

**Environmental Assessment for
the Establishment of Elk (*Cervus elaphus*) in
Great Smoky Mountains National Park**



Environmental Assessment Executive Summary

Elk Status and Management in Great Smoky Mountains National Park

SUMMARY

Elk were extirpated from the southern Appalachians in the early 1800's pre-dating Great Smoky Mountains National Park (GRSM, Park) establishment in 1934. In 1991, Park management took steps to initiate a habitat feasibility study to determine whether elk could survive in GRSM. The feasibility study concluded that there seemed to be adequate resources required by elk in and around GRSM, but many questions remained and could be answered only by reintroducing a small population of elk in the southern Appalachians and studying the results.

An experimental release of elk was initiated in 2001 to assess the feasibility of population reestablishment in GRSM. Research efforts from 2001 to 2008 demonstrated that the current elk population had limited impact on the vegetation in GRSM, the demographic data collected supported that the population was currently sustainable, and human-elk conflicts were minimal. Estimated long-term growth rates and simulations maintained a positive growth rate in 100% of trials and produced an average annual growth rate of 1.070. This outcome indicates a sustainable elk population has been established in the Park, and has resulted in the need to develop long-term management plans for this population.

Four alternatives are proposed: a No Action Alternative where the current elk management would continue based on short-term research objectives of the experimental release; an Adaptive Management Alternative where elk (the Preferred and Environmentally Preferred Alternative) are managed as a permanent resource in GRSM; an alternative with extremely limited management of elk; and an alternative implementing complete elk removal.

Individual impact topics, identified by interdisciplinary teams, were analyzed in this environmental assessment to determine the potential effects that would occur as a result of implementation of the alternatives presented in this environmental assessment and elk management plan. Alternatives were evaluated for natural resource concerns, cultural resource concerns and impacts on the community and Park operations.

ALTERNATIVES

Four alternatives are proposed: a No Action Alternative where the current elk management would continue based on short-term research objectives of the experimental release; an Adaptive Management Alternative where elk (the Preferred and Environmentally Preferred Alternative) are managed as a permanent resource in GRSM; an alternative with extremely limited management of elk; and an alternative implementing complete elk removal. Under the Adaptive Management Alternative, resource management staff in cooperation with visitor Protection staff would monitor and assess the long-term status and impacts of elk in GRSM. Adaptive management would be used to assess whether an adjustment to management regimes needs to be made, for example, if the population appears to be at substantial risk, excessively expands, or disease is detected.

Two alternatives were considered but dismissed. The complete elk removal alternative and the limited management alternative were not consistent with the Park's mission to restore native species, when feasible. Based on the scientific studies conducted, the preferred alternative would best protect the integrity of the Park ecosystem, while continuing to support the restoration of a native species to its extirpated range and balancing the long-term operational demands of the Park.

Mitigation efforts to prevent or minimize potential negative effects of long-term management of the GRSM elk herd include continued monitoring of a subset of elk, cooperatively working with state and federal partners, and the flexibility of utilizing adaptive management based on changing information and Park goals. Impacts of the alternatives were assessed and are presented in chapter 4.0 of the environmental assessment and elk management plan.

PUBLIC COMMENT

If you wish to comment on the environmental assessment, you may mail comments to the name and address below. This environmental assessment will be on public review for 30 days. The EA has been posted and is available for public review on the NPS' Planning, Environment, and Public Comment web site at <http://parkplanning.nps.gov>. To access the project site select Great Smoky Mountains National Park and click on the "*Project Title*" link. The public can provide comments directly on the project site by clicking on "Comment on document" from the menu on the left. Our practice is to make comments, including names, home addresses, home phone numbers, and email addresses of respondents, available for public review. Individual respondents may request that we withhold their names and/or home addresses, etc., but if you wish us to consider withholding this information you must state this prominently at the beginning of your comments. In addition, you must present a rationale for withholding this information. This rationale must demonstrate that disclosure would constitute a clearly unwarranted invasion of privacy. Unsupported assertions will not meet this burden. In the absence of exceptional, documentable circumstances, this information will be released. We will always make submissions from organizations or businesses, and from individuals

identifying themselves as representatives of or officials of organizations or businesses, available for public inspection in their entirety.

COMMENTS MUST BE RECEIVED BY September 27, 2010. Please address written comments to:

Superintendent
Great Smoky Mountains National Park
107 Park Headquarters Rd
Gatlinburg, Tennessee 37738

TABLE OF CONTENTS

Executive Summary	1
CHAPTER 1.0	9
<i>PURPOSE OF AND NEED FOR ACTION</i>	<i>9</i>
PURPOSE OF THE ENVIRONMENTAL ASSESSMENT/	9
ELK MANAGEMENT PLAN	9
NEED FOR ACTION	9
OBJECTIVES	10
<i>BACKGROUND</i>	<i>10</i>
ELK ECOLOGY AND RESEARCH PROJECT BACKGROUND	10
ELK RESEARCH FINDINGS	13
Elk Acquisition	13
Home Ranges and Movements	14
Survival	14
Reproduction	14
Mortality	15
Habitat Use	15
Food Habits	15
Vegetation Methods and Impacts	16
Elk-Human Conflict	17
Population Viability	17
Summary of University of Tennessee Research Findings and Recommendations	18
<i>SCOPING PROCESS AND PUBLIC PARTICIPATION</i>	<i>19</i>
<i>GENERAL ISSUES AND IMPACT TOPICS</i>	<i>19</i>
Cultural Resources	20
Natural Resources-Vegetation and Fish and Wildlife Resources (including Endangered and Threatened Plant and Animal Species)	20
Socioeconomic Conditions	20
Visitor Use and Experience	20
Park Management and Operations	21
Visitor and Employee Safety	21
<i>OTHER TOPICS CONSIDERED BUT NOT FURTHER ANALYZED</i>	<i>21</i>
Adjacent Land Users	21
Diseases and Disease Agents	21
Environmental Justice	22
Indian Trust Resources	22
Natural Lightscapes	23
Natural Resources	23
Natural Soundscapes	24
Non-Federal Lands within GRSM	25
Public Safety/Transportation	25
Prime or Unique Farmland	25
CHAPTER 2.0	27
<i>INTRODUCTION AND OVERVIEW OF ALTERNATIVES</i>	<i>27</i>
<i>ALTERNATIVE DEVELOPMENT</i>	<i>27</i>
<i>THE NO ACTION ALTERNATIVE</i>	<i>27</i>

<i>ADAPTIVE MANAGEMENT ALTERNATIVE</i>	28
GRSM Elk Population Management Goal	29
GRSM Vegetation and Elk Habitat Management Goal	31
GRSM Recreational Management Goal	33
<i>ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION</i>	33
<i>IDENTIFICATION OF THE PREFERRED ALTERNATIVE</i>	34
<i>ENVIRONMENTALLY PREFERRED ALTERNATIVE</i>	34
CHAPTER 3.0	37
<i>AFFECTED ENVIRONMENT</i>	37
Natural Resources	37
Vegetation (including Threatened and Endangered Species).....	37
Fish and Wildlife Resources (including Threatened and Endangered)	42
Cultural Resources	45
Archeological Resources	45
Historic Structures	45
Cultural Landscapes.....	45
Other Cultural Resources	46
Park Management and Operations	46
Resource Management and Science Staff -	46
Visitor and Resource Protection Staff -	46
Resource Education Staff -	46
Elk Bugle Corps Volunteer Group -	47
Facility Management Staff-	47
Socioeconomic Conditions	47
Landowner Property Damage -	48
Visitor and Employee Safety.....	49
Visitor Use and Experience	50
CHAPTER 4.0	52
<i>ENVIRONMENTAL CONSEQUENCES</i>	52
DEFINITIONS.....	52
<i>NO ACTION ALTERNATIVE</i>	55
NATURAL RESOURCES	55
Vegetation (included sensitive and rare/threatened and endangered).....	56
Wildlife (including Threatened and Endangered Species).....	57
NATURAL RESOURCE IMPAIRMENT:	58
CULTURAL RESOURCES	59
CULTURAL RESOURCES IMPAIRMENT:	59
SOCIOECONOMIC IMPACTS	60
PARK MANAGEMENT AND OPERATIONS IMPACTS	61
VISITOR AND EMPLOYEE SAFETY IMPACTS.....	61
VISITOR USE AND EXPERIENCE IMPACTS	62
<i>ADAPTIVE MANAGEMENT ALTERNATIVE</i>	62
<i>(Environmentally Preferred and Preferred Alternative)</i>	62
NATURAL RESOURCES	62
Vegetation (included sensitive and rare/threatened and endangered).....	62
Wildlife (including Threatened and Endangered Species).....	Error! Bookmark not defined.
NATURAL RESOURCES IMPAIRMENT	66
CULTURAL RESOURCES	66
CULTURAL RESOURCES IMPAIRMENT:	67

SOCIOECONOMIC IMPACTS	68
PARK MANAGEMENT AND OPERATIONS IMPACTS	69
VISITOR AND EMPLOYEE SAFETY IMPACTS	70
VISITOR USE AND EXPERIENCE IMPACTS	70
CHAPTER 5.....	73
<i>CONSULTATION AND COORDINATION.....</i>	73
THE SCOPING PROCESS.....	73
INTERNAL SCOPING.....	73
SPECIFIC AGENCY CONSULTATION.....	74
Blue Ridge Parkway (National Park Service)-	74
Eastern Band of the Cherokee Indians (EBCI)-	74
Tennessee Department of Natural Resources-	74
U. S. Fish and Wildlife Service-	74
U. S. Forest Service-	75
RELATIONSHIP TO OTHER PLANNING EFFORTS	76
Cataloochee Development Concept Plan	76
GRSM Fire Management Plan	76
North Carolina Chronic Wasting Disease Response Plan.....	76
Tennessee Chronic Wasting Disease Response Plan.....	76
CHAPTER 6.....	78
<i>COMPLIANCE WITH APPLICABLE LAWS AND REGULATIONS</i>	78
NORTH CAROLINA ELK STATUS	78
NPS ORGANIC ACT	78
NPS MANAGEMENT POLICIES 2006.....	79
DIRECTOR'S ORDER #12: CONSERVATION PLANNING,	80
ENVIRONMENTAL IMPACT ANALYSIS AND DECISION-MAKING	80
NATURAL RESOURCE REFERENCE MANUAL 77	80
NATIONAL ENVIRONMENTAL POLICY ACT OF 1969, AS AMENDED	80
CODE OF FEDERAL REGULATIONS, TITLE 43	80
CODE OF FEDERAL REGULATIONS, TITLE 36	81
ENDANGERED SPECIES ACT of 1973	81
WILDERNESS ACT	81
CLEAN WATER ACT	82
EXECUTIVE ORDER 11988 (FLOODPLAIN MANAGEMENT) and	82
EXECUTIVE ORDER 11990 (PROTECTION OF WETLANDS)	82
SECTION 106 of.....	82
THE NATIONAL HISTORIC PRESERVATION ACT OF 1966, as amended	82
ARCHEOLOGICAL RESOURCES PROTECTION ACT of 1979.....	82
COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION and LIABILITY ACT	83
CLEAN AIR ACT	83
TOXIC SUBSTANCES CONTROL ACT	83
RESOURCE CONSERVATION and RECOVERY ACT	83
AMERICANS WITH DISABILITIES ACT of 1990	83
CHAPTER 7.....	85
<i>LIST OF PREPARERS.....</i>	85
CHAPTER 8.....	87
<i>LITERATURE CITED.....</i>	87
APPENDIX A.....	93

<i>GRSM ELK MANAGEMENT PLAN 2010-2025</i>	94
PURPOSE AND GOALS OF THE PLAN	94
SPECIES ASSESSMENT	95
Natural History.....	95
GRSM Population Status.....	95
GENERAL GOALS AND ASSOCIATED CONCERNS.....	96
MONITORING AND OPPORTUNISTIC RESEARCH	98
GRSM ELK POPULATION MANAGEMENT GOAL	99
GRSM VEGETATION AND ELK HABITAT MANAGEMENT GOAL.....	102
GRSM RECREATIONAL/EDUCATIONAL MANAGEMENT GOAL	107
COST CONSIDERATIONS	107
ADAPTIVE MANAGEMENT STRATEGY.....	108
APPENDIX B and C (Separate Attachments)	111

Purpose of and Need for Action

CHAPTER 1.0

PURPOSE OF AND NEED FOR ACTION

PURPOSE OF THE ENVIRONMENTAL ASSESSMENT/ ELK MANAGEMENT PLAN

This “Purpose of and Need for Action” chapter describes what this plan intends to accomplish and explains why the National Park Service (NPS) is taking action at this time. This Environmental Assessment and elk management plan is needed to guide the management, monitoring, and future research of elk, *Cervus elaphus*, at Great Smoky Mountains National Park (GRSM, Park). The purpose of this action is to develop an elk management plan that supports the long-term conservation of this native species and the natural and cultural landscapes in Great Smoky Mountains National Park now that the experimental (research) phase has ended. The Environmental Assessment presents alternatives for managing elk and retains and assesses the impacts of two alternatives. The EA assesses the impacts that could result from permanence of the elk herd via the implementation of the No Action and the Adaptive Management Alternative. Input received through this public process will be used to refine the elk management plan. Therefore, the Adaptive Management Alternative is extensively discussed in the attached draft elk management plan (Appendix A) to serve as the basis for comment. Brief summaries of purpose, need, background, and issues and impact topics are presented here.

NEED FOR ACTION

Extremely rare at the turn of the 19th century, elk populations were extirpated by overharvesting and habitat loss from the southern Appalachians by the mid-1800’s (Murie 1951, O’Gara and Dundas 2002, and Gerhart 2005). Management Policies (NPS 2006) state that the NPS will strive to restore extirpated native plant and animal species to parks assuming appropriate criteria associated with species characteristics, causation of loss, and park management are met. An extensive analysis of these criteria was completed as part of the initial Environmental Assessment completed in June 2000; all criteria were met or satisfied. An experimental release was conducted from 2001 to 2008 to determine whether elk could again prosper in this region. Action is needed at this time to address the fate and future management of that experimental population in the long term and to ensure that the presence of elk supports native vegetation, wildlife, and the cultural landscape. Any such plan must be consistent with the laws, policies, and regulations that guide the National Park Service and must also communicate the plan to adjacent community, state, and federal partners in the long-term management of the species.

OBJECTIVES

Objectives are specific statements of purpose that describe what should be accomplished, to a large degree, for elk management to be considered a success. Development of the objectives was done with legal and regulatory mandates in mind and with an awareness of the complexity of relationships between the numerous species, ecosystems, and ecological processes that future management actions would affect. The objectives for managing the elk population were grounded in the Great Smoky Mountains National Park's enabling legislation, purpose, significance, and mission goals and they are compatible with direction and guidance provided by the Park's Statement of Significance and General Management Plan (USDOI NPS 1982) and Management Policies (NPS 2006). All alternatives selected for detailed analysis must meet the intent of the objectives, and they must resolve the purpose of and need for action. The objectives for the Great Smoky Mountains National Park elk management plan are to

1. Maintain the elk population at a level that does not exceed what would be expected under natural conditions to the extent possible.

This "natural condition" would require the following management goals:

- i. Maintain a sustainable, healthy, free-roaming elk population.
- ii. Maintain the elk population at a size that does not have substantive negative impacts to Park vegetation.

2. Recognize the natural, social, cultural, and economic significance of the elk population.

The public identified a need to address restoration of elk to enhance biodiversity within the GRSM ecosystem. Within this context, the issue of elk restoration must be managed at the species population level so as to be beneficial or non-detrimental to all species (plant and animal), or cultural resources. Furthermore, the Park recognizes the need to continue working with the surrounding community to facilitate an understanding of elk biology and the complexity of returning this large herbivore to the landscape in and around GRSM.

BACKGROUND

ELK ECOLOGY AND RESEARCH PROJECT BACKGROUND

Prior to European settlement, approximately 10 million elk (*Cervus elaphus*) inhabited North America (Seton 1927). Though once plentiful in the Carolinas (Brickell 1737, Van Doren 1955), Eastern elk (*C. e. canadensis*) numbers began to decline in the 1700s because of large-scale habitat loss, unregulated hunting, and competition with domestic livestock (Christensen 1998, O'Gara and Dundas 2002). Although a few scattered animals were documented in the Black Mountains in North Carolina (Cope 1870), in the

bottomlands of west Tennessee (Rhoads 1897), and in the Allegheny Mountains of Virginia (Gerhart 2005), the Eastern elk was essentially extirpated by the mid-1800s.

The mission of the National Park Service at Great Smoky Mountains National Park is grounded in the Park's legislative mandate found in the Act of Congress dated May 22, 1926, which states that Great Smoky Mountains National Park is "for the benefit and enjoyment of the people." Based on that mandate, Great Smoky Mountains National Park was officially established in 1934 to preserve the diverse resources within and to provide for public benefit from and enjoyment of those resources in ways which will leave them the most unaltered by human influences. As shown in the figure below, the Park is located within the Southern Appalachian Mountains in Tennessee and North Carolina.

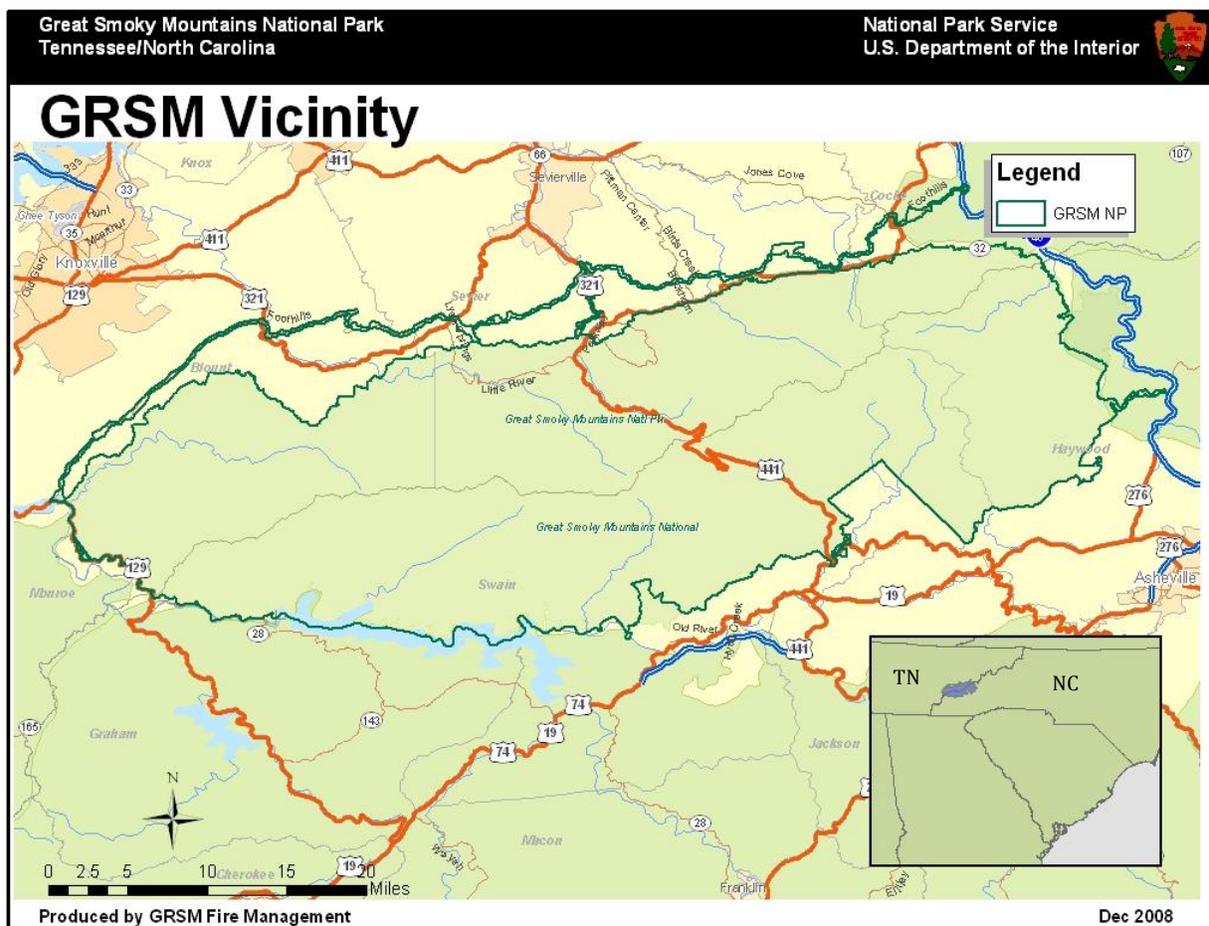


Figure 1. Great Smoky Mountains National Park, North Carolina and Tennessee, USA, 2009.

The feasibility of elk restoration in GRSM was studied for over a decade culminating with a University of Tennessee thesis entitled: "Feasibility Assessment for the Reintroduction of North American Elk into Great Smoky Mountains National Park" (Long 1996). Based on that assessment, the Park announced a decision in September 1998 to begin planning for an experimental release of elk. Because of positive responses from the

public and the positive environmental and disease risk assessments (see appendices), NPS approved an experimental elk release in GRSM. In June 2000, GRSM released an Environmental Assessment for the planned experiment, which was designed to determine the sustainability of an elk herd in GRSM. Provisions of the experiment required that all elk released and all that were born in the Park were radio-collared and tracked to evaluate their breeding success, movements, food habits, habitat use and impact, causes of mortality, and human impacts including possible conflicts with farmers outside the Park. The research component of the experiment was conducted by the University of Tennessee under guidance from the USGS Biological Resources Division and lasted from 2001 to 2008.

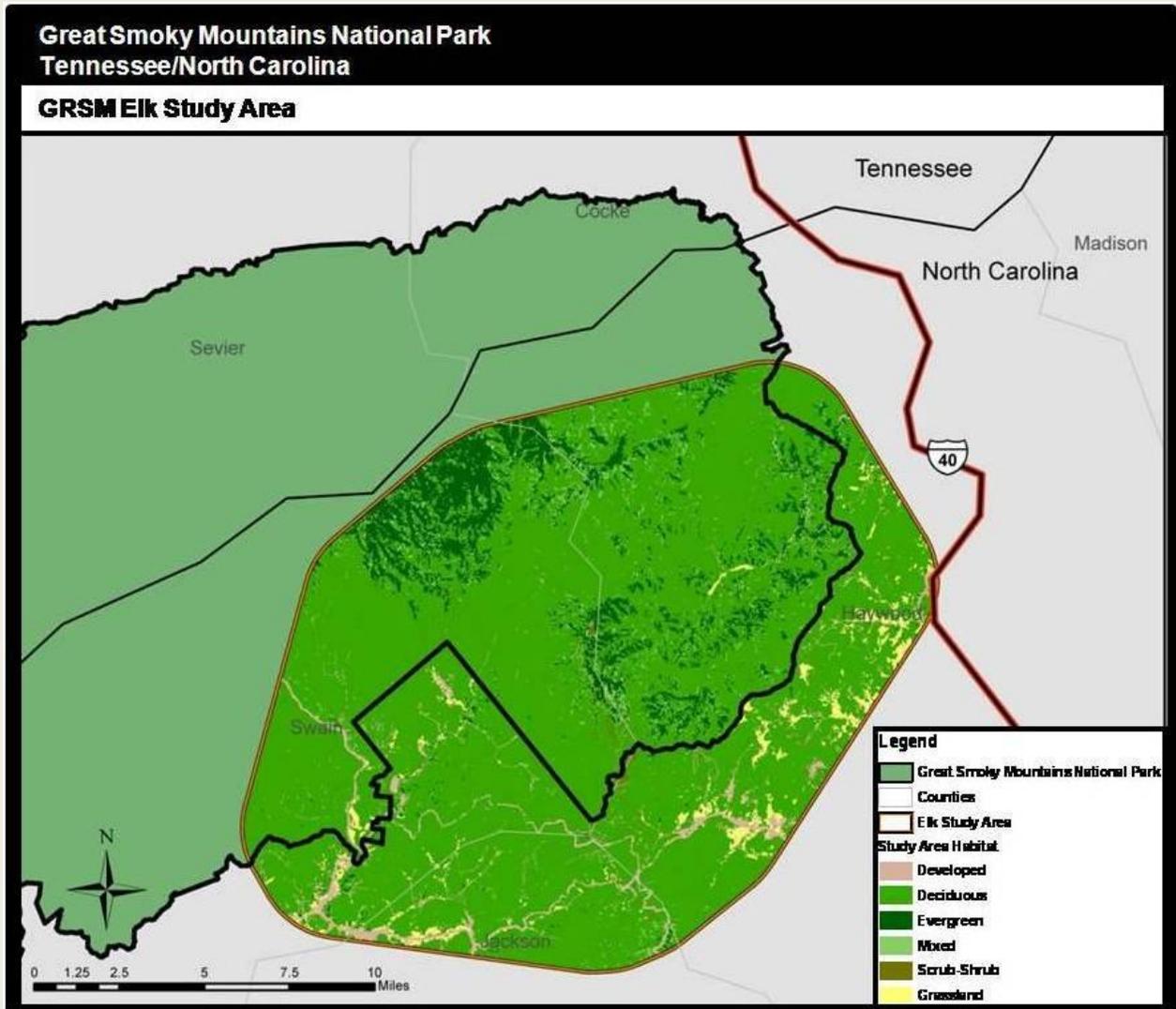


Figure 2. Great Smoky Mountains National Park elk project study area, North Carolina, USA, 2009.

As shown in the figure above, the elk research project was conducted in the eastern portion of GRSM, centered on Cataloochee Valley in Haywood County, North Carolina (35° 38' 23.000 north latitude and 83° 04' 55.000 west longitude). The nearest major roadway to

the release site was U.S. Interstate 40, which was adjacent to the eastern boundary of the Park.

GRSM managers sought assurance that the reintroduction of elk would be successful, beneficial, and feasible over the long-term before committing to supporting a long-term resident elk population. NPS biologists were most concerned with the viability of the elk herd and potential impacts to vegetation communities and private lands adjacent to GRSM. To address those questions, specific research was conducted to evaluate population dynamics (sex and age distribution, mortality rates, natality rates, recruitment), habitat use, home-range size and placement, and the feasibility of establishing a permanent elk population in GRSM.

Thus, specific objectives of the research were to:

- 1) estimate survival rates and reproductive success, assess home ranges, and identify causes of mortality of reintroduced elk;
- 2) determine whether mortality rates varied by age, sex, or release technique;
- 3) assess habitat use and food habits and evaluate impacts of the elk reintroduction (e.g., impacts to native vegetation or agricultural crops, fence damage, highway mortality); and
- 4) assess the probability of success of releasing elk to establish a permanent, viable population at GRSM.

ELK RESEARCH FINDINGS

Research projects were conducted on the experimental elk population between 2001 and 2008. Murrow (2007) evaluated all facets of the population from 2001 to 2006, and Yarkovich (2009) continued that research from 2006 to 2009. The following summary synthesizes the findings of both projects from the perspective of the University of Tennessee. Please see Murrow (2007) and Yarkovich (2009) for further methodological detail.

Elk Acquisition

The original proposal recommended 3 elk releases, totaling 75 to 90 animals; only 2 releases took place. The last release was not permitted due to changes in interstate transport regulations during this phased reintroduction. All animals had to come from herds that originated from Elk Island National Park, Alberta, Canada because of their stringent disease monitoring protocols. On 2 April 2001, 25 (13 males (M):12 females (F)) elk from the Elk and Bison Prairie at Land between the Lakes National Recreation Area, in Kentucky and Tennessee, were released into Cataloochee Valley (elk were originally brought to Land Between the Lakes from the Elk Island herd). The following year, on 20 April 2002, 27 (8M:19F) elk originally from Elk Island National Park, Alberta, Canada, were released into Cataloochee Valley. These elk were thought to be the closest genetically to the extinct eastern species because of their geographic proximity and similar body characteristics (Murrow 2007) consistent with Management Policies (NPS 2006, Section

4.4.2.2). Elk are extremely robust to inbreeding, so the same original source herd was not detrimental.

Home Ranges and Movements

Elk utilized relatively small annual home ranges in GRSM, but were within ranges reported from other elk populations (Franklin et al. 1975, Witmer and deCalesta 1985, Pope 1994, Millspaugh 1995, Cole et al. 1997). Annual home-range sizes calculated from 2001 to 2004 averaged 10.4 km² for females ($n = 9$, SE = 5.2) and 22.4 km² for males ($n = 8$, SE = 6.8). In comparison to western herds, elk in GRSM did not migrate and this likely contributed to the small home ranges. Although, elk have been in GRSM a limited amount of time and may not yet have established distant areas for feeding, previously introduced elk in the eastern U.S. have not shown migratory movements either (Moran 1973). Though home-range dynamics of elk are influenced by the ability to traverse different habitat types (Craighead et al. 1973, Anderson and Rongstad 1989) and movements related to breeding and parturition (Craighead et al. 1973), variation in resource distribution seemed to be the main determinant of size and placement of home ranges in GRSM.

Elk did not show homing behavior or extensive movements, such as those documented by Allred (1950) and Anderson (1958), likely because of the source herds' natural history, existing herd cohesiveness, the long distance of relocation, and the restricted area of grasslands in GRSM. The furthest straight-line distance of an elk traveling during the 8-year period was 65 km. However, such movements were rare. As time progressed and elk became established, elk settled into the area and dispersal movements lessened in occurrence.

Survival

Examining the entire 8-year experimental period, survival was similar to other unhunted elk populations (Eberhardt et al. 1996, Ballard et al. 2000, Larkin et al. 2003, Bender et al. 2005). Overall, survival rates were higher for female elk than for male elk. As a result, although the sex ratio of calves was skewed slightly towards males, the overall sex ratio for the GRSM elk herd is slightly in favor of female elk (0.452 male).

Survival of captured and radio-collared calves in GRSM was initially relatively low but still within the range documented for elk (Thorne et al. 1976, Oldemeyer et al. 1990). GRSM officials initiated short-term predator management in 2006 as a response to limited prime calving habitat, high calf predation by black bears in 2005, and the cancellation of the 3rd release of elk. Overall, mean annual calf survival averaged 0.656 (the probability of a calf surviving to 1 year of age was 65.6%), for the entire 8-year study period, and is well within the range documented for elk elsewhere. Furthermore, upon cessation of the predator management in 2008, calf survival remained high.

Reproduction

Calving occasions ranged from May through August with most births occurring during the last week of May and the first 2 weeks of June. Reproductive rates for elk herds are highly variable in the literature (40%–92%) and are correlated with female body

condition prior to breeding, as is age of primiparity (Hudson et al. 1991, Kohlmann 1999, Larkin et al. 2003). Reproductive rates (percentage of cows giving birth) for the GRSM herd varied by age class (36.4–87.5%) and were similar to those reported for reintroduced elk in the Southeast (Larkin et al. 2003) and of source herds (Rob Kaye, Elk Island National Park, unpublished data, Curtis Fowler, Land Between the Lakes, personal communication).

Mortality

The largest source of mortality for subadult and adult elk was from cerebrospinal encephalitis related to meningeal worm (*Parelaphostrongylus tenuis*), which is associated with white-tailed deer. Although it has been hypothesized that meningeal worm limits elk populations in areas where elk are conspecific with white-tailed deer, it is the degree of exposure, age of elk, individual and population experience with meningeal worm, and environmental moisture level which effects the gastropod host populations. All of those influence the potential severity of this parasite (Bender et al. 2005). However, elk have been successfully reintroduced to areas with sympatric high-density white-tailed deer populations (Bender et al. 2005). White-tailed deer in GRSM are known to be a frequent host of meningeal worm, which do not seem to affect deer but are potentially pathogenic to elk and other cervids (Anderson and Prestwood 1981). Although meningeal worm accounted for approximately half of the documented adult and subadult mortalities, its impacts on the elk herd in GRSM were small. The major source of calf mortality; however, was black bear predation. Of the 20 (2001-2008) identifiable calf mortalities 13 (65%) were due to black bears.

Habitat Use

Whereas elk often make use of all available habitats (Irwin and Peek 1983, Skovlin et al. 2002), they typically select open grazing habitat (Jenkins and Wright 1988, Suter et al. 2004). Elk selected and preferred treeless areas (both maintained and natural) during the research study, both annually and seasonally, but only 1–3% of GRSM consists of such openings. Also, the results of the research studies indicated that habitats selected by elk were associated with areas of moderate landscape complexity at fine and coarse scales, moderate area of edge habitat, gentle slopes (<10°), and high patch richness (Murrow 2007). This was logical because elk are often associated with patches of interspersed habitat, which provide direct access to forage and cover (Wisdom et al. 1986) and greater selection and quantity of forage (Skovlin et al. 2002). Elk are opportunistic and can move to take advantage of locally abundant food sources brought about by ecological and climatic factors. While elk typically elect more open habitat, elk in GRSM are showing that they are capable of doing well in predominantly forested habitats.

Food Habits

As shown below, in GRSM, fecal analyses were typical of many western elk herd diets with the primary component being graminoids (Kingery et al. 1996). The analyzed elk diets consisted of ≤5% plant material from deciduous or evergreen browse (Murrow 2007). This shows that although the vast majority of elk habitat available was forested,

they were mainly utilizing open grazing land as forage and not exploiting forested resources. Although no fecal analysis was conducted during 2006–2008, field necropsies of several elk indicated they were heavily utilizing acorns (*Quercus rubra*) as a food source during fall and winter. This may have indicated a shift in elk forage utilization, as the animals learned what was available.

Table 1. Microhistological analysis results of annual elk diet composition for elk in Cataloochee study area, Great Smoky Mountains National Park, North Carolina, 2003-2005.

	2003	2004	2005	Average
Grasses	63%	69%	67%	66%
Forbs	14%	14%	6%	11%
Sedges/rushes	11%	6%	11%	9%
Conifers	5%	5%	4%	5%
Shrubs	5%	5%	3%	4%
Ferns	2%	1%	8%	4%
Others	0%	0%	1%	1%

Vegetation Methods and Impacts

Vegetation data from 54 paired plots were compared to determine if there was an overall effect from feeding by elk between 2002 and 2005. Woody stem density, woody seedling density, and herbaceous cover were each classified into 7 relevant vegetation groups (deciduous tree, deciduous shrub, evergreen tree, evergreen shrub, grass and sedges, forb, or fern). After collapsing all species into the 7 categories, differences between the 2 sampled years were calculated and ranked. The average height or counts for 2002 were subtracted from those for 2005 for each plot. The ranked difference scores were tested for normality with the Shapiro-Wilk W statistic and with the Levene’s test for homogeneity of variance. Using the ranked difference scores between 2002 and 2005 as the dependent variable, an analysis of variance was performed with a randomized block design to determine if differences in total plant counts or individual species group abundance occurred between years in the treatment or control. Specifically, researchers tried to identify any change in overall plant abundance or change in general plant group composition over time. If temporal changes were detected with ANOVA, then the least significant difference mean separation technique was used to determine whether those

changes differed between treatment and control plots. An alpha value of 0.1 was used for all vegetation statistics to minimize Type II errors and maximize the probability to detect any impacts of elk browsing.

Coves were heavily used by this small population of elk. Vegetation plots detected no change in rich coves, but woody stems decreased in acid coves in the experimental plot, particularly deciduous species (Abundance of Woody Stems: $F_{1, 7} = 6.09$, $P = 0.02$, Composition of Woody stems: $F_{3, 49} = 2.58$, $P = 0.06$, respectively). In general, there was a decrease in the deciduous woody stem abundance in the treatment (elk) and a gain in the control (no elk). Given the recruitment of deciduous woody stems and seedlings seen in other landform classes, this may represent an impact from elk. However, when the cove strata were combined differences in seedling abundance and composition were detected but in the opposite way ($F_{1, 9} = 7.17$, $P = 0.03$, $F_{2, 96} = 2.46$, $P = 0.09$, respectively). There was a significant gain in total counts in the experimental plots (with elk feeding) but not in the control. No impacts were detected on ridge tops, side slopes, or in the grasslands.

Over all tests, little change was detected in the vegetation biomass and composition from 2002 to 2005 that could be attributed to elk. These findings were probably a result of a small elk herd that had an overall low impact on vegetation, but high variability and data noise associated with vegetation sampling reduced the power of the statistical tests used.

Elk-Human Conflict

Elk interact with a large number of annual visitors to Cataloochee Valley, all of which have been non-threatening, and such habituation can be an advantage to elk in winter in places that allow feeding or highly urbanized areas (Thompson and Henderson 1999). However, elk habituation to human activity may increase the potential for elk-human conflict, especially in areas outside of GRSM.

There were 10 major (requiring an in-person action response) instances of human-elk conflict during the first 6 years of the experimental reintroduction project. Those events required intervention by NPS personnel, which included public education, placement of animal deterrents, aversive conditioning, fence construction, elk removal, and euthanasia when other methods were unsuccessful or if the seriousness of the conflict required immediate action. Elk were using private pastures or grasslands outside of GRSM in all cases of nuisance activity. However, 7 of those events occurred in 1 localized area. Of the 10 instances, 5 involved elk interacting with cattle and 3 involved damage to vegetation or agricultural crops. During the study, 2 vehicle collisions were documented. It resulted in the death of 2 elk; no human injuries occurred.

Population Viability

UT researchers considered population sustainability to be the conservation goal, which was defined as a geometric mean growth rate >1 (positive growth) over a 25-year projection period in viability analyses (Murrow et al. 2009). However, as of spring 2009, the GRSM elk herd remained small (~93 animals), and thus will likely remain sensitive to slight changes among survival and fecundity rates for several years to come. Projections using the sex and age distribution estimated for 1 March 2009, the last instance of analysis, produced a growth rate of 1.071, which indicated slow positive growth. Population

modeling indicates the GRSM elk population should persist, but the GRSM elk herd is small and slight changes in adult survival have been documented to have dramatic effects on the rate of increase in elk populations (Nelson and Peek 1982).

Summary of University of Tennessee Research Findings and Recommendations

(These recommendations do not necessarily reflect actions that will be taken by GRSM)

When considering a permanent elk herd in GRSM, managers consider their biological needs and elk-human conflict issues (Witmer 1990, Lyon and Christensen 2002, Larkin et al 2004). Until this experiment was completed, Park officials were unsure what habitat requirements, disease issues, and public response would be with a reintroduction of elk. During the 8 years since the initial release, elk primarily remained within the general release area, no major diseases of concern have been detected in the herd, and the small population shows positive growth despite the presence of meningeal worm. Additionally, there have been relatively few human-elk conflicts, although addressing elk nuisance complaints have required commitments of time and money.

An additional release of 25 elk was planned for 2003 but was not possible because of national concerns regarding chronic wasting disease through the movement of potentially infected animals. Demographic estimates would have been more precise had more animals been released and the population likely would have been more resilient to stochastic events. This population should be viable but that could change if there is any catastrophe or multiple years of high mortality occur. Based on available habitat and current vital rates, there is a good chance that this population will remain at lower population levels and still have some risk of extinction.

Meningeal worm was the main cause of mortality for subadults and adults whereas black bear predation was the main cause of calf mortality. Although a healthy predator population could potentially keep growth of a large population of elk in check, growth of the small reintroduced elk population was negatively affected by bear predation. Calf survival increased concurrently with the short-term predator management that was initiated by GRSM biologists, and may have allowed the population time to grow and females to learn to better protect their offspring.

At low densities, elk likely have limited impacts on grass abundance. Lacey and Van Poolen (1981), in a review of field studies in the western United States, concluded that net primary production on grazed areas averaged 68% lower than that on protected areas. At high densities, plants may be repeatedly grazed, allowing little opportunity for tissues to recover and produce new growth (Webster et al. 2005). In the grassland plots studied, no changes were detected that could be attributed to the GRSM elk population. Based on the available data, the current population of elk in GRSM has minimal impacts on the vegetation. However, as the population increases in size, this impact would need to be reevaluated. For this reason, UT suggests maintaining a subset of the vegetation exclosures for future evaluations.

Population abundance of elk will be generally limited within the Park because of a lack of forest openings. Managers of most elk programs indicated that grasslands were important and that they must be maintained by mowing, burning, or disking. Suitable openings in GRSM are present and include high elevation grassy balds, Cades Cove, and Cataloochee Valley. Those areas represent a small portion of the total land area of GRSM.

Elk extensively used Cataloochee Valley, and have yet to and may not migrate to Cades Cove. Maintenance and expansion of more open areas would be essential if a larger elk population is desired. It would be beneficial to create or maintain other areas for elk in the eastern portion of GRSM; this could be accomplished by manually reopening selected areas or frequent burning at high intensity to promote major opening of the forest canopy and more diverse understory vegetation.

The probability of establishing a permanent elk population in GRSM is relatively high, under current population growth models. The long-term viability and sustainability may hinge on management that includes monitoring elk survival, rotational burning in and around Cataloochee Valley to maintain and create openings, responding to human-elk conflicts, and monitoring elk population impacts on other Park resources.

SCOPING PROCESS AND PUBLIC PARTICIPATION

NEPA regulations require an “early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action.” An in-depth scoping process was conducted during the initial NEPA process at the beginning of the experimental project phase. To further determine the scope of issues to be analyzed in this long-term plan, meetings were conducted with Park staff and other parties associated with preparing this document. As a result of this scoping effort, several issues were identified as requiring further analysis in this plan. These issues and topics represent existing concerns, as well as concerns that might arise during consideration and analysis of alternatives. See Chapter 5 “Consultation and Coordination” for a description of public and agency involvement that took place during the development of this document.

GENERAL ISSUES AND IMPACT TOPICS

National Environmental Policy Act describes the relationship between actions (proposed, connected, cumulative, similar) and environmental resources, including natural, cultural, and socioeconomic resources. Issues are usually problems that the current management practices have caused or that any of the proposed alternatives might cause. They also may be questions, concerns, problems, or other relationships, including beneficial ones. Issues need to be addressed in the analysis of the proposed management actions and alternatives. Along with issues that may surround managing elk, the range of potential natural and cultural resources and elements of the human environment that might be of concern or might be affected by the implementation of the elk management plan are identified for analyzes in the environmental assessment.

The following issues and impact topics were identified by the interdisciplinary team and by the public during the internal and external scoping period during the initial EA entitled: Environmental Assessment for the Experimental Release and Re-establishment of Elk (*Cervus elaphus*) in Great Smoky Mountains National Park. Subsequent discussions with management and partners indicate these topics are still relevant to the current analysis. Initial analysis showed that some of these issues were not problematic; the

section “Issues/Impact Topics Considered but Not Evaluated Further” at the end of this chapter explains why each was dismissed. Relevant aspects of those issues and impact topics that were retained are discussed in detail under the appropriate section in Chapter 3 “Affected Environment” and Chapter 4 “Environmental Consequences.” Relevant laws, regulations, and policies are discussed in “Laws, Regulations, Policies, and Plans” in Chapter 7. The topics that were retained for detailed analysis follow:

Cultural Resources

GRSM contains 91 historic structures, and there is a possibility that elk could damage those structures. The damage would probably be in the form of scarring historic structures during shedding of velvet prior to breeding season. It is possible that the presence of elk, particularly when they congregate, may expose archeological resources. Therefore, cultural resources were retained for consideration.

Natural Resources-Vegetation and Fish and Wildlife Resources (including Endangered and Threatened Plant and Animal Species)

Elk have the capacity to impact natural resources such as vegetation. Those impacts can be positive and/or negative. Therefore, the actions implemented by the plan could affect the natural resources in the Park. Furthermore, since there is potential for elk vegetation disturbance and consumption to enable the spread of exotic plants, this potential issue will be covered within the vegetation section of the EA and will be incorporated into the Park’s exotic plant management plan.

As an herbivore, elk are considered mixed feeders that primarily feed on grasses supplemented with woody browse and acorns during the fall. Competition for vegetative cover and food resources could occur. Therefore, the actions implemented by the plan could affect fish and wildlife resources.

Socioeconomic Conditions

Elk have the potential to impact adjacent land users and businesses, including farmers and orchard growers, residence owners, and businesses involved in the tourism industry. Elk eat shrubbery, gardens, lawns, and agricultural crops on private and public property. Therefore, impacts to neighboring land users were determined to be primarily financial. Additionally, elk can be a major tourism attraction on public and private property. Therefore, impacts because of such ecotourism were determined to be primarily financial. The actions implemented by the plan could affect socioeconomic conditions for such businesses.

Visitor Use and Experience

Visitors are attracted to GRSM for various reasons. Camping, hiking, foliage and wildflower viewing, wildlife watching, and fly-fishing are all popular activities. Because some people visit the Park to view elk, the increase in visitors could impact the experience for all visitors. Large number of visitors who come to the park to view elk may cause traffic congestion and noise in popular elk-viewing areas. This could detract from the values typically associated with the national park experience, such as solitude and quiet. Prescribed fire could generate smoke and odors or could close portions of the Park, which

could detract from the Park experience. On the other hand, many visitors coming into the park will benefit from the enhanced aesthetic and educational experience that comes from viewing elk and learning about elk ecology. Therefore, the actions implemented by the plan could affect how visitors would use and experience the Park.

Park Management and Operations

Park management and operations refers to the current staff available to adequately protect and preserve vital Park resources and provide for an effective visitor experience. Elk management activities have the potential to impact staffing levels and the operating budget necessary to conduct Park operations. Therefore, the actions implemented by the plan will directly affect Park management and operations.

Visitor and Employee Safety

An elk population has the potential to increase safety risks for humans. With a growing elk population there may be an increased safety risk for people who inadvertently or intentionally disturb cows or their calves. Increased elk concentrations may also increase risk of human contact with bull elk during the breeding season. Increased abundance and concentrations of elk in the fields along roadways may cause visitors driving automobiles to slow down or stop as they seek to view elk, which increases traffic congestion and accidents. Therefore, the actions implemented by the plan could affect how visitor and employee safety.

OTHER TOPICS CONSIDERED BUT NOT FURTHER ANALYZED

The following issues could be dismissed from further analysis, as explained below.

Adjacent Land Users

Actions taken under this plan have the potential to affect adjacent private land owners/users, including farmers and orchard growers, residence owners, Eastern Band of Cherokee and US Forest Service lands. Impacts to neighboring land users were determined to be primarily financial; therefore, such impacts are not considered in their own section but are discussed in this plan under the socioeconomic discussion.

Diseases and Disease Agents

For the initial EA, GRSM personnel sought information on known diseases that afflict elk from the Southeastern Cooperative Wildlife Disease Study (SCWDS). Following is a list of significant diseases and parasites that were identified by the SCWDS:

- Chronic Wasting Disease (CWD)
- Bovine Brucellosis
- Bovine Tuberculosis (TB)
- Paratuberculosis
- *Elaphostrongylus cervi*
- Septicemic pasteurellosis

Nettles and Corn (1998) stated that no elk should be used as re-establishment stock if any one of these diseases / parasites were present in the source herd. GRSM recognized the severity of disease in cervids and established exclusionary criterion for source elk during the decision making process of the initial program. Source animals were acquired from approved sources only and all recommended animal testing was done (see Initial EA). In the 8 years of disease data that has been gathered, no infectious disease of concern has been detected in the GRSM herd. Furthermore, the 1 parasite of concern that was detected in an originally released animal was found upon necropsy (*Echinococcus granulosus*). The elk was a dead-end host for that parasite, so the parasite was not spread. Therefore, diseases and disease agents are dismissed from further consideration. Note that appropriate disease testing will continue to take place in the GRSM elk herd (see Management Plan).

Environmental Justice

According to the United States Environmental Protection Agency (USEPA), environmental justice is the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or socioeconomic group, should bear a disproportionate share of the adverse environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. Executive Order 12898, "General Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing the disproportionately high and/or adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. Any actions related to the elk program would not be expected to have health or environmental effects on minorities or low-income populations or communities as defined in the USEPA Draft Environmental Justice Guidance (USEPA 1996). Residents within the surrounding communities that may be affected by elk would be affected similarly by each alternative considered (socioeconomic impacts). Since the proposed changes in any one particular elk management scheme should not result in any disproportionate change to this factor, this topic has been dismissed from further consideration aside from the considerations in socioeconomic conditions.

Indian Trust Resources

Indian trust resources include those resources not on Native American owned property, but rather on DOI administered lands that are held in trust on behalf of Native American tribes. Secretarial Order 3175 requires that any anticipated impacts to Native American trust resources from a proposed project or action by DOI agencies be explicitly addressed in environmental documents. The federal Indian Trust responsibility is a legally enforceable fiduciary obligation on the part of the United States to protect tribal lands, assets, resources, and treaty rights, and it represents a duty to carry out the mandates of federal law with respect to Native American and Alaska Native tribes. GRSM as a public holding is not considered a Native American trust resource and there are not any such

designated resources at the Park. The elk program and the proposed alternatives do not conflict with any American Indian interests. Therefore, this topic will not be carried forward into the detailed analysis.

Natural Lightscapes

In accordance with NPS Management Policies, 2001 (2001), the NPS strives to preserve natural ambient lightscapes, which are resources and values that exist in the absence of human caused light. Any actions related to the elk program at the Park would not be expected to result in any changes to the existing lightscape conditions. Therefore, this topic will not be carried forward into the detailed analysis.

Natural Resources

- *Air Quality* —

The Clean Air Act of 1973 (as amended) and associated NPS policies require the NPS to protect air quality in parks and other holdings. The intent of this topic is to assess actions that may improve and protect air quality for human health and ecosystem benefits, or that may have an adverse effect. In general, this topic analyzes far reaching and local influences on air quality, many of which are out of the control of the NPS. GRSM is designated a Class I area per the Clean Air Act of 1973, which provides the highest level of air-quality protection. Thus, temporary impacts on air quality and visibility in the Park during ecologically essential fires are anticipated, discussed, and managed in the GRSM Fire Management Plan. So, when applicable, implementation of small-scale burns would be conducted according to specifications in the fire management plan incorporating best management practices and mitigation measures to reduce air quality effects. All necessary permits would be obtained to conduct any beneficial burn activities. As a result of the small-scale nature of burns that would occur with implementation of mitigations, the effects on air quality would be short-term and would not exceed a minor level. For further details please refer to the GRSM Fire Management Plan. Visitation has likely increased due to elk viewing to these areas of the Park but overall visitation has remained stable throughout the Park, thus the net increase of auto emissions is negligible. Therefore, air quality was not retained for further consideration.

- *Aquatic Wildlife Resources* —

None of the alternatives proposed in this plan would foreseeably affect any aquatic wildlife resources. As a result, this resource was not retained for further analysis.

- *Climate Change* —

The project would not likely result in substantial increases in vehicle traffic in the Park from the current condition, which has stabilized, and thus no real increase in greenhouse gas emissions would occur. The amount of increase or decrease of emissions is small compared to the Park's baseline emissions and to local or state emissions, thus the project's contribution to climate change was dismissed from further analysis.

- *Floodplains* —

Floodplain or flood-prone areas include those low-lying areas that are flooded during 100 year storm events. Executive Order 11988 instructs federal agencies to avoid, to the extent possible, the long- and short-term, adverse impacts associated with the occupancy and modification of floodplains and wetlands, and to avoid direct or indirect support of development in floodplains and wetlands wherever there is a practicable

alternative. Director's Order # 77-2 addresses development in floodplains. None of the alternatives being considered involve the filling or alterations of floodplain areas, and do not require the construction of any structures. Given that the alternatives proposed will not affect floodplain values, this topic will not be carried forward into the detailed analysis.

- *Impacts to Geology or Soils* —

GRSM is host to a variety of outstanding geological features with unusual intrinsic value. Many of these geological features are regularly viewed and studied by a wide range of visitors, educators, and scientists and are considered a valuable natural resource. Any elk management actions that would involve construction, such as erecting exclosures under the management alternative could potentially impact soils. However, it was determined that such impacts would be no more than negligible because of the small area disturbed for fence construction. Furthermore, the Park archeologist would be contacted prior to the construction of any proposed fence to ensure that work would not disturb historic or prehistoric archeological sites. Lastly, while large groups of elk can cause soil disturbance, while congregated in a small area, this herd is small and if it did occur it would be localized. Therefore, this issue was dismissed from further analysis.

- *Nonnative (Exotic) Species* —

There is conflicting evidence regarding the strength of the potential for elk vegetation disturbance to enable the spread of exotic plants. In general, there is a lack of an identified cause-effect relationship between elk herbivory and exotic plant spread (Vavra et al 2007) and exotic versus native plant spread by wild ungulates (Bartuszevige and Endress 2008). However, since there is established potential for elk vegetation disturbance to enable the spread of exotic plants, this issue is covered within the vegetation section of the EA and will be incorporated into and managed by the Park's exotic plant management plan.

- *Water Resources* —

Water resources include freshwater aquatic resources such as ponds, lakes, and streams. This topic relates to maintaining good water quality, protecting areas from flooding, protecting aquatic ecosystems, and assessing activities that could have beneficial or adverse effects on water resources. None of the alternatives require any physical alterations to water resources. Although there would be potential effects on water quality from elk droppings, the impacts would be so minor and/or localized that these aspects of water quality were not carried through for detailed analysis. This decision was supported by water quality data collected from 8 sites around Cataloochee Valley prior to and after the release of elk.

- *Wetlands* —

The vegetative wetland component issues are evaluated in the "Vegetation" sections of this assessment.

- *Wild and scenic rivers* —

Wild and scenic rivers are designated by the federal mandate and are provided with advance protection at the federal, state, and local levels. Wild and scenic rivers have not been designated within GRSM boundaries; therefore, this topic will not be carried forward into the detailed analysis.

Natural Soundscapes

In accordance with NPS Management Policies, 2001 (2000) and NPS Director's Order 47: Sound Preservation and Noise Management (2001c), an important part of the NPS mission is preservation of natural soundscapes associated with Parks. Natural soundscapes exist in the absence of human-caused sound. The natural ambient soundscape is the aggregate of all the natural sounds that occur in Park units, together with the physical capacity for transmitting natural sounds. The frequencies, magnitudes, and durations of human-caused sound considered acceptable varies among NPS units, as well as potentially throughout each park unit, and are generally greater in developed areas and less in undeveloped areas. Elk management strategies that might include anesthetization and darting as a means of relocating or managing individual elk could affect visitors and wildlife because of firearm noise. It is unlikely that firearm noise would be substantial, although at night, with background noise reduced, firearm discharges would be audibly noticeable. Therefore, when feasible, suppressors would be used to reduce noise from firearm discharges. Because impacts to soundscapes are not expected to be more than negligible under any of the proposed alternatives, this impact topic was dismissed from further analysis.

Non-Federal Lands within GRSM

Private Residential and Commercial Properties and Municipal and State lands: Of the 522,000 acres within the Park boundaries, the NPS owns all terrestrial and submerged lands. Elk management is not seen as an issue that affects landownership or development. The proposed alternatives will not hinder or alter in an adverse or beneficial way public and private access to any areas in the Park; therefore, this topic will not be advanced into the detailed analysis.

Public Safety/Transportation

GRSM does not have a public transportation system that operates and the elk program does not require or include any transportation services. Although some elk/vehicle collisions have occurred in or adjacent to GRSM, this issue is not a primary focus for elk management due to the low number of such collisions. The Park has lowered speed limits to protect visitors, wildlife, and property. The road design also includes numerous curves and turns to ensure reduced vehicle speeds. Since impacts relating to elk/vehicle collisions would be negligible, this topic was dismissed from further analysis. However, Departments of Transportation for the states of North Carolina and Tennessee will be consulted and given the opportunity to review and comment on this EA/management plan.

Prime or Unique Farmland

The Natural Resource Conservation Service (SSM, USDA Handbook No. 18, October 1993) defines prime farmland as soil that produces general crops such as common foods, forage, fiber, and oil seed. Unique farmland is defined as soil that produces specialty crops such as fruits, vegetables, and nuts. The soil types in the GRSM area provide limited support for prime farmland and unique farmland based on these definitions. Both categories require that the land be available for farming uses. Lands within GRSM are not available for farming and therefore do not meet the definitions. Therefore, this topic was dismissed from further analysis.

Alternatives

CHAPTER 2.0

INTRODUCTION AND OVERVIEW OF ALTERNATIVES

The *National Environmental Policy Act* requires federal agencies to explore a range of reasonable alternatives and to analyze what impacts the alternatives could have on the human environment, which the act defines as the natural and physical environment and the relationship of people with that environment. This “Alternatives” chapter describes the various actions that could be implemented for current and future management of elk in Great Smoky Mountains National Park. The analysis of said impacts is presented in *Chapter 4: Environmental Consequences*. This chapter describes the alternatives developed by the interdisciplinary team for this Draft Elk Environmental Assessment/Management Plan. Input from the science team and the public was considered and used to refine the preliminary alternatives as the planning process progressed. All alternatives were developed to meet the purpose, need, and objectives of this plan. This chapter also describes each alternative, summarizes the important features of the alternatives and their effectiveness in meeting objectives of this EA/plan. A stand-alone management plan based on the preferred alternative can be found in Appendix A. The remainder of the chapter addresses the alternatives that were considered but eliminated from detailed analysis, identifies of the agency’s preferred alternative, and the environmentally preferred alternative.

ALTERNATIVE DEVELOPMENT

The National Park Service and cooperating agencies conducted numerous internal meetings to define a broad range of alternatives based on the objectives of the plan. Preliminary alternatives considered actions that other agencies on the planning team might take to address elk related issues outside the Park. Based on public input and agency needs, the range of alternatives captures the most divergent, yet reasonable, scenarios that could be implemented within the Park. The National Park Service realized at the onset of the planning process that the preferred alternative must include a formal monitoring program to track elk effects on other Park resources, and that that plan, if selected, needed to be based on adaptive management, allowing modification of management actions based on future research and monitoring information. Action alternatives were developed by an interdisciplinary planning team, with feedback from the scoping and science team during the planning process.

THE NO ACTION ALTERNATIVE

The alternatives must include a “no-action” alternative, as prescribed by NEPA regulations at 40 CFR 1502.14. It should be noted that prior compliance (June 2000 elk environmental assessment: Appendix B; separate attachment) was conducted to initiate

the elk reintroduction program in 2001 and traditionally one would consider the “no action” as no elk reintroduction. This alternative was already evaluated under the prior compliance, which ultimately led to the experimental reintroduction of elk (i.e, the No Action Alternative was not selected in previous compliance). NEPA guidance thus dictates that the No Action Alternative currently to be evaluated must take into account the presence of the population, and describes the current management approach for the Park. This management action is based on the continuation of the existing elk management as it resulted from the initial 2001 compliance process, which has been geared toward successfully answering the major ecological, societal, and logical questions regarding elk natural history in and around GRSM.

The No Action Alternative involves intensive management of elk within their current locations, although there would be no prescribed pro-active management strategies, such as herd reduction if the population grew too large. All elk would continue to be collared and monitored daily including calves. Park personnel would respond to all elk incidents within and, in cooperation with the NCWRC, outside of the Park. This management scheme would be geared toward continuing to gather information on the elk population and refrain from active management around a set of broad population objectives based on that gathered information. This No Action Alternative would continue to revolve around evaluating the overall elk status by monitoring metrics used to assess the elk population viability. The No Action Alternative would be labor intensive and would require the continuation of extensive animal handling, which would be more invasive of the population.

ADAPTIVE MANAGEMENT ALTERNATIVE

The Adaptive Management Alternative includes long-term management of elk with the continuing objective of maintaining an established, healthy elk population in GRSM. This alternative meets the management objectives of Great Smoky Mountains National Park and the purpose of and need for action as expressed in *Chapter 1: Purpose and Need for Action*. Because this action alternative meets the Park’s objectives and is technically and economically feasible, it is considered “reasonable”.

Adaptive management combines the advantages of the scientific method with the flexibility to address the human and technical complexities inherent in managing complex environmental issues. The goal is to give policy makers a better framework for applying scientific principles to complex environmental decisions. Furthermore, this alternative allows for the evolution of elk management over time, as more information and data is gathered.

In general, the Adaptive Management Alternative would include long-term selective population and habitat monitoring (reduced from the No Action Alternative). Resource management staff in cooperation with Resource and Visitor Protection staff and surrounding agencies would work pro-actively and cooperatively to monitor and manage elk. All ‘out of Park’ elk nuisance incidents would be evaluated on a case by case basis with NPS, upon request of the NCWRC or EBCI, playing a supportive role while the appropriate jurisdictional agency handles the issue or situation. In transition, NPS would assist and

train other agencies in elk handling and related aversive conditioning and exclusionary methods. Furthermore, if over time, the elk population and vegetation monitoring indicates that conditions are falling outside those expected within natural variation, the population management strategies could be reevaluated and adjusted. All details provided here can be found in Appendix A: GRSM Elk Management Plan.

Given an overall objective to maintain an elk population within the Park that is self-sustaining with acceptable impacts to Park resources, there are three management goals this alternative addresses regarding elk in GRSM. These goals encompass the main issues and concerns that the scoping committee identified throughout the EA process. While each overall management goal will address corresponding elk concerns, they are not limited by them. The goals are as follows:

1. **GRSM ELK POPULATION MANAGEMENT GOAL:** GRSM will maintain a healthy elk population that is managed within the capabilities of GRSM and in consideration of other land uses within the Park.
2. **GRSM VEGETATION AND ELK HABITAT MANAGEMENT GOAL:** GRSM will identify, monitor and, when necessary, mitigate impacts of elk on vegetation or other natural or cultural resources, and when appropriate and feasible, GRSM will implement strategies that may support/improve elk habitat.
3. **GRSM RECREATIONAL MANAGEMENT GOAL:** GRSM will maintain safe viewing opportunities of elk, while educating the public regarding their natural history and biology.

These three goals are not mutually exclusive. They cover a comprehensive and interwoven alternative to adaptively and actively manage the GRSM elk herd, while incorporating and reacting to specific objectives and outcomes.

Below is a general flow list for adaptive management metrics, issue indicators or triggers, and corresponding management actions for elk in GRSM. This is provided to give an overall and concise review of the entire elk management plan as it pertains to this Environmental Assessment (please see Appendix A: GRSM Elk Management Plan for details).

The overall objective of this alternative is to maintain an elk population within the Park that is self-sustaining with acceptable impacts to Park resources. Generally, the overall goal will be achieved by meeting the three overarching management goals. Each specific goal is fulfilled by specific objectives, when applicable. Success in meeting the specific objectives are evaluated by unique metrics or monitoring techniques. When data collected during monitoring indicates a problem or issue has arisen, other management strategies will be evaluated for implementation and appropriate action will be taken. The implementation of some of the management strategies or actions described may require additional compliance documentation. This will be accomplished consistent with NPS guidance (Director's Order 12). Monitoring will then continue to determine the management strategies' success or failure and to reassess further management needs.

GRSM Elk Population Management Goal

GRSM will maintain a healthy elk population that is managed within the capabilities of GRSM and in consideration of other land uses within the Park. The first population objective is to maintain an understanding of general elk population dynamics, including population size, herd sex ratio, mortality and natality rates. A subset of the elk population, primarily adult females, will be monitored. The number of animals monitored may vary depending on how many elk (age/sex classes) are currently radio collared. The general monitoring goal will be to maintain 25 females, 5 males, all possible calves during their first year, elk that travel long distances and any known nuisance animals. When possible and feasible, elk will be collared during winter and calves will be captured and collared immediately after birth and/or at ~10 months of age. Anesthesia will follow all established protocols (Murrow 2007). General animal data will be collected and compiled 1-4 times per month, identifying known population size, distribution, and structure. Collected data will include animal sex, id, pregnancy status, approximate age, female-calf association, general health, etc. Additionally, when feasible, the current population model will be updated annually (SAFL-USGS). Roadside calf-cow counts will be conducted biyearly, once during early winter and again in late spring. These counts will provide an index to abundance and a rough estimate of recruitment. Any possible data for non-collared animals will be formally collected simultaneously with the cow-calf counts.

If extensive female dispersal or extremes in birth rates, recruitment rates, survival rates, or population growth is documented, the Park would evaluate potential changes in management. In many instances no action may be required. However, if there are decreases in certain vital rates (ex. calf survival), the Park may consider population augmentation (if possible) or short-term predator management, such as black bear relocation. Both of those management techniques have shown to be effective at population support in the GRSM herd. On the other hand, if there are substantial increases in vital rates, the Park may translocate elk to other herds (if feasible and needed) or cull a portion of the herd. Both of those techniques have been shown to stabilize or decrease population growth or expansion in other elk herds.

The second population objective is to address nuisance elk behavior in GRSM and adjacent private and public properties. GRSM will provide training, assistance with aversive conditioning, exclusionary techniques and equipment use when necessary to any state or federal agency in need. Park employees will evaluate and record problem behaviors of elk. They will also identify roadways most impacted by elk. There is quite a range of behaviors that would require direct elk management, from habituation to physical building and grounds damage. Each instance of human-elk conflict would be evaluated individually based on locale, severity, individual elk history, etc. A range of strategies are available to managers, including but not limited to the following:

- Aversive conditioning
- Permanent fencing
- Animal deterrents
- Animal relocation
- Animal euthanasia
- Creating parking areas or established pull-outs
- Instructional/elk crossing signs
- Reduced speed limits
- Flashing warning lights

- Stop signs in unconventional locations
- Speed bumps or humps
- Unique traffic management plans during certain times of the year
- Elk Bugle Corps expansion during certain times of the year

All management actions taken inside the Park will be coordinated through the Park biologists. Any actions taken outside Park boundaries will be done only at the request of the appropriate jurisdictional authorities.

The third population objective is to maintain an understanding of general elk population health and continued disease surveillance. Elk will be monitor for indicators of disease and general health when individuals are captured for radiocollaring and during visual inspection of the herd while radio-tracking. Additionally, Park employees will collect samples for CWD monitoring whenever feasible. If a disease of concern is detected, depending on the disease, an array of actions may take place. For example, if meningeal worm is suspected, the Park may take no action or, if the animal is severely brain damaged, euthanize the animal, as has happened in the past with this herd. If a more serious regulatory disease is detected, the herd could be culled severely or totally depopulated. So, depending on the disease found, the Park will consider the impacts of the disease, the health and well being of the animal and elk herd, and the disease impact to the other resources in and around the Park. Then, one of an array of actions will be taken which include the following:

- No action
- Population augmentation
- Predator management
- Elk treatment/inoculation
- Elk culling
- Total depopulation

GRSM Vegetation and Elk Habitat Management Goal

GRSM will identify, monitor and, when necessary, mitigate impacts of elk on vegetation or other natural or cultural resources, and when appropriate and feasible, GRSM will implement strategies that may support/improve elk habitat. The primary objective of this goal is to further an understanding of the trends of elk impacts on Park vegetation, including such parameters as changes in biomass, species richness and diversity, and plant recruitment rates. The Park will also attempt to identify indicator plant species that best capture the impacts of elk within certain communities. Specifically, the Park will monitor herbaceous vegetation, shrubs, and saplings in an experimental context over time to yield measurable results to show the level of impact to vegetation structure, regeneration, or cover.

The vegetation monitoring will be a three-part program: vegetation plots or exclosures, elk trails and transects, and calculations of regeneration and consumption (see Appendix A: GRSM Elk Management Plan).

Existing conditions would be measured to establish a set of the current baseline conditions in addition to the baselines established by Murrow 2007 via elk exclosures and paired control plots. A subset of permanent exclosures (exclosures = 3) and duplicate control plots (total measured = 6) will be established and monitored. These exclosures will be permanent, 12 meters by 12 meters in size, and the bottom of the fencing will be raised

to approximately 24 inches above ground level to allow wildlife species other than elk to enter the plot. Exclosures will be monitored every 3-5 years for specific elk impacts. Vegetation monitoring will mimic the monitoring currently done in the existing deer exclosures which generally consists of monitoring the herbaceous and woody plant species in 1 meter plots recording species composition, height growth and percent vegetation cover. One exclosure/control plot will be located in a cove/wetland land cover type, one will be in a hemlock conservation area, and one will be in grassland.

These three paired-plots will be complimented by multiple existing plots in and around Cataloochee Valley. Existing metrics useful in analyzing elk impacts and unique elk metrics will be identified and/or added to the existing vegetation monitoring program in GRSM. This will allow more substantial monitoring and identification of appropriate elk-use indicator species.

Established elk trails will be GPS recorded and updated yearly, when feasible. Vegetation transects along the elk or hiking trails will be monitored. Four transects will be monitored perpendicular to each of 5 established elk trails (total transects = 20), angled perpendicular to the slope, and repeated every 3-5 years. Transects will start at randomly (during establishment) selected points along selected sections of five elk or hiking trails. Those trails will be distributed across the elk range in easily accessible areas of varying elk densities. Preferably, the 5 elk trails will vary in use from heavy to rare or none based on fecal pellet rates and subjective knowledge of the elk technician. At least one trail will bisect established wetlands. Subplot sampling will occur at 10 m² plots every 50 meters, for a total of 200 meters (total subplots = 80). The subplots will be marked with GPS, nearest tree tagged at base, and an embedded rebar stake. The sampling will assess general landscape elk impact trends, such as soil disturbance, litter depth disturbance, exotic plant growth, browse intensity (average height and percent cover of shrub-like species), percent cover by life form, dominant species, browsed and unbrowsed twigs and stem, and elk fecal pellet counts as an indirect measure of use. Additionally, slope, aspect, and elevation will be recorded.

Vegetation consumption and cohort regeneration are two distinct measurements that would stand alone. Vegetation consumption would be measured to indirectly monitor elk use and forage availability in grasslands. At least 20 general areas will be designated in the grasslands where vegetation can be clipped, dried and weighed. The vegetation will be clipped from a different site within the designated area each sampling year. Clipped plots will be 1-m². Since the communities should be the same within each area, all vegetation will be dried together and converted to kg/hectare, wet and dry. GRSM will monitor consumption (offtake) of grasslands as trend data, with a general goal of less than 8% of sites consumed at >50% offtake. Regeneration of cohorts will be calculated as stems per acre reaching 5, 10, 15,... years of age. Such stand-level regeneration would be measured every 5 years estimated from the control plots at the 3 major exclosure monitoring sites by height (stems/acre between 1.5 and 2.5 m in height), aging of increment cores (stems/acre < 10 years of age), stem diameter at breast height, and stem density (stems/acre).

There are no known threatened or endangered plant species populations within the current elk range, however, known rare and sensitive vegetation populations will be monitored in accordance with the Park's Rare Plant Monitoring Protocol, and if needed, they will be protected by exclusionary methods or by other techniques to reduce the likelihood of damage. The locations and type of fence used, the method of transportation to

remote locations, and the equipment used to install the fences would be determined based on cost, effectiveness, and a minimum requirement and minimum tool analysis. Furthermore, biologists tracking elk can monitor for herd expansion or movements into new areas to alert Park staff to possible conflicts.

The effectiveness of specific management actions and resource conditions would be monitored through the 15-year life of the management plan. This information would be used to adapt management actions as needed to meet plan objectives. If vegetation surveillance indicates that there is an increasingly negative level of impact on other resources, the Park may reconsider the current management actions. Furthermore, vegetation monitoring may be adapted over time to better capture what is happening on the landscape. Special attention will be given to identifying indicator species that may be substituted for the more general vegetation monitoring across all species.

If major changes in canopy and understory species composition, species diversity, species richness, growth rates of woody plants, percent cover and vegetation structure, or tree regeneration and establishment are documented or upland herbaceous vegetation (grass-like species) are heavily grazed (offtake sites consumed excessively), management or mitigation actions will be taken. Those actions, depending on the individual trigger, could include any or all of the following:

- Exclusionary fencing and/or deterrents
- Plant translocation/reestablishment
- Aversive conditioning
- Elk translocation
- Elk culling

For example, if a negative trend in offtake measurements are found along with decreases in plot percent cover, elk maybe offered for population augmentation in other populations or culled by Park biologists within the Park.

GRSM Recreational Management Goal

GRSM will maintain safe viewing opportunities of elk, while educating the public regarding their natural history and biology. The Park will provide safe elk viewing opportunities. Appropriate educational materials will be developed/updated. Interpretive contacts, programs, and websites will be improved and updated. The Park will continue offering outreach programs to schools, groups, and community organizations.

ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

Section 4.5(E)(6) of the NPS NEPA Guidelines (NPS 2001c), reasons to eliminate an alternative as infeasible include technical infeasibility, inability to meet project objectives or resolve need, conflicts with plans, policies or laws “such that a major change” would be needed to implement, and duplication with other, less environmentally damaging, less expensive or more feasible options, or has too great an environmental impact. This section describes those alternatives or management tools that were eliminated from further consideration and the basis for excluding them from analysis in this EA/plan.

The Limited Management Alternative would involve limited management of elk within their current locations. Elk populations would be allowed to develop independent of any pro-active management strategies. Park personnel would still respond to incidents within the Park concerning elk as they would any wildlife issue. However, elk incidents outside the Park would be the responsibility of the local or state wildlife officials as they would any other wildlife concern within their jurisdiction. If the elk herd decreased in numbers slowly over time, no management actions would be taken to support or increase the population. All pro-active management, excluding vegetation impacts, disease monitoring, and extreme nuisance incidents, would cease. This alternative was eliminated from further consideration because it does not meet the overall goal of species restoration and conflicts with public interest and NPS policies. Therefore, the option of Limited Management of the small elk herd was not considered further.

The other alternative, which was eliminated from further consideration, was a Removal Alternative, which would prescribe the complete removal/relocation of the elk population. Complete removal of every elk at this point would be extremely technically difficult and disproportionately expensive. Furthermore, the overall goal of restoration of native animal species when feasible (NPS Management Policies Section 4.4.2.2) would be undermined and conflicts with the public interest in elk, state laws (cervid transportation), and NPS policies. Therefore, the option of removal of the elk herd was not considered further.

IDENTIFICATION OF THE PREFERRED ALTERNATIVE

Identification of the preferred alternative is based on the overall ability of the alternative to meet Park objectives, support the purpose of the Park, and minimize adverse effects on the resources of the Park, while providing for public use and enjoyment. The Adaptive Management Alternative best meets Park objectives, while minimizing potential adverse effects and is cost-effective. Therefore, the Adaptive Management Alternative is the preferred alternative.

ENVIRONMENTALLY PREFERRED ALTERNATIVE

The National Park Service is required to identify the environmentally preferred alternative(s) for any of its proposed projects. That alternative is the alternative that will promote the national environmental policy expressed in NEPA (Section 101 (b)). This includes alternatives that:

- 1) Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
- 2) Ensure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings;

- 3) Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;
- 4) Preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice;
- 5) Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities; and
- 6) Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

In essence, the environmentally preferred alternative would be the one(s) 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" (CEQ, 1978). The environmentally preferred alternative would cause the least damage to the biological and physical environment, and would best protect, preserve, and enhance historical, cultural, and natural resources.

Eight years of experimental data have indicated that there is high potential for reestablishing a permanent elk population within the Park with limited impacts to Park resources or values, given proper management. In fact, the reintroduction is consistent with NPS policy and meets the criteria for restoration of native animal species (Section 4.4.2.2, Management Policies 2006). Therefore, the Adaptive Management Alternative represents the environmentally preferred alternative and this finding is consistent with Director's Order 12 in the determination of the environmentally preferred alternative.

While the No Action Alternative provides for many of the same objectives as the Adaptive Management Alternative, it is more intensive and invasive management of the elk herd (i.e., additional monitoring, radio collaring, etc) and the no action (current management) is lacking an established assessment of long-term elk population size and structure and trends of elk impacts on vegetation. Therefore, the No Action Alternative could potentially result in increased handling stress and does not adequately protect the resources of the Park over the long-term.

The Adaptive Management Alternative seems to best balance the stewardship responsibilities, ensuring productive surroundings, attaining uses without degradations, preserving natural resources, maintaining diversity, achieving balanced use versus preservation, and enhancing the quality of the resources. Therefore, the selected and environmentally preferred alternative is the Adaptive Management Alternative since it best meets multiple goals.

Affected Environments

CHAPTER 3.0

AFFECTED ENVIRONMENT

The “Affected Environment” describes existing conditions for those elements of the natural and cultural environments that would be affected by the implementation of the actions considered in this environmental assessment. The main natural resources component addressed is vegetation including rare, unusual, threatened, and endangered vegetation. Visitor use and experience, visitor and employee safety, socioeconomic conditions, and Park management and operations are also addressed. Impacts for each retained topic/issue are then analyzed in “Chapter 4: Environmental Consequences.”

Generally, GRSM is part of the large Appalachian Mountain system, which consists of a series of mountain ridges in the Unaka Range trending northeast to southwest from Maine to Georgia. GRSM is a 2,072 km² national park surrounded by 12,141 km² forested mosaic comprised of Cherokee, Pisgah, and Nantahala national forests. The Unaka Range is cut into segments by northwesterly flowing tributaries of the Tennessee River. The Pigeon River cuts the main ridge of the Unakas on the northeast and the Little Tennessee cuts the main ridge of the Unakas on the southwest (USDI NPS 1982). GRSM is notable for having extreme variations in topography, with elevations ranging from 270 to 2,024 m, and >65% of the Park having slopes >15°. Precipitation varied from 140 to 220 cm/year within GRSM (Stephens 1969), which is classified as a warm-temperate rain forest (Thorntwaite 1948). The Park is home to a diverse array of life, including over 1,600 species of flowering plants, dozens of species of native fish, more than 230 species of birds, and 65 species of mammals. With yearly visitation averaging between 9 and 10 million visitors, this Park has the highest visitation of any national park in the National Park System.

Natural Resources

Vegetation (including Threatened and Endangered Species)

The forests of GRSM have been described as the most complex and diverse in North America. Due to its topographical relief, complex soils, and position in the continent, GRSM supports an enormous diversity of vegetation and is one of the largest blocks of temperate deciduous forest in North America. Almost 99% of the Park is forested. The Park has more vascular plant species than any other unit in the national park system, while the number of nonvascular plant species ranks among the highest of any area in North America north of Mexico (Rock and Langdon 1991). More than 1,600 species of vascular plants have been identified in the Park, including over 100 native tree species. Of these, approximately 160 species are considered rare and over 350 species are nonnative. More than 4,000 non-flowering plant species are present including > 2,250 species of fungi and > 302 species of lichens. About 10 plant taxa that are new to the Park are discovered each year. Approximately 100,000 acres of old-growth forest are found in the Park (USDOI NPS GRSM 2000).

Despite its large size (>200,000 ha) and protected status, many biotic and abiotic factors have altered and continue to threaten plant communities within GRSM. Among

biotic factors, exotic species have been the most destructive. During the 1930s, chestnut blight, an infection by fungus native to Asia, virtually eliminated the American chestnut (*Castanea dentata*) from the forest landscape of eastern North America. Since it was first found in North America in 1954 (Speers 1958), the non-native balsam woolly adelgid (*Adelges piceae*) has decimated Fraser fir (*Abies fraseri*) populations in high-elevation spruce-fir forests within GRSM (Smith and Nicholas 1998, Jenkins 2003), and the non-native hemlock woolly adelgid (*Adelges tsugae*) will cause large scale mortality of hemlock (*Tsuga canadensis*) in the Park during the next decade (Taylor 2002). Since the late 1980s, dogwood anthracnose (*Discula destructiva*), a pathogenic fungus, has killed dogwood trees throughout the Park and mortality has been as high as 90% in some forest types (Jenkins and White 2002). Over the past decade, beech bark disease, a non-native insect/fungus complex, has decimated American beech (*Fagus grandifolia*) trees in high-elevation hardwood forests (Vandermaast 2005).

Whittaker (1956) identified 15 vegetation types along complex gradients of moisture and elevation. However, 8 vegetation types are considered dominant; these are:

- Pastures and cultivated fields
- Heath and grassy balds (above 4,000 feet in elevation)
- Spruce / fir forest (above 4,500 feet in elevation)
- Northern hardwood forest (3,500 to 5,000 feet in elevation)
- Cove hardwood forest (below 4,500 feet in elevation)
- Hemlock forest (3,500 to 4,000 feet in elevation)
- Closed oak forest (predominantly below 4,500 feet in elevation)
- Open pine / oak forest (found along dry ridges)

More recently (White et al. 2003), NatureServe and The University of Georgia Center for Remote Sensing and Mapping Science classified the Parks' vegetation into 79 community types. All of these communities were given a Global Conservation Status Ranking, and GRSM has 27 Imperiled or Critically Imperiled communities. Jenkins (2007) grouped the 79 vegetation communities in GRSM into 11 major types of communities based on similarities in vegetation composition. Eight communities are forested types (montane alluvial forests, early successional forests, cove forests, hemlock forests, montane oak-hickory forests, xeric ridge forests, high-elevation hardwood forests, and spruce-fir forests) and three are non-forested types (heath balds, grassy balds, and grasslands). We modified the groupings to include wetlands and to combine pine and oak forest types, as is done in the current draft Vegetation Monitoring plan (2010).

Dominant Vegetation Communities and current leading concerns:

Oak/Pine Forests (combines Montane Oak-hickory Forests and Xeric Ridge Forests) – Oak and Pine Forests represent 47% of Park area. Oaks (*Quercus* spp.) and pines (*Pinus* spp.) dominate these forest types, many of which have been highly altered by fire exclusion practices, southern pine beetle, and the loss of American chestnut (*Castanea dentata*). Oak mast is an important food source for mammals and invertebrates (Matschke 1964, Henry and Conley 1972, Pozzanghera, S. A.

1990, Scott and Pelton 1975, Vaughn 2002, Wathen 1983, Wenworth 1992, Wolff 1996).

High-elevation Hardwood Forests – High-elevation hardwood forests represent 17% of Park area. Canopy dominants include yellow birch (*Betula alleghaniensis*), American beech (*Fagus grandifolia*), and northern red oak (*Quercus rubra*). High-elevation beech gaps are one of the most threatened communities in the southern Appalachians due to beech bark disease and hog damage (Bratton 1975, Howe and Bratton 1976, Huff 1977, Howe et al. 1981, Lacki and Lancia 1986). Ozone has been shown to damage herbaceous species within this vegetation type (Somers et al. 1998). Acid deposition can mobilize toxic aluminum in the soil and change the cation capacity availability (Fenn et al. 2006).

Cove Hardwood Forests – Cove hardwood forests represent 12% of Park area. Cove forests are the Park's most floristically diverse, with canopies dominated by sugar maple (*Acer saccharum*), yellow buckeye (*Aesculus flava*), American basswood (*Tilia americana* var. *heterophylla*), and silverbell (*Halesia tetraptera* var. *monticola*), eastern hemlock (*Tsuga canadensis*), *L. tulipifera*, sweet birch (*Betula lenta*), and red maple (*Acer rubrum*). Ozone has been shown to have a negative effect on growth in sensitive species and a compositional shift in this community (SAMI 2002).

High -elevation Spruce-fir Forests – Spruce-fir forests represent 8% of Park area. Spruce-fir forests within the Park represent 74% of all spruce-fir in the southern Appalachians (Dull et al. 1988). These forests provide critical habitat for a number of endangered and endemic plants and animals (USFWS 1990). At least 90% of mature Fraser fir have been killed by balsam woolly adelgid since it was found within GRSM in 1960. Additional stressors include chronic acid deposition, ozone, and climatic stress (Johnson et al. 1986).

Additional Vegetation Communities of Concern and leading stressors:

Early Successional Forests – Early successional forests represent 5% of Park area. This forest type regenerated on abandoned agricultural land or heavily logged areas, and is transitional on the landscape. Species typically occurring in this forest type are *L. tulipifera*, black locust (*Robinia pseudoacacia*), and Virginia pine (*Pinus virginiana*). Known stressors include ozone and southern pine beetle (*Dendroctonus frontalis*) (SAMI 2002,).

Hemlock Forests – Although hemlock forests comprise only 2% of Park area, hemlock is one of the most common tree species in the Park and occurs as a co-dominant or subcanopy species across a broad range of forest community associations (Jenkins 2007). Hemlock forests in the Park have seen widespread mortality due to the hemlock woolly adelgid, which was first found in GRSM in 2002. The Park has invested millions of dollars to try and preserve hemlock forests and has established conservation areas throughout the Park, including Cataloochee Valley.

Montane Alluvial Forests – Montane alluvial forests represent 1.3% of Park area. This type is uncommon in GRSM because it occupies a very discrete landscape position. Species occurring in montane alluvial forests include American sycamore (*Platanus occidentalis*), *L. tulipifera*, and white ash (*Fraxinus americana*). This community type has been impacted by development, but remaining areas may be susceptible to human disturbance. Ash species are vulnerable to emerald ash borer (*Agrilus planipennis*), a non-native beetle that is likely to spread to GRSM within a few years.

Heath Balds – Heath balds are a shrubland community type of unknown origins representing approximately 1% of Park area. The vegetation consists of dense ericaceous shrubs, such as catawba rhododendron (*Rhododendron catawbiense*). This community is thought to be stable, but can be impacted by landslides during significant rain events (Ford 2009).

Grasslands/grassy balds – These communities are treeless areas with variable composition (Jenkins 2007). GRSM contains approximately 940 ha (less than 1% of Park area) of this community type. Grassy balds are found at high elevations while grasslands occur at low elevations. Both types may be anthropogenic in origin. These communities can be significantly altered by invasive non-native plants and hogs.

Wetlands – Although not represented in Jenkins' (2007) vegetation communities, wetlands have a unique assemblage of plant species. White et al. (2003) addressed wetland communities in GRSM as non-alluvial areas "dominated by plants adapted to anaerobic conditions imposed by substrate saturation or inundation during 10% or more of the growing season...". Many of the Park's wetlands are impacted by exotic plants and hogs and are vulnerable to multiple other stressors

Under Section 7 of the Endangered Species Act (ESA) of 1973, as amended, any action likely to adversely affect a species classified as federally protected is subject to review by the USFWS. Specific surveys for protected species have been conducted for the determination of presence or absence in association with the fire management program and are conducted as part of Park monitoring. There are 5 plants indigenous to the North Carolina counties within GRSM listed under the authority of the Endangered Species Act of 1973 as federally endangered or threatened; these are:

- Rock Gnome Lichen (*Gymnoderma lineare*) – Endangered
General Habitat: On rocks in areas of high humidity either at high elevations (usually vertical cliff faces) or on boulders and large rock outcrops in deep river gorges at lower elevations.
- Small-Whorled Pogonia (*Isotria medeoloides*) - Threatened
General Habitat: In North Carolina, this species is typically found in montane oak-hickory or acidic cove forests. The understory structure and

composition of occupied sites can be quite variable, ranging from dense rhododendron thickets to open/sparse shrub and sub-shrub strata. Herbaceous cover tends to be sparse, however at least two sites are characterized by fairly dense stands of New York fern (*Thelypteris noveboracensis*). Sites known to support this species range from 2,000 to 4,000 feet in elevation. The species does not appear to exhibit strong affinities for a particular aspect, soil type, or underlying geologic substrate.

- Spreading Avens (*Geum radiatum*) - Endangered
General Habitat: Southern Blue Ridge Mountains on high-elevation cliffs, outcrops, and steep slopes which are exposed to full sun; also in thin, gravelly soils of grassy balds near summit outcrops.
- Swamp Pink (*Helonias bullata*) - Threatened
General Habitat: Wetlands that are saturated but not flooded, including southern Appalachian bogs and swamps. Atlantic white cedar swamps, swampy forests bordering small streams; boggy meadows and spring seepage areas. Commonly associated with some evergreens, including white cedar, pitch pine, American larch, and black spruce.
- Virginia Spiraea (*Spiraea virginiana*) - Threatened
General Habitat: Rocky flood-scoured riverbanks in gorges or canyons.

These species are currently found in several western North Carolina counties. The Rock Gnome Lichen, Spreading Avens, and Virginia Spiraea occur in habitats that elk most likely would not use or impact. While the Small-Whorled Pogonia and Swamp Pink may occur in areas of eventual elk use, to date, no known population has been documented to be impacted by elk herbivory. Furthermore, the Small-Whorled Pogonia occurs in very small clumped grouping which could easily be protected, and Swamp Pink is at its southern range, with its stronghold occurring in New Jersey.

In addition to the federally listed species, GRSM maintains a database of plant species listed by the states of North Carolina and Tennessee. Management of these plant species will be according to the guidance established by the respective state. The Park has 14 Federal Species of Concern, and approximately 68 state listed plants (from both NC and TN). Additionally, there are non-listed species and some communities mapped Park-wide that are ranked by NatureServe as G1 “critically globally imperiled” and G2 “globally imperiled.” Murrow 2007 indicated at the low population level (2005: n ~ 70), elk had little effect on percent cover of forbs and grasses, trends in plant species abundance or composition, and there was little to no difference in grazed versus ungrazed plots.

The diversity of the herbaceous plants comprising the elk range and their future relationship with elk herbivory is beyond the scope of this plan to detail or speculate, given the short period of time elk have been in GRSM. At present, many vegetation measurements and herbivory metrics within the elk range have not been thoroughly documented, such as annual aboveground production of herbaceous vegetation, herbaceous root biomass, annual herbaceous offtake rates (herbaceous consumption), and current grazing pressures. Murrow 2007 indicated at the low population level (2005: n ~ 70), elk had little effect on percent cover of forbs and grasses, trends in plant species

abundance or composition, and there was little to no difference in grazed versus ungrazed plots. However, it is the intent of the incorporated management plan to actively seek a better understanding of impacts of elk on GRSM and to identify metrics and thresholds that will indicate plant community health in the presence of elk.

Fish and Wildlife Resources (including Threatened and Endangered)

The wildlife resources in the Park include common large mammals (e.g., black bear (*Ursus americanus*) and white-tailed deer (*Odocoileus virginianus*), medium-sized mammals (e.g., eastern cottontail rabbit (*Sylvilagus floridanus*), striped skunk (*Mephitis mephitis*), opossum (*Didelphis virginiana*), woodchuck or groundhog (*Marmota monax*), red fox (*Vulpes vulva*), gray fox (*Urocyon cinereoargenteus*), and raccoon (*Procyon lotor*), and several species of small mammals (e.g., various species of shrews, mice, and voles).

GRSM is a premier place for birds. From the high, exposed peaks, to the warmer, sheltered lowlands, some 240 species of birds have been found in the Park. Sixty species are year-round residents. Nearly 120 species of birds breed in the park, including 52 species from the neo-tropics. Many other species use the Park as an important stopover and foraging area during their semiannual migration. More birds will be heard than seen in the Park's dense, tall forests, where more than 100 species of birds a day can be found during peak migration (late April and early May).

Migratory and resident bird species are well documented throughout the Park. Some common species sighted in the Park include juncos, mourning doves, chimney swifts, eastern phoebes, barn swallows, blue jays, indigo buntings, cardinals, towhees, sparrows, eastern bluebirds, eastern meadowlarks, field sparrows, red-winged blackbirds, crows, chickadees, wild turkeys, and warblers. Golden eagles have been sighted flying over the Park in autumn. Pileated woodpeckers nest in dead wood on hardwood or deciduous trees and prefer mature coniferous, mixed, or deciduous forests and have been found nesting in some portions of the Park where pines are prevalent. The barred owl, screech owl, and Chuck Will's widow are the most common birds heard in the Park at night. Open fields in the Park provide habitat for red-tailed hawks, American kestrels, northern bobwhite quail, wild turkeys, killdeer, eastern bluebirds, field sparrows, and eastern meadowlarks. In the summer, the Park is visited by barn swallows, downy woodpeckers, ruby-throated hummingbirds, common yellowthroat, blue grosbeak, Acadian flycatchers, eastern wood pewees, blue-gray gnatcatchers, eastern kingbirds, barn swallows, yellow warblers, indigo buntings, and orchard orioles.

Three major groups of reptiles are found in the Park: turtles, lizards, and snakes. The most common snakes in the Park are the northern ring-neck snake (*Diadophis punctatus edwardsii*), black rat snake (*Elaphe obsoleta*), eastern garter snake (*Thamnophis sirtalis*), northern water snake (*Nerodia sipedon*), eastern milk snake (*Lampropeltis triangulum triangulum*), and northern copperhead. Timber rattlesnakes can be found on the dry ridges.

GRSM is the "Salamander Capital of the World." Climatic and geologic factors have combined to spur the development of 31 salamander species in five families, making this one of the most diverse areas on earth for this order. In fact, lungless salamanders have undergone an extraordinary level of evolutionary diversification in the Park, accounting for 24 of the salamander species in the Park and making it the center of

diversity for the family. In total, 31 salamanders and 13 frogs are known to inhabit GRSM.

Insects make up the bulk of the non-microbial diversity in GRSM. Estimates of the number and type of species found in the Park are, at best, educated guesses, and only through further research will the total number that inhabit the Smokies be approached. Many insects are beneficial to the environment and the Park's ecosystem, performing key tasks, such as plant pollination and organic decomposition and recycling, and serving as food for birds, fish, and other animals. Without insects performing these services, hundreds of plants and other animals would disappear from the Park. Some insects, however, are agricultural pests or serve as disease vectors that can affect plants and other animals, including humans. Some of these insect pests are responsible for the decline in eastern hemlock and Fraser fir within the Park and in the surrounding areas.

Under Section 7 of the Endangered Species Act (ESA) of 1973, as amended, any action likely to adversely affect a species classified as federally protected is subject to review by the USFWS. Investigations regarding these species are determined in consultation with NPS, USFWS, NCWRC, and TWRA. There are 14 animals (vertebrates and invertebrates) indigenous to the counties within GRSM listed under the authority of the Endangered Species Act of 1973 as federally endangered or threatened; these are: Gray Bat (*Myotis grisescens*) – Endangered; Appalachian Elktoe (*Alasmidonta raveneliana*) – Endangered; Oyster Mussel (*Epioblasma capsaeformis*) – Endangered; Fine-rayed Pigtoe (*Fusconaia cuneolus*) – Endangered; Green-blossom Pearly Mussel (*Epioblasma torulosa gubernaculum*) – Endangered; Little-wing Pearly Mussel (*Pegias fabula*) – Endangered; Carolina Northern Flying Squirrel (*Glaucomys sabrinus coloratus*) – Endangered; Indiana Bat (*Myotis sodalis*) – Endangered; Spotfin Chub (*Hybopsis monacha*) – Threatened; Duskytail Darter (*Etheostoma percnurum*) – Endangered; Smoky Madtom (*Noturus baileyi*) – Endangered; Yellowfin Madtom (*Noturus flavipinnis*) – Endangered; Spruce- Fir Moss Spider (*Microhexura montivaga*) – Endangered; and Noonday Globe (*Mesodon clarki nantahala*) – Threatened. The Bald Eagle (*Haliaeetus leucocephalus*) has been recently down listed from Threatened but is still protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c). The following descriptions provide a brief overview of the documented species utilizing the counties in North Carolina that overlap GRSM.

Appalachian Elktoe. The Appalachian elktoe (*Alasmidonta raveneliana*) is a mussel that requires relatively shallow, medium-sized creeks and rivers with cool, clean, well-oxygenated, moderate- to fast-flowing water. The species is most often found in riffles, runs, and shallow flowing pools with stable, relatively silt-free, coarse sand and gravel substrate associated with cobble, boulders, and/or bedrock. Currently, the Appalachian elktoe has a very fragmented, relict distribution. The species still survives in scattered pockets of suitable habitat in portions of the Little Tennessee River system, Pigeon River system, Mills River, and Little River in North Carolina, and the Nolichucky River system in North Carolina and Tennessee.

Gray Bat. Gray bats (*Myotis grisescens*) are cave residents year-round, although different caves are usually occupied in summer and winter. Few have been found roosting outside caves. They hibernate primarily in deep vertical caves with large

rooms acting as cold air traps. Gray bats have been located in Haywood and Swain counties, NC.

Indiana Bat. The Indiana bat (*Myotis sodalis*) is a federal- and state-listed endangered species that utilizes cave habitats for winter hibernation. Indiana bats mate in the fall, but the female Indiana bats do not actually become pregnant until spring. Indiana bats migrate to tree roost sites in the spring, where they form maternity colonies consisting of 20 to 100 members. The bats roost beneath the shedding bark of live or dead trees, bearing only one young per female. Indiana bats have been documented hibernating in four separate caves in GRSM, and summer maternity colonies have been found in Blount and Swain county portions of GRSM.

Carolina Northern Flying Squirrel. Carolina Northern flying squirrel (*Glaucomys sabrinus coloratus*) distribution is limited to the central and southern Appalachians. Within the southern Appalachians, and within Great Smoky Mountains National Park (GSMNP), this subspecies is confined to disjunct “islands” of suitable habitat consisting of high-elevation ridges and peaks of limited size separated from each other by deep valleys or small ridges of xeric forest. Much natural history information is lacking because the northern flying squirrel is rare, extremely mobile, and occupies remote areas. The species does not occur in defined, predictable localities, making planning and protection measures difficult to undertake, but potential habitat is considered above 4,500 feet in elevation.

Duskytail Darter, Smoky Madtom, Yellowfin Madtom, and Spotfin Chub. Efforts to reintroduce native fish species to Abrams Creek were begun by the USFWS in 1986. Although there are no confirmed historical records, four federal-listed fish species — the endangered duskytail darter (*Etheostoma percnurum*), the endangered smoky madtom (*Noturus baileyi*), the threatened yellowfin madtom (*Noturus flavipinnis*), and the threatened spotfin chub (*Cyprinella monacha*) — likely inhabited Abrams Creek below Abrams Falls and other areas of the Park in the past.

Noonday Globe. The noonday globe (*Mesodon clarki nantahala*) is one of the nation's rarest land snails, is restricted to a small area of the Nantahala Gorge in Swain County, North Carolina, outside of the boundary of GRSM.

Little-Wing Pearlymussel. This mussel (*Pegias fabula*) inhabits small to medium streams, with low-turbidity, cool-water, and high to moderate gradients. The nearest population to GRSM occurs in the Tennessee River System from the Little Tennessee River (Macon and Swain Counties, NC).

Spruce-fir moss spider. This spider (*Microhexura montivaga*) is an extremely rare invertebrate endemic to the southern Appalachians. Its long-term viability is unknown. The typical habitat consists of moss growing on rocks and boulders in *shaded* situations. They have occasionally been found in moss mats growing on logs and in moss-litter mats at the base of large rocks. Specifically, the microhabitat of the spruce-fir moss spider appears to be associated with moderately thick and

humid, but well-drained, moss and liverwort mats growing in sheltered spots on surfaces of rock outcrops and boulders in mature high-elevation forests dominated by the Fraser fir (*Abies fraseri*). Only six populations are currently known to exist, four of which occur in Great Smoky Mountains National Park (GSMNP). Habitats at all six extant sites have been both severely limited and degraded by loss of Fraser fir trees.

In addition to the federally listed species, GRSM maintains a database of 320 plant and animal species listed by the states of North Carolina and Tennessee. Management of these plant and animal species will be according to the guidance established by the respective state. The Park has 14 Federal Species of Concern, and 25 state listed animals (from both NC and TN). Additionally, there are non-listed species and some communities mapped park-wide that are ranked by NatureServe as G1 “critically globally imperiled” and G2 “globally imperiled.”

Cultural Resources

Archeological Resources

Archeological evidence of people utilizing the abundant natural resources of the Smokies begins 12,000 years ago and continues until the formation of the Great Smoky Mountains National Park in 1934. In the Smokies, archeological resources consist of prehistoric and aboriginal sites that represent several southeastern cultural periods, as well as historic sites related to mountain culture and the Park development period.

While over 500 archeological sites have been found within the Park boundary, the total remains unknown. Archeological sites have been identified in virtually all the Park’s biotic zones and in various geomorphic settings. For instance, rock art or shelters have been identified on slopes exceeding 10%. Both buried and above ground ruins are considered to have archeological significance. Archeological significance is further dependent on the context or placement of archeological objects and/or features within a soil matrix or across geographic space. A registry of known archeological sites is maintained in the Park’s service wide Archeological Sites Management System (ASMIS).

Historic Structures

Over 197 structures are listed on the Park’s List of Classified Structures (LCS). These structures include historic buildings and early Park infrastructure including roads, bridges, and visitor centers.

Cultural Landscapes

The National Park Service maintains a database of historically significant landscapes in the National Park Service known as the Cultural Landscape Inventory (CLI). The Park contains 42 landscapes and component landscapes currently listed on the CLI. These include both landscapes that are documented or certified as cultural landscapes and those that have been identified for further study as cultural landscapes (D. Flaugh, GRSM Landscape Architect, personal communication).

Other Cultural Resources

Over 150 known cemeteries are located within the Park's boundaries. Most of these cemeteries are bounded by forest cover.

Park Management and Operations

Management of elk and vegetation and the visitors that enjoy these resources within the Park requires the participation of five Park divisions: Administration, Facility, Planning and Professional Services, Natural and Cultural Resource Management and Science, Resource Education, and Visitor and Resource Protection. However, the bulk of elk management and monitoring is done by the Division of Resource Management and Science staff and the Division of Visitor and Resource Protection staff.

Resource Management and Science Staff –

Various staff from Resource Management conducts wildlife management activities, fire management, park planning, forest pest and exotic plant control, and biological monitoring throughout the Park. This group also coordinates the work of outside scientists who conduct formal studies within the Park, such as biologists, social scientists, and archeologists and are also responsible for coordination with other state and federal agencies regarding elk. The North Carolina Wildlife Resources Commission (NCWRC) assists the National Park Service with elk conflicts and poaching incidents outside the Park boundaries.

There is one dedicated Resource Management biologist position for elk in Cataloochee Valley. The Resources Management Division staff member conducts elk monitoring weekly. Aerial monitoring for elk is conducted as needed to locate elk that have made long distance movements. Testing all dead elk, if feasible, for chronic wasting disease is ongoing. New born calves are located and collared in spring and summer and all nuisance elk issues are handled by resource management staff members. The dedicated elk staff member also educates the public beyond the boundaries of the Park by outreach presentations to local service clubs, conservation organizations, and other interested groups.

Visitor and Resource Protection Staff –

The ranger staff that deal with elk management includes all law enforcement rangers. Law enforcement rangers are often responsible for crowd and traffic control associated with visitors who come to view the elk throughout the year and heavily in fall. Because of the remote nature of Cataloochee Valley, law enforcement rangers provide information and education services regarding elk and control traffic flow with help from the Elk Bugle Corps volunteers. Should illegal killing of elk occur outside the Park, natural resource management and protection ranger staff will, if requested and feasible, assist with investigation of the incident in conjunction with NCWRC.

Resource Education Staff –

The resource education staff provides information and education services at visitor centers and interpretive programs, as well as writing publications and creating exhibits.

Visitor center hours and the number of programs that are offered by the Park are directly related to the amount of staff available. The Park's periodical educational materials contain information on the elk population. The staff also educates the public beyond the boundaries of the Park by outreach presentations to local service clubs, conservation organizations, and other interested groups.

Elk Bugle Corps Volunteer Group –

The Elk Bugle Corp is a volunteer group that is managed cooperatively among Resource Management, Protection, and Education Staff. The 85-member group has been in existence since 2007. Volunteers in the Elk Bugle Corps are not NPS staff; however, they make an important contribution to the responsibilities of the Park staff and provide logistical support during the peak elk viewing seasons.

The Bugle Corps is a significant source of visitor contacts, providing natural history facts and information regarding elk management issues. The volunteers receive training each year, including the most current status of management efforts for the elk population. The primary tasks of the Elk Bugle Corps include:

- ✓ Patrolling areas of the Park frequented by elk.
- ✓ Provide information to park visitors about elk and the Park.
- ✓ Provide visitor safety and traffic control.
- ✓ Report violations and other infractions.
- ✓ Observe and record visitor statistics information.

Facility Management Staff–

The Facility Management Division is responsible for general upkeep of the Park, including maintenance of Park roads, trails, Park vehicles, and Park facilities. Their primary tasks include road grading, care of Park buildings (plumbing, painting, carpentry, electrical), maintenance of utility systems (water laboratory), repair of backcountry bridges, care of stock animals and stables, and maintenance of trails. They also are periodically involved in reporting elk with behavioral, health, or locational issues.

The increased amount of visitation to Cataloochee Valley, especially in fall, causes an increase in the demands on maintenance staff, due to greater use of facilities such as restrooms, trash receptacles, and campgrounds. These issues are being addressed separately in the Cataloochee Development Concept Plan.

Socioeconomic Conditions

Eight counties encompass or lie close to boundaries of GRSM: Blount, Sevier, Cocke and Monroe counties in Tennessee are situated on the western and northern end, and Graham, Jackson, Swain and Haywood counties in North Carolina occupy the eastern and southern vicinity of the Park. The area surrounding the Park is home to 2 national parkways, 3 national forests, the Cherokee Indian reservation, an extensive system of lakes developed by the Tennessee Valley Authority (TVA) and the Aluminum Company of America (ALCOA), and land belonging to private individuals and organizations. Land surrounding the Park is mostly rural, consisting primarily of forested foothills and mountains. Approximately 84% of the land within a 6-mile radius of GRSM boundary is

forested. The remaining areas consist mostly of agricultural land (10%) and urban development (2%). Small towns and communities, some adjacent to the Park, are scattered throughout the region. The mean human population density of the eight county region is 80 individuals/square mile. The majority of the people in the 8-county region are employed in retail trade, manufacturing, tourism and personal services. Much of the economy is tourism-related and land traditionally used for forests and agriculture is increasingly being replaced by resort communities, vacation homes, and retail business (GRSM 2004).

GRSM has an annual budget of \$20 million and provides an economic hub generating over upwards of \$800 million a year for surrounding tourist communities (USDI NPS GRSM 2000) and over 14,000 jobs. The areas in which the concentration of elk are highest and in which visitation is most influenced by the presence of elk are the places which this proposed actions will primarily effect. The towns of Maggie Valley and Waynesville in Haywood County and Cherokee in Swain and Jackson Counties on the southeast side of the Park may be affected. The major components of socioeconomic conditions likely to be effected in Maggie Valley, Waynesville and Cherokee include ecotourism and landowner property damage. Elk viewing in western states and eastern states that have reintroduced elk has proven to be of major economic benefit. Western areas, such as the National Elk Refuge in Jackson Hole, Wyoming, attribute millions of dollars annually to the local economy through elk viewing. With only three years into an elk reintroduction program, the State of Kentucky estimates that elk viewing has brought millions of dollars, annually to the counties in which elk have been released. Pennsylvania estimates that hunting and viewing elk add over \$24 million to local and state economy. The exact level of monetary benefits to the community is unknown but considered to be significant in Maggie Valley and Waynesville, NC and on Eastern Band of Cherokee Indian's Tribal lands, including increased visitation and consumption directly related to elk viewing and elk paraphernalia sales.

Landowner Property Damage -

When elk move outside the boundaries of GRSM, the potential for real estate damage to adjacent landowners exists. Recognizing the potential for damage, GRSM has been cooperatively working with the following agencies to manage elk movements outside of Park boundaries during the experimental program (2001 - 2008); these agencies were:

- Tennessee Wildlife Resources Agency (TWRA)
- North Carolina Wildlife Resources Commission (NCWRC)
- United States Forest Service (USFS)
- Eastern Band of the Cherokee Indians
- Local agricultural groups and individuals
- North Carolina Department of Agriculture

Elk generally have remained in the Park, only a few individual animals have strayed beyond the boundary with the exception of a small population that has moved into the White Oak area just outside the Park. In general, areas with significant agricultural activities outside the Park were termed "No Elk Zones." Elk have been allowed to remain in areas outside the

Park unless significant conflicts or incidences were documented. If that occurred, elk were moved back to the Park. If Park staff was unable to alter behavior or relocate a nuisance animal and it continued to cause significant problems, the animal was euthanized.

From 2001-2008, there were approximately 30 reports (counting multiple reports from the same people as only being one report) that reported property damage or some form of nuisance activity. Most of these complaints were caused by the same 6 animals. There are four specific locations of documented elk-human conflict: private property on the Cherokee Indian Reservation around the Oconaluftee Visitor Center and Big Cove, the Suttontown area off of Cove Creek Road, and the White Oak community off of White Oak Road. The overall acreage negatively impacted by elk has been small (<200 total acres across 4 counties in 2 states) consisting mostly of small family gardens, non-commercial fruit trees, and minor fence damage. To date, there have been four elk euthanized because of nuisance issues.

Visitor and Employee Safety

Elk are prevalent throughout western national parks, national forests, and BLM properties. Although elk have been documented to exhibit aggression toward predators, wild elk are generally timid in the presence of humans and will tend to move away from man. However, like all wild animals, elk behavior can be unpredictable. Humans who approach too closely may trigger defensive behavior. The large meadows bisected by a main road in Cataloochee Valley in the eastern part of the Park are attractive to elk. Staff and volunteers take extra precautions to reduce such incidents in these areas. However, despite warning signs, volunteers and rangers intervene regularly to return visitors to a safe distance from elk. In 2008, the Park enacted changes to its compendium that prohibits visitors from intentionally approaching to within a minimum distance of 50 yards for black bears and elk to both protect the visitor and the animal. Violations of this regulation can result in fines or arrest.

When the elk are easily visible along the roadway, in meadows, and near the Oconaluftee visitor center, traffic could become unsafe. As shown in the table below, the number of vehicles increased during the first 3 years of the project with a peak in 2003. Since 2003, the number of vehicles entering Cataloochee Valley has stabilized. The approximately doubling of vehicles in Cataloochee is not significant given the extremely high number of vehicles and visitors coming to GRSM every year. However, traffic congestion associated with the increased visitation for elk viewing may result in minor vehicle collisions at low speeds. An even greater concern is the associated risk with higher speed highways and unexpected stops for elk viewing or elk crossings. As of 2009, there have been five elk-vehicle collisions, with no human injuries and four elk deaths.

Table 2. Number of Vehicles Entering Cataloochee Valley, 2000-2008

	Total Vehicles	Total Visits
2000	27,597	65,432
2001*	52,943	124,844
2002	59,513	142,039
2003	89,840	214,000
2004	48,229	112,919
2005	53,881	127,114
2006	55,108	130,099
2007	48,080	113,343
2008	63,288	148,528

* Year elk were first released.

Visitor Use and Experience

The broad management goals of the Park are to preserve the Park's diverse resources while providing for public benefit and enjoyment. GRSM is the most heavily visited Park of the National Park System, averaging between 9 and 10 million visitors annually. The principal use of GRSM is recreational. Activities include viewing wildlife and scenery from motor vehicles, hiking, camping, horseback riding, and fishing. Park visitation rates vary seasonally, peaking between June and October (USDI NPS GRSM 2000). Visitation tends to be heavier during weekends and holidays, and backcountry use is high during college breaks. The Park's natural features are the main attraction for visitors, with most activities restricted to driving through the Park, or picnicking, rather than backcountry camping and hiking (USDI NPS 1982).

The National Park Service does not track where visitors go once within the Park; however, the Park's primary attractions are its scenery and wildlife. The most popular elk viewing areas include Cataloochee Valley and Oconaluftee Visitor center. This visitation is especially high during calving and breeding seasons.

Environmental Consequences

CHAPTER 4.0

ENVIRONMENTAL CONSEQUENCES

NEPA requires that a range of reasonable alternatives and the unavoidable environmental consequences associated with implementation of the alternatives be revealed prior to undertaking proposed federal actions. This chapter provides a summary of the analysis of the environmental consequences associated with implementation of the No Action Alternative and the Adaptive Management Alternative.

The goals of NPS management for all resources are achieved through consideration of the potential resource impacts associated with each alternative and identification of an alternative that balances unavoidable impacts with the goals and objectives for the project. Resource impacts associated with each alternative may differ in their context, intensity and duration and this balanced approach considers the merit of all resources equally.

Impact topics are the resources of concern that could be affected by the range of alternatives. Specific impact topics were developed to ensure that alternatives were compared on the basis of the most relevant topics. The following impact topics were evaluated: natural resources, park management and operations, socioeconomic conditions, visitor and employee safety, and visitor use and experience. Other issues and impacts categories were dismissed due to the nature of the project and the lack of direct relevance to the project (see Chapter 1).

While there are approximately 10 years of data on the GRSM elk population, there are obviously many questions that have incomplete answers and future conditions that NPS cannot evaluate at this time. This lack of data is exacerbated by the fact that there is not scientific data on elk in habitat similar to the southern Appalachians. Therefore, these impacts have been evaluated on the available data gathered over the last 10 years. GRSM continues to gather information on the impacts of the current elk herd and recognizes the need to continue to identify what information is lacking and what data will be crucial for proper elk management in the future.

DEFINITIONS

Context: Context is the setting within which an impact is analyzed, such as the affected region or locality and the affected interests. In this EA, the intensity of impacts is evaluated within a local context, primarily considering effects to the Park area itself. The intensity of effects on cumulative impacts is evaluated in a regional context, and considers effects further in time and effects from other projects.

Cumulative Impacts: The CEQ regulations, which implement the NEPA (42 USC 4321 et seq.), require assessment of cumulative impacts in the decision making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are

considered for all alternatives and focus on a regional area well beyond the Park boundary. Cumulative impacts were determined by combining the impacts of each alternative with other past, present, and reasonably foreseeable future actions within the Park and the vicinity. These impacts are assessed on a regional basis. These projects include development within the region, long-term population trends, cultural and social changes.

Type of Impact: Impacts are categorized in two different and contrasting types: adverse and beneficial. Adverse impacts are considered contrary to the goals, objectives, management policies, and practices of the NPS and the public interest or welfare. These impacts are of a kind likely to be damaging, harmful, or unfavorable to one or more of the various impact topics. Beneficial impacts are believed to promote favorable conditions for the impact topics.

Direct and Indirect Impacts: Direct impacts include effects on the resource actually caused by the proposed action, generally at the immediate site of the action and at the time of the action. Direct impacts can extend into the future and are often permanent, but can be temporary. A direct effect is an effect that is caused by an action and occurs at the same time and place. An example of a direct impact would be the filling of a portion of a stream, which immediately causes habitat loss at that location. Indirect impacts generally occur as a result of a "side-effect" of a direct impact, but occur later in time or further in distance than the action. An indirect impact could result from silt flowing downstream, creating turbid conditions, and adversely affecting water quality.

Levels of Intensity: Levels of intensity refers to severity of the impact, whether it is negligible or major, or somewhere in between. The gradient of this grading system can be general or very detailed, but ultimately the assumptions and subjectivity of the system affect its sensitivity. A simple and subjective rating system is used in this EA, which includes a rating scale of "no effect, negligible, minor, moderate, and major effects." The authors of this EA based the rating system score on studies completed, data and information obtained from scientific and administrative sources, discussions with relevant individuals, public comments, common sense, and professional opinion.

Duration: Duration describes how long an impact would be expected to last. In this EA, impacts are described as either being short-term or long-term. Short-term is an impact that would last no more than two years. Long-term would be an impact that would last for more than two years.

For **natural resources** impacts:

Negligible: Impacts would be barely detectable, measurable, or observable.

Minor: Adverse Impacts would be detectable, but not expected to have an overall effect on the natural community. Impacts generally affect less than one-half acre vegetation or would not be expected to influence the population of any wildlife species, or may influence a small number of individual of a species.

Moderate: Impacts would be clearly detectable, but could have short-term

appreciable effects on the local ecology. Impacts may affect up to one-acre of vegetation, but would not threaten the continued existence of any natural community. Impacts would have short-term effects.

Major: Long-term or permanent, highly noticeable effects on the population of a species, natural community, community ecology, or natural processes. Impacts may affect over one-acre of vegetation or may affect the continued existence of any natural community or species.

For **cultural resource** impacts including cultural heritage:

Impacts to cultural resources are described in terms of type, context, duration, and intensity, as described above, which is consistent with the regulations of the Council on Environmental Quality (1978) that implement the National Environmental Policy Act. These impact analyses also are intended to comply with the requirements of Section 106 of the National Historic Preservation Act (NHPA). Under the Advisory Council's regulations, a determination of either adverse effect or no adverse effect must also be made for affected 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 National Register. 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 National Register.

Negligible: Impact to the resource is barely perceptible and not measurable and is confined to a very small local area. The Section 106 determination of effect would be no adverse effect.

Minor: Adverse impact – Impact(s) would not affect a character-defining pattern, behaviors of individuals, and features of the local heritage. The Section 106 determination of effect would be no adverse effect.

Moderate: Adverse impacts would alter a character-defining pattern or features of the local heritage, but would not diminish the integrity of the local heritage. The Section 106 determination would be adverse effect.

Major: Adverse impacts would alter a character-defining pattern or features of the local heritage and diminishing the integrity of the local heritage. The Section 106 effect would be adverse effect.

For **Park management and operations** impacts:

Negligible: Impacts would be barely detectable, any alterations or conflicts with legislative mandates, goals, policies, etc. could be alleviated through a brief administrative process.

Minor: A waiver or other administrative process for two management policies would be required or the NPS would deviate from two policies or guidelines.

Moderate: A waiver from more than two management policies would be required or the NPS would deviate from one or two policies and guidelines. The NPS would deviate from any legislative mandate.

Major: Adverse impacts include deviation from NPS policies and/or guidelines would require extensive administrative change.

For **socioeconomic condition** impacts:

Negligible: Impact to local businesses and communities would be barely perceptible and not measurable and confined to a very small area.

Minor: Limited adverse effects on local businesses and communities would be temporary and restricted to elk related issues/businesses in the immediate area.

Moderate: Local businesses, including those not directly related to elk, would lose or gain visitor/agricultural related business in the immediate area and other portions of Tennessee and North Carolina adjacent to the Park.

Major: Significant losses of visitor/agricultural generated business in the immediate area and throughout the Southeast.

For **visitor and employee safety** impacts:

Negligible: Impacts would be barely detectable, hence visitors/employees would not be aware of any effects or changes to the elk program. There would be no noticeable change in safety.

Minor: For adverse impacts, visitors/employees would be aware of the safety issues, but this would not appreciably increase risk for the majority of visitors/staff. For beneficial impacts, public/staff safety would be enhanced for a small number.

Moderate: Adverse impacts would result in a change of a few critical safety factors for the public and/or Park staff. Public satisfaction would begin to either decline or increase as a result of the effect.

Major: Multiple critical characteristics of visitor and employee safety would change. The public would be aware of the effects associated with implementing the alternative and public/employee satisfaction would markedly decline or increase.

For **visitor use and experience** impacts:

Negligible: Impacts would be barely detectable; hence, visitors would not be aware of any effects or changes to the elk program. There would be no noticeable change in public use and experience or in any indicators of visitor satisfaction or behavior.

Minor: For adverse impacts, visitors would be aware of effects, but this would not appreciably limit critical characteristics of a majority of the visitors.

Moderate: Adverse impacts would result in a change of a few critical characteristics of the desired public experience. Public satisfaction would begin to either decline or increase as a result of the effect.

Major: Multiple critical characteristics of the desired public experience would change. The public would be aware of the effects associated with implementing the alternative and public satisfaction would markedly decline or increase.

NO ACTION ALTERNATIVE

NATURAL RESOURCES

Vegetation (included sensitive and rare/threatened and endangered)

The No Action Alternative would involve the continuation of all vegetation monitoring that was already occurring as part of the routine GRSM inventory and monitoring program prior to the elk release. However, no new sampling would be initiated that is geared specifically toward the management of elk.

Impact Analysis: Park vegetation would be utilized by elk for food, cover, and travelling and this could have an adverse effect on said vegetation. As an herbivore, elk are considered grazers feeding primarily on grasses supplemented with woody browse and acorns during the fall. Barring any significant changes, the habitat analysis of elk in the Park conducted by Murrow (2007) suggests that there is sufficient vegetation to provide an adequate food source and cover for the current small elk population without negatively impacting vegetation used by other wildlife or destroying habitat.

There are five plants indigenous to the western North Carolina counties within GRSM listed under the authority of the Endangered Species Act of 1973 that are endangered or threatened. The Rock Gnome Lichen, Spreading Avens, and Virginia Spiraea occur in such specific and rugged habitats that elk most likely would not use or impact. While the Small-Whorled Pogonia and Swamp Pink may occur in areas of eventual elk use, to date, no known population has been documented to be impacted by elk herbivory or even within the current elk range. At the beginning of the experimental project (Appendix C; separate attachment), the Park initiated informal consultation with the U.S. Fish and Wildlife Service and received concurrence that this alternative would result in no effect to listed species.

In addition to these species, there are other plant species that are considered sensitive. The possibility exists that any of these species may occur within areas elk currently reside or areas where they would range in the future. There has been no documentation of elk impacting these specific species (as a food source or trampled in trails, bedding areas, and/or wallows), and none is expected. During the implementation of the No Action Alternative, elk movement would be monitored through the use of radio-telemetry; however, individual plant species impacts would not be monitored throughout the range of elk unless monitoring is already underway for other purposes. If resource management staff, during regular vegetation monitoring, encounter areas that plant populations are being negatively impacted in the long-term, they could implement exclusionary measures, as appropriate.

There could be direct management activities associated with elk that would be beneficial to certain vegetative communities. There is the possibility that elk could be beneficial to maintaining the grassy balds atop mountains. This would decrease the need for manual / mechanical control of encroaching woody species. Elk have been documented utilizing bald habitat in GRSM. The overall impact to vegetation in the GRSM has been determined to be local moderate impacts and minor impacts for the Park overall.

Cumulative Impacts: Potential for bald maintenance could be an additive managerial benefit. However, with the No Action Alternative, there would be no active long-term elk-vegetation monitoring. Management objectives would remain fixed and inflexible, and the future impacts on natural resources, while difficult to predict, could

range from minor to moderate, based on other Parks' experiences and the last 10 years of elk and vegetation data that has thus far been collected. Therefore, there could be localized negative cumulative impacts.

Conclusions: At current densities, elk do not appear to be a threat to Park vegetation. The overall impact to vegetation in GRSM has been determined to be moderate. In the No Action Alternative, impacts to vegetation will only be monitored in ways that have already been monitored in Cataloochee Valley in the past, prior to the presence of elk. There is potential for major adverse impacts on vegetation that is repeatedly fed upon by elk over time, including impacts such as regeneration issues, changes in habitat for other species, and changes in forest structure. In the No Action Alternative, elk management remains unchanged and thus any adverse effect on vegetation over time would be additive while certain habitats may be slightly benefited. The impacts of continuing the current elk management at Great Smoky Mountains National Park (No Action Alternative) were determined to result in beneficial and moderate localized adverse effects.

Wildlife (including Threatened and Endangered Species)

The No Action Alternative would implement no changes to the past and current management of other wildlife in and around Cataloochee and other areas with elk.

Impact Analysis: Competition for vegetative cover is unlikely to be an issue as supported by other reintroduction efforts in eastern states and the fact that they coexist with the same or similar animal species throughout their western range. For example, elk and deer have been coexisting in the same ranges for thousands of years. The species have overlapping but not identical feeding style and requirements. Deer have biological characteristics that require them to specialize in eating nutritious browse like shrubs that are high in energy and easy to digest. Elk are generalists in that they are adapted to eating nutritionally deficient grasses as well as nutritious shrubs. The limited competitive effects of elk on deer are even further reduced in areas that have milder winter climates.

Acorns, when available, provide an important food source for wildlife species in the fall and winter. The significance elk would have on the annual acorn crop within the Park thus far appears to be negligible, based on the food habit study conducted and limited necropsy results. During the experimental program there was no evidence of elk utilizing acorns until the 6th year of the project. Elk calves may have a minor beneficial impact since they are a food source for black bears and to a lesser degree, coyotes. Overall impact to other wildlife in GRSM has been determined to be negligible.

There are 20 animals (vertebrates and invertebrates) indigenous to GRSM and surrounding area listed under the authority of the Endangered Species Act of 1973 as federally endangered or threatened. In addition to these species, there are other animal species that are considered sensitive. GRSM has evaluated the habitat requirements and impact of competition for food and cover, as well as direct conflict and determined that the current elk population would not adversely or beneficially impact any of these federally listed threatened and endangered animal species. At the beginning of the experimental project (Appendix C; separate attachment) and during the current environmental assessment development, the Park initiated informal consultation with the U.S. Fish and Wildlife Service and received concurrence that this alternative would result in no effect to

listed species. The impact to threatened and endangered species has been determined to be negligible, as has the potential impact to the other wildlife species in the Park. There is no evidence or data to suggest the fauna in GRSM would be negatively impacted by this elk herd.

The No Action Alternative involves intensive management of elk within their current locations. Elk would continue to be managed by park staff through the use of animal deterrents, aversive conditioning, fence construction, and elk removal. Euthanasia would continue to be used on a case by case basis when other elk management actions are unsuccessful or if immediate action is determined to be necessary. All elk would continue to be collared and monitored daily including calves. Park personnel would respond to all elk incidents within and, in cooperation with the NCWRC, outside of the Park. These animal handling techniques would be labor intensive and would require the continuation of extensive animal handling – from collaring and monitoring to aversion conditioning to elk removal and / or euthanasia. During the eight-year experimental period this same intensity of animal handling techniques was used and the overall elk population grew. It is expected that under the No Action Alternative, the effects of continuing the same extensive level of animal handling would be negligible to the herd.

Under the No Action Alternative there would be no prescribed pro-active management strategies, such as herd reduction, if the population grew too large. Unbounded positive growth in the long term can reasonably be expected to lead to population related consequences to elk such as increased competition for resources among elk (leading to increased energy expenditures), increased elk movement, and may influence the transmission of density dependent diseases.

Cumulative Impacts: Minor additive beneficial effects are expected for black bears and to a lesser degree coyotes. This beneficial effect comes in the form of a wildlife food source (elk calves) available to these predators species. At the current small population size, there would be no adverse effect to other wildlife species due to competition for food or cover. With a future increasing elk population, the foreseeable adverse effects would still be negligible. Initially under this alternative, elk as a species would initially see no beneficial or adverse effects under this alternative. While there is a lack of scientific data on elk in habitat similar to the southern Appalachians elsewhere in the U.S., positive growth in elk population is expected to continue and lead to increased competition for resources among elk and increased herd and individual animal movement. The adverse effects of these population related conditions may result in minor to moderate adverse effects upon elk.

Conclusion: The No Action Alternative has thus demonstrated the potential for a negligible adverse and beneficial impact to other wildlife natural resources.

NATURAL RESOURCE IMPAIRMENT: Localized, minor to moderate effects could be expected in both the short and long-term regarding elk impacts to vegetation. These conclusions are drawn based on other National Park's experiences and professional opinions. While there is no evidence to suggest this alternative rising to the level of impairment and the current data does not indicate that this elk herd is adversely affecting

any natural resource in the Park, the possible future impact to vegetation and the lack of monitoring and mitigation proposed in this No Action Alternative could potentially lead to adverse impacts to Park natural resources.

While there are approximately 10 years of data on the GRSM elk population, there are several questions that have incomplete answers and future conditions that NPS cannot anticipate. This lack of data is exacerbated by the fact that there is not scientific data on elk in habitat similar to the southern Appalachians elsewhere in the U.S. Therefore, these impacts have been evaluated on all available data, along with many professional opinions.

CULTURAL RESOURCES

The No Action Alternative would implement no changes to the past and current management of cultural resources in and around Cataloochee and other areas with elk.

Impacts Analysis: The adverse effects of elk on cultural resources are largely focused on two aspects, protection of historic structures and on protection of archeological resources. In addition, elk may result in a minor beneficial influence on the cultural landscapes by contributing to the landscape and maintaining open fields. Although GRSM does contain several historic structures, any elk damage would probably be in the form of direct scarring historic structures during shedding of velvet and during the breeding season. This possibility would be considered remote and would be difficult to detect. The impact to historic structure would be negligible. None of the activities associated with this action would affect museum collections. It is possible that the presence of elk, particularly when they congregate, may expose archeological resources; however, this possibility is considered to be remote, localized and would be difficult to detect, and the impact would be negligible.

Cultural Resources Cumulative Impacts: Cumulative adverse effects to historic structures may be additive over time but would still be minor and easily mitigated. There are no foreseeable cumulative impacts to archeological resources or cultural heritage other than the attractive element of visitation to the areas where elk congregate which may have indirect cumulative impacts to historic structures, archeology or cultural landscapes (i.e., graffiti, litter, trampling).

Cultural Resources Conclusion: The No Action Alternative has thus demonstrated the potential for a negligible adverse and long-term beneficial impact to cultural resources.

CULTURAL RESOURCES IMPAIRMENT: This alternative would not produce any major direct or indirect adverse impacts and any impacts that do occur would not rise to the level of impairment of archeological resources, historic resources, and cultural landscapes whose conservation is necessary to the purpose of the establishment of the Park, that are key to the natural or cultural integrity of the Park, or that are actions identified as a management goal of the Park. This determination is based on the fact that integrity of these resources will not be destroyed and opportunities for enjoyment of these resources

would still exist. Further, any localized adverse effects that may occur in the short and long-term would be mitigated through preservation, restoration, or protective measures of these significant cultural resources.

While there are approximately 10 years of data on the GRSM elk population, there are obviously many questions that have incomplete answers and future conditions that NPS cannot evaluate at this time. This lack of data is exacerbated by the fact that there is not scientific data on elk in habitat similar to the southern Appalachians. Therefore, these impacts have been evaluated on the available data gathered over the last 10 years. GRSM continues to gather information on the impacts of the current elk herd and recognizes the need to continue to identify what information is lacking and what data will be crucial for proper elk management in the future.

SOCIOECONOMIC IMPACTS

Maintaining the elk program via the No Action Alternative would continue the socioeconomic benefits and losses that have been realized to date.

Impact Analysis: While specifics have not been gathered, based on elk nuisance issues, the level of monetary adverse impacts associated with property damage and elk to the community is assumed to be negligible overall but minor in four specific locations: private property on the Cherokee Indian Reservation around the Oconaluftee Visitor Center and Big Cove, the Suttontown area off of Cove Creek Road, and the White Oak community off of White Oak Road. The overall acreage negatively impacted by elk has been small (<200 total acres across 4 counties in 2 states) consisting mostly of small family gardens, non-commercial fruit trees, and minor fence damage. Under the No Action Alternative, property damage would likely not change. The past zone management would continue (see Appendix B; separate attachment)

Monetary benefits to the community are unknown but considered to provide both direct and indirect enhancements to the communities of Waynesville and Maggie Valley, NC and on the Cherokee Indian Reservation, including increased visitation and consumption directly related to elk viewing and elk paraphernalia sales.

Cumulative effects: With the no action alternative, elk management would remain unchanged and thus minor beneficial effects can be identified with ecotourism and would be potentially additive over time. A minor adverse effect can be identified with elk-human conflict which could be additive with population growth over time.

Conclusion: Minor monetary beneficial effects would be expected when considering the benefits of elk ecotourism in the Park and within other areas regionally. Localized minor adverse effects would be expected over-time owing to land-owner property damage in the surrounding community. The No Action Alternative combats the adverse impacts of elk on the socio-economic conditions with aversive conditioning and community education regarding elk biology and management, which is a continuation of current policy.

PARK MANAGEMENT AND OPERATIONS IMPACTS

Maintaining the elk program via the No Action Alternative would continue the existing Park management and operations program.

Impact Analysis: Retaining the No Action Alternative would continue impacting Park management and operations, as it is to date. However, the possibility of increased direct adverse impact on Park staff time may occur with an expanding elk population (no population control options). There is potential for additional duties for resource management staff and Park rangers, especially regarding elk-human conflict and traffic control. However, primary responsibility of responding to elk nuisance issues outside of Park boundaries will be coordinated with and slowly be transitioned to the appropriate jurisdictional body.

Cumulative Impacts: Cumulative impacts are largely associated with increased visitation to the Cataloochee Valley as a result of elk reintroduction. With increased visitation, there has been a need to increase facilities (i.e., restrooms and picnicking sites) to accommodate visitation. The added facilities were previously envisioned and planned with the Cataloochee Design Concept Planning (DCP) process and therefore were not inconsistent with the needs of the elk associated visitation. The added facilities may increase staffing needs in the Cataloochee area, but again that was contemplated in the DCP process. Cumulative impacts would therefore be considered moderate but localized. Cumulative impacts are largely considered beneficial as the Park is intended to support a positive visitor experience.

Conclusion: The No Action Alternative has thus demonstrated the potential for minor adverse impacts associated with Park management and operations resources due to increased staffing needs but is balanced by the beneficial effects of improving visitation to the area and the direct beneficial impact of transitioning elk outside of Park boundaries to the appropriate agency.

VISITOR AND EMPLOYEE SAFETY IMPACTS

Maintaining the elk program No Action Alternative would continue the visitor and employee safety issues that have been realized to date.

Impact Analysis: Humans who approach elk too closely may trigger defensive behavior in elk. Protection of visitors by staff and volunteers is a primary concern and resulted in a 2001 revision to the Park's Compendium requiring a minimum 50 yard distance be maintained between elk and visitors/staff. Traffic congestion associated with visitation to elk congregation areas may also increase risk associated with vehicle collisions and accident related personal injuries. However, there have been few issues in GRSM, and the No Action Alternative would continue the current level of enforcement.

Cumulative Impacts: There are no cumulative adverse or beneficial effects expected when considering the No Action Alternative and other Visitor and Employee Safety issues.

Conclusion: The adverse impacts associated with Visitor and Employee Safety issues under this alternative are considered negligible.

VISITOR USE AND EXPERIENCE IMPACTS

The No Action Alternative for elk management would not involve any alterations to experience or opportunities for visitors.

Impact Analysis: The Southern Appalachian Mountains and the Great Smoky Mountains are known for their unique beauty and diversity. People now visit the Park with expectations of experiencing outdoor activities that would include the benefit of seeing elk. The indirect recreational benefits of elk viewing extend to areas outside the Park. Many visitors come from areas outside the Southern Appalachians to see elk in the Park. These benefits would be considered minor. The No Action Alternative continues to permit this experience and would have no adverse effect on the current uses of the Park by the community. No direct adverse effects are expected with the No Action Alternative for elk management as it does not involve any alterations to land-use. Elk management does not adversely affect other recreational activities. Conflicts between elk viewers and other recreational and residential activities are minimized by the fact that many of these activities are not collocated. However, elk could create some minor indirect adverse effects among the perception by the non-elk visitors. Individuals may avoid visiting the Park due to traffic/visitor volume in Cataloochee during certain times of the year.

Cumulative Impacts: Beneficial effects to recreational uses are expected when considering the benefits of elk in the Park and within other areas regionally.

Conclusion: The No Action Alternative continues to permit the current elk experience and would have negligible adverse effects on the current uses of the Park by the community and does not involve any alterations to land-use. Issues surrounding Visitor Use and Experience are considered negligible.

ADAPTIVE MANAGEMENT ALTERNATIVE (Environmentally Preferred and Preferred Alternative)

NATURAL RESOURCES

Vegetation (included sensitive and rare/threatened and endangered)

The Adaptive Management Alternative prescribes unique vegetation monitoring to follow trends in elk feeding impacts and vegetative response (Appendix A). This

monitoring would be supplemental to and in conjunction with the inventory and monitoring the Park already has in place.

Impact Analysis: Park vegetation will be utilized by elk for food and cover and this would potentially have an adverse effect on said vegetation. As an herbivore, elk are considered grazers feeding primarily on grasses supplemented with woody browse and acorns during the fall. The habitat analysis of elk in the Park conducted by Murrow (2007) suggests that there is sufficient vegetation to provide an adequate food source and cover for the currently small elk population without negatively impacting vegetation used by other wildlife or destroying habitat.

There are five plants indigenous to the western North Carolina counties within GRSM listed under the authority of the Endangered Species Act of 1973 that are endangered or threatened. The Rock Gnome Lichen, Spreading Avens, and Virginia Spiraea occur in habitats that elk most likely would not use or impact. While the Small-Whorled Pogonia and Swamp Pink may occur in areas of eventual elk use, to date, no known population has been documented to be impacted by elk herbivory. Furthermore, the Small-Whorled Pogonia occurs in very small clumped grouping which could easily be protected and Swamp Pink is at its southern range, with its stronghold occurring in New Jersey. The size of this elk population and current elk density have not demonstrated any impact to any of the listed species. At the beginning of the experimental project (Appendix C; separate attachment), the Park initiated informal consultation with the U.S. Fish and Wildlife Service (USFWS) and received concurrence that this alternative would result in no effect to listed species. Currently, informal consultation has initiated by telephone with USFWS, and the endangered and threatened species list has been updated from the 2000 assessment.

There are other plant species that are considered sensitive. The possibility exists that any of these species may occur within areas elk currently reside or areas where they will range in the future. Currently, there has been no documentation of elk impacting these species (as a food source or trampled in trails, bedding areas, and/or wallows). Under the Adaptive Management Alternative, elk movement would be monitored through the use of radio-telemetry, and overlapping known populations of endangered/sensitive/rare species would be monitored as deemed appropriate.

There are activities associated with elk that could be beneficial to certain vegetation communities, such as certain Bald communities or coves habitats being encroached by white pine. If elk help to maintain the grassy balds atop mountains, this would decrease the need for manual / mechanical control of encroaching woody species. Elk have been documented utilizing bald habitat in GRSM. The overall impact to vegetation in the GRSM would be locally moderate adverse.

Cumulative Impacts: Overall, vegetation communities would likely incur minor adverse and beneficial effects with the implementation of the Adaptive Management Alternative. Potential for bald maintenance could be an additive managerial benefit. With adaptive management, there would be active elk-vegetation monitoring, and elk management objectives would be flexible depending on identified impacts. Although the timing and intensity of the monitoring may vary, management objectives would be adjusted based on accumulated information, thereby allowing for flexible management of elk and limiting additive impacts on vegetation communities. This management style

negates the potential for major adverse cumulative impacts on vegetation that is repeatedly fed upon by elk. When those cumulative impacts are detected in monitoring, Park staff will have an array of management options to prevent further degradation. Cumulative effects associated with other Park related issues would be the same as those presented under the No Action Alternative and include minor localized impacts associated with increased visitation (i.e., trampling of roadside vegetation) and development related vegetation impacts such as construction of additional restroom, picnicking facilities, or road improvements which are covered in the Cataloochee Development Concept Plan. Those cumulative impacts would be covered in a separate compliance document when/if that plan comes to fruition.

Conclusions: At current densities and based on all available data, elk do not appear to be a threat to Park vegetation at this time. Elk in Great Smoky Mountains National Park were determined to result in beneficial and moderate localized adverse effects based on their future potential to impact vegetation. However, in the Adaptive Management Alternative, impacts to vegetation will be monitored to determine trends in elk-vegetation relationships and guide population manipulation to compensate. Thus, the impacts of the adaptive management of elk in GRSM were determined to result in minor beneficial and minor localized adverse effects. The overall impact to vegetation in the GRSM would be minor because of the monitoring that will take place over time and the array of management responses available for mitigation.

Wildlife (including Threatened and Endangered Species)

The Adaptive Management Alternative for elk does not involve any alterations to current wildlife management, aside from the management of the elk population itself.

Impact Analysis: The impacts of the Adaptive Management Alternative are the same as the No Action Alternative for all wildlife resources. However, if there are decreases in certain vital rates, the Park many consider short-term predator management including bear relocation. During a segment of the experimental phase of the project (2006, 2007 2008), bears captured in the primary calving area were relocated to other areas within the Park. Bear relocation and the associated handling process are widely accepted aversive conditioning techniques in the management of bears showing negligible adverse effect to bear. The Adaptive Management Alternative should otherwise not directly or indirectly adversely or beneficially impact any of wildlife species, including federally listed threatened and endangered animal species. The impact to wildlife other than elk, including threatened and endangered species, has been determined to be negligible.

Under the Adaptive Management Alternative, a subset of the elk population will be monitored. The actual number of animals monitored with radio- telemetry equipment would vary with a general monitoring goal being to maintain 25 females, 5 males, all possible calves during their first year, elk that travel long distances and any known nuisance animals. The overall number of elk monitored would be less than under the No Action Alternative while the same animal handling procedures would be required to accomplish this monitoring. During the eight-year experimental period, one animal is known to have suffered adverse effect from the handling techniques used. The overall elk

population also grew under these conditions of animal handling. While individual elk may suffer short-term adverse effects from the handling techniques used, it is expected that under the Adaptive Management Alternative the impacts of monitoring the elk would be negligible to minor adverse to the GRSM elk herd.

Under the Adaptive Management Alternative, if there are increases in vital rates and /or there are signs/indications through monitoring that visitor or other resource considerations related to an increased elk population level are becoming evident, the Park may translocate (animal relocation) elk to other herds or areas (if feasible and needed) or cull (animal euthanasia) a portion of the herd. Both of those techniques have been shown to stabilize or decrease population growth or expansion in other elk herds. Translocation and culling of elk when managed as an ongoing action guided by the result of monitoring, would result in removals of small numbers of elk at any one time (general goal of managing to remove no more than five to ten elk at any one time).

Removal activities, whether through culling or relocation, would cause intermittent disturbance of the elk herd. Individual elk actually removed from the herd would experience moderate (translocation) to major (culling) adverse effect. Remaining individual elk would experience increased stress and expenditure of energy as a result of noise and / or roundup activities. Dependent upon the time of year, other environmental conditions may result in additional stress to the animals (heat, cold, drought, snow cover). Park management, when managing to remove small numbers of animals, will have more flexibility in accomplishing these removal activities at certain times of the year and by using means resulting in less stress to the remaining herd. The impact of removal activities on the elk herd would be adverse minor to moderate in the short term while the long term impact managing the herd size would be a major beneficial impact as a result of maintaining a healthful balance of elk population to available suitable habitat.

When addressing nuisance elk behavior in GRSM and adjacent private and public properties the same elk management techniques as those used in the eight-year experimental period will be implemented. Aversive conditioning, fencing and animal deterrents have all been utilized under the eight-year experimental period with varying degrees of success dependent upon the individual animal and the behavior being managed. While the individual animal would experience some stress as a result of these management actions, when successful, normally reduce or eliminate the nuisance behavior and allow for the continued survival of the individual animal. Animal euthanasia, during the eight-year experimental period was implemented on a case by case basis. During the eight-year experimental period, the overall elk population in GRSM grew. The impact to the GRSM elk herd of these continued activities is expected to be negligible.

Under the Adaptive Management Alternative the Park would monitor the herd for general health and disease surveillance. As part of the monitoring activities discussed above, elk will be monitored for indicators of disease and general health when individuals are captured for radio-collaring and during visual inspection of the herd while radio-tracking. Additionally, Park employees will collect samples for CWD monitoring whenever feasible. If a disease of concern is detected, depending on the disease, an array of actions may take place. For example, if meningeal worm is suspected, the Park may take no action or, if the animal shows symptoms of neurologic problems in heavy visitor use areas, the animal may be euthanized and removed. If a more serious regulatory disease is detected,

the disease impact to other animal resources in and around the park will be considered and the herd could be culled severely or totally depopulated.

Cumulative Impacts: No additive beneficial effects are expected to wildlife other than elk and at the small population size; the adverse effects to wildlife other than elk would be negligible. Furthermore, the Adaptive Management Alternative allows for changes in management, given any significant increase in elk population size. These management actions will result in minor to moderate adverse impacts to the GRSM elk herd in the short term but major beneficial impacts to the GRSM elk herd over the long term. In the unlikely incidence of a regulatory disease being detected in the Park elk herd, the utilization of the most aggressive action of total depopulation would have a major adverse impact on the GRSM elk herd but could have a major beneficial impact in preventing the potential spread of the disease to other animal populations. Other Park operations and visitation would be conducted as under the no action and thus cumulative impacts associated with DCP activities or visitation would be the same and considered negligible.

Conclusion: The Adaptive Management Alternative has thus demonstrated the potential for a negligible adverse and beneficial impact to other wildlife natural resources. The impact to wildlife, including threatened and endangered species, has been determined to be negligible.

NATURAL RESOURCES IMPAIRMENT: Under the Adaptive Management Alternative, impacts to vegetation would be monitored to generally gauge the overall status of the elk population and its effects on the Park's natural resources. Based on the results of such monitoring, Park staff would be able to react to changing conditions associated with the elk population and adjust management actions to protect resources. Therefore, only negligible and minor adverse effects are expected for natural resources, and those effects would not rise to the level of impairment. This determination of impairment was assessed based on the fact that the integrity of these resources will not be allowed to be destroyed and opportunities for enjoyment of these resources will still be present.

While there are approximately 10 years of data on the GRSM elk population, there are obviously many questions that have incomplete answers and future conditions that NPS cannot evaluate at this time. This lack of data is exacerbated by the fact that there is not scientific data on elk in habitat similar to the southern Appalachians. Therefore, these impacts have been evaluated on the available data gathered over the last 10 years. GRSM continues to gather information on the impacts of the current elk herd and recognizes the need to continue to identify what information is lacking and what data will be crucial for proper elk management in the future.

CULTURAL RESOURCES

The Adaptive Management Alternative would not result in any change to the past and current management of cultural resources in and around Cataloochee and other areas with elk.

Impacts Analysis: The impacts of the Adaptive Management Alternative would be the same as the No Action Alternative for all cultural resources. The effects of elk on cultural resources would largely be focused on two aspects, protection of historic structures and on protection of archeological resources. In addition, elk can be a beneficial influence on the cultural landscapes by maintaining the open field appearance and contributing to the cultural landscape. Although GRSM does contain several historic structures, any elk damage would probably be in the form of scarring historic structures during shedding of velvet and during the breeding season. This possibility would be considered remote and would be difficult to detect. The impact to historic structures would be negligible and the same under either alternative considered. None of the proposed actions would affect museum collections. It is possible that the presence of elk, particularly when they congregate, may expose archeological resources; however, this possibility would be considered to be remote and would be difficult to detect as it would be localized, and the impact would be negligible.

Cultural Resources Cumulative Impacts: Cumulative adverse effects to historic structures may be additive over time but would still be minor and easily mitigated. There are no foreseeable cumulative impacts to archeological resources or cultural heritage other than the attractive element of visitation to the areas where elk congregate which may have indirect cumulative impacts to historic structures, archeology or cultural landscapes (i.e., graffiti, litter, trampling).

Cultural Resources Conclusion: The Adaptive Management Alternative has thus demonstrated the potential for a negligible adverse and beneficial impact to cultural resources.

CULTURAL RESOURCES IMPAIRMENT: This alternative would not produce any major adverse impacts and any impacts that do occur would not rise to the level of impairment of archeological resources, historic resources, and cultural landscapes whose conservation is necessary to the purpose of the establishment of the Park, that are key to the natural or cultural integrity of the Park, or that are actions identified as a management goal of the Park. This determination of impairment was based on the fact that the integrity of these resources will not be destroyed and opportunities for enjoyment of these resources will still be present. Further, adverse effects that may occur could be mitigated through preservation, restoration, or protective measures of these significant cultural resources.

While there are approximately 10 years of data on the GRSM elk population, there are obviously many questions that have incomplete answers and future conditions that NPS cannot evaluate at this time. This lack of data is exacerbated by the fact that there is not scientific data on elk in habitat similar to the southern Appalachians. Therefore, these impacts have been evaluated on the available data gathered over the last 10 years. GRSM

continues to gather information on the impacts of the current elk herd and recognizes the need to continue to identify what information is lacking and what data will be crucial for proper elk management in the future.

SOCIOECONOMIC IMPACTS

Maintaining the elk program via the Adaptive Management Alternative would continue the socioeconomic benefits and losses that have been realized to date.

Impact Analysis: The impacts of the Adaptive Management Alternative are the same as the No Action Alternative for the socioeconomic issues. The level of monetary negative impacts to the community is negligible overall but minor in four specific locations: private property on the Cherokee Indian Reservation around the Oconaluftee visitor center and Big Cove, the Suttontown area off of Cove Creek Road, and the White Oak community off of White Oak Road. The overall acreage negatively impacted by elk has been small (<200 total acres across 4 counties in 2 states) consisting mostly of small family gardens, non-commercial fruit trees, and minor fence damage. Under the Adaptive Management Alternative these types of incidents are still likely to occur but are generally minor and localized. These effects may be mitigated some by timely aversive conditioning which may serve as a deterrent of future behaviors.

The monetary benefits to the community are considered to be both direct and indirect enhancements to the communities of Waynesville and Maggie Valley, NC and on the Cherokee Indian Reservation. The monetary benefit comes in the form of increased consumer spending directly related to elk viewing and elk paraphernalia sales. This monetary benefit should remain the same under the Adaptive Management Alternative.

Cumulative effects: With the Adaptive Management Alternative, elk management remains unchanged and thus a minor beneficial effect can be identified with ecotourism and would be potentially be additive over time. A minor adverse effect can be identified with elk-human conflict which could be additive with population growth over time. Cumulative effects associated with increased visitation are long-term and beneficial. The Adaptive Management Alternative combats the adverse impacts of elk on the socio-economic conditions with aversive conditioning, community education regarding elk biology and management, and potential for population size manipulation if critical threshold criteria are reached (see Elk Management Plan, Appendix A).

Conclusion: Minor monetary beneficial effects are expected when considering the benefits of elk ecotourism in the Park and within other areas regionally. Minor adverse effects are potentially expected over time associated with land-owner property damage in the surrounding community but should be mitigated based on authorized agency action and adaptive Management population monitoring within the Park. The Adaptive Management Alternative has thus demonstrated the potential for a negligible adverse and beneficial impact to socioeconomics.

PARK MANAGEMENT AND OPERATIONS IMPACTS

The Adaptive Management Alternative will potentially impact Park management and operations in two differing ways: one adverse and one beneficial.

Impact Analysis: The possibility of increased direct adverse impact may occur with an expanding elk population. There is potential for additional duties for resource management staff and Park rangers in training state and tribal partner resource staff in elk management and behavior, especially regarding elk-human conflict and traffic control. There are mechanisms within the Adaptive Management Alternative that allow for manipulation of the elk population size if certain gauges are triggered and may result in increased resource management efforts to address those management issues. If elk monitoring indicated that elk were adversely impacting other natural resources, action may be taken to meet elk management objectives (i.e., reduce impacts to Park resources) and a series management tools would be available (see Elk Management Plan).

There is a beneficial effect relating to management and operations, given that elk-human conflict and nuisance issues outside the Park will be transitioned to the proper land-governing agency, i.e. NCWRC, TWRA, U. S. Forest Service, and Cherokee Indian Reservation Wildlife Staff.

Cumulative Impacts:

The Adaptive Management Alternative, as with the No Action Alternative, has cumulative impacts largely associated with increased visitation to the Cataloochee Valley as a result of elk reintroduction. With increased visitation, there has been a need to increase facilities (i.e., restrooms and picnicking sites) and staffing, including volunteers to accommodate visitation. The added facilities were previously envisioned and planned with the Cataloochee Design Concept Planning (DCP) process and therefore were not inconsistent with the needs of the elk associated visitation. Cumulative impacts would therefore be considered moderate but localized. Cumulative impacts are largely considered beneficial as the Park is intended to support a positive visitor experience.

Conclusion: Cumulative impacts associated with increased visitation due to the elk population have resulted in changes to Park staffing and the use of volunteers to address visitor needs. This impact would occur regardless of the alternative as the animals are present under each scenario. The Adaptive Management Alternative supports flexible management of the elk population based on scientific evidence and resource management concerns.

The Adaptive Management Alternative demonstrates the potential for a minor adverse impact associated with Park management and operations resources, which is balanced by the elk management plan (Appendix A) and the moderate beneficial effects of improving visitation to the area. It also demonstrates the potential for minor direct beneficial impacts by turning over primary responsibility for elk outside Park boundaries, which is the same in the no action. Therefore, Park management and operational issues are negligible.

VISITOR AND EMPLOYEE SAFETY IMPACTS

The Adaptive Management Alternative would continue the visitor and employee safety issues that have been realized to date.

Impact Analysis: The direct, indirect, and cumulative benefits from the Adaptive Management Alternative would be the same as for the No Action Alternative. Humans who approach too closely may trigger defensive behavior in elk. Protecting visitors places staff and volunteers at risk. Traffic congestion increases risk of vehicle collisions and associated personal injuries. However, there have been few issues in GRSM, and the Adaptive Management Alternative would continue the current enforcement and handling of these situations.

Cumulative Impacts: There are no cumulative adverse effects expected when considering the Adaptive Management Alternative and other Visitor and Employee Safety issues.

Conclusion: The impacts associated with Visitor and Employee Safety issues under this alternative are negligible.

VISITOR USE AND EXPERIENCE IMPACTS

The Adaptive Management Alternative for elk management does not involve any alterations to opportunities for visitors.

Impact Analysis: The direct, indirect, and cumulative benefits from the Adaptive Management Alternative would be the same as for the No Action Alternative. People now visit the Park with expectations of experiencing outdoor activities that would include seeing elk. The indirect recreational benefits of elk viewing extend to areas outside the Park. Many visitors come from areas outside the Southern Appalachians to see elk in the Park. These benefits would be considered minor. The action alternative continues to permit this experience and would have no adverse effect on the current uses of the Park by the community. No direct adverse effects are expected with this alternative for elk management as it does not involve any alterations to land-use. Elk management does not adversely affect other recreational activities. Conflicts between elk viewers and other recreational and residential activities are minimized by the fact that many of these activities are not collocated. However, elk could create some minor indirect adverse effects among the perception by the non-elk visitors. Individuals may avoid visiting the Park due to traffic/visitor volume in Cataloochee during certain times of the year.

Cumulative Impacts: Moderate beneficial effects to recreational uses are expected when considering the benefits of elk in the Park and within other areas regionally. No effects are expected to land-use components of the region.

Conclusion: This action alternative continues to permit the current elk experience and would have negligible adverse effects on the current uses of the Park by the community

and does not involve any alterations to land-use. Issues surrounding Visitor Use and Experience are considered negligible.

Consultation, Coordination, and Planning

CHAPTER 5

CONSULTATION AND COORDINATION

The intent of the National Environmental Policy Act is to encourage the participation of federal and state-involved agencies and affected citizens in the assessment procedure, as appropriate. This section describes the consultation that occurred during development of this Environmental Assessment and Elk Management Plan, including consultation with scientific experts and other agencies. This chapter also includes a description of the public involvement process and a list of the recipients of the draft document.

THE SCOPING PROCESS

The National Park Service divides the scoping process into two parts: internal scoping and external or public scoping. Internal scoping involved discussions among NPS personnel regarding the purpose of and need for management actions, issues, management alternatives, mitigation measures, the analysis boundary, appropriate level of documentation, available references and guidance, and other related topics. Public scoping is the early involvement of the interested and affected public in the environmental analysis process. The public scoping process helps ensure that people have an opportunity to comment and contribute early in the decision-making process. For this assessment and planning document, project information was distributed to individuals, agencies, and organizations initially in 2000. The objectives of this current Environmental Assessment are not a significant deviation from the initial EA conducted in 2000. Given these goals, the Park contacted pertinent agencies in an abbreviated partner stakeholder scoping process in developing this second EA. The following sections describe the various ways scoping was conducted for this assessment.

INTERNAL SCOPING

The internal scoping process began on February 19, 2009, at Great Smoky Mountains National Park headquarters, Gatlinburg, Tennessee. During the meetings, NPS employees identified the purpose of and need for action, management objectives, issues, and impact topics. Various roles and responsibilities for developing the elk management plan were also clarified. In addition, the Park had coordinated with The University of Tennessee for 8 years prior regarding all aspects of elk ecology in GRSM.

Internally, the proposal was reviewed by the Park management team and discussed with personnel from all divisions to make them aware of the proposal, solicit input, and to answer questions. Park employees evaluated the proper information and determined what was needed to be collected and evaluated, thereby allowing for proper management direction.

SPECIFIC AGENCY CONSULTATION

To date the NPS has consulted with the following groups and individuals on this Environmental Assessment:

- Tennessee Wildlife Resources Agency (TWRA)
- North Carolina Wildlife Resources Commission (NCWRC)
- United States Forest Service (USFS)
- Eastern Band of the Cherokee Indians
- University of Tennessee Staff
- North Carolina and Tennessee Department of Transportation Staff

Blue Ridge Parkway (National Park Service)-

A meeting was held on August 17, 2009 to initiate consultation with staff of the Blue Ridge Parkway regarding elk in GRSM and on other NPS lands in NC. Primary Contact: Bambi Teague

Eastern Band of the Cherokee Indians (EBCI)-

A meeting was held on June 11, 2009 to initiate consultation with the Cherokee Tribal leaders regarding elk in GRSM and on Cherokee lands. In June of 2009, a draft Memorandum of Understanding was submitted to the EBCI for consideration and based on input received during our June meeting. Primary Contact: Forrest G. Parker

North Carolina Wildlife Resources Commission-

A meeting was held on March 10, 2009 to initiate formal consultation with NCWRC regarding elk in GRSM and on other lands in NC. Two other meetings have taken place since that initiation, most recently February 26, 2010. Currently, NCWRC is in the internal process of vetting agency objectives and future management goals regarding elk. When their goals and objectives are finalized (~2-5 years), a more comprehensive, cooperative, and adaptive plan between the agencies may be established. GRSM recognizes NCWRC may have their own objectives and that both agencies goals may change over time. Primary Contact: David Cobb, Gordon Myers, Brad Howard

Tennessee Department of Natural Resources-

A meeting was held on May 18, 2009 to initiate consultation with TWRA regarding elk in GRSM and on other lands in TN adjacent to GRSM. TWRA was supportive of Park objectives and agreed to cooperatively manage elk that move in and out of the Park. Primary Contact: Steve Bennett

U. S. Fish and Wildlife Service- Informal consultation between Great Smoky Mountains National Park and U. S. Fish and Wildlife Service started in May of 2000. A letter dated September 20, 2000, from Great Smoky Mountains National Park requested formal consultation with the U. S. Fish and Wildlife Service about the impact of elk on federally listed rare, threatened, or endangered species in the Park. The U.S. Fish and Wildlife

Service replied on October 3, 2000, that no further consultation under Section 7 of the Endangered Species Act would be required because of the lack of foreseeable impacts on said species. The current Environmental Assessment has again been discussed in informal consultation with the Asheville Office of USFWS via telephone. GRSM has reviewed and updated the current endangered species list. The finalized document will be provided to USFWS in order to seek additional input in elk management.

U. S. Forest Service-

A meeting was held on May 18, 2009 (TN) and August 17, 2009 (NC) to initiate consultation with the USFS regarding elk in GRSM and on Forest Service in NC and TN. USFS has no current policy regarding elk on FS lands, and plan on reviewing that with their management. They agreed to work cooperatively with the Park. Primary Contact: Laura M. Lewis (TN) and Sheryl A. Bryan (NC).

This Draft Elk Management Plan / Environmental Assessment will be sent to the following agencies, organizations, and businesses, and will be available to other entities and individuals who requested a copy. Copies will be provided to libraries in the local communities, as well as at Park Headquarters.

- ✓ Blue Ridge Parkway
- ✓ Eastern Band of the Cherokee Indians
- ✓ North Carolina Department of Agriculture
- ✓ North Carolina Wildlife Resources Commission
- ✓ Tennessee Department of Transportation
- ✓ Tennessee Wildlife Resources Agency
- ✓ North Carolina Department of Transportation
- ✓ U. S. Fish and Wildlife Service
- ✓ U. S. Forest Service (NC and TN)

The public involvement activities for this Elk Management Plan / Environmental Assessment fulfill the requirements of the National Environmental Policy Act and NPS Director's Order #12 (NPS 2001b). Public notice regarding the availability of this Environmental Assessment will be distributed to any interested parties. A public comment period is scheduled to run from to The EA has been posted and is available for public review on the NPS' Planning web site at <http://parkplanning.nps.gov>. To access the project site select Great Smoky Mountains National Park and click on the "Project Title" link. The public can provide comments directly on the project site by clicking on "Comment on document" from the menu on the left. Written comments can be submitted to:

Superintendent
Great Smoky Mountains National Park
108 Park Headquarter Road
Gatlinburg, TN 37738

Public comments will be reviewed and responded to on an individual basis. Public comment will be summarized in the decision document.

RELATIONSHIP TO OTHER PLANNING EFFORTS

Several plans for GRSM and plans and policies defined by other agencies or organizations were considered in the development of this environmental assessment and elk management plan. These plans were considered and consulted prior to and during the planning and compiling of this document.

Cataloochee Development Concept Plan

This plan details resource management, visitor services, and development actions for the Cataloochee area within Great Smoky Mountains National Park. Since the main area elk reside in GRSM is Cataloochee, this plan is crucial to the future of all aspects of elk management. As this plan comes to fruition, appropriate NEPA documents and analyses will be produced.

GRSM Fire Management Plan

This plan details fire policy, objectives, and management throughout Great Smoky Mountains National Park. Since elk can be impacted by fire (both positively and negatively), this plan is integral to future aspects of elk management.

North Carolina Chronic Wasting Disease Response Plan

Chronic Wasting Disease (CWD) is a contagious neurological disease specific to species within the deer (Cervidae) family, including white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), Rocky Mountain elk (*Cervus elaphus*), and moose (*Alces alces*). Historical CWD surveillance and management actions for both captive and free-ranging cervids were initiated in 1999 and continue today. Discovery of CWD in Wisconsin prompted the North Carolina Wildlife Resources Commission (NCWRC) to develop a preventative disease management strategy in May 2002. Monitoring and surveillance of CWD were expanded for free-ranging white-tailed deer, including a statewide systematic sampling of hunter- and vehicle-killed deer and sampling around captive cervid facilities known to have imported cervids into North Carolina. Since CWD can be carried by elk, it was important to consider NCWRC policies and procedures regarding this disease. To date, no case of CWD has been detected in any cervid in North Carolina.

Tennessee Chronic Wasting Disease Response Plan

Due to the serious nature of the CWD, the Tennessee Wildlife Resources Agency (TWRA) elected to begin monitoring for the presence of CWD in Tennessee in 2002 by the collecting and testing tissue samples from selected wild deer and elk. Active surveillance through the collection of tissue samples from hunter killed deer, especially around captive cervid facilities and other high-risk areas will continue to be conducted well into the future. The Agency's surveillance efforts are designed to identify CWD in free-ranging and/or captive deer within the state of Tennessee. If CWD is identified, the CWD Response Plan outlines TWRA's management activities that will determine the magnitude and geographic extent of the CWD infection and control transmission of the disease.

Legislation and Regulation **Compliance**

CHAPTER 6

COMPLIANCE WITH APPLICABLE LAWS AND REGULATIONS

NORTH CAROLINA ELK STATUS

Elk in North Carolina are considered a nongame species of special concern. NCWRC instituted a rule change in 2009: (H52) allows the executive director to issue depredation permits for special concern species (15A NCAC 101 .0102 Protection of Endangered/Threatened/Special Concern). Any change in the legal designation of elk (e.g., game or unlisted nongame species) would require changes in North Carolina General Statutes or NCWRC rules.

NPS ORGANIC ACT

By enacting the NPS Organic Act of 1916, Congress directed the U.S. Department of the Interior and the National Park Service to manage units of the National Park System “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 U.S.C. 1). The Redwood National Park Expansion Act of 1978 reiterates this mandate by stating that the National Park Service 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 U.S.C. 1a-1).

Despite these mandates, the Organic Act and its amendments afford the National Park Service latitude when making resource decisions. By these acts Congress “empowered [the National Park Service] 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)). Yet, courts have consistently interpreted the Organic Act and its amendments to elevate resource conservation above visitor recreation. In *Michigan United Conservation Clubs v. Lujan* (949 F.2d 202, 206 (6th Cir. 1991)) the court stated, “Congress placed specific emphasis on conservation.” In *National Rifle Association of America v. Potter* (628 F.Supp. 903, 909 (D.D.C. 1986)) the court stated, “In the Organic Act Congress speaks of but a single purpose, namely, conservation.” The NPS Management Policies 2001 (USDI NPS 2000c) also recognize that resource conservation takes precedence over visitor recreation. The policy dictates, “when there is a conflict between conserving resources and values and providing for enjoyment of them, conservation is to be predominant” (USDI NPS 2000c, sec. 1.4.3).

Because conservation remains predominant, the National Park Service seeks to avoid or to minimize adverse impacts on park resources and values; however, the agency has discretion to allow negative impacts when necessary (USDI NPS 2000c, sec. 1.4.3). While some actions and activities cause impacts, the National Park Service cannot allow an

adverse impact that constitutes resource impairment (USDI NPS 2000c, sec. 1.4.3). Actions that impair park resources are prohibited unless a law directly and specifically allows for such actions (16 U.S.C. 1a-1). An action constitutes an impairment when, in the professional judgment of the responsible manager, 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” (USDI NPS 2000c, sec. 1.4.4). To determine impairment, the Park Service 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” (USDI NPS 2000c, sec. 1.4.4). Therefore, this plan assesses the effects of the alternatives on park resources and values, and it determines if these effects would cause impairment.

An impact on any park resource or value may constitute an impairment, but an impact would be more likely to constitute an impairment to the extent that it has a major adverse effect on 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.

NPS MANAGEMENT POLICIES 2006

Several sections from the *NPS Management Policies 2001* (NPS 2006) are relevant to future elk management in Great Smoky Mountains National Park, as described below. The *Management Policies* instruct park units to maintain as parts of the natural ecosystems of parks all native plants and animals. The National Park Service will achieve this maintenance 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” (NPS 2006c, sec. 4.4.1). Furthermore, the National Park Service “will adopt park resource preservation, development, and use management strategies that are intended to maintain the natural population fluctuations and processes that influence the dynamics of individual plant and animal populations, groups of plant and animal populations, and migratory animal populations in parks” (NPS 2006, sec. 4.4.1.1). Whenever the Park Service identifies a possible need for reducing the size of a park plant or animal population, the decision will be based on scientifically valid resource information that has been obtained through consultation with technical experts, literature review, inventory, monitoring, or research (NPS 2006, sec. 4.4.2.1).

Section 4.4.2 of the *Management Policies* also states that: Whenever possible, natural processes will be relied upon to maintain native plant and animal species, and to influence natural fluctuations in populations of these species. The Service may intervene to manage individuals or populations of native species when at least one of the following conditions exists: a population occurs in 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; to protect specific cultural resources of parks; to protect rare, threatened, or endangered species.

Section 4.4.2.1 of the *Management Policies* states, where visitor use or human activities cannot be modified or curtailed, the Service may directly reduce the animal population by using several animal population management techniques, either separately or together. These techniques include relocation, public hunting on lands outside the Park, habitat management, predator restoration, reproductive intervention, and destruction of animals by NPS personnel or their authorized agents. Where animal populations are reduced, destroyed animals may be left in natural areas of the Park to decompose.

DIRECTOR'S ORDER #12: CONSERVATION PLANNING, ENVIRONMENTAL IMPACT ANALYSIS AND DECISION-MAKING

NPS *Director's Order #12* and its accompanying handbook (NPS 2001b) lay the groundwork for how the National Park Service complies with the *National Environmental Policy Act* (NEPA). *Director's Order #12* and the handbook set forth a planning process for incorporating scientific and technical information and for establishing an administrative record for NPS projects. *Director's Order #12* requires that impacts to 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 in the short and long term, cumulatively, and within context, based on an understanding and interpretation by resource professionals and specialists. *Director's Order #12* also requires that an analysis of impairment to park resources and values be made as part of the NEPA document.

NATURAL RESOURCE REFERENCE MANUAL 77

The *Natural Resource Reference Manual 77*, which supersedes the 1991 *NPS 77: Natural Resource Management Guideline*, provides guidance for NPS employees responsible for managing, conserving, and protecting the natural resources found in National Park System units.

NATIONAL ENVIRONMENTAL POLICY ACT OF 1969, AS AMENDED

The National Environmental Policy Act (NEPA) requires consideration of the environmental effects of proposed federal actions. NEPA also ensures that environmental information is available to public officials and members of the public before decisions are made and before actions are taken. This Environmental Assessment provides a description of adaptive management of the existing elk population, as well as for the No Action Alternative, and summarizes potential environmental consequences of the Adaptive Management Alternative. A public review period will be held.

CODE OF FEDERAL REGULATIONS, TITLE 43

Title 43 of the *Code of Federal Regulations* (CFR) 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.”

CODE OF FEDERAL REGULATIONS, TITLE 36

Title 36 of the Code of Federal Regulations provides the regulations “for the proper use, management, government, and protection of persons, property, and natural and cultural resources within areas under the jurisdiction of the National Park Service” (36 CFR 1.1(a)).

ENDANGERED SPECIES ACT of 1973

Section 7 of the Endangered Species Act directs all federal agencies to further the purposes of the act. Federal agencies are required to consult with the U.S. Fish and Wildlife Service to ensure that any action authorized, funded, or carried out by the agency does not jeopardize the continued existence of listed species or critical habitat. The U.S. Fish and Wildlife Service has been consulted on this project and, although several listed species exist in areas that elk reside, the USFWS does not believe that these species will be adversely affected by elk, given the ability to adaptively manage the population (see Elk Management Plan).

WILDERNESS ACT

The Wilderness Act, passed on September 3, 1964, established a national wilderness preservation system, “administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness” (16 United States Code Section 1131). The Wilderness Act further defined wilderness as “an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, and which is protected and managed to preserve its natural conditions” (16 United States Code Section 1131). The Wilderness Act gives the agency managing the wilderness

responsibility for preserving the wilderness character of the area and devoting the area to the public purposes of recreational, scenic, scientific, educational, conservation, and historical use (16 United States Code Section 1133). Certain uses are specifically prohibited, except for areas where these uses have already become established. The act states that “there shall be no commercial enterprise and no permanent road within any wilderness area designated by this chapter and except as necessary to meet minimum requirements for the administration of the area . . . , there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area” (16 United States Code Section 1133). The proposed actions will have no effects on Wilderness.

CLEAN WATER ACT

The proposed actions will have no effects on water quality. No elk management activities would result in release of sediment or contaminants to the environment are planned under either alternative proposed and thus would not need to comply with the requirements of sections 401 and 404 of the Clean Water Act and other applicable federal, state and local regulations.

EXECUTIVE ORDER 11988 (FLOODPLAIN MANAGEMENT) and EXECUTIVE ORDER 11990 (PROTECTION OF WETLANDS)

Executive Orders 11988 and 11990 direct federal agencies to enhance floodplain and wetlands value, to avoid development in flood plains and wetlands whenever possible, and to minimize adverse impacts if development cannot be avoided. The preferred alternative does not constitute development, thus it is not necessary to file a Statement of Findings.

SECTION 106 of THE NATIONAL HISTORIC PRESERVATION ACT OF 1966, as amended

Section 106 of the National Historic Preservation Act requires that an assessment be conducted of any project, activity, or program that could change the character or use of properties listed in or eligible for listing in the National Register of Historic Places. None of the alternatives would have an impact on any properties listed in or determined eligible for listing in the National Register of Historic Places according to the Cultural Resource Coordinator.

ARCHEOLOGICAL RESOURCES PROTECTION ACT of 1979

The Archeological Resources Protection Act requires that archeological resources be identified and that proper permits be obtained prior to excavating any resources. The NPS has not identified any archeological resources impacted by this project.

COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION and LIABILITY ACT

The Comprehensive Environmental Response, Compensation and Liability Act established regulations regarding the assessment, remediation, and liability for remediation of hazardous substances that have caused contamination. No areas within the Park have been designated as a National Priority List site, nor found to contain any hazardous materials.

CLEAN AIR ACT

The Clean Air Act establishes regulations regarding disclosure, control, and abatement of air pollutants. The alteration in use of the areas associated with the project is not expected to have a significant impact on regional air quality. Therefore, the alternatives are compatible with the requirements of the Clean Air Act.

TOXIC SUBSTANCES CONTROL ACT

The Toxic Substances Control Act establishes regulations regarding proper management and disposal of polychlorinated biphenyls (PCBs) and other hazardous chemicals. The proposed project will not involve the use of any hazardous materials.

RESOURCE CONSERVATION and RECOVERY ACT

The Resource Conservation and Recovery Act establishes regulations regarding the generation, transportation, storage, treatment, and disposal of hazardous waste. No hazardous materials are to be used as part of the proposed project.

AMERICANS WITH DISABILITIES ACT of 1990

The Americans with Disabilities Act (ADA) establishes federal guidelines that define requirements for disabled access to parking facilities, pathways, and buildings. The ADA is not applicable because no development is planned in association with elk management and the Park currently provides ADA compliant facilities

List of Preparers

CHAPTER 7

LIST OF PREPARERS

The following people contributed to writing this assessment and elk management plan as preparers or consultants:

Name	Title	Park/Division/Organization
Dale A. Ditmanson	Superintendent	GRSM
Kevin FitzGerald	Assistant Superintendent	GRSM
Nancy Finley	Division Chief	GRSM Resource Management and Science
Kim Delozier	Supervisory Wildlife Biologist	GRSM Resource Management and Science
Joe Yarkovich	Biological Science Tech	GRSM Resource Management and Science
Keith Langdon	I and M coordinator	GRSM Resource Management and Science
Tom Remaley	Forester	GRSM Resource Management and Science
Janet Rock	Botanist	GRSM Resource Management and Science
Steve Moore	Supervisory Fisheries Biologist	GRSM Resource Management and Science
Mark Taylor	Fire Management officer	GRSM Resource Management and Science
Tobias Miller	Trails Supervisor	GRSM Facility management
Bill Wright	Chief Ranger	GRSM Resource and visitor protection
Jami Hammond	NEPA Coordinator	National Park Service: Southeast Regional Office
Jennifer L. Murrow	Private Consultant	ANRS, inc.
Belinda Esham	Private Consultant	ANRS, inc.

Literature Cited

CHAPTER 8

LITERATURE CITED

- Allred, W. J. 1950. Re-establishment of seasonal elk migration through transplanting. *Transactions of the North American Wildlife and Natural Resources Conference* 15:597–611.
- Anderson, C. C. 1958. The elk of Jackson Hole: A review of Jackson Hole Elk Studies. Wyoming Game and Fish Commission, Bulletin 10.
- Anderson, D. E., and O. J. Rongstad. 1989. Home-range estimates of red-tailed hawks based on random and systematic relocations. *Journal of Wildlife Management* 53:802–807.
- Anderson, R. C., and A. K. Prestwood. 1981. Lungworms. Pages 266–317 in W. R. Davidson, editor. *Diseases and Parasites of White-tailed deer*. Miscellaneous Publication. No. 7, Tall Timbers Research Station, Tallahassee, Florida, USA.
- Ballard, W. B., H. A. Whitlaw, B. F. Wakeling, R. L. Brown, J. C. deVos, and M. C. Wallace. 2000. Survival of female elk in northern Arizona. *Journal of Wildlife Management* 64:500–504.
- Bender, L. C., S. M. Schmitt, E. Carlson, J. B. Haufler, and D. E. Beyer. 2005. Mortality of rocky mountain elk in Michigan due to meningeal worm. *Journal of Wildlife Diseases* 41:134–140.
- Brickell, J. 1737. *The natural history of North Carolina*. James Carson, Dublin, Ireland.
- Binkley, D., F. Singer, M. Kaye, and R. Rochelle. 2003. Influence of elk grazing on soil properties in Rocky Mountain National Park. *Forest Ecology and Management* 185:239-247.
- Britzke, E. R., M. J. Harvey, and S. C. Loeb. 2003. Indiana bat, *Myotis sodalis*, maternity roosts in the southern United States. *Southeastern Naturalist* 2:235–242.
- Britzke, E. R., A. C. Hicks, S. L. Von Oettingen, and S. R. Darling. 2006. Description of spring roost trees used by female Indiana bats (*Myotis sodalis*) in the Lake Champlain Valley of Vermont and New York. *American Midland Naturalist* 155:181–187.
- (CEQ) Council on Environmental Quality. 1978 Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act. Code of Federal Regulations Title 40, Parts 1500–1508. Washington, D.C.

- Christensen, A. G. 1998. The status of elk; 1975–1995 historical and future trends. *Proceedings of the Western States and Provinces Elk Workshop Proceedings* 78:157–165.
- Cole, E. K., M. D. Pope, and R. G. Anthony. 1997. Effects of road management on movement and survival of Roosevelt elk. *Journal of Wildlife Management* 61:1115–1126.
- Cope, E. D. 1870. Observations on the fauna of the southern Alleghenies. *American Naturalist* 4:392–402.
- Coughenour, M.B. 2002. Elk in the Rocky Mountain National Park Ecosystem – A Model-based Assessment. Final report to USGS Biological Resources Division and U.S. National Park Service. August 2002.
- Craighead, J. J., F. C. Craighead, R. L. Ruff, and B. W. O'Gara. 1973. Home ranges and activity patterns of nonmigratory elk of the Madison drainage herd as determined by biotelemetry. *Wildlife Monographs* 33.
- Eberhardt, L. E., L. L. Eberhardt, B. L. Tiller, and L. L. Caldwell. 1996. Growth of an isolated elk population. *Journal of Wildlife Management* 60:369–373.
- (ESA) Endangered Species Act. 1973. Public Law 93-205, 87 Stat. 884, as amended; 16 US Code 1531-1544.
- Franklin, W. L., A. S. Mossman, and M. Dole. 1975. Social organization and home range of Roosevelt elk. *Journal of Mammalogy* 56:102–118.
- Gerhart, D. C. 2005. Skull and antlers of extinct Eastern elk unearthed at Iroquois National Wildlife Refuge in northwestern New York. <http://www.fws.gov/historicPreservation/archives/elkBones_012405.html>. Accessed May 3 2006.
- (GRSM) Great Smoky Mountains National Park. 2004. Visitor use data 1993 to 2003.
- Hudson, R. J., H. M. Kozak, J. Z. Adamczewski, and C. D. Olsen. 1991. Reproductive performance of farmed wapiti. *Small Ruminant Resources* 4:19–28.
- Humphrey, S. R., A. R. Richter, and J. B. Cope. 1977. Summer habitat and ecology of the endangered Indiana bat, *Myotis sodalis*. *Journal of Mammalogy* 58:334–346.
- Irwin, L. L., and J. M. Peek. 1983. Elk habitat use relative to forest succession in Idaho. *Journal of Wildlife Management* 47:664–672.
- Jenkins, K. J., and R. G. Wright. 1988. Resource partitioning and competition among cervids in the Northern Rocky Mountains. *Journal of Applied Ecology* 25:11–24.

- Kingery, J. L., J. C. Mosley, and K. C. Bordwell. 1996. Dietary overlap among cattle and cervids in northern Idaho forests. *Journal of Range Management* 49:8–15.
- Kohlmann, S. G. 1999. Adaptive fetal sex allocation in elk: evidence and implications. *Journal of Wildlife Management* 63:1109–1117.
- Lacey, J. R., and H. W. Van Poolen. 1981. Comparison of herbage production on moderately grazed and ungrazed western ranges. *Journal of Rangeland Management* 34:210–212.
- Larkin, J. L., J. J. Cox, M. W. Wichrowski, M. R. Dzialak, and D. S. Maehr. 2004. Influences on release-site fidelity of translocated elk. *Restoration Ecology* 12:97–105.
- Larkin, J. L., D. S. Maehr, J. J. Cox, D. C. Bolin, and M. W. Wichrowski. 2003. Demographic characteristics of a reintroduced elk population in Kentucky. *Journal of Wildlife Management* 67:467–476.
- Loeb, Susan. 2002. “SRS Researchers Track Indiana Bats in the Smokies.” Newsletter, 8 December. Asheville, N.C.: USDA Forest Service Southern Research Station (SRS).
- Long, J. R. 1996. Feasibility Assessment for the Reintroduction of North American Elk Into Great Smoky Mountains National Park. M.S. Thesis, University of Tennessee, Knoxville, TN. 148 pp.
- Lyon, L. J., and A. G. Christensen. 2002. Elk and land management. Pages 557–581 *in* D. E. Toweill and J. W. Thomas, editors. *North American elk: ecology and management*. Smithsonian Institution Press, Washington, D.C., USA.
- Millsbaugh, J. J. 1995. Seasonal movements, habitat use patterns and the effects of human disturbances on elk in Custer State Park, South Dakota. Thesis, South Dakota State University, Brookings, South Dakota, USA.
- Moran, A. J. 1973. The Rocky Mountain elk in Michigan. Wildlife Division Research and Development Report 267. Department of Natural Resources, Lansing, Michigan, USA.
- Murie, O.J. 1951. *The Elk of North America*. Stackpole Company, Harrisburg, PA. 376pp.
- Murrow, J. L., J. D. Clark, and E. K. Delozier. 2009. Demographic analysis of an experimentally released population of elk in Great Smoky Mountains National Park. *Journal of Wildlife Management* 73:1261–1268.
- Murrow, J. L. 2007. An experimental release of elk into Great Smoky Mountains National Park. Dissertation, University of Tennessee, Knoxville, USA.

- Nelson, L. J., and J. M. Peek. 1982. Effect of survival and fecundity on rate of increase of elk. *Journal of Wildlife Management* 46:535–540.
- Nettles, V. F. and J. L. Corn. 1998. Model Health Protocol for Importation of Wild Elk (*Cervus elaphus*) For Restoration. Southeastern Cooperative Wildlife Disease Study. University of Georgia, Athens, GA.
- (NPS) National Park Service . 2006. Management Policies 2006. <http://www.nps.gov/policy/mp2006.pdf>
- (NPS) National Park Service. 2001b. Director’s Order #12 and Handbook: Conservation Planning, Environmental Impact Analysis, and Decision Making [Washington D.C.].
- (NPS) National Park Service. 2001c. Director’s Order 47: Sound Preservation and Noise Management. Washington, DC
- (NPS) National Park Service . 2000. Management Policies 2001. NPS D1416. [Washington, D.C.].
- O’Gara, B. W., and R. G. Dundas. 2002. Distribution: past and present. Pages 67–120 in D. E. Toweill and J. W. Thomas, editors. *North American elk: ecology and management*. Smithsonian Institution Press, Washington, D.C., USA.
- Oldemeyer J. L., R. L. Robbins, B. L. Smith, R. L. Callas, D. B. Koch, and E. R. Loft. 1993. Effect of feeding level on elk weights and reproductive success at the National Elk Refuge. Pages 64–86 in R. L. Callas, D. B. Koch and E. R. Loft, editors. 1990 *Proceedings of the Western States & Providence Elk Workshop*. California Fish and Game Department, Eureka, California, USA.
- Pope, M. D. 1994. Roosevelt elk habitat use in the Oregon coast range. Thesis. Oregon State University. Oregon, USA.
- Rhoads, S. N. 1897. Contributions to the zoology of Tennessee. Number 3: Mammals. *Proceedings of the Academy of Natural Sciences of Philadelphia, Pennsylvania, USA*.
- Rock and Langdon. 1991. Rare Plant Species Report of Great Smoky Mountains National Park: 1989 - 1990. Unpublished Report, Great Smoky Mountains National Park.
- Seton, E. T. 1927. *Lives of game animals*. Volume 3. Doubleday, Page and Company, Garden City, New York, USA.
- Singer, F.J., L.C. Zeigenfuss, B. Lubow, and M.J. Rock. 2002 Ecological evaluation of the potential overabundance of ungulates in U.S. National Parks: a case study. In *Ecological Evaluation of the Abundance and Effects of Elk Herbivory in Rocky Mountain National Park, Colorado, 1994-1999*, edited by F.J. Singer and L.C.

- Zeigenfuss, 205-248. Fort Collins CO: Colorado State University and U.S. Geological Survey.
- Skovlin, J. M, P. Zager, and B. K. Johnson. 2002. Habitat requirement evaluations. Pages 531–556 in D. E. Toweill and J. W. Thomas, editors. North American elk: ecology and management. Smithsonian Institution Press, Washington, D.C., USA.
- Stephens, L. A. 1969. A comparison of climatic elements at four elevations in the Great Smoky Mountains National Park. Thesis, University of Tennessee, Knoxville, Tennessee, USA.
- Stohlgren, T.J. 2001b. Rocky Mountain National Park Long-Term Monitoring Plan. Report to Rocky Mountain National Park. 137 pp.
- Suter, W., U. Suter, B. Krusi, M. Schuetz, and B. Kruesi. 2004. Spatial variation of summer diet of red deer in the eastern Swiss Alps. *Wildlife Biology* 10:43–50.
- Thompson, M. J., and R. E. Henderson. 1999. Elk habituation as a credibility challenge to wildlife professionals. *Wildlife Society Bulletin* 26:477–483.
- Thorne, E. T., R. E. Dean, and W. G. Hepworth. 1976. Nutrition during gestation in relation to successful reproduction in elk. *Journal of Wildlife Management* 40:330–335.
- Thornwaite, C. W. 1948. An approach toward a rational classification of climate. *Geological Review* 38:55–94.
- (USDI NPS) United States Department of Interior, National Park Service. 2000. Draft Strategic Plan (2000). US Department of the Interior, National Park Service. Washington, DC.
- (USDI NPS) United States Department of Interior, National Park Service, Denver Service Center. 1982. Final Environmental Impact Statement for the General Management Plan - Great Smoky Mountains National Park (North Carolina - Tennessee). 307 pp.
- U.S. Fish and Wildlife Service. 2004. “Indiana Bat, *Myotis sodalis*.” Fact sheet. Available on internet at <http://www.fws.gov/northeast/pdf/indianabat.fs.pdf> (accessed 22 August 2006).
- Van Doren, M., ed. 1955. *Travels Of William Bartram*. Dover Publ. Inc. New York, NY 414pp.
- Vavra, M., C. G. Parks, and M. Wisdom. 2007. The good, the bad, and the ungulate. *Forest Ecology and Management* 246:66–72.
- Webster, C. R., M. A. Jenkins, and J. H. Rock. 2005. Long-term response of spring flora to chronic herbivory and deer exclusion in Great Smoky Mountains National Park, USA.

Biological Conservation 125:297-307.

Whittaker, R.H. 1956. Vegetation of The Great Smoky Mountains. Ecological Monographs 26: 1-80.

Wisdom, M. J., L. R. Bright, C. G. Carey, W. W. Hines, R. J. Pederson, D. A. Smithey, J. W. Thomas, and G. W. Witmer. 1986. A model to evaluate elk habitat in western Oregon. U.S. Forest Service Publication R6-F&WL-216-1986.

Witmer, G. W. 1990. Re-introduction of elk in the United States. Journal of the Pennsylvania Academy of Science 64:131-135.

Witmer, G. W., and D. S. deCalesta. 1985. Effects of forest roads on habitat use by Roosevelt elk. Northwest Science 59:122-125.

Yarkovich, J. G. 2009. Black bear relocation as a method to reduce elk calf predation within Great Smoky Mountains National Park. University of Tennessee, Knoxville, USA.

Zeigenfuss, L.C., F.J. Singer, and D. Bowden. 2002. Vegetation responses to natural regulation of elk in Rocky Mountain National Park. Biological Science Report USGS/BRD/BSR-1999-0003. Denver: U.S. Government Printing Office.

APPENDIX A
GRSM ELK MANAGEMENT PLAN 2010-2025

GRSM ELK MANAGEMENT PLAN 2010-2025

PURPOSE AND GOALS OF THE PLAN

This plan was developed by a 15 person team made up of members of the scoping committees for the environmental assessment, Resource Management staff, and elk biologists. The group identified issues to be addressed in the plan, and then, developed an array of strategies to address the issues. This document will provide overall guidance and direction for Great Smoky Mountains National Park's (GRSM, Park) elk management program for 15 years from the date of approval (~2010-2025).

The purpose of this guideline is to serve as an advisory outline to the adaptive management of elk in a manner that allows wild elk to live naturally and provide for safe visitor use and the protection of other Park resources. The plan briefly describes general information on elk natural history, management, habitat, and population status. Next, the plan discusses issues concerning elk management in GRSM identified by the EA. Then, general goals, objectives, and strategies for adaptively managing elk populations are identified. The plan will be used to help set priorities for the elk management program and will provide overall guidance of individual management issues by providing an explanation of monitoring needs and an array of options. Finally, the plan was written to help educate Park employees, cooperators, concessionaires, visitors, and neighbors about their responsibility and role in maintaining healthy elk habitat, biology, and behavior.

The process of using information as it becomes available to alter management actions is called adaptive management. Adaptive management is an iterative process that requires selecting and implementing management actions, careful monitoring, comparing results with objectives, and using feedback to make future management decisions. This process recognizes the importance of continually improving management techniques through flexibility and adaptation instead of adhering rigidly to a standard set of management actions. The National Park Service recognizes that the Adaptive Management Alternative was developed with scientific information and data, including models that are provisional and possibly imprecise. However, because the alternative incorporates the principal of adaptive management, which approaches management as a learning process or continuous experiment in which incorporating the results of prior actions allows managers to remain flexible and adapt to uncertainty, this should be manageable. Therefore, the National Park Service will continue to incorporate elk and vegetation monitoring data and the best available science to guide management actions and ensuring progress toward meeting the plan's goals. The adaptive management plan does not employ a population size target to guide management actions. Instead, it utilizes vegetation monitoring, population monitoring, and population modeling predictions to assess the population status and impacts. Therefore, the overall objective is to maintain an elk population within the Park that is self-sustaining and with acceptable impacts to Park resources. It should be noted that based on adaptive management, management actions to control the elk population could be taken if the elk population causes unacceptable resource impacts.

SPECIES ASSESSMENT

Natural History

Elk (*Cervus elaphus*) are members of the cervid family along with deer, moose, and caribou. There are six recognized subspecies of elk in North America. All of the elk in GRSM are of the subspecies known as Manitoban elk (*Cervus elaphus manitobensis*). Elk males, females, and young are known as bulls, cows, and calves respectively. Calves are born, usually one, after a gestation period of approximately 8 to 8.5 months. Twins are extremely rare. Calves are normally born from mid May until mid June and weigh approximately 12-15 pounds at birth. Elk are gregarious animals and often gather into large nursery bands of cows and calves in early summer.

The antlers of bulls begin to grow as soon as the old antlers are shed in late winter or early spring. Bulls generally live apart from the cows and calves through the summer antler growing period. Bulls often band together in small groups during this time. The velvet that covers and provides nourishment to the growing antlers begins to shed in early August. The rut or breeding period for elk begins in early September and continues until late October in GRSM. The peak of the breeding occurs in the first week of October. In early September, bulls begin to bugle and gather cows into harems of approximately 3-20 females. Breeding bulls vigorously defend these harems from other "satellite" bulls who will attempt to claim cows for themselves. After the breeding season, bulls leave the cows and calves and become reclusive or band together with other bulls. In late spring, cows seek solitude for calving.

Elk have an extremely variable diet and therefore can live in a variety of habitats. Elk consume a combination of grasses, forbs, fruits (acorns) and shrubs. The percentage of each food type in the diet depends on its availability. Elk that live in grasslands consume mostly grasses while elk in mountain lands may consume large quantities of browse. Types of food consumption are also related to the season. Elk eat mostly grasses and forbs during summer. In the fall, acorns are part of their diet. In winter, they consume more ferns and browse.

Cover is an important component of elk habitat. Elk require some element of cover for escape and protection. Elk that are disturbed may move to areas of dense cover for seclusion and security away from roads and people. Elk also use thick cover to escape winter storms as well as summer heat. Elk are generally migratory animals that are known to travel large distances between summer and winter ranges. Travel corridors and migration routes are important components of elk habitat. There are some herds of elk, however, which do not migrate and can be found in the same general area year-round. GRSM elk herds display very small seasonal migrations, mostly related to breeding.

GRSM Population Status

Elk, along with white-tailed deer, were probably common game animals in the GRSM area prior to settlement times. Indians, trappers, and pioneers all utilized elk as a source of food and clothing. Elk were released back into GRSM in 2001 and 2002. In 2001, 25 elk were obtained from LBL and in 2002, 27 elk were obtained from EINP. The GRSM elk herd has slowly increased since the initial release. The yearly population estimate for 2009 was just over 100 individual elk spread between 3 main groups of animals, the primary group being within the Park boundary in Cataloochee Valley.

Approximately 9 million people visit GRSM annually, creating a situation for human/elk encounters. Unfortunately, Park visitors can have long-term impacts on elk behavior. Some visitors intentionally feed elk despite prominently displayed regulations prohibiting the feeding of wildlife. Some visitors' desire to see and photograph elk overshadows their understanding of Park regulations or the potential danger of elk. Elk are intelligent and easily adaptable animals. Elk can quickly adapt to human presence, and if elk learn that they can get food from human sources, they become food conditioned. That behavior is nearly impossible to reverse. Elk are also highly mobile and often travel beyond the Park boundary. They utilize public and private land outside of GRSM during all seasons. This can cause conflicts between private landowners and elk, especially on lands used for small crop cultivation and livestock operations.

GENERAL GOALS AND ASSOCIATED CONCERNS

Given an overall objective to maintain an elk population within the Park that is self-sustaining with acceptable impacts to park resources, there are three management goals this plan addresses regarding elk in GRSM. These goals encompass the main issues and concerns that the scoping committee identified throughout the EA process. While each overall management goal will address corresponding elk concerns, they are not limited by them. The goals are as follows:

- 1. GRSM ELK POPULATION MANAGEMENT GOAL:** GRSM will maintain a healthy elk population that is managed within the capabilities of GRSM and in consideration of other land uses within the Park.
- 2. GRSM VEGETATION AND ELK HABITAT MANAGEMENT GOAL:** GRSM will identify, monitor and, when necessary, mitigate impacts of elk on vegetation or other natural or cultural resources, and when appropriate and feasible, GRSM will implement strategies that may support/improve elk habitat.
- 3. GRSM RECREATIONAL MANAGEMENT GOAL:** GRSM will maintain safe viewing opportunities of elk, while educating the public regarding their natural history and biology.

These three goals are not mutually exclusive. They cover a comprehensive and interwoven plan to adaptively and actively manage the GRSM elk herd, while incorporating and reacting to specific objectives and outcomes. The plan must be taken in its entirety and was not designed to be used in portions or pieces.

The following are summaries of the main concerns that were identified regarding long-term management of elk in GRSM. Each major concern or issue is addressed by one or more of the elk management goals.

Population Size (Goal 1)

In the past, elk herd size in national parks has been a source of considerable controversy. When elk herds get too large in islands of habitat, the health of individual

animals suffers, native vegetation and other resources can be negatively impacted, and other wildlife may have trouble competing for resources. For example, concern about the number of elk in Rocky Mountain National Park (RMNP) started around 1930 due to the failing conditions of the herd's winter range as a result of over-browsing. Because of this, elk populations were controlled from 1944 to 1968. Since then, a lack of natural predators and the loss of migration corridors have enabled a dramatic increase in elk numbers. The resulting overabundant herds have decimated the park's aspen and willow stands that provide crucial habitat to them and many other wildlife species. Unlike RMNP, GRSM has a sizeable predator population that has already shown the ability to affect the elk population growth. However, there are still concerns regarding the long-term population growth potential of GRSM's elk herd, herd expansion into other areas, and the multi-faceted impacts of an expanding and increasing population.

Disease Issues (Goal 1)

The regulatory diseases of greatest concern during the initial elk release were Chronic Wasting Disease (CWD), brucellosis, and tuberculosis. To date, there have been no negative impacts from disease on the elk population in GRSM or impacts to other species. GRSM did extensive elk testing prior to and during the first 2 years of release (Morrow 2007). That testing eliminated the major concerns surrounding translocated elk having brucellosis and tuberculosis, thereby exposing uninfected cattle to those diseases. However, if cattle outside of GRSM contract those diseases, it would be possible for elk to contract them, so updated disease information will be important to track. Furthermore, given the severity and far-reaching impacts of CWD, surveillance for that disease is an important part of long-term elk management in GRSM and will be continued.

Vegetation Impacts (Goal 1 and 2)

As an herbivore, elk are considered mixed feeders that primarily feed on grasses supplemented with woody browse and acorns during the fall in GRSM. Therefore, elk have the capacity to heavily impact such vegetation. Those impacts can be positive and/or negative. Therefore, the actions implemented by the EA could affect these natural resources in the Park beyond the naturally occurring cycles already in existence in the Park. Furthermore, there is a slight potential for elk vegetation disturbance or fecal pellets to enable the spread of exotic plants. For these reasons, vegetation monitoring must be an essential part of this management plan.

Habitat Improvement (Goal 1 and 2)

Healthy and productive elk herds require good habitat. Both the quantity and quality of habitat are important to sustaining elk populations. The quality of habitat is a major factor in determining elk herd size. Elk habitat in the east is severely fragmented due to human expansion and development. When appropriate, habitat improvement projects can be helpful for maintaining healthy herds and better herd cohesion. When habitat improvement projects are completed, elk and deer benefit along with numerous other wildlife and plant species. Therefore, habitat improvement suggestions, primarily prescribed fire, are made in this management plan.

Winter Feeding (Goal 1 and 2)

Historically, supplemental feeding was considered a viable solution to a lack of suitable winter range. However, there is abundant evidence that the potential harm created by feeding elk can far outweigh the limited benefits. Winter feeding programs are generally very costly and can cause problems for elk including behavioral changes, range destruction, and expansion of disease problems. For this reason, GRSM and this management plan do not support winter feeding of elk in any capacity.

Competition (Goal 1 and 2)

Competition occurs when two species use the same limited resource, and one of the two suffers in some way because of that use. Competition can potentially occur between elk and other ungulates such as livestock or deer. Concern has been expressed by some sportsmen and others that elk populations are responsible for declines in deer herds. There is currently no evidence to support that idea. Throughout the U. S., deer herd declines have occurred in areas where there are few or no elk and deer herd increases have occurred in areas where there are large elk populations. However, future elk herd and vegetation monitoring will provide data that would further support/alleviate this concern by studying deer exclosures (Cades cove), elk exclosures, and open plots.

Depredation Issues/Private Lands (Goal 1, 2, and 3)

In some localized areas, depredation can be a significant problem. Depredation problems need to be addressed in a timely and efficient manner so that landowners will better tolerate migratory/expanding populations of elk. The value of private lands to the elk population cannot be overstated. Unfortunately, private rural lands around GRSM are being quickly converted to housing developments, recreational properties, or other uses. Therefore, programs which provide education or incentives to private landowners to manage their properties for elk and other wildlife are critical to the long-term success of the elk management program. GRSM has committed substantial resources to address depredation concerns. At the time this management plan was written, there was no official state (NC/TN) or federal program designed to assist land owners with depredation situations in or around GRSM. In this management plan, the Park includes a varied, partnered approach to handling this problem in the future.

MONITORING AND OPPORTUNISTIC RESEARCH

The effectiveness of specific management actions and resource conditions will be monitored through the 15-year life of the plan. This information will be used to adapt management actions as needed to meet overall plan goals. Monitoring will be conducted in the short and long-term on geographic scales ranging from site-specific to community or landscape level. The frequency of monitoring actions will be higher in early years and may decrease later if less frequent data collection is found to be sufficient. Specific types of monitoring are discussed with each goal stated below.

The National Park Service will take the opportunity to conduct opportunistic future research that could benefit management of elk in the future. All animals that are selected to be monitored will be fitted with a radio-transmitter collar with a unique visual identifier.

One priority that GRSM recognizes is the need to continue gathering data for continuing the annual population modeling provided by The Southern Appalachian Field Laboratory of United States Geological Survey (SAFL-USGS). If feasible, the Park also recognizes the benefit of incorporate the existing elk population model into an ecosystem simulation model. The simulation model could then be used in the future to adjust the level of management actions within the framework of the Adaptive Management Plan.

GRSM ELK POPULATION MANAGEMENT GOAL

GRSM will attempt to maintain a healthy elk population that is managed within GRSM and in consideration of other land uses within the Park. Because the population health (including population size) directly impacts each of the previously stated concerns, this goal is critical in managing elk in GRSM. The adaptive management plan does not employ a specific population size target. It will primarily use resource monitoring and population monitoring to assess the population status and impacts. It should be noted that based on adaptive management, management actions to control the elk population (i.e. culling) could be taken if the elk population size results in undue resource impacts and based on population objectives, vegetation objectives, and disease monitoring. Likewise, actions could be taken to respond to a low or diminishing population to ensure the goal of maintaining a sustainable population. To ascertain the overall status of the elk population, three main elk population objectives have been identified.

Population Objective 1: Maintain an understanding of general elk population dynamics, including population size, herd sex ratio, mortality and natality rates.

Management Strategies and Monitoring (Elk Population Size, Composition, and Distribution)

The elk population size, composition, and distribution would be monitored using multiple population surveys each year. The overall distribution of elk in GRSM will not be manipulated. The current population model will be modified and updated annually to incorporate all new data (SAFL-USGS). On the primary range (Cataloochee Valley), the National Park Service will conduct a combination of general ground surveys and mark-resight surveys to count and classify elk, followed by population modeling to estimate the population size for GRSM. Radio telemetry could be used as needed to provide more detailed information on elk movements and distribution.

It would be impractical to continue monitoring the entire elk population. Therefore, this objective will be accomplished through monitoring a subset of the current elk population (including mortality and natality). The number of animals monitored may vary depending on how many elk (age/sex classes) are currently radio collared. The general monitoring goal will be to maintain 25 females, 5 males, all possible calves during their first year, elk that travel long distances and any known nuisance animals. When possible and feasible, elk will be collared during winter and calves will be captured and collared immediately after birth and/or at ~10 months of age. Anesthesia will follow all established protocols (Murrow 2007).

General animal data will be collected and compiled 1-4 times per month, identifying known population size, distribution, and structure. When feasible, the data will be provided yearly to SAFL-USGS for population model updating. Collected data will include animal sex, id, pregnancy status, approximate age, mortality rate, female-calf association, general health, etc. Roadside calf-cow counts will be conducted biyearly, once during early winter and again in late spring. These counts will provide an index to abundance and a rough estimate of recruitment. Any possible data for non-collared animals will be formally collected simultaneously with the cow-calf counts.

The elk population will be evaluated based on physical health, reproduction rates, dispersal rates, and pertinent vegetation parameters. The combination of these data will be used to assess the overall population status and health. While the probability of the need for lethal reduction (culling) is low, given the issues experienced by other Parks, GRSM would be remiss if it was not included as a management option.

If there was overwhelming supportive evidence, i.e. extensive female dispersal, extreme, sustained increases in population growth, an undesirable change in plant species composition, plant growth, or succession in a large area, that the elk herd has exceeded the capabilities of GRSM to support the existing elk herd and there was no legal hunting alternative on state public and private lands, NPS personnel would have the ability to use firearms or chemical immobilization followed by lethal injection to reduce the elk population. To mitigate impacts on visitor's use, consideration would be given to the type of firearm used and the time of day actions were taken. Lethal reductions would be performed to minimize the likelihood of orphan calves and to minimize visitor impacts. The National Park Service would use specially trained National Park Service staff to perform reduction activities. Based on monitoring data of elk population size and demographics, determination of the number of elk to be removed or controlled would be determined based on collaborations between the National Park Service, and various elk population researchers from the scientific community. On the other hand, if future monitoring data indicated a decreasing elk population, Park staff would have a suite of management options available, including but not limited to the following: allowing the elk population to decrease, specific habitat manipulation, population augmentation or predator management.

Any direct management of individual animals, ranging from calf collaring to live capture to lethal removal will be conducted in a manner that minimizes stress, pain, and suffering. Use of remote delivery systems for anesthetizing (e.g., dart guns) would also be conducted by trained personnel under Director's Order 77-4. Efforts would be made to deliver immediately lethal shots to target animals, and shooters would be required to successfully complete NPS firearms qualifications. When euthanizing animals the National Park Service will use recommendations from the American Veterinary Medical Association (AVMA) Guidelines on Euthanasia, 2007. The degree of human contact during all procedures that require handling of wild animals would be minimized, and the National Park Service would "reduce pain and distress to the greatest extent possible during the taking of an animal's life" (AVMA Guidelines on Euthanasia 2007).

Population Objective 2: Addressing nuisance elk behavior in GRSM and adjacent private and public properties.

Management Strategies and Monitoring

Generally, GRSM will continue to evaluate elk in the Park that display food conditioned/habituated/nuisance behavior and determine appropriate management actions. GRSM staff and volunteers will record problem behaviors displayed so that the appropriate biologist or staff member can make recommendations regarding management of elk that best suits the individual situation. The decision to mitigate elk incidents should be based on an evaluation of current and previous reports and on the particular circumstances of the incident. The approach to handle the incident should be considered within the context of the fundamental purpose of GRSM. Concurrence should be obtained from the biologist and/or Chief of Resource Management and Science prior to implementing any of the previously mentioned management actions.

The decision to euthanize an elk will be approved by the Superintendent's Office after consultation with the Chief of Resource Management and Science and the appropriate wildlife biologists, unless there is an immediate public safety threat, a need to euthanize an animal with acute injuries, or any unforeseen circumstance. As a rule, euthanasia should only be carried out by the appropriate, qualified wildlife biologist or trained staff member.

Elk on or near roadways has been cited as one major elk-visitor management issue, especially as it relates to traffic congestion in Cataloochee Valley and around the Oconaluftee visitor center, creating dangerous situations for visitors, and impacts to roadsides. There are many ways to aid in mitigating this situation. Those might include the following: aversive conditioning of habituated or food conditioned animals, permanent fencing, creating parking areas or established pull-outs, instructional signs, reduced speed limits, flashing lights, stop signs in unconventional locations, or speed bumps or humps, and detailed traffic management plans during certain times of the year. The Elk Bugle Corps (EBC) will be used to help manage visitor-elk interactions and educate visitors in Cataloochee Valley. If roadside elk encounters increase throughout other areas of the Park, the EBC could be expanded to help GRSM manage these wildlife encounters. Managers will be required to be creative in finding solutions to problems that will be long-term realities of managing human/elk interactions.

Nuisance activities reported outside of GRSM include damage to pastures, crops, fences, buildings or structures, flower beds, fruit trees and domestic pets and/or livestock. These nuisance activities have the potential to strain the relationship between landowners, other agencies, and GRSM. During the experimental phase GRSM has, under the guidance of NCWRC, taken the lead for responding to nuisance activity outside the Park. This has been accomplished by providing educational information, animal deterrents, aversive conditioning, fencing, relocation, and animal euthanasia, when necessary.

This management plan transitions responsibility when there is human-elk conflict on properties outside of GRSM, primary responsibility will fall to the appropriate state or federal agency with jurisdiction over wildlife on those lands. However, given the novelty of elk management in the east and past experience in elk management, GRSM will, providing that resources allow, continue to work with and provide guidance, and where feasible, support to any agency that requests assistance. GRSM will provide training, assistance with aversive conditioning, exclusionary techniques and loaning equipment when necessary to any state or federal agency in need. This Management Plan sets the stage for GRSM to work cooperatively with other state, federal, and private agencies including the following:

- Eastern Band of Cherokee Indians
- North Carolina Wildlife Resources Commission
- Tennessee Wildlife Resources Agency
- USFS
- NCDOT (I-40)
- TDOT (I-40)
- North Carolina Department of Agriculture
- Local Farmers/Landowners

To keep an open line of communication, GRSM will continue to participate in professional elk workshops and meetings (e.g. Eastern Elk Workshop) at which time periodic updates will be provided.

Population Objective 3: Maintain an understanding of general elk population health and continued disease surveillance.

Management Strategies and Monitoring

GRSM can be confident in the regulatory disease testing that occurred before releasing elk and can therefore dismiss any major concern regarding individual elk that were released into GRSM carrying brucellosis or tuberculosis. There is no way to mitigate the possibility of elk contracting those diseases from infected cattle.

Given the national significance of chronic wasting disease, monitoring for CWD should continue. Therefore, appropriate tissue will continue to be collected and tested on all available newly-deceased elk. The tissue to be collected is the parasympathetic vagal nucleus in the dorsal portion of the medulla oblongata at the obex in the brain stem. The sample will be placed in a sterile container with formalin solution and sent for testing at the Colorado State University Veterinary Diagnostic Laboratory, Fort Collins, Colorado. If improved CWD disease surveillance techniques are determined, they will be evaluated for inclusion into GRSM’s existing disease monitoring program. Furthermore, if elk show signs of sickness or unusual behavior, personnel will contact the Park’s consulting veterinarian: Dr. Ed Ramsay, University of Tennessee.

GRSM VEGETATION AND ELK HABITAT MANAGEMENT GOAL

GRSM will attempt to maintain a healthy elk population that is managed within habitat capabilities of GRSM and in consideration of other land uses within the Park. There are two specific objectives for this overall goal: establishing quality long-term vegetation monitoring and improvement and management of existing elk habitat.

The combination of the vegetation data and population parameters will be used to assess the overall health and continuing success of the GRSM elk herd. However, the vegetation monitoring will be the primary driver of the assessment parameters and therefore is a critical component in managing elk in GRSM. The adaptive management plan does not employ a specific population size target nor does it employ a specific vegetation

target or particular plant species that would indicate significant negative impact. The vegetation monitoring will be established to determine trends and general effects of elk on GRSM. Over time, more specific vegetative goals and indicator species to monitor may be developed. It should be noted that while preparing this document, an extensive literature review was conducted and there was little relevance in vegetation monitoring methods that would be applicable to this ecosystem. Thus, a primary objective of this plan's monitoring is to develop appropriate indicators of vegetation stress/impacts that result from elk forage behavior. Until those specific vegetation indicators can be established, NPS will rely on consistent, consecutive negative trends in vegetation data for ≥ 5 years as an indicator for management reevaluation.

When it is feasible and appropriate, habitat improvements that are within the context of the fundamental purposes of the Park will be carried out, with the goal of managing a sustainable population. Thus, habitat improvements may be limited by that goal in that too much enhancement may lead to population sizes that lead to resource impacts, while too little may result in population declines. These alterations would be expected to improve overall elk habitat along with the habitat of many other wildlife and plant species.

Vegetation Objective: Further an understanding of the trends of elk impacts on Park vegetation, including such parameters as biomass, species richness and diversity, and plant recruitment rates. The Park will also attempt to identify indicator plant species that best capture the impacts of elk within certain communities.

Management Strategies and Monitoring

Many of the Park's vegetation communities have already been impacted by non-native diseases (chestnut blight on American chestnut, beech bark disease on American beech, butternut canker on butternut), non-native insects (balsam woolly adelgid on Fraser fir, hemlock woolly adelgid on eastern hemlock), invasive plants (multiflora rose, tree of heaven, garlic mustard), or native and non-native animals (browsing by white-tailed deer in grassland/woodland communities, rooting by European wild hog in wetlands). In many ways, elk will be an additional stressor to be considered by the *Draft Vegetation Monitoring Protocol* and within this management plan.

At this time, there are no established desired future conditions for Park vegetation and no set 'acceptable' levels of impact by elk. This was done purposefully to allow for the continued development of the understanding of the elk-vegetation relationship. However, several general metrics and thresholds have been provided as an initial starting gauge, so the plan would have some checks and balances (based on the 2006 ROMO Elk and Vegetation Management Plan and the Rocky Mountain National Park long-term monitoring program (Stohlgren et al. 2001b). The Park will manage the elk population based on the effects elk have on the vegetation, and vegetation will be monitored to determine whether elk management actions are successful. As time proceeds and data are gathered, acceptable levels will be more firmly established. General guidelines and example thresholds are presented here as a starting point of continuing elk monitoring.

Monitoring of vegetation would be limited to herbaceous vegetation, shrubs, and tree saplings within the Park elk range because these are most closely linked with elk

herbivory. The monitoring protocols should be designed in an experimental context to yield measurable results to show the level of impact to vegetation structure, regeneration, or cover. Examples of some design considerations are outlined by Zeigenfuss et al. (2002) and Binkley et al. (2003) in the Rocky Mountain National Park long-term monitoring program (Stohlgren et al. 2001b). Collection of baseline data would occur before any management actions are taken.

Monitoring Questions for Vegetation Communities:

How are plant understory and herbaceous species' abundance and composition changing in the presence of elk? Which plants best reflect this change?

Typical Elk Metrics:

- canopy and understory species composition
- species diversity
- species richness
- growth rates of woody plants
- consumption/offtake (should be measured annually)
- Percent cover and vegetation structure (height, canopy volume, and stem density) (should be measured every 5 years)
- Tree regeneration and establishment

The desired condition for upland herbaceous vegetation (grasses) would be an increase in the diversity of grazing levels so that not all areas are heavily grazed (59% averaged across sites; Singer et al. 2002), but at no point should there be more than 1% of sites consumed at greater than 80% offtake and no more than 8% of sites consumed at 50 to 80% offtake (Coughenour 2002). Percent cover and measurements of vegetation structure (height, canopy volume, and stem density) would be measured at least every 5 years. Future thresholds will be established by evaluating long-term growth and species richness trends, as well as reviewing available literature. Thresholds for some vegetation communities and stressors may be straight forward, while other thresholds may prove problematic or impossible due to naturally occurring vegetation community succession.

Elk vegetation monitoring can be incorporated into the permanent vegetation plots throughout the Park (*see* Draft Vegetation Monitoring Plan) and will include similar metrics used in the deer monitoring design considerations outlined in the GRSM long-term monitoring program for ease of future comparisons. Therefore, all attempts should be made to incorporate elk-specific metrics in the long-term vegetation monitoring plots. Fortunately, many of the suggested metrics are already incorporated in the current Park vegetation monitoring. Additional long-term plots should be added in high elk-use areas.

The vegetation monitoring will be a three-part program: vegetation plots or exclosures, elk trails and transects, and calculations of regeneration and consumption. Timing of data collection will be variable. Lastly, if feasible, elk fecal pellets should be collected and analyzed to identify future food habits of elk after the population has had more time to establish itself (Murrow 2007).

Elk Exclosures/Vegetation Plots-

Existing conditions would be measured to establish a set of baseline conditions in addition to the baselines established by Murrow 2007 via elk exclosures and paired control plots. The current conditions are described in the “Affected Environment” chapter and Murrow 2007. A subset of permanent exclosures (exclosures = 3) and duplicate control plots (total measured = 6) will be established and monitored. These exclosures will be permanent, 12 meters by 12 meters in size, and the bottom of the fencing will be raised to approximately 24 inches above ground level to allow for wildlife species other than elk to enter the plot. Placement of the paired plots, in 3 general areas throughout Cataloochee Valley will be based on the initial exclosure locations established by Murrow 2007. Exclosures will be monitored every 3-5 years for specific elk impacts. Vegetation monitoring will mimic the monitoring currently done in the existing deer exclosures which generally consists of monitoring the herbaceous and woody plants species in 1 meter plots recording species composition, height growth and percent vegetation cover. One exclosure/control plot will be located in a cove/wetland land cover type, one will be in a hemlock conservation area, and one will be in grassland.

These three paired-plots will be complimented by multiple permanent plots in and around Cataloochee Valley. Existing metrics useful in analyzing elk impacts and unique elk metrics will be identified and/or added to the existing vegetation monitoring program in GRSM. This will allow more substantial monitoring and identification of appropriate elk-use indicator species.

Elk Trails and Transects-

Established elk trails will be GPS recorded and updated yearly, when feasible. Vegetation transects along the elk or hiking trails will be monitored. Four transects will be monitored perpendicular to each of 5 established elk trails (total transects = 20), angled perpendicular to the slope, and repeated every 3-5 years. Transects will start at randomly (during establishment) selected points along selected sections of five elk or hiking trails. Those trails will be distributed across the elk range in easily accessible areas of varying elk densities. Preferably, the 5 elk trails will vary in use from heavy to rare or none based on fecal pellet rates and subjective knowledge of the elk technician. At least one trail will bisect established wetlands.

Subplot sampling will occur at 10 m² plots every 50 meters, for a total of 200 meters (total subplots = 80). The subplots will be marked with GPS, nearest tree tagged at base, and an embedded rebar stake. The sampling will assess general landscape elk impact trends, such as soil disturbance, litter depth disturbance, exotic plant growth, browse intensity (average height and percent cover of shrub-like species), percent cover by life form, dominant species, browsed and unbrowsed twigs and stem, and elk fecal pellet counts as an indirect measure of use. Additionally, slope, aspect, and elevation will be recorded.

Consumption and Regeneration-

Vegetation consumption and cohort regeneration are two distinct measurements that would stand alone. Vegetation consumption would be measured to indirectly monitor elk use/forage availability in grasslands. At least 20 general areas will be designated in the grasslands where vegetation can be clipped, dried and weighed. The vegetation will be clipped from a different site within the designated area each year of sampling. Clipped

plots will be 1-m². Since the communities should be the same within each area, all vegetation will be dried together and converted to kg/hectare, wet and dry. The measurements will be calculated as trend data, and GRSM will monitor consumption (offtake) of grasslands with a general goal of less than 8% of sites consumed at >50% offtake. Regeneration of cohorts will be calculated as stems per acre reaching 5, 10, 15,... years of age. Such stand-level regeneration would be measured every 5 years estimated from the control plots at the 3 major exclosure monitoring sites by height (stems/acre between 1.5 and 2.5 m in height), aging of increment cores (stems/acre < 10 years of age), stem diameter at breast height, and stem density (stems/acre).

Elk Fencing-

There are no known threatened or endangered plant species populations within the current elk range, however, known rare and sensitive vegetation populations will be monitored in accordance with the Park's Rare Plant Monitoring Protocol, and if needed, they will be protected by exclusionary methods or by other techniques to reduce the likelihood of damage. Fence options include substantially supported, 7 foot, metal or polypropylene fabric. Which fence designs are used would depend on the location and the potential effects on the view, and movement of other wildlife species. The locations and type of fence used, the method of transportation to remote locations, and the equipment used to install the fences would be determined based on cost, effectiveness, and a minimum requirement and minimum tool analysis.

The effectiveness of specific management actions and resource conditions would be monitored through the 15-year life of the plan. This information would be used to adapt management actions as needed to meet plan objectives. If vegetation surveillance indicates that there is an increasingly negative level of impact on other resources, the Park may reconsider the current management actions. Furthermore, vegetation monitoring may be adapted over time to better capture what is happening on the landscape. Special attention will be given to identifying indicator species that may be substituted for the more general vegetation monitoring across all species.

Habitat Objective: Implement habitat management to support the self-sustaining elk population along with the habitat of many other wildlife and plant species.

Management Strategies and Monitoring

When it is feasible and appropriate, habitat improvements that are within the context of the fundamental purposes of the Park will be carried out. These would be expected to improve overall elk habitat along with the habitat of many other wildlife and plant species. Should habitat improvement result in increases to elk populations that result in resource impact, the Park may curtail or reduce habitat improvement activities. Depending on the area and need, different management strategies may be employed, such as prescribed fire and timing of the cuttings of fields and/or balds. Burning has been shown to be crucial for quality habitat for elk and many other species. As such, emphasis will be placed on prescribed fire in the eastern portion of GRSM during the initial implementation of this management plan. All burns would be done and monitored in

accordance with the GRSM Fire Management Plan. The ability to utilize these techniques would be largely subject to weather, other Park priorities, funding and staffing.

Although GRSM recognizes the stochastic dangers given the small size of the existing elk herd, the Park recognizes the elk species' potential to grow beyond sustainable limits. Therefore, these habitat improvements will be done with the sole intention of improving the habitat utilized by the existing elk population, not with the intention of increasing the herd size.

GRSM RECREATIONAL/EDUCATIONAL MANAGEMENT GOAL

GRSM will provide safe viewing opportunities/experience while educating public regarding elk biology and natural history. Public education efforts would be enhanced to provide additional information about elk and their role in the GRSM ecosystem. In addition, educational materials would be developed to inform and increase public understanding of the management actions taking place in the Park and the effects these actions have on vegetation, other wildlife, and visitors. Enhancements to the education program within the Park could include any or all of the following: Improved interpretive contacts and programs would detail the resource issues and management plan, monitoring program, and results and status of the resource. Literature and brochures would also be developed and provided to the public at visitor centers, entrance stations, and community events. If feasible, an enhanced display about elk would be erected at the entrance to Cataloochee Valley. A website dedicated to the management plan would be developed describing the information above, and, as information is collected, the website would be updated with results of field surveys. Outreach programs to schools, groups, and community organizations would be developed and implemented. Such outreach programs will be carried out by Park staff, VIPs, and Elk Bugle Corps volunteers.

COST CONSIDERATIONS

Cost estimates for the components of the alternatives include capital costs that occur once during the project, as well as annual or recurring costs that are incurred throughout the life of the project. There are estimated one time infrastructure and annual costs associated with this management plan. Costs to consider include: chronic wasting disease testing, necropsies, monitoring, education/interpretation, aversion methods, fencing, trapping, immobilization, euthanasia, and exclosures. Furthermore, with the increases in visitation to Cataloochee Valley that have accompanied the presence of elk, there have been significant impacts on the Park facilities in that area. Primarily the impact has been on the roads and visitor facilities in Cataloochee Valley. Costs will be incurred for the maintenance and enhancement of these facilities. Cost, efficiency, and effectiveness would be the factors that determine when supplemental personnel are needed and determine the extent to which this plan can be realized. Funding for this management plan may come from the following: base allocation, donations, and special project monies.

ADAPTIVE MANAGEMENT STRATEGY

Below is a general flow list for adaptive management of elk in GRSM. This is provided to give an overall and concise review of the entire elk management plan, but it is lacking in many details provided previously.

The overall objective of this plan is to maintain an elk population within the Park that is self-sustaining with acceptable impacts to Park resources. Generally, the overall goal will be achieved by meeting the three overarching management goals. Each specific goal is fulfilled by specific objectives, when applicable. Success in meeting the specific objectives are evaluated by unique metrics or monitoring techniques. When data collected during monitoring indicates a problem or issue, other management strategies will be evaluated for implementation. Monitoring will then continue to determine the management strategies' success or failure.

✓ **GRSM ELK POPULATION MANAGEMENT GOAL:** GRSM will maintain a healthy elk population that is managed within the capabilities of GRSM and in consideration of other land uses within the Park.

Population Objective 1: Maintain an understanding of general elk population dynamics, including population size, herd sex ratio, mortality and natality rates.

- **Specific Metrics and Monitoring:**
 - Monitor a subset of the elk population via multiple population surveys each year. Collected data will include animal sex, id, pregnancy status, approximate age, mortality rate, female-calf association, general health, etc.
 - Annually update population model (SAFL-USGS).
- **Monitoring Triggers (if applicable):**
 - Extensive female dispersal.
 - Extremes in birth rates/recruitment rates/survival/population growth.
- **Possible Management Strategies:**
 - No action.
 - Population augmentation.
 - Predator management.
 - Elk translocation/culling.

Population Objective 2: Addressing nuisance elk behavior in GRSM and adjacent private and public properties. GRSM will provide training, assistance with aversive conditioning, exclusionary techniques and loaning equipment when necessary to any state or federal agency in need.

- **Specific Metrics and Monitoring:**
 - Evaluate and record problem behaviors of elk.
 - Create consensus on roadways most impacted.
- **Possible Management Strategies within GRSM:**
 - Aversive conditioning.

- Permanent fencing.
- Animal deterrents.
- Animal relocation.
- Animal euthanasia.
- Creating parking areas or established pull-outs.
- Instructional/elk crossing signs.
- Reduced speed limits.
- Flashing warning lights.
- Stop signs in unconventional locations.
- Speed bumps or humps.
- Unique traffic management plans during certain times of the year.
- Elk Bugle Corps expansion during certain times of the year.

Population Objective 3: Maintain an understanding of general elk population health and continued disease surveillance.

- **Specific Metrics and Monitoring:**
 - Monitor general elk health when radiocollaring.
 - Collect samples for CWD monitoring.
- **Monitoring Triggers (if applicable):**
 - Detection of disease of concern.
- **Possible Management Strategies:**
 - No action.
 - Population augmentation.
 - Predator management.
 - Elk treatment/inoculation.
 - Elk culling.
 - Total depopulation.

✓ **GRSM VEGETATION AND ELK HABITAT MANAGEMENT GOAL:** GRSM will identify, monitor and, when necessary, mitigate impacts of elk on vegetation or other natural or cultural resources, and when appropriate and feasible, GRSM will implement strategies that may support/improve elk habitat.

Habitat Objective 1: Further an understanding of the trends of elk impacts on Park vegetation, including such parameters as changes in biomass, species richness and diversity, and plant recruitment rates. The Park will also attempt to identify indicator plant species that best capture the impacts of elk within certain communities.

- **Specific Metrics and Monitoring:**
 - Monitor herbaceous vegetation, shrubs, and saplings in an experimental context to yield measurable results to show the level of impact to vegetation structure, regeneration, or cover. The vegetation monitoring will be a three-part program: vegetation plots or exclosures, elk trails and transects, and calculations of regeneration and consumption.

- When feasible, elk fecal pellets will be collected and analyzed to identify future food habits of elk.
- **Monitoring Triggers (if applicable):**
 - Upland herbaceous vegetation (grass-like species) is heavily grazed: Offtake sites consumed >50%.
 - Major changes in canopy and understory species composition, species diversity, species richness, growth rates of woody plants, percent cover and vegetation structure, or tree regeneration and establishment.
- **Possible Management Strategies:**
 - Exclusionary fencing and/or deterrents.
 - Plant translocation.
 - Aversive conditioning.
 - Elk translocation.
 - Elk culling.

Habitat Objective 2: Implement habitat management to support the self-sustaining elk population along with the habitat of many other wildlife and plant species.

- **Management Strategies:**
 - prescribed fire.
 - cuttings of fields and/or balds.

✓ **GRSM RECREATIONAL MANAGEMENT GOAL:** GRSM will maintain safe viewing opportunities of elk, while educating the public regarding their natural history and biology.

- **Management Strategies:**
 - Provide safe viewing opportunities.
 - Educational materials would be developed.
 - Improved interpretive contacts and programs.
 - Literature and brochures at visitor centers and community events.
 - Create an up-to-date website dedicated to elk biology and management.
 - Outreach programs to schools, groups, and community organizations.

APPENDIX B and C (Separate Attachments)

June 2000 Elk Environmental Assessment and USFWS Correspondences, respectively