity to hear bulls bugle would increase, with long-term benefits to the natural soundscape.

Cumulative Impacts

Several activities in the park have or are contributing to cumulative effects to the visitor experience. The park is in the process of upgrading old wayside exhibits, as well as adding new exhibits along Highway 385 and Highway 87. These actions are considered cumulative benefits to the visitor experience in that they provide additional opportunities to learn more about park resources and resources (NPS 2006c). In addition, elk interpretive programs currently offered by the park in the fall are considered a, cumulative benefit to the visitor experience. Currently, portions of the east part of the park (roads, trails) are closed to visitors during the annual bison roundup in the fall, resulting in negligible to minor, cumulative adverse, localized effects to the visitor experience resulting from these infrequent closures. The use of helicopters (approximately two days) during the annual bison roundups results in cumulative negligible to minor adverse effects to the park's soundscape.

Conclusions

The implementation of the no-action alternative would result in long-term, localized benefits to the visitor experience and soundscape resulting from the continuation of enhanced elk viewing opportunities and elk "bugling" over current conditions. In addition, negligible, long-term, adverse effects to the visitor experience related to the park's soundscape can be expected (use of aircraft, firearms). Cumulative benefits to the visitor experience are provided through enhanced interpretative exhibits and the continuing elk programs provided by the park in the fall. The annual bison roundup also results in additional cumulative adverse effects (negligible to minor) when access to certain park areas is restricted and helicopter noise is experienced by visitors. When compared to action alternatives, the no-action alternative would result in the fewest adverse effects to the visitor experience.

ALTERNATIVE B—HUNTING OUTSIDE THE PARK

The emphasis of this alternative is the reduction and maintenance of the park's elk population via the state-managed public hunt on lands outside the park.

Elk Management Activities

Alternative B includes an increase in the number of hunters during initial reduction, as well as the potential for hazing by helicopter or other means. Visitors would be restricted during hazing operations and so would not be in the immediate vicinity of elk management activities. However, hunting may take place very near the park fenced boundaries, and an occasional backcountry visitor may hear shooting or be aware hunting and hazing are taking place. For visitors comfortable with hunting or the idea of hazing elk out of the park, these activities would have no or only beneficial impacts. Others who expect an experience relatively free of human activity, or who object to or are uncomfortable with hunting may experience negligible to moderate or even major adverse impacts. A major adverse impact would involve relocating to avoid contact with elk management activities, and it is possible that some visitors may do so if they are exposed to hunters, shooting, hazing or elk trying to gain access to the park over high fences. Closing the area would keep adverse impacts to most visitors in the negligible to minor range. The impact would be short-term for most visitors, but could affect others over a longer period of time.

Wildlife Viewing Opportunities

Under this alternative, the park's elk population could be significantly reduced during the fall—the height of elk viewing season. During the initial reduction phase, the elk population is likely to vary depending on the success of the management actions. Still, the ultimate goal is the reduction and maintenance of elk numbers within the park at numbers lower than those observed in the recent past. As many visitors come to the park in the fall specifically to view elk and hear the bulls "bugling," this expected decrease in the elk population could result in minor to moderate, long-term, localized, adverse effects to the visitor experience.

Soundscape

Under this alternative, helicopters may be used to haze elk out of the park in the early fall and intermittently throughout the hunting season, depending on population goals. Noise levels of helicopter takeoffs/approaches (90–110 decibels) and flyovers (80–93 decibels) have been found to be annoying to visitors in close proximity to or directly under helicopter activity (FAA 2005) (for comparison, normal conversation occurs at about 60 decibels).

Backcountry areas where helicopter hazing activities occur would be closed to visitors during hazing activities for visitor safety. As noise levels diminish significantly with distance from the source, terrain, climate, etc., it is expected that the addition of such noise to the park's backcountry soundscape would have a negligible to minor, long-term, localized adverse effect on visitor experience. Soundscapes in frontcountry locations are typically compromised by the inherent activities occurring in these areas (vehicular traffic, visitor center activities, etc.). As a result, it is believed that adverse effects to the soundscape in these areas from the use of helicopters would have no greater than negligible to minor, long-term impacts to the visitor experience.

Reduction in the number of elk and changes to the bull:cow ratio would reduce "bugling" of elk in the long-term, a minor adverse impact to the natural soundscape compared to no action.

Backcountry Access Restrictions

During helicopter hazing activities (fall) in the backcountry, visitor access to these areas (roads, trails, camping areas) would be closed for visitor safety. The second highest use of the designated backcountry in 2005 was recorded in September (42 permits, see the "Affected Environment" section). As this coincides with the timing of potential backcountry closures due to hazing activities, minor, long-term, localized adverse effects to the visitor experience would be expected.

Cumulative Impacts

Cumulative impacts under alternative B are similar to those described under the no-action alternative.

Conclusions

Short to long-term beneficial impacts to some visitors, and negligible to major adverse impacts to others from witnessing elk management activities or knowing they are ongoing may occur. The decrease in the elk population expected under alternative B (hunting outside the park) would result in minor to moderate, localized, long-term, adverse effects to the visitor experience due to the likely decrease in opportunities to view elk and hear bulls "bugling." Effects to the park's natural soundscape from helicopter hazing are expected to result in negligible to minor, long-term, localized adverse effects on the visitor experience. Additional minor adverse impacts to the soundscape from a reduction in elk "bugling" would occur. The closure of the backcountry to visitors during management actions (hazing) would likely result in minor, long-term, localized adverse effects to the visitor experience. In addition to the effects of this alternative, cumulative effects to the visitor experience include benefits from elk educational and interpretive programs and exhibits provided by the park. The annual bison roundup also results in additional cumulative adverse effects (negligible to minor) when access to certain park areas is restricted and helicopter noise is experienced by visitors. When compared to the no-action alternative, alternative B would result in additional negligible to moderate, long-term, adverse effects to the visitor experience.

ALTERNATIVE C—ROUNDUP AND LIVE SHIPMENT OR EUTHANASIA

The focus of this alternative is the reduction and maintenance of the elk population through roundup and live shipment/donation or euthanasia.

Elk Management Activities

Management activities in alternative C include helicopter roundup of elk each year, holding in capture facilities and either transporting to a processing facility via truck transport of live elk, or euthanasia and exsanguination on site. As noted below, these activities could be noisy enough that visitors are aware of them. Visitors could also see helicopters flying overhead or large numbers of elk running by. An occasional visitor could attempt to find the capture facility (which would be closed to the public during roundup), and some could deliberately schedule visits during roundup and capture. These visitors may witness elk panicking, trying to jump high walls, in squeeze chutes or being killed. For those visitors comfortable with these activities, no impact or only beneficial impacts to their experience would result. For those who are either unaware these events have been scheduled, or who are offended, upset or uncomfortable with them, impacts would be adverse. Scheduling elk management activities in the winter and closing the backcountry, capture facility etc. to all visitation during elk management activities would keep adverse impacts from becoming more than negligible or minor for most visitors. It is possible that an occasional wintertime visitor could experience moderate or even major adverse effects, prompting them to move to another location in or out of the park. The impact would be short-term for most visitors, but could affect others over a longer period of time.

Wildlife Viewing Opportunities

Effects to wildlife viewing opportunities under this alternative are similar to those expected under alternative B—minor to moderate, localized, and long term.

Soundscape

Helicopters may be used to move elk to the existing wildlife corral facility (see figure 2 in the “Purpose of and Need for Action” chapter) for either live shipping or euthanasia. Roundup would likely occur between January and February of each year and could last for up to two weeks depending on the success of the roundup techniques. Noise levels of helicopter takeoffs/approaches (90–110 decibels) and flyovers (80–93 decibels) may be annoying to visitors in close proximity to or directly under helicopter activity (FAA 2005) (for comparison, normal conversation occurs at about 60 decibels).

If a partner for live shipping/donation is not obtained, the use of firearms (rifles) for the euthanasia of elk in the wildlife corrals is possible. The corrals are located approximately six miles from the frontcountry areas of the park (visitor center, etc.; see figure 2 in the “Purpose of and Need for Action” chapter). Noise levels of firearms range from approximately 140 to as high as 165 decibels at the site of use. If shooting is used as the method of euthanasia, it could be expected to continue for two to three weeks as animals are brought in from the backcountry. The use of aircraft and firearms would be confined to the backcountry, away from the developed frontcountry area (visitor center, etc.) where the majority of visitors are expected in January and February (the period of lowest annual visitation [6% of annual visitation]). For visitor safety and to mitigate adverse impacts to their experience, access to backcountry areas (roads, trails, camping, wildlife corrals) would be closed during management actions (aircraft/firearms use). Noise levels diminish significantly with distance from the source, terrain, climate, etc. resulting in fewer potential effects to visitors experience related to the park’s natural soundscape. It is unlikely that firearms noise emanating from the wildlife corrals six miles north of the visitor center would be audible in the frontcountry and, therefore, no effects to visitor experience are expected from it. Impacts to the park’s soundscape from aircraft use in the backcountry is expected to create negligible to minor, long-term, localized adverse effect on the visitor experience, depending on whether these actions were slightly audible/noticeable to frontcountry visitors.

The effects to the natural soundscape of reduced number of elk and changes in the bull:cow ratio (reduced elk “bugling”) would be similar to those described in alternative B—long term, minor, and adverse.

Backcountry Access Restrictions

During wintertime management actions (roundup/shipping, use of firearms) in the backcountry, access to these areas (trails, roads, wildlife corral) would be closed for visitor safety. Though a specific site has not been identified, incineration activities would also be conducted away from the park’s frontcountry areas, and possibly outside park boundaries. If conducted in the park, this area would also be closed to visitors but would involve a much smaller area than would roundup activities. Because January and February are times of very low backcountry use, it is unlikely that visitors would experience more than localized, negligible, long-term, adverse effects resulting from backcountry access restrictions.

Cumulative Impacts

Cumulative impacts under alternative C are similar to those described under the no-action alternative.

Conclusions

Short to long-term beneficial impacts to some visitors, and negligible to major adverse impacts to others from witnessing elk management activities or knowing they are ongoing may occur. Decreasing elk populations would result in minor to moderate, long-term, localized adverse effects to the visitor experience caused by reduced opportunities to view elk in the park. Aircraft-generated noise which could impact the park's natural soundscape would be confined to the backcountry areas of the park, closed to visitors during management actions. This is expected to result in negligible to minor, short-term, localized adverse effects to the visitor experience. It is unlikely that park visitors would experience effects to the soundscape from the use of firearms. Additional minor adverse impacts to the soundscape from a reduction in elk "bugling" would occur. The closure of backcountry areas to visitors during management actions (roundup, shipping, euthanasia, incineration) would likely result in negligible, short-term, localized adverse effects to the visitor experience. In addition to the effects of this alternative, cumulative effects to the visitor experience include benefits from elk educational and interpretive programs and exhibits currently provided by the park. The annual bison roundup also results in additional cumulative adverse effects (negligible to minor) when access to certain park areas is restricted and helicopter noise is experienced by visitors. When compared to the no-action alternative, alternative C would result in additional negligible to moderate, long- and short-term, localized adverse effects to the visitor experience.

ALTERNATIVE D—SHARPSHOOTING

Under this alternative, sharpshooting within the park would be used to reduce and maintain the elk herd at target population levels.

Elk Management Activities

Management activities in alternative D include the use of guns to shoot elk and of helicopters to remove carcasses, although some carcasses would remain (see *Carcasses Left in the Field*, below). Rifles would likely have noise suppressors and visitors would be largely unaware of them. In addition, the backcountry would be closed to visitors on the days where sharpshooting or helicopter activities would take place. It is unlikely then that any visitors would see elk killed or transported and the impact may be simply from knowing these activities are taking place. For those visitors comfortable with these management actions, no impact or only beneficial impacts to their experience would result. For those who are unaware these events have been scheduled or are upset or uncomfortable with elk management activities, impacts would be adverse. An occasional visitor may experience moderate or major adverse impacts because of elk management activities, although closures of the backcountry would keep adverse impacts to negligible or minor for most visitors and the chance of witnessing an elk shooting would be extremely remote. The impact would be short-term for most visitors, but could affect others over a longer period of time.

Wildlife Viewing Opportunities

During the initial reduction phase, the elk population is likely to vary depending on the success of the management actions under this alternative. Many who currently visit the park in the fall (September) specifically to view elk and hear the bull's "bugling" would likely begin to notice diminishing numbers of animals as initial reduction efforts proceed. Not only would numbers of elk decrease, but it is possible that elk would be more reclusive during sharpshooting activities. Large movements of elk outside the park are considered unlikely, as noise-suppressed rifles would be used and elk may be relatively unaware of the culling operation taking place around them. The ultimate reduction and maintenance of elk numbers within the park at levels lower than those observed in the recent past would alter wildlife viewing opportunities. The effect on the visitor experience could range from minor to moderate, adverse, localized and long term, with the more intense effects expected during the initial reduction phase. The effects to visitor experience are similar to those expected under alternatives B and C—minor to moderate, long term, localized, and adverse.

Soundscape

Sharpshooting could occur in the park's backcountry areas anytime of the year, but primarily between August 1 and March 1, although rifles would be noise-suppressed and visitors would likely not hear them. Helicopters used for sling-loading carcasses out of backcountry areas after sharpshooting activities would contribute to impacts to the park's natural soundscape. Noise levels of helicopter takeoffs/approaches (90–110 decibels) and flyovers (80–93 decibels) have been found to be annoying to some visitors in close proximity to or directly under helicopter activity (FAA 2005) (for comparison, normal conversation occurs at about 60 decibels). Cars and trucks are less noisy, on the order of 65–70 decibels at 100 meters distance (League for the Hard of Hearing, 2005).

The use of firearms and aircraft under this alternative would be confined to backcountry areas, away from frontcountry facilities and services (visitor center, etc.) where the majority of visitation occurs. For visitor safety and to mitigate effects to their experience, access to these management areas (backcountry roads, trails, camping areas, wildlife corrals, incineration location) would be closed. Noise levels diminish significantly with distance from the source, terrain, climate, etc., resulting in a relatively low number of visitors that could potentially be affected.

The months of August and September represent approximately 30% of annual park visitation, with many visiting the park in September to view the elk and hear their "bugling." October through March represents the lowest annual visitation rates for the park (see the "Affected Environment" chapter). It is expected that the addition of these new noise sources to the park's soundscape would have a negligible to minor, long-term, localized adverse effects on the visitor experience, depending on whether these actions were slightly audible/noticeable to visitors in other areas of the park.

The effects to the natural soundscape of reduced number of elk and changes in the bull:cow ratio (reduced elk "bugling") would be similar to those described in alternatives B and C—long term, minor and adverse.

Backcountry Access Restrictions

During management actions (sharpshooting, sling-loading), access to backcountry areas (trails, roads, capture facility, incineration site) would be closed for visitor safety reasons. Only a small number of visitors use the park's backcountry during the period from October to March. However August and September see some of the highest monthly backcountry use. In addition to permit holders (related to overnight stays), it is likely that some visitors use the backcountry year-round on a day-use basis but these numbers are not recorded. Effects to the visitor experience related to backcountry closures are expected to include negligible to minor, adverse, long-term and localized impacts during the months of October to March when backcountry use is at its lowest. In addition, moderate to possibly major, adverse, long-term and localized effects could occur during the months of August and September when 35% of backcountry use occurs. However, these more intense effects during the fall months would likely be mitigated to moderate by the park providing educational materials on the ecological reasons for the management actions (see the "Mitigation Measures" section in the "Alternatives" chapter).

Carcasses Left in Field

Under this alternative, elk carcasses, as determined by park staff, may be left in the field if they are very difficult to remove or if it is deemed environmentally preferred. As CWD has not been detected in free-ranging elk less than 18 months old (NPS 2006a), the park may elect to leave most calf carcasses in the field. With a variety and density of predators in the area, carcasses can be reduced in a matter of days.

However, the park currently has very few large predators; the number of mountain lions and coyotes in the park are lower than in the recent past (NPS 2006i) and there are no wolves present. Consequently, it is possible that elk carcasses left in the field could be evident to visitors for up to two weeks. While backcountry areas would be closed to visitors during management actions, it is possible that the re-opening of certain areas could overlap with this two week period and could affect visitor experience. Effects to the visitor experience as a result would likely vary from long-term and beneficial for those that understand and appreciate the ecological process, to negligible to minor, long term and adverse for those not expecting or wanting to encounter carcasses. Adverse effects could likely be mitigated to benefits for some visitors by the park providing educational material on the environmental value of leaving carcasses in the field and the factors used to make such decisions.

Cumulative Impacts

Cumulative impacts under alternative D are similar to those described under the no-action alternative.

Conclusions

Under alternative D, short to long-term beneficial impacts to some visitors, and negligible to major adverse impacts to others from witnessing elk management activities or knowing they are ongoing may occur. The expected long-term decrease in the elk population would result in minor to moderate, long-term, adverse effects to the visitor experience related to fewer opportunities for viewing elk. Soundscape impacts from the use of firearms (sharpshooting) and helicopters (sling-loading carcasses) would be confined to the backcountry areas of the park which would be closed to visitors. This is expected to result in negligible to minor, long-term, localized adverse effects to the visitor experience (similar to alternatives B and C). Additional minor adverse impacts to the soundscape from a reduction in elk "bugling" would occur. The closure of the backcountry to visitors during management actions (helicopters, firearms use, incineration) would likely result in negligible to moderate, long-term, localized adverse effects to the visitor experience, depending on the month. Long-term benefits and adverse impacts of negligible to minor intensity are expected related to carcasses being left in the backcountry. In addition to the effects of this alternative, cumulative effects to the visitor experience include benefits from elk educational and interpretive programs and exhibits provided by the park. The annual bison roundup also results in additional cumulative adverse effects (negligible to minor) when access to certain park areas is restricted and helicopter noise is experienced by visitors. When compared to the no-action alternative, alternative D would result in additional negligible to moderate, long-term, adverse effects to the visitor experience. In addition, benefits are expected.

ALTERNATIVE E—CONTRACEPTION (STERILIZATION) (MAINTENANCE ONLY)

This alternative would result in the permanent sterilization of a predetermined number of reproductive female elk in the park to maintain elk population goals after initial reduction efforts (alternatives B–D). At this time, sterilization has not been proven through science to effectively manage wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Elk Management Activities

Management activities in alternative E include helicopter roundup of elk each year, holding in capture facilities for treatment and observation. Impacts would similar to those described for alternative C, although sterilizing elk would offend a different group of visitors than capture for slaughter and processing. Scheduling elk management activities in the winter and closing the backcountry, capture facility etc. to all visitation during elk management activities would keep adverse impacts from becoming more than negligible or minor for most visitors. It is possible that an occasional wintertime visitor could experience moderate or even major adverse effects, prompting them to move to another location in or out of the park. The impact would be short-term for most visitors, but could affect others over a longer period of time.

Wildlife Viewing Opportunities

This option is viewed as a maintenance tool for use after initial reduction actions have achieved their goals (alternatives B–D). Accordingly, notable effects to wildlife viewing opportunities would have occurred during this initial reduction period. Once maintenance efforts are underway, it is assumed that the elk population would be stabilized. The eventual implementation of this maintenance option would likely result in no greater than negligible, long-term, localized and adverse effects to the visitor experience related to wildlife viewing opportunities.

Soundscape

Effects to the park's natural soundscape related to the use of aircraft under this alternative are similar to those described under alternative C—negligible to minor, localized, and long term.

Backcountry Access Restrictions

During wintertime helicopter use, visitor access to certain backcountry areas (trails, roads, wildlife corral) would be closed. Due to low backcountry use during the winter months, it is unlikely that visitors would experience more than localized, negligible, long-term, adverse effects resulting from access restrictions.

Cumulative Impacts

Cumulative impacts under alternative E are similar to those described under the no-action alternative.

Conclusions

Under alternative E, short to long-term beneficial impacts to some visitors, and negligible to major adverse impacts to others from witnessing elk management activities or knowing they are ongoing may occur. Long-term maintenance activities under alternative E would result in negligible, adverse, long-term, localized effects to wildlife viewing opportunities. In addition, negligible to minor, long-term, localized adverse effects to the visitor experience related to soundscape impacts (helicopters) are possible (similar to alternatives B–D). Localized, negligible, long-term, adverse effects are possible resulting from access restrictions during management actions. In addition to the effects of this alternative, cumulative impacts to the visitor experience include benefits from elk interpretive and educational programs and exhibits provided by the park. The annual bison roundup also results in additional cumulative adverse effects (negligible to minor) when access to certain park areas is restricted and helicopter noise is experienced by visitors. When compared to the no-action alternative, alternative E would result in additional negligible to minor, long-term, adverse effects to the visitor experience.

ALTERNATIVE F—FERTILITY CONTROL AGENT (MAINTENANCE ONLY)

This alternative focuses on treating cow elk with chemical fertility control agents solely to maintain the elk herd at target population goals after initial reduction efforts (alternatives B–D). At this time, fertility control agents have not been effective in controlling population growth in large free-ranging wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Elk Management Activities

Management activities in alternative F include helicopter roundup of elk each year, holding in capture facilities for treatment and observation. Impacts would similar to those described for alternative E. Scheduling elk management activities in the winter and closing the backcountry, capture facility etc. to all visitation during elk management activities would keep adverse impacts from witnessing these activities or knowing they are ongoing becoming more than negligible or minor for most visitors. It is possible that an occasional wintertime visitor could experience moderate or even major adverse effects, prompting them to move to another location in or out of the park. The impact would be short-term for most visitors, but could affect others over a longer period of time

Wildlife Viewing Opportunities

This option is viewed as a maintenance tool for use after initial reduction actions have achieved their goals (alternatives B–D). Effects to the wildlife viewing opportunities and visitor experience under this alternative would be similar to those described under alternative E—negligible, long term, localized, and adverse.

Soundscape

Helicopters may be used to roundup elk for contraceptive procedures. If fertility control agents are administered in the winter, during times of lowest park visitation, types and intensities of effects to the visitor experience related to park soundscape impacts (helicopter noise) would be similar to that described under alternative B (negligible to minor, long term, localized, adverse). If administered during the summer, the time of highest park visitation, adverse effects to the visitor experience from soundscape impacts (helicopter noise) would be similar in context (localized) and duration (long-term) but would tend toward minor in intensity as a result of the increased numbers of visitors potentially affected.

Backcountry Access Restrictions

If fertility control agents are administered in the winter during the time of lowest park visitation, effects to the visitor experience related to restricted access to backcountry areas during management actions would be negligible, long term, localized and adverse (similar to alternative E). If administered during the summer, the time of highest park visitation, adverse effects to the visitor experience due to restricted backcountry access would be similar in context and duration but would be minor to moderate in intensity.

Cumulative Impacts

Cumulative impacts under alternative F are similar to those described under the no-action alternative.

Conclusions

Under alternative F, short to long-term beneficial impacts to some visitors, and negligible to major adverse impacts to others from witnessing elk management activities or knowing they are ongoing may occur. Negligible, adverse, long-term, localized effects to wildlife viewing opportunities are possible. In addition, negligible to minor, long-term, localized adverse effects to the visitor experience related to soundscape impacts (helicopter noise) are possible (similar to all other action alternatives). Effects to the visitor experience related to backcountry restrictions are dependent on the time of year. Localized, negligible, short-term, adverse effects resulting from access restrictions in the winter are possible; similar effects but of minor to moderate intensity are expected from access restrictions in the summer. In addition to the effects of this alternative, cumulative impacts to the visitor experience include benefits from elk interpretive and educational programs and exhibits provided by the park. The annual bison roundup also results in additional cumulative adverse effects (negligible to minor) when access to certain park areas is restricted and helicopter noise is experienced by visitors. When compared to the no-action alternative, alternative F would result in additional negligible to moderate, long-term, adverse effects to the visitor experience, with the intensity of these effects being dependent on the time of year management actions are implemented.

SOCIOECONOMICS

GUIDING REGULATIONS AND POLICIES

The *National Environmental Policy Act* requires an environmental impact statement for any major federal action that significantly affects the human environment, including the socioeconomic effects of a proposal (see the “Summary of Laws and Policies” section). In addition, NEPA requires that agencies examine the indirect effects of their proposed actions which are defined as “reasonably foreseeable impacts that occur removed in time or space from the proposed action” (CEQ 1508.8). For instance, such indirect effects of an agency’s proposal could include impacts to land uses and resources of neighboring local, state, or federal land jurisdictions. In addition, the NPS *Management Policies 2006* charge the NPS with working “cooperatively with others to improve the condition of parks…and to integrate parks into sustainable ecological, cultural, and socioeconomic systems” (NPS 2006d, sec. 2.1.3). The same policies discuss impacts as “the likely effect of an action or proposed action upon specific natural, cultural or socioeconomic resources” (NPS 2006d: glossary).

METHODOLOGIES FOR ANALYSIS OF IMPACTS

Geographic Area Evaluated for Impacts

The geographic area analyzed for the socioeconomic impacts of the proposed alternatives includes the area inside Wind Cave National Park, and the broader area outside the park encompassing the two counties surrounding the park, Custer County and Fall River County. Hunting impacts are evaluated in the area defined by the SDGFP hunting units H3 and H4.

Issues

The issues addressed in this study and identified during the scoping process include:

- Impacts to the local economy related to visitation to Wind Cave National Park and hunting in adjacent areas.

- Impacts from modification of hunting protocols.
- Impacts to surrounding landowners from elk crop depredation and the related state policies to address this concern.

Assessment Methods

This section analyzes the relationship among the elk population, the park's elk management polices, and socioeconomic variables in the region. The relevant socioeconomic variables identified in this analysis include the number of recreational visits, and the economic impacts of park recreation and tourism on spending, income and jobs in the local economy. Changes in elk population and management policies also impact hunting activity in the region. Management policies that reduce the elk population would also change depredation impacts on lands outside the park.

The socioeconomic impacts from each alternative are evaluated in three categories: (1) tourism and recreation; (2) hunting activity; and (3) state programs and elk impacts on private land. The specific impacts are discussed in more detail below.

The NPS utilizes the Money Generation Model to estimate the economic impacts of recreation visits to park units on local economies. The economic impacts of Wind Cave National Park were evaluated using the MGM model for the year 2003. This analysis assumed the following distribution of the type of visits: 20% day trips by locals; 40% day trips by non-locals; 30% overnight trips in hotels; and 10% overnight trips camping. The Money Generation Model provides an estimate based on similar situations from around the country and may vary widely.

Current policies and prevailing conditions provide the basis for constructing baseline conditions in the no-action alternative. Each action alternative is assessed relative to the no-action alternative. Changes to elk management policy may impact socioeconomic variables through the changes in the overall elk population and the public perception about those policies. Reducing the elk population in the park reduces the prospective number of elk sightings by the average visitor and could lead to lower total visits to the park. Changes in elk management policies could also impact public perceptions through direct observation at the park, or indirect media sources such as newspapers, television, radio, or the internet. A negative public reaction to a policy change could lead to lower visits, while a positive public reaction could stimulate an increase in park visits. Elk management policy changes that influence park visitation are assumed to have a proportional impact on the economic variables of the local economy. This analysis of socioeconomic impacts draws upon the framework and methodology used in the consideration of elk reduction management alternatives for Rocky Mountain National Park (NPS 2006c).

Impact Threshold Definitions

Negligible: No observable or measurable impacts on the socioeconomic variables.

Minor: The impact on socioeconomic variables would be small but measurable. These impacts would be more localized than widespread in the region.

Moderate: The impact on socioeconomic variables would be detectable, readily apparent and widespread at the county level.

Major: The impact on socioeconomic variables would be readily apparent and so large as to substantially change the economy or social services within the county.

Duration of Impact

Short-term: Impacts would occur less than five years after the implementation of a management policy.

Long-term: Effects would occur five years or more after the implementation of a management policy.

ALTERNATIVE A—NO ACTION

Alternative A, the no-action alternative, assumes no new management actions beyond the current elk management policy (monitoring and targeted surveillance) for Wind Cave National Park.

Tourism and Recreation

Wind Cave National Park attracts thousands of visitors every year for tourism and recreation purposes. Visitors to the region impact the local economy through spending at retail stores, restaurants, hotels and other businesses. The economic impact of total visitor spending to the local economy in 2005 is estimated to be $39.8 million in sales, $16.5 million in personal income, $26.1 million in value added, and 894 jobs.

Elk are one of the attractions that bring visitors to Wind Cave National Park. During the fall, the phenomenon of the elk rut and elk "bugling" attracts visitors to the park. Elk contribute to the number of total visits to the park, although it is a factor difficult to quantify. It is assumed that elk draw about 10% of the total recreation visits to the park. (The 10% estimate for elk induced-visitation is based on the attributes of Wind Cave National Park and is lower than the 15% estimate used in a similar analysis of elk visitation for Rocky Mountain National Park [NPS 2006c]). As applied to the no-action alternative, elk-induced visitation is responsible for an estimated $4.0 million in sales, $1.6 million in personal income, $2.6 million in value added, and 89 jobs.

Under the no-action alternative, the elk population would increase. However, for this analysis, it is assumed that elk would continue to migrate in the numbers they do currently, and that visitation related to elk numbers would not change. Given these assumptions, alternative A leads to a continuation of short- and long-term beneficial impacts to tourism and recreation.

Hunting

Under current policy, elk in Wind Cave National Park can migrate outside the park boundaries and be hunted during elk season in state hunting units H3, H4, and Custer State Park (see figure 2 in the "Purpose of and Need for Action" chapter). In 2005, the SDGFP issued 1,075 elk licenses in units H3 and H4, and reported a total of 426 elk harvested from units H3 and H4. The estimated 1,075 hunters in units H3 and H4 in 2005 spent an average of 6.08 days hunting for a total of 6,532 total hunting days. Total trip expenditures for elk hunting in units H3 and H4 was $307,004 in 2005. Under the no-action alternative, it is estimated that the number of elk licenses and elk harvests in units H3 and H4 would continue to increase as the wintering population in the park grows to carrying capacity. Although the percentage of elk in hunting units H3 and H4 that winter in the park is unknown, a reasonable guess is between 15 and 25% (Kintigh 2007). If true, 80–140 additional elk (e.g., 15–25% of 550 additional elk) may be available for hunting in the later years of this alternative and an additional 200–350 hunting tags issued. The corresponding expected level of hunting trip expenditures impacting the local economy would be around

$55,000–100,000 per year, or a total of up to $400,000 in elk hunting revenues from H3 and H4, a benefit over existing conditions.

State Programs and Elk Impacts on Adjacent Land

In response to concern about elk impacts on private lands, the SDGFP developed a series of programs designed to prevent or mitigate wildlife depredation on private land. The area impacted near Wind Cave National Park has been designated the Elk Emphasis Area (EEA) (see the "Affected Environment" chapter and figure 12 for detail). The SDGFP now operates five distinct programs to address elk depredation in the EEA (elk hunting access agreements and hayland, food plot, cable, and stackyard contracts). For the year 2006, the SDGFP entered into 32 contracts that cover over 20,000 acres in the EAA. The total cost for these five programs in 2006 was $72,886.

The no-action alternative assumes the continuation of the current policy to address elk depredation on private land. If the elk migration remained stable at current levels, the SDGFP programs would remain at or near current levels. If elk migration grew beyond current levels in the future, the depredation impacts on private land could increase, prompting the SDGFP to expand current programs to counter the potential increase of depredation on private land. Alternative A would continue or increase the current moderate short-term and long-term adverse impacts of elk depredation on private land and the state programs to address elk depredation.

Cumulative Impacts

Some communities around Wind Cave National Park are growing while others are remaining stable. The population in Custer County has grown 27.9% over the past fifteen years. In Fall River County, however, the population did not change over the same period. Income is generally higher in Custer County. Median household income is about 30% higher and per capita personal income is 7.5% higher in Custer County relative to Fall River County. From 1994 to 2004, the average annual growth rate for per capita personal income has been 4.0% and 4.1%, respectively. Individuals in both counties derive 45%, a relatively large portion, of their income from non-work income. The unemployment rate for both counties has remained around 3% to 4% over the past five years.

The tourism-based sectors are very important to the local economy in Custer County and Fall River County. The tourism-based economy contributes 27.4% of the jobs and 18.7% of the income in Custer County, and 15.9% of the jobs and 13.9% of the total income in Fall River County. Over the past ten years, Wind Cave National Park visits ranged from about 600,000 to 800,000 visitors each year. The economic impact of Wind Cave National Park visitor spending contributes $39.8 million in sales, $16.5 million in personal income, 894 jobs, and 26.1 million in value added. Hunting activity has significantly increased over the past 15 years. The number of elk licenses issued in state hunting units H3 and H4 increased from 109 in 1991 to 1,075 in 2005, and total elk harvests increased from 62 in 1991 to 426 in 2005.

Under the no-action alternative, current policy does not reduce the size of the elk population and the adverse impact on vegetation to the area, and in fact the size of the herd is assumed to increase. The higher elk population and density would reduce the forage capacity of the region and lead to higher elk vulnerability to stochastic mortality events and CWD. Barring a large adverse impact on the elk population by stochastic events, no change is expected related to elk induced visitation or current hunting activity. No other significant socioeconomic cumulative impacts are anticipated. Alternative A would continue long-term beneficial impacts from tourism and recreation, as well as from hunting activity. There would also be the continuation of long-term moderate adverse impacts of elk depredation on private land along with the state programs to address elk depredation.

Conclusions

Alternative A, the no action alternative, provides a continuation of short- and long-term beneficial impacts to tourism and recreation. Additional elk available for hunting could mean a beneficial impact for hunting activity and revenues in the region in the later years of the no-action alternative. Alternative A leads to continuation of moderate short- and long-term adverse impacts of elk depredation on private land and continuation of state programs to address elk depredation. Unchecked long-term growth of the elk population carries risks of reducing the forage capacity, and increases the vulnerability of the elk to stochastic mortality events and CWD.

ALTERNATIVE B—HUNTING OUTSIDE THE PARK

Alternative B uses hunting outside the park to reduce and maintain elk population at target population goals.

Tourism and Recreation

In this alternative, the park would restrict elk from migrating back into the park and coordinate a larger elk harvest with the SDGFP to reduce the elk population. A certain segment of the public may have a negative reaction to a policy that kills elk and reduces the total elk population, despite the underlying objectives of such a policy. A smaller elk population may also reduce the likelihood of a visitor viewing elk in its natural habitat, and thereby reduce total visits to the park. The potential adverse public reaction could be mitigated by a public outreach program that communicates the reasons an elk reduction program improves the ecosystem health of the park (see the "Elements Common to All Action Alternatives" section in the "Alternatives" chapter). At the same time, this alternative could result in an increased number of elk on adjacent lands, particularly during the initial reduction phase of the plan (first 2–3 years). This increase could expand wildlife viewing opportunities in these areas and help to further mitigate adverse public reaction to the park's elk management actions.

The potential negative public perception of this alternative is difficult to quantify. A reasonable estimate of the impact on elk-induced visitation is that it would drop by as much as 5% during the initial reduction phase as predicted in the analysis of impacts to visitation attributed to elk reduction for Rocky Mountain National Park (NPS 2006c). A short-term decline in visitation of this size would affect the local economy by an estimated $200,000 loss in sales, $82,000 loss in personal income, $130,000 reduction in value added and a loss of 4 jobs. The negative public reaction would create a short-term minor to moderate adverse impact on tourism. After the initial reduction period, the negative reaction would subside and visitation rates would return to the prevailing levels. The long-term impact of alternative B on tourism and recreation would be negligible.

Hunting

In this alternative, hunting activity would increase in game units H3 and H4 over the initial reduction period and the elk population within the park would drop to the lower end of the 232 to 475 range. The number of elk licenses issued and expected harvest levels in these hunting units would depend upon the adaptive management decisions that incorporate the updated information on elk herds and forage conditions.

In an effort to assess the socioeconomic impacts, it is estimated that hunting activity would increase to attain additional annual elk harvests in the range of 100 to 250 elk per year within hunting units H3 and H4 over the first five years. In 2005, the estimated success rate of harvests to licenses issued was 40% in hunting units H3 and H4 (SDGFP 2006c). For this same success rate, the number of hunting licenses issued would increase by 250 to 650 over the current level of licenses issued (1,075). Assuming each elk license leads to 6.08 days of hunting, the increase of hunting activity associated with 250 to 650 additional elk hunters per year translates to 1,520 to 3,952 additional hunting days, respectively. Given an average hunter day expenditure of $47 in South Dakota, total trip expenditures linked to elk hunting in game units H3 and H4 would increase by a range of $71,440 to $185,477 per year, respectively, during the initial reduction period. The short-term impact of alternative B on hunting activity would be a beneficial impact.

After the initial reduction period, the annual harvest rate would return to a lower level consistent with the smaller elk population, forage conditions, and other factors. All alternatives would use an adaptive management approach where targeted levels of elk management would be based on the best available information. For this analysis, it is estimated that hunting activity and harvest rates would reflect the historical record during the early 1990s when the elk population wintering at the park was in the 232–475 range. Based on that data, it is estimated that about 250–400 licenses would be issued and 100–160 elk would be harvested each year. This level of hunting activity corresponds to about 1500–2400 hunting days and total hunting trip expenditures equal to $70,000 to $144,000 annually for units H3 and H4 as compared to the current $307,000 and potential increase to $400,000 under the no-action alternative. This long-term reduction in hunting activity under alternative B would be a moderate adverse impact.

State Programs and Elk Impacts on Adjacent Land

During initial reduction activities, it is expected that increased public hunting would occur outside the park. This period would temporarily increase the impacts on private lands or federal USFS lands leased for grazing located near the park. While many of these additional animals would be hunted, the higher number of elk on private lands would potentially lead to greater depredation from elk foraging and adverse impacts on crops and fencing. These potential impacts could prompt the SDGFP to increase the number of agreements (hayland, food plot, cable, and stackyard) to offset the increased number of elk outside the park. Additionally, the SDGFP may increase the number of elk hunting access agreements that would support the policy of increased hunting activity on private lands. Shortly before the hunting season when gates are raised, elk may congregate on USFS lands leased for cattle grazing and consume forage that would otherwise be available for cattle. However, elk are currently unrestricted by any NPS activity from foraging on these same lands, and the time under alternative B that they would be deterred from re-entering the park would be short and occur shortly before elk hunting season. The net result of alternative B is a short-term moderate adverse impact from increased depredation on private lands and increased state resources to address these impacts, but is likely only a short-term minor impact to revenues to those ranchers using federal USFS lands for grazing.

After the initial reduction period, there would be fewer elk migrating onto private lands relative to current elk population levels. The lower elk population would have fewer depredation impacts on private lands near the park or on USFS lands leased for grazing. The exact amount of depredation impacts is difficult to assess and quantify, but a smaller elk population would lead to a material reduction in depredation impacts over the long term. As a result, the SDGFP programs and resources to address depredation impacts could be reduced after the initial reduction period. Thus, alternative B involves a long-term beneficial impact on elk depredation and state policies to address depredation as well as to ranchers grazing cattle on leased USFS lands adjacent to the park.

Cumulative Impacts

The cumulative impacts of this alternative would be the same as described above for alternative A.

Conclusion

Alternative B, hunting outside the park, leads to short-term minor to moderate adverse impacts on tourism and recreation, and a long-term negligible impact on tourism and recreation. Alternative B would have a short-term beneficial impact on hunting activity, and a long-term moderate adverse impact on hunting activity. Alternative B would also have a short-term moderate adverse impact on elk depredation and state policies to address depredation, a short-term minor impact on ranchers leasing USFS lands for grazing, and then a long-term beneficial impact. When compared to the no-action alternative, alternative B would result in increased adverse socioeconomic effects to tourism/recreation and hunting. In addition, both adverse and beneficial effects to state programs addressing elk impacts on private lands would be increased when compared to no action.

ALTERNATIVE C—ROUNDUP AND LIVE SHIPMENT OR EUTHANASIA

Alternative C proposes to reduce and maintain the elk population through roundup and live shipment/donation or euthanasia.

Tourism and Recreation

The elk roundup would occur within the park's corral facility during mid-winter. Some portion of the population may have a negative perception because it runs counter to traditional NPS roles, creates an invasive impact on elk and other wildlife, and reduces the total population of elk in the park. The donation of meat to individuals may soften the negative perception if the program helps other individuals. If testing finds high levels of CWD in the herds, there would be less meat available to donate through the program. Effects to tourism and recreation under this alternative are similar to those described under alternative B—short term, minor to moderate and adverse, as well as long term and negligible.

Hunting

The roundup and shipping alternative would reduce the elk population without expanding hunting activity outside the park. As the elk population declines, state wildlife managers would have to lower the targeted elk harvests and issue fewer elk licenses relative to the current 2005 levels. Over the first five years, elk harvests would decline from 400 harvested per year to long-term maintenance levels consistent with levels in the mid 1990s when elk wintering in the park were within the management capacity of 232–475 elk. Based on those data, it is estimated that about 250–400 licenses would be issued and 100–160 elk would be harvested each year. This level of hunting activity corresponds to about 1500–2400 hunting days and total hunting trip expenditures equal to $70,000 to $144,000 annually for hunting units H3 and H4 as compared to the current $307,000 and potential increase to $400,000 under the no-action alternative. This long-term reduction in hunting activity under alternative C would be a moderate adverse impact.

State Programs and Elk Impacts on Adjacent Land

In this alternative, the initial reduction period relies on a lethal reduction method inside the park boundary. Unlike alternative B, this alternative would not result in an increase of elk on lands outside the park. The initial reduction period would have fewer elk migrating outside the park and would lead to a reduction of depredation impacts on private lands and ranchers leasing adjacent USFS lands. Fewer depredation impacts would enable the SDGFP to reduce their programs and resources devoted to prevention and mitigation of adverse elk impacts on private lands. Alternative C produces a short-term beneficial impact on elk depredation.

Once the elk population reaches the targeted level of 232 to 475 elk, the smaller elk population would have significantly less depredation impacts on private lands near the park as well as benefits for ranchers leasing USFS lands for grazing. SDGFP programs and resources to address depredation impacts could be correspondingly reduced during the longer term maintenance period. Alternative C yields a long-term beneficial impact from declining elk depredation.

Cumulative Impacts

Alternative C would result in cumulative impacts as described under alternative A.

Conclusion

Alternative C would create short-term minor to moderate adverse impacts on tourism and recreation, and then a long-term negligible impact on tourism and recreation. Alternative C would produce a long-term moderate adverse impact on hunting activity and revenues. Alternative C produces a short-term beneficial impact on elk depredation and state policies to address depredation, and then a long-term beneficial impact on depredation and on ranchers leasing USFS lands outside the park. When compared to the no-action alternative, alternative C would result in increased adverse socioeconomic effects to tourism/recreation and hunting, as well as increased benefits to state programs addressing elk impacts on private lands.

ALTERNATIVE D—SHARPSHOOTING

Alternative D would utilize sharpshooters to reduce and maintain the elk population within the park at target population levels.

Tourism and Recreation

In this alternative, the sharpshooting of elk would take place inside the park. Similar to the reasons discussed above, some portion of the population may adversely perceive the change in policy because it runs counter to traditional NPS roles, it directly harms the targeted elk, and it reduces the total population of elk in the park. Even if sharpshooting takes place during the low visitation period during winter, press coverage of the program could prompt a negative reaction that would result in a reduction of future visits. Effects to tourism and recreation under this alternative are similar to those described under alternative B—short term, minor to moderate and adverse, as well as long term and negligible.

Hunting

The sharpshooting alternative reduces the elk population without expanding public hunting activity. Similar to alternative C discussed above, the smaller elk population leads to lower elk harvests and elk licenses issued relative to current 2005 levels. The reduction in hunting activity leads to smaller hunting trip spending for units H3 and H4 relative to hunting activity in 2005. Similar to the long-term effects of other alternatives, it is estimated that about 250–400 licenses would be issued and 100–160 elk would be harvested each year. This level of hunting activity corresponds to about 1500–2400 hunting days and total hunting trip expenditures equal to $70,000 to $144,000 annually for hunting units H3 and H4 as compared to the current $307,000 and potential increase to $400,000 under the no-action alternative. This long-term reduction in hunting activity under alternative D would be a moderate adverse impact.

State Programs and Elk Impacts on Adjacent Land

The sharpshooting alternative utilizes lands inside the park to reduce the elk population. Effects related to elk depredation on private lands and ranchers leasing USFS lands adjacent to the park for grazing under this alternative would be similar to those described under alternative C—short- and long-term benefits.

Cumulative Impacts

Cumulative impacts would be the same as described above for alternative A.

Conclusion

Alternative D, the sharpshooting alternative, would create a short-term minor to moderate adverse impact on tourism and recreation, and then a long-term negligible impact on tourism and recreation. Alternative D would produce a long-term moderate adverse impact on hunting because of the smaller elk population. Alternative D would also have a short-term beneficial impact on elk depredation and state policies to address depredation and grazing on leased USFS lands, and then a long-term beneficial impact. When compared to the no-action alternative, alternative D would result in increased adverse socioeconomic effects to tourism/recreation and hunting, as well as increased benefits to state programs addressing elk impacts on private lands.

ALTERNATIVE E—CONTRACEPTION (STERILIZATION) (MAINTENANCE ONLY)

Alternative E would use a surgical sterilization procedure to maintain the elk population at the targeted population after initial reduction (alternatives B–D). At this time, sterilization has not been proven through science to effectively manage wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Tourism and Recreation

Some in the general population may view surgical sterilization more favorably to other forms of lethal reduction methods inside or outside the park. On the other hand, others may view this less favorably because it is very invasive to the animal. Surgery in the field runs the risk of infections and other complications. It is estimated that the procedure would have a 5% to 20% mortality rate.

This alternative would be used as a maintenance tool to be combined with one or more other initial reduction techniques (alternatives B–D). The public reaction to a combined policy may be more adverse since some portions of the public would be upset with the killing techniques and others would disagree with the surgical contraception procedure. Combining contraception maintenance methods with other initial reduction techniques may result in a larger reduction of visitors to the park than the case of a single elk reduction technique.

It is assumed that elk-induced visitation could drop in the range of 5% to 10% during the initial reduction phase. The corresponding impacts on the local economy would be an estimated $200,000 to $398,000 loss in sales, $82,000 to $165,000 loss in personal income, $130,000 to $261,000 reduction in value added, and a loss of 4 to 9 jobs. Despite the potential for a slightly larger initial negative public reaction, the short-term impact is deemed to be minor to moderate adverse impact on tourism to recreation. After the initial reduction period, visitation rates would return to the prevailing levels such that alternative E has a long-term negligible impact on tourism and recreation.

Hunting

The use of surgical sterilization as a maintenance alternative would maintain a smaller elk population without expanding public hunting activity. Similar to alternative C discussed above and assuming that public hunting is not used for the lethal reduction method, the smaller elk population would lead to lower elk harvests and elk licenses within adjacent hunting units relative to the current 2005 levels. The reduction in hunting activity would lead to smaller hunting trip spending for units H3 and H4 relative to hunting activity in 2005. (If this alternative were combined with expanded public hunting, such as under alternative B, then the initial reduction phase would temporarily increase elk licenses issued and elk harvests.) Once targeted population levels are reached, the maintenance period would result in lower hunting activity as discussed above. Overall, alternative E with lethal reduction in the park leads to a short-term minor to moderate adverse impact on hunting activity and a long-term moderate adverse impact on hunting activity.

State Programs and Elk Impacts on Adjacent Land

Assuming this maintenance alternative is paired with an initial lethal reduction method (alternatives B–D), effects to elk depredation and grazing on adjacent leased USFS lands would be similar to those described under alternative C—short-and long-term benefits.

Cumulative Impacts

Cumulative impacts would be the same as described above for alternative A.

Conclusion

Alternative E, the surgical sterilization alternative, would lead to a short-term minor to moderate adverse impact on tourism and recreation, and then a long-term negligible impact on tourism and recreation. Alternative E would produce a long-term moderate adverse impact on hunting activity. Moreover, alternative E creates a short- and long-term beneficial impacts on elk depredation and on leased USFS lands used for cattle grazing due to the smaller elk population. When compared to the no-action alternative, alternative E would result in increased adverse socioeconomic effects to tourism/recreation and hunting, as well as increased benefits to state programs addressing elk impacts on private lands.

ALTERNATIVE F—FERTILITY CONTROL AGENT (MAINTENANCE ONLY)

Alternative F involves treating cow elk with chemical fertility control agents solely to maintain the elk population at target goals after initial reduction (alternatives B–D). At this time, fertility control agents have not been effective in controlling population growth in large free-ranging wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Tourism and Recreation

Some members of the population may also have an adverse reaction to fertility control measures on elk. Fertility control may diminish the perception of wildness in the elk, and potentially the overall wildness of the park. The combined use of fertility control with lethal reduction techniques may result in a larger reduction of visitors to the park than the case of a single elk reduction technique.

Effects to tourism and recreation under this alternative are similar to those described under alternative E—short term, minor to moderate, and adverse, as well as long term and negligible.

Hunting

The fertility control agent alternative combined with another lethal reduction method would reduce the elk population without expanding public hunting activity. Similar to alternatives discussed above, the smaller elk population leads to lower targeted elk harvests and elk licenses issued relative the current 2005 levels. The reduction in hunting activity leads to smaller hunting trip spending for units H3 and H4 relative to hunting activity in 2005. Alternative F produces a long-term moderate adverse impact on hunting activity.

State Programs and Elk Impacts on Adjacent Land

Similar to alternative E above, this alternative would only reach the targeted elk population in the desired timeframe if combined with initial lethal reduction methods (alternatives B–D). Beneficial effects to elk depredation and adjacent USFS lands leased for cattle grazing under this alternative are similar to those described under alternative E—short- and long-term benefits.

Cumulative Impacts

Cumulative effects would be the same as described above for alternative A.

Conclusion

Alternative F, the fertility agent alternative, would yield a short-term minor to moderate adverse impact on tourism and recreation, followed by a long-term negligible impact on tourism and recreation. Alternative F would produce a long-term moderate adverse impact on hunting activity. Finally, alternative F creates a short- and long-term beneficial impacts on elk depredation and on adjacent USFS lands leased for cattle grazing due to the smaller elk population. When compared to the no-action alternative, alternative F would result in increased adverse socioeconomic effects to tourism/recreation and hunting, and increased benefits to state programs addressing elk impacts on private lands.

PARK OPERATIONS

Park operations for Wind Cave National Park include five management divisions—Interpretation, Resource Management, Resource and Visitor Protection, Maintenance, and Administration, all of which could be affected by the proposed management actions in some alternatives. This analysis focuses on the ability of the park to adequately and efficiently provide for functions that ensure efficient park operations over the life of the elk management plan.

GUIDING REGULATIONS AND POLICIES

NPS *Management Policies 2006* (NPS 2006d) detail the basic service-wide policies for implementation of the Organic Act, including NPS park operations. The NPS *Management Policies 2006* require that park operations achieve certain conditions related to the accomplishment of management goals through environmental leadership and the use of sustainable practices in planning, design siting, construction and maintenance. Additional policy guidance can be found in separate NPS director's orders specific to each division.

METHODOLOGIES AND ASSUMPTIONS FOR ANALYSIS OF IMPACTS

The following discussion describes the methodology used to evaluate the impacts to park operations that could result from implementation of any of the proposed alternatives.

Issues

The following issues have been compiled from both internal and public scoping efforts and include the following potential effects to park operations related to:

- Specific elk management actions (roundup, monitoring, euthanasia, contraception, etc.) (Resource Management division).
- Structural modifications of fencing (raising height, gate installation) and wildlife corral for elk management actions (Maintenance division).
- Oversight of firearms/aircraft use for resource management within park (Resource and Visitor Protection division).
- Implementation of backcountry access restrictions (Resource and Visitor Protection division).
- Provision of educational/interpretive products for the public related to elk management actions (Interpretation division).
- Coordination with other agencies regarding elk management (Resource Management division).
- Contract initiation/contractor oversight and general contract oversight (Resource Management and Administration divisions).

Assumptions

- Analysis of effects to park operations is based on current knowledge. Implementation of management options is expected to result in refinement of methods to ensure that plan goals are met as efficiently as possible, with the fewest impacts to park operations.
- Implementation of any of the action alternatives would require the use of some contracted workers, with oversight/direction by park staff.

Impact Threshold Definitions

The following thresholds were used to determine the magnitude of impacts to park operations.

Negligible: Park operations would not be affected or the effect would not be noticeable outside normal variability.

Minor: The effect would be detectable but would be of a magnitude that it would not have an appreciable effect on park operations.

Moderate: The effect would be readily apparent and would result in appreciable change in park operations in a manner noticeable to staff.

Major: The effect would be readily apparent and would result in a substantial change in park operations in a manner noticeable to staff and the public.

Duration of Impacts

Short-term: Effects would be perceptible to staff and/or visitors intermittently and would last for less than one year.

Long-term: Effects would be repeatedly perceptible to staff and visitors, lasting for at least a year or more.

ALTERNATIVE A—NO ACTION

Under the no-action alternative, current elk management efforts (monitoring and targeted surveillance) would continue. Information related to elk and their management would continue to be provided to the public via the park newspaper, website, and the visitor center staff.

Resource Management

The Resource Management division currently conducts a variety of elk management activities (annual monitoring, vegetation restoration, targeted surveillance, etc.). As the population grows under the no-action alternative, these duties may become more difficult. Collectively, these management efforts are believed to represent negligible to minor, long-term adverse impacts on park operations.

Interpretation

The Interpretation division regularly provides educational information on elk and their management through the visitor center, annual September programs, and in the park's newspaper and website—a negligible, long-term, adverse effect to park operations.

Resource and Visitor Protection

Resource and Visitor Protection staff would be responsible for dispatching of elk identified with clinical signs of CWD. On average, such action is required less than five times a year and is considered a negligible, adverse, long-term impact to park operations.

Cumulative Impacts

Funding and budget constraints continue to limit the amount of staff time available for elk management activities within the park. Park operations within Wind Cave National Park include numerous ongoing efforts related to goals involving natural and cultural resources management and protection (e.g., annual bison roundup, wildlife monitoring, targeted surveillance), maintenance and construction of park facilities (boundary fences, wildlife corral, exclosures, visitor facilities), provision of visitor services and public outreach, and visitor and staff safety. In addition, the 2002 NPS prohibition on elk translocation left the park without a viable elk management tool. This has resulted in minor, adverse cumulative effects to park operations related to the resulting impacts (e.g., vegetation mitigation) of the current ad-hoc nature of elk management. Collectively these issues result in minor, cumulative, adverse impacts to park operations.

In addition, several natural resources projects and planning efforts have recently been completed or are nearing completion (e.g., Fire Management Plan [NPS 2005a]; *Black-Tailed Prairie Dog Management Plan/EA* [NPS 2006a], Draft Vegetation Management Plan [NPS 2006e], Bison Management Plan [NPS 2006b]). The implementation of these plans would likely result in cumulative benefits to park operations in their ability to improve efficiency of resource management.

Conclusions

Under the no-action alternative, existing elk management-related activities would continue and perhaps become more time consuming as the elk population grows, representing negligible to minor adverse, long-term effects to the Resource Management division and negligible, adverse, long-term effects to the Interpretive division. Dispatching elk exhibiting clinical signs of CWD would result in negligible, adverse, long-term effects to the Resource and Visitor Protection division. In addition to these effects, cumulative effects to park operations include benefits related to implementation of recently completed natural resource management plans, as well as minor adverse impacts resulting from effects of dwindling funding, ongoing natural and cultural resource management, provision of visitor facilities/services, and the lack of a clear elk management plan.

ALTERNATIVE B—HUNTING OUTSIDE THE PARK

The emphasis of this alternative is the reduction and maintenance of the park's elk population via the state-managed public hunt on lands outside the park.

Resource Management

Under this alternative, park staff would be involved in monitoring of the elk population, CWD-target-surveillance activities, coordination with the SDGFP regarding numbers of hunting licenses for the fall hunt, coordination with park staff (Maintenance) regarding installation and operation of fence gates and raising of the southwestern fence, initiation of contracting documents (helicopters, etc.), and oversight/direction of contractors' work. Resulting impacts to park operations are expected to be minor, long term and adverse.

Interpretation

Under this alternative, park staff would provide information and educational materials to the public regarding elk management actions via information disseminated at the Visitor Center, the park newspaper and website, and other effective means of communication. The park currently uses the same means to provide elk-related information. Providing this additional information related to specific actions and their timing would likely result in negligible to minor, adverse, long-term effects to park operations. The more intense minor adverse effects would be related to the need for new educational materials expected in the first year or two of the plan.

Resource and Visitor Protection

Resource and visitor protection staff would be responsible for backcountry closures during the implementation of management actions (hazing via helicopter or other methods). This would involve informing the public of the closures and ensuring compliance. Much of this effort would occur in the front country (Visitor Center) but backcountry work (signage, patrols) would be necessary to ensure visitor compliance. This could occur from late summer to December (end of hunting season) but would likely only involve a day or two for any one hazing event. In addition, the staff is responsible for the dispatching of animals which show clinical signs of CWD. Collectively, these actions would result in negligible to minor, adverse, long-term effect to park operations.

Maintenance

Maintenance staff would be responsible for the raising of the approximately four miles of lowered fence line along the southwestern park boundary and for the installation of gates within the western, and possibly eastern, fence line. This effort would occur during the first year of initial reduction. This division would also be responsible for opening and closing the gates, with direction from the Resource Management staff, to ensure the appropriate number of elk had left the park for adjacent areas. This effort would be ongoing throughout the life of the plan, occurring annually during periods when elk are known to move between the park and adjacent lands (early spring to fall). Adverse effects to park operations would range from minor to moderate. Moderate, adverse effects would be short term and related to the raising of the lowered fence area and installation of gates. The annual work involved in opening and closing gates at appropriate times would result in minor adverse long-term impacts.

Administration

This division would be responsible for general oversight of all necessary contracting (e.g., air operations)—a negligible, long-term, adverse effect on park operations.

Cumulative Impacts

Cumulative impacts to park operations under alternative B are similar to those described under the no-action alternative with the exception of the cumulative adverse effects resulting from the lack of a comprehensive elk management plan.

Conclusions

Under alternative B, elk management efforts would involve negligible to moderate, adverse effects to park operations. These include minor, long-term, adverse effects to the Resource Management division; negligible to minor, long-term adverse effects to the Interpretation division; minor to moderate, short- and long-term adverse effects to the Maintenance division; negligible to minor, long-term adverse effects to the Resources and Visitor Protection division; and negligible, long-term adverse effects to the Administration division. In addition, cumulative effects to park operations include benefits related to implementation of recently completed natural resource management plans, as well as minor adverse impacts resulting from effects of funding constraints, ongoing natural and cultural resource management activities, and provision of visitor facilities/services. When compared to the no-action alternative, additional minor and moderate, long-term, adverse effects to park operations are to be expected under this alternative.

ALTERNATIVE C—ROUNDUP AND LIVE SHIPMENT OR EUTHANASIA

The focus of this alternative is the reduction and maintenance of the elk population through roundup and live shipment/donation or euthanasia.

Resource Management

Under this alternative, park staff would be involved in monitoring of the elk population; CWD-targeted surveillance activities; coordination with and directing park staff (Maintenance) regarding corral modifications (see discussion below under “Maintenance”); initiation of contracting documents (e.g., partner agreements, helicopters, animal transport, meat processing); oversight/direction of contractors’ work and euthanasia activities, if necessary. Euthanasia activities under this alternative could include captive bolting and exsanguination, shooting, or lethal injection. Euthanasia actions and CWD sampling for all euthanized elk would be conducted by park staff. Resulting impacts to park operations are expected to range from negligible to possibly moderate, long term and adverse. Less intense effects are related to ongoing monitoring activities while the most intense effects are possible as a result of staff time required for partnering coordination efforts or euthanasia activities.

Interpretation

Impacts to park operations under this alternative are similar to those described under alternative B (negligible to minor, long term, adverse) and are related to providing the public and visitors with information and educational materials regarding elk management actions.

Resource and Visitor Protection

Under this alternative, park staff would be responsible for backcountry closures during the implementation of management actions (roundup, shipping, euthanasia). This would involve informing the public of the closures and ensuring compliance. Much of this would occur at the Visitor Center with backcountry patrols likely necessary to ensure that visitors comply. This would occur in January or February, with roundup activities involving no more than two weeks. Should a partner for shipping/processing/meat donation not be obtained, qualified park staff within this division would be involved in the euthanizing of corralled animals. In addition, staff is responsible for the dispatching of animals which show clinical signs of CWD. Collectively, these actions would be considered a minor to moderate, adverse effect to park operations, with the more intense effects (moderate) occurring only if euthanasia of a large number of elk is required.

Maintenance

Under this alternative, park staff would be responsible for any necessary wildlife corral modifications (e.g., construction of an additional squeeze chute or modification of existing chute; modifications required for removal of carcasses of euthanized elk, modifications required for containment of blood, tissue, etc.). In addition, if no partner is identified for assistance with meat processing and donation and elk are euthanized in the corrals, park staff would be responsible for transporting the carcasses for incineration. Collectively, these activities could result in long-term, minor to moderate adverse effects to park operations. More intense effects (moderate) would be related to carcass disposal activities under the euthanasia option which would need to be accomplished in a relatively short time frame every year and could involve hundreds of elk, particularly during initial reduction activities.

Administration

This division would be responsible for the overall management of contracts for air operations, live shipment/meat packing/donation or incineration. This would result in minor, long-term adverse affects to park operations.

Cumulative Impacts

Cumulative impacts to park operations under alternative C are similar to those described under the no-action alternative with the exception of the adverse effects resulting from the lack of a comprehensive elk management plan.

Conclusions

Under alternative C, elk management efforts would involve negligible to possibly moderate, long-term, adverse effects to park operations. These include negligible to moderate, adverse effects to the Resource Management division; negligible to minor, adverse effects to the Interpretation division; minor to moderate, adverse effects to the Resource and Visitor Protection and Maintenance divisions; and minor, adverse effects to Administration. In addition, cumulative effects to park operations include benefits related to implementation of recently completed natural resource management plans, as well as minor adverse impacts resulting from effects of funding constraints, ongoing natural and cultural resource management activities, and provision of visitor facilities/services. When compared to the no-action alternative, this alternative represents a notable increase in the type and intensity of adverse effects to park operations.

ALTERNATIVE D—SHARPSHOOTING

Under this alternative, sharpshooting within the park would be used to reduce and maintain the elk herd at target population levels.

Resource Management

Under this alternative, park staff would be involved in monitoring of the elk population; CWD-targeted surveillance activities; initiation of contracting documents for contractors (e.g., helicopters, sharpshooters); oversight and implementation of sharpshooting, CWD testing, and assistance with carcass disposition. Resulting adverse impacts to park operations are expected to be long term and minor in intensity.

Interpretation

Impacts to park operations under this alternative are similar to those described under alternative B (negligible to minor, long term, adverse) and are related to providing the public and visitors with information and educational materials regarding elk management actions.

Resource and Visitor Protection

Under this alternative, park staff would be responsible for backcountry closures during the implementation of management actions (i.e., sharpshooting, sling-loading carcasses out of backcountry). This would involve informing the public of the closures and ensuring compliance. Much of this would occur at the Visitor Center with backcountry patrols likely necessary to ensure that the public complies. These actions could occur anywhere between August 1 and March 1. In addition, staff is responsible for the dispatching of animals which show clinical signs of CWD. Collectively, these actions are expected to result in minor, long-term, adverse effect to park operations.

Maintenance

This division would be responsible for the disposition of elk carcasses which have been sling-loaded to a central drop-off site within the park. This would include incinerating under reduction, which would require the loading and transport of a large number of elk to the appropriate site or landfill of CWD positive animals under maintenance. This division would also contribute efforts to incineration activities (loading of elk/fuel into incinerator). Collectively, these efforts would result in minor, long-term adverse effects to park operations.

Administration

This division would be responsible for the completion of contracts for air operations, sharpshooters, and incineration/landfilling activities. This would result in minor, long-term, adverse effects to park operations.

Cumulative Impacts

Cumulative impacts to park operations under alternative C are similar to those described under the no-action alternative with the exception of the adverse effects resulting from the lack of a comprehensive elk management plan.

Conclusions

Under alternative D, elk management efforts would involve negligible to minor, long-term adverse effects to park operations. These include minor effects to the Resource Management and Resource and Visitor Protection. Adverse effects to the Interpretation (negligible to minor) and Administration (minor) divisions are also expected. Minor adverse effects to the Maintenance division are expected. In addition, cumulative effects to park operations include benefits related to implementation of recently completed natural resource management plans, as well as minor adverse impacts resulting from effects of dwindling funding, ongoing natural and cultural resource management activities, and provision of visitor facilities/services. When compared to the no-action alternative, this alternative would result in a slight increase in adverse (minor) effects to park operations.

ALTERNATIVE E—CONTRACEPTION (STERILIZATION) (MAINTENANCE ONLY)

This alternative would result in the permanent sterilization of a predetermined number of the park’s reproductive female elk population to maintain target population goals after initial reduction efforts (alternatives B–D). At this time, sterilization has not been proven through science to effectively manage wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Resource Management

Effects to park operations under this alternative related to monitoring, contract initiation, and oversight activities are similar to those described under alternative D—long term, minor, and adverse.

In addition, park staff would be responsible for care of corralled animals, assistance in surgical sterilization procedures, marking of treated elk, observance of treated animals for 24-hour post-procedure, CWD testing and carcass disposal. Resulting impacts to park operations related to these tasks are related to the type of surgical procedure used. For example, if 300 elk were treated with the tubal ligations option, treatment would involve about 75 days (4 elk per day). If the same number were treated with the ovariectomy method, the treatment period would involve about 15 days (20 elk per day). Under the former method (tubal ligation), time and effort required by staff would be approximately five times what is expected with the ovariectomy option. Should the tubal ligation method be chosen, the more extensive staff efforts required would result in moderate, adverse, long-term effects to park operations. Comparatively, use of the ovariectomy option would likely result in similar effects of minor intensity.

Interpretation

Impacts to park operations under this alternative are similar to those described under alternative B (negligible to minor, long term, adverse) and are related to providing the public and visitors with information and educational materials regarding elk management actions.

Resource and Visitor Protection

Under this alternative, park staff would be responsible for backcountry closures during the implementation of management actions (e.g., roundup, surgical procedures). This would involve informing the public of the closures and ensuring compliance. Much of this would occur at the Visitor Center with backcountry patrols likely necessary to ensure that the public complies. These actions would likely occur in mid-winter (January). In addition, staff is responsible for the dispatching of animals which show clinical signs of CWD. Collectively, these actions are expected to result in negligible to minor, long-term, adverse effect to park operations.

Maintenance

This division would be involved in care of corralled animals, assistance in surgical sterilization procedures, marking of treated elk, observance of treated animals for 24-hour post-procedure, and CWD testing/carcass disposal, if necessary. Depending on the method of sterilization technique used, adverse, long-term impacts to park operations could range from minor to moderate.

Administration

This division would be responsible for the completion of contracts for air operations and veterinarian assistance, where necessary. This would result in negligible, long-term, adverse effects to park operations

Cumulative Impacts

Cumulative impacts to park operations under alternative C are similar to those described under the no-action alternative with the exception of the adverse effects resulting from the lack of a comprehensive elk management plan.

Conclusions

Under alternative E, elk management efforts could involve negligible to moderate, long-term, adverse effects to park operations. These include minor to moderate effects to the Resource Management division, as well as negligible to minor to the Resource and Visitor Protection and Interpretation divisions. Minor to moderate, long-term effects are expected for the Maintenance division and negligible, long-term effects would occur for the Administration division. In addition, cumulative effects to park operations include benefits related to implementation of recently completed natural resource management plans, as well as minor adverse impacts resulting from effects of funding constraints, ongoing natural and cultural resource management activities, and provision of visitor facilities/services. When compared to the no-action alternative, this alternative would result in an increase in the types and intensity (moderate) of adverse effects to park operations.

ALTERNATIVE F—FERTILITY CONTROL AGENT (MAINTENANCE ONLY)

Under this alternative, cow elk would be treated with chemical fertility control agents solely to maintain the elk population at target goals once initial reduction efforts (alternatives B–D) are completed. At this time, fertility control agents have not been effective in controlling population growth in large free-ranging wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Resource Management

Effects to park operations under this alternative related to monitoring, contract initiation, and oversight activities are similar to those described under alternative D—long term, minor and adverse.

In addition, park staff would be responsible for assistance in corralling of elk, care of corralled elk, assistance in the administration of chemical agents, and marking of treated animals. Resulting impacts to park operations related to these tasks are unknown at this time but could range from minor to moderate, long term and adverse depending on staffing requirements and time requirements.

Interpretation

Impacts to park operations under this alternative are similar to those described under alternative B (negligible to minor, long term, adverse) and are related to providing the public and visitors with information and educational materials regarding elk management actions.

Resource and Visitor Protection

Under this alternative, park staff would be responsible for backcountry closures during the implementation of management actions (e.g., roundup, treatment procedures). This would involve informing the public of the closures and ensuring compliance. Much of this would occur at the Visitor Center with backcountry patrols likely necessary to ensure that the public complies. The timing of these actions is unknown at this time. In addition, staff is responsible for the dispatching of animals that show clinical signs of CWD. Collectively, these actions are expected to result in no more than a minor, long-term, adverse effect to park operations.

Maintenance

This division would participate in care of corralled animals, marking of treated elk, and CWD testing/carcass disposal, if necessary. As a result, adverse, long-term effects to park operations would be minor.

Administration

Effects to park operations under this alternative would be similar to those described under alternative E—negligible, long term, and adverse.

Cumulative Impacts

Cumulative impacts to park operations under alternative C are similar to those described under the no-action alternative with the exception of the adverse effects resulting from the lack of a comprehensive elk management plan.

Conclusions

Under alternative F, elk management efforts could involve negligible to moderate, adverse, long-term effects to park operations. These include minor to moderate effects to the Resource Management division; minor effects to Resource and Visitor Protection and Maintenance divisions; negligible to minor effects to Interpretation; and negligible effects to Administration. In addition, cumulative effects to park operations include benefits related to implementation of recently completed natural resource management plans, as well as minor adverse impacts resulting from effects of funding constraints, ongoing natural and cultural resource management activities, and provision of visitor facilities/services. When compared to the no-action alternative, this alternative would result in an increase in the types and intensity (moderate) of adverse effects to park operations.

HUMAN HEALTH AND SAFETY

The NPS strives to provide safe and healthful conditions for visitors and park staff and considers the safety and health of employees, contractors, volunteers, and the public to be a core value.

GUIDING REGULATIONS AND POLICIES

NPS *Management Policies 2006* (NPS 2006d) provides guidance on parks providing a safe and healthful environment for visitors and employees. NPS managers are directed to exercise good judgment and discretion and, above all, be mindful that the safeguarding of human life must not be compromised. All employees are to be trained and informed on how to do their jobs safely and should be provided the necessary clothing, materials, and equipment to perform their duties with minimal personal risk (NPS 2006d, sec. 1.9.1.4). The NPS *Management Policies 2006* also direct parks to, whenever possible, reduce or remove known hazards and apply other appropriate measures, including closures, guarding, signing, or other forms of education to ensure public health and safety (NPS 2006d, sec. 8.2.5.1). Parks must also ensure compliance with other federal, tribal, state, and local agencies charged with health and safety responsibilities.

Director's Order 50B: Occupational Safety and Health Program, addresses the responsibilities of managing an effective occupational safety and health program for NPS employees and requires the integration of safety and health into every operation and activity. Where needed, employees would receive specialized training to safely perform assigned tasks and to effectively respond to emergencies. The overall purpose of Director's Order 50B is to establish and implement a continuously improving and measurable risk management process that: (1) provides for the occupational safety and health of NPS employees; (2) provides for the safety and health of the visiting public; and (3) maximizes the utilization of NPS human and physical resources, and minimizes monetary losses through effective workers' compensation case management (NPS 1999:1). Contractors employed by the NPS are required to comply with all applicable safety and health provisions and requirements.

Director's Order 50C: Public Risk Management, addresses the risk of accident, injury or illness to those who participate in work or recreational activities in the parks. The NPS is committed to reducing these risks and their associated pain, suffering, and financial expense. "Within units of the National Park System, the NPS and its commercial operators, special use permittees, cooperators, and contractors will meet or exceed all applicable laws relating to public safety, health, and the environment. Where conflicts arise between codes and standards, the more stringent requirement(s) will be used" (NPS 2001b)

Director's Order 83: Public Health, addresses NPS compliance with prescribed public health policies, practices and procedures (NPS 2004c). This order establishes NPS policy with respect to all public health activities within areas of NPS jurisdiction, regardless of whether those activities are carried out by NPS or other Federal employees, or by other organizations, including the U.S. Public Health Service (PHS). This includes the most recent PHS guidance document related to human consumption of meat from areas affected by CWD—"Elk and Deer Meat from Areas Affected by Chronic Wasting Disease: A Guide to Donation for Human Consumption" (NPS 2006h). This document provides guidance regarding procedures for handling in the field, processing/distribution, and donation of elk and deer meat gathered from parks in areas affected by CWD.

Director's Order 9: Law Enforcement Program, addresses firearms training and certification for all employees authorized to use firearms in the course of resource management duties. Required training is outlined including safety, marksmanship, maintenance, storage, accountability, and control and security. Methods to reduce risk to human safety are addressed including limiting shooting operations to non-peak times in high-visitation areas, and using area closures, where necessary.

Director's Order 77-4: Use of Pharmaceuticals for Wildlife, addresses the policy, requirements, and responsibilities for administration or application of pharmaceuticals to wildlife within units of the National Park System. All those involved in administration of pharmaceuticals to wildlife must possess adequate knowledge and experience in the use of pharmaceuticals for wildlife to assure human safety and to provide an adequate standard for professional care. This includes compliance with all Drug Enforcement Agency regulations when handling or using anesthetics or controlled substances, and fulfillment of certification requirements to administer anesthetics or controlled substances to wildlife. Projects involving such substances must develop protocols for the use of anesthetics or controlled substances for wildlife (NPS 2002).

Director's Order 60: Aviation Management, provides management guidance on conducting legal, safe and cost effective aviation programs, while minimizing adverse impacts that can result to visitor enjoyment and park resources. In addition, the use of aircraft in national parks for wildlife monitoring or management shall be in accordance with Federal Aviation Administration regulations (350–354, Department of the Interior Departmental Manuals) (NPS 2003c).

METHODOLOGIES AND ASSUMPTIONS FOR ANALYSIS OF IMPACTS

The management of elk within Wind Cave National Park primarily involves potential risks to the health and safety of park staff and contractors. These risks are related to the use of aircraft, firearms, power tools/equipment, and sharp instruments; exposure to potentially harmful materials; exposure to noise; proximity to hunters; handling of live corralled animals, incineration activities; and movement/transport of elk carcasses. Under one alternative (C), there is the potential for meat from carcasses testing negative for CWD to be donated to the public. The effects to human health and safety from this proposal are also analyzed. The potential consumption of elk meat by the public from animals that have been treated with pharmaceuticals (alternatives E and F) is also analyzed.

In addition to the guidance provided in regulations discussed above, the analysis of specific effects of noise (aircraft, firearms, power tools) on workers' health and safety is guided by professional and industry standards. Noise impacts affecting humans can range from temporary, mild annoyances for local residents to noise-induced hearing loss resulting from a combination of high sound levels and an extended period of exposure to sound above 85–90 dBA for more than eight hours. The A-weighted sound level, or dBA, gives greater weight to the frequencies of sound to which the human ear is most sensitive. Sound levels in decibels (dB) are calculated on a logarithmic scale and each 10-decibel increase is perceived as an approximate doubling of loudness. In general, the louder the noise, the less time required before hearing loss occurs. According to the National Institute for Occupational Safety and Health (NIOSH), the maximum exposure time at 85 dBA is 8 hours. At 110 dBA, the maximum exposure time is thirty minutes. Noise levels above 140 dBA can cause damage to hearing after just one exposure (table 22).

The health effects of noise include hearing loss, but have also been associated with other physiological changes, including elevation in blood pressure and gastrointestinal changes (increased peristaltic esophageal contraction and gastric emptying). Background noise may also disturb sleep, increase annoyance and may even increase aggression if it is loud and chronic (League for the Hard of Hearing 2005). Table 22 presents exposure thresholds for noise as defined by the National Institute for Occupational Safety and Health (NIOSH).

TABLE 22. EXPOSURE THRESHOLDS FOR NOISE (NIOSH 2006)

A-weighted decibel	NIOSH exposure threshold
Up to 80 dBA	No limit
81–90 dBA	8 hours
91–95 dBA	4 hours
96–100 dBA	2 hours
101–104 dBA	1 hours
105–110 dBA	30 minutes
111–120 dBA	7.5 minutes
121–130 dBA	3.75 minutes
131–140	No exposure is safe

The following discussion describes additional methodology used to evaluate the impacts to health and safety that could result from implementation of any of the proposed alternatives.

Geographic Area Evaluated for Impacts

This section analyzes impacts to public health and safety from management activities sponsored by the park. For the most part, this focuses on management actions/effects to park staff and contractors within park boundaries. However, it also includes issues related to the health and safety of the public outside park boundaries (e.g., donation of processed elk meat, hunting outside the park).

Issues

The following health and safety issues have been compiled from both internal and public scoping efforts:

- Use of aircraft (hazing, surveys, roundup, sling-loading, etc.).
- Handling of live animals (roundup, contraception procedures, marking of treated animals, general care).
- Hazing on horseback, by foot, etc.
- Administration of pharmaceuticals.
- Euthanasia activities.
- Handling of carcasses (CWD testing, disposal).
- Human consumption of elk meat.
- Facility modifications.
- Exposure to noise (aircraft, power equipment/tools, firearms).
- Hunting outside the park.
- Use of or exposure to firearms.

Assumptions

- Effects to health and safety related to meat processing activities by an off-site contractor are not analyzed. It is assumed such contractors would be USDA-approved and would work in compliance with all related industry health and safety regulations.
- No health and safety effects to park visitors are anticipated as management areas would be closed to the public.
- Funding permitting, targeted surveillance to identify and remove (shoot) elk that exhibit clinical signs of CWD would continue.

Impact Threshold Definitions

Analysis methods are qualitative and are based on reviews of existing data and literature and best professional judgment. The following thresholds were used to determine the magnitude of impacts on health and safety.

Negligible: The impact on human health and safety would not be measurable or perceptible.

Minor: The impact on human health and safety would be measurable or perceptible, but it would be limited in effect.

Moderate: The impact on human health and safety would be readily apparent and would result in effects sufficient to cause a noticeable change in rates or severity of injuries or in the numbers of incidents posing risks to human health and safety.

Major: The impact on human health and safety would be substantial, resulting in noticeable effects that could lead to serious human injury/disease, including death.

Duration of Impact

Short-term: Effects on human health and safety would persist for less than one year.

Long-term: Effects on human health and safety would persist for one year or more.

MITIGATION MEASURES

- All tasks associated with the proposed plan would be conducted with the highest priority being the health and safety of workers involved. This would be accomplished by strict adherence to related guidance documents such as those listed above (in the "Policies and Regulations" section) and other specific health and safety protocols which currently guide ongoing park activities (e.g., bison roundup, facility maintenance or construction, firearms use). This would include federal firearms laws administered by the Bureau of Alcohol, Tobacco, and Firearms. All federal employees or authorized agents would be required to have the appropriate skills and proficiencies in the use of firearms and protecting public safety. In addition, these personnel would have experience in the use of firearms for the removal of wildlife.
- Where applicable, ACETA (Aerial Capture, Eradication and Tagging of Animals) (USDI 2006) certification would be required for pilots. The use of firearms for management activities would comply with appropriate NPS guidance (*Director's Order 9: Law Enforcement Program*). Guidance provided by other experienced wildlife professionals related to health and safety would also be implemented, where appropriate. This includes safety protocols related to, among other things, the handling of live elk and carcasses, blood containment, and CWD sampling (Bates n.d.; Larsen 2006). All health and safety protocols (personal protective equipment [e.g., rubber/nitrile gloves, eye/mouth/nose protection], clean-up operations, etc.) would be established prior to plan implementation. Where appropriate, training of staff and/or contractors in specific techniques and methods would occur prior to plan implementation.
- All hazers and their animals (alternative B) would display distinguishing markings (e.g., blaze orange vests, flags) to identify themselves to potential hunters outside park boundaries.
- Donation of meat under alternative B would be in accordance with "Elk and Deer Meat from Areas Affected by Chronic Wasting Disease: A Guide to Donation for Human Consumption" (NPS 2006h). Among other things, this document provides specific guidance on donation (e.g., no donation of sick, emaciated or otherwise unhealthy appearing animals), handling of carcasses in the field (protective measures to minimize CWD exposure), and processing and distribution (e.g., CWD testing, informed consent). All carcasses from (alternative C) which meat would be donated to the public would be tested for CWD. Only meat from carcasses testing negative would be donated for public consumption.

ACTIONS COMMON TO ALL ALTERNATIVES

CWD-Related Tasks

Under all alternatives, the park would conduct targeted surveillance to identify and remove those elk that exhibit clinical signs of CWD. Occasionally, it is necessary to remove these elk by shooting. Samples for CWD are taken from all carcasses which are then stored until test results are obtained. Carcasses testing positive for CWD are landfilled or transported to Colorado State University for additional testing and incineration while those testing negative are typically returned to the backcountry where natural decomposition occurs. Effects to human health and safety associated with these tasks are related to the use of firearms (accidental gunshot, hearing loss), knives, and other tools used for CWD sample collection (cuts or abrasions, and exposure to possibly diseased tissue), and carcass disposal (handling of carcasses weighing hundreds of pounds). Collectively, these tasks would likely result in minor, long-term, and adverse effects to health and safety.

ALTERNATIVE A—NO ACTION

Under the no-action alternative, current elk management efforts (monitoring and targeted surveillance) would continue.

Aircraft Use

Contractors and staff members would continue to conduct aerial surveys to monitor elk population numbers. The use of aircraft involves risk of mechanical malfunction or pilot error, both of which can result in serious accident to staff or contractors. These flights currently comply with NPS management direction designed to protect human health and safety. These include NPS *Management Policies 2006* (NPS 2006d, sec. 1.9.14), Director's Order 50C (NPS 2001b), Director's Order 60: Aviation Management (NPS 2003b) and Federal Aviation Administration regulations. These management regulations provide guidance on conducting legal and safe aviation programs, while minimizing impacts to human health and safety and park resources. Risks to health and safety from the use of aircraft include accidents involving pilot error and equipment malfunctions. With continuing compliance with relevant NPS and FAA guidance for safe operation of aircraft, the continuance of aerial surveys for elk and forage monitoring is believed to have the potential to result in no more than negligible to minor, adverse, long-term effects to human health and safety.

Aircraft noise could also affect workers' health and safety. Helicopters and small fixed-wing aircraft would be used in aerial monitoring of wildlife under this alternative. The current use of aircraft for wildlife monitoring involves takeoff and landings from sites outside the park (where the aircraft contractors land the aircraft). Effects to workers from noise from monitoring flyovers of the park would be negligible (surveys typically take less than four hours per year) and short term (see tables 22 and 23). All staff working in aircraft operations are required to wear personal protective equipment, including hearing protection, to ensure health and safety.

TABLE 23. EXPECTED NOISE LEVELS FROM HELICOPTER USE

Distance from Source (meters)	Helicopter dBA level (average)
1	118
2	112
4	106
8	100
16	94
32	88
64	82
128	74
256	68
512	62
1,024	56
2,048	50
4,096	44
8,192	38

Cumulative Impacts

Past, present, and reasonably foreseeable future projects within the park have and would affect human health and safety. The occasional roundup and translocation of elk (prior to 2002) and the ongoing annual roundup and shipment of bison likely contribute minor, adverse cumulative impacts to human health and safety related to working in close proximity to confined wildlife. Ongoing CWD-related work (targeted surveillance/removal, testing, and carcass removal) contributes negligible to minor, adverse cumulative effects. In addition, the implementation of past and recently adopted resource management plans (fire management, prairie dogs, etc.), repair or construction of infrastructure (structures, trails, roadways, campgrounds, etc.), and ongoing monitoring and management actions (aerial surveys, bison roundup) contribute to negligible to minor cumulative adverse effects to human health and safety. At the same time, cumulative benefits derive from the maintenance of facilities and resource management actions (e.g., fire) in that risks to health and safety are reduced by their implementation.

Conclusions

Implementation of the no-action alternative would result in negligible to minor, long-term adverse effects to human health and safety related to the use of aircraft for elk monitoring surveys. In addition to these effects, cumulative effects to health and safety include benefits (maintenance of facilities, resource management) and negligible to minor adverse effects (resource management, infrastructure repair or construction, targeted surveillance activities). When compared to action alternatives C–F, the no-action alternative presents notably fewer adverse effects to human health and safety. When compared to alternative B, the no-action alternative would result in slightly fewer adverse effects.

ALTERNATIVE B—HUNTING OUTSIDE THE PARK

The emphasis of this alternative is reduction and maintenance of the park's elk population via the existing state-managed public hunt on lands outside the park.

Aircraft Use

Contractors and staff members would continue to conduct aerial surveys to monitor elk population numbers as described in alternative A. In addition, helicopters may be used to haze elk out of the park to make them available for the annual public hunt. Effects to health and safety from these tasks would be similar to those described under the no-action alternative—negligible to minor, long term, adverse.

Aircraft noise could also affect workers' health and safety. The use of helicopters and small fixed-wing aircraft for monitoring and hazing would likely involve takeoffs and landings from sites outside the park (where the aircraft contractors house the aircraft). However, it is possible the helicopter would land, most likely adjacent to the wildlife corrals, or hover in some areas of the park. Helicopters can be quite loud on takeoff, approach and even on flyovers (see table 23). Noise levels from helicopters at close range vary depending on the angle to the receiver. They are lowest when the helicopter is facing the receiver, higher when the helicopter is on either side, and highest when the receiver is behind the helicopter (Avarindakshan et al. 2002). Effects to workers from noise generated by helicopters would be dependent on their proximity to the aircraft and the length of exposure. During takeoffs, landings and hovering, noise levels received by workers could exceed a safe level (e.g., at approximately 16 to 32 meters, noise levels could range from 88–94 dBA, see tables 22 and 23) for short periods of time (less than an hour per day for less than a week a year). Assuming that, all staff working in aircraft operations are required to wear personal protective equipment, including hearing protection, to ensure health and safety, effects of this level of aircraft noise are expected to be negligible to minor, short term, and adverse.

Hazing Elk Out of Park (by any means other than aircraft)

Under this alternative, hazing techniques other than the use of helicopters may be used to move elk out of the park to adjacent lands where they may be hunted. This would be accomplished within the park by people on foot or horseback, the use of noisemakers, and possibly the use of dogs. As these efforts are likely to occur during hunting season(s) for lands immediately adjacent to the park, it is possible that hunters could mistake hazers for wildlife. In addition, stray bullets and accidental shots and, to a lesser degree, arrows during archery season, would create safety risks to hazers in areas close to the park boundary, immediately adjacent to hunting units. All hazers and their animals would display distinguishing markings to identify themselves to hunters outside park boundaries. This would result in negligible to minor, adverse, long-term effects to human health and safety related to proximity to hunters and their weapons.

Facility Modifications

Under this alternative, modifications (raising southwest fence height, installing gates) to the park's boundary fence would occur during the first year of initial reduction, primarily along the western perimeter. This work would involve the use of hand and power tools and the handling or lifting of heavy materials, all of which have the potential to result in cuts, abrasions, muscle strains and effects to hearing. Power tools vary in the noise generated by type and manufacturer. For instance, noise emitted from power saws can range from approximately 95 dBA (circular saw) to 100 dBA (reciprocating saw). Noise from power drills typically ranges from 89–94 dBA (NIOSH 2006). These types of tools require the use of hearing protection to mitigate hearing loss (see table 22) when used for extended period of time. For all facility modifications work, appropriate safety mitigation measures would be implemented (see the "Mitigation" section above) and the work would be conducted in accordance with related NPS health and safety guidance (see the "Policies and Regulations" section above). Collectively, these efforts would represent short-term, adverse risks to health and safety of negligible to minor intensity.

Human Consumption of Elk Meat

Under this alternative, hunters would continue to harvest elk on lands adjacent to the park. In fact, it is expected that the number of elk harvested by hunters on these lands would increase as a result of raised boundary fencing and the closure of gates within the fence denying animals re-entry to the park in the fall. Increased numbers of elk outside the park during hunting season would be particularly notable during initial reduction efforts (first five years of plan).

In 2005, 13 of 3,248 (0.4%) elk tested for CWD in South Dakota were identified as positive (infected with the disease). Since CWD testing in the park began in 2002, eleven elk and eight deer have tested positive for CWD (NPS 2006i). "Chronic wasting disease belongs to a group of diseases known as transmissible spongiform encephalopathies (TSE's), which includes scrapie, bovine spongiform encephalopathy (BSE), and Cruetzfeldt-Jakob disease. TSE's cause distinctive lesions in the brain and consistently result in death" (NPS 2006h:3). There is currently no evidence that CWD is naturally transmitted to humans from elk (Colorado Division of Wildlife [CDOW] 2003; NPS 2006h; SDGFP 2006b). However, because prions causing CWD accumulate mainly in the brain, eyes, spinal cord, lymph nodes, tonsils, pancreas, and spleen, it is advised that these animal parts not be consumed. New research indicates that the prions causing CWD can accumulate in muscle tissue, but at relatively low levels and with no evidence of an increased risk to humans (SDGFP 2006b).

The SDGFP advises hunters to take precautions such as not consuming wild animals that appear sick, wearing protective clothing when processing animals, not handling or consuming brain or spinal tissues, etc. (SDGFP 2006b). All hunters are encouraged to have harvested elk tested for CWD to provide hunters with information with which to make decisions regarding meat consumption. It is estimated that approximately 60% of the harvest is voluntarily tested for CWD. Once hunters receive results (positive or negative) it is their choice to consume the meat or turn the carcass in for another tag or a refund.

Based on current knowledge of risks related to transmission of CWD from elk to humans, as well as precautions (CWD testing) encouraged by the SDGFP, expected effects to human health and safety resulting from consumption of elk meat harvested from areas where CWD has been identified are believed to be no more than negligible, long term, and adverse. If future research findings warrant it, this assessment may require re-evaluation of the effects to human health and safety.

Increased Hunting Adjacent to Park

Large state-managed hunting units (H3 and H4) are located immediately adjacent to the park and it is expected that the numbers of hunting licenses for these units would increase under this alternative. While it is unknown how these additional hunters would choose their hunting locations or whether their choices would cause crowding, risks associated with hunting—primarily the use of firearms—are likely to increase during the period of initial reduction activities. This is directly related to the increased numbers (possibly hundreds) of new licenses that may be issued for these two hunting units. As hunters typically try to avoid crowding, risks from the potential additional use of firearms to human health and safety on these lands surrounding the park would likely result in negligible to minor, long-term, adverse effects.

Cumulative Impacts

Cumulative impacts affecting human health and safety under this alternative are similar to those described under the no-action alternative.

Conclusions

This alternative would result in negligible to minor adverse effects to human health and safety related to the use of aircraft for elk monitoring surveys and hazing activities (similar effects to those expected under no action). Hazing by other means (humans on horseback or on foot, etc.) would result in negligible to minor, long-term, adverse effects to health and safety. Necessary modifications to the park boundary fence line and installation of gates within boundary fencing would result in negligible to minor, short-term, adverse effects to health and safety. Negligible, long-term, adverse effects to human health and safety are possible as a result of consumption of elk meat harvested in areas where CWD has been identified. Negligible to minor, long-term, adverse effects to human health and safety are also possible as a result of the potential increased firearms use related to the issuance of possibly hundreds of additional elk licenses. Existing cumulative effects to health and safety include benefits (maintenance of facilities, resource management) and negligible to minor adverse effects (resource management, infrastructure repair or construction, CWD-related tasks). When compared to the no-action alternative, alternative B would result in a slight increase in the frequency of impacts to human health and safety.

ALTERNATIVE C—ROUNDUP AND LIVE SHIPMENT OR EUTHANASIA

The focus of this alternative is the reduction and maintenance of the elk population via roundup and live shipment/donation or euthanasia.

Aircraft Use

Risks to safety from operating fixed wing aircraft or helicopters would be similar to those for other alternatives, that is negligible to minor, long term and adverse. Aircraft would be used for surveying and annually to round up elk into the park's capture facility.

Aircraft noise would also affect workers' health and safety in the same way as described above for alternative B. All staff working in aircraft operations would be required to wear personal protective equipment, including hearing protection, to ensure health and safety effects of this level of aircraft noise would remain negligible to minor, short term, and adverse.

Facility Modifications

Necessary modifications to the corral facility would occur in the first year of the plan, likely involving park staff's use of hand and power tools and the handling or lifting of heavy construction materials. These tasks have the potential to result in strains, abrasions and cuts to workers, and potential effects to hearing. Corral modifications would be conducted in accordance with related NPS health and safety guidance (see the "Policies and Regulations" section) and mitigation measures (see above). Effects to worker health and safety under this alternative are expected to be similar to that described under alternative B—negligible to minor, adverse, and short term.

Human Consumption of Elk Meat

Under this alternative, meat testing negative for CWD may be donated to the public in accordance with NPS guidance (Elk and Deer Meat from Areas Affected by Chronic Wasting Disease: A Guide to Donation for Human Consumption, NPS Public Health Program [NPS 2006h] (please refer to discussion under alternative B ["Human Consumption of Elk Meat"] for information related to CWD). Since CWD testing in the park began in 2002, eleven elk and eight deer have tested positive for CWD (NPS 2006i). Chronic wasting disease causes lesions in the brain and consistently results in death (NPS 2006h). Prions causing CWD are believed to accumulate mainly in the brain, eyes, spinal cord, lymph nodes, tonsils, pancreas, and spleen. Therefore, these tissues would not be processed/donated.

There is currently no evidence that CWD is naturally transmitted to humans from elk (Colorado Division of Wildlife [CDOW] 2003; NPS 2006h; SDGFP 2006b). Regardless, any carcass that tests positive for the disease, as well as any clean animals processed in the same batch as one found to be positive for CWD, would be disposed of in a landfill or incinerated (not distributed to the public), minimizing further the public's exposure to the disease.

Recipients of the donated elk meat would sign an informed consent form and would receive information related to the fact that the meat has tested negative for CWD, as well as information on any potential human health risks, as understood by current science. Based on current knowledge of risks related to transmission of CWD to humans, expected effects to human health and safety resulting from donation of CWD-negative meat are believed to be no more than negligible, long term, and adverse. If future research findings warrant it, this assessment may require re-evaluation of the effects to human health and safety from meat donated under this alternative.

Handling of Live Elk

As helicopters bring elk into the vicinity of the wildlife corral, park staff would guide or direct them into the corral facility and would be responsible for moving the animals within the corral and chute system.

The corralling of these large wild animals, which weigh an average 500 pounds (females) and 700 pounds (males), would present safety risks for workers in close proximity to them. Under the live shipping option, park staff would be responsible for any necessary antler removal. Staff would also be responsible for the care of the animals prior to shipping or euthanasia. During this time, appropriate precautions would be taken to reduce the agitation of confined elk, thereby reducing risks to the safety of both humans and animals. Risks involved to human health and safety in the handling of live animals under this alternative include movement of large numbers of elk (corralling, squeeze chutes), the use of hand and/or power tools for antler removal, and the general potential for bodily harm when in close proximity to confined wildlife. These activities have the potential to result in cuts, abrasion, contusions and more serious injuries such as bone fractures. Safety protocols would be established prior to plan implementation to maximize human health and safety (see the “Mitigation” section above). Collectively, these tasks represent minor, long-term, adverse effects to human health and safety.

Euthanasia Activities

Under the live shipping/donation option, calves less than 100 pounds may be euthanized in the corrals and their carcasses placed in backcountry locations by park staff. If the live shipping/donation option is not feasible, park staff would be responsible for euthanizing all corralled elk. This could involve hundreds of animals, depending on the year. Elk would first be rendered unconscious with a captive bolt and then exsanguinated (jugular vein cut), shot or administered a lethal injection (risks to health and safety related to lethal injections are discussed below under “Use of Pharmaceuticals”).

Exsanguination involves the use of knives, which presents risks to workers including cuts, abrasions, contusions, bone fractures and exposure to potentially infectious materials. The shooting of elk involves the use of firearms which includes risk of accidental gunshot and hearing loss. Appropriate and current firearms certifications would be required for all staff and contractors involved in this activity (see the “Mitigation” section above).

There is a possibility that firearms may be used to dispatch animals (e.g., large antlered bulls). To mitigate for the possibility of injury related to accidental discharge, all workers using firearms would be appropriately certified for their use (see Director’s Order 9 above). There also exists the potential for workers’ hearing to be affected by the use of firearms. The EPA has not established clearly defined allowable noise exposure limits for gunfire like those enforced in industrial settings. However, they have estimated that exposure to one impulse noise per day over about 150 dB has the potential to damage hearing over time. Most shotguns, high power rifles, and pistols can produce sound levels that high or higher (National Hearing Conservation Association 2006). Noise levels of firearms can range from approximately 140–170 decibels (dB) at the site of use (Academy of Family Physicians 2000; U.S. Department of Health and Human Services 2003). There is no safe exposure to noise at the levels expected from firearms (table 22), making adequate ear protection a requirement to protect health and safety (NPS 1999).

Effects to human health and safety resulting from euthanasia activities include the possibility for increased frequency and severity of injuries inherent in the tools and equipment used for euthanasia activities (firearms, knives, etc.). Establishing safety protocols prior to plan implementation and compliance with existing NPS worker safety regulations (e.g., Director’s Order 9 and 50B; see the “Policies and Regulations” section above) and other professional guidance (Bates n.d.) (see the “Mitigation” section above) would likely result in long-term, adverse, minor to possibly moderate effects to health and safety. The potential for the more intense adverse effects (moderate) is more likely if all corralled elk are euthanized (no live shipping/donation), increasing the potential for injury vs. the much smaller number of elk (calves) euthanized under the live shipping/donation option. Regardless, with adequate staffing and appropriate training and equipment, the likelihood of these more intense effects is reduced.

Handling of Carcasses

Under this alternative, CWD samples would be obtained from all euthanized elk. It is not believed that CWD is naturally transmissible from animals to humans (SDGFP 2006b); however, protective clothing would be worn by staff or contractors involved in obtaining these samples in order to minimize exposure to other potentially infectious materials such as E. coli and blood parasites (Powers 2006) (see the “Mitigation” section above). Most health risks associated with sampling would be related to handling carcasses (muscle strains), the use of knives and other sharp instruments for obtaining CWD test samples (abrasions or cuts), and exposure to potentially infectious materials.

Park staff would either incinerate (if no partner responsible for shipment, processing and meat distribution obtained) or place carcasses (calves and accidental deaths) in backcountry locations, both of which require the movement and transport of a large number of carcasses from the corral facility. Incineration involves equipment set-up and take-down, continuous fueling (wood) of equipment, appropriate placement of elk carcasses, and/or tending of process (placement of fuel and carcasses) until incineration is complete (see details in the “Alternatives” chapter). While heavy equipment or vehicles (e.g., front-end loader) would be used for most of the heavy lifting for either incineration or landfilling, it is likely that workers would be involved in some moving or manipulation of approximately 500- to 700-pound carcasses to position them for removal. These activities can potentially result in muscle strain, cuts and abrasions. Operation of the incinerator (e.g., fueling) also has the potential to result in burns to workers.

Tasks related to the handling of carcasses (CWD testing and carcass disposal) involve movement of heavy objects and the use of tools and equipment which present risks to health and safety (e.g., power tools or hand tools, knives, large vehicles or front end loaders, incinerator). Collectively, these result in additional risk to workers of muscle strains, cuts or abrasions, exposure to infectious materials, and burns. Establishment of safety protocols (e.g., protective clothing [e.g., gloves, hearing and eye protection], safe techniques for moving heavy objects, etc. [Bates n.d.]) would occur prior to these activities (see “Mitigation” section above). Coupled with compliance with existing NPS worker safety regulations (see the “Policies and Regulations” section above), these activities would result in long-term, adverse, minor effects to health and safety.

Administration of Pharmaceuticals

Under this alternative, elk may be euthanized by lethal injection (sodium pentobarbital or potassium chloride). An NPS vet would administer or supervise administration of the drugs. The use of pharmaceuticals for wild animals within park units is guided by Director’s Order 77-4, which requires that NPS staff “possess adequate knowledge and experience in the use of pharmaceuticals for wildlife to assure human safety…” (NPS 2002, sec. 1). As accidental exposure to some pharmaceuticals is potentially lethal to humans, this guidance document recommends establishing protocols for their safe use prior to using the pharmaceuticals. Compliance with Director’s Order 77-4 and the establishment of health and safety field protocols related to the use of pharmaceuticals would likely result in no greater than minor, long-term, adverse effects to human health and safety related to the use of drugs for euthanasia.

Cumulative Impacts

Cumulative impacts affecting human health and safety under this alternative are similar to those described under the no-action alternative.

Conclusions

This alternative would result in negligible to minor, long-term adverse effects to human health and safety related to the use of aircraft for elk monitoring surveys and roundup activities. Required corral modifications would likely result in negligible to minor, short-term, adverse effects. Based on current knowledge, human consumption of donated elk meat testing negative for CWD would result in negligible, long-term, adverse effects to health and safety. The handling of live animals prior to live shipping (corralling, antler removal, short-term care) would result in minor, long-term, adverse effects. Euthanasia of corralled elk could result in minor to possibly moderate, long-term, adverse effects to human health and safety. Minor, long-term, adverse effects are expected from the handling of carcasses (CWD testing, disposal) and the use of pharmaceuticals for lethal injection. Existing cumulative effects to health and safety include benefits (maintenance of facilities, resource management) and negligible to minor adverse effects (resource management, infrastructure repair or construction, CWD-related work). When compared to the no-action alternative, alternative C would result in an increase in numbers of potential risks as well as increased levels of risk (minor to possibly major adverse effects) to human health and safety.

ALTERNATIVE D—SHARPSHOOTING

Under this alternative, sharpshooting within the park would be used to reduce and maintain the elk herd at target population levels.

Aircraft Use

Contractors and staff would continue to use aircraft for elk and forage surveys. In addition, helicopters would be used to sling-load elk carcasses out of the backcountry. Effects to health and safety from these tasks would be similar to those described under the no-action alternative—negligible to minor, long term and adverse.

Noise from aircraft would also affect workers' health and safety. Helicopters would be used to sling-load dispatched elk from the backcountry to a central site (expected to occur over several months) which would involve hovering over specific areas for short periods of time. Helicopter use would likely involve takeoffs and landings from sites outside the park (where the aircraft contractors house the aircraft). However, it is possible the helicopter would land at some point within park boundaries. Effects to workers from noise generated by the use of helicopters would be similar to those described under alternative C; however, alternative D would involve more hours of helicopter time and impacts are more likely to be minor rather than negligible. They would be short term and adverse. Staff and contractors would be required to wear ear protection to minimize risks.

Euthanasia Activities

Under alternative D, sharpshooters would be used to remove the appropriate number of elk from the park using noise-suppressed firearms and elevating risk of human injury related to accidental gunshot. Appropriate certification would be required for those using firearms for management actions (see the "Mitigation" section above). In addition, the use of firearms in all cases would be in compliance with safety regulations (see the "Policies and Regulations" section above). These activities would likely result in long-term adverse effects ranging from negligible to moderate, with the more intense effects possible in the unlikely event of serious injury.

Handling of Carcasses

Similar to alternative C, under this alternative park staff would obtain CWD samples from all elk carcasses. Carcasses would be sling-loaded out of the backcountry by helicopters and incinerated, which would require the transport of a large number of carcasses from the sling-load drop-off site. The handling of elk carcasses under this alternative is similar to that described under alternative C, resulting in similar effects to human health and safety—minor, adverse, and long term.

Cumulative Impacts

Cumulative impacts affecting human health and safety under this alternative are similar to those described under the no-action alternative.

Conclusions

This alternative would result in negligible to minor, long-term, adverse effects to human health and safety related to the use of aircraft for elk monitoring surveys and sling-loading of carcasses out of the backcountry (similar to that under no action). The handling of carcasses (CWD sample collection, incineration, or landfilling) would result in minor, long-term, adverse effects to health and safety. Negligible to moderate, long-term, adverse effects related to euthanasia activities (use of firearms) are possible. Existing cumulative effects to health and safety include benefits (maintenance of facilities, resource management) and negligible to minor adverse effects (resource management, infrastructure repair or construction, CWD-related work). When compared to the no-action alternative, alternative D would increase the potential risks to human health and safety in the frequency of occurrence of potential risks and in the potential intensity of effects (possibly moderate, adverse) of these risks.

ALTERNATIVE E—CONTRACEPTION (STERILIZATION) (MAINTENANCE ONLY)

This alternative would be implemented solely to maintain elk at target population goals after initial reduction (alternatives B–D) through permanent sterilization of a predetermined number of the park's reproductive female elk population. At this time, sterilization has not been proven through science to effectively manage wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Use of Aircraft

As in other alternatives, fixed wing aircraft and helicopters would be used for elk and forage surveys. In addition, helicopters would be used to roundup elk for sterilization. Effects to health and safety from these tasks would be similar to those described under the no-action alternative—negligible to minor, long term and adverse.

Aircraft noise would also affect workers' health and safety. Small fixed-wing aircraft or helicopters would continue to be used in aerial monitoring of wildlife (typically less than four hours per year). Helicopters would be used to bring elk into the wildlife corrals for treatment (expected to occur over several months) during the month of January. Helicopter use would likely involve takeoffs and landings from sites outside the park (where the aircraft contractors house the aircraft). However, it is possible the helicopter would land at some point within park boundaries. Effects to workers from noise generated by the use of helicopters would be similar to that described under alternative C—negligible to minor, short term, and adverse. Workers would be required to wear ear protection if needed.

Human Consumption of Elk Meat

Antibiotics and anti-inflammatory drugs administered to treated elk after sterilization would have associated withdrawal times during which time human consumption of treated elk meat should be restricted (e.g., 30–45 days) (Powers 2006). An NPS veterinarian, using guidance from the Food and Drug Administration, would determine withdrawal periods and human consumption restrictions. Elk hunting occurs in areas immediately adjacent to the park in the fall of each year. As treatment of elk is planned for mid-winter (after hunting season), it is believed that the use of these drugs would present no risks to human health and safety related to hunters' consumption of treated elk meat.

In the unlikely event that treatment of elk occurs during a period when the animals could be hunted in areas adjacent to the park, the marking of elk would include information on the drug treatment and the related withdrawal date after which human consumption would be considered safe. Markings could include paint, collars or other "do not eat" indicators. In this situation, adverse effects to human health and safety are considered negligible, adverse and short term.

Handling of Live Animals

Elk would be rounded up and corralled in the existing wildlife facility where they would be cared for by staff before and after the procedure. Corralling of these large wild animals (500–700 pounds) would present safety risk for workers in close proximity to them. During these activities, precautions would be taken to reduce the agitation of the corralled elk in order to reduce risk of injury to both staff and animals. Surgical procedures would be conducted by NPS veterinarians with assistance by park staff. It is possible that elk would need to be anesthetized (via injection) prior to sterilization procedures. A single dose of antibiotics and possibly an anti-inflammatory would be administered to treated elk (see the "Use of Pharmaceuticals" section for discussion on related effects). Animals would be permanently marked in a manner immediately identifiable in the field. Treated elk would be held for a 24-hour observation period to ensure their recovery and to attend to those experiencing difficulty.

Collectively, the tasks involved in the handling of live animals under this option would likely result in minor to moderate, long-term, adverse effects to health and safety. These risks are related to the staff and/or contractors' close proximity to confined animals, exposure to surgical instruments and syringes, and the care and observation of corralled animals for a period ranging from approximately 2 to 10 weeks, depending on the surgical procedure (see related discussion on timing in the "Park Operations" section). The intensity of these effects would be related to the number of elk handled or treated in any one year (i.e., the number of elk to which park staff are exposed), with more intense impacts possible as numbers increase.

Handling of Carcasses

Elk mortality rates related to these procedures are unknown but are estimated to be approximately 5%–20%. Those that experience life-threatening effects during the observation period would be euthanized. Elk carcasses would be tested for CWD and transported to a landfill, if positive, or placed in the backcountry if environmentally preferred. Effects resulting from these tasks are related to use of knives and other tools for CWD sampling, and muscle strains and abrasions possible during carcass movement or transport. Minor, long-term, adverse impacts to health and safety are expected.

Administration of Pharmaceuticals

The administration of anesthesia, antibiotics and anti-inflammatory drugs under this alternative would be conducted by an NPS veterinarian in compliance with *Director's Order 77-4: Use of Pharmaceuticals for Wildlife*. This guidance requires that staff involved in pharmaceutical administration be adequately trained to assure human safety. In addition, safety protocols would be established prior to the commencement of these activities (see the "Mitigation" section above). Exposure to syringes and the potential for accidental injection related to the administration of drugs to wildlife would result in negligible to minor, adverse and long-term impacts.

Cumulative Impacts

Cumulative impacts affecting human health and safety under this alternative are similar to those described under the no-action alternative.

Conclusions

This alternative would result in negligible to minor adverse effects to human health and safety related to the use of aircraft for elk monitoring surveys and capture of elk for treatment (roundup, etc.) (similar to that under no action). Negligible, short-term, adverse effects related to the human consumption of elk meat treated with antibiotics or anti-inflammatory drugs are possible. The handling of animals (surgical procedures, care for and observation of, CWD testing, carcass disposal) under this alternative is expected to result in minor to moderate, long-term, adverse effects to health and safety. The use of pharmaceuticals for wildlife would pose negligible to minor, long-term, adverse effects to human health and safety. Existing cumulative effects to health and safety include benefits (maintenance of facilities, resource management) and negligible to minor adverse effects (resource management, infrastructure repair or construction, CWD-related work). When compared to the no-action alternative, alternative E would result in possible additional minor and moderate adverse impacts.

ALTERNATIVE F—FERTILITY CONTROL AGENT (MAINTENANCE ONLY)

Under this alternative, the elk population would be maintained at target goals reached after initial reduction efforts (alternatives B–D) via administration of a fertility control agent. As no such agents are currently available, certain details (e.g., method or timing of treatment) are not known. This analysis is considered general in its scope and is designed to identify issues that may be of primary concern to health and safety. At this time, fertility control agents effective in controlling population growth in large free-ranging wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Use of Aircraft

Impacts to health and safety from conducting annual aerial surveys to monitor elk population numbers and forage conditions would be the same as in other other alternatives, that is, negligible to minor, long term and adverse. In addition, helicopters would be used to roundup elk for administration of fertility control agents. Effects to health and safety from these tasks would be similar to those described under alternative C—negligible to minor, long term and adverse.

Aircraft noise could also affect workers' health and safety, with effects similar or identical to those described for alternative E above—that is, negligible to minor, short term, and adverse.

Human Consumption of Elk Meat

Where appropriate, treated elk would be permanently marked for easy identification by hunters. Permanent marking of animals would include information about withdrawal periods and known risks related to consuming meat of elk treated with fertility control agents. This information would be specific to the particular selected agent. Effects of human consumption of treated elk meat prior to the withdrawal are believed to include, among other things, the possibility of sterility in humans, but are not believed to include death (Powers 2006). Given the fact that the specific pharmaceutical is unknown, it is assumed that long-term, adverse effects to human health and safety could range from negligible to moderate and would be related to detrimental physical effects to humans caused by consuming meat from treated elk prior to the advised withdrawal date.

Handling of Live Animals

Cow elk may be rounded up and treated with the fertility agent in the existing wildlife facility. As handling of these large (500–700 pounds) animals presents safety risks to works, precautions would be taken to reduce the agitation of the corralled elk to ensure the safety of both staff and the animals. Treatment would be administered by NPS staff. Risks to human health and safety are related to the potential exposure to large numbers of confined animals and the actual handling of individual elk for drug administration. Effects to health and safety are expected to be no greater than minor, adverse, and long term.

Administration of Pharmaceuticals

Potential risks to human health and safety include accidental injury from accidental injection with fertility control agents. For example, accidental injection with GonaCon™ can result in temporary sterility in humans (NPS 2006c). Another agent, Leuprolide, can result in side effects (hot flashes, impotence, temporary infertility, atrophic genitalia, potentially fatal cardiac effects, etc.) and may cause fetal harm when pregnant women are exposed to it (Chemical Safety Associates 2000). Compliance with NPS safety procedures (e.g., *Director's Order 77-4: Use of Pharmaceuticals for Wildlife*) and establishment of health and safety protocols prior to plan implementation (see the "Mitigation" section above) would likely result in impacts similar to those under alternative E—minor, long term and adverse.

Cumulative Impacts

Cumulative impacts affecting human health and safety under this alternative are similar to those described under the no-action alternative.

Conclusions

This alternative would result in negligible to minor, long-term, adverse effects to human health and safety related to the use of aircraft for elk monitoring surveys and capture of elk for treatment (roundup) (similar to that under no action). Negligible to moderate, long-term, adverse effects related to the human consumption of elk meat treated with fertility control agents are possible. The handling of live animals (treatment procedures, marking) under this alternative is expected to result in negligible to minor, long-term, adverse effects to health and safety. Minor, long-term, adverse effects could result from the risks involved in the administration of chemicals that are potentially dangerous to humans. Existing cumulative effects to health and safety include benefits (maintenance of facilities, resource management) and negligible to minor adverse effects (resource management, infrastructure repair or construction, CWD-related work). When compared to the no-action alternative, alternative F would result in additional minor adverse risks to health and safety.

SUSTAINABILITY AND LONG-TERM MANAGEMENT

The *National Environmental Policy Act* requires that all environmental impact statements consider long-term impacts and effects of foreclosing on future options (sec. 101[b]). These considerations must address the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity (NEPA sec. 102[c][iv]). As further explained in Director's Order 12, "sustainable development is that which meets the needs of the present without compromising the ability of future generations to meet their needs" (NPS 2001a:58). This relationship is discussed below for each alternative.

ALTERNATIVE A—NO ACTION

Under this alternative, the park would continue managing the park's elk without the benefit of a management plan focused on the appropriate size of the park's elk population supportable by available forage. Elk populations have historically fluctuated over the years and have exceeded the high end of this range numerous times over the past 40 years. When the elk population increases significantly over the target numbers recommended by the Science Team (232–475 animals), as it would likely do in the later years of this alternative, the park's resources would be negatively affected (NPS 2006g). The elk population itself would begin to experience increased competition with other elk and ungulates, and would be forced to occupy lower quality habitat. Calf mortality would increase, recruitment would decrease and the survival of older adults would drop. Accessibility to high quality forage would decrease, with drops in body condition, pregnancy rate and increased energy expended in competition for forage that is available. Vegetation, particularly shrublands, herbaceous riparian vegetation and hardwood trees, would be unable to reproduce and would likely decrease in aerial extent in the park. Wildlife dependent on these habitats would also decrease. In the long-term, the park would become more homogenous, with less diversity in its plant and animal life. Adverse impacts to cultural resources and other park issues (e.g., visitor experiences, park operations, etc.) would also continue to occur throughout the park. The no-action alternative would result in numerous long-term adverse effects to many of the park's resources, most of which outweigh the current benefits realized under this alternative. In the short term, this alternative would provide for the existing use of the land while jeopardizing the enhancement of long-term productivity of park resources, some of which (wildlife) are mentioned in the park's enabling legislation. There would be no impairment of park resources and values as defined by *NPS Management Policies 2006* (NPS 2006d).

ALTERNATIVE B—HUNTING OUTSIDE THE PARK

Under this alternative, elk populations within the park would be reduced over a five-year period through hunting outside the park on adjacent public and private lands. The elk population would be managed to levels considered environmentally sustainable (232–475) based on the amount and condition of forage available and the needs of other priority wildlife species (bison, black-tailed prairie dogs, pronghorn) which use the same habitat (NPS 2006g). Reduced over-grazing and browsing by elk would provide long-term benefits to many of the park's resources, particularly natural resources (vegetation, wildlife, soils).

Negative effects of this alternative are associated primarily with specific initial reduction elk management actions occurring intermittently for several weeks a year throughout the first five years of the plan. Actions proposed under this alternative may also be used on a smaller scale for long-term maintenance, resulting in still fewer negative effects. Sustained adverse effects to park resources are expected for natural resources (vegetation, soils), visitor experience, socioeconomics (hunting) and park operations under this alternative, similar to those expected under alternatives C and D and considerably fewer when compared to the no-action alternative. Compared to the no-action alternative, this alternative would result in improved conditions for the enhancement of long-term productivity of park resources, particularly vegetation and wildlife. Some of these resources (e.g., bison) are mentioned in the park's enabling legislation. In addition, the effective reduction of the elk population to an environmentally sustainable level would result in a more balanced natural ecosystem.

ALTERNATIVE C—ROUNDUP AND LIVE SHIPMENT OR EUTHANASIA

Under this alternative, elk populations would be reduced over a two-year period through roundup/live shipping/donation or euthanasia. As is the case under all initial reduction options (alternatives B–D), the elk population would be managed in a similar manner to that described under alternative B. Benefits and adverse impacts which affect the short-term uses of the environment and the maintenance and enhancement of long-term productivity are similar under this alternative as those described under alternative B.

ALTERNATIVE D—SHARPSHOOTING

Under this alternative, elk populations would be initially reduced over a four to five year period via sharpshooting. As is the case under all action alternatives (B–D), the elk population would be managed in a similar manner to that described under alternative B. Benefits and adverse impacts which affect the short-term uses of the environment and the maintenance and enhancement of long-term productivity are similar under this alternative as those described under alternative B.

ALTERNATIVE E—CONTRACEPTION (STERILIZATION) (MAINTENANCE ONLY)

This alternative would be most effectively used as a maintenance tool for use after initial reduction efforts (alternatives B–D). Elk populations would be maintained over the life of the plan (20 years) through the surgical contraception of the appropriate number of reproductive females. The elk population would be managed in accordance with target population goals described in alternative B. Adverse effects are primarily associated with short-term management actions though sustained negative impacts related to socioeconomics (hunting opportunities) and park operations are possible. Maintenance of the park's elk population at environmentally sustainable levels would contribute to the benefits to park resources realized under the initial reduction phases (alternatives B–D). Some of these resources (e.g., bison) are mentioned in the park's enabling legislation. Compared to the no-action alternative, maintenance actions under this alternative are expected to provide continuing improved conditions for the long-term productivity and enhancement of the park's resources, particularly vegetation and wildlife. At this time, sterilization has not been proven through science to effectively manage wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

ALTERNATIVE F—FERTILITY CONTROL AGENT

(MAINTENANCE ONLY)

This alternative would be most effectively used as a maintenance tool for use after initial reduction efforts (alternatives B–D). Elk populations would be maintained over the life of the plan (20 years) through the use of fertility control agents administered to the appropriate number of reproductive females. The elk population would be managed in accordance with target goals described in alternative B. Benefits and adverse impacts which affect the short-term uses of the environment and the maintenance and enhancement of long-term productivity are similar under this alternative as those described under alternative E with the addition of possible negative effects to human health and safety. At this time, fertility control agents have not been effective in controlling population growth in large free-ranging wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

All environmental impact statements are to summarize any commitments of resources the alternatives would entail. This includes irreversible, or long-term or permanent losses, and irretrievable or short-term commitments. The NPS must also determine if such effects on park resources would mean that, once gone, the resource could not be replaced or restored (NEPA sec. 102[c][v]).

ALTERNATIVE A—NO ACTION

The no-action alternative would result in long-term adverse impacts to the health of the elk population, vegetation communities and wildlife diversity. These would continue as long as the elk population maintains its size at or around food-based carrying capacity in the park. However, should natural conditions such as a series of harsh winters or natural immigration and establishment of a substantial wolf population result in herd reductions, vegetation and wildlife would likely return. Therefore the impacts to natural resources are primarily irretrievable, rather than irreversible. Exceptions to this may include aspen and other hardwoods, and eroded soils. These resources may not re-establish even if the elk herd is reduced in size.

ALTERNATIVE B—HUNTING OUTSIDE THE PARK

As is true under alternatives C and D, this alternative would result in the reduction of the park's elk population to an environmentally sustainable level and would improve conditions for the park's resources, particularly vegetation and wildlife. As is also true under alternatives C and D, it is expected that the condition of shrubland, riparian, meadow, and grassland habitats would be improved, though management actions may cause minor, reversible adverse effects (trampling, disturbance). Hardwoods may still be permanently eliminated in the park by continued elk browsing. In contrast with the no-action alternative, most wildlife species would experience benefits from reduced competition for forage and habitat, though management actions (human activity) may cause minor, reversible adverse effects. Soil loss from erosion, considered irreversible, would be minimized as the park's elk population is reduced. Minor, irreversible effects to archeological resources are possible but unlikely.

ALTERNATIVE C—ROUNDUP AND LIVE SHIPMENT OR EUTHANASIA

As is true under alternatives B and D, this alternative would result in the reduction of the park's elk population to an environmentally sustainable level and would improve conditions for the park's resources, particularly vegetation and wildlife. Irreversible or irretrievable commitment of resources under this alternative are similar to those described under alternative B. In addition, negative effects to soils are possible due to possible CWD contamination at incineration sites.

ALTERNATIVE D—SHARPSHOOTING

As is true under alternatives B and C, this alternative would result in the reduction of the park's elk population to an environmentally sustainable level and would improve conditions for the park's resources, particularly vegetation and wildlife. Irreversible or irretrievable commitment of resources under this alternative are similar to those described under alternative C.

ALTERNATIVE E—CONTRACEPTION (STERILIZATION) (MAINTENANCE ONLY)

This alternative is considered a maintenance tool for use once the park's target population goals for elk have been reached through initial reduction efforts (alternatives B–D). Through the maintenance phase (the last 15 years of the 20 year plan), it is expected that the condition of shrubland, riparian, meadow, and grassland habitats would continue in their improved state, though management actions may cause minor, reversible adverse effects (trampling, disturbance). Hardwoods may still be permanently eliminated in the park by continued elk browsing. At this time, sterilization has not been proven through science to effectively manage wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

ALTERNATIVE F—FERTILITY CONTROL AGENT (MAINTENANCE ONLY)

Like alternative E, this alternative is considered solely as a maintenance tool for use once the park's target population goals for elk have been reached through initial reduction efforts (alternatives B–D). Irreversible or irretrievable commitment of resources under this alternative are similar to those described under alternative C. At this time, fertility control agents have not been effective in controlling population growth in large free-ranging wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

ADVERSE IMPACTS THAT COULD NOT BE AVOIDED

The NPS is required to consider if the alternative actions would result in impacts that could not be fully mitigated or avoided (NEPA sec. 102[c][ii]).

ALTERNATIVE A—NO ACTION

The no-action alternative would result in many unavoidable adverse effects to the park's natural resources resulting from growth of the elk herd. Hardwoods may be permanently lost from the park due to over browsing by elk. Reductions in the range and extent of rare vegetative communities in the park where elk are known to congregate, including riparian, meadow and shrublands, would experience soil compaction and erosion, increased suspended sediment during storm events, and ultimately less ability for vegetation to reproduce as seed sources are consumed. Wildlife dependent on these vegetative communities for food or shelter, including mule deer, white-tailed deer, pronghorn, small mammals and migratory birds would experience decreases in available habitat and permanent displacement. Expenditures of State-run programs designed to address elk-related impacts on private land would continue to affect the socioeconomics of the region.

ALTERNATIVE B—HUNTING OUTSIDE THE PARK

Negative impacts to park resources which could not be mitigated or avoided under this alternative include those to hardwoods and soils. Even at lower numbers of elk, browsing of aspen, oak and cottonwoods may still prevent their regeneration and could result in a decrease and perhaps loss of this species from certain areas of the park. Soils may experience erosion where elk congregate and once lost would not be regenerated for decades or longer. As is true under all action alternatives (B–D), park visitors are expected to experience reduced opportunities for wildlife viewing. Negative effects to the socioeconomics of the region include those related to the possibility reduced visitor use due to negative perception of the plan and long-term reductions in hunting opportunities on adjacent lands once initial target population goals are met. In addition, elk-related property damage to adjacent landowners is expected to result in the continuation of expenditures of State-run programs designed to address such impacts, another unavoidable socioeconomic effect. Park operations are also expected to incur unavoidable negative effects related to implementation of the management plan.

ALTERNATIVE C—ROUNDUP AND LIVE SHIPMENT OR EUTHANASIA

Negative impacts to park resources which could not be mitigated or avoided under this alternative include those to hardwoods and soils. As is true under all action alternatives (B–D), park visitors are expected to experience reduced opportunities for wildlife viewing. Negative effects to the socioeconomics of the region include those related to the possibility of reduced visitor use due to negative perception of the plan and long-term reductions in hunting opportunities on adjacent lands during both initial reduction and maintenance phases. If euthanasia is the preferred option under this alternative, human health and safety and park operations are much more likely to experience unavoidable adverse effects.

ALTERNATIVE D—SHARPSHOOTING

Negative impacts to park resources which could not be mitigated or avoided under this alternative include those to hardwoods and soils. As is true under all action alternatives (B–D), park visitors are expected to experience reduced opportunities for wildlife viewing and, under this alternative, may experience greater unavoidable impacts caused by backcountry closures. Negative effects to the socioeconomics of the region include those related to the possibility of reduced visitor use due to negative perception of the plan and long-term reductions in hunting opportunities on adjacent lands during both initial reduction and maintenance phases. The use of firearms for sharpshooting would create the potential for negative effects to human health and safety.

ALTERNATIVE E—CONTRACEPTION (STERILIZATION) (MAINTENANCE ONLY)

As alternative E would be used during the maintenance phase of the management plan, after initial target population goals are met, its unavoidable adverse effects are not expected to be as intense as those for action alternatives (B–D). These would include impacts to vegetation (potential loss of hardwoods within the park) and wildlife (prairie dog colonies located in close proximity to wildlife corrals used for roundup). Negative effects to the socioeconomics of the region include those related to the possibility of reduced visitor use due to negative perception of the plan and long-term reductions in hunting opportunities on adjacent lands. Park operations and human health and safety would also incur unavoidable effects related to proposed surgical sterilization procedures and exposure to wild confined animals. At this time, sterilization has not been proven through science to effectively manage wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

ALTERNATIVE F—FERTILITY CONTROL AGENT (MAINTENANCE ONLY)

As is the case under alternative E, alternative F would be used only during the maintenance phase of the management plan, after initial reduction goals are met. Adverse, unavoidable effects, expected to be less intense than those under action alternative (B–D), are similar to those described under alternative E. However, depending on the specific fertility control agent chosen for use, backcountry closures could result in greater impacts. In addition, negative effects to human health and safety which cannot be mitigated completely include the potential for accidental injection of pharmaceuticals during treatment of elk, as well as the possibility of human consumption of elk treated with fertility control agents prior to the withdrawal date (by hunters, etc.). At this time, fertility control agents have not been effective in controlling population growth in large free-ranging wildlife populations. The park will not use this alternative for population maintenance unless future scientific studies prove sterilization methods to be effective and efficient means of elk population control and the preferred and adaptive management efforts fail to maintain elk population within the target range.

Consultation and Coordination

CHAPTER 5: CONSULTATION AND COORDINATION

Public consultation for this plan/EIS included scoping and workshops for comments on the draft document. In addition, the National Park Service (NPS) conducted extensive internal scoping among NPS staff and other land and wildlife management agencies. Public scoping, held after initial internal scoping, was designed to encourage early involvement of the interested and affected public in the environmental analysis process. Internal and public scoping were essential early components of the NEPA planning process for the Elk Management Plan whereas a 60-day period for commenting on the draft document and workshops to collect input and answer questions on the draft plan/EIS provided an opportunity for in-depth public review.

INTERNAL SCOPING

As defined in a Memorandum of Understanding (MOU), the NPS and the SDGFP are cooperating agencies for the preparation of the Wind Cave National Park elk management plan (NPS and SDGFP 2003). This same document identifies the NPS as the lead agency, responsible for all aspects of developing the plan/EIS, including selection of a preferred alternative for public review, and documenting the selection of an alternative to implement by preparing a record of decision. Under this MOU, the NPS has sole approval authority and responsibility for proposed actions within Wind Cave National Park. As a cooperating agency, the SDGFP is responsible for effective coordination of planning efforts and for sharing expertise on regional wildlife management issues (hunting/trapping, CWD, threatened and endangered species, general ecological information and socioeconomic concerns) (NPS and SDGFP 2003).

Internal scoping efforts conducted in the summer of 2004 included staff members from the park, the NPS Biological Resource Management Division, the NPS Midwest Regional Office, the NPS Environmental Quality Division, the SDGFP, Custer State Park, the USFS (Black Hills National Forest), the USGS (Biological Resources Division) and contractors. This group worked to define the purpose, need and objectives of the elk management plan, as well as to identify preliminary action alternatives, mitigation measures, and associated issues and impact topics to present to the public for comment. Other issues addressed included the history of elk management in the park, the goals of public participation, and a preliminary list of potentially interested and affected parties (NPS 2005b).

In 2006 (February 27 through March 2), an alternatives development workshop was held. All previously involved groups (listed above) were invited. In addition to NPS staff and contractors, representatives from the SDGFP and the USFS were present. This meeting resulted in the development of alternatives for analysis in the draft plan/EIS, taking into consideration public comments received in August of 2005 (see below).

PUBLIC INVOLVEMENT EFFORTS IN THE PLANNING PROCESS

PUBLIC SCOPING

The NPS intent in the public involvement process is to provide opportunities for the interested and affected public to be involved in meaningful ways, to listen to their concerns and values, and to consider these in shaping decisions and policies. Public scoping is a key part of the public involvement process, and one which is vital to NPS analysis of the issues surrounding elk management at Wind Cave National Park.

The public scoping process began with the publication of a Notice of Intent on December 17, 2004 in the Federal Register (Federal Register, Volume 69, Number 242). In August of 2005, five public scoping meetings were held across South Dakota in Sioux Falls, Pierre, Rapid City, Hot Springs, and Custer. Presentations by NPS staff related to elk management and the NEPA planning process were made twice at each meeting. These presentations were designed to provide the public with background information on the planning process, as well as to encourage comments and questions related to elk management strategies within Wind Cave National Park. In addition, posters related to elk management issues were displayed. Posters included information on the history of elk management within the park, management issues that need to be addressed, the purpose and need for and objectives of an elk management plan, information on CWD, methods of elk management which have been used in other parks, and information on how to become involved in the planning process. Park and contracting staff were available to answer questions, facilitate discussion and record public comments and suggestions.

Prior to the scoping meetings, 314 brochures were mailed to potentially interested parties including federal, state and local agencies, tribes, conservation groups and private individuals. Brochures were also available at the public meetings. Brochure information included a short overview of the history of elk management in the park, the purpose and need for action, planning objectives, and environmental issues. It also extended an invitation to the public to attend the upcoming public scoping meetings and explained the park's desire to provide information and solicit the public's suggestions and comments related to elk management issues. It also provided information on the variety of ways in which the public could comment on the planning efforts.

A total of 42 members of the public attended the public meetings. These included unaffiliated individuals as well as representatives from recreation, preservation and media groups, the USFS, and the Office of U.S. Representative Herseth Sandlin (South Dakota). Most public participants provided their comments verbally at the meetings (recorded on flipcharts). In addition, several members of the public provided comments through email, fax or letter; or directly through the NPS PEPC (Planning, Environment and Public Comment System) website. In total, 49 commenters provided input to the park on the proposed elk management planning efforts.

The majority of comments focused on

- the need to explore a variety of control management options, including lethal options;
- support for/opposition to hunting inside the park;
- manipulation of the park's boundary fence (gates, raising fence, etc.) to allow or deny elk access to the park during certain times of the year;
- concerns related to the "wasting of resources" (CWD-negative elk carcasses, hides, etc.);
- agricultural losses caused by overgrazing elk on lands adjacent to the park; and
- support for/opposition to reintroduction of wolves to the park.

The concern for the "wasting of resources" mentioned above was an issue raised by numerous commenters during public scoping. It was of particular concern that the meat of elk killed be used (e.g., donating to charities). The overriding theme was that it is not acceptable to "waste" the resource.

The remaining comments included, among other things, issues related to the use of reproductive controls to manage the park's elk population, testing for and tracking of CWD prevalence, effects of management actions on park operations and visitor experience, the condition of the park's ecosystem related to wildlife management, and the humane treatment of elk.

Public input was used by park staff, the SDGFP, and contractors to develop the final range of alternatives to be considered for analysis in this plan/EIS.

PUBLIC REVIEW OF THE DRAFT PLAN/EIS

A notice of availability of the draft EIS was published in the Federal Register on June 20, 2008, which is the same day the 60-day public review of the draft began. Public meetings to receive comments and answer questions on the draft took place during the week of July 21–24, 2008. Four meetings, in Sioux Falls, Pierre, Hot Springs, and Custer were conducted, with several park specialists and EIS contractors on hand to address concerns. A short presentation summarizing elk management at the park preceded the public comment input process. Participants who wished their comments to be on record were encouraged to provide them in writing on comment sheets provided at the workshop, or to verbally dictate them to a recorder at each of the public input sessions. Posters summarizing findings were stationed in the room. The Wind Cave National Park Superintendent, Chief of Resource Management, biologist and biological technicians answered the public participants' questions. Seven people attended the Sioux Falls meeting, there were no attendees at the Pierre meeting, five people attended the Hot Springs meeting and twelve attended the Custer meeting.

In addition, electronic comments could be submitted to the park's website or to the NPS Planning, Environment and Public Comment (PEPC) website or be submitted by mail or fax. The public review period for the draft plan/EIS closed August 18, 2008. The park received 33 pieces of correspondence which contained 167 comments on various topics. Of these, 24 were from individuals, one was from a conservation/preservation group, two from other organizations, two from tribal entities, two from state entities, and two from federal government entities. Comments were divided into "substantive" and "non-substantive" groups as prescribed by the Council on Environmental Quality NEPA regulations. According to CEQ, substantive comments raise an issue regarding law or regulation, agency procedure or performance, compliance with stated objectives, validity of impact analyses, or other matters of practical or procedural importance. Non-substantive comments offer opinions or provide information not directly related to the issues or impact analysis. Non-substantive comments were acknowledged and considered by the NPS, but did not require responses. Substantive comments were grouped into issues and "concern statements" prepared for responses. Members of the park team responded to the concern statements and these responses are addressed in "Appendix N: Comment Response Report."

Each person or entity that received the draft plan/EIS will receive a paper copy of this final plan/EIS. The electronic version of the final document will also be posted on the NPS PEPC website (http://parkplanning.nps.gov). Following the publication of a notice of availability of this final EIS in the Federal Register, a 30-day waiting period will begin before the Record of Decision documenting the reasoning and choosing of a final selected alternative is signed and implementation of that alternative can begin. At this time, it is anticipated that the selected alternative will be alternative B, the same as the preferred and environmentally preferable alternative identified in the draft plan/EIS.

AGENCY CONSULTATION

U.S. FISH AND WILDLIFE SERVICE

A list of threatened and endangered species in Custer County was obtained by accessing the USFWS website for South Dakota Field Office on May 18, 2006. In addition, the park completed informal consultation with the USFWS indicating the preferred alternative would have "no effect" or at the most would not be “likely to adversely affect” black-footed ferrets. The letter sent by the park to USFWS is part of appendix G of this plan/EIS.

The reintroduction of sterilized wolves to accomplish elk population goals was discussed in detail and ultimately dismissed as an alternative (see the “Alternatives” chapter). Management of the gray wolf, listed as “endangered” under the Endangered Species Act, is the purview of the U.S. Fish and Wildlife Service. Informal discussions occurred between the park and the USFWS regarding the reintroduction of sterilized gray wolves as an elk management tool. The USFWS determined that this would be considered a “take” under the Endangered Species Act (Larson 2006a) and would require a permit. Ultimately, the USFWS indicated that the agency would not support this option and would not have the resources to expend on the establishment of a population of wolves that would not contribute to the recovery goals of the species, would not contribute to the breeding population, and whose focus for reintroduction would be maintenance of elk populations (Larson 2006b; appendix G).

In addition, it is possible that the gray wolf would be de-listed by the USFWS in the future, at which time management of the species would revert to the State of South Dakota for lands outside Wind Cave National Park. The SDGFP, a cooperating agency in this elk management plan/EIS, voiced strong opposition to the reintroduction of predators as an elk management tool (SDGFP 2006a; appendix H).

STATE HISTORIC PRESERVATION OFFICER

As part of the consultation process, a letter was sent to inform the SHPO of the park’s plans to prepare an Elk Management Plan and EIS. The letter requested the department’s participation (appendix K). The plan/EIS was sent to the SHPO for review and comment, and the agency’s response agreeing that no adverse effects to cultural resources would occur if the elk management plan were implemented is included in this final plan/EIS (appendix K).

SOUTH DAKOTA STATE VETERINARIAN

As part of the consultation process, a letter was sent to inform the State Veterinarian of the park’s plans to prepare an elk management plan and EIS. The letter requested the department’s participation (appendix L).

AMERICAN INDIANS

A number of tribes and tribal organization may have an interest in the park’s elk management efforts. As part of the consultation process, a letter was sent to inform the American Indians of the park’s plans to prepare an elk management plan and EIS. The letter requested their participation (appendix M). As part of the government-to-government consultation process, copies of the draft plan/EIS were sent to the tribes for their review and comment. These tribes and tribal organizations included the following:

- Crow Creek Sioux Tribal Council
- Ponca Tribe of Oklahoma
- Apache Tribe of Oklahoma
- Rosebud Sioux Tribal Council
- Cheyenne River Sioux Tribe
- Three Affiliated Tribes Business Council
- Arapaho Business Committee

- Lower Brule Sioux Tribal Council
- Fort Peck Tribal Executive Board
- Standing Rock Sioux Tribal Council
- Ponca Tribe of Nebraska
- Northern Cheyenne Tribal Council
- Cheyenne-Arapaho Tribes of Oklahoma
- Santee Sioux Tribal Council
- Oglala Sioux Tribal Council
- Flandreau Santee Sioux Executive Committee
- Kiowa Tribe of Oklahoma
- Lower Sioux Indian Community
- Fort Belknap Community Council
- Yankton Sioux Tribal Bus. & Claims Comm.
- Sisseton-Wahpeton Sioux Tribal Council

PREPARERS AND CONTRIBUTORS

Tables 24–26 provide information on authors of and contributors to this document including Planning Team Participants, Science Team Members, and EIS Preparers.

TABLE 24. PLANNING TEAM PARTICIPANTS

Name	Title
National Park Service	
Vidal Davila	Superintendent, Wind Cave National Park
Linda Stoll	Superintendent, Wind Cave National Park (Retired)
Dan Foster	Chief of Resource Management, Wind Cave National Park
Dan Roddy	Biologist, Wind Cave National Park
Barbara Muenchau	Biological Science Technician, Wind Cave National Park
Tom Farrell	Chief of Interpretation, Wind Cave National Park
Duane Weber	Biological Science Technician, Wind Cave National Park
Marie Curtin	Biological Science Technician, Wind Cave National Park
Bill Koncerak	Resource Management Specialist (GIS), Wind Cave National Park
Jim Dahlberg	Maintenance Foreman, Wind Cave National Park

Name	Title
Rick Mossman	Chief Ranger, Wind Cave National Park
Steve Schrempp	Facility Manager, Wind Cave National Park
Jenny Powers	Wildlife Veterinarian, Biological Resources Management Division
Rod O'Sullivan	Environmental Protection Specialist, Biological Resources Management Division
Melissa Stedeford	Environmental Quality Division
Michael Mayer	Environmental Quality Division
Dan Licht	Wildlife Biologist, Midwest Regional Office
South Dakota Department of Game, Fish and Parks	
Mike Kintigh	Regional Supervisor, Region 1
George Vandel	Assistant Director / Technical Services
Ted Benzon	Senior Wildlife Biologist
Steve Griffin	Wildlife Biologist
John Kanta	Wildlife Biologist
Custer State Park (SDGFP)	
Ron Walker	Resource Program Manager (Retired)
Gary Brundige	Resource Program Manager
U.S. Forest Service	
Randy Griebel	Biologist
Cara Staab	Biologist
Total Quality NEPA	
Heidi West	NEPA Analyst
Kathie Joyner	NEPA Analyst
URS	
Nancy VanDyke	Facilitator
Beth Kunkel	Wildlife Biologist
Haydenwing Associates	
Larry Haydenwing	Biologist
Travis Olsen	Biologist

TABLE 25. SCIENCE TEAM MEMBERS

Name	Title	Organization / Location
Mr. Dan Foster	Chief of Resource Management	NPS — Wind Cave National Park
Mr. Dan Licht	Acting Inventory & Monitoring Coordinator	NPS — Midwest Regional Office
Dr. Jenny Powers	Wildlife Veterinarian	NPS — Biological Resources Management Division
Mr. Dan Roddy	Biologist	NPS — Wind Cave National Park
Mr. Kerry Burns	Wildlife Biologist	USFS — Black Hills National Forest
Dr. Dan Uresk	Research Biologist	USFS — Rocky Mountain Research Station
Ms. Beth Kunkel	Wildlife Biologist - Team Facilitator/Report Preparation	URS Corporation
Mr. Rusty Schmidt	Biologist	URS Corporation
Dr. Gary Brundige	Resource Program Manager	SDGFP
Mr. Steve Griffin	Wildlife Biologist	SDGFP
Mr. Mike Kintigh	Regional Supervisor	SDGFP
Dr. Josh Millspaugh	Professor of Quantitative Ecology	University of Missouri
Dr. Glen Sargeant	Research Wildlife Biologist and Statistician	USGS — Northern Prairie Wildlife Research Center

TABLE 26. DOCUMENT PREPARERS

Name	Role	Education	Experience
Heidi West Total Quality NEPA	NEPA Analyst Responsible for EIS team facilitation; air quality, water quality/soils impact, wildlife (elk) analyses; and document review.	Ph.D. Environmental Science and Engineering M.A. Science Communication M.S. Biology B.S. Biology	22 years in environmental planning (13 years involved with NPS NEPA)
Kathie Joyner Total Quality NEPA	NEPA Analyst Responsible for visitor experience, cultural resources, park operations, and human health and safety; document coordination.	M.A. Anthropology/ Archeology B.A. Education	26 years in environmental planning (state and federal environmental policy acts) and environmental resource compliance requirements.
Harvey Nyberg Total Quality NEPA	Responsible for wildlife and vegetation impact analysis	M.S. Fisheries and Wildlife Management B.S. Fisheries and Wildlife Management	26 years with Montana Fish, Wildlife & Parks (biologist)
Steve Sweeney Total Quality NEPA	Responsible for CWD impact analysis	B.S. Zoology M.S. Wildlife Biology / Forest Sciences D.V.M.	25 years as a field ecologist, university instructor, and wildlife veterinarian.
Peter Jones Total Quality NEPA	Responsible for document editing.	B.A. Anthropology M.A. Human Science Ph.D. Psychology 2007	5 plus years in environmental planning and environmental and cultural resource compliance requirements.
Tom Carr Total Quality NEPA	Responsible for socioeconomic impact analysis.	B.A. Economics Ph.D. Economics J.D.	25 years as an economics and legal analyst and professor.