Draft Step-Down Plan
Bison and Elk Management

A Structured Framework for Reducing Reliance on Supplemental Winter Feeding

National Elk Refuge

Grand Teton National Park

Wyoming

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Contents

Figures

Tables

Summary

Overview

In 2007, the National Elk Refuge (NER) and Grand Teton National Park (GRTE) published a Record of Decision (ROD; USFWS and NPS 2007a) for a bison and elk management plan. The Bison and Elk Management Plan (BEMP) (USFWS and NPS 2007b) was developed to guide management of the Jackson bison and elk herds on NER and GRTE lands, focused on four broad goals:

1) habitat conservation;
2) sustainable populations;
3) numbers of elk and bison; and
4) disease management.

The final Bison and Elk Management Plan directed the NER and 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 GRTE; continue hunting bison and elk on the NER; continue the elk reduction program, when necessary, in 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 Step-Down Plan for decreasing the need for supplemental feeding on the NER. This Step-Down Plan for Bison and Elk Management was developed specifically to address 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 hunted to near-extinction 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 (Boyce 1989), high animal concentrations have created an unnatural situation that has contributed to an increased risk for major outbreaks of exotic diseases (Murie 1951, Franson and Smith 1988, Samuel et al. 1991), currently demonstrated by the high level of brucellosis in the elk and bison herds (Cross et al. 2010, Kamath et al. 2016). It has also resulted in damage to and loss of habitat due to browsing of willow, cottonwood, and aspen stands (Smith et al. 2004), thereby reducing other wildlife associated with woody vegetation.

The BEMP and this step-down plan 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 feeding grounds and the number of days they are fed. The potential risk of catastrophic disease outbreaks and the need to mitigate this threat is a vital component in achieving the BEMP Sustainable Populations Goal.

Objectives

This Step-Down Plan addresses several objectives under a broader BEMP goal of sustainable populations, which directed the agencies to: 1) develop a dynamic, structured framework 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, 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 include some or all of:

1) the level of forage production and availability on the National Elk Refuge;
5) desired herd sizes and age/sex ratios,
6) effective mitigation of bison and elk co-mingling with livestock on private lands;
7) winter distribution patterns of elk and bison;
8) prevalence of brucellosis, chronic wasting disease, and other wildlife diseases; and
9) public support.

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 freestanding forage, while maintaining population and herd ratio objectives and public support.

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; and adaptive modifications to the approach; and repeated trials.

The Step-Down Plan's primary focus will be on lands under NER authority. However, some strategies will also incorporate activities in GRTE, and on non-federal lands in collaboration with landowners and WGFD. Primary management practices that can be altered to achieve reduced reliance of bison and elk on supplemental feed fall into the three broad categories of:

1) timing and intensity of winter feeding,
2) timing and intensity of hunting, and
3) overall and herd segment specific harvest levels.

Measuring the success of Step-Down Plan strategies will require knowledge of several bison and elk herd attributes. Because we are interested in reducing the intensity of elk and bison feeding throughout the entire winter season, which includes both the number of animals on feed and the duration of feeding, we will use measurements of elk-fed-days (EFD; the total number of elk fed per day per season derived from daily feeding ground estimates) and bison-fed-days (BFD; the total number of bison fed per day derived from daily feeding ground estimates) to evaluate feeding intensity. For example, if 5,000 elk were fed for 100 days during a given winter, feeding intensity for that winter would equal 5,000 elk X 100 days = 500,000 EFD. Average baseline feeding intensity during the post-BEMP to pre-Step-Down Plan period from 2008-2017 was 505,680 EFD (range = 223,614-746,800), and 43,701 BFD (range = 26,035-82,124). No feeding occurred in 2018 due to rare low-snow conditions that allowed easy access to natural forage for most of the winter. Reductions in EFD and BFD compared to these baselines will represent progress in meeting feeding reduction objectives under the Step-Down Plan. Reductions in EFD and BFD could be achieved by reducing the length of the feed season, reducing the number of elk and bison on feed, or some combination of both factors.

Initial success of Step-Down Plan implementation will be a consistent decline in the 3-year running average of elk and bison fed days from the established baseline. While the BEMP did not 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. These levels of reduction are consistent with elk and bison predominantly relying on freestanding forage rather than supplemental feed.

Similarly, there are population-specific objectives derived from the BEMP and Phase 1 of

the Step-Down Plan for 5,000 elk wintering on NER and 500 bison wintering in the Jackson Hole area. Progress towards these objectives will be measured using annual classification counts and the average number of elk and bison counted during daily feeding ground estimates.

CHRONIC WASTING DISEASE

As of 2018, chronic wasting disease (CWD) has been detected in a road-killed mule deer within the range of the Jackson Elk Herd. The NER has implemented mandatory CWD testing of all elk harvested on the refuge. Continued surveillance at sample sizes sufficient to detect 1% prevalence with 95% confidence will take place.

WINTER FEEDING

Currently, the initiation of supplemental winter feeding occurs when available forage drops to 300 lbs./acre along transects in areas with highly preferred grasses. This protocol will change to delay the initiation of feeding.

The strategy of delaying the start of supplemental feeding is to encourage elk and bison to use native winter range, especially those individuals that have not previously received a food reward on the Refuge. Over time, it is anticipated a cohort of animals will develop that are not conditioned to the Refuge supplemental feeding program, which will reduce herd concentrations and the risk of disease transmission.

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 and bison fed days, the parameter we will use to measure progress toward reducing reliance on supplemental feeding.

During the first several years of Step-Down Plan implementation, the initiation of feeding will be delayed for short durations of time (days). This will provide an opportunity to monitor elk and bison behavioral responses to delayed feeding and identify private land conflict areas that may require focused mitigation measures.

As bison and elk behavioral responses are better understood, feeding delays will be extended to encourage a redistribution of elk and bison to native winter range. However, other factors outside of the scope of this plan such as wolf numbers and distribution could reduce the effectiveness of this strategy.

Variables that influence feeding initiation date will be considered (Table 4, Figure 9). During the last 20 years, feeding initiation dates, which have been based on forage availability, have varied from December 30 to February 28 (except in 2018, when no feeding occurred). Under the Step-Down Plan, the magnitude of the delay in feeding initiation date will be influenced by seasonality. For example, delaying feeding by two weeks in January is likely to be more successful in dispersing animals to native range than doing so in February, when food stress and the potential 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. Finally, the distribution of animals, particularly on private, livestock producing lands, would be considered prior to delaying feeding initiation date.

Monitoring programs will include measures of elk calf winter mortality on NER. The BEMP anticipated that total elk winter mortality (currently 1-2%) could increase up to 3 percentage points, with most of the increase in elk mortality occurring amongst very old age classes and calves. If Step-Down Plan implementation results in elk winter mortality levels in excess of these levels, adaptive action could be taken to mitigate these effects in future years.

In the early years of Step-Down Plan implementation, the seasonal termination of feeding is expected to occur about a week earlier than current conditions (current average end date 2 April; range = 24 March – 20 April). Under current management, feeding termination date has been based on a snow cover index and a subjective evaluation of available forage and forage greenness. We will develop methods to quantify these variables and objectively determine feeding termination date as the Step-Down Plan is implemented.

HARVEST/HUNTING

Few options for manipulating elk hunting are currently available because the Jackson elk herd is at or near the 11,000 WGFD objective. Proposed changes include allowing limited any elk permits; allowing a bow season near developments on the NER; delaying the elk hunting season to coincide with migration timing; and alternating open and closed areas to encourage animal movements or facilitate harvest.

Based on summer bull ratios in GRTE that were chronically below 35 bulls: 100 cows, permit types

for the park's elk reduction program (ERP) went to "antlerless only" in 2012. Additionally, the "antlerless only" hunt structure aligns with primary objective and intent of the ERP. ERP permit structures in the park will likely remain antlerless. Park and refuge officials will work together to support this goal as expanded hunting opportunities is considered.

The proportion of the Jackson Elk Herd that winters on NER has increased in the past 2 decades. This trend is correlated with a decline in elk use of native winter range and an increase in the proportion of NER elk that occupy winter ranges immediately adjacent to the Refuge. If efforts to encourage increased use of native winter range are unsuccessful, agencies will collaborate with the WGFD in the public process of reviewing and adjusting the future Jackson elk herd population objective. This will provide a level of harvest flexibility more commensurate with addressing changes in herd distribution.

Bison hunts on the NER (bison hunting is prohibited in 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.

The effectiveness of NER late-season harvest regimes is influenced by December 1st winter closures immediately east of the refuge on Bridger-Teton National Forest (BTNF) lands. Extensive elk telemetry data suggest that delaying the winter closures could help reduce winter elk numbers on the Refuge. NER officials will work with BTNF and WGFD officials to explore the possibility of allowing hunting in limited areas after December 1st.

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 limited areas to separate elk and bison from livestock feed lines, hazing elk and bison away from livestock feed lines, and purchasing private lands easements or leases to prevent co-mingling.

Vegetation Restoration

Various approaches to restore the Kelly Hayfields in GRTE (4,500 acres) were initiated in 2008. Work will likely be complete in 2035. Objectives of ecological restoration include restoring abandoned hayfields to native plant communities to improve wildlife forage and habitat, and providing visitor opportunities to enjoy wildlife viewing within a natural setting. The restoration process involves removal of non-native vegetation, collecting and propagating native seeds and plants, as well as the seeding of native plants.

Of the 4,500 acres targeted for ecological restoration in the Kelly Hayfields of GRTE, 1,235 acres are currently under restoration treatment and 3,265 acres remain non-native pasture. Maintenance of restored ecological conditions will require management efforts in perpetuity to keep non-native species from colonizing restored areas. The park will continue to seek funding for restoration of the remaining areas as well as maintenance of the restored pastures.

Strategies Considered but Rejected

Strategies considered but rejected include fertility control in elk and bison, agency reduction of either elk or bison, and altering rations of supplemental feed. These strategies were rejected because they were not included in the BEMP preferred alternative and/or because they were not supported by cooperating agencies.

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 D). 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; 3) determining elk and bison fed days each feeding season; 4) estimating winter mortality; 5) brucellosis seroprevalence rates; and 6) 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 and sustained commitment. Change is unlikely to happen fast, and interpreting effects of 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 management direction will be presented in an annual Step-Down Plan update/report, completed by NER staff by the end of June.

Public Outreach / Education

De-emphasizing the supplemental feeding program will be a major paradigm shift especially for the residents of Jackson Hole and Teton County, but will also be of interest to others in Wyoming and across the nation familiar with the long history of feeding elk on the National Elk Refuge. The general public and especially key stakeholder groups must understand the biological needs for and strategies of the Step-Down Plan in order to gain general consent to modify longstanding elk and 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

Thirty adult cow elk were captured on NER feeding grounds in 2016 and Telonics Iridium GPS collars were deployed with a 90-minute fix interval. Collars were deployed on 36 additional adult cow elk in February-March 2017. Additional GPS collars will be deployed in winter 2019, and, assuming adequate funding, in winter 2020 as well. Public outreach, private lands conflict mitigation and contacts, and enhanced forage monitoring will occur in fall 2019 through January 2020. Delays in the initiation of the feed season will begin in winter 2020.

Introduction

In 2007, the National Elk Refuge (NER) and Grand Teton National Park (GRTE) published a Record of Decision (ROD; USFWS and NPS 2007a) for a bison and elk management plan. The Bison and Elk Management Plan (BEMP; USFWS and NPS 2007b) was developed to guide management of the Jackson bison and elk herds on NER and 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 Step-Down 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 (see Figure 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 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 geographic regions that include GRTE, Yellowstone National Park (YNP), the Gros Ventre drainage, Teton Wilderness, and Southwest Boundary 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 hunted to near-extinction, 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). Over time, changes in land use and development in these areas, over hunting, and establishment of feeding grounds probably reduced the use of these areas by Jackson elk.

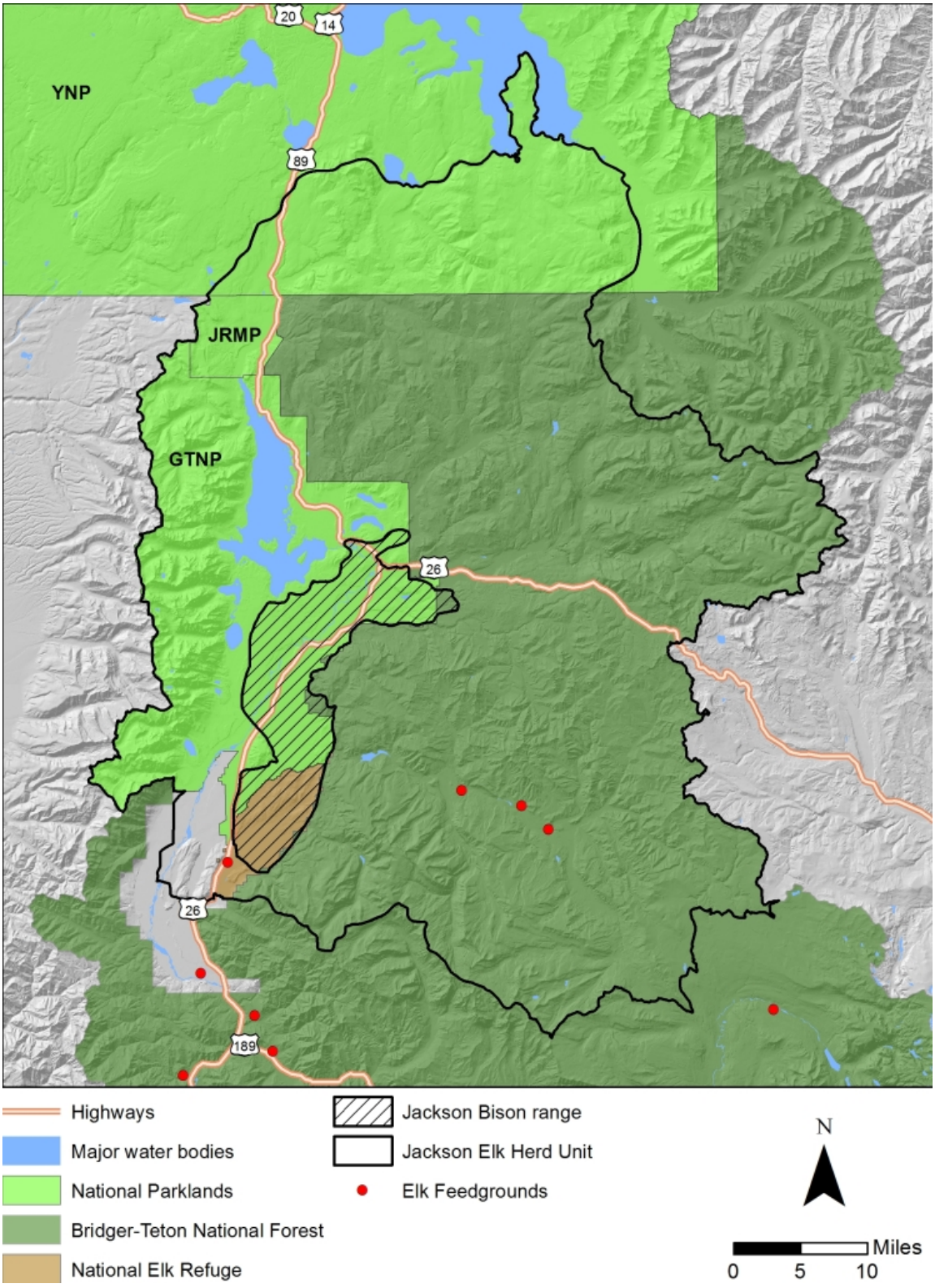

Figure 1. Jackson elk and bison herd ranges, including the National Elk Refuge, Grand Teton and Yellowstone National Parks, and Bridger-Teton National Forest.

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. Significant numbers of elk died during several severe winters in the late 1800s and early 1900s. The primary reasons for these mortality events included the loss of available winter range in Jackson Hole due to new ranching operations and an expansion of Jackson. The expansion 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, behavioral conditioning of elk to winter feeding, and the desire to maintain a population objective established in the context of supplemental feeding. In recent times, the population has fluctuated near the herd objective of 11,000 that was adopted by the WGFD (see Figure 2).

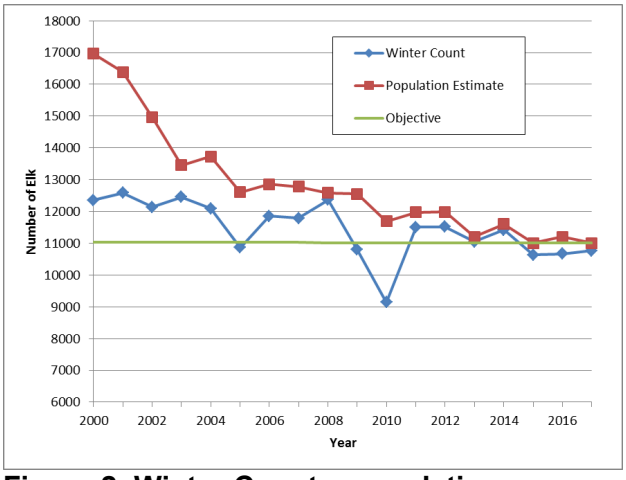

Figure 2. Winter Counts, population estimates, and herd objective for the Jackson elk herd, 2000-2017.

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 GRTE 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 hunted to near-extinction outside Yellowstone National Park by the mid-1880s. In 1948, 20 bison from 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 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 GRTE in 1950 had enveloped the Wildlife Park, and this allowed the bison to range freely and was consistent with National Park Service wildlife management policy. The herd remained small and wintered mostly in the Snake River bottoms in 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 and acceptable to managers. In 1980, bison discovered and utilized supplemental feed provided to elk in winter, and they have continued to do so ever since.

The discovery of supplemental feed by bison has had several consequences, including a significant increase in the population's growth rate (see Figure 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 stable movement patterns, wintering almost entirely on the

NER and summering within GRTE and adjacent lands on the BTNF (see figure 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, which is demonstrated in the high level of brucellosis in the elk and bison herds. It has also resulted in damage to and loss of habitat due to browsing of willow, cottonwood, and aspen stands and thereby reducing availability of these habitats to other wildlife as well as unusually low winter mortality, which has affected predators and other species and has required intensive hunting programs.

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 1958. The group consists of biologists and agency administrators from the NER, GRTE, YNP, BTNF, and WGFD, 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 (Figure 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 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 (see Figure 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 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 in the NER and GRTE, continue hunting bison and elk on the NER, continue the elk reduction program in GRTE in concert with the parks enabling legislation, 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 framework of management actions which adaptively decrease the need for supplemental feeding on the NER.

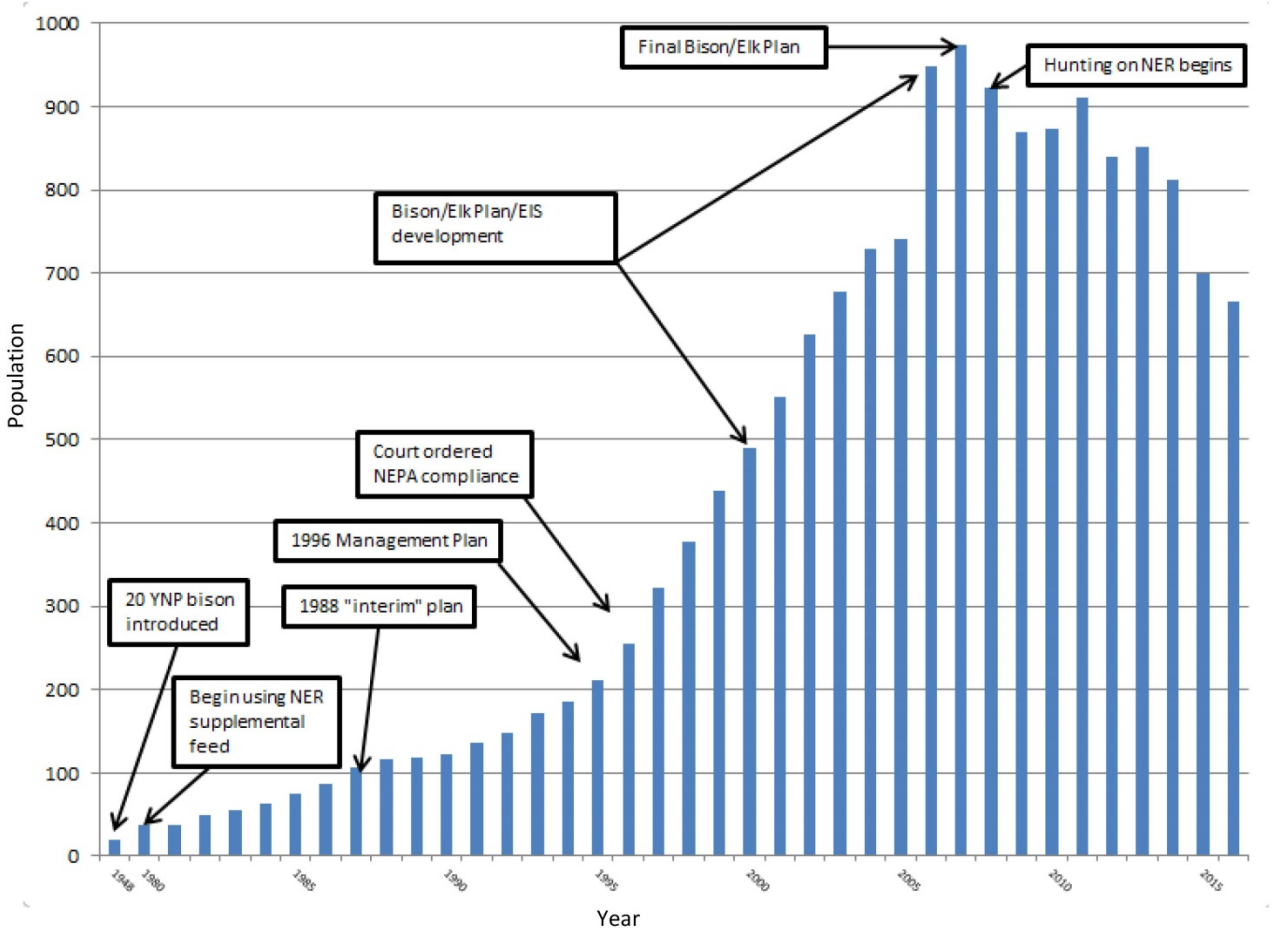

Figure 3. Population growth and planning history for the Jackson bison herd, 1948-2016.

This Bison and Elk Management Step-Down 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 (see Figure 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 Step-Down 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 District Court for the District of Columbia sided in favor of the agencies in this case. In 2011, the plaintiffs appealed this ruling to the United States Court of Appeals for the District of Columbia Circuit. This Court affirmed the District Court ruling (Defenders of Wildlife et al. v. the U.S. Department of Interior and State of Wyoming 2011).

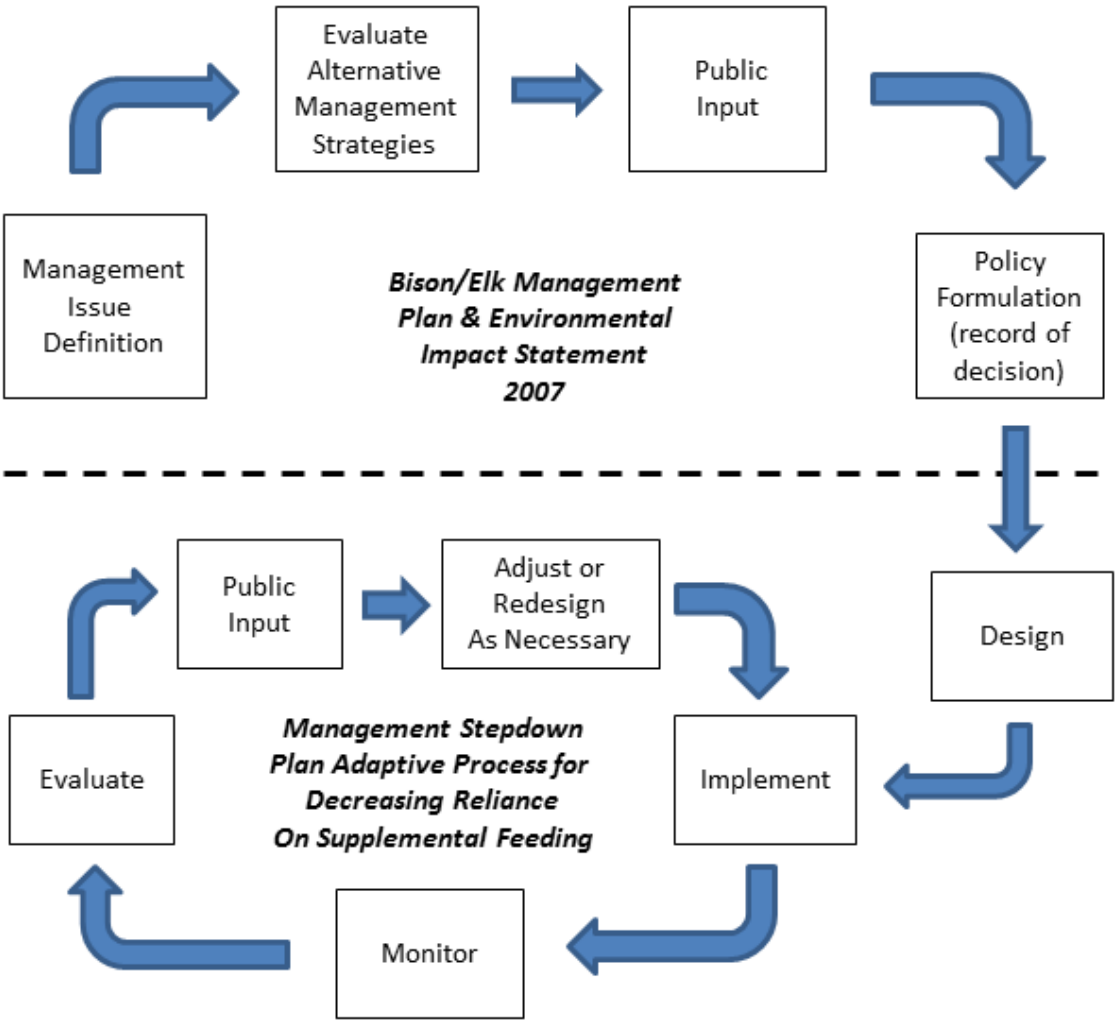

Figure 4. Step-down planning on the National Elk Refuge as it relates to the BEMP.

National Environmental Policy Act Compliance

The 2007 BEMP/EIS and 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 step-down plan does not duplicate or add to this process, but rather, it tiers to the existing 2007 BEMP/EIS and is intended to be used 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.

Step-Down Planning

The use of adaptive management plans has 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. Four elements generally included in 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 all of the adaptive management planning elements outlined in the Department of Interior Adaptive Management Technical Guide (2007). 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 freestanding forage (BEMP ROD p.5).

Table 1. 2007 Bison/Elk Management Plan Goals and Objectives
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 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 35:100 bull-to-cow ratios in park summer elk 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.
Note: * Step-down plan objective

Objectives

The management direction and desired conditions stated in the BEMP called for the NER and 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 four primary goals, 20 associated objectives were identified (see table 1). This Step-Down Plan addresses four objectives under the goal of sustainable populations (see Figure 5).

The reduction of animals on feed at the NER was proposed to be spread over two phases. In Phase 1, 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 NPS 2007a). Desired conditions include animals relying predominantly on native habitat and cultivated forage on NER. Important consideration criteria for implementing Phase 2 will include: 1) the level of forage production and availability on the NER 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 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 for progressively transitioning from winter feeding of elk and bison on the NER to greater reliance on freestanding forage, while maintaining population and herd ratio objectives.

This Plan focuses on management actions to 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.

Management Actions and Strategies

Background

The principal goal of reducing reliance on supplemental feeding is to limit transmission of density dependent diseases in elk and bison while simultaneously minimizing winter mortality in elk. We will attempt to achieve this goal by experimentally reducing feed season length and closely monitoring elk and bison distribution and winter mortality.

Elk have been fed on the NER each year in all but 10 winters since 1912, and bison have been fed there since 1980. The attraction of highly nutritious, easily accessible food during winter months is powerful to both species, and their knowledge of NER feeding grounds 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 use of feeding grounds is a learned behavior, decreasing feed season length will potentially reduce the likelihood of elk that winter on native range finding NER feeding grounds. Over time, this could result in a greater percentage of elk using native winter range relative to NER feeding grounds. Because it is largely unprecedented,

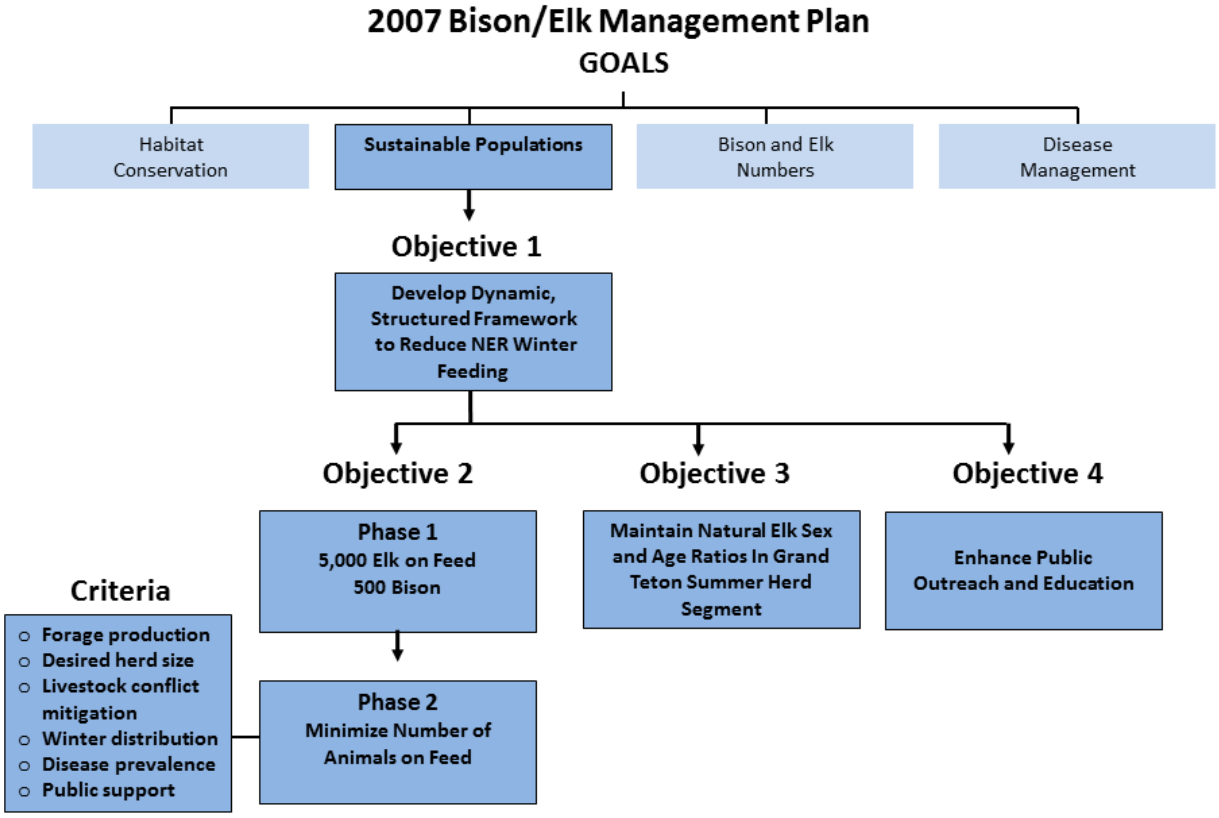

Figure 5. Relationship of the Step-Down Plan to the BEMP goals, phasing of objectives, and consideration criteria for Phase 2.

the concept of modifying this behavior on such a large scale is daunting and poses questions for which there are no immediate answers. In some cases, the likelihood a specific management strategy's success will only be able to be roughly estimated, and unanticipated results are likely. Closely monitoring forage availability, elk and bison distribution, and elk mortality will allow us to evaluate the effectiveness of management actions and adjust management actions as needed should unintended negative consequences arise.

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

IMPORTANT CHANGES SINCE 2007

The BEMP was developed based on data collected and knowledge that existed up until its ROD. 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 545 during winter 2016-2017 (Figure 3) through hunting programs administered by WGFD. Licensing changes enacted by WGFD in 2014 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.

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 (see figure 6), this will make achieving the Phase I

objective of 5,000 elk on feed and any future elk population reductions more difficult.

Frequently Asked Question

Question:

The BEMP has an objective of 5,000 elk wintering on NER. Why has that objective not been achieved through increased elk harvest/hunting?

Response

The overall Jackson Elk Herd population has declined and is currently close to the 11,000 elk objective, but the number of elk wintering on NER has been well above the 5,000 elk objective since implementation of the BEMP in 2007 (Mean =7,100 elk). When the analysis was conducted for the BEMP, elk winter distribution data suggested that 5,000 elk could winter on NER while still maintaining 11,000 elk in the Jackson Elk Herd overall. However, the proportion of the Jackson Elk Herd that winters on NER has increased significantly over time, and based on current elk distribution it is no longer possible to winter 5,000 elk on NER and maintain 11,000 elk in the overall Jackson Elk Herd. Although increasing elk harvest above current levels would likely allow us to achieve the 5,000 elk objective for NER, it would also reduce the overall Jackson Elk Herd population below the 11,000 objective. If increasing elk harvest is not plausible, the only other option to meet the 5,000 elk objective on NER is to change winter elk distribution, which is the principal strategy of the Step-down plan.

Preliminary analysis suggests that the increasing proportion of the Jackson elk herd wintering on NER has been associated with 1) Declines in elk use of native winter range and movements of elk from State feed-grounds in the Gros Ventre drainage to NER, and 2) increasing numbers of elk that summer immediately adjacent to NER (Cole and Foley et al. 2015).

Refuge-wide herbaceous forage production averaged 14,387 (SD = 4,125) 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 that 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 have implications for elk and bison

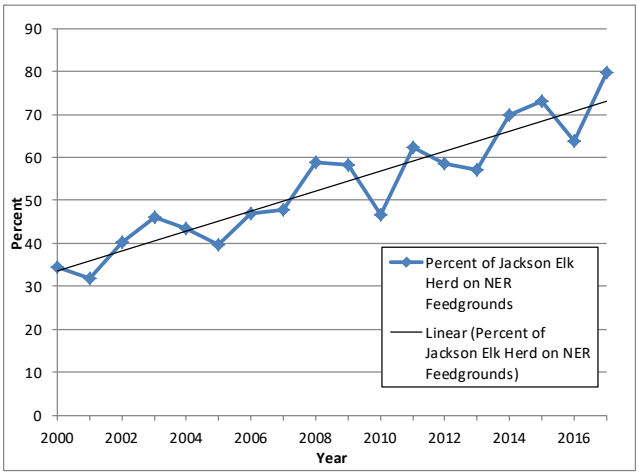

Figure 6. Trend of National Elk Refuge elk on supplemental feed as a proportion of the Jackson elk herd.

management. Moderate to long-term effects of climate change in Jackson Hole will likely include increases in average temperature, a reduction in the duration and distribution of snow cover, an increase in the number of frost free days, increased wildfire frequency, and changes in plant community composition and structure including loss of forest and shrub cover and an increase in invasive plants (Riginos and Newcomb 2015). The net effect of these changes relative to the implementation of the Step-Down Plan remains uncertain.

CURRENT MANAGEMENT

Ongoing primary management actions on the NER include winter feeding, harvest, irrigation, and hazing. In 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 Step-Down Plan strategies that will follow.

CHRONIC WASTING DISEASE

Supplemental feeding has occurred in all but 10 winters on NER since 1912, and although this

strategy minimizes winter elk mortality from starvation, contributes to Wyoming state elk herd objectives, eliminates commingling with livestock, and keeps elk off adjacent roadways, 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/km2 (0.06 to 0.45/ac) 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 range from 77-16,850/km2 (0.31-68/ac; NER unpublished data), which suggests that the introduction of CWD to NER elk would have significant negative population effects over time.

Using population data specific to the Jackson elk herd, we recently completed a modelling exercise that estimates the predicted prevalence of CWD and the effects of the disease on population growth rate (Galloway et al. 2017). It is important to note that these predictions are based on a potential invasion of the disease, and there is currently no evidence that CWD is present in the Jackson elk herd. In the absence of hunting, the model predicts that the population will decline when CWD prevalence reaches 7% in adult and yearling cow elk (95% Bayesian credible interval, BCI: 0%23% prevalence). However, when current cow elk harvest levels are included as a source of mortality in the population, the model predicts that the Jackson elk population will decline at any level of CWD prevalence. Prior research in Rocky National Park showed infection probability of cow elk averaged 8% (95% credible interval = .05 .12). This average infection rate and its associated uncertainty were used as a prior distribution to forecast the effect of the introduction of 5 elk with CWD into the Jackson population. Forecasts included a wide range of CWD prevalence rates after 5 years (median = 10%, 95% Bayesian credible interval = 6% 16%). The prior distribution of infection rates has a large effect on model outcomes. Because the infection rate is based on Rocky Mountain National Park data and does not vary over time, the model likely overestimates prevalence in the early years following introduction of CWD, and underestimates the effects of the disease later on when both infected animals and CWD prions become more common in the environment.

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 declines 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 for forage off the NER, which would increase the potential of comingling with cattle causing damage to private lands, and moving across Highway 89 where the risk of vehicles hitting elk is high. 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 determined by biomass of forage produced during the previous growing season, rate of forage consumption during fall and winter, and snow conditions.

Index sites are used to sample forage biomass and determine when feeding should be initiated. These sites are selected annually to represent plant communities that are highly preferred by elk due to plant species composition and the persistence of green vegetation. Weekly sampling begins in late December to estimate available forage biomass at each index site. When average available forage across index sites is below 300 lbs./ac, biologists typically recommend that supplemental feeding be initiated.

During 1995–2017, the average initiation of winter feeding in NER occurred 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 a desire to avoid elk-cattle comingling on nearby private lands. Coordination of winter feeding dates on the NER and WGFD-operated Gros Ventre drainage feeding grounds (Alkali, Patrol Cabin, and 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 feeding grounds and native range is shown in Table 2.

Table 2. Annual distribution of wintering elk from the Jackson elk herd during February classification counts relative to the current objective, 2011-2017

	Objective	2011	2012	2013	2014	2015	2016	2017	Mean
NER	5,000	7,746	7,360	6,285	8,296	8,390	7,290	8,879	7,749
Gros Ventre	3,500	2,775	3,265	2,982	2,326	1,162	1,667	1,243	2,203
Native Range[1]	2,500	982	894	1,784	801	913	1,711	644	1,104
Total	11,000	11,503	11,519	11,051	11,423	10,465	10,668	10,766	11,056

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

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 feeding ground and provide a heavy feed ration, which helps keep them in this area. This strategy prevents bison from mingling with elk and prevents bison from moving to areas where conflicts with humans are more likely.

HARVEST

Total hunter harvest of the Jackson elk herd was gradually reduced over the last decade as the population neared objective (see Figure 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 2015, 422 ± 102 (mean ± SD, range = 329-612) hunters harvested 196 ± 95 (range = 126-457) elk per year during the NER hunt.

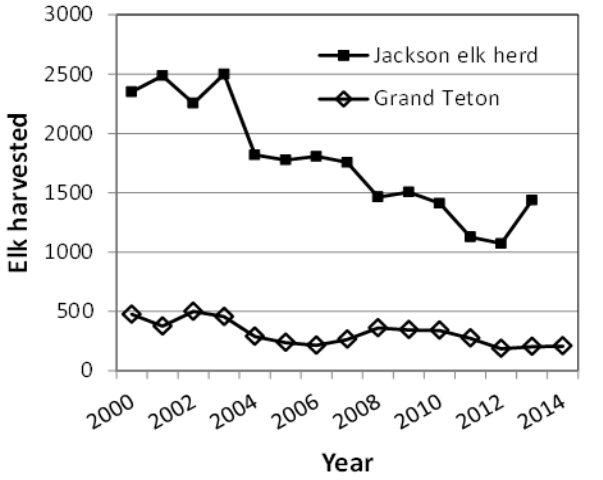

Figure 7. Estimated elk harvests for the whole Jackson elk herd and the portion that occurs in Grand Teton National Park, 2000-2014.

The 1950 legislation that created GRTE 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 and 1960), when 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 GRTE harvest accounts for about 25% of the overall Jackson elk herd harvest, and has been an important factor in regulating the population. Increased predation, likely a result of increases in grizzly bears and wolves over the last 20 years, has decreased the need for large harvests in GRTE.

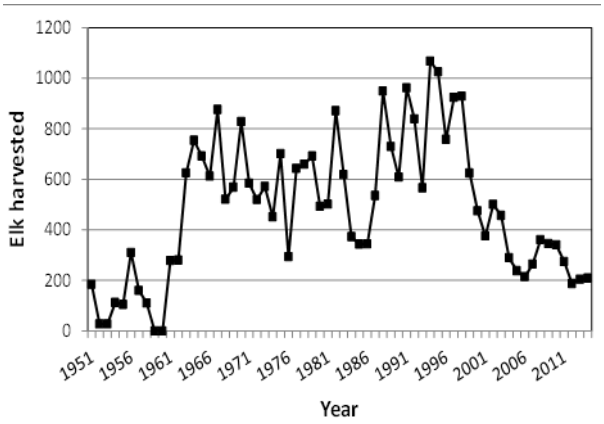

Figure 8. Elk harvest in Grand Teton National Park, 1950-2015.

Bison hunting begins 15 August 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, harvest has been 210 ± 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 (see Figure 3). Tribal bison harvest of up to five 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.

Bison hunting is not allowed in GRTE because of long-standing NPS policy that prohibits most hunting in national parks. Bison quickly learned to take advantage of the safety of GRTE, which has made hunter harvest goals difficult to achieve. Many bison stay in GRTE during the hunting season, with only occasional short-term movements to the NER, until severe winter conditions occur. In response, NER and WGFD managers have attempted to extend the hunt to late January while minimizing the conflict with the initiation of winter feeding. The unpredictable nature of winter conditions that time of year makes this challenging, and has (or could) 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. Hazing of elk and bison by WGFD staff also occurs on private lands adjacent to NER periodically throughout the year.

VEGETATION RESTORATION AND PROTECTION

The BEMP identified approximately 4,500 acres of previously irrigated and cultivated grasslands in GRTE in need of restoration to native sagebrush grasslands community. Objectives of ecological restoration include restoring abandoned hayfields to native plant communities to improve wildlife forage and habitat, and visitor opportunities to enjoy wildlife viewing within a natural setting. After 2 years of research and field studies, restoration efforts began in 2008. The restoration process involves several steps including removal of non-native vegetation through repeated herbicide applications, collection, and propagation of native grass, forb and shrub seeds, and finally native seeding. Repeated herbicide treatments have been warranted prior to native seed planting as well as spot treatments of invasive weed species subsequent to native seeding. Substantial progress in this endeavor has been made since 2008, including 1,235 acres of previously cultivated lands under restoration treatment. Of the 1,235 acres undergoing treatment, 745 acres has been seeded with native grass, shrub, and select forb mixes, and 89 acres are considered fully restored. Two-hundred and seventy-five of these acres are currently fenced to reduce grazing pressure of early native vegetation establishment from bison and other ungulates. All treatments are monitored for native plant establishment and invasive plant infestations and treatments will be adjusted as necessary. Invasive plant treatments may have to continue indefinitely. GRTE will continue to seek funding for restoration of the remaining areas as well as maintenance of the restored pastures.

PRIVATE LANDS MITIGATION

Fencing of haystacks 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 in residential areas. Other mitigation methods, should wildlife conflicts become a significant issue, could include long-term leases to allow for wintering elk, purchase of permanent conservation easements, or direct compensation to support specific actions (e..g removing cattle from certain areas during the spring when they may be particularly vulnerable to brucellosis transmission).

COMMON METHODS, ASSUMPTIONS, AND CONSTRAINTS

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, GRTE, and WGFD biologists. This survey occurs one day in 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 elk were 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.

Initial success of the Step-Down Plan will be a consistent decline in the 3-year running average of elk and bison fed days from the established baseline. While the BEMP does not provide specific measurement criteria to determine when the NER has successfully attained the objective 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. This level was chosen to define success because it indicates that elk and bison will predominately be foraging on freestanding natural and cultivated plants on NER and adjacent winter ranges rather than on supplemental feed.

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 various species apply. Some requirements for maintaining certain habitat types could limit methods used and areas considered for habitat improvements in GRTE and the BTNF. Such improvements could increase elk and bison use of native winter range off the Refuge while simultaneously reducing use of feedlines. Similarly, compliance with the 2015 sage grouse amendment to the 1990 Bridger-Teton National Forest Land and Resource Management Plan and the Wyoming greater sage-grouse core area protection executive order (2011-5 and supplement 2013-3) could affect 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.

Table 3. Summary of potential step-down 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 ceremonial take
- Bison/elk hunt end date (Feb. 1st)
    - WGFD, brucellosis safety
- Carcass disposal (Feb. 15th)
    - WGFD, brucellosis safety

Table 3. Summary of potential step-down plan constraints
• 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

Note: [1]Endangered Species Act

Strategies

This section describes the management action this Step-Down Plan proposes to implement. As such, it unveils the heart of management changes proposed to begin the process of transitioning to 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 BEMP.

Initial strategies for achieving sustainable population goals identified in the BEMP (Table 1) are presented by the objectives 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 function 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 A.

OBJECTIVE

1) Implement a phased reduction of animals wintering on NER to 5,000 elk and 500 bison, and,
2) Influence elk and bison to rely predominantly on native habitat (Table 1).

The first phase will be to reduce the number of elk on NER feed to approximately 5,000 and maintain a target population of about 500 bison. The second phase will be to manage bison and elk populations to achieve desired conditions, with animals relying predominately on available native habitat (NER, GRTE, and USFS lands) and cultivated forage (NER).

As previously mentioned, 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. Efforts to scale back elk supplemental feeding operations in other parts of North America have been rare and fraught with controversy (Smith 2001). 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 consideration of more aggressive strategies when the BEMP is updated in 2022.

Chronic Wasting Disease

Since 1997, NER has cooperated with WGFD to conduct intensive surveillance for CWD in the Jackson Elk Herd unit. GRTE has also collaborated with WGFD to collect samples from the ERP and from road-killed cervids. Although this effort indicates that CWD is not currently found in the Jackson elk herd, 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 [USFWS and NPS, 2007b]. Given that CWD has been detected in a mule deer in GRTE, this level of surveillance is warranted.

In 2016, the WGFD cooperated with federal agencies and other stakeholders to revise the 2006 Wyoming CWD Management Plan. The NER and USFWS Region 6 Wildlife Health Office staff participated in several meetings associated with this effort. The Wyoming CWD Plan lists several management responses for consideration if CWD is detected on or adjacent to State or NER elk feeding grounds. Early detection of CWD in the Jackson elk herd is essential to allow implementation of management responses.

The BEMP (2007) identifies the management response to the arrival of CWD as following the State of Wyoming CWD Plan in effect in 2007. The Wyoming CWD Plan was updated and significantly changed in 2016. In light of changes in the Wyoming State CWD Plan, and the results of CWD Studies completed since 2007, the NER management response to CWD has been updated and will be included in a NER Disease Contingency Plan, as identified in the NER Comprehensive Conservation Plan (2016). The CWD section of the NER Disease Contingency Plan will remain consistent with the goals of the BEMP. The NER Disease Contingency Plan is scheduled to be completed in 2019.

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 end, delaying initiation of feeding is likely to have the greatest impact by gradually conditioning animals to "expect" feed to be available later in the winter; this could build cohorts of animals that rely primarily on native winter range. To reduce supplemental feeding, 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, which is the parameter we will use to measure progress toward reducing reliance on supplemental feeding.

During the first several years, the initiation of feeding will be delayed for short durations of time (days). This will provide an opportunity to monitor elk and bison behavioral responses to delayed feeding (Figure 9) and identify private land conflict areas that may require assistance with focused mitigation measures.

As bison and elk behavioral responses are better understood, and targeted mitigation on private lands is achieved as needed, feeding delays will be extended depending on several variables (see Table 4, Figure 10). During the last 20 years, feeding initiation dates, which have been based on forage availability, have varied from December 30 to February 28. Under the Step-Down Plan, the magnitude of the delay in feeding initiation date will be influenced by seasonality. For example, delaying

feeding by two weeks in January is likely to be more successful in dispersing

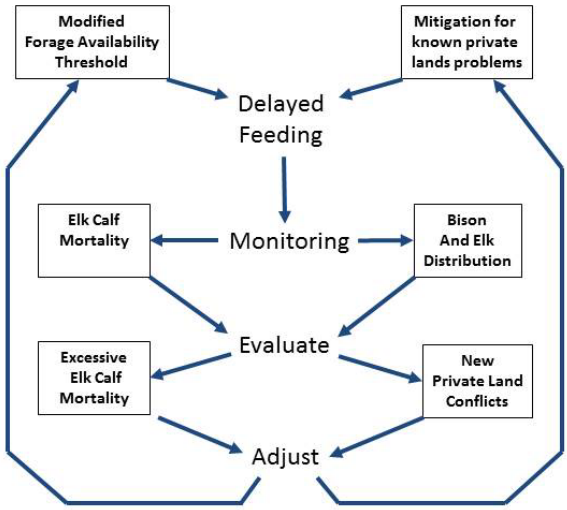

Figure 9. Framework for delayed feeding strategy under the step-down plan.

Frequently Asked Question

Question:

Why is your principal strategy to delay the start of the feed season?

Response:

By delaying the start of the supplemental feed season, we decrease the probability that elk that use native winter range or state feeding grounds will discover NER feeding grounds. Because elk use of feeding grounds is a learned behavior, over time this could increase the proportion of elk that winter on native winter range, reduce the number of elk that move from the Gros Ventre drainage to NER, and decrease the NER wintering elk population. The resulting shift in elk distribution would allow us to achieve the 5,000 elk objective for NER. Because 5,000 elk and 500 bison is close to the estimated carrying capacity of NER habitat, less feeding will be necessary at these population levels.

animals to native range than doing so in February, when food stress and the potential for animals to move to private lands is greater. Forage availability could also have an influence on feeding initiation date, particularly if a freeze-thaw event resulted in an acute and large reduction in available forage. Forage availability would also be affected by the numbers of elk and bison on the NER. Finally, the distribution of animals, particularly on private, livestock producing lands would be considered in determining feeding initiation date.

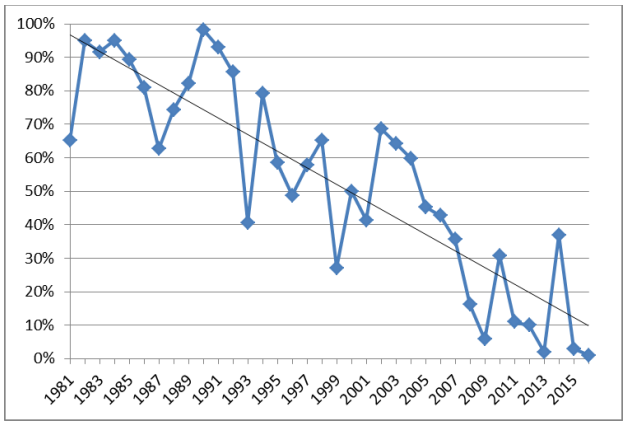

Figure 10. The percentage of elk that wintered on NER as of December 1; showing a progressively later annual fall/winter arrival over the past several decades.

A primary concern of manipulating feeding is elk winter mortality, particularly among calves. For example, research on unfed elk populations in Yellowstone National Park suggested an average elk calf winter mortality of 28%, with the majority of cases caused by malnutrition (Singer et al. 1997). Similarly, Smith and Anderson (1998) found unfed winter elk calf mortality of 29% compared to 11% for elk calves using feeding grounds. As food becomes limited in winter, calves are usually the first to experience nutritional deficit and winter mortality because they are displaced by animals that are more dominant, they have limited fat reserves, and are more susceptible to cold temperatures than larger animals. Monitoring programs will include measures of elk calf winter mortality on NER. The BEMP anticipated that total elk winter mortality (currently 1-2%) could increase up to 3 percentage points under the preferred alternative, with most of the increase in elk mortality occurring amongst very old age classes and calves. If Step-Down Plan implementation results in winter elk mortality levels in excess of these levels, adaptive action could be taken to mitigate these effects in future years (Appendix A).

In the early years of Step-Down Plan implementation, the seasonal termination of feeding is expected to occur about a week earlier than current conditions (current average end date 2 April; range = 24 March – 20 April). Under current management, feeding termination date has been based on a snow cover index and a subjective evaluation of available forage and forage greenness. We will develop methods to quantify these variables and objectively determine feeding termination date during the period of Step-Down Plan implementation.

The Step-Down Plan 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 (NWRS Improvement Act; 1997) and the NER CCP [USFWS, 2015] and possibly encourage more hunters to participate in antlerless elk hunts. Monitoring programs and consideration of bull ratios in the GRTE summer segment (since most park bulls migrate to the NER) would help inform levels of proposed take. 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 (see Figure 10).

General elk harvest patterns in GRTE would continue to be based on need for harvest, summer segment population estimates, herd status relative to population objective, herd demographic parameters, herd-wide distribution of harvest, 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. Agencies will collaborate with the WGFD in the public process of reviewing and adjusting the future 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.

Bison hunts on the NER (bison hunting is prohibited in GRTE) would see little initial change (Table 4). Consideration would be given to later end dates that are commensurate with delayed feeding, and possible escorted hunting in the South Unit to help with distribution. Special limited hunts designed to discourage bison from attempting to leave the NER via the south boundary into the town of Jackson will also be considered.

A cattle guard was 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.

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, but also that elk are sensitive to hunting pressure that can cause elk movements to areas that cause management issues for WGFD. NER officials will work with BTNF and WGFD officials to explore the possibility of allowing hunting in limited areas after December 1 in the future.

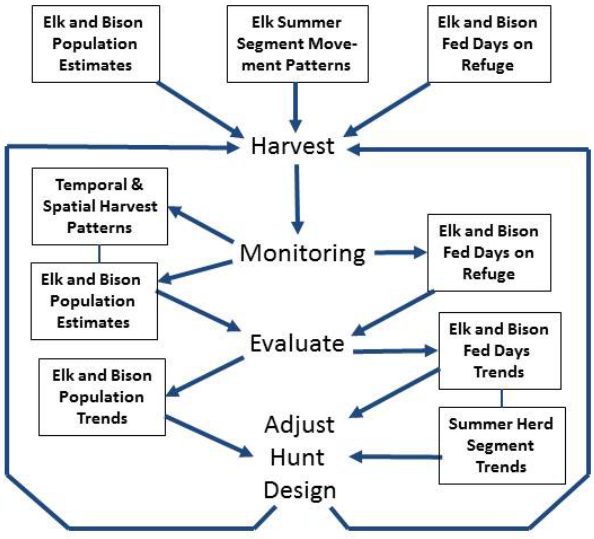

Figure 11. Framework for harvest strategy under the step-down plan.

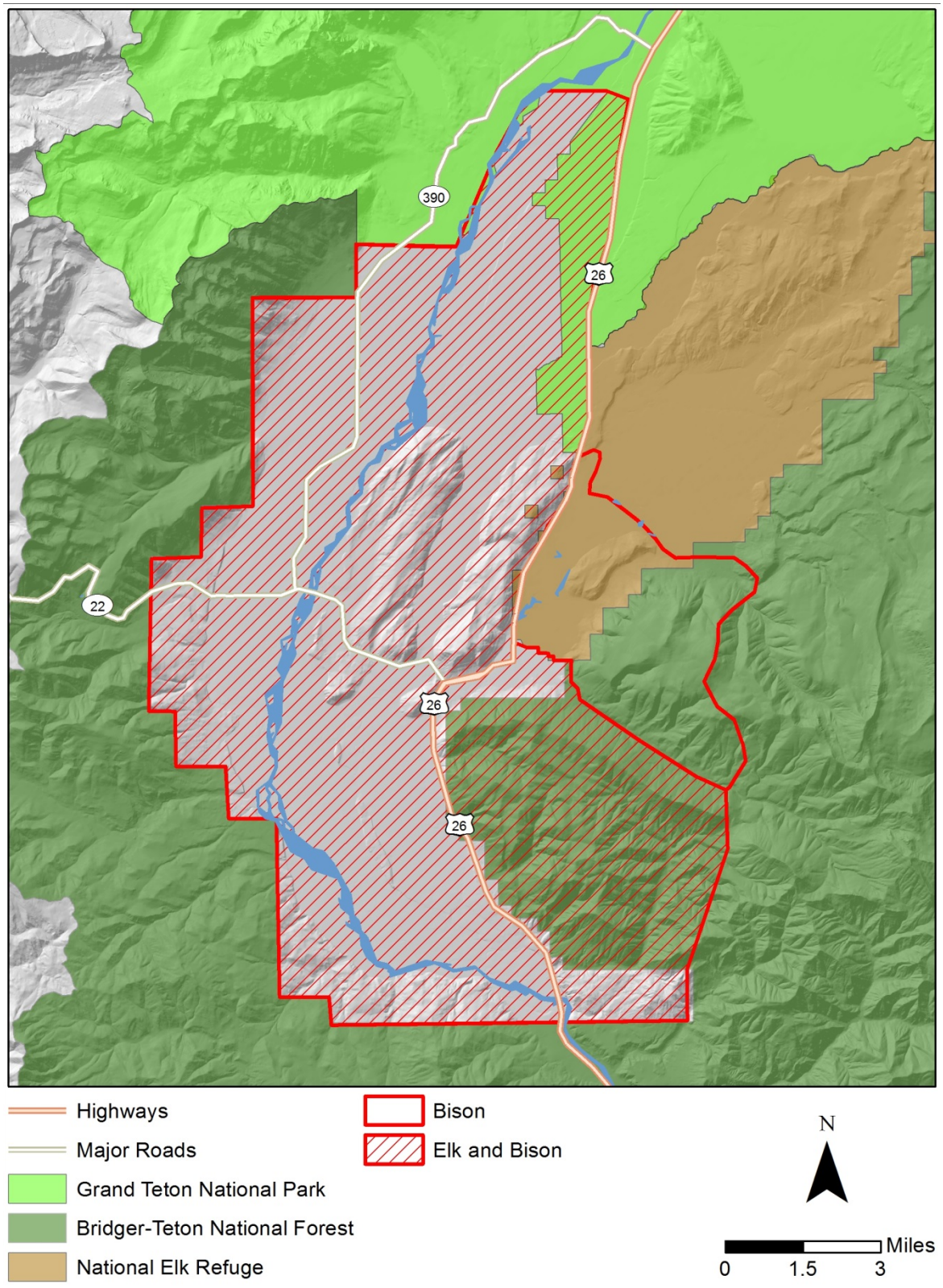

Figure 12. Areas with high potential for conflict of elk and bison with human activities. Significant elk or bison movements to these areas from NER during winter months could result in changes and/or review of the step-down plan.

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 elk and bison management harvest programs (Figs. 9 and 11).

Hazing

Minor changes in hazing practices are anticipated initially under this Step-Down Plan framework.

Private Lands Mitigation

Delaying the onset of NER feeding is likely to result in changes in bison and elk distribution (Appendix D). 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, such as 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 or leases to prevent co-mingling.

A database will be established to track non-agricultural conflicts on private lands to determine trends that will help evaluate the effectiveness of Step-Down Plan mitigation efforts.

Preventing elk and especially bison from entering the Town of Jackson is essential in maximizing public safety and minimizing private property conflicts. Currently, bison are hazed northward when they drift south of Miller Butte. A cattle guard was 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

The varied approaches to restore the Kelly Hayfields in GRTE (4,500 acres) was initiated in 2008 following 2 years of research and field studies (Moeny 2008) (see Figure 13).

The approach to ecological restoration includes serial treatments to

1) remove non-native species (e.g., herbicide application and prescribed burning);
2) seed native shrub, grass, and forb species; and
3) Treat subsequent invasive plants by applying herbicides and, where appropriate, construct temporary fences to protect recently seeded pastures from colonization of non-native species and damage from large herbivores during early phases of restoration.

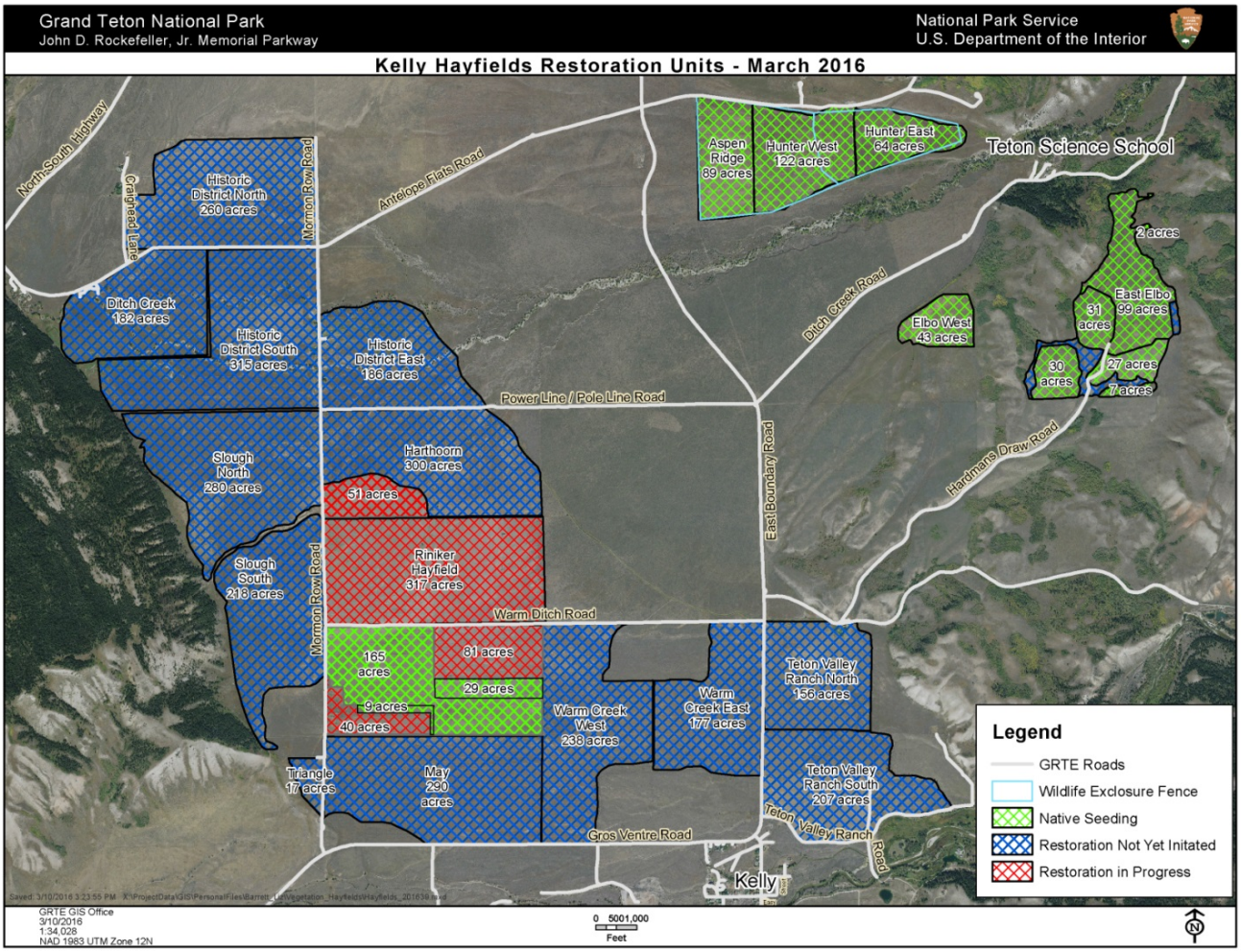

Figure 13. Units and status of the Kelly Hayfields ecological restoration effort in Grand Teton National Park, March 2016.

OBJECTIVE

1) Maintain 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 summer bull ratios for elk in GRTE that were chronically below 35 bulls:100 cows, permit types for the park's elk reduction program (ERP) went to "antlerless only" in 2012. Additionally, the "antlerless only" hunt structure aligns with primary objective and intent of the ERP. ERP permit structures in the park will likely remain antlerless. Park and refuge officials will work together to support this goal as expanded refuge hunting opportunities are considered.

Table 4. Comparison of current and primary step-down plan components and parameters			
Action	Current Management	Proposed Management	Comment
Winter Feeding:			
Feed	Pelleted alfalfa	Pelleted alfalfa	No change
Ration	Full ration average: 8-12 lbs./day/elk	No Change	No change, to minimize calf mortality. Note average daily ration over the entire feed season is lower than a full ration because feed rate is gradually increased at the beginning of the feed season and gradually reduced at the end to facilitate rumen acclimation
	20-22 lbs./day/bison	20 lbs./day/bison	
Start criteria:			
Available standing forage	300 lbs./acre, as measured at traditional key index sites	Generally later; index sites to be increased in number and distribution	Influencing factors: -time of season -forage availability -number 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 than current management	Ongoing development of more objective criteria for future implementation
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	2008-2017 Average: 5.3% (range 1.1-19.6%)	Potentially higher than current levels but less than native winter range	
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)	2008-2017 Average:	<=3%	
	1.5% (range 0.6-3.5%)		

Table 4. Comparison of current and primary step-down plan components and parameters			
Action	Current Management	Proposed Management	Comment
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	Unknown, but will be monitored based on summer distribution of radio collared elk	Based on summer distribution of elk that were randomly radio collared on NER.
Harvest, National Elk Refuge elk:			
Frequency	Annual	Annual	
Begin Date	2nd week October	No Change	Modified as necessary
End Date	3nd week December	No Change	Modified as necessary
Structure	- 1 week initial drawing	- 1 week initial drawing	
	- 1 week left over 1st served	- 1 week left over 1st served	
	- partial week alternate	- partial week alternate	
	-daily 1st served alternates	- daily 1st served alternates	
Refuge permit types	- 1st week any elk	- Primarily antlerless only	
	- Antlerless only remainder of season	- limited any elk permits throughout season	
	Restrict access to specific locations	Restrict access to specific locations	
Access		Consider expanding to allow bow hunting near developed areas	
Hunt area boundaries			
Harvest, National Elk Refuge bison:	Annual	Annual	
Frequency	August 15th	August 15th	
Begin date	2nd or 3rd week January	Consider later dates as appropriate	Modified as necessary
End date	As per WGFD	As per WGFD	Modified as necessary
Hunting Season Structure	Any bison or cow/calf per state license	Any bison or cow/calf per state license	
Refuge permit types	Restrict access to specific locations	Restrict access to specific locations	
Access	Limited to north of Nowlin Creek area	Consider escorted hunting in South Unit as needed	
Hunt area boundaries			Guided hunts in South Unit when authorized
Harvest, Grand Teton NP elk:	As needed	As needed	
Frequency	3rd week October	3rd week October	

Table 4. Comparison of current and primary step-down plan components and parameters			
Action	Current Management	Proposed Management	Comment
Begin Date	2nd week December	2nd week December	Modified as necessary
End Date	Antlerless only	Antlerless only[2]	Modified as necessary
License types	Cartridge limits	Cartridge limits	
Special regulations:	Bear spray required	Bear spray required	
	Hunter safety card required	Hunter safety card required	
Harvest, Bridger-Teton NF, Elk Hunt Area 80:			
Begin Date		15-Dec	
End Date			Would require change in winter closure dates
Harvest, Elk Hunt Area 78			
Structure			Changes at discretion of WGFD
License Types			
Private Lands Mitigation:		Incentives for non-breeding operation	
Cattle commingling		Increased fencing	
Hay depredation			
Landscape damage			
Easement acquisition			
Vegetation Restoration/ Protection: Elk Refuge	Herbicide treatments, prescribed burning, native seed propagation and planting, and protection and maintenance of restored pastures	Same as Current Management for remaining non-native grasslands in Kelly Hayfields	
Vegetation Restoration/ Protection: Grand Teton	Herbicide treatments, prescribed burning, native seed propagation and planting, and protection and maintenance of restored pastures	Same as Current Management for remaining non-native grasslands in Kelly Hayfields	

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 Step-Down Plan (Table 5). Since they were not part of the ROD, additional NEPA compliance would be necessary to incorporate any of them into this Step-Down Plan, and they are not being considered at this time.

Models of System Dynamics

Models provide a simplified representation of the biological system being managed. We will use modeling to quantify the effects of our management actions on two key responses of interest, elk distribution, and elk calf winter mortality. There are suites of possible factors that affect the proportion of elk on NER feeding grounds 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 D). 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 elk calf winter mortality is a potential result of reduced feed season length. Several factors influence elk calf winter survival on NER (Figure 14). Models will be used to assess the effects of available forage on elk calf winter survival (Appendix D). Over time, this will allow us to assess the effects of our principal management strategy (reducing feed season length) relative to elk calf winter survival.

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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 Step-Down Plan 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 Step-Down Plan because current hunting programs successfully reduced bison numbers to 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.
Private Lands Hunting Coordinator	The WGFD contacted private landowners and ranchers in the Spring Gulch area and discussed this concept to enhance elk harvest of short distance migrants. Generally, landowner interest was low.

Notes:
[1] Page 77 at http://www.fws.gov/bisonandelkplan/Final%20EIS/Volume%201/4_Chapter_2_Alternatives.pdf
[2] USFWS and NPS 2007

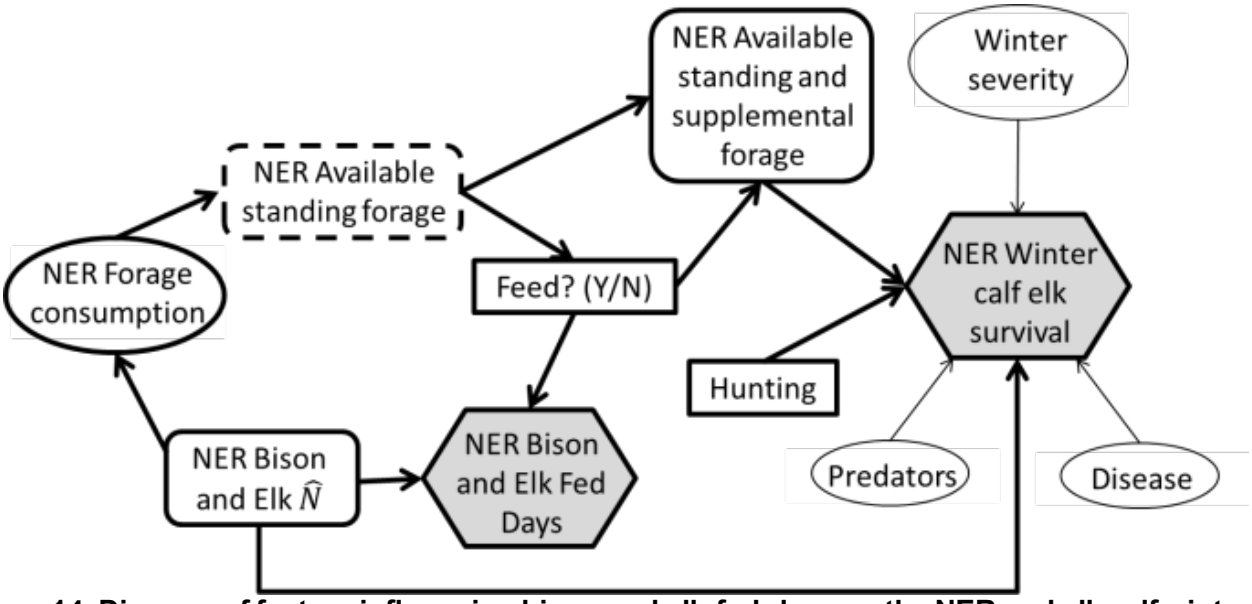


Figure 14. Diagram of factors influencing bison and elk-fed-days on the NER and elk calf winter survival.

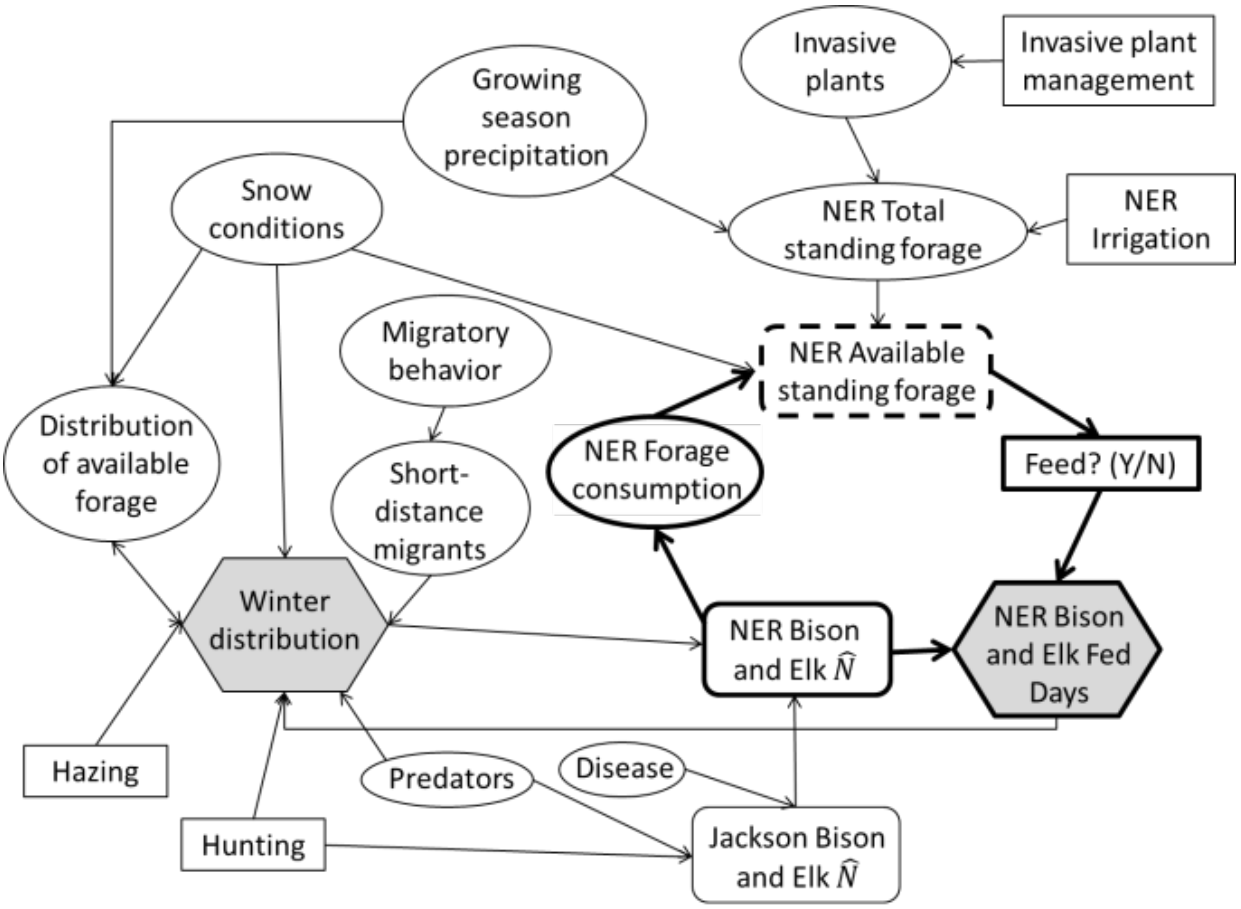


Figure 15. Diagram of outcome influences from BEMP (USFWS 2007a).

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 Appendix B). 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 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 three historic key index sites, three random sites in areas preferred by elk, and three 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 Appendix B). At least two 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 Step-Down Plan strategy is to delay the initiation of supplemental feeding after average forage production reaches the 300 lbs./ac level at key index sites. Therefore, the monitoring period will be extended to include this period of delayed feeding.

Proportion of Elk Wintering on NER

A principal Step-Down Plan 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 slowly conditioning elk to seek food elsewhere. As feeding periods are shortened, the probability of younger elk age classes discovering NER feeding grounds will be reduced, and, hypothetically, that proportion of the Jackson elk herd that utilizes NER feeding grounds will decline over time. We will measure this effect by examining changes in the winter distribution of the Jackson elk herd. WGFD annual trend/classification count data provide a multi-year baseline data set to measure changes in the winter distribution of the Jackson elk herd and categorizes observations by location. In each year, we will calculate the proportion of total classified elk in the Jackson elk herd that are classified on NER feeding grounds. We will compare the 3-year running average post Step-Down Plan implementation to the pre-implementation baseline. The pretreatment baseline will be comprised of data from 2008 through 2017 a period that represents BEMP implementation prior to Step-Down Plan actions (Figure 16). No feeding occurred in 2018, a very rare occurrence under the old feeding protocol, so that year is not included in the baseline.

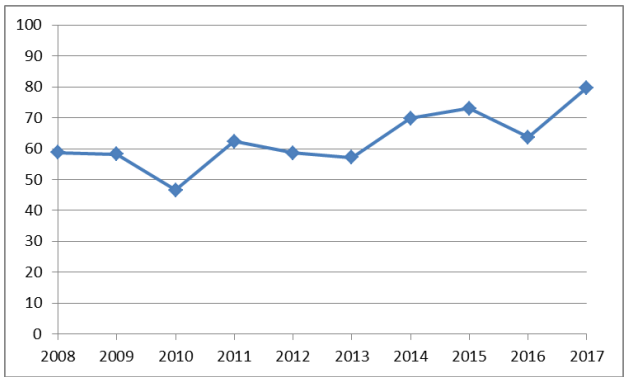


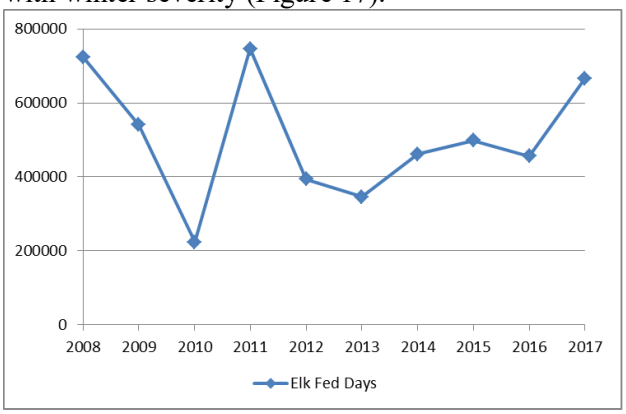
Figure 16. Proportion of Jackson elk herd on NER feeding grounds during BEMP implementation.
*No feeding occurred in 2018

Elk Fed Days and Bison Fed Days

The BEMP and Step-Down Plan 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 feeding grounds and the number of days they are fed. We further assume the variables elk-fed-days (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:

EFD= ∑ Total elk counted on feed during daily feeding ground counts for duration of feed season
BFD= ∑ Total bison counted on feed during daily feeding ground counts for duration of feed season

Because EFD and BFD are influenced by feed season length and the number of animals on feed, the Step-Down Plan 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 feeding grounds. We will evaluate changes in EFD and BFD by comparing the 3-year running average post Step-Down Plan implementation compared to mean EFD and BFD from 2008−2017 The running average is an appropriate comparison because it will help account for wide annual variation in EFD and BFD associated with winter severity (Figure 17).



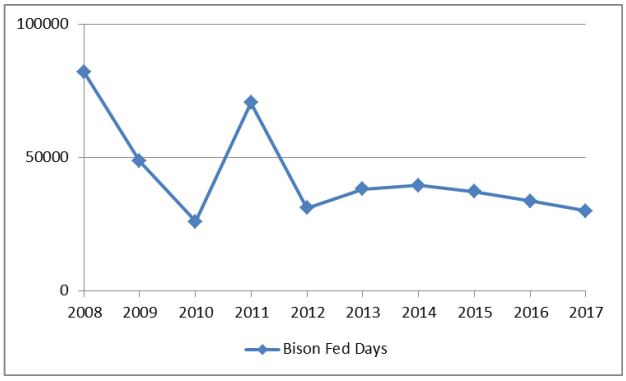


Figure 17. Elk-fed-days (EFD) and Bison-fed-days (BFD) after implementation of the BEMP but prior to the implementation of the Step-down plan.
*2018 anomalous non-feed year data not included.
*2019 data not compiled.

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 feeding grounds as the denominator. We will continue to monitor elk winter mortality using the same methods post-Step-Down Plan implementation, which will allow trend comparisons to the pre Step-Down Plan baseline (Figure 18). Under the Step-Down Plan framework, we believe the 3-year running averages for total and elk calf winter mortality will be within the range of variation exhibited by the pre Step-Down Plan

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-Step-Down Plan mortality in excess of these levels may warrant shortening the feeding initiation delay in subsequent years.

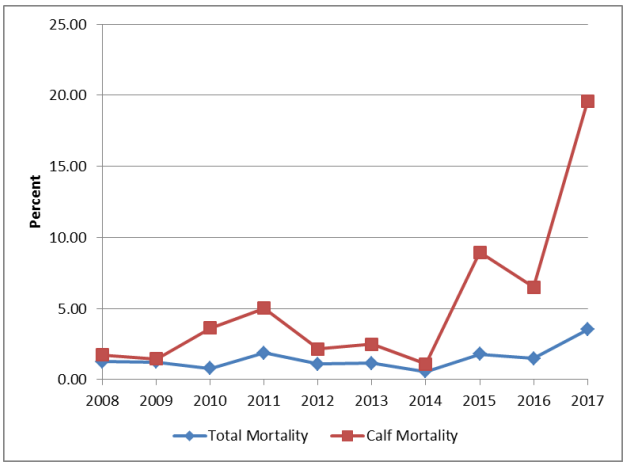


Figure 18. Total elk (blue) and calf (red) winter mortality, percent.

Elk Collaring

One of the Step-Down Plan'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 sample of 50 GPS-collared elk that winter on NER throughout the Step-Down Plan 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-Step-Down Plan baseline data.

NER has elk GPS-collar data available from 2008-2017 which represents the post-BEMP, pre-Step-Down Plan baseline period. We hypothesize that elk movements from NER to surrounding private lands will increase during the Step-Down Plan 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 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 likely result in elk distribution changes.

Thirty adult cow elk were captured on NER feeding grounds in February 2016 and Telonics Iridium GPS collars were deployed with a 90-minute fix interval. Collars were deployed on 36 additional adult cow elk in February-March 2017. 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 2019 and 2020 to maintain the 50 elk desired sample size over the life of the Step-Down Plan implementation period.

Ancillary data that will be collected and analyzed during the elk capture and collar data analysis 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 Step-Down Plan implementation. Elk captured during elk collaring operations will be tested for brucellosis exposure. The averaged 2019-2020 Brucellosis seroprevalence rate will be the pre-treatment baseline to evaluate post Step-Down Plan change. Chronic wasting disease (CWD) has been monitored in the Jackson elk herd 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 Jackson elk herd, which given the long term persistence of the disease, provides overwhelming evidence that CWD is not currently endemic to the Jackson elk herd. However, most evidence suggests that the distribution of CWD is increasing and that its introduction to the Jackson elk herd is inevitable. Early detection is critical to ensure a management response; 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 experience suggests that dedicated personnel are necessary to ensure minimum sample size.

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 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 and sustained commitment. Change is unlikely to happen fast, and interpreting effects of 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 at an annual management Step-Down 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 NER, GRTE, and USFS lands, and on NER cultivated forage. However, 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.

Frequently Asked Question:
Question:
Why is the Step-Down Plan vague regarding the magnitude in the reduction of feeding days and specific triggers that would lead to either more aggressive or conservative reduction in feeding days?
Response:
This is the first time that the strategy of delaying feed season initiation has been employed to reduce reliance on supplemental feeding. There is uncertainty regarding the effects of this strategy on elk and bison distribution and elk winter mortality; therefore, it is important to maintain flexibility in plan implementation to avoid significant unintended negative consequences. Unintended negative consequences the Step-Down Plan seeks to avoid include 1) elk or bison moving to areas where they damage property, risk human safety, or commingle with livestock, and 2) elk winter mortality levels significantly higher than baseline levels.

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 complex, dynamic, and interwoven components 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 Step-Down Plan 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 in EFD and BFD, 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 evaluating a matrix of effects. These evaluations will be included in annual Step-Down Plan 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 due to NEPA requirements, any further consideration of reduced herd sizes by the NER or GRTE are beyond the scope of this plan. However, Wyoming Game and Fish Commission 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 be drawn upon for this purpose.

Table 6. Elk winter distribution and elk calf mortality variables			
Variable	**Source**	**Elk Winter Distribution Model**	**Elk Calf Mortality Model**
Proportion Jackson Elk Herd on NER Feeding grounds	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 Elk Winter Mortality (calf)	NER elk winter 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 feeding ground 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

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 Step-Down Plan 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 Step-Down Plan in order to gain general consent to modify longstanding elk/bison herd management methods.

A detailed communication plan to guide outreach and education efforts can be found in Appendix C.

Schedule

Table 7. Proposed implementation schedule for the Step-Down Plan	
Action	**Date**
GPS Collar minimum 10 elk (Iridium platform)	February 2019
Implement enhanced forage monitoring	January 2020
Initiate changes in supplemental feeding protocol	January/February 2020
First Monitoring/Evaluation/Annual Report	June 2020

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Frequently Asked Questions

Question

Why is the Step-Down Plan vague regarding the magnitude in the reduction of feeding days and specific triggers that would lead to either more aggressive or conservative reduction in feeding days?

Response

This is the first time that the strategy of delaying feed season initiation has been employed to reduce reliance on supplemental feeding. There is uncertainty regarding the effects of this strategy on elk and bison distribution and elk winter mortality; therefore, it is important to maintain flexibility in plan implementation to avoid significant unintended negative consequences. Unintended negative consequences the Step-Down Plan seeks to avoid include 1) elk or bison moving to areas where they damage property, risk human safety, or commingle with livestock, and 2) elk winter mortality levels significantly higher than baseline levels.

Question

Why were reductions to the Jackson Elk Herd and Jackson Bison Herd population objectives not considered as a strategy to reduce reliance on supplemental feeding?

Response

The BEMP has clear population objectives of 5,000 elk wintering on NER and 500 wintering bison. Modifying those population objectives would require additional NEPA analysis. The BEMP also agreed to support State elk herd objectives. The WGFD completed a public process in 2016 to set the population objective for the overall Jackson Elk Herd, and that objective remains unchanged at 11,000 elk.

Question

The BEMP has an objective of 5,000 elk wintering on NER. Why has that objective not been achieved through increased elk harvest?

Response

The overall Jackson Elk Herd population has declined and is currently close to the 11,000 elk objective, but the number of elk wintering on NER has been well above the 5,000 elk objective since implementation of the BEMP in 2007 (mean =7,100 elk). When the analysis was conducted for the BEMP, elk winter distribution data suggested that 5,000 elk could winter on NER while still maintaining 11,000 elk in the Jackson Elk Herd overall. However, the proportion of the Jackson Elk Herd that winters on NER has increased significantly over time, and based on current elk distribution it is no longer possible to winter 5,000 elk on NER and maintain 11,000 elk in the overall Jackson Elk Herd. Although increasing elk harvest above current levels would likely allow us to achieve the 5,000 elk objective for NER, it would also reduce the overall Jackson Elk Herd population below the 11,000 objective. If increasing elk harvest in not plausible, the only other option to meet the 5,000 elk objective on NER is to change winter elk distribution, which is the principal strategy of the Step-Down Plan.

Question

Why is your principal strategy to delay the start of the feed season?

Response

By delaying the start of the supplemental feed season we decrease the probability that elk that use native winter range or state feed grounds will discover NER feed grounds. Because elk use of feed grounds is a learned behavior, over time this could increase the proportion of elk that winter on native winter range, reduce the number of elk that move from the Gros Ventre drainage to NER, and decrease the NER wintering elk population. The resulting shift in elk distribution would allow us to achieve the 5,000 elk objective for NER. Because 5,000 elk and 500 bison is close to the estimated carrying capacity of NER habitat, less feeding will be necessary at these population levels.

Question

Will delaying the start of the feed season result in elk starvation?

Response

Our goal is to delay elk feeding a sufficient amount of time to affect elk distribution without causing an increase in elk mortality.

Appendix A

Summary of Potential Impacts

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 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 pasteurellosis, 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 B

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 Step-Down Plan. To facilitate comparison with pre-Step-Down Plan 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 Step-Down Plan 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 C

Communication Plan

Communication Goals

Prior to the Step-Down Plan's Implementation

- Utilize a variety of outreach methods to inform the public on the goals and timing of the Step-Down 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.
- Work directly with ranch and other private land owners to understand preferences for elk comingling compensation or mitigation methods.

During the Step-Down 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.
- Maintain effective communication with ranch and other private landowners to monitor the effectiveness of elk comingling compensation and mitigation methods.
- Provide a comprehensive overview of the Step-Down Plan by providing links and references to previous outreach and background information.

Communication Objectives

- Work with current media contacts to promote news of the Step-Down Plan via print, radio, Web, and social media platforms.
- Utilize new media and social media tools to provide information on why the Step-Down 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 Step-Down Plan.
- Monitor print media on Refuge elk and bison management to see how the Step own 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 additional photos where additional 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.
- A grant-funded project to interview private landowners about acceptable elk comingling mitigation and compensation methods began in summer 2018. To date, 10 ranch owners representing about 2,000 acres of potential elk winter range have been interviewed.

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, particularly 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; 1 bison is equivalent to 3 elk.

Appendix D

Models

Elk Winter Distribution Models

The proportion of the JEH that winter on the NER will be linked to factors hypothesized to influence elk winter distribution 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. The random year effect can be considered a latent variable describing elk behavior manifested as observed winter distribution. 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 is:

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

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).

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.

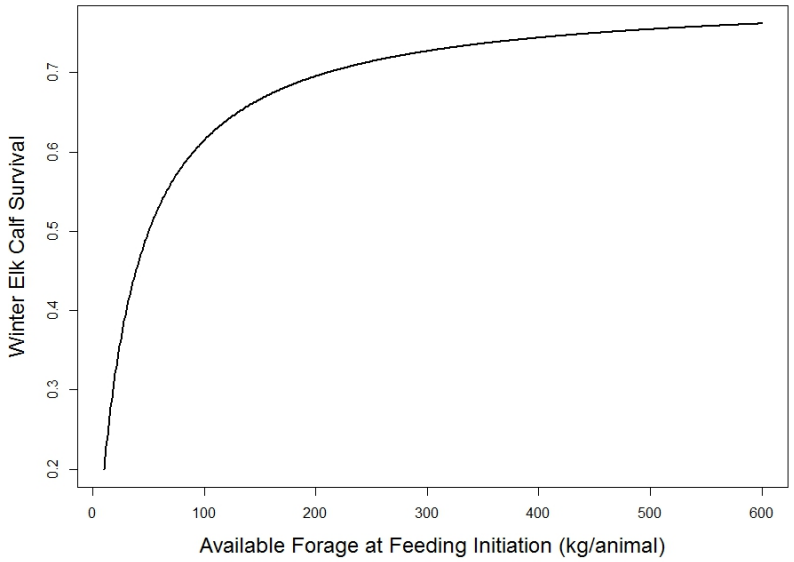
While calf survival is a function of multiple factors the primary management action influencing calf survival is supplemental winter feeding. Current winter feeding initiation criteria lead to calf survival generally higher

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.