August 21, 2015 Draft

BISON AND ELK MANAGEMENT STEP DOWN PLAN

A Structured Framework for Reducing Reliance on Supplemental Winter Feeding

National Elk Refuge

Grand Teton National Park

~~July 24~~August 24, 2015

BISON AND ELK
MANAGEMENT STEPDOWN PLAN

For the

National Elk Refuge,

Grand Teton National Park,

John D. Rockefeller, Jr. Memorial Parkway

Teton County, Wyoming

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EXECUTIVE SUMMARY [S1]

Overview

In 2007, the National Elk Refuge (NER) and Grand Teton National Park (~~GTNP~~GRTE) published a Record of Decision (ROD; USFWS and USNPS 2007a) for a bison and elk management plan. The Bison and Elk Management Plan (BEMP; USFWS and USNPS 2007b) was developed to guide management of the Jackson bison and elk herds on NER and ~~GTNP~~GRTE lands, focused on four broad goals related to: 1) habitat conservation; 2) sustainable populations; 3) numbers of elk and bison; and 4) disease management. The final plan directed the NER and ~~GTNP~~GRTE (in conjunction with the Wyoming Game and Fish Department: WGFD) to maintain the state's elk herd objective of 11,000; establish a bison population objective of 500; restore habitat on the NER and in ~~GTNP~~GRTE; continue hunting bison and elk on the NER; continue the elk reduction program, when necessary, in ~~GTNP~~GRTE; allow the WGFD to continue to vaccinate elk and bison for brucellosis using existing vaccines until more effective vaccines become available; and develop a dynamic, structured framework and adaptive management plan for decreasing the need for supplemental feeding on the NER. ***This Bison and Elk Management Stepdown Plan was developed to ~~address the latter and~~ specifically addresses the criteria for a structured framework referenced in the Record of Decision.***

Background

Winter feeding of elk in Jackson was originally initiated to reduce winter mortality of elk and minimize depredation of ranchers' hay. The loss of available winter range in Jackson Hole due to new ranching operations and a growing town resulted in significant numbers of elk dying during several severe winters in the late 1800s and early 1900s. This prompted local citizens and organizations, as well as state and federal officials in Jackson Hole, to begin feeding elk in the winter of 1910–11. Congress heeded the appeals for assistance and on August 10, 1912, established the National Elk Refuge. Today, the need for the refuge's winter elk feeding program is a direct result of reduced access to significant parts of elk native winter range, loss of historic migration patterns, behavioral conditioning of elk to winter feeding, and the desire to maintain a population objective established in the context of supplemental feeding.

Bison were extirpated outside Yellowstone National Park (YNP) by the mid-1880s but in 1948 were reintroduced to Jackson Hole when 20 bison from (YNP) were released near Moran, Wyoming. The herd remained small until discovering elk feedlines in 1980, when the population began sustained population growth. Bison and elk that winter on the NER are migratory and occupy summer ranges predominantly to the north.

While there have been many benefits associated with wintering large numbers of elk and bison on the NER, high animal concentrations have created an unnatural situation that has contributed to an increased risk for potentially major outbreaks of exotic diseases, damage to and loss of habitat due to browsing of willow, cottonwood, and aspen stands, thereby reducing other wildlife associated with woody vegetation, unusually low winter mortality, which affects predators and other species and requires intensive hunting programs, and a high level of brucellosis in elk and bison herds.

Objectives

This stepdown plan addresses several objectives under a broader BEMP goal of sustainable populations, which directed the agencies to: 1) Develop a dynamic, structured framework~~n adaptive management plan~~ for reducing NER supplemental feeding; 2) [implement a] phased reduction of animals on feed: a) Phase 1, to 5,000 elk and 500 bison, and b) Phase 2 [to a point

where] elk and bison rely predominantly on native habitat; 3) maintain natural elk bull-to-cow ratios in park summer herd; and 4) Enhance public outreach/education. The BEMP further stated that consideration criteria for implementing the 2nd phase of reduced feeding would~~ill~~ include some or all of: 1) the level of forage production and availability on the National Elk Refuge ~~and adjacent winter ranges~~, 2) ~~maintenance of~~ desired herd sizes and age/sex ratios, 3) ~~the ability to~~ effective~~ly~~ mitigate of bison and elk ~~livestock conflicts, such as~~ co-mingling with livestock on private lands ~~during high risk disease transmission periods~~, 4) ~~maintaining desirable~~ winter distribution patterns of elk and bison, 5) ~~the~~ prevalence of brucellosis, chronic wasting disease, and other wildlife diseases, and 6) public support.[S2] **In short, the overall objective of this plan is to provide a path for progressively transitioning from winter feeding of elk and bison on the NER to greater reliance on free-standing forage, while maintaining population and herd ratio objectives and public support[S3].**

Strategies

Elk have been fed for some period during nearly every winter on the National Elk Refuge since 1912, and bison have been fed there since 1980. The attraction of highly nutritious, easily accessible food during a time of year when natural forage is typically most limited is powerful to both species, and their knowledge of its existence has been passed down through generations. As a result, elk and bison have been strongly conditioned to seek supplemental food on the NER, even when natural forage is available and even abundant during some years. Attempting to modify this behavior on a large scale is unprecedented and will necessarily require investigation, constant evaluation, modifications to approach when indicated, and repeated trials.

Since this plan is centrally tied to supplemental winter feeding on the NER, its focus will be on lands under NER authority. However, some strategies will also incorporate activities in ~~GTNP~~GRTE, and on non-federal lands in collaboration with land owners and WGFD. Primary management practices that can be altered to achieve reduced reliance of bison and elk on supplemental feed fall into the 3 broad categories of 1) timing and intensity of winter feeding, 2) timing and intensity of hunting, and 3) herd segment specific and overall harvest levels.

Measuring the success of strategies toward objectives will require knowledge of several bison and elk herd attributes. Rather than basing progress toward the number of elk on feed for the entire season on those present during the day of the survey only, we will use a more meaningful measurement. Since we are more interested in the intensity of elk feeding throughout the entire feeding period, which includes both the number of animals on feed and the duration of feeding, we will use a measurement of elk-fed-days (EFD; the total number of elk fed per day per season) as a gauge of feeding intensity (see monitoring section). For example, if 5,000 were elk fed for 100 days during the winter, feeding intensity for that winter would equal 5,000 elk X 100 days = 50,000 EFD, whereas if 5,000 elk were fed for 50 days, EFD would equal 25,000. We determined feeding intensity benchmarks for bison and elk-fed based on an actual average of 64 days of feeding from 1995-2007. Based on the Phase I objectives of 500 bison and 5,000 elk, fed-days benchmarks would be 64 x 500 = 32,000 for bison and 64 x 5,000 = 320,000 for elk. These values will assist in determining efficacy of strategies toward reducing reliance of both species on supplemental winter feeding.

Initial success of ~~AMP~~MSP implementation will be a consistent decline in the 3-year running average of elk and bison fed days from the established baseline.[S4] While the BEMP did provide specific measurement criteria for the definition of "transitioning from intensive supplemental winter feeding to greater reliance on free-standing forage" we will consider this objective met when the 3-year running average of elk and

bison fed days is <50% of baseline for 5 years in a row.

Chronic Wasting Disease. CWD has been detected within 40 miles of the JEH in moose, within 70 miles in deer, and within 175 miles in elk. Continued surveillance at sample sizes sufficient to detect 1% prevalence with 95% confidence will take place. Some aspects of CWD response planning could change depending on the outcome of the WGFD CWD management plan revision process.

Winter Feeding. Initially, supplemental feeding will be delayed by approximately 2 weeks, depending on several variables (Table 4, Fig. ~~9~~10). Time of season could influence this interval, most likely shortening it as the feeding initiation date gets later. During the last 20 years, feeding initiation dates, which have been based on forage availability, have varied from December 30 to February 28. Delaying feeding by two weeks in January, for example, is likely to be more successful than doing so in February, when food stress and tendency for animals to move to private lands is greater. Forage availability could also have an influence, particularly if a freeze thaw event resulted in an acute and large reduction in available forage. Both time of season and forage availability considerations would be affected by the numbers of elk and bison on the NER. And finally, the distribution of animals, particularly on private, livestock producing lands, would be considered. Monitoring programs will include measures of calf mortality and it will be an influencing parameter in feedback mechanisms. The BEMP anticipated that elk mortality could increase from 1-2% overall to 1-5%.[S5]

Initially, the termination of feeding, which is now based on a snow cover index and subjective evaluation of available forage, will occur about a week earlier. The combination of a 2 week delay in feed initiation and 1 week advance in termination would shorten the feeding season by 3 weeks on average, or 32% based on an average feeding season length of 9.3 weeks from 1995-2015.

Harvest. Few options for manipulating elk hunting are currently available because the JEH is at or near the 11,000 WGFD objective. Proposed changes include allowing limited any elk permits and consideration of a bow season near developments on the NER, and shifting the season later to better coincide with migration timing.

Based on bull ratios in the park summer herd that were chronically below 35 bulls:100 cows, permit types for the park's elk reduction program (ERP) went to antlerless only in 2012. ERP permit structures in the park will remain antlerless only unless bull ratios consistently exceed 35:100 cows. Park and refuge officials will work together to support this goal, recognizing that bulls harvested on the NER are most likely from the park summer herd segment.

Recent trends of reduced use of traditional winter range and increases in short-distance migrant summer herd segments have led to significant increases of winter elk concentrations on the NER. Serious consideration should be given to reducing the Jackson Elk Herd population objective, which would provide level of harvest flexibility more commensurate with addressing these herd changes.

Bison hunts on the NER (bison hunting is prohibited in ~~GTNP~~GRTE) would see little initial change (Table 4). Consideration would be given to later hunt end dates commensurate with delayed feeding, and possible escorted hunting in the South Unit to help with distribution or discouraging bison from attempting to leave the NER via the south boundary into the town of Jackson. Serious consideration should be given to reducing the bison herd population objective in the future to lower winter NER forage consumption and help reduce elk and bison winter concentrations. Genetic diversity could be addressed by periodically introducing bison from other herds.

Effectiveness of NER late-season harvest regimes is affected by December 1st winter closures immediately east of the refuge on BTNF lands. Extensive elk telemetry data suggest that delaying the winter closures could aid elk management objectives. NER officials will work with BTNF and WGFD officials to explore the possibility of allowing hunting in limited areas after December 1st in the future.

Private Lands Mitigation. Several strategies would be employed to mitigate likely changes in bison and elk distribution, including providing incentives for non-breeding cattle operations, increased fencing in some limited areas to separate elk/bison from livestock feed lines, hazing elk/bison away from livestock feed lines and purchasing private lands easements to prevent co-mingling. A vital component in implementing these mitigation measures is to establish three seasonal wildlife conflict technician positions supervised by WGFD.

Vegetation Restoration. [to be completed after these sections are drafted in the plan]

Strategies Considered But Rejected

Strategies considered by rejected included fertility control in elk and bison, agency reduction of either elk or bison, and altering rations of supplemental feed.

Models and Monitoring

Models will be used to identify the relative influence of our principal management strategy (a reduction in feed season length) and other factors on winter elk distribution (Appendix 3). Over time this will allow us to assess whether changes in elk distribution were the result of our management actions or due to factors outside of our control.

A robust monitoring program will be necessary to track the effects of actions implemented under this plan. Critical monitoring components will include: 1) enhanced forage production and availability sampling; 2) measuring animal abundance and distribution including differences in some sex and age classes; determining elk and bison fed days each feeding season; 3) estimating winter mortality; 4) brucellosis seroprevalence rates; and 5) CWD surveillance. In many cases, attribute baselines for the period preceding implementation of this plan have been developed for comparison after the plan is implemented.

Evaluation/Future Management

Modifying elk and bison behavior while reducing supplemental feeding will require a long-term, sustained commitment. Change is unlikely to happen fast, and interpreting effects of ~~adaptive~~ management actions will be complicated by varying environmental conditions from year to year. Actions completed each year, the results of monitoring programs, and any proposed changes in course will be presented in an annual ~~adaptive~~ management stepdown plan update/report, completed by NER staff by the end of March for the previous year.

Public Outreach/Education

De-emphasizing the supplemental feeding program will be a major paradigm shift for the residents of Jackson Hole, Teton County, and the State of Wyoming. The general public and especially key stakeholder groups must understand the biological needs for and strategies of the ~~AMP~~MSP in order to gain general consent to modify longstanding elk/bison herd management methods. A detailed communication plan has been developed that identifies key messages and utilizes a variety of outreach methods, including print, video, and voice material, utilizing social media, and meetings with elected officials, state and local governments, agency and tribal partners, community organizations, stakeholders, and the general public.

Schedule

Assuming adequate funding, actions under this plan will begin with radio-collaring elk in February 2016, followed by public outreach, private lands conflict mitigation and contacts, and enhanced forage monitoring in March 2016, and initiating supplemental feeding changes in January 2017.

Budget

INTRODUCTION

In 2007, the National Elk Refuge (NER) and Grand Teton National Park (~~GTNP~~GRTE) published a Record of Decision (ROD; USFWS and USNPS 2007a) for a bison and elk management plan. The Bison and Elk Management Plan (BEMP; USFWS and USNPS 2007b) was developed to guide management of the Jackson bison and elk herds on NER and ~~GTNP~~GRTE lands. It included directives for forthcoming development of adaptive management practices to address several objectives in the plan, including a desired future condition of elk and bison relying predominantly on native forage. This Bison and Elk Management Stepdown~~Adaptive Management~~ Plan has been developed expressly for that purpose.

Bison and Elk Populations

While Jackson Hole is probably best known for the splendor and ruggedness of the Teton Range, the Jackson bison and elk herds rank among the top characterizing features of the valley. Both figure prominently in Jackson Hole's history and culture, although bison were absent from the valley for about 100 years between the mid-1800s and mid-1900s.

The Jackson elk herd occupies approximately 8,000 km^2 in the upper Snake River watershed north of the town of Jackson (Fig. 1). Much of the herd is migratory, moving between distinct wintering and summer ranges. Primary wintering areas include the Buffalo Valley, lower elevations of the Gros Ventre River drainage, the National Elk Refuge (NER), and areas adjacent to the NER on Bridger-Teton National Forest (BTNF) lands. Summering areas occur throughout the herd's range and for convenience are divided into five~~our~~ geographic regions that include Grand Teton National Park (~~GTNP~~GRTE), Yellowstone National Park (YNP), the Gros Ventre drainage, ~~and~~ Teton Wilderness, and Southwest Boundry area, which includes private and public lands in the vicinity of GRTE's southwest boundary.

In the late 1800s, when elk populations all over North America were being extirpated, the residents of Jackson Hole protected elk from "tusk hunters" and large-scale commercial hunting operations. Elk are just as important to today's residents of the valley. Thousands of people each year have the opportunity to see elk at close range on the refuge while riding on horse-drawn sleighs. Thousands of pounds of shed elk antlers are sold at an annual antler auction each spring in the town square. Elk are important to backcountry users as well as to people that never leave the road. Jackson Hole is a popular destination for instate and out-of-state elk hunters. The draw of elk to visitors contributes significantly to the local economy.

Winter feeding of elk in Jackson Hole began in 1910 and was originally initiated to reduce winter mortality of elk and minimize depredation of ranchers' hay. According to historical reports, before Euro-American settlement some Jackson elk wintered in the southern portion of Jackson Hole (present location of the NER town of Jackson) and may have used areas outside Jackson Hole, including the Green River and Wind River basins to the south and east, respectively, and the Snake River basin to the southwest in what is now eastern Idaho (Allred 1950; Anderson 1958; Blair 1987; Barnes 1912; Sheldon 1927). Radio-collar studies have documented small numbers of Jackson elk wintering in each of these areas in recent times as well (NER and GRTE, unpublished data ~~*citations*~~). Over time, changes in land use and development in these areas, over hunting, and establishment of feedgrounds probably reduced the use of these areas by Jackson elk.

By the end of the 19th century the Jackson elk herd was believed to be largely confined to Jackson Hole and the immediately surrounding area, where wintering conditions are often harsh. Compounded by the loss of available winter

range in Jackson Hole due to new ranching operations and a growing town, significant numbers of elk died during several severe winters in the late 1800s and early 1900s. This prompted local citizens and organizations, as well as state and federal officials in Jackson Hole, to begin feeding elk in the winter of 1910–11. Congress heeded the appeals for assistance and on August 10, 1912, appropriated $45,000 for the purchase of lands and maintenance of a “winter game (elk)

reserve" (37 Stat. 293). The first winter census in the area was conducted in 1912 and showed about 20,000 elk residing in Jackson Hole and the Hoback River drainage (the latter is not within the Jackson elk herd's range).

Today, the need for the refuge's winter elk feeding program is a direct result of reduced access to significant parts of elk native winter range, loss of historic migration patterns,

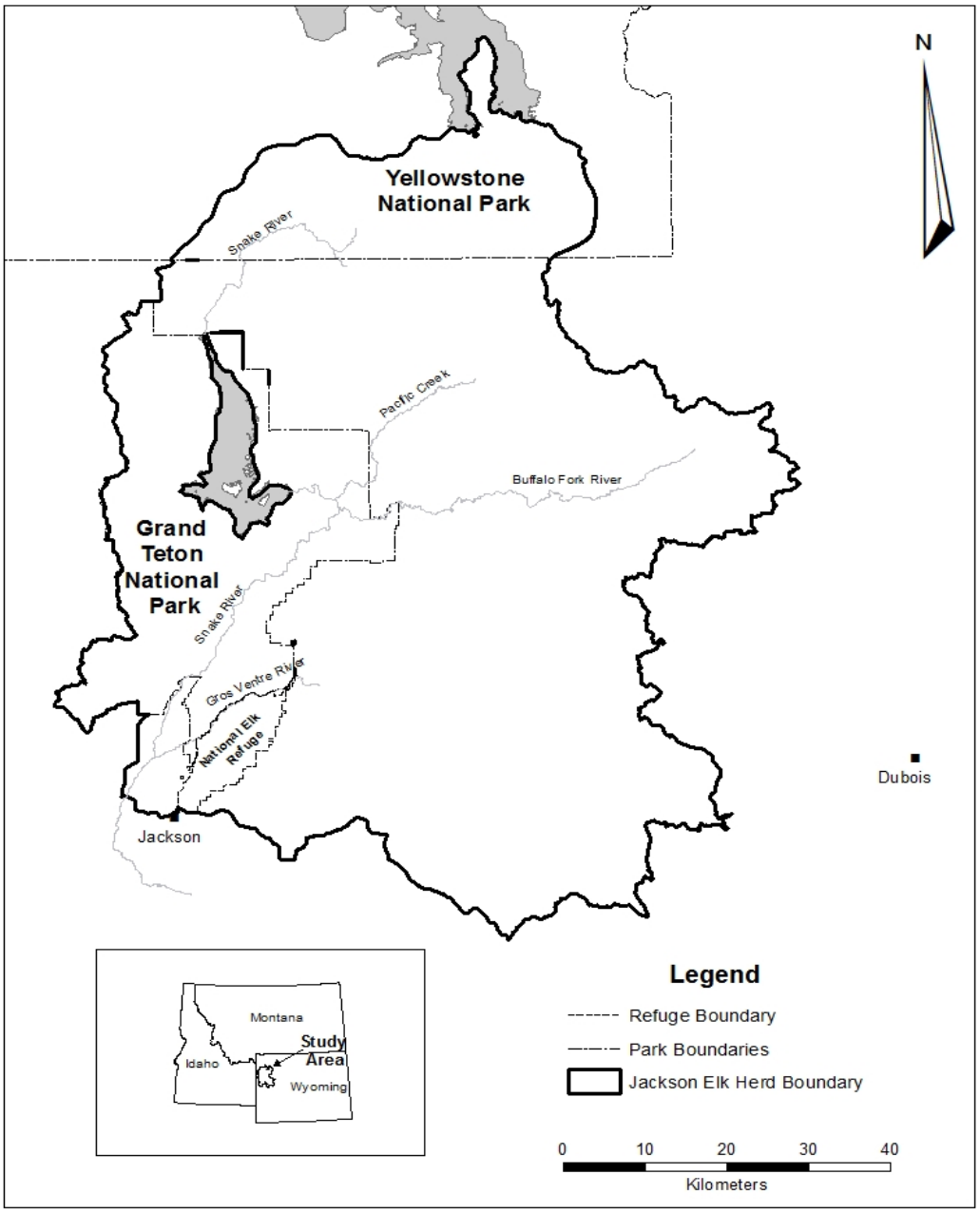


Figure 1. Jackson elk and bison herd ranges, including the National Elk Refuge, Grand Teton and Yellowstone National Parks, and Bridger-Teton National Forest. [include bison range, labels for continental divide and Bridger-Teton National Forest, and in Legend Jackson elk herd unit].

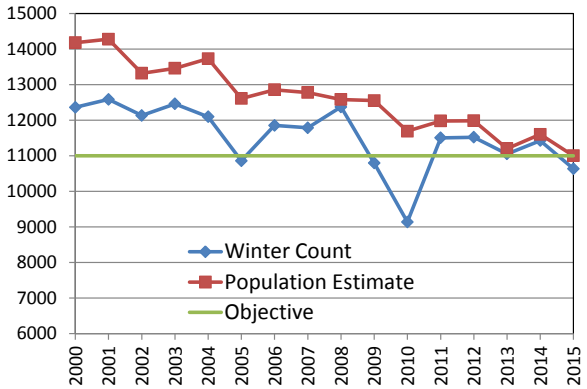


Figure 2. Winter counts, population estimates, and herd objective for the Jackson elk herd, 2000-2015.

behavioral conditioning of elk to winter feeding, and the desire to maintain a population objective established in the context of supplemental feeding. Its population in recent times has fluctuated near~~both above and below~~ its herd objective of 11,000 adopted by the WGFD (Fig. 2)

An iconic symbol of the American West, bison are also popular with visitors and residents. Because so few opportunities remain to see bison in the wild, viewing and photographing them in Grand Teton National Park with the Teton Range in the background is a treasured opportunity for many of the valley's visitors. Similar to elk, there is also a high level of interest in bison hunting. Bison are of particular interest to nearby American Indian tribes and tribes in other parts of the United States because the animals are central to their culture and tradition.

Bison are native to Jackson Hole, as evidenced by the presence of prehistoric bison remains throughout the valley, but were extirpated outside Yellowstone National Park by the mid-1880s. In 1948, 20 bison from Yellowstone National Park (YNP) were reintroduced to the 1,500-acre Jackson Hole Wildlife Park near Moran. The Jackson Hole Wildlife Park was a private, non-profit organization sponsored by the New York Zoological Society, the Jackson Hole Preserve, Inc., and the Wyoming Game and Fish Department (WGFD). A population of 15–30 bison was maintained in a large enclosure there until 1963, when brucellosis was discovered in the herd (likely transferred with the original 20 animals from YNP). At that time, all the adult animals were destroyed, but four vaccinated yearlings and five vaccinated calves were retained. In 1964 twelve certified brucellosis free bison from Theodore Roosevelt National Park were added to the herd. In 1968 the herd (down to 11 animals) escaped the confines of the wildlife park, and a year later the decision was made to allow them to range freely. The expansion of ~~GTNP~~GRTE in 1950 had enveloped the Wildlife Park, and allowing the bison to free range was and remains consistent with National Park Service wildlife management policy. The herd remained small and wintered mostly in the Snake River bottoms in ~~GTNP~~GRTE until 1975, when it followed the winter environmental gradient to the NER and began wintering there. The use of standing forage by bison on the NER was viewed as natural behavior thus acceptable to managers. In 1980, however, bison discovered and utilized supplemental feed provided for elk, and they have continued to do so every winter since.

The discovery of supplemental feed by bison has had several consequences, including a significant increase in the population's growth rate (Fig 3). Bison on the elk feedlines have at times disrupted feeding operations and displaced and injured elk. To minimize conflicts between bison and elk, managers have provided separate feedlines for bison since 1984. As the population has grown, separating elk and bison on feedlines has become increasingly difficult, and a variety of feeding strategies are employed to help reduce displacement of elk.

As the herd has grown it has maintained fairly stable movement patterns, wintering almost entirely on the NER and summering within ~~GTNP~~GRTE and adjacent lands on the BTNF (Fig. 1).

While there have been many benefits associated with wintering large numbers of elk and bison on

the NER, high animal concentrations have created an unnatural situation that has contributed to an increased risk for potentially major outbreaks of exotic diseases, damage to and loss of habitat due to browsing of willow, cottonwood, and aspen stands, thereby reducing other wildlife associated with woody vegetation, unusually low winter mortality, which affects predators and other species and requires intensive hunting programs, and a high level of brucellosis in elk and bison herds.

Planning History

Jackson's bison and elk populations have been the subject of previous planning efforts. Elk management and research has been guided by the Jackson Hole Cooperative Elk Studies Group since it was established in 19583 [verify date]. The group consists of biologists and agency administrators from the National Elk Refuge, Grand Teton and Yellowstone National Parks, the Bridger-Teton National Forest, and Wyoming Game and Fish Department, who meet at least annually to coordinate management of the population and its habitat. Coordination of bison management began soon after they started frequenting the NER in 1976 and using supplemental feed provided to elk in 1980 (Fig. 3). Release of an "Interim" plan that called for maintaining a herd of 90-110 bison while data were gathered for a long term plan occurred in 1988. It was followed by implementation of a sport hunt outside GRTE, administered by WGFD. This plan was halted after litigation in which the plan's violation of NEPA was successfully argued by plaintiffs.

In 1996, after considerable herd growth, a new long term management plan and environmental

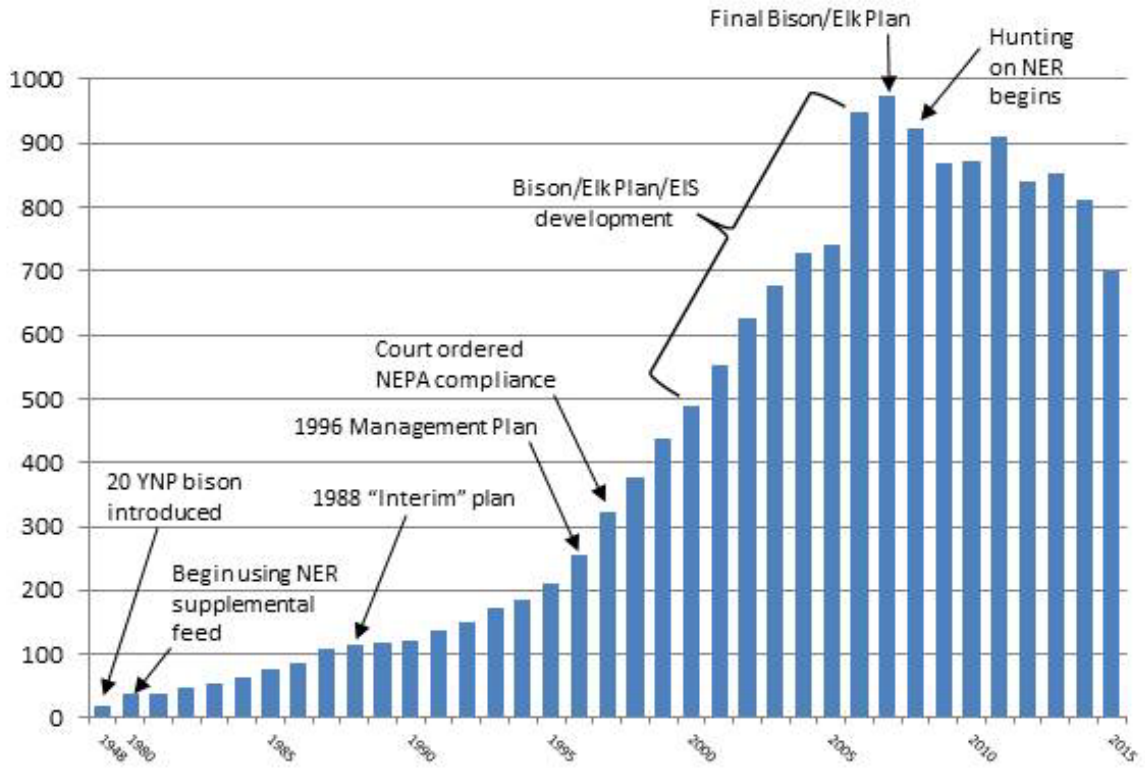


Figure 3. Population growth and planning history for the Jackson bison herd, 1948-2015.

assessment for the Jackson bison herd was released (Fig 3). This plan had strong support and called for maintaining a herd size of 350-400 bison, but it was shelved a year later when plaintiffs from the earlier litigation successfully argued that, because the plan failed to consider the effects of feeding elk on bison management, it also violated NEPA and was not sufficient. This led to development of the draft bison and elk management plan and environmental impact statement from 2000-2006 and release of the final plan in 2007 (Fig 3).

The 2007 Bison and Elk Management Plan (BEMP; USFWS 2007) considered six alternatives for bison and elk management focused on four broad goals related to: 1) habitat conservation; 2) sustainable populations; 3) numbers of elk and bison; and 4) disease management. The primary management scenarios presented in the alternatives included the status quo, terminating elk and bison hunting on the NER and the elk reduction program in ~~GTNP~~GRTE, brucellosis vaccination options, restoring habitat, improving forage, and decreasing or phasing out supplemental winter feeding.

The final BEMP (USFWS 2007; www.fws.gov/bisonandelkplan) which set management direction for 15 years or until a subsequent plan is developed, proposed to maintain the state's elk herd objective of 11,000, establish a bison population objective of 500, restore habitat on the NER and in ~~GTNP~~GRTE, continue hunting bison and elk on the NER, continue the elk reduction program in ~~GTNP~~GRTE, when necessary, in concert with the parks enabling legislation (citation), allow the WGFD to continue to vaccinate elk and bison for brucellosis using existing vaccines until more effective vaccines become available~~continue to vaccinate elk for and effective vaccine becomes available~~, and develop a dynamic framework and adaptive management plan for decreasing the need for supplemental feeding on the NER. ***This Bison and Elk Management Stepdown Plan was developed to address the latter and specifically addresses the criteria for a structured framework listed on page 5 of the Record of Decision*** **(Fig. 4).** It does not address other on-going bison and elk management actions already prescribed by the BEMP.

The BEMP scheduled the completion of the~~an Adaptive Management~~ Management Stepdown Plan for 2008. However, litigation challenging the BEMP in 2008 led to the decision to postpone its development until litigation was resolved. As of March 2015, two court rulings have upheld the 2007 BEMP and ROD. In a lawsuit against the BEMP and its author agencies (Defenders of Wildlife et al. v. the U.S. Department of Interior and State of Wyoming 2010), plaintiffs argued that the BEMP violated the National Wildlife Refuge System Improvement Act (National Wildlife Refuge System Improvement Act 1997) by disrupting the biological integrity of the Refuge, and that the plan and the accompanying EIS violated NEPA because they were insufficiently detailed to allow a reasonably complete discussion of mitigation. The crux of the plaintiff's argument was that the plan did not set a specific date for the cessation of supplemental feeding. In response, the agencies argued that the plan constituted a valid exercise of discretion and that it and the EIS were sufficiently detailed to satisfy the requirements of NEPA. In March 2010 the United States 4th District Court sided in favor of the agencies in this case. In 2011 the plaintiffs appealed this ruling to the United States 4th Circuit Court. The Circuit Court affirmed the District Court ruling (Defenders of Wildlife et al. v. the U.S. Department of Interior and State of Wyoming 2011).

National Environmental Protection Act Compliance

The 2007 BEMP/EIS and Final Record of Decision (ROD) satisfied NEPA requirements for current bison and elk management through a detailed analysis of alternative management actions and their likely effect on the environment, and substantial involvement of the public in the process. This ~~adaptive~~ management stepdown

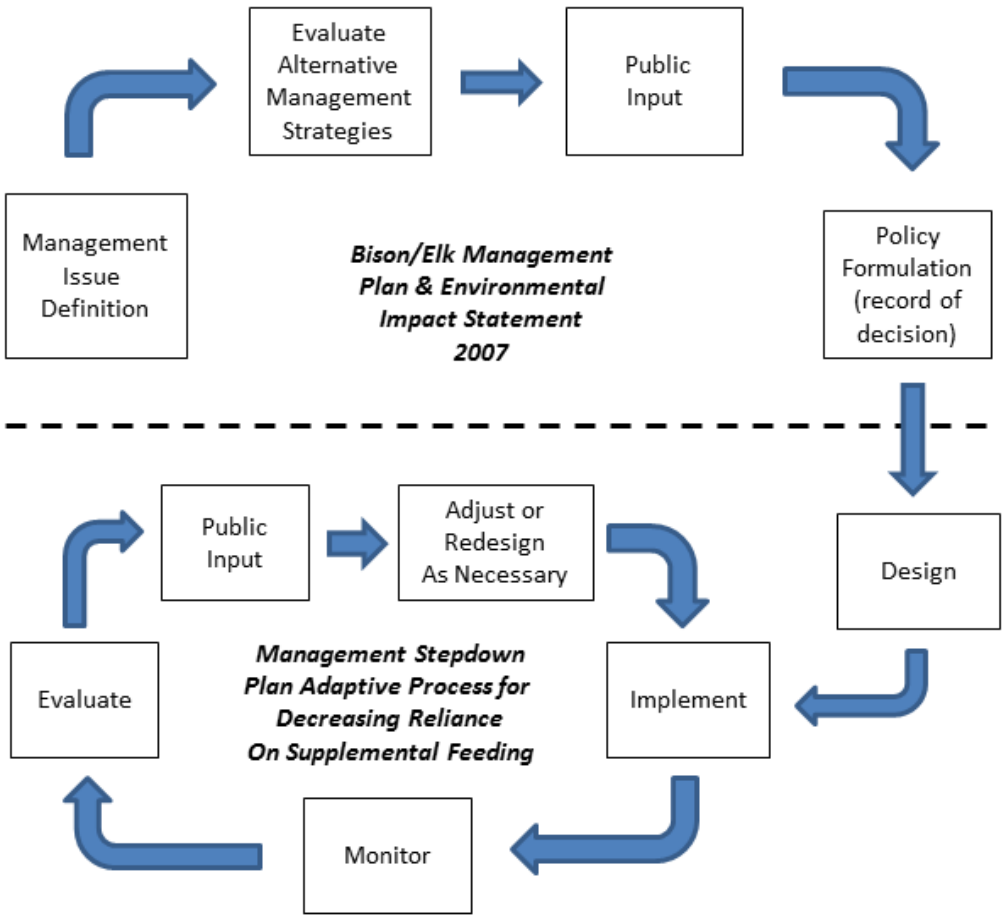


Figure 4. ~~Adaptive m~~Management stepdown planning for supplemental feeding on the National Elk Refuge and its relationship to the 2007 Bison/Elk Management Plan and Environmental Assessment.

plan is does not duplicate or add to this process. It is designed to ~~carefully~~ tier off of the BEMP as a dynamic implementation guide to one part of the preferred alternative outlined in the BEMP ROD. As such, references to NEPA covered in the BEMP will be included where necessary in this document, and the discussion of any action that would require additional NEPA compliance will be explicitly stated as such in that context.

~~Adaptive~~ Management Stepdown Planning

The use of ~~A~~adaptive management plans ha~~sve~~ gained popularity in natural resource management planning because, by definition, they allow modifications of strategy based on monitoring results and outcomes toward reaching specific goals or objectives. ~~The~~Four elements generally included in an ~~re are four essential elements to an~~ adaptive management approach include: 1) well defined and mutually agreed upon objectives, 2) knowledge (including descriptive models) of the dynamics of the system being managed, 3) clearly articulated management actions and strategies, and 4) a monitoring program to evaluate responses of the system to management actions (Walters 1986).

This step-down plan utilizes adaptive management planning principles but is not intended to include~~meet~~ all of the adaptive management planning elements outlined in the

Department of Interior Adaptive Management Technical Guide (2007).[S6] This Step-Down Plan is more accurately described as a "structured framework" of adaptive management actions that progressively transitions from supplemental winter feeding to greater reliance on free-standing forage (BEMP ROD p.5).

OBJECTIVES

The management direction and desired conditions stated in the BEMP called for the NER and ~~GTNP~~GRTE staffs to work with others (agencies, partners, etc) to "adaptively manage elk and bison in a manner that contributes to the State's herd objectives yet allows for the biotic integrity and environmental health of the resources to be sustained," so that the public can enjoy a variety of compatible wildlife-dependent recreational opportunities. Under the BEMP's 4 primary goals, 20 associated objectives were identified~~addressed~~ (Table 1). This ~~adaptive~~ management stepdown plan addresses four objectives under the goal of sustainable populations (Fig. 5).

The reduction of animals on feed at the NER was proposed to be spread over two phases. In Phase 1 ~~of the second objective~~, the aim is to reduce the average number of elk on feed to 5,000 (while maintaining WGFD's 11,000 elk herd objective), and reduce the winter population of bison to the BEMP recommended and WGFD-adopted objective of 500. In Phase 2, the overall objective is to reduce the reliance of bison and elk on supplemental feed (USFWS and USNPS 2007a). Desired conditions include animals relying predominantly on native habitat and cultivated forage. Important consideration criteria for implementing Phase 2 will include: 1) the level of forage production and availability on the National Elk Refuge and adjacent winter ranges, 2) maintenance of desired herd sizes and age/sex ratios, 3) the ability to effectively mitigate bison and elk livestock conflicts, such as co-mingling on on private lands during high risk disease transmission periods, 4) maintaining desirable winter distribution patterns of elk and bison, 5) the prevalence of brucellosis, chronic wasting disease, and other wildlife diseases, and 6) public support. In short, the overall objective of this plan is to outline a framework~~provide a path~~ for progressively transitioning from winter feeding of elk and bison on the NER to greater reliance on free-standing forage, while maintaining population and herd ratio objectives.

This Plan focuses on management actions to initially achieve Phase 1 objectives. However, if successful, these actions will continue to be used to achieve the Phase 2 objective of reducing reliance on supplemental feeding while considering the six criteria listed above.

Table 1. 2007 Bison/Elk Management Plan Goals and Objectives (~~Adaptive~~ Management Stepdown Plan objectives shaded)

Goal: Habitat Conservation

Objectives:

- Conserve important private lands.
- Increase forage production.
- Minimize non-native plants.
- Protect sagebrush grasslands.
- Restore willow, aspen, and cottonwood.
- Perpetuate natural mosaic of plant communities.

Goal: Sustainable Populations

Objectives (BEMP pages 135-136):

- Develop structured framework~~adaptive management plan~~ for reducing NER supplemental feeding.
- Phase reduction of animals on feed: 1) to 5,000 elk and 500 bison, and 2) elk and bison rely predominantly on native habitat.
- Maintain natural bull-to-cow ratios in park summer herd.
- Ensure a genetically viable bison herd with close to an even sex ratio.
- Enhance public outreach/education.

Goal: Elk and Bison Numbers

Objectives:

- Maintain state elk herd objective of 11,000.
- Maintain a genetically viable bison population of about 500 animals.

Goal: Disease Management

Objectives:

- Manage brucellosis transmission risk from elk and bison to livestock.
- Manage feeding to reduce brucellosis transmission among bison and elk.
- Educate hunters about wildlife disease human health hazards.

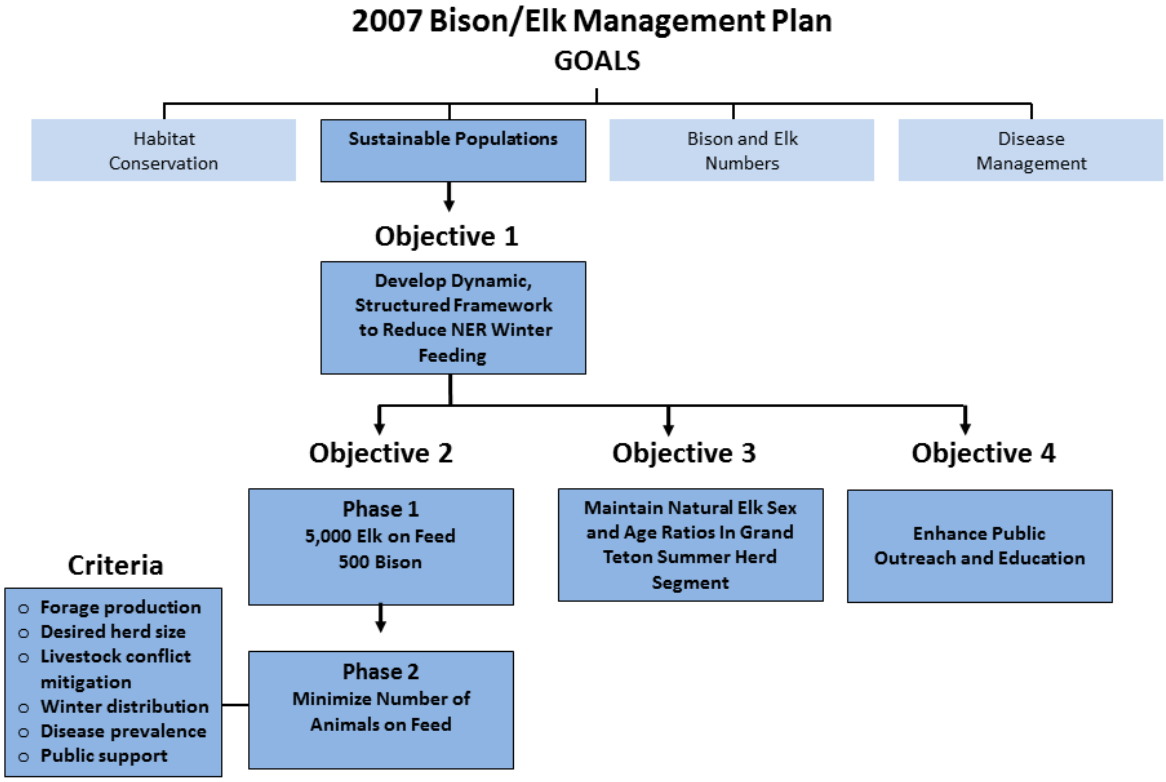


Figure 5. Relationship of Adaptive Management Plan to the 2007 Bison/Elk Management plan goals, phasing of objectives, and consideration criteria for reducing the reliance of elk and bison on supplemental feed during phase 2.

MANAGEMENT ACTIONS AND STRATEGIES

Background

Elk have been fed for some period during nearly every winter on the National Elk Refuge since 1912, and bison have been fed there since 1980. The attraction of highly nutritious, easily accessible food during a time of year when natural forage is typically most limited is powerful to both species, and their knowledge of its existence has been passed down through generations. As a result, elk and bison have been strongly conditioned to seek supplemental food on the NER, even when natural forage is available and even abundant during some years. Because it is largely unprecedented, the concept of modifying this behavior on such a large scale is daunting and fraught with questions for which there is no answer. In some cases, the likelihood a specific management strategy's success will only be able to be roughly estimated, and unanticipated results are likely. The management stepdown approach will necessarily be one of investigation, constant evaluation, modifications to approach when indicated, and repeated trials (Fig 4). As such the approach will also be experimental, guided by rigorous analysis and design, based on abundant empirical information, and monitored at an intensity commensurate with necessary decision making.

Since this plan is centrally tied to supplemental winter feeding on the NER, its focus will be on lands under NER authority. However, some strategies will also incorporate activities in

~~GTNP~~GRTE, and on non-federal lands in collaboration with land owners and WGFD. Primary management practices that can be altered to achieve reduced reliance of bison and elk on supplemental feed fall into the 3 broad categories of 1) timing and intensity of winter feeding, 2) timing and intensity of hunting, and 3) herd segment specific and overall harvest levels.

Important Changes Since 2007

The BEMP was developed based on data collected and knowledge that existed up until its Record of Decision in 2007. Since then, important changes have taken place, some of which are advantageous to this effort and~~,~~ some of which are not.

A primary change that will facilitate meeting objectives under this plan is the reduction of the bison population from nearly 1,200 animals in 2007 to about 700 during winter 2014-2015 (Fig. 3) through hunting programs administered by WGFD. Licensing changes ~~were~~ enacted in 2014 ~~to help increase harvest of female bison. These~~ included a reduction in the bison cow/calf license fee (from $416 to $263 for residents and $2522 to $1022 for non-residents) and eliminating the once-in-a-lifetime restriction on a successful bison hunter to only those that successfully harvested a bull. Continued progress toward the 500 animal herd objective will require sustained harvest success.

During the same period, the Jackson elk herd has declined from nearly 13,000 to its objective of 11,000, but because the proportion of the Jackson Elk Herd that winters on NER has increased dramatically (Fig. 6), this will make achieving the Phase I objective of 5,000 elk on feed and any future elk population reductions more difficult. Preliminary modeling suggests that the increasing proportion of the Jackson Elk Herd wintering on NER has been associated with 1) changes in elk winter distribution associated with wolves (NER, unpublished data) and 2) high numbers of elk that summer immediately adjacent to NER (Cole and Foley et al. 2015).

Refuge-wide herbaceous forage production averaged 14,387 (SD = 4125) tons during 1998–2013. In recent years irrigation of approximately 3,600 acres has increased refuge-wide forage production by approximately 10% compared to what would have been produced with precipitation alone, and by 15% in the southern portion of NER which receives the greatest use by elk and bison.

Since 2007, the general awareness of climate change among the public has greatly increased. A strong, credible body of scientific evidence shows that climate change is occurring, is caused largely by human activities, and poses significant risks for a broad range of human and natural systems (National Academy of Science 2010). Ecological systems in the GYE are likely to be affected and associated changes may~~will~~ have implications for elk and bison management.

Current Management

Ongoing primary management actions on the NER include winter feeding, harvest, irrigation, and hazing. In ~~GTNP~~GRTE, harvest of elk during the Elk Reduction Program takes place, when necessary, in collaboration with WGFD, and restoration of previously cultivated and irrigated sagebrush-grasslands is ongoing. Fundamental components of each of these will be briefly described below to provide a basis for comparison to ~~adaptive~~ management stepdown strategies that will follow.

Chronic Wasting Disease

Supplemental feeding has occurred in all but 9 winters on NER since 1912, and although this strategy minimizes winter elk mortality from starvation and contributes to Wyoming state elk herd objectives, elk occur at numbers and densities well in excess of carrying capacity (Smith et al. 2004, Lubow and Smith 2004). Considerable evidence suggests that Chronic Wasting Disease (CWD) transmission and prevalence are density dependent (Peters et al. 2000, Williams et al. 2002). Monello et al. (2014)

found that elk densities of 15-110 per square km in Rocky Mountain National Park were associated with 13% CWD prevalence, and they predicted elk population declines when CWD prevalence exceeded 13%. NER elk densities commonly exceed 160 per square km (NER unpublished data), which suggests that the introduction of CWD to NER elk would have significant negative population effects over time.

Winter Feeding

Initiation of feeding has the primary objectives of 1) minimizing elk winter mortality, focusing on calves since they are the most susceptible age class, and 2) minimizing comingling of elk with cattle on nearby adjacent private lands. Winter feeding begins when available forage reaches approximately 300 lbs/ac. Historic radio telemetry data and observations of elk movements indicate that when available forage delclines below 300 lbs/ac., some elk leave NER for surrounding private lands. Therefore, the purpose of this feeding trigger is to keep elk on the NER and prevent them from searching off-refuge for forage which increases the potential of comingling. This trigger is not a warning that a significant nutritional deficit threshold has been reached. Available winter forage for elk and bison on the NER is largely determined by biomass of forage produced during the previous growing season, rate of forage consumption during fall and winter, and how snow conditions affect forage availability.

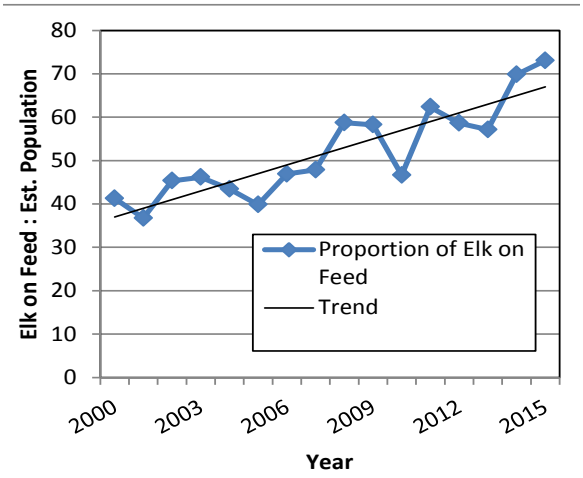


Figure 6. Increasing trend of National Elk Refuge elk on feed as a proportion of the Jackson Elk Herd estimated population size.

Forage biomass estimates are calculated annually based on sampling at index sites. Index sites are selected subjectively each year based on presence of vegetation highly palatable to elk.

During 1995–2013, on average, initiation of NER winter feeding occurred on 28 January (range 30 December - 28 February), and feeding was terminated on 3 April (range 20 March - 20 April). Variation in feeding initiation and termination dates has been based on winter conditions and elk-cattle comingling problems on nearby private lands. Coordination of winter feeding dates on the NER and WGFD-operated Gros Ventre drainage feedgrounds (Alkali, Patrol Cabin, Fish Creek) occurs annually to help minimize movement of elk between these areas. This coordination will continue regardless of the management strategy employed. The relationship of recent elk numbers and objectives for NER and WGFD-operated feedgrounds and native range is

Table 2. Annual distribution of wintering elk from the Jackson Elk Herd during February classification counts, 2011–2015, relative to the current objective.

	OBJECTIVE	2011	2012	2013	2014	2015	mean
NER	5,000	7,746	7,360	6,285	8,296	8,390	7,615
Gros Ventre	3,500	2,775	3,265	2,982	2,326	1,162	2,502
Native Range[1]	2,500	982	894	1,784	801	913	1,075
Total	11,000	11,503	11,519	11,051	11,423	10,465	11,192

[1]Excludes objectives for native range adjacent to Gros Ventre feedgrounds.

shown in Table 2.

Bison discovered refuge feeding operations in 1980, and since that time they have been fed each year to help minimize disruption to elk feeding operations. Because bison displace elk from feedlines, NER staff attempt to feed most bison in the northernmost refuge feedground and to provide a heavy feed ration, which helps keep them in this area. This strategy prevents bison from mingling with elk and also prevents bison from moving to areas where conflicts with humans are more likely.

~~Bison are fed as necessary to help minimize disruption to elk feeding operations. Bison will readily displace elk from feedlines, so since bison started using feedlines in 1980 refuge staff have developed a strategy of keeping most bison at the northernmost feedground (McBride) by feeding them there prior to feeding elk. Bison are provided a ration consistent with encouraging them to stay in this area away from elk feeding areas. This has also reduced conflicts associated with bison moving into Jackson or to the Nowlin area of the NER where commercial sleigh rides occur.~~

Harvest

Total harvest of the JEH was gradually reduced over the last decade as the population neared objective (Fig. 7). Elk hunting on the NER (Hunt Area 77) typically begins in mid-October and ends in mid-December, with peak harvest in recent years occurring in late November to early December. From 2005 to 2011 an average of 393 (SD = 56, range 329-457) hunters harvested 161 (SD = 38, range 126-225) elk per year during the NER hunt.

The 1950 legislation that created Grand Teton National Park provided for a controlled reduction of elk, when necessary, in specific portions of the park, primarily east of the Snake River. Elk reduction programs have taken place in the park each year since 1950 except two (1959, 1960), when ~~GTNP~~GRTE and WGFD officials agreed a reduction was not necessary (Figure 8). Season dates have varied over the years but recently have run from mid-October to early-December. The ~~GTNP~~GRTE harvest accounts for about 25% of the JEH overall harvest, thus has been an important factor in regulating the population. Increased natural regulation, likely a result of increases in grizzly bears and wolves over the last 20 years, has decreased the need for large harvests in the park.

Bison hunting begins on August 15 and ends in early to mid-January. Most harvest occurs on the NER, with some additional harvest on private and BTNF lands. Since resuming the bison hunt in 2007, mean harvest has been 210 (SD = 45.5, range 139-301) bison per year. This level of harvest has been sufficient to arrest the exponential growth of the population, reducing bison numbers from the peak in 2007 to about 700 animals in winter 2015 (Fig 3). Tribal bison harvest of up to 5 animals for ceremonial purposes was authorized in the BEMP. Translocation of wild bison to lands outside of Teton County is not currently permitted due to brucellosis concerns.

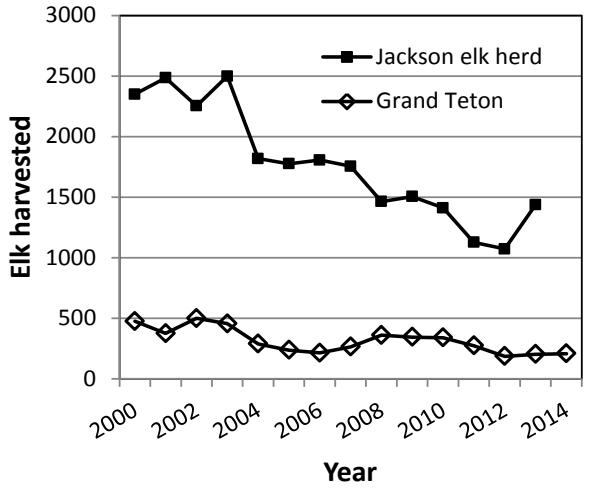


Figure 7. Estimated elk harvests for Grand Teton National Park and the Jackson elk herd (including the park) 2000–2014.

Bison hunting is not allowed in ~~GTNP~~GRTE because of long standing National Park Service policy that prohibits most hunting in national parks. Bison quickly learned to take advantage of the parks safety, which has made obtaining hunter harvest goals difficult. Many bison stay in the park during the hunting season, with only occasional short term movements to the NER, until severe winter conditions occur. In response, NER and WGFD managers attempt to balance extending the hunt as late in January as practicable without conflicting with winter feeding. The unpredictable nature of winter conditions that time of year makes this–a risky proposition, and can result in the use of emergency season extensions or reductions.

Hazing

NER staff haze elk and bison to conserve winter forage, prevent year round use of winter range, and in some cases to prevent elk and bison from moving to private lands or other areas where conflicts with humans are likely. Hazing using ATVs has proven most effective. The strategy is typically employed during 3 time periods: 1)In May to move elk and bison off NER that are lingering on NER winter range; 2) In July when some bison typically return to NER; and 3) In the period just prior to feeding initiation when elk and bison are most likely to leave NER for private lands.

~~Elk and bison are hazed in spring to encourage movement off of NER winter ranges. Methods used have included ATVs, on foot, and on horseback, but recently ATV use has been found most effective. It's possible that some elk and bison might remain on the NER year around without hazing. If animals fail to leave the NER following the termination of feeding and adequate green up has occurred, they are typically hazed to the north in late April to early May. Elk will stay off the NER until fall migration, and bison will generally remain in GTNP until mid-July. From July to early August bison often make forays back to the NER and are hazed back to GTNP to protect winter forage. Hazing efforts in August cease several days to weeks before the bison hunting season in an effort to increase hunter harvest.~~

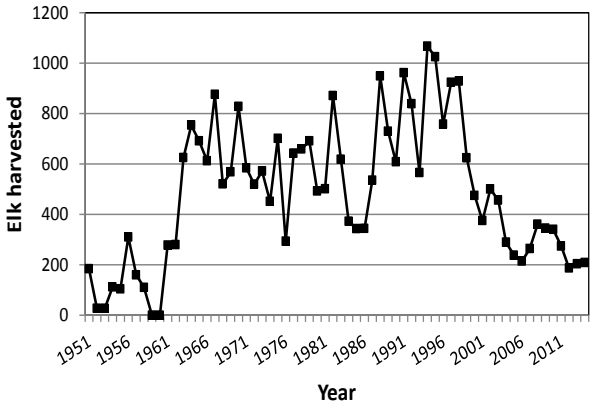


Figure 8. Elk harvest in Grand Teton National Park, 1950-2015.

Vegetation Restoration and Protection

The BEMP identified approximately 4,~~0~~500 acreas of previously irrigated and cultivated grasslands in ~~GTNP~~GRTE in need of restoration to native sagebrush grasslands community. Objectives of ecological restoration include restoring abandoned hayfields to native communities to improve wildlife forage and habitat, and visitor opportunities to enjoy wildlife viewing. After 2 years of research and field studies, restoration efforts began in 2008. The restoration process involves several steps including: prescribed fire,

herbicide applications, cereal grain cover crops, and finally native seeding. Substantial progress in this endeavor has been made since 2007, including: Currently, 1,184 acres of previously cultivated lands are under restoration treatment. Of the 1,184 acres undergoing treatment, 657 acres has been seeded with native grass, shrub, and select fob mixes. One hundred of these acres are currently fenced to reduce grazing pressure from bison and other ungulates. The remaining 527 acres will be seeded once removal of the invasive vegetation is successful. All treatments are monitored for native plant establishment and invasive plant infestations and treatments will be adjusted as necessary. The park will continue to seek funding for additional restoration of the remaining areas. ~~Substantial progress in this endeavor has been made since 2007, including: [GTNP folks please add short description of methodological research and implementation, followed by what remains to be accomplished]~~

Private Lands Mitigation

Fencing of hay stacks and livestock feedlines has been historically used to mitigate particularly difficult conflicts on private lands. Targeted fencing of golf course greens and sand traps fall through spring has also been successful in some situations for mitigating elk and bison presence and associated damage in these areas. It is important to note that the county has a 'wildlife-friendly' fence policy and does not support extensive fencing that is impermeable to wildlife.

Methods, Assumptions, and Constraints Common to All Strategies

Measuring the success of strategies toward objectives will require knowledge of several bison and elk herd attributes, particularly population sizes. Measurements of the Jackson bison herd will be based on the annual mid-winter census and sex and age classification survey performed by NER, ~~GTNP~~GRTE, and WGDF biologists. This survey occurs one day in early February and includes ground counts of animals on feed at the NER and aerial counts of outlying bison across their winter ranges on the refuge, park, and Bridger-Teton National Forest.

Elk population estimates will also be based on mid-winter aerial and ground counts. However, the mid-winter counts are undertaken during a single survey period and do not necessarily represent either peak or cumulative abundance of elk on feed. Rather than basing progress toward the number of elk on feed for the entire season on those present during the day of the survey only, we will use a more meaningful measurement. Since we are more interested in the intensity of elk feeding throughout the entire feeding period, which includes both the number of animals on feed and the duration of feeding, we will use a measurement of elk-fed-days (EFD; the total number of elk fed per day per season) as a gauge of feeding intensity (see monitoring section). For example, if 5,000 were elk fed for 100 days during the winter, feeding intensity for that winter would equal 5,000 elk X 100 days = 500,000 EFD, whereas if 5,000 elk were fed for 50 days, EFD would equal 250,000.

We determined feeding intensity benchmarks for bison and elk-fed based on an actual average of 64 days of feeding from 1995-2007. Based on the Phase I objectives of 500 bison and 5,000 elk, fed-days benchmarks would be 64 x 500 = 32,000 for bison and 64 x 5,000 = 320,000 for elk. These values will assist in determining efficacy of strategies toward reducing reliance of both species on supplemental winter feeding.

Implementation of the ~~AMP~~MSP will have successfully attained the objective of "transitioning from intensive supplemental winter feeding to greater reliance on free-standing forage" when supplemental feeding was not used for more than 50% of the years in a 5 year period.[S7]

Initial success of ~~AMP~~MSP implementation will be a consistent decline in the 3-year running average of elk and bison fed days from the established baseline.[S8] While the BEMP did provide specific measurement criteria for the definition of

Table 3. Summary of potential Adaptive Management Plan constraints.

Policy

- ESA[1] Lynx – limits on habitat impacts
- Greater Sage Grouse – core area protection
- 2007 BEMP/EIS (federal actions/lands)
  - No fertility control
  - No test and slaughter
  - Limited tribal harvest
- Bison/elk hunt end date (Feb. 1st)
  - WGFD, brucelosis safety
- Carcass disposal (Feb. 15th)
  - WGFD, brucellosis safety
- Forest Service winter closure (Dec. 1st – April 30th)
- Easement limitation (NER boundary)

Winter Feeding

- Only during non-hunting periods

Harvest

- State regulations

Vegetation Restoration/Protection

- Bison/elk distribution
- Exotic plant species management

Private Lands

- Owner agreements

Social

- Hunter density (safety; hunt quality)
- Elk/bison winter mortality levels
- Public safety (ungulate/vehicle collisions)
- Disease
- Land-use conflicts (agricultural and residential)

Biological

- Disease (bison/elk/cattle commingling)
- Sage grouse habitat conflicts
- Fencing/wildlife conflicts
- Elk herd distribution
  - summer segment distribution goals

Funding

- Easement purchase
- Plan implementation

[1]Endangered Species Act

"transitioning from intensive supplemental winter feeding to greater reliance on free-standing forage" we will consider this objective met when the 3-year running average of elk and bison fed days is <50% of baseline for 5 years in a row.

Several management constraints are common to the strategies discussed below (Table 3). Many law and policy constraints are applicable but we include here only those most pertinent. Endangered Species Act (16 USC 1531 et seq.) requirements for wolves, grizzly bears, lynx, and others apply. Lynx requirements for maintaining certain habitat types could limit methods used and areas considered for habitat improvements in ~~GTNP~~GRTE. Similarly, compliance with the Wyoming greater sage-grouse core area protection executive order (2011-5 and supplement 2013-3) could restrict habitat manipulations. NEPA compliance conducted as part of the BEMP/EIS constrains what federal actions can be taken as a part of this plan. State regulations constrain late (winter) hunt and carcass disposal timing to protect against brucellosis contamination, since February-April represent the period bison and elk are most likely to transmit the disease. Restrictions on hunting timing also result from BTNF winter range closures, immediately east of the NER and elsewhere, December 1 to April 30. Additional details about these and other constraints will be included in discussions about specific strategies that follow.

Strategies

This section ~~will~~ describes the management action this ~~A~~SMP proposes to implement. As such, it unveils the heart of management changes proposed~~necessary~~ to begin the process of transitioning to ~~more~~ greater reliance of bison and elk on native forage during winter. Fundamentally, the strategies discussed in this plan represent an experiment designed to achieve Phase I objectives of 5,000 elk and 500 bison on NER and are a first step towards reducing reliance on supplemental feeding while

meeting the sustainable population goals identified in the ~~A~~SMP.

Initial strategies for achieving sustainable population goals identified in the BEMP (Table 1) are presented by objective below. The primary management actions available to the agencies to achieve phase I objectives are modifications to winter feeding and hunting seasons. To a lesser extent, vegetation protection and restoration can be important, particularly for improving long-term ecological balance and enhancing natural production of native forage. Private lands are also an integral component as changes in elk and bison distribution occur and new challenges develop. The likely consequences of implementing these strategies were evaluated in the BEMP. The most relevant of these are summarized in Appendix 1.

Objective: *[Implement] a phased reduction of animals on NER feed: 1) to 5,000 elk and 500 bison, and 2) [to an extent where] elk and bison rely predominantly on native habitat* (Table 1).

~~This objective is what the need for an adaptive management plan – **this document** – is central to.~~ The first phase objective will be to reduce the number of elk on NER feed to approximately 5,000 and achieve a target population of about 500 bison. The second phase objective will be to adaptively manage bison and elk populations to achieve desired conditions, with animals relying predominately on available native habitat (on refuge, park, and forest lands) and cultivated forage (on the NER).

As previously mentioned, the concept of reducing winter feeding after more than 100 years of the practice, and the associated behavioral conditioning of elk and bison to its presence, represents a formidable challenge that must be approached cautiously and systematically. The strategies discussed below have been developed in this context, with appropriate feedback mechanisms through rigorous monitoring and frequent evaluation. Inability to meet this objective under the strategies presented here would trigger a thorough evaluation and development of more aggressive strategies.

Chronic Wasting Disease

The BEMP states that "If [CWD] infection is found, strategies from the state's *Chronic Wasting Disease Management Plan* (WGFD 2006) will be implemented to reduce transmission (BEMP p.127).

In 2014 WGFD began the revision process for the Wyoming CWD Management Plan (2006), which to date has not been completed.. WGFD has cooperated with federal agencies and other stakeholders to revise the plan, and NER and USFWS Region 6 Wildlife Health Office staff participated in several meetings associated with this effort. One goal of the CWD Management Plan update is to develop specific management responses should CWD be detected on or adjacent to State or NER elk feedgrounds. Early detection of CWD in the JEH is essential to ensure an effective management response.

When completed, the State of Wyoming's updated Chronic Wasting Disease Management Plan will be evaluated to determine if these new strategies will be implemented on the NER or if other strategies will be used.

Since 1997 NER has cooperated with Wyoming Game and Fish Department (WGFD) to conduct surveillance for CWD in the JEH unit. GRTE has also collaborated with WGFD to collect samples from the park's elk reduction program and from road-killed cervids. Although this effort indicates that CWD is not currently found in the JEH, continued surveillance at sample sizes sufficient to detect 1% prevalence with 95% confidence annually will be critical to ensure a timely management response and limit the long-term population effects of the disease (USFWS and NPS 2007). Given that CWD has been detected within 40 miles of the JEH in moose, within 70 miles in deer, and within 175 miles in elk, this level of surveillance is warranted.

Winter Feeding

Winter feeding actions that could be modified include starting date, ending date, and daily ration. To modify elk and bison behavior in the long run, delaying initiation of feeding is likely to have the greatest impact by gradually conditioning them to expect feed later on average, with the desired outcome of building a cohort of animals that rely primarily on native winter range and are not food conditioned. To reduce supplemental feeding overall, ending feeding early would also help decrease the amount of feed provided per animal per year. Both would help decrease the total elk/bison fed days, the parameter we will use to measure progress toward reducing supplemental feeding.

Initially, supplemental feeding will be delayed by approximately 2 weeks, depending on several variables (Table 4, Fig. 9). Time of season could influence this interval, most likely shortening it as the feeding initiation date gets later. During the last 20 years, feeding initiation dates, which have been based on forage availability, have varied from December 30 to February 28. Delaying feeding by two weeks in January, for example, is likely to have fewer negative effects~~be more successful~~ than doing so in February, when food stress and tendency for animals to move to private lands is greater. Forage availability could also have an influence, particularly if a freeze thaw event resulted in an acute and large reduction in available forage. Both time of season and forage availability considerations would be affected by the numbers of elk and bison on the NER. And finally, the distribution of animals, particularly on private, livestock producing lands, would be considered.

A primary concern of manipulating feeding is elk winter mortality, particularly among calves. As food becomes limited in winter, calves are usually the first to experience nutritional deficit and winter mortality ~~suffer~~ because of being displaced by more dominant animals. Monitoring programs will include measures of calf mortality and it will be an influencing parameter in feedback mechanisms. The BEMP anticipated that elk mortality could increase from 1-2% overall to 1-5% (Appendix 1).

Initially, the termination of feeding, which is now based on a snow cover index and subjective evaluation of available forage, will occur about a week earlier. The combination of a 2 week delay in feed initiation and 1 week advance in termination would shorten the feeding season by 3 weeks on average, or 32% based on an average feeding season length of 9.3 weeks from 1995-2015.

The ~~A~~MSP winter feeding strategy would include the establishment of additional key forage index sites and on-going measurements at those sites throughout the winter.

Harvest

Currently the Jackson elk herd is at the Wyoming Game and Fish Commission established objective of 11,000 animals, which means there is less flexibility in manipulation of harvest regimes than there would be if the herd was above objective. Initially there would be little change in elk harvest programs on the NER, with the exception of allowing a limited number of any elk permits throughout the season, considering allowing bow hunting near developed areas (roads and buildings) and shifting the season about a week later (Table 4). Allowing a limited number of any elk permits would be consistent with providing sport hunting recreation on National Wildlife Refuges (citation, NWR system act) and the NER (citation, CMP?), and possibly encourage more hunters to participate in antlerless elk hunts. Monitoring programs and consideration of bull ratios in the ~~GTNP~~GRTE summer segment (since most park bulls migrate to the NER) would help inform levels of take proposed. Bow hunting in areas currently closed to firearms will likely increase harvest by eliminating "no-hunt" areas which can become sanctuaries for large numbers of elk. Shifting the hunt one week later is consistent with later migrations and will improve harvest effectiveness (Fig. 9).

General elk harvest patterns in ~~GTNP~~GRTE would continue to be based on need for harvest, summer segment population estimates, and mitigation for impacts on other resources and visitor activities.

Elk herd population objectives are reviewed every five years by the Wyoming Game and Fish Commission and adjusted as necessary. Serious consideration should be given to reducing the Jackson Elk Herd population objective. Lowering the population would help compensate for reduced use of traditional native winter range and increased growth of short-distance migrants which has led to significant increases of winter elk concentrations on the NER.

The annual fall/winter arrival of elk to the NER during the past several decades has been occurring progressively later. This trend may necessitate extending the elk hunting season later into the year to achieve harvest objectives.

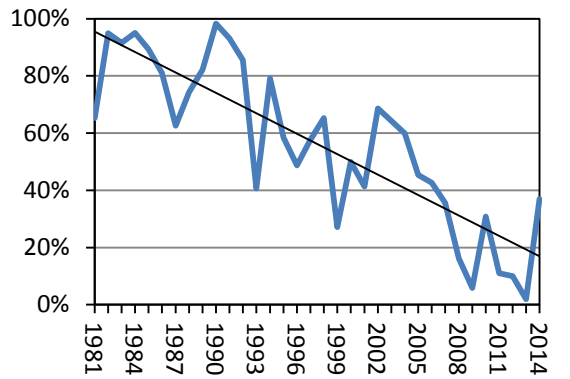


Figure ~~2~~9. The percentage of elk that wintered on NER counted there on December 1, showing progressively later annual fall/winter arrival of elk to the NER during the past several decades ~~has been occurring progressively later~~. This trend may necessitate extending the elk hunting season later into the year to achieve harvest objectives.

Bison hunts on the NER (bison hunting is prohibited in ~~GTNP~~GRTE) would see little initial change (Table 4). Consideration would be given to later hunt end dates commensurate with delayed feeding, and possible escorted hunting in the South Unit to help with distribution or discouraging bison from attempting to leave the NER via the south boundary into the town of Jackson. If progress toward reaching the herd objective of 500 animals continues and the objective is reached ~~in the near future~~, WGFD will adjust harvest quotas in the context of the objective, as necessary, to address population changes through time. ~~State quotas will likely be reduced and management flexibility will increase.~~

A cattle guard will be installed on the Refuge Road near the east end of Broadway Avenue to help prevent bison and elk herds from entering the Town of Jackson. This will reduce the potential for dangerous human/wildlife interactions.

~~Serious consideration should be given to reducing the bison herd population objective in the future. This would lower winter forage consumption on the NER and help reduce elk and bison winter concentrations.~~

~~The current bison herd objective is ". . . maintain and ensure a genetically viable population of approximately 500 animals (five year average), with as close to an even sex ratio as possible to maximize maintenance of genetic variation over time. . ." (BEMP p. 136).~~

~~The Jackson bison herd is not considered part of the U.S. Fish and Wildlife Service's meta-population approach to bison conservation because of its high prevalence of brucellosis. This disease prevents the export of Jackson bison to other DOI conservation herds.~~

~~The 500 bison population objective was set primarily to preserve existing genetic diversity assuming extremely limited natural genetic transfer with the Yellowstone or other DOI bison conservation herds. Genetic diversity can be~~

~~maintained for a Jackson bison herd less than 500 if bison with desirable genetic diversity are periodically imported from other DOI bison conservation herds.~~

Currently, the effectiveness of NER late-season harvest regimes is affected by December 1st winter closures immediately east of the refuge on BTNF lands. Extensive elk telemetry data suggest that delaying the winter closures could aid elk management objectives. NER officials will work with BTNF and WGFD officials to explore the possibility of allowing hunting in limited areas after December 1st in the future.

Annual herd-wide population estimates, elk summer herd segment estimates in GRTE and NER, temporal and spatial harvest patterns, and animal-fed-days would be monitored, and the resulting information would be used to inform ongoing evaluation of ~~adaptive~~ elk and bison management harvest programs (Figs. 9 and 10).

Hazing

No change in hazing practices is anticipated initially under this ~~adaptive~~ management stepdown framework.

Private Lands Mitigation

Delaying the onset of NER feeding is likely to result in changes in bison and elk distribution (Appendix 1). Some elk or bison may move to private lands in search of forage. Of greatest concern is the potential for elk or bison to commingle with cattle of cow/calf operations, where brucellosis transmission could have considerable consequences, in the worst case requiring depopulation of the cattle herd.

Several strategies would be employed to mitigate potential problems (Table 4), including providing incentives for non-breeding cattle operations (because brucellosis transmission to slaughter-bound cattle is not economically important), increased fencing in some limited areas to separate elk/bison from livestock feed lines, haze elk/bison away from livestock feed lines and purchase private lands easements to prevent co-mingling. A vital component in implementing these mitigation measures is to establish three seasonal Wildlife Conflict Technician positions which are supervised by the WGFD. These Technicians are also critical to the success of an expanded monitoring program vital to the ~~AMP~~MSP (see Monitoring section below).

A database will be established to track non-agricultural conflicts on private lands to determine trends which will help evaluate the effectiveness of ~~AMP~~MSP mitigation efforts.

Preventing elk and especially bison from entering the Town of Jackson is essential in minimizing safety and private property conflicts. Currently, bison are hazed northward when they drift south of Miller Butte. A double cattle guard will be installed on the Refuge Road just north of Broadway Avenue. This barrier is designed to prevent elk/bison from entering the Town of Jackson.

Vegetation Restoration/Protection

[NER and ~~GTNP~~GRTE staff to draft material]

Objective: *Maintain natural bull-to-cow ratios in park summer herd* (Table 1).

National Park Service management policy (NPS 2006) provides guidance for maintaining naturally regulated wildlife populations, free from the impacts of humans, to the greatest extent possible. The final BEMP identified a goal of maintaining park elk bull:cow ratios (a common way of expressing sex and age ratios in wild ungulate populations) near 35 adult bulls per 100 adult cows, based on estimates of what this ratio would be in a herd free from the effects of human harvest. The sex and age ratios of most North American elk populations are affected by sport hunting and herd managers generally maintain lower bull ratios.

Harvest

Based on bull ratios in the park summer herd that were chronically below 35 bulls:100 cows, permit types for the park's elk reduction program (ERP) went to antlerless only in 2012. ERP permit structures in the park will remain antlerless only unless the bull ratios consistently exceed 35:100 cows. Park and refuge officials will work together to support this goal, recognizing that bulls harvested on the NER are most likely from the park summer herd segment.

A private lands ~~H~~hunting ~~C~~coordinator ~~P~~position, ~~would be~~ established and supervised by the WGFD, may be considered as need and opportunity arise. This position would ~~to~~ promote and coordinate hunting activity focused on Southern Herd Segment harvest in and around private lands in the Spring Gulch Area north to Moose, WY (Hunt Area 78).

Table 4 [incomplete]. Comparison of current and adaptive primary management components and parameters.

Action	Current Management	~~Adaptive~~ Management Stepdown Plan	Comments
Winter Feeding:			
Feed	Pelleted alfalfa	Pelleted alfalfa	No change
Ration	8 lbs/day/elk 20 lbs/day/bison	8 lbs/day/elk 20 lbs/day/bison	No change, to minimize calf mortality
Start criteria:			
Available standing forage	300 lbs/acre, as measured at traditional key index sites	Generally 2 weeks later; index sites to be increased in number and distribution	Influencing factors: - time of season - forage availability - numbers of elk/bison on NER - elk/bison distribution
End criteria:			
Available forage	Based on a snow cover index and subjective estimate of when residual or new forage is adequate	Generally 1 week earlier	Development of more objective criteria for future implemen-tation ongoing
Monitoring:			
Animals on feed	Mid-winter census	Elk/bison fed days[1]	
Proportion of JEH on NER feed	Mid-winter census	Mid-winter census	
Calf mortality ~~threshold~~	2008-2015 Average: 3.3% (range 1.1-9.0%)	<= 10%	
Elk/bison distribution - visual			
Elk/bison distribution – collars	Almost no documented use of private lands during feeding operations	Unknown, but likely higher use of private lands than current management	
Elk Winter mortality (all age classes)	2008-2015 Average: 1.2% (range 0.6-1.9%)	<=3%	
Elk summer range segment Proportions for NER wintering elk	Approximately 40% GTNP North of Moose 35% South Snake River 10%Gros Ventre/Flat Creek 10% Teton Wilderness 5% Southern Yellowstone[1]	Unknown, but will be monitored based on summer distribution of radio collared elk	
Harvest, National Elk Refuge elk:			
Frequency	Annual	Annual	
Begin Date	2nd week October	3rd week October	Modified as necessary
End Date	2nd week December	3rd week December	Modified as necessary

Table 4, continued. Comparison of current and adaptive primary management components and parameters.

Action	Current Management	~~Adaptive~~ Management Stepdown Plan	Comments
Harvest, National Elk Refuge elk:			
Refuge permit types	- 1st week any elk - Antlerless only remainder of season	- Primarily antlerless only - limited any elk permits throughout season	
Access	Restrict access to specific locations	Restrict access to specific locations	
Hunt area boundaries		Consider expanding to allow bow hunting near developed areas	
Harvest, National Elk Refuge bison:			
Frequency	Annual	Annual	
Begin date	August 15th	August 15th	Modified as necessary
End date	2nd or 3rd week January	Consider later dates as appropriate	Modified as necessary
structure	As per WGFD	As per WGFD	
Refuge permit types	Any bison or cow/calf per state license	Any bison or cow/calf per state license	
access	Restrict access to specific locations	Restrict access to specific locations	
Hunt area boundaries	Limited to north of Nowlin Creek area	Consider escorted hunting in South Unit as needed	Guided hunts in South Unit when authorized
Harvest, Grand Teton NP elk:			
Frequency	As needed	As needed	
Begin Date	3rd week October	3rd week October	Modified as necessary
End Date	2nd week December	2nd week December	Modified as necessary
License types	Antlerless only	Antlerless only‡	
Special regulations:	Cartridge limits	Cartridge limits	
	Bear spray required	Bear spray required	
	Hunter safety card required	Hunter safety card required	
Harvest, Bridger-Teton NF, Elk Hunt Area 80:			
Begin Date			
End Date		December 15	Would require change in winter closure dates

‡~~Any elk licenses could be offered if bull ratios in the park consistently exceed BEMP criteria.~~

Table 4, continued. Comparison of current and adaptive primary management components and parameters.

Action	Current Management	~~Adaptive~~ Management Stepdown Plan	Comments
Harvest, Elk Hunt Area 78			
Structure			Changes at discretion of WGFD
License types			
Private Lands Mitigation:			
Cattle commingling		Incentives for non-breeding operation	
Hay depredation		Increased fencing	
Landscape damage			
Easement acquisition			
Vegetation Restoration/ Protection: Elk Refuge			
Vegetation Restoration/ Protection: Grand Teton			

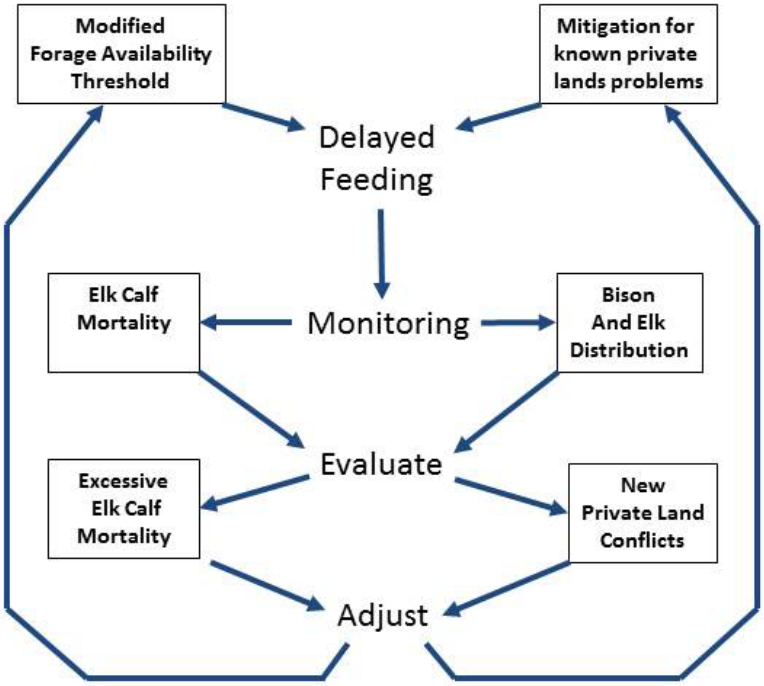


Figure ~~9~~10. ~~[example]~~ Framework for delayed feeding strategy under ~~and adaptive m~~Management Stepdown Plan.

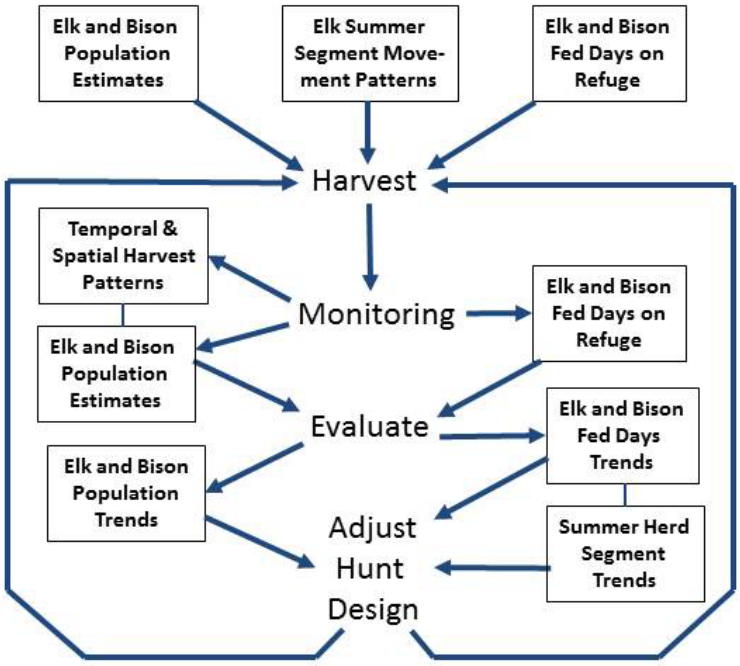


Figure 1~~0~~. ~~[example]~~ Framework for harvest strategy ~~and adaptive~~ under ~~m~~Management Stepdown Plan.

Strategies Considered But Rejected

The BEMP considered several additional strategies for elk and bison management that, for a variety of reasons, were not selected for implementation in the preferred alternative and Record of Decision. The agencies reconsidered a subset of these during the development of this ~~AMP~~MSP (Table 5). Since they were not part of the ROD, additional NEPA compliance would be necessary to incorporate any of them into this ~~adaptive~~ management stepdown plan, and thus they are not being considered at this time.

Table 5. Strategies considered but rejected.

Strategy Considered	Reason Rejected
Fertility control in elk	Judged not reasonable or feasible in BEMP, primarily due to major technical, social, and financial hurdles[1]. For ~~AMP~~MSP discussed primarily with regard to the difficult to harvest herd segment in Hunt Area 78 on private lands, where federal agencies have no jurisdiction.
Fertility control in bison	Impacts discussed at length in BEMP[2]. Not considered for ~~AMP~~MSP because current hunting programs appear effective at slowly moving the herd toward the 500 animal herd objective.
Agency reduction of bison or elk	Not considered necessary or desirable on federal lands because current hunting programs that utilize sport hunters are effective at meeting herd objectives.
Altering rations of supplemental feed	Rejected as a strategy because reducing daily feed ration below 8 lbs/elk would be enough feed to encourage elk to remain on NER but would result in unacceptably high elk calf mortality rates.

MODELS OF SYSTEM DYNAMICS

Models provide a simplified representation of the biological system being managed. ~~Adaptive management uses models of the managed system to link the objective response (e.g., elk winter distribution) to changes in the system resulting from management actions (e.g., altered initiation and cessation of winter feeding).~~ We will use modeling to quantify the effects of our management actions on 2 key repsonses of interest, elk distribution and winter elk calf mortality.

Fig. 1~~1~~2 describes possible factors that affect winter elk distribution (the proportion of elk on NER feedgrounds versus native winter range). Models will be used to identify the relative influence of our principal management strategy (a reduction in feed season length) and other factors on winter elk distribution (Appendix 3). Over time this will allow us to assess whether changes in elk distribution were the result of our management actions or due to factors outside of our control.

An increase in calf elk winter mortality is a potential result of reduced feed season length. Fig. 13~~2~~ portrays factors that influence winter calf elk survival on NER.

Models will be used to assess the effects of available forage on winter calf elk survival (Appendix 4). Over time this will allow us to assess the effects of our principal management strategy (reducing feed season length) relative to winter elk calf survival. ~~other factors on elk calf survival and potentially adjust our management actions based on model results.~~

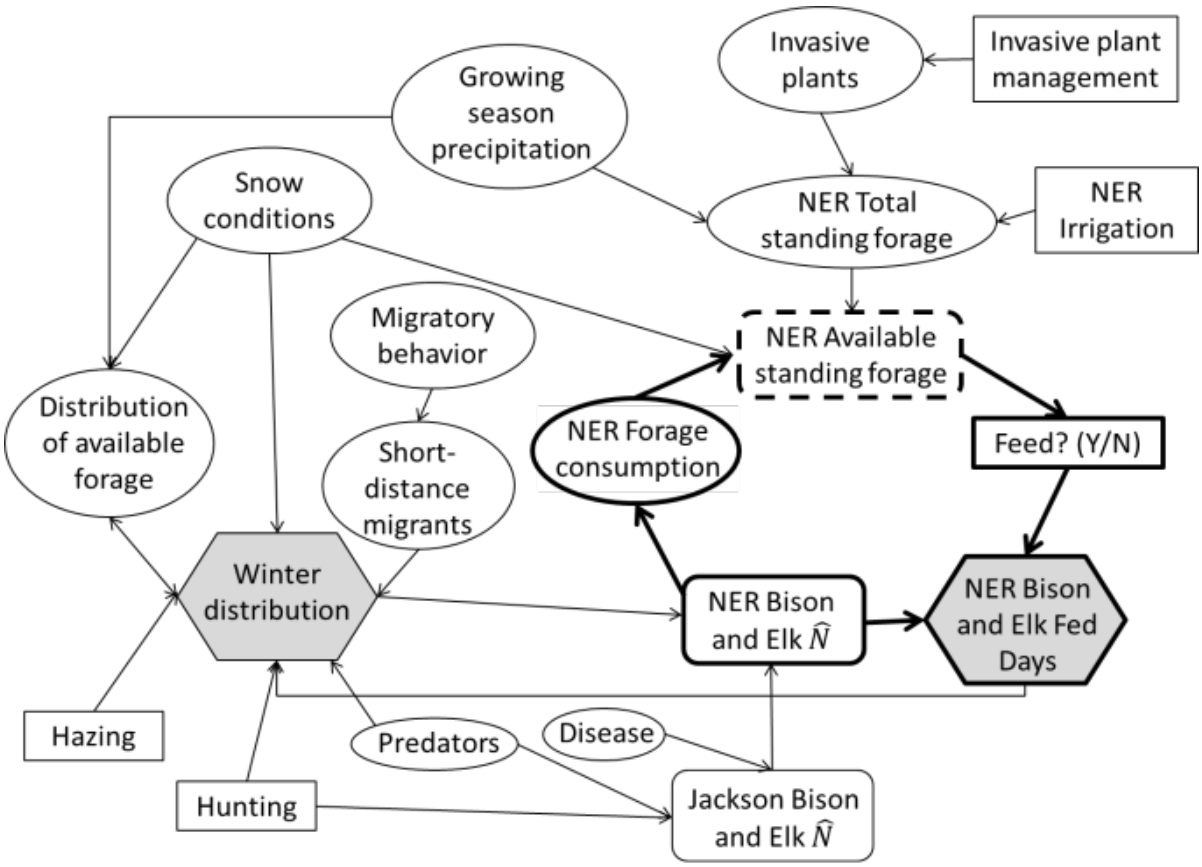


Figure 1~~1~~2. Influence diagram depicting factors (including management actions) influencing outcomes identified in the Bison and Elk Management Plan (BEMP; USFWS 2007a). Gray hexagons represent outcomes, rectangles represent management actions, rounded rectangles represent factors with numerical objectives, and ovals represent factors outside of management control. Bolded polygons and arrows represent outcomes and factors limited to the National Elk Refuge (NER). Available standing forage on the NER (dashed rectangle) is the BEMP criteria with a defined threshold to trigger initiation of supplemental winter feeding.

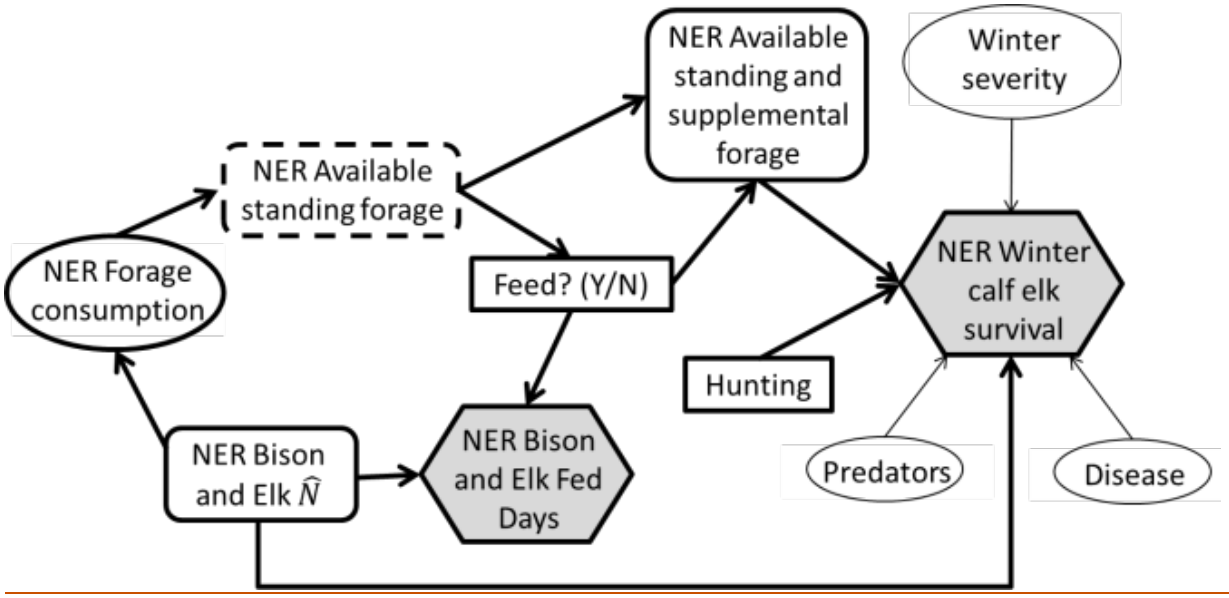


Figure 1~~2~~3. Influence diagram depicting factors (including management actions) influencing bison and elk fed days on the National Elk Refuge (see text for description) and winter calf elk survival. Gray hexagons represent outcomes, rectangles represent management actions, rounded rectangles represent factors with numerical objectives, and ovals represent factors outside of management control. Bolded polygons and arrows represent outcomes and factors limited to the National Elk Refuge (NER). Available standing forage on the NER (dashed rectangle) is the BEMP criteria with a defined threshold to trigger initiation of supplemental winter feeding.

MONITORING

Feeding Initiation Monitoring

NER uses weekly field estimates of the amount of forage available to elk to determine feeding initiation date. Currently measurements are taken at key index sites representing areas preferred by elk on NER (see supplemental materials at end of this section). These methods will be enhanced by 1) increasing the number of sampled sites to better represent the total amount of forage available to elk on the southern half of NER; 2) increasing the precision of estimates at each site by increasing the number of observers; and 3) extending the monitoring period later in the winter to assess the relationship between available forage and elk and bison distribution.

To better represent the total amount of forage available on the southern half of NER, a subsample of current key index sites will be retained to facilitate comparison with historic data, but additional random sample sites stratified by elk habitat preference will be added. Historic elk distribution mapping and elk GPS collar data (NER unpublished data) suggest that the areas most preferred by elk on southern NER are associated with moderate to high forage production and green vegetation. Because the distribution of forage production and greenness characteristics vary annually based on irrigation and precipitation patterns, we will annually map areas preferred and not preferred by elk and sample sites will be randomly selected within each of these mapped categories. At least 3 historic key index sites, 3 random sites in areas preferred by elk, and 3 sites in areas not preferred by elk will be sampled each week from late December through the initiation of supplemental feeding.

Currently the NER biologist is the only person trained in the techniques used to estimate available forage (see supplemental materials). At least 2 additional personnel will be trained in these techniques. This will provide a backup in the event of future personnel changes and will facilitate error estimates of the available forage measurements at each site.

Currently NER and WYGFD biologists monitor available forage conditions at least weekly from late December until average available forage at key index sites nears the threshold level of 300 lbs. per acre and feeding is initiated. The principal ~~AMP~~MSP strategy is to delay the initiation of supplemental feeding by 2 weeks after average forage production reaches the 300 lbs. per acre level at key index sites. Therefore the monitoring period will be extended to include the intervening 2 weeks.

Proportion of Elk Wintering on NER

A principal ~~AMP~~MSP goal is to reduce the number of elk wintering on NER. Our strategy will be to effect redistribution of elk to native winter range from NER over time via shortening the duration of the feed season, and thus slowly conditioning elk to seek food elsewhere. As feeding periods are shortened, the probability of younger elk age classes discovering NER feedgrounds will be reduced, and, hypothetically, that proportion of the JEH that utilizes NER feedgrounds will decline over time. We will measure this effect by examining changes in the winter distribution of the JEH. WGFD annual trend/classification count data provide a multi-year baseline data set to measure changes in the winter distribution of the JEH and categorizes observations by location. In each year, we will calculate the proportion of total classified elk in the JEH that are classified on NER feedgrounds. We will compare the 3-year running average post ~~AMP~~MSP implementation to the pre-implementation baseline. The pretreatment baseline will be comprised of data from 2008-2016, a time period that represents BEMP implementation prior to ~~AMP~~MSP actions (Figure 13).

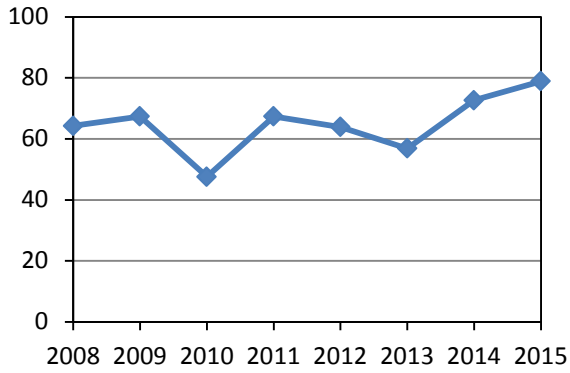
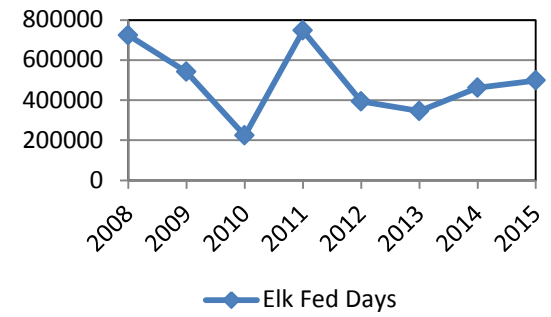


Figure1~~4~~3. Proportion of the Jackson Elk Herd that was classified on NER feedgrounds in the period following implementation of the Bison and Elk Management Plan and prior to the implementation of the ~~Adaptive~~ Management Stepdown Plan (2008-2015). These values represent the pretreatment baseline which will be compared to the 3 year running average post ~~AMP~~MSP implementation.

Elk Fed Days and Bison Fed Days

The BEMP and ~~AMP~~MSP implicitly assume that the transmission rate and prevalence of elk and bison diseases are density dependent and positively correlated with the number of elk and bison utilizing feedgrounds and the number of days they are fed. We further assume the variables elk-fed-eays (EFD) and bison-fed-days (BFD) are a proxy for these conditions. EFD and BFD will be calculated annually for each species based on the following formulas:



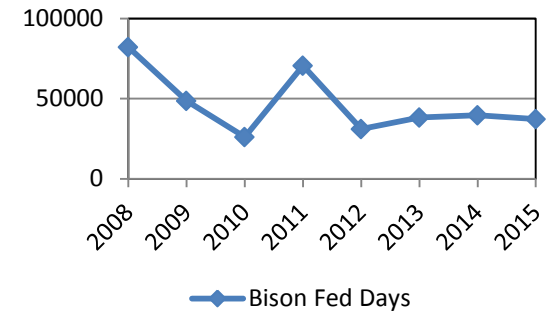


Figure154. Elk Fed Days (EFD) and Bison Fed Days (BFD) in the period following implementation of the Bison and Elk Management Plan and prior to the implementation of the ~~Adaptive~~ Management Stepdown Plan (2008-2015). These values represent the pretreatment baseline which will be compared to the 3 year running average EFD and BFD post ~~AMP~~MSP implementation.

EFD= ∑ Total elk counted on feed during daily feedground counts for duration of feed season

BFD= ∑ Total bison counted on feed during daily feedground counts for duration of feed season

Because EFD and BFD are influenced by feed season length and the number of animals on feed, the ~~A~~MSP strategy of delaying the initiation of supplemental feeding will inherently reduce the number of EFD and BFD through a reduction in average feed season length. We believe that EFD will be further reduced by encouraging a greater proportion of the Jackson Elk Herd to winter on native winter range, thereby reducing the number of elk occupying NER feedgrounds. We will evaluate changes in EFD and BFD by comparing the 3-year running average post ~~A~~MSP implementation compared to mean EFD and BFD from 2008-2015. The running average is an appropriate comparison because it will help account for wide annual variation in EFD and BFD associated with winter severity (Fig. 154)

Elk Winter Mortality Monitoring

NER has used consistent methods to monitor winter elk mortality since 1982. Each winter NER biologists and other refuge staff conduct a survey of all non-hunting related winter elk mortalities that occur on NER from November through April. Mortalities are tallied by age/sex class and percent mortality is calculated using the corresponding number of elk classified on NER feedgrounds as the denominator. We will continue to monitor elk winter mortality using the same methods post ~~AMP~~MSP implementation, which will allow trend comparisons to the pre ~~AMP~~MSP baseline (Figure 15). Under the ~~AMP~~MSP framework, we believe the 3 year running averages for total and calf winter elk mortality will be within the range of variation exhibited by the pre ~~AMP~~MSP baseline. Historic monitoring suggests that calf and total mortality are sensitive to winter severity and disease outbreaks, and that winter mortality occasionally exceeds >3% total mortality and >10% calf mortality. Post ~~AMP~~MSP mortality in excess of these levels may warrant shortening the 2-week feeding initiation delay in subsequent years.

Elk Collaring

One of the ~~A~~MSP's principal strategies is to shorten the length of the feed season to encourage elk use of native winter range, but we anticipate that this strategy will also result in an increase in elk conflicts on surrounding private land in the town of Jackson and the Spring Gulch areas, potentially including large groups of elk. To quantify this effect and provide real time information to WGFD and NER managers to facilitate a response, we propose maintaining a

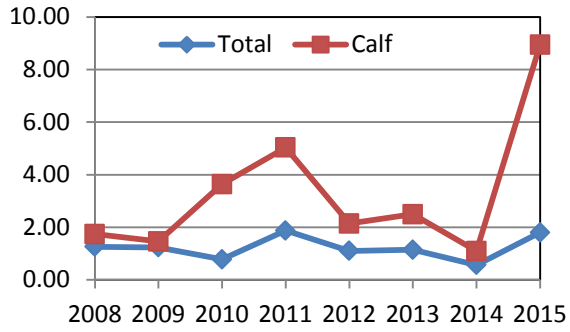


Figure165. Total and calf elk winter mortality (%) on NER in the period following implementation of the Bison and Elk Management Plan and prior to the implementation of the ~~Adaptive~~ Management Stepdown Plan (2008-2015). These values represent the pretreatment baseline which will be compared to the 3 year running average post ~~AMP~~MSP implementation.

sample of 50 GPS collars on elk that winter on NER throughout the ~~AMP~~MSP implementation period. Forty -five elk represents approximately 0.5% (1 in 200) of the NER winter elk population. This sample size will not be sufficient to detect all elk movements from NER to surrounding private lands, particularly movements by small groups of mature bull elk, but it will be sufficient to detect and quantify significant movements of cow/calf/yearling elk groups compared to pre-~~AMP~~MSP baseline data.

NER has elk GPS collar data available from the 2008-2013, which represents the post BMP, pre ~~AMP~~MSP baseline period. We hypothesize that elk movements from NER to surrounding private lands will increase during the ~~AMP~~MSP implementation period compared to the pre-treatment baseline. This will be tested by comparing the number of incidents that elk left NER for surrounding private lands (per elk/per year), and the proportion of elk GPS fixes on NER versus private lands during time periods of interest. The principal time period of interest is late December-March because this represents the period after the NER elk hunting season, and prior to and during NER feeding operations. This is the season when changes to the NER feeding program would be most likely to result in elk distribution changes.

Fifty adult cow elk will be captured on NER feedgrounds during February-March 2016 and Telonics Iridium GPS collars will be deployed with a 90 minute fix collection interval. Given 83% annual survival for adult cow elk in the Jackson Elk Herd (Cole and Foley et al. 2015) and 3 year collar life, approximately 10 additional elk will need to be collared each year in winter 2017 and 2018 to maintain the 50 elk desired sample size.

Ancillary data that will be collected and analyzed during the elk capture and collar data analysis process includes brucellosis seroprevalence, pregnancy rate, and elk summer range determination for comparison to the findings of Cole and Foley et al. (2015).

Disease

The primary purpose of limiting reliance on supplemental feeding is to reduce the prevalence of endemic elk and bison diseases and mitigate transmission risk associated with the introduction of novel diseases. We hypothesize that brucellosis seroprevalence will decline post ~~AMP~~MSP implementation. There are no recent brucellosis seroprevalence data for elk on the National Elk Refuge, but >50 elk will be captured during elk collaring operations in winter 2016, and each elk will be tested for Brucellosis exposure. The 2016 Brucellosis seroprevalence rate will be the pre-treatment baseline to evaluate post ~~AMP~~MSP change.

Chronic wasting disease (CWD) has been monitored in the JEH since 1997, and since 2008 it has been monitored with sufficient sample size to detect 1% prevalence with 95% confidence. No CWD positive cases have been detected in the JEH, which given the long term persistence of the disease, provides overwhelming evidence that CWD is not currently endemic to the JEH. However, most evidence suggests that the distribution of CWD is increasing and that its

introduction to the JEH is inevitable. Early detection is critical to ensure an adequate management response, and therefore ongoing monitoring at sample sizes sufficient to detect 1% CWD prevalence with 95% confidence is necessary. CWD is sampled by testing tissues collected primarily from hunter harvested elk, and past experience suggests that 2 full time technicians working from September-December are necessary to ensure minimum sample size. Typical costs associated with 2 technicians are $32,000 per year.

Data Collected for Modeling

To facilitate modeling, we will collect data on the following associated variables (Table 6). The table lists variables and how they relate to our efforts

Table- 6. Variables to be used in models to explain elk winter distribution in the Jackson Elk Herd and elk calf mortality on NER.

VARIABLE	SOURCE	Elk Winter Distribution Model	Elk Calf Mortality Model
Proportion Jackson Elk Herd on NER Feedgrounds	WGFD/NER Jackson Elk Herd February Classification Count	Yes	No
Proportion Jackson Elk Herd from South Snake River summer segment	Determined from elk GPS collar data for elk captured on NER	Yes	No
Number of wolf packs in the Jackson Elk Herd unit	GTNP and WGFD wolf monitoring data	Yes	Yes
Estimated total wolf numbers in Jackson Elk Herd unit	GTNP and WGFD wolf monitoring data	Yes	Yes
Estimated number of wolves using NER in winter	NER observations	Yes	Yes
Total NER herbaceous forage biomass	NER forage production survey data	Yes	Yes
Snow Water Equivalent	NOAA snowtell site data	Yes	Yes
NER Winter elk Mortality (calf)	NER winter elk mortality survey	No	Yes
Snow Depth	NOAA Snowtell sites and NER measurements	Yes	Yes
Available Forage	NER and GTNP monitoring in winter months	Yes	Yes
NER Elk and Bison Fed Days	NER feeding records and daily feedground estimates of elk and bison	Yes	Yes
NER Feeding Start Date	NER feeding records	Yes	Yes
Gros Ventre Feeding Start date	WGFD feeding records	Yes	No
Elk Hunting Pressure by Hunt Area	Estimated number of hunter days from WGFD completion reports	Yes	Yes

to use modeling to explain changes in elk distribution and elk calf mortality relative to our principal action of reducing feed season length.

EVALUATION/FUTURE MANAGEMENT

Modifying elk and bison behavior while reducing supplemental feeding will require a long-term, sustained commitment. Change is unlikely to happen fast, and interpreting effects of ~~adaptive~~ management actions will be complicated by varying environmental conditions from year to year. Consequently, we anticipate that the strategies outlined in this plan will be in place for a minimum of 5 years, after which an initial evaluation of the program will be made. Actions completed each year, the results of monitoring programs, and any proposed changes in course will be presented in an annual ~~adaptive~~ management stepdown plan update/report, completed by NER staff by the end of March for the previous year.

Consistent with objectives outlined in the BEMP, the long-term goal of this plan is reduce the reliance of bison and elk on intensive supplemental feeding, using adaptive management principles through a structured framework of management actions, to achieve a desired condition of animals relying predominately on native habitat on refuge, park, and forest lands, and on NER cultivated forage. But because there is no precedent for what this plan proposes, there are few responses to proposed management actions that can be predicted to a degree of certainty commensurate with establishing definable thresholds or other objective criteria for success in the short term.

Factors that will be considered in evaluating the success of the program will include the trend of EFD and BFD, type and frequency of private lands conflicts, the proportion of the Jackson elk herd wintering on the NER, presence or absence of CWD and other infectious diseases, elk and bison population size and distribution, elk calf winter mortality, and public support. These are complex, dynamic, and interwoven components that, together with the management stepdown actions, make up the framework for decreasing reliance on supplemental feeding. As such, the effects of changing biological, social, and political conditions on these components will be part of the evaluation process.

In the context of this larger framework, however, we believe evaluation of the trend in EFD and BFD will be most important after the first 5 years of MSP implementation. The direction and magnitude of the trend observed will provide a preliminary basis for evaluation and decisions about continued management actions. Initial success with reduced feeding will be associated with a declining trend, with greater magnitudes indicating higher degrees of success. However, determinations of overall program success will necessarily include evaluation of all system components. For example, gains in reduced feeding come could be accompanied by an increase in private land conflicts, which would affect overall success determinations. While the overriding strategy will be to decrease feeding as aggressively as possible while gauging effects on other system components, overall measures of program success through time will necessarily involve a complex matrix of component evaluation. These evaluations will be included in annual MSP reports.

As proposed and new management strategies are implemented and evaluated under this plan, at some point in the future it may become apparent that meeting reduced feeding goals will not possible without reducing elk and/or bison population objectives. Population objectives for both herds are set by Wyoming Game and Fish Commission and are evaluated regularly by WGFD personnel, including public review through

annual season setting meetings. The BEMP supported the State herd objectives of 500 bison and 11,000 elk, and thus due to NEPA requirements any further consideration of reduced herd sizes by the NER or GRTE are beyond the scope of this plan. However, WGFC changes to Jackson bison or elk herd objectives are not constrained by the BEMP.

Investigating the potential effects of climate change on elk and bison management will also be important in the long-term. During implementation of this plan, we will collect a variety of data that could~~an~~ be drawn upon for this purpose.

PUBLIC OUTREACH AND EDUCATION

The practice of winter feeding is inexorably woven into the historic fabric of Jackson Hole. Elk are identified with the rich and unique legacy for which Jackson Hole is known around the world. De-emphasizing the supplemental feeding program will be a major paradigm shift for the residents of Jackson Hole, Teton County, and the State of Wyoming.

An effective Public Outreach and Education program is essential for effective ~~AMP~~MSP implementation. The practice of feeding elk evokes passionate responses from those that oppose and those that support this practice. The general public and especially key stakeholder groups must understand the biological needs for and strategies of the ~~AMP~~MSP in order to gain general consent to modify longstanding elk/bison herd management methods.

A detail communication plan to guide outreach and education efforts can be found in Appendix 3.

SCHEDULE

Table 6. Adaptive Management Plan proposed schedule.

Action	Date
GPS Collar 30-40 elk prior to strategy implementation (Iridium platform)	February 2016
Public outreach and education	March 2016
Initiate private lands conflicts mitigation contacts/actions	March 1, 2016
Implement enhanced forage monitoring	March 1, 2016
Initiate changes in supplemental feeding protocol	January 2017
Monitoring/Evaluation/Annual Report	June 2017

Table 7. Anticipated schedule of annual Adaptive Management Plan activities.

Activity	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
Elk and bison classification		x										
Irrigation						x	x	x	x			
Forage estimates	x	x	x	x								x
Etc…..												

[This table just for example. We could do the same with longer term schedule using years instead of months at the top if desired/necessary.]

BUDGET

Table 8. [incomplete]. Estimated Adaptive Management Plan budget above current expenditures, years 1-5.

Agency / Activity	Year 1	2	3	4	5
National Elk Refuge:					
Monitoring:					
Seasonal Biological Technician (0.5 FTE, GS-7)	24,000	25,000	26,000	27,000	28,000
Bison/elk fed days					
Mid-winter census					
Elk summer herd segment distribution[1]					
Expanded standing forage estimates[1]					
Chronic Wasting Disease, 2 seasonal biot-techs	32,000	32,000	32,000	32,000	32,000
Winter bison/elk distribution					
Irrigation					
50 Elk radio telemetry collars; Iridium Platform	$115,000	$25,000	$25,000	$25,000	$25,000
Bison barrier at NER south entrance	$80,000	$1,000	$1,000	$1,000	$1,000
Adaptive Management Plan annual reporting	$2,000	$2,000	$2,000	$2,000	$2,000
Private lands:					
Easements / Acquisition					
Damage reimbursements (Wyoming)					
Conflict mitigation coordination (Wyoming)	$91,000	$91,000	$91,000	$91,000	$91,000
Vegetation restoration/protection[1]					
Public Outreach and Education	$11,000	$1,000	$1,000	$1,000	$1,000
Subtotal					
Grand Teton National Park:					
Monitoring:					
Summer elk classification/distribution	10,000	11,000	12,000	13,000	14,000
Collaborative elk monitoring (GRTE portion)					
Hunter harvest					
Harvest age distribution					
Transition range forage production/utilization					
Vegetation Restoration/Protection					
Monitoring	16,0000	16,000	18,000	20,000	20,000
Temporary bison fencing	24,000			40,000	
Temporary fence maintenance	6,000	8,000	8,000	6,000	10,000
Hayfields restoration	84,000	70,000	70,000	90,000	90,000
Exotic plant mitigation	50,000	52,000	46,000	60,000	66,000
Seed propagation				94,000	66,000
Elk Reduction Program					
Subtotal					
Wyoming Game and Fish Department:[2]					
Private lands:					
elk harvest coordination					
Easements / Acquisition					
Damage reimbursements					
Conflict mitigation coordination					
Add additional lines and categories as needed					
Subtotal					
Grand Total					

[1] See detail in Appendix

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APPENDIX 1. Summary of primary potential impacts associated with reduced supplemental feeding, as identified in alternative 4 environmental consequences section of the Final Bison and Elk Management Plan/Environmental Impact Statement (USFWS and USNPS 2007).

Populations

- Jackson elk herd objective of 11,000 would be maintained.
- New Jackson bison herd objective of 500 established.

Winter Feeding

- Supplemental feeding could be delayed or could occur earlier compared to current practices.
- Changes [to feeding program could] include alterations in the timing of feeding and providing supplemental feed in fewer years.
- Ration or pellet composition might need to be changed.
- Supplemental feeding would be initiated according to established criteria, including pre-winter forage production, assessments of forage utilization (done jointly by WGFD and NER personnel), elk condition and movements, and potentially on the January 1 index of winter severity calculations for elk (Farnes, Heydon, and Hansen 1999).
- Mechanical means could be used to increase forage access for elk after snow crusting events.
- Changes in the refuge supplemental feeding program could begin to affect elk nutrition (negligible adverse effect on NER elk from lower nutrition).
- Displacement of elk by bison during competition for standing forage would decrease as the bison herd is reduced.
- Aggressive social interactions involving competition for food among elk and bison would increase overall as feeding periods are reduced.

Winter Distribution

- Elk densities on the NER would decline due to more reliance on standing forage and wider distribution.
- Elk use of lands surrounding the NER would increase, including:
    - USFS lands east of the NER
    - Gros Ventre feedgrounds possibly
    - Southern ~~GTNP~~GRTE
    - State feedgrounds south of the NER
- Most of winter distribution shift would involve elk in the Yellowstone, Teton Wilderness, and Gros Ventre segments.
- As ungulate numbers decreased and supplemental feeding was reduced, competition and aggressive social interactions on the refuge would also be reduced.
- Elk and bison distribution would increase as the animals relied more on native winter range.
- Fewer animals would be present on the refuge.

Mortality

- As supplemental feeding is reduced, natural factors such as climate and native forage availability would have a greater influence on numbers, movements, distribution, and mortality.
- More elk would be subject to natural factors affecting mortality, including loss of body condition, predation, and starvation.
- Increased mortality on and off the refuge would mainly affect older elk and calves, and some prime bulls entering the winter energetically stressed due to rut activities.

- Late winter calf ratios could decrease as a result of higher winter calf mortality
- Average winter mortality on the refuge would increase from 1%–2% annually to an estimated 1%–5%.
- Overall, a higher total winter mortality rate of approximately 5% could be expected.

Disease

- Reductions in supplemental feeding or elk numbers would reduce the potential for impacts due to tuberculosis, septicemic pasturelosis, and CWD.
- The health and sustainability of the Jackson elk herd would be increased gradually as supplemental feeding was reduced and there was greater reliance on standing forage and wider ungulate distribution.
- Health and sustainability of the Jackson elk herd would be enhanced in the long term.
- Wider distribution of elk would result in moderate reductions in both the prevalence and potential transmission of brucellosis, as well as potential for spread of diseases not yet in the population.

Private Lands

- The agencies would work closely with the WGFD and landowners, including livestock producers, to coordinate actions that would prevent conflicts due to elk dispersal and to defray costs of managing potential conflicts. Preventing access to food/hay rewards on private lands would be vital for effective management.
- Private land conservation easements within NER boundaries would promote wider distribution.

APPENDIX 2. Monitoring Supplemental Materials: Feeding Initiation Methods

At each sample site, 10 subplots will be measured at every 5 steps along the random bearing determined for each site. At each subplot a 13.27" diameter metal sampling ring will be placed on the ground. The amount of forage available to elk within the sampling ring (dry weight in grams) will be visually estimated. The 13.27" diameter subplot allows easy conversion from grams to lbs. per acre (each gram is equivalent to 100 lbs. per acre). During annual forage production sampling, refuge biologist Eric Cole has made approximately 1,000 of these visual estimates per year for 17 years, and 33% of Cole's estimates have been verified by clipping and weighing. Therefore, Cole will be the principal estimator, but additional personnel will be trained in these techniques to provide redundancy in the event of personnel changes, and to increase the number of observers to facilitate estimation of error.

Estimating available forage within the sample ring at each subplot is relatively straightforward when snow cover is limited, but estimating how much of the forage is accessible to elk when snow is dense, deep and crusted can be subjective. To decrease the subjectivity of the estimation process, if the area under the sample ring is covered with snow, only forage that can be exposed with a gloved hand will be included in the estimate of available forage. Forage that is fouled with manure and/or flush with the ground due to trampling and/or encrusted in ice will not be included in the estimate of available forage.

At each subplot the estimate of available forage (dry weight g) will be converted to an equivalent lbs./acre value (1 gram=100 lbs./acre). The arithmetic mean of available forage (lbs./acre) for the 10 subplots provides an estimate of available forage for each index site. There are 3 sample site categories: 1) Historic Key Index Sites that have been used since 2007, 2) New randomly selected sites within areas preferred by elk, and 3) New randomly selected sites in areas not preferred by elk. Historic key index sites were not randomly selected, but were instead selected to represent areas most preferred by elk on the south end of NER. These were the sites used to determine when supplemental feeding would be initiated from 2007 until the implementation of the ~~AMP~~MSP. To facilitate comparison with pre-~~AMP~~MSP data, we will continue to use mean lbs. per acre across historic key index sites to determine the 300 lbs. per acre threshold. However, post ~~AMP~~MSP implementation we will delay feeding initiation by 2 weeks once the 300 lbs./acre level has been reached. We will concurrently sample at randomly selected sites stratified on an annual basis between areas highly preferred and not highly preferred by elk. This will enable us to quantify the relationship between mean forage availability at historic key index sites and random sites over time.

APPENDIX 3. Communication Plan

Communication Goals

Prior to the ~~Adaptive~~ Management Stepdown Plan's Implementation

- Utilize a variety of outreach methods to inform the public on the goals and timing of the ~~Adaptive~~ Management Stepdown Plan implementation and possible effects on wintering herds.
- Utilize a variety of outreach methods to inform the public on public comment opportunities.
- Identify and coordinate key messages and outreach with USFWS regional and national offices, State and federal agency partners, non-profits, elected officials, and other identified audiences.

During the ~~Adaptive~~ Management Stepdown Plan's Implementation

- Continue to utilize a variety of outreach methods to describe current management actions as well as measurable and noticeable changes on the landscape, in animal behavior, or in animal health.
- Provide a comprehensive overview of the ~~Adaptive~~ Management Stepdown Plan by providing links and references to previous outreach and background information.

Communication Objectives

- Work with current media contacts to promote news of the ~~Adaptive~~ Management Stepdown Plan via print, radio, Web, and social media platforms.
- Utilize new media and social media tools to provide information on why the ~~Adaptive~~ Management Stepdown Plan was developed, what public comment opportunities exist, and how the plan is being implemented.
- Plan, coordinate, and execute public meetings to allow for public comment and questions on the plan.
- Develop and provide methods for the public to submit written comments on the ~~Adaptive~~ Management Stepdown Plan.
- Monitor print media on Refuge elk and bison management to see how ~~Adaptive~~ Management Stepdown Plan objectives and reactions are being portrayed to the public.

Current Outreach Resources

- National Elk Refuge web site
- National Elk Refuge news release list
- (approximately 300 contacts)
- National Elk Refuge Twitter site (1,039 followers)
- Bison and Elk Management Plan web site (http://www.fws.gov/bisonandelkplan/)
- Space for an 11" x 17" poster in the Visitor Center on Refuge management topics
- Display panels in the Visitor Center theater for temporary displays

Available Supporting Outreach Resources

- USFWS Mountain–Prairie External Affairs staff
- USFWS Mountain–Prairie web site, including the

- "Top Stories" feature
- USFWS Mountain–Prairie Twitter site USFWS Mountain-Prairie Region Facebook page
- USFWS National Wildlife Refuge System
- Facebook page
- USFWS Facebook page

Previous Outreach Efforts

- NER routinely writes and disseminates news releases on Refuge management activities, including the Comprehensive Conservation Plan, supplemental feeding, herd health monitoring, and forage production.
- Post the above news stories as Content.
- Management System (CMS) articles.
- Post CMS news story promos so they prominently appear on the home page, linking readers to the articles.
- Send out Twitter messages linking viewers back to the news stories.
- Prepare, upload and provide links to Adobe PDF versions of news stories with addtional photos where additonal images are available and/or help understand or visualize the content.
- Utilized the Conservation link on the web Content
- Management System to post information about
  the Bison and Elk Management Plan and the draft Comprehensive Conservation Plan.
- Retained and provided a link to the original Bison and Elk Management web page (http://www.fws.gov/bisonandelkplan/) that was developed during the planning process. The web site includes links to the Final Plan/EIS, Record of Decision, Federal Register Notice of Availability for both the Record of Decision and Final Plan/EIS, associated news releases, public meeting highlights, and other related documents. Note: the National Elk Refuge does not manage the site.

Additional Outreach Opportunities

- Public meetings in Jackson and other identified locations.
- Service produced video; video could be posted to the National Elk Refuge's multimedia web page, or USFWS Mountain–Prairie home page "Top Video" feature.
- Live radio interview on KHOL (Jackson, WY radio)
- Wyoming Public Radio interview with Refuge management staff
- Interviews with local print media sources
- Updates at community leader meetings such as Rotary Club, Jackson Hole Chamber of Commerce board meetings, and interagency breakfast meetings (with Federal agencies and local elected officials).

Target Audiences

Internal

- Regional and National USFWS Leadership
- Refuge permanent staff
- Refuge seasonal staff
- Refuge volunteers

External

- Congressional representatives
- State of Wyoming leadership
- Federal agency partners, particulary Grand Teton National Park and the Bridger–Teton National Forest
- Wyoming Game & Fish Department
- Other NER partners, including county and town agencies and local nonprofit organizations
- Local elected officials
- Private landowners in proximity to the National
- Elk Refuge or neighboring Federal lands
- Tribes
- Local and state media
- Local public

Key Outreach Topics

- Overview of BEMP objectives
- Strategy to change elk/bison behavior
- Threat of disease
- Natural mortality rates
- Anticipated winter distribution changes for bison/elk
- Mitigate negative effects on private lands
- Change elk behavior and distribution while avoiding increased mortality.
- Explain the historic reasons a supplemental feeding program began and why it was continued.
- Explain the NER's limited large ungulate carrying capacity and the disproportionate impact of bison on available forage; 3 elk = 1 bison.

APPENDIX 4. Models

Elk winter distribution model

The proportion of the JEH that winter on the NER will be linked to factors hypothesized to influence elk winter distribution (Fig. 2) using a generalized linear mixed effects model (GLMM). A GLMM can account for a proportional response variable (i.e., constrained to the interval 0–1) using a log link and binomially-distributed errors. A GLMM also includes fixed and random effects, with the latter capturing residual model variance otherwise not explained by fixed effects. Year will be including as a random effect, providing several benefits. First, we don't assume years are independent and comprise all of the factor levels of interest. Instead, the effect of year is treated as a random variable, with individual year effects realizations of that distribution. This allows inference to non-sampled factor levels, i.e. years, by estimating a latent population-level proportion of elk expected to winter on the NER regardless of fixed effect influences. Thus, the random year effect can be considered a latent variable describing elk behavior manifested as observed winter distribution.[WJ9] Second, because year effects are not treated as independent, estimated effects of year on the proportion of JEH elk wintering on the NER are dependent on all factor levels, leading to greater precision when estimating individual year effects (Kéry 2010).

The full GLMM incorporating fixed effects for each factor identified as influencing elk winter distribution (Fig. 2) is:

$$P_t = \beta_{0(t)} + \beta_1 * AFI_t + \beta_2 * SDM_t + \beta_3 * WP_t + \beta_4 * GSP_t + \beta_5 * SWE_t + \varepsilon_t$$ [WJ10]

where the random intercept and residual model variance are

$B_{0(t)} \sim N(\mu_{\beta_0}, \sigma^2_{\beta_0})$, and

$\varepsilon_t \sim N(0, \sigma^2)$, respectively.

Fixed effects include 1) per capita available forage at initiation of winter feeding (*AFI*) , 2) proportion of the JEH that are short-distance migrants (*SDM*), 3) number of wolf packs present on JEH native winter range (*WP*), 4) growing season (May–August) precipitation for the Wyoming Snake Drainage climate division (*GSP*; a proxy for available forage on native winter range), and 5) snow water equivalent on 1 January at Thumb Divide (*SWE*; a proxy for early winter severity). [WJ11][WJ12]

Elk calf winter survival and forage deficits

The Forage Accounting Model of Hobbs et al. (2003) has as an output weekly available forage biomass for the NER (sum of predictions for 30 × 30 m cells). These predictions account for snow conditions using a proxy of SWE and decrement total available biomass by 35% to account for unpalatable plants within the total estimate. [WJ13]

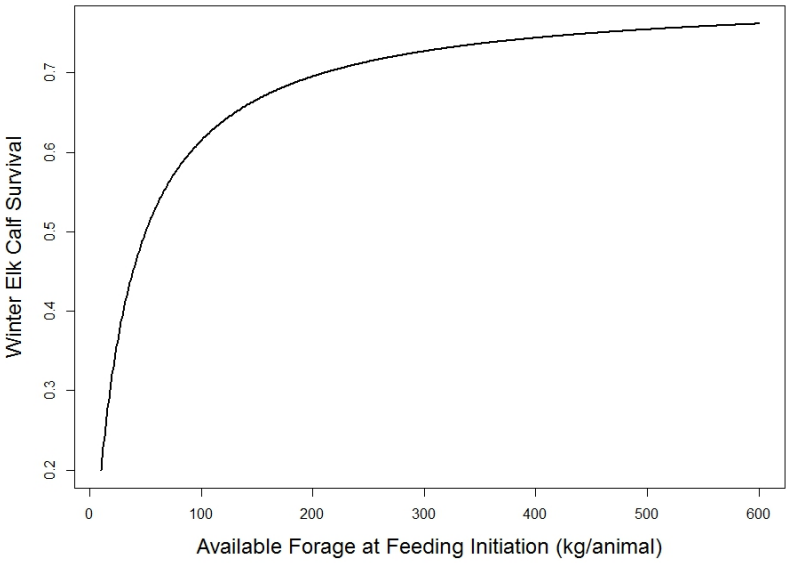
While calf survival is a function of multiple factors (Fig. 3), the primary management action influencing calf survival is supplemental winter feeding[KD14]. Current winter feeding initiation criteria lead to calf survival generally higher than in unfed populations. Proposed feeding initiation criteria will result in later

initiation of supplemental feed, which will be most influential to calf survival. There is currently little understanding regarding the relationship between initiation of winter feeding and calf survival, except that current feeding initiation criteria result in high calf survival. We believe a threshold level of available forage at initiation of winter feeding exists such that winter calf survival reaches an asymptote. Below this threshold, calf survival is hypothesized to decline quickly with reductions in available forage at winter feeding initiation. Available forage at the initiation of winter feeding will be related to on elk calf winter survival using a saturating function (i.e., Holling type-II functional response; Fig. 6) by

$$S_t = \frac{aAFI_t}{b + AFI_t}.$$

The parameters *a* and *b* determine how calf survival is related to available forage. Maximum calf survival is *a*, and *b* represents the value of available forage to an individual when survival is 50% of *a* (Hilborn and Mangel 1997).

Although this approach doesn't capture forage deficits *per se*, it does provide a potentially sensitive proxy for this concept. It is assumed that a forage deficit for calves would occur at a point on the curve of the relationship between calf survival and available forage at initiation of supplemental feeding. Modeling the response of winter calf elk survival to changes in feeding initiation criteria facilitates our ability to maximize the influence of feeding initiation criteria on winter distribution while minimizing the likelihood of a large mortality event.



Hypothesized relationship between winter survival of elk calves and per capita available forage at initiation of winter feeding on the National Elk Refuge.