CONTENTS

IMPACTS ON THE JACKSON BISON HERD

This section describes the effects of the alternatives on bison numbers, distribution, movements, calf production, mortality, and the health of the Jackson bison herd. It also identifies and explains the factors that would influence the population and that would lead to the population effects described below.

METHODOLOGY USED TO ANALYZE EFFECTS

The same methodology as described for impacts on elk was used for impacts on bison.

As previously described, under all alternatives except Alternative 2 the U.S. Fish and Wildlife Service and the National Park Service would work cooperatively with the Wyoming Game and Fish Department to achieve population objectives, including herd ratios, the determination of hunting seasons, and the evaluation of hunt areas. The Wyoming Game and Fish Department would formally establish objectives and strategies after public review and approval by the Wyoming Game and Fish Commission.

When comparing impacts of Alternatives 2–5 to Alternative 1, it was assumed that the increasing bison population under Alternative 1 would remain on the refuge during winter because the feeding program would encourage bison to stay there.

The primary actions under the management alternatives that could play a role in influencing disease prevalence and transmission in the Jackson elk and bison herds are summarized in Table 2-4. The impact analysis assumes that winter feeding would have been fully phased back to anticipated levels prior to a non-endemic disease being introduced into the elk or bison herd.

Total numbers of Jackson bison and those wintering on the refuge would be essentially the same, except for the very few bison that remained on native winter range and did not migrate to the feedgrounds on the refuge.

The analyses are quantitative wherever data allowed. Where sufficient numeric information was not available, qualitative or relative assessments were made. Impact levels, as defined during the disease expert meeting, would be the same as for elk (see page **Error! Bookmark not defined.**).

Discussion of direct, indirect, secondary, short-term (less than 5 years), long-term (15–20 years or longer), and cumulative impacts are included as appropriate.

IMPACTS OF THE ALTERNATIVES

IMPACTS COMMON TO ALL ALTERNATIVES

Although the prevalence of brucellosis would vary among alternatives, brucellosis would not likely be eradicated from the Jackson bison herd under any alternative, even with a highly effective vaccine (Peterson, Grant, and Davis 1991b; Gross, Miller, and Kreeger 1998; HaydenWing and Olson 2003). Measurements of brucellosis seroprevalence in the bison herd range from 58% (84/145 harvested bison; 1999–2003; WGFD unpubl. data) to 84% (110/131, study animal sampling included some non-random age and repeat sampling; 1997–2004, GTNP, unpubl. data). Seroprevalence differences could be due to sampling error, testing methods, and criteria used (Roffe pers. comm. 2003).

There is no evidence that bison are susceptible to the strains of *Pasteurella multocida* which cause the septicemic form of the disease in elk. Bison probably do not get the elk strain (Disease Expert Meeting 2002), and septicemic pasteurellosis would not impact the Jackson bison herd under any of the alternatives.

Bison are likely susceptible to other forms of necrobacillosis such as foot rot, but the thorough review of disease literature conducted for this document (Peterson 2003) found no documented cases of necrobacillosis, or necrotic stomatitis, in bison. Necrotic stomatitis would not impact bison and was dropped from further analysis.

Three documented viral microparasites, bovine viral diarrhea, parainfluenza virus-3, and bovine respiratory syncytial virus, were also dropped from further analysis. Seroprevalence for these three viruses can be high in the Jackson bison herd, but no associated clinical disease has been documented in the herd.

Although bison may have their own species of *Psoroptes*, no records of these mites have been reported in the Greater Yellowstone Area. Therefore, psoroptic scabies are not expected to impact bison under any of the alternatives and are not discussed further in this section.

Bison would not be adversely affected by elk lungworms under any of the alternatives. Because lungworms are specific to the particular host species, the risk of interspecies transmission is low (Peterson 2003; Disease Expert Meeting 2002). The lungworm, which is thought to be the most detrimental parasitic helminth known to occur in the Jackson elk herd (Worley 1979; Smits 1991; Peterson 2003), also infects bison, but its prevalence in Greater Yellowstone Area bison herds is unknown (Peterson 2003). Other gastrointestinal parasites and helminths are only incidental in the Jackson bison herd (Peterson 2003), and effects are expected to be minimal under all alternatives. Therefore, these other parasites are not considered in detail in the following analysis.

Vesicular stomatitis, an undocumented viral microparasites not analyzed in detail because no impacts are likely in bison (Disease Expert Meeting 2002).

Foot-and-mouth disease and rinderpest are not analyzed in detail because there are no documented records of these viral microparasites in the United States, and if either became established in the United States, the national response would be major and very aggressive (Disease Expert Meeting 2002).

Bison are not susceptible to chronic wasting disease. Based on current information, only elk, mule deer, and white-tailed deer are susceptible (Williams et al. 2002), and it is unlikely that bison would be affected.

There are no impacts at present from bovine tuberculosis, bovine paratuberculosis, or chronic wasting disease. Discussion of potential impacts if these diseases infected the herd is addressed in the context of the effects each alternative would have on transmission and prevalence if one or more of these diseases were introduced.

ALTERNATIVE 1

Analysis

In the following sections, short- and long-term effects are discussed together unless otherwise noted.

Bison Numbers

In the most recent annual Jackson bison herd census and classification, conducted on February 24, 2004, 729 bison were counted. Continued low mortality under this alternative would facilitate rapid herd growth. Average herd growth ranged from 10% to 14% (an average of 10% when the WGFD harvest removed approximately 40–50 bison per year from 2001 to 2004; 14% from 1990 to 2004). Bison numbers would be expected to increase to approximately 800–1,000 by spring 2006 (when the signing of the record of decision is anticipated) and to exceed 2,000 by mid-2014 if harvest continues to remove 40–50 bison per year.

Distribution and Movements of Bison

Although the number of bison in this area prior to Euro-American settlement is unknown, bison remains indicate that they were found in the central valley of Jackson Hole, along the Gros Ventre River, the west slope of the Gros Ventre Range, on the National Elk Refuge, and along the Snake River south of Jackson (Fryxell 1928; Ferris 1940; Love 1972). Because these remains represent mortalities in key wintering areas, bison likely inhabited the northern areas of Jackson Hole as well, especially in summer.

The growing bison herd would likely increase its movements and distribution under Alternative 1, moving seasonally between the park and the refuge, and perhaps also using Bridger-Teton National Forest lands and the Gros Ventre River drainage to the east. More bison than under baseline conditions would likely venture onto private lands, including the airport and golf course areas west of the refuge and south of the park and private sections of Buffalo Valley east of the park. These range expansions could be short-lived, however, if the Wyoming Game and Fish Department exercised its prerogative to remove bison on private lands where the animals could threaten human safety and damage property.

Expansion has been limited to date partly because bison have a strong fidelity to seasonal ranges and forage has not been limiting. As the herd grew to over 700 (its size in early 2004), its range expanded to the east only slightly. In November and December 1998, when there were about 440 animals in the herd, more bison used areas of Bridger-Teton National Forest just beyond the eastern refuge boundary. The following year, 1999, bison again used this area and expanded their range to include the Shadow Mountain area north of the refuge and east of the park. This was also the first year a large group spent most of the winter in the East Elk Ranch portion of the park. Since 2000, bison have continued to range outside the eastern edge of the refuge and the park, including Bridger-Teton National Forest areas east of East Elk Ranch towards Buffalo Valley and Shadow Mountain. Although the bison gradually colonized beyond the eastern edge of traditional areas, they did not greatly expand their range despite nearly doubling herd size in six years.

Factors that would continue to influence winter distribution include greater snow depths and correspondingly smaller amounts of available forage in the park (Farnes, Heydon, and Hansen 1999; Hobbs et al. 2003), irrigation and cultivation practices on the refuge, and long-term supplemental feeding on the refuge. The attraction of easily obtainable, abundant food would continue to restrict bison movements and distribution during winter feeding periods.

Shallower snow depths on the refuge as compared to other parts of Jackson Hole used by bison would continue to attract bison during the transition and winter seasons. Irrigation and farming practices, including the cultivation of 2,400 acres of the southern part of the refuge and supplemental feeding, would also continue to attract bison southward and possibly decrease the amount of time bison spend in transitional areas in the park and the refuge where native forage is available. A negligible amount of prescribed fire would continue to enhance forage and habitat and attract bison to treated areas.

During supplemental feeding periods, bison disperse to nearby areas after eating at the feedlines to feed on standing forage, and they rest during a large part of the day (Smith and Robbins 1984). If bison numbers grow to 2,000, the average 85-day feeding period might need to be expanded because of over-grazing and forage competition with elk on the refuge. Bison distribution under Alternative 1 would likely encompass the entire south end of the refuge.

It is expected that harvest would continue to play a limited role in restraining bison herd growth and the bison population would number an estimated 2,000 by the year 2014 and continue to expand their range, primarily to the east.

Bison Behavior, Social Interactions, and Nutrition

As the bison herd increased under Alternative 1, the number and frequency of aggressive interactions, particularly those due to competition for forage such as displacement of elk, would likely increase.

Nutritional status would likely remain the same as under baseline conditions because supplemental feeding would continue. Currently, bison that are fed presumably have improved nutritional status over bison on native range, although in recent years, bison on the refuge have been seen gnawing on roots and branches and eating twigs, behaviors that could indicate dietary inadequacies (Cole, pers. comm. 2004). Because bison turn to standing forage on the refuge when not actively eating at feedlines, the increase in numbers expected under Alternative 1 could result in a negligible decline in available forage and nutrition, by 0.5% in the short term and 2.5% in the long term.

Supplemental feeding would continue to contribute to the greater survival of out-of-season, late-born calves. Calves born outside the typical spring/summer birthing season would normally be highly disadvantaged from an evolutionary point of view because they would be less likely to thrive (J. G. Cook et al. 2004).

Disease Prevalence and Transmission

Bovine Brucellosis

Prevalence in Herd — Brucellosis seroprevalence in the Jackson bison herd would likely continue to be high (58%–84%, WGFD unpubl. data; Cain et al. 2001, 2002, 2004; Williams et al. 1993). The increased density of bison associated with this larger population could elevate prevalence of brucellosis, but the increase would be negligible to minor in the long term because seroprevalence is already high.

Transmission among Bison — In the short term, potential for transmission of brucellosis among bison would remain unchanged from current levels. Bison are social, gregarious animals and this behavior leads to increased opportunities for transmission of brucellosis. Increased concentration of bison on feedgrounds, rather than herd size overall, is believed to amplify transmission, as indicated by higher brucellosis seroprevalence in the 700+ Jackson bison herd compared to the 2,400+ animal herd in Yellowstone National Park (29.5%–31.8%) (Meyer and Meagher 1997; Williams et al. 1993; WGFD unpublished files). Under Alternative 1 transmission rates could increase, but because transmission is already high, the long-term effects would be negligible.

Transmission from Elk to Bison — Modeling of brucellosis in the Jackson bison herd has suggested that the herd may have contracted brucellosis from the infected elk with whom they began sharing feedlines during the winter of 1979–80 (Peterson, Grant, and Davis 1991b). It is likely that transmission from elk to bison continues at some unknown rate today, and that as herd size increases, transmission would also increase. Transmission from bison to elk was covered previously in the elk impact section on disease prevalence and transmission.

Bovine Tuberculosis and Paratuberculosis

Bovine tuberculosis and paratuberculosis are not present in the Jackson bison herd. The risk of major adverse consequences from the introduction of either disease would be highest under Alternative 1 because of increased bison numbers combined with annual winter feeding. (See the discussion for elk under Alternative 1, "Disease Prevalence and Transmission," for more detail.) The following impacts would occur if these diseases became established in the herd.

If bovine tuberculosis became established in bison on the refuge, it would likely be transmitted quickly (through aerosols and ingestion) and have a high prevalence in the herd (Peterson 2003), and it would be self-sustainable in the population under Alternative 1. It is also probable that bovine paratuberculosis would be sustained in the Jackson bison herd.

Transmission of bovine tuberculosis and paratuberculosis from elk to bison would be very likely (HaydenWing and Olson 2003) under Alternative 1 because elk and bison would commingle on the refuge during winter as they were fed, elk and bison numbers and densities would be high, and bison numbers would continue to grow.

Malignant Catarrhal Fever

There are no reports of malignant catarrhal fever in the Jackson bison herd (Peterson 2003). The risk of introduction into either the bison or elk herd through contact with infected domestic sheep is described in greater detail in the section for elk under "Disease Prevalence and Transmission," Alternative 1. Those alternatives that increase dispersion of animals through reductions in supplemental feeding, such as Alternatives 2 and 6, would also increase the chance of contact between Jackson elk or bison and infected domestic sheep. Alternative 1 would have less risk of bison contracting or spreading the disease than these two alternatives, but a greater risk than Alternatives 3, 4, or 5, because of the ever increasing size of the bison population. More bison present would increase the chance of an individual animal contracting malignant catarrhal fever.

The primary factor that would influence impacts from malignant catarrhal fever, if it becomes established, is animal density. Specific changes in prevalence in the herds, herd production, recruitment, mortality, and transmission are unknown for any of the alternatives. For bison, impacts would likely be greatest under Alternative 1 because numbers and density would be highest.

Calving, Age and Sex Ratios, and Recruitment

Because Alternative 1 would not include any hunting on the National Elk Refuge, and because only a small fraction of bison are harvested each year on adjoining lands, age and sex ratios of the bison herd would only be negligibly affected by hunting.

Sex ratios during 1999–2004 (excluding 2003 when there was no classification count) averaged between 80 and 90 bulls per 100 cows, and 39–45 calves per 100 cows. Hunting takes more bulls than cows and WGFD removals on private property tend to be bulls.

Brucellosis would not impact bison production and recruitment rates more than a small amount, even in the long term. This is because female bison tend to only lose their first pregnancy following infection (Cain et al. 2001), with minimal impacts to their lifetime reproductive potential. Birth fluids and material during subsequent deliveries, however, are often infectious. The Jackson bison herd is a chronically infected herd, and abortion rates in chronically infected ruminant herds are typically in the single digits (Herriges et al. 1989; Peterson, Grant, and Davis 1991a, b; Smith and Robbins 1994).

Figure 3-2 (see Chapter 3) illustrates the relatively small difference brucellosis prevalence makes in overall production. Even if 100% of female bison become infected with brucellosis and produced 10 calves in their lifetime, approximately 10% of potential calf production would be lost to abortion. Therefore, any increase in prevalence expected under Alternative 1 in the long term would not increase overall bison calf losses beyond the negligible level (up to 10%).

If bovine tuberculosis or bovine paratuberculosis became established in Jackson Hole, they would affect production and recruitment mainly by lowering the number of adult females. Bovine tuberculosis or bovine paratuberculosis could also affect age ratios because they would increase mortality particularly in older animals.

If these diseases were introduced into the Jackson bison herd, the impacts on production and recruitment would increase over time as the number of clinical cases increased. The number of clinical cases of bovine tuberculosis would be much lower than prevalence. Subclinical infections of bovine tuberculosis do not affect fertility of female African buffalo (*Syncerus caffer*; Rodwell, White, and Boyce 2001), and this is likely the case in bison. Therefore, the potential for impacts on production and recruitment would be much lower than the prevalence rates.

Mortality

Under Alternative 1 the overall annual mortality rate would continue to be relatively low and would likely remain similar to recent levels of about 6%–7%. Harvest currently causes the greatest number of known deaths, although vehicle collisions, natural causes, agency removals and other unknown causes contribute. Mortality rates determined from a radio-telemetry study monitoring a sub-sample of female bison from 1997 to 2003 allowed more precise information to be gathered and support low mortality levels (Cain, unpubl. data). The total number of deaths (13) that occurred during the study was small and mortality averaged 7% including harvest (5% excluding harvest deaths; methods from Heisey and Fuller 1985). Hunters killed 4, a vehicle killed 1, and 8 died of natural causes. Annual survival rates were high (95% and 93%, excluding and including harvest mortality, respectively).

This alternative would impose no controls on the growth of the bison herd, and as noted above, it is expected that the herd would continue its current rate of increase. Although it is possible that more bison could leave the safety of the refuge and park and be subject to hunting, it is also possible that the percentage of the herd subject to hunting would stay the same. Only negligible to minor increases in the harvest of bison are expected in the long term.

Agency removals would likely increase over baseline conditions as bison numbers continue to rise and they increasingly venture onto private lands. Agencies removed 10 bison during 1997–2003; the percentage of the herd removed ranged from 0% (no removals in two years) to 0.7%.

The number of bison killed by vehicle collisions could increase under Alternative 1 due to a larger bison herd, if movements and distribution increased within and outside the refuge and the park. Bison deaths from vehicle collisions in recent years have been variable and fluctuating levels would continue. During 1997–2003, vehicles killed 0.3%–1.3% of the herd each year.

Mortality due to natural causes would likely remain similar to baseline conditions. Predators would continue to have limited success at preying on bison although calves and weak or impaired individuals would still be killed opportunistically.

If bovine tuberculosis and paratuberculosis were introduced to the herd, adult bison mortality would increase as the number of clinical cases of bovine tuberculosis or bovine paratuberculosis increase. Because bison numbers and densities would be higher under Alternative 1 than any other alternatives, this alternative would result in the highest mortality of any alternative.

Health, Sustainability, and Naturalness

The Jackson bison herd might maintain relatively good health and continue to be self-sustaining if a serious non-endemic disease other than brucellosis did not infect it. However, high ungulate concentrations during nearly annual winter feeding would increase the risk of disease transmission and adverse impacts if the herd became infected. Concentrating large numbers of bison on feedlines for several months nearly every year would increase the chances of contact with infected adults or aborted fetuses of bison and elk infected with brucellosis, as well as increase the probability of quickly spreading any new disease. Risk would be particularly high under Alternative 1 because of the combination of high numbers of bison and elk and high frequency of supplemental feeding.

Barring the introduction of serious non-endemic disease, the herd would continue to be genetically viable. Limited harvest and lower-than-natural winter mortality would continue to allow nearly all bison in the herd to survive and reproduce, and the herd would expand from the 800–1,000 bison existing at the time of the Record of Decision.

Under this alternative, management would continue to affect the naturalness of population parameters and processes in the bison herd. The size of the bison herd would be larger than the number of bison that inhabited the valley prior to Euro-American settlement, especially in winter. Rather than many groups of bison roaming in search of available forage, as occurred naturally, the herd would continue to be concentrated together in a relatively small area for several months each winter.

The sex ratio would likely not be substantially different than natural conditions because hunting at this low level has only a minimal influence on the sex ratio. The age ratio would continue to be altered by the winter feeding program, as calves would have a higher chance of survival when born in the winter than in natural populations.

Because of its effects on mortality rate, distribution and movement, production and recruitment of calves, Alternative 1 would result in the lowest level of naturalness in the bison herd even though some aspects of naturalness (e.g., sex ratio, fewer hunter-killed bison) would be higher than under some alternatives.

Conclusion

Under all alternatives there would be an estimated 800–1,000 bison in the Jackson herd at the signing of the record of decision. Based on the previous five-year growth rate, under Alternative a the number of bison could grow to as many as 2,000 by 2014. Larger numbers of bison on the refuge would also likely result in increased competition for forage and displacement of elk, as well as increased movements and distribution, possibly making greater use of the national forest and private lands in Jackson Hole and Buffalo Valley. Nutritional status would remain high (due to supplemental feeding in the winter), and production, recruitment, and annual survival would remain high. The sex ratio would likely remain near 1:1, and calf production and recruitment would remain high as compared to a non-fed population.

The risk of a non-endemic infectious disease quickly spreading through the bison population would be the highest of any alternative due primarily to the near-annual winter feeding program and the growing numbers of bison. Therefore, this alternative would have the greatest risk of a non-endemic infectious disease having a major adverse impact to survival, population size, and sustainability. The prevalence of brucellosis in the bison herd would remain high (58%–84%) and could increase somewhat due to higher bison numbers and greater chances for transmission. Of all alternatives, Alternative 1 would result in the lowest level of long-term health, sustainability, and naturalness in the bison herd.

Barring the establishment of a fatal, infectious disease, no impairment to the bison herd is expected. If such a disease did become established, this alternative would have the highest chance of substantially reducing or perhaps even impairing the park herd.

ALTERNATIVE 2

Analysis

Bison Numbers

Under this alternative bison numbers would decrease, perhaps substantially, over time as supplemental feeding was phased out. No objective for bison numbers is set for Alternative 2. A herd size of 250–500 was chosen for the purposes of this analysis, although under minimal management population highs might exceed 500 bison and population lows might be lower than 250.

Despite this alternative's emphasis on minimal management, fertility control would be used during the short term to lower calf production and reduce herd growth, thus limiting increases in mortality as the feeding program was phased out (see text box and Appendix B for a more detailed discussion). Changes in the population would be closely monitored, and adaptive management would identify exactly when fertility control would be discontinued and points at which the feeding program would be phased back. Additional NEPA analysis could be needed prior to fertility control implementation if information on the state-of-the-art had changed significantly.

Converting cultivated fields on the refuge to native vegetation and discontinuing irrigation would provide less forage and could contribute to lower bison numbers. Some bison would leave the area in search of additional native winter range and enter Bridger-Teton National Forest, where hunting is allowed. Therefore, deaths from hunting would be possible.

Herd size would decrease primarily during severe winters, and perhaps during above-average winters, although enhancements in winter habitat in areas of Buffalo Valley and the Gros Ventre River drainage could provide additional forage in lieu of feeding. Agency removals and perhaps harvest would increase to some extent outside the refuge and the park. In the long term, bison numbers would fluctuate more naturally, based on weather conditions and predation, and more widely than under baseline conditions and compared to Alternative 1. Bison numbers could increase after fertility control was discontinued (after 15 years).

Distribution and Movements of Bison

Distribution would not differ initially from baseline conditions and Alternative 1 because supplemental feeding and cultivation of forage would continue to attract bison to the refuge. As the number of non-feeding years increased and cultivation stopped, bison would increasingly disperse to find native forage. The effects of short-term fertility control on bison movements and distribution would vary depending on which contraceptive method was chosen), and the timing, as previously discussed. Disturbance during winter could cause some dispersal and a wider distribution. More likely, displaced bison would move a short distance and return to the feeding area, either after a short calming period or after the fertility control operation ended for the day. There would be no known effects on movements and distribution beyond short-duration negligible to minor levels of disturbance during contraceptive delivery.

If contraceptives were used in other seasons, immobilization effects on bison movements and distribution would be similar to those of public hunting in that darters would shoot either from a vehicle or after approaching bison on foot. Movements and distribution would likely increase because bison could immediately leave areas where contraceptive delivery was taking place. Effects on distribution would be major if movements were extensive, although bison would likely not move beyond their normal distribution on the east side of the park.

Fertility Control in Bison

Fertility control in bison could be achieved through surgical sterilization, which would be permanent, or biochemical contraception, which usually lasts for one breeding season. (Chemical sterilization caused by injecting a caustic chemical into gonads and rendering animals permanently infertile is not considered.) It is estimated that 800–1,000 bison would be wintering on the refuge at the time the record of decision was signed, and 36% (288–360) would be adult females.

Permanent sterilization of female bison would involve immobilization and performing an ovariectomy, which if performed in the first trimester of an animal's pregnancy would cause abortion. Consequently, they should not be performed any sooner than February or early March to avoid pregnant bison that are in their first or early in their second trimester (Roffe, pers. comm. 2004). Late-breeding females that were still in their first trimester of pregnancy would abort their fetuses after removal of the ovaries even when sterilizations were performed after February or March. Since Jackson bison have high levels of brucellosis, this could increase transmission among elk and bison. If these operations were conducted on the refuge feedlines, a maximum of 8 operations per day could be performed or up to an estimated 440 operations per season (assuming a 55-day season).

In Grand Teton National Park bison tend to congregate on the east side of the park. If animals were not next to a road, teams would have to hike within darting range (35–75 yards). Animals that have never been darted before would be easier to approach than animals that have been previously captured. Bison are potentially dangerous when stalked too closely, and extra care must be taken when working on an animal while surrounded by other bison. For the purpose of this analysis, 5 bison per day could be surgically sterilized, or up to an estimated maximum of 420 bison per season (assuming an 84-day season; Roffe, pers. comm. 2004).

Using biochemical contraception, such as porcine zona pellucida (PZP), gonadatropin releasing hormone (GnRH), or leuprolide, on the refuge feedlines would make it relatively easy to find and dart animals, compared to other seasons when they are free-ranging. Each animal would have to be handled, either to tag it with a "Do Not Consume" tag (if PZP or GnRH was used because neither of these chemicals has been approved by the Food and Drug Administration for human consumption) or to hand inject the contraceptive (if GnRH or leuprolide was used). A maximum of about 16 bison per day could be treated if each animal had to be handled (Roffe, pers. comm. 2004). The risk of causing abortions on the feedlines and the potential for increasing transmission of brucellosis would be an important consideration because many bison would be pregnant during the feeding period. PZP is the only biochemical contraceptive that has been shown to be safe during all stages of pregnancy (L. A. Miller, pers. comm. 2004; Kirkpatrick, pers. comm. 2002). Conversely, leuprolide causes abortion when administered to animals during any stage of pregnancy (Wild, pers. comm. 2003) and would likely not be used in the winter or spring on the refuge. GnRH is safe in the later stages of pregnancy but could not be used early in the winter feeding season (Rhyan, pers. comm. 2003).

If biochemical contraception was administered in Grand Teton National Park, 8 bison per day could be treated (Roffe, pers. comm. 2004). If delivery occurred in July, August, September, and October, PZP and GnRH would likely not cause abortions in bison while cattle are grazing in the park. However, if leuprolide was used, late-breeding females could abort, increasing the potential for transmission of brucellosis to cattle.

Unlike treatment with GnRh or leuprolide, which require a single injection, animals receiving PZP treatment for the first time would need a booster shot after about 30 days. In addition, ungulates contracepted with PZP have experienced repeated estrous cycling beyond the normal breeding season (Heilmann et al. 1998; L. A. Miller, Johns, and Killian 2000b). Biologists would need to determine if this is an acceptable behavioral side effect.

The quickest way to bring down numbers would be to prevent pregnancy in all adult females for at least the first few years. This would have the added benefit of potentially reducing the spread of brucellosis among bison or to cattle grazing in the park. However, permanent surgical sterilization of all females would mean that the herd would eventually become extinct, so biologists would have to determine the exact percentage that could be surgically sterilized and still maintain genetic viability. In the absence of hunting on the refuge, it would take longer than 10 years to reduce the herd to 450–500 animals if fewer than 100% of the female bison were surgically sterilized or biochemically contracepted. If biochemical contraception was used, after reducing the herd to approximately 450–500 animals, treatment could be stopped and natural forces could be allowed to regulate bison numbers in the future. Changes in the population would be closely monitored, and adaptive management would identify when fertility control would be discontinued and points at which the feeding program would be phased back.

Some bison would likely travel south and onto private lands in and near the town of Jackson. Hunting on the northern end of the refuge would encourage movement south as well. Removals of individual animals on private land by WGFD personnel could increase as a result.

Based strictly on environmental conditions, results of a forage availability model (Hobbs et al. 2003) indicated that ungulates could winter best in the Gros Ventre River drainage and south of the town of Jackson in the Snake River Valley, particularly near Alpine and including lower portions of Hoback Canyon. Forage enhancements east of the refuge and the park could also attract ungulates. But private lands interspersed with national forest and elk feedgrounds in all these areas would impede bison colonization, and free-ranging bison would likely not be allowed. They would be hunted or removed by the state because of threats to public safety, property, or the health of domestic livestock (WGFC regulations, ch. 41 (2002) and 15 (2004)).

Negligible changes to distribution would occur due to the elimination of prescribed fire and the nutritious grasses that it creates on the refuge. No changes to the prescribed fire program in the park would be made under this alternative.

In addition, if attempts to acquire conservation easements were successful, these procurements would prevent further loss of habitat to development, providing bison with continuing sources of good habitat and promoting wider distribution.

As noted above, no bison herd size objective is built into this alternative, and the herd could be smaller than 250 or larger than 500. If it was on the small end of this range, distribution in the long term could remain similar to what it is now, and the entire herd could overwinter on the refuge and subsist on native forage. If the herd was larger, it is likely that numbers would still fall below current baseline conditions and would undoubtedly be smaller than under the long term under Alternative 1.

Areas of summer distribution would be expected to remain similar to areas currently used under baseline conditions because of the inclination bison have for traditional areas.

Bison Behavior, Social Interactions, and Nutrition

The effects of short-term fertility control on behavior and social interactions would vary depending on the timing of delivery, delivery method, and type of contraceptive, as previously discussed. If bison were darted and immobilized during winters when supplemental feeding on the refuge was taking place, they could be displaced from feedlines, and some animals could leave one feeding group and join another. Some bison could become agitated, expend energy running, or be involved in social interactions more frequently than usual. If bison responded in this way, the amount of time spent feeding would decrease and injuries, including goring, could increase. These short-duration, negligible to minor behavioral effects would be relatively uncommon if fertility control only occurred during feeding years. The presence of active feedgrounds would increase the likelihood that bison would remain nearby and would not move more than a short distance from the feeding area.

If bison were immobilized in the park during other seasons, behavioral effects would be of short duration and negligible to minor, similar to those described above. Temporary habitat loss would occur due to short-term disturbance. If some bison became agitated and ran from their group, they could run farther than they would on winter feedgrounds. During the rut the possibility of injuries and greater energetic expenditures would likely be similar to what would occur at winter feedgrounds, but some effects could increase. Rutting bulls in large breeding groups might interfere with immobilization activities or run after females that have been darted with immobilization drugs but had not yet become immobile.

Ballistic delivery, whether on the refuge during winter or in the park during other seasons, would also cause short-duration, negligible to minor behavioral effects, but not the same extent as immobilization. Darts would strike individual bison but no other handling would be required. Numbers of personnel for a limited time would be similar to those required for immobilization.

The various fertility control methods would affect bison behavior differently and for varying lengths of time. For example, surgical sterilization would alter breeding behavior in treated cows permanently, and reversible contraceptives would influence behavior for shorter time periods.

Permanently sterilized cow bison would not experience estrous cycles, but would behave normally otherwise. Rhyan and Drew (2002) state that in most herds there probably are individual animals that do not experience estrus because of health-related conditions, which would be similar to sterilized cows. Social interactions and energetic expenditures would decrease because bulls would ignore these anestrous cows during the breeding period, and the nutritional status of treated cows would be improved. Treated cows would be able to forage undisturbed by bulls during the breeding season. These effects would begin during the short term under Alternative 2 and would continue for the life of treated bison, unlike short-term, reversible contraceptives. Behavioral and nutritional effects during the breeding season would be similar in bison repeatedly treated with a contraceptive that inhibits estrus. Bison repeatedly treated would experience the short-duration effects associated with immobilization or ballistic delivery multiple times compared to surgically sterilized bison that would require one procedure.

The use of PZP vaccines would increase disturbance and alter behavior in several ways. Most formulations require one or more booster vaccinations to provide sterility for more than one year, and repeated deliveries would increase short-term disturbance. In addition, PZP vaccines in some species cause recycling (estrous cycles that continue to occur beyond the normal breeding period). If treated bison cows experienced repeated estrous cycles during the breeding period because they continued cycling but were infertile, the nutritional status of bison would be decreased for both treated cows and bulls. Treated cows would experience increased caloric expenditure and decreased feeding during early winter, as would bulls that continue to form breeding associations and exhibit rutting behavior in response to the presence of receptive cows. Declines in physical condition could affect winter survival of dominant bulls and treated cows. Although both bulls and treated cows in food-stressed populations could experience greater stress if the breeding period is prolonged, not becoming pregnant and not lactating could compensate females for increased stress (McShea et al. 1997).

GnRH vaccines, in contrast, do not cause repeated estrous cycles, and they contain a diluted, approved cattle vaccine as an adjuvant to boost immune response rather than Freund's Complete Adjuvant (FCA; a non-FDA approved adjuvant used with PZP). In recent studies, GnRH has produced sterility for one to two years with a single injection in female white-tailed deer (L. A. Miller et al. 1997), and preliminary results in bison are promising (Rhyan and Drew 2002). Treated females would require boosting each fall or every other fall to maintain high titers and infertility. The lack of estrous cycling and breeding behavior in treated cows would decrease social interactions and energetic expenditures, and improve nutritional status, similar to sterilization effects.

GnRH agonists contain synthetic compounds to make them more potent than GnRH alone. Leuprolide has been effective for one breeding season in captive elk (Baker et al. 2002). Delivery in this case was through subdermal implants, which would require immobilization. During trials in elk, rates of reproductive behavior were similar for treated and untreated females although the daily rate of sexual behavior decreased over time for untreated females. Sexual interest towards treated females was extended early in the breeding season compared to pregnant, untreated females, but recurrent estrous cycles and ovulation did not occur. If bison cows were treated with leuprolide, these extended interactions would increase energetic demands and nutritional status in treated females and breeding males to a limited extent. Because leuprolide may cause abortions, delivery must occur prior to the breeding season (Wild, pers. comm. 2003).

The gradual reduction of years of supplemental feeding on the refuge under Alternative 2 would confine feedline behavior and competitive social interactions associated with feedlines to feeding years (see Alternative 1 for more detail). Interactions common on feedlines would be much less prevalent during non-feeding years.

Overall, bison nutrition could begin to decline in the short term as numbers remained high and feeding stopped. As supplemental feeding was reduced to fewer winters, cultivated fields would be converted to native vegetation, and bison would have to rely on native vegetation. During severe winters nutritional status could be decreased, and moderate to major increases in mortality could occur compared to existing (unnatural) conditions. As bison dispersed, were hunted, or died of malnutrition and the herd decreased in size, nutrition levels would likely rebound.

Eventually, nutritional status of bison under Alternative 2 would mimic free-ranging, non-fed bison populations. Bison would be expected to exhibit behavioral and metabolic changes to survive winter stresses similar to those exhibited by deer and elk. Reduced activity levels and metabolic rates, as well as insulated winter coats, behavioral adaptations, and catabolism of body fat allow white-tailed deer to cope with the energetic costs of winter (Mautz 1978). Although some bison could die during above-average and severe winters because of decreased nutrition and body condition, at low numbers most should be able to maintain adequate nutritional levels on native forage. Although decreases in cultivation and loss of herbaceous forage on the refuge would contribute to lower nutritional levels, this could be partially mitigated by the greater long-term palatability of some native species (Brock, pers. comm. 2003) and habitat enhancements outside the refuge and park. Fall range on the refuge and in the park would also be more available to elk due to the elimination of hunting or elk reduction in those areas. If as a result elk foraged longer in the park and moved onto the refuge later, there could be more forage on the refuge for winter use by both bison and elk. Because fewer bison would be more widely dispersed, the use by bison of woody vegetation on the refuge would decrease in the long term.

Competition with elk for forage in transition habitat would continue, but decrease under Alternative 2. Displacement of elk would occur more rarely because of fewer bison and elk, and wider ungulate distribution on native range. This would also be true in winter habitat in below-average to average winters. During shortages of native forage in above-average winters, aggressive social interactions involving competition for food with other bison and with elk could increase.

Disease Prevalence and Transmission

Bovine Brucellosis

Prevalence in Herd — It has been shown that the proportion of a bison population infected with brucellosis increases as a relatively simple function of population density in a bison population that is not supplementally fed (Dobson and Meagher 1996), even in a population as small as 200 animals. Given 250 as a lower end estimate for this herd after feeding stopped, it is likely that brucellosis would still be maintained in the Jackson bison herd, although at reduced prevalence. Decreased animal density and elimination of supplemental feeding would result in a moderate, long-term decrease in brucellosis prevalence in the Jackson bison herd compared to Alternative 1.

Effects of Brucellosis on Herd Production

Brucellosis currently results in less than 10% loss of calves in the Jackson bison herd. Reduction in prevalence would also reduce the loss of calves, but since it would only affect the first birth of most females, overall effects on herd productivity would be negligible. If the percentage of female bison infected with brucellosis in their lifetime was reduced to 30% and the females produced 10 calves in their lifetimes, on average, the overall loss in calf production due to brucellosis would only be approximately 3.0% (see Figure 3-2).

Transmission among Bison — The lower density and lower prevalence of brucellosis would result in fewer abortions and less chance of contact with abortions that do occur. Although this would mean a major reduction in transmission of bison on the refuge, transmission would likely remain higher than levels that occur in Yellowstone National Park due to initially higher seroprevalence (Meyer and Meagher 1997).

Transmission from Elk to Bison — Although rates of transmission from elk to bison would not change in the short term, a major decline in transmission rates from elk to bison would eventually occur as populations declined and prevalence in elk dramatically decreased. In the absence of winter feeding, interspecies transmission between elk and bison would be low (Ferrari and Garrott 2002).

Bovine Tuberculosis and Paratuberculosis

Neither of these diseases is present in the bison herd. Both the risk of either spreading in the herd and the prevalence in the herd should it become infected are much lower than under Alternative 1. This is also true of the risk of spread from elk to bison. Overall Alternative 2 would have a relative major benefit in reducing risk, prevalence and transmission of both bovine tuberculosis and bovine paratuberculosis compared to Alternative 1. The reasons for these decreases in risk and in potential prevalence are the phasing out of the supplemental feeding program and associated densities, and the reduced number of both bison and elk. See the discussion for elk under Alternative 1 for “Disease Prevalence and Transmission” for more details.

Malignant Catarrhal Fever

The risk of contracting malignant catarrhal fever would be greatest under Alternative 2 (along with Alternative 3, and Alternative 6 to a lesser degree) because of possible migration out of Jackson Hole to other wintering areas. For greater detail, see the elk section under "Disease Prevalence and Transmission," Alternative 1.

If malignant catarrhal fever became established, the relatively low levels of bison and elk density would likely keep the spread minimized, and the potential for impacts would be lowest under Alternative 2 (along with Alternative 6) compared to all other alternatives.

Calving, Age and Sex Ratios, and Recruitment

Hunting on Bridger-Teton National Forest lands could affect herd composition. In order to maintain an approximately equal sex ratio, which would be typical of unmanaged herds, harvest would need to remove approximately equal numbers of both sexes. In the short term, more females would be targeted (Brimeyer, pers. comm. 2004) to reduce herd growth. In the long term, this could switch to bulls, which are generally preferred by hunters. Because hunting ratios would be dependent on which bison left the safety of the refuge and park, harvest might not be able to maintain specific bull-to-cow ratios.

Gradual increases in calf winter mortality and the use of fertility control during the short term would lower the proportion of calves in the herd compared to baseline conditions and Alternative 1. Although more older bison would also succumb to winter mortality, calves would likely be the most vulnerable. Ratios would reflect fewer calves and a greater proportion of bison older than 1 year. Decreases in the number of calves would depend on success in delivering the contraceptive and on the length of the fertility control period in the case of short-term contraceptives. Male to female ratios would likely remain similar to those under baseline conditions and what would occur under Alternative 1.

Various forms of fertility control would also alter breeding ratios. If some females were permanently sterilized, they would not experience estrus and would be unavailable for breeding. Bulls would ignore them during the breeding period. With some forms of short-term contraception, treated females would experience estrous cycles and engage in breeding activities but would not become pregnant. They would attract the interest of males for longer periods of time than would untreated cows that might become pregnant early in the breeding season.

More bison could be removed annually by WGFD personnel due to impacts on private property, compared to Alternative 1, because the refuge feedground would no longer restrict the winter distribution of most of the bison herd. Although increases in agency removals could taper as the herd became smaller, the percentage affected in the population could remain static.

Mortality rates would increase, especially in older bison and calves. Calf production and recruitment would both likely be lower in the long term compared to Alternative 1, as bison calves would experience greater mortality and a higher number of adult females would be in poorer condition and would not bear calves. Reductions in brucellosis and abortions would result in a minor to moderate decrease in calf losses in the long term, but this would constitute only a negligible positive contribution to calf production in the herd in the long term.

If bovine tuberculosis or paratuberculosis infected the population, production and recruitment could be reduced if reproductive age bison died, as well as calves themselves. Bovine tuberculosis and paratuberculosis could also affect age ratios because they tend to kill older animals. Because densities, and hence prevalence, would be significantly lower under Alternative 1, the potential number of clinical cases and the overall effect on mortality rates and production losses would be lower. A major difference in production losses would be possible, although the effect on production in the herd would be low.

Mortality

Bison mortality unrelated to harvest would gradually increase under Alternative 2 as supplemental feeding and cultivation of standing forage were reduced and greater reliance on natural forage occurred. Because winter feeding would first be eliminated in mild winters and then in progressively severe winters, initially there would be little change from baseline mortality levels. Bison would gradually be more affected by natural processes and mortality would reflect winter severity, ranging from low during mild winters to high during severe winters. Habitat enhancement outside the refuge could decrease winter mortality to some extent.

The WGFD hunt program would be unchanged from the program under baseline conditions and Alternative 1. Harvest would continue in Bridger-Teton National Forest east of the refuge and the park, its success dependent on fall bison distribution and the number of bison that leave safe areas. Because high numbers of bison would exist initially and distribution could increase as bison increasingly depend on native vegetation in more years, harvest could increase in the short term. However, if the bison herd becomes smaller during the short term and/or fall distribution does not increase substantially, annual harvest in the national forest would likely remain low, similar to harvest levels under baseline conditions. These bison movements could also increase the number of bison deaths from vehicle collisions.

Predation on bison would likely increase negligibly. Although the species is large-bodied, able to defend young, and less vulnerable than other prey, predators would kill more bison under Alternative 2 because total dependence on natural forage in above-average and severe winters would lower physical condition in some animals, making them easier prey. This increase would likely be compensatory because some vulnerable bison would otherwise succumb to winter mortality. Calves, cows, and older bison would continue to be the most vulnerable to predation.

The increase in mortality from reduced body condition would be lowered somewhat by a reduction in prevalence of brucellosis and the potential for new infectious disease to spread. As noted above, potential mortality from bovine tuberculosis or bovine paratuberculosis would be lower under Alternative 2 by a moderate to major amount compared to Alternative 1 because prevalence and thus, number of clinical cases would be lower by a major amount.

Health, Sustainability, and Naturalness

The health and sustainability of the Jackson bison herd would increase gradually as supplemental feeding was progressively reduced to fewer years and there was greater reliance on natural forage. Lower bison numbers and concentrations in the short term would result in lower disease prevalence and transmission of current diseases such as brucellosis, as well as of any non-endemic infectious disease. Alternative 2 would lower the risk of future population declines or depopulation events from bovine tuberculosis, for example, or other non-endemic disease. Effects of hunting on health and sustainability would continue to be negligible, and they might be reduced in the long term if herd size decreased significantly. Fertility control would diminish naturalness temporarily in terms of population processes, but its use would be short term. Fertility control would be discontinued when the size of the population better matched the available forage, which would enhance naturalness in terms of population size and habitat conditions, or when the bison herd size approached 400, whichever occurred first. Health and sustainability under Alternative 2 would be greater than what would occur under all other alternatives, except Alternative 6.

Barring the introduction of a serious non-endemic disease or very high mortality, the herd would continue to be genetically viable. If severe weather conditions occurred in consecutive years, high mortality, resulting in a small herd size, could threaten genetic viability. A herd of 500 bison or more would be genetically viable and "self-sustaining." But without human intervention, genetic viability could be threatened if the herd dropped below 400 animals and effective population size decreased below 100 (Berger 1996). If the herd fell below 400, the periodic introduction of females from genetically unrelated herds would be required. This occurred when nine bison moved from Yellowstone National Park to Jackson Hole in 1996–97, but similar movements might not recur. Herds without cattle genes and with high genetic variability would be candidates for donors to the Jackson herd should the need arise for managers to accomplish introductions.

The bison herd would be more natural because it would rely on native forage and be more subject to environmental factors. Bison numbers, recruitment rates, and age and sex ratios would also be more natural without supplemental feeding. As in unfed populations, climate and the abundance of native forage would have a much greater influence on movements and distribution. As the size of the herd decreased, bison numbers would be closer to the low number of bison that probably inhabited the valley prior to Euro-American settlement. Fewer human-related deaths (such as traffic collisions) would occur once bison numbers reached a lower level.

Bison behavior would also become more natural. Competitive social interactions and displacement of elk and other bison from feedlines would decrease as densities declined.

Of all alternatives, Alternative 2 (and Alternative 6) would result in the highest level of naturalness in the bison herd, although some aspects of naturalness (e.g. short term use of fertility control, potential introductions to address genetic concerns, and resultant changes in calf production and age ratios) would temporarily be lower under Alternative 2 than under other alternatives.

Conclusion

In the long term under Alternative 2, there would be an estimated 250–500 bison in the Jackson herd, which would be lower than Alternatives 1 and 2, and similar to or below Alternatives 4, 5 and 6. After supplemental feeding and forage production on the refuge were phased out, and after fertility control ended, bison would disperse onto native range and become more subject to climate, predation, and the abundance of forage. Nutritional status would fluctuate with winter severity, precipitation and available forage, and mortality would increase during more severe winters in particular. Although annual survival, recruitment, and sex and age ratios would be more natural and reflective of non-fed populations, they would vary from Alternative 1. Recruitment and annual survival would decrease compared to Alternative 1. Although genetic viability could be threatened if the bison herd decreased below 400 animals, periodic introduction of unrelated bison would be used to counter this threat to herd health.

The risk of a non-endemic infectious disease quickly spreading through the herd, and associated major adverse impacts, would be the lowest (along with Alternative 6) of any alternative. The prevalence of brucellosis in the bison herd would be moderately lower than under Alternative 1.

Contraception in the short term under Alternative 2 would cause temporary impacts on population numbers and ratios. During years fertility control was undertaken, the proportion of calves in the Jackson bison herd would be reduced, and older animals would constitute most of the herd. If surgical sterilization were performed, effects would continue for the lifespans of treated animals, possibly for several years into the long term. The effects of reversible contraceptives would be temporary, and age distributions would return to pre-contraception levels after several years.

Alternative 2 (along with Alternative 6) would result in higher levels of long-term health, sustainability, and naturalness in the bison herd than what would occur under Alternatives 3–5.

No impairment to park bison would occur under Alternative 2. If the park population dropped below that needed to sustain genetic viability, bison from other areas would be screened and imported to increase the size and genetic variability of the herd.

ALTERNATIVE 3

Analysis

This alternative would actively manage elk and bison to keep numbers at designated levels (1,000–2,000 elk, 800–1,000 bison) by minimizing supplemental feeding, using habitat improvement, and changing hunting regimes to encourage elk and bison to disperse. Feeding would be reduced over time so that, by year 10–15, imported feed would be used only in the most severe winters. Vaccination for brucellosis would occur if a safe vaccine with more than 50% effectiveness was developed.

Bison Numbers

The bison population objective under Alternative 3 would be the number in the herd at the signing of the record of decision. This number is expected to be between 800 and 1,000 if herd growth continues at 10%–14% (including losses from hunt mortality). Initiating bison hunting on the refuge would sustain bison numbers at the objective. The herd would be smaller than under Alternative 1 but larger than under the other alternatives.

Distribution and Movements of Bison

As in Alternative 2, winter feeding would be decreased over a 15-year period, and distribution during feeding years would remain similar to baseline conditions. As reliance on standing forage in non-feeding years increased and feeding occurred in an estimate 2 of 10 winters on average, bison movements and distribution would similarly increase.

Irrigation and cultivation of standing forage on the refuge could continue as it is now under Option A of this alternative, or be phased out and converted to native range under Option B. Under Option A, bison movements to the refuge during the winter would continue, although at lower numbers than under Alternative 1. Fewer bison might move to the refuge under Option B without the attraction of cultivated fields. Under either option bison would also range to areas outside the refuge where habitat enhancements would occur, including Buffalo Valley and forest lands east of the park. The Gros Ventre River drainage could also draw bison. Prescribed fires on the refuge, as well as in the park, would continue to enhance forage and habitat and attract bison to treated areas, as under baseline conditions and Alternative 1. If attempts to acquire conservation easements were successful, these procurements would prevent further loss of habitat to development, providing bison with continuing sources of good habitat and promoting wider distribution.

As in Alternative 2, bison might also use areas along the Refuge Road and wander into the town of Jackson, resulting in the increased potential for WGFD removals from private land.

Alternative 3 includes the initiation of a bison hunt on the refuge. This change could temporarily alter distribution in the fall as bison move away from the hunt areas to safe, non-hunt areas on the refuge, in the park, or in Bridger-Teton National Forest during the hunting season. Bison could increase use of the southern part of the park (Antelope Flats, the Kelly hayfields, and Blacktail Butte) during this period and the northern fifth of the refuge because these areas would be closed to hunting under this alternative.

If safe brucellosis vaccines were developed with a minimum efficacy of 50% for both bison and elk, vaccine delivery would take place during winter supplemental feeding on the refuge. Individual animals would need to be immobilized unless biobullet use on bison became viable by the time an appropriate vaccine was available. Darting and immobilization or delivery of a biobullet using airguns on refuge feedgrounds would likely cause bison to move a short distance and return to the feeding area, either after a short calming period or after vaccination activities end for the day.

Delivery of an effective oral vaccine in food during non-feeding years, if such a vaccine was developed and used, could temporarily change distribution.

Bison Behavior, Social Interactions, and Nutrition

Changes in feeding and forage, hunting and to a lesser degree, vaccination if it occurred, could influence behavior, social interactions and nutrition.

Competition for food on the refuge would shift from that during supplemental feeding seen now, to competition for available cultivated and native forage. Competition for standing forage would be particularly high during non-feeding years in the short term, before bison and elk numbers drop. Over time bison social interactions and displacements of elk and other bison would decrease due to lower elk numbers and densities and wider ungulate distribution on native range. During years with supplemental feeding (estimated as 2 years of 10), social interactions would be similar to baseline conditions. After the morning feeding period, when bison and elk would disperse short distances to feed on nearby vegetation, more interactions and displacements would occur in localized areas than would occur in non-feeding years.

Bison hunting on the refuge could also temporarily affect bison behavior and nutrition, as bison would be agitated and nervous, and expend additional energy avoiding hunters.

Bison could temporarily experience increased nervousness and excitability or increased ener getic expenditures from running or aggressive social interactions from short-term vaccination activities.

Delivery of an effective oral vaccine in food during non-feeding years, if such a vaccine was developed and used, could temporarily change distribution and behavior as compared to a normal non-feeding situation. Changes in bison distribution and densities at vaccine delivery sites might cause short-duration, localized increases in aggressive social interactions. If an oral vaccine was delivered during winter supplemental feeding, distribution and movements would remain similar to baseline conditions and Alternative 1. Additional analysis under the National Environmental Policy Act might be needed prior to implementation of oral vaccine delivery.

The nutritional status of bison would be lower in some years as supplemental feeding was reduced, although not as much as under Alternative 2 because feeding would continue in severe winters. Bison would be managed so that numbers would approximate existing baseline levels, but the number of elk would be dramatically reduced. In addition, irrigation and cultivation on the refuge could continue (Option A) and habitat outside the park in the adjacent Bridger-Teton National Forest would be improved. The northern fifth of the refuge would be closed to elk hunting, which would further disperse elk away from lands grazed by bison on the refuge. Bison would be more likely to stay longer in these transition areas, which would preserve larger amounts of forage on the refuge for winter use. During milder years, some bison would likely winter there if forage remained accessible.

Total amounts of herbaceous forage under Option B would be similar to those described under impacts of Alternative 2 (an estimated 12% less than under baseline conditions and an estimated 10% lower than under Alternative 1 in the long term). Although herbaceous forage would be reduced, conversion to native species (particularly bunch grasses which hold nutrients in plant parts longer than some cultivated species) would at least partially offset reduced productivity (Brock, pers. comm. 2003). During winters with above-average snow, to the extent that snow depths make the vegetation inaccessible to bison, nutrition and body condition could decrease.

Bison use of woody vegetation would decline under Alternative 3 compared to use under Alternative 1 and baseline conditions, although not as much as under Alternatives 2 and 6. The high concentrations of bison that have been attracted to and maintained near feedgrounds would be reduced as supplemental feeding on the refuge occurs in fewer years. Use would increase during some above-average winters when forage was more difficult to access because of snow and would partially offset decreases in use due to wider distribution.

Disease Prevalence and Transmission

Bovine Brucellosis

Prevalence in Herd — Reduced animal densities on the refuge due to fewer feeding years and habitat enhancements outside the refuge and park would have minor to moderate beneficial impacts on brucellosis seroprevalence, even in the absence of vaccination.

Modeling efforts by Gross, Miller, and Kreeger (1998) and Dobson and Meagher (1996) suggested that approximately 50%–60% of bison in a population would have to be successfully vaccinated in order to eliminate brucellosis in the long term. If a vaccine was only 50% effective, modeling of the Jackson bison herd by Peterson, Grant, and Davis (1991b) indicated that delivery to 95% of bison calves would lower seroprevalence by approximately 50% over 20 years, a moderate decrease. Vaccine efficacy of 50% or greater was designated as the desired level because this level might be attainable and could have some significant impact on prevalence. Biobullet or oral delivery would be required to achieve this kind of vaccination success.

Transmission among Bison — Bison maintain brucellosis at relatively high rates under free-ranging, non-fed conditions (Dobson and Meagher 1996). Transmission rates under this alternative would be lower than under Alternative 1 due to wider dispersal in most years and a reduced prevalence rate. During the most severe winters, when feeding would occur, potential for transmission would be higher than in non-feeding years. Overall, the transmission rate among bison without vaccination would be reduced by a negligible to minor amount under Alternative 3 in the long term. With vaccination, transmission rates might be reduced by a moderate amount.

Transmission from Elk to Bison — In the absence of winter feeding, transmission between elk and bison is low (Ferrari and Garrott 2002) because behavioral differences normally keep the two species separate. As a result, the risk of potential transmission from elk to bison would result in moderate to major reductions under this alternative.

Bovine Tuberculosis and Paratuberculosis

Bovine tuberculosis and paratuberculosis are not present in the Jackson bison herd. The relative risk among the alternatives that either of these diseases would become established would be low under Alternative 3 because of the reduction of winter feeding to severe winters only. If either were to infect the bison herd, prevalence would be moderately lower under Alternative 3 compared to Alternative 1 because of lower numbers and reduced winter feeding. Transmission rate would also be lower by a minor to moderate amount than if it were to infect the herd under Alternative 1. Transmission potential from elk to bison would be lower by a moderate to major amount because of these same factors and the significantly fewer elk on the refuge.

Malignant Catarrhal Fever

The risk of introducing malignant catarrhal fever would be higher in this alternative than most others (except Alternative 2) because dispersion would be encouraged, but the risk of it spreading or having major adverse impacts would be lower than Alternative 1 and similar to Alternatives 4 and 5 because of similar winter feeding scenarios and bison/elk densities.

The panel of wildlife disease experts did not believe enough information existed to determine the more subtle differences in impacts of malignant catarrhal fever under Alternatives 3, 4, and 5 (Disease Expert Meeting 2002). Although more bison would exist under Alternative 3 than under Alternatives 4 and 5, feeding under Alternative 3 would occur in only 2 out of 10 years. Alternatives 4 and 5 would have fewer bison but also would have more winter feeding, which would maintain higher densities, and stresses, while bison were being fed. Overall, the potential for impacts under Alternative 3 would be similar to Alternatives 4 and 5, but greater than under Alternatives 2 and 6, and less than under Alternative 1.

Calving, Age and Sex Ratios, and Recruitment

Although hunting has the potential to affect sex and age ratios, WGFD personnel would issue hunting licenses in proportions that would maintain a bull-to-cow ratio of 1:1 and natural age ratios. By doing so, effective population size and genetic variability would be maximized.

Continuing to feed bison in severe winters would result in a higher survival rate in calves than in unfed populations, although calf mortality would increase beyond what it is under baseline conditions. Reductions in abortions due to brucellosis, hunter harvest, and increased winter mortality could affect bison recruitment. Overall, no substantial change in recruitment rates from those under baseline conditions would occur. This would be true even if a vaccination program was implemented, as increased recruitment that would otherwise be lost due to brucellosis-related abortion would be small.

There are no impacts at present from bovine tuberculosis or bovine paratuberculosis. If these diseases became established in Jackson Hole, they would affect production and recruitment through increased mortality and lowering the number of animals that produce calves. These diseases could also affect age ratios because they would increase mortality in older animals particularly.

The potential number of clinical cases of bovine tuberculosis and paratuberculosis and losses in recruitment would be lower by a moderate amount under Alternative 3 due to lower prevalence, but this would constitute only a negligible increase in production and recruitment In the entire herd compared to Alternative 1.

Mortality

Increasing reliance on native forage and hunter harvest would increase mortality under Alternative 3 compared to Alternative 1.

Because supplemental feeding would only occur in severe winters, non-harvest mortality would be greater than the 5% per year under baseline conditions and Alternative 1, but would likely remain relatively low. Habitat enhancements outside the park and the refuge could reduce some of the potential increases in mortality due to lowered nutritional status. If Option A was selected, cultivating standing forage on the refuge would help mitigate the reduced frequency of winter feeding and related mortality. If Option B was selected and the refuge was returned to native forage, additional mortality could result. It is also possible that increased distribution of remaining elk onto the northern fifth of the refuge and in areas of the park closed to elk reduction might result in additional forage being available to bison, somewhat mitigating the effect on nutrition-related mortality rate increases.

Mortality due to vehicle collisions would be expected to increase from baseline conditions but would likely remain lower than under Alternative 1 because the bison herd would not continue to grow. Management removals would increase if more bison attempted to use areas outside the park and the refuge.

Predation on bison would increase negligibly in some years. Reliance on standing forage in above-average winters would lower physical condition in some animals, making them easier prey. This increase would likely be compensatory because some vulnerable bison would otherwise succumb to winter mortality. Calves, cows, and older bison would continue to be most vulnerable to predation.

A bison harvest on the refuge on the same lands open to elk hunting would be part of this alternative. In combination with harvest from Bridger-Teton National Forest, harvest of approximately 13% would be required to maintain bison at the target of between 800 and 1,000 animals, assuming bulls and cows would be harvested at even rates. This would be a major increase over current conditions (5%–7% harvest mortality) and could be larger than the harvest percentage under Alternative 1 (however, the degree of movement onto forest lands and hence vulnerability to harvest when the herd approached 2,000 animals under Alternative 1 is unknown). An assumption for analysis is that 50 bison would be harvested annually in the national forest and the balance would be harvested on the refuge.

Disease-related mortality, including abortions from brucellosis, and the relative potential for deaths from other diseases would be less than under Alternative 1 because of reduced potential for spread and reduced prevalence related to lower densities and numbers.

Health, Sustainability, and Naturalness

The health and sustainability of the Jackson bison herd would increase gradually as there was greater reliance on standing forage and wider ungulate distribution. This would improve both the genetic make-up of the herd, and reduce the chance of major adverse impacts from the spread of disease. The prevalence of brucellosis would fall without vaccination, but would decrease even further if a safe and effective vaccine were applied. Effects would be similar but more limited than what would occur under Alternative 2.

Barring the introduction of serious, non-endemic disease or extreme decreases in population size, the bison herd would continue to be self-sustainable and maintain genetic viability at a herd size of 800–1,000 animals. Higher mortality could occur in above-average winters, which would be exacerbated in some years by pre-winter drought. Overwinter mortality of the less fit might be expected to increase the frequency of beneficial genotypes and improve herd health (Mills, pers. comm. 2003), although to a lesser degree than under Alternative 2.

The long-term health and sustainability of the bison herd would be lower than under Alternatives 2 and 6 and higher than under Alternatives 1, 4, and 5.

Naturalness would also increase as bison increasingly distribute themselves according to available forage, and environmental factors, such as winter weather and predators, would have an increasingly stronger influence on mortality. Mortality would increase in some years and more closely approximate mortality in non-fed herds. The size of the herd would be larger than, but closer to, the number that likely inhabited the valley prior to Euro-American settlement than under Alternative 1.

Naturalness would increase in terms of population processes although to a lesser extent than under

Alternatives 2 and 6. Production and recruitment rates would be more natural and calves born outside of the normal birthing season would be less likely to survive. Winter mortality rates would be closer to unfed populations, and would differ among age and sex classes in a more natural way. Bison would distribute themselves more naturally, expend more energy accessing winter forage, and maintain a more natural nutritional status.

Bison behavior would also become more natural. Competitive social interactions and displacement of elk and other bison from feedlines would decrease.

Harvest would have a minimal influence on the sex ratio because the bison population would be maintained at approximately 1:1 ratio of bulls to cows, typical of native, non-hunted herds.

Alternative 3 would result in a higher level of naturalness in the bison herd than would Alternatives 1, 4, and 5. Naturalness would be less than under Alternatives 2 and 6 mainly because of the continuation of winter feeding in some years.

Conclusion

In the long term under Alternative 3, there would be 800–1,000 bison in the Jackson herd. Numbers would be maintained at baseline levels and would be lower than in the long term under Alternative 1. Numbers would be higher than under Alternatives 2 through 6.

The bison herd would increase its movements and distribution due to reductions in years of supplemental feeding to approximately 2 years of 10 (roughly how often severe winters would occur). Increased winter mortality would result. The herd would be more responsive to natural conditions and the extent to which nutritional status reflects winter severity, precipitation regimes, and available forage would increase. Recruitment and annual survival could decrease to some extent compared to Alternative 1, although less than under Alternative 2. The sex ratio would remain near 1:1, and calf production and recruitment would be similar to levels found in non-fed populations in similar environments. Genetic viability would be sustained in a herd of 800–1,000 bison.

Reductions in density for both bison and elk, and in numbers of elk would lower the risk of quick spread and major impacts from disease in the bison population.

A minor to moderate decrease in brucellosis prevalence in the bison herd related to increased dispersion and reductions in the frequency of supplemental feeding would occur. Vaccination with an effective vaccine to a large portion of bison calves each year could result in moderate reductions. This would only be possible with biobullet or oral vaccines.

Alternative 3 would result in levels of long-term health, sustainability and naturalness in the bison herd that would be lower than under Alternatives 2 and 6 and higher than Alternatives 1, 4, and 5.

Barring the introduction of serious non-endemic disease, Alternative 3 would not impair the bison population in the park. Alternative 3 would have a lower potential for impairment than would Alternatives 1, 4, and 5, and a higher potential for impairment would Alternatives 2 and 6.

ALTERNATIVE 4

Analysis

Bison Numbers

Reductions in the frequency of supplemental feeding and a bison hunt on the refuge and in the park would reduce bison numbers to 450–500. Assuming implementation in 2006, the herd by then would number approximately 800 to 1,000 bison, and harvest in the first few years would exceed that in the long term. An average of 70 bison per year would need to be harvested to maintain the herd at 450–500 once this number was reached.

Distribution and Movements of Bison

During non-feeding years, movements and distribution could increase as bison attempted to find forage. Although bison would primarily use traditional areas, they would also range onto Bridger-Teton National Forest lands to a greater degree, particularly following habitat enhancements by partner agencies. They could also travel southward, along Refuge Road and near Jackson. Wider distribution within traditional areas would occur during non-feeding years even with fewer bison. In addition, if attempts to acquire conservation easements were successful, these procurements would provide additional habitat and promote wider distribution.

Increases in distribution would likely be less than under Alternatives 2, 3 and 6. It is unlikely that the bison population would expand into the Gros Ventre River drainage.

Bison hunting would be initiated on lands open to elk hunting on the refuge, but would continue to be prohibited in the park. Limited tribal reductions would also be allowed. Movements and distribution could then change as bison move away to safe, non-hunt areas in the refuge and park from October through December. If they moved to private lands, WGFD personnel could exercise their prerogative to haze or destroy animals because of safety or damage concerns (WGFC regulations, ch. 41 (2002) and 15 (2004)).

Cultivated fields on the refuge would continue to attract bison and the greater amounts of forage produced by enhanced irrigation and farming techniques would likely increase time spent by bison in those areas compared to baseline levels and Alternative 1. Prescribed fires on the refuge and in the park would also continue to enhance forage and habitat and would attract bison to treated areas, as under baseline conditions and Alternative 1.

Three exclosures, protecting approximately 1,000 acres of willow habitat in poor condition, 100 acres of remnant cottonwood communities along upper Flat Creek, and 1,000 acres of aspen habitat, would prevent access to approximately 9% of available acreage on the refuge. Monitoring and adaptive management might indicate that these exclosures should be removed at some time.

The shape of the aspen exclosure, wider east to west than north to south, could temporarily affect north-south bison movements (Cole, pers. comm. 2003).

If a brucellosis vaccine with a minimum efficacy of 50% for bison were found during the short term, short-duration negligible to minor changes in movements and distribution would be similar to those described under Alternative 3 in "Distribution and Movements of Bison."

Bison Behavior, Social Interactions, and Nutrition

Competition for standing forage in non-feeding years would increase during the initial years of this alternative when bison and elk numbers would be similar to baseline numbers. Amounts of available herbaceous vegetation produced on the refuge would be negligibly (an estimated 4%) lower than under baseline conditions and the initial stages of Alternative 1 because of the exclosures. Over time, wider elk and bison distribution could decrease forage competition. Aggressive social interactions and displacements associated with supplemental feeding would decrease in the long term as the frequency of feeding declines.

In the long term, nutritional status could be lower in some years than under baseline conditions and Alternative 1, although the decrease would have negligible adverse effects for the most part. In years when supplemental feeding occurred (during severe and above-average winters), nutritional status could be similar to baseline conditions and Alternative 1. Although exclosures would decrease the amount of herbaceous forage available to the herd, the amount per bison would increase in the long term because of lower numbers of both elk and bison, and because irrigation changes would help double cultivated forage in all years.

Changes in hunting practices would also cause short-duration adverse effects on bison behavior and possibly on nutrition. Implementing a refuge hunt could cause agitation, nervousness and energetic expenditures from avoiding hunters. Bison are not currently hunted on the refuge or in the park; the prohibition on bison hunting would continue in the park. However, bison would be hunted in all areas of the refuge open to elk hunting. Because bison hunting is also allowed in the Bridger-Teton National Forest adjoining the refuge, impacts on bison behavior and nutrition could continue as animals leaving the refuge to avoid hunters would continue to be susceptible to hunting on these lands.

If bison were vaccinated (a safe and effective vaccine must first be developed), some negligible impacts of airgun delivery to bison behavior, such as increased nervousness, excitability and aggressiveness, could occur. Oral vaccines (in feed) would not impact bison during feeding years, but could alter behavior as well as distribution and movements for short periods of time during non-feeding years. Additional analysis under the National Environmental Policy Act might be needed prior to implementation of a vaccination program.

Disease Prevalence and Transmission

Bovine Brucellosis

Prevalence in Herd — In the long term, as the frequency of winter feeding and bison numbers were reduced on the refuge, bison would experience a negligible decrease in the prevalence of brucellosis. The decrease would not be as great as in Alternative 3, because although numbers would be lower, winter feeding would be more frequent. If a vaccine that was at least 50% effective for bison was delivered to a high proportion of susceptible calves (95%) on the refuge each year, an additional moderate reduction in seroprevalence would be possible.

Transmission among Bison — As noted in Alternative 3, transmission rates would likely only decline by a negligible amount without vaccination based on high prevalence numbers for free-ranging herds and the gregarious nature of bison. Transmission would remain high during feeding years, and would drop during non-feeding years as the chances of encountering an aborted fetus or birth site would decrease if bison were more dispersed. Vaccination would further reduce abortions and transmission rates by a minor to moderate amount.

Transmission from Elk to Bison — The reduction in the frequency of feeding, as well as numbers of both elk and bison would result in a minor to moderate decrease in the risk of transmission from elk to bison. This would be true with or without vaccination.

Bovine Tuberculosis and Paratuberculosis

Both the risk of contracting either of these diseases, and the degree of impact to the herd should it become infected would be midrange in the alternatives. Because the frequency of feeding would be more important in determining risk of transmission, Alternative 4 would have greater potential for contracting these diseases and similar potential for impact should either become established as described above for Alternative 3.

Malignant Catarrhal Fever

Because feeding regimes and fewer numbers of elk and bison would likely keep bison on the refuge for the most part during the winter, the risk of contracting malignant catarrhal fever would be low, and less than under Alternatives 1, 2, 3, and 6.

The panel of wildlife disease experts did not believe enough information existed to differentiate potential impacts between Alternatives 3–5 (Disease Expert Meeting 2002) if the disease were to become established. Therefore, the potential for adverse impacts under Alternative 4 would be similar to 3 and 5, greater than under Alternatives 2 and 6, and less than under Alternative 1.

Calving, Age and Sex Ratios, and Recruitment

Some negligible increase in mortality not related to hunting would occur under Alternative 4, and would primarily affect older bison and calves, or prime bulls entering the winter energetically stressed from rut activities.

Bison hunting on the refuge would maintain a bull-to-cow ratio of 1:1 and natural age ratios. By doing so, effective population size and genetic variability would be maximized.

Feeding bison in above-average and severe winters would result in a higher survival rate in calves than in unfed populations, although calf mortality would increase beyond what it is under baseline conditions. Reductions in abortions from brucellosis would also increase recruitment by a minor amount for this segment of the herd. Hunter harvest and increased mortality related to fewer feeding years could diminish effects from increases in calf recruitment related to lower brucellosis prevalence, but it is also possible that overall, no substantial change in recruitment rates from those under baseline conditions would occur. This is true even if vaccination was implemented, as increased recruitment in the segment of the herd that would otherwise be lost due to brucellosis-related abortion would be small.

If bovine tuberculosis or paratuberculosis infected the population, increases in mortality would affect both adults and calves. Because productive adults would die, production rates would also decrease.

Mortality

Continued supplemental feeding in more severe winters, increases in cultivated forage on the refuge, and agency efforts to enhance habitat east of the refuge and park would likely keep increased mortality unrelated to hunting low, although it would increase by a negligible amount over baseline conditions. Some small increase in predation related to poorer body condition related to increased reliance on native forage could also occur. Agency removals related to bison dispersing onto private land would likely increase initially in some years compared to baseline conditions until herd reductions have brought the population closer to objective. Because the bison herd would grow indefinitely under Alternative 1, and agency removals would likely occur more frequently, Alternative 4 could have lower non-harvest mortality than under the no-action scenario in the long term.

Harvests, particularly in the short term, would increase dramatically over baseline and no-action conditions. Currently, 40–50 bison are harvested each year from Bridger-Teton National Forest and private lands. This would need to be increased to 140–150 bison per year to achieve the target number of 450–500 bison within 10–15 years. This would be a 300% increase, and a major short-term increase in mortality. Harvest would be maintained in the long term at about 55–85 bison per year once the population objective was reached. This harvest would be about 30% higher than under baseline conditions, representing a moderate increase.

Disease-related mortality would drop. Brucellosis-related abortions would drop as prevalence dropped, and would further decrease if a safe and effective vaccine was applied to a large proportion of female calves.

If bovine tuberculosis or bovine paratuberculosis infected the herd, potential increases in mortality would be moderately less than under the Alternatives 1 and 5 (and higher than other alternatives) because prevalence and the number of clinical cases would be moderately lower.

Health, Sustainability, and Naturalness

As in other alternatives that reduce the frequency of supplemental feeding, the health and sustainability of the Jackson bison herd would be increased gradually as a result of a greater reliance on standing forage, and wider ungulate distribution. Impacts from diseases in the herd or potentially infecting the herd would be reduced, and vaccination would reduce disease transmission and prevalence even further, if it occurred. Health and sustainability under Alternative 4 would be less than under Alternatives 2, 3, and 6, and greater than under Alternatives 1 and 5.

Naturalness would also increase as bison increasingly distribute themselves according to the distribution of available forage on native range and natural phenomena, such as winter weather and predators, would have a stronger influence on mortality in some years. Mortality and recruitment would be closer to those in non-fed herds. Bison would distribute themselves more naturally, expend more energy accessing winter forage, and maintain a more natural nutritional status. Sex and age ratios would be more natural, and sex ratios in particular would be maintained through a managed harvest to mimic unhunted, unfed herds. Bison behavior would also become more natural than under Alternatives 1 and 5, but less than Alternatives 2, 3, and 6. Competitive social interactions and displacement of elk and other bison would decrease because there would be fewer elk and bison, wider ungulate distribution, and lower densities. Although bison numbers of 450–500 could be higher than the number of bison that likely inhabited the valley prior to Euro-American settlement, it would be closer to what might have existed historically.

Conclusion

In the long term under Alternative 4 there would be 450–500 bison in the Jackson herd, lower than baseline conditions or Alternative 1. The bison herd would increase its movements, distribution, and reliance on native winter range in some years due to reductions in the frequency of winter feeding. Increased winter mortality could result, although these increases would likely be negligible. The herd would be more responsive to natural conditions and the extent to which nutritional status reflects winter severity, precipitation regimes, and available forage would increase. Recruitment and annual survival could decrease to some extent compared to Alternative 1, although less than under Alternatives 2, 3, and 6. The sex ratio would remain near 1:1, and calf recruitment would be more similar to levels found in non-fed populations in similar environments. Genetic viability would be sustained in a herd of 450–500 bison.

Reducing supplemental feeding and initiating a bison hunt on the refuge would reduce bison numbers, increase distribution, and reduce potential disease transmission. Habitat enhancement efforts outside the park and refuge would also encourage wider bison distribution. Amounts of standing forage on the refuge would be decreased by a negligible to minor degree because greater use of exclosures would offset increases in refuge forage production on cultivated fields.

No impairment of park bison would occur under Alternative 4.

ALTERNATIVE 5

Analysis

Bison Numbers

Bison numbers would gradually be reduced to 400 bison from the approximately 800–1,000 anticipated to exist at the signing of the record of decision (baseline conditions). Harvest on the refuge and the national forest would lower numbers to the objective.

Distribution and Movements of Bison

Supplemental feeding would remain the same as in Alternative 1. Irrigation improvements would be used to increase cultivated forage on the refuge to help compensate for exclosures around woody vegetation. Although exclosures and cultivation could slightly modify bison distribution and movements of bison on the refuge, hunting would be the primary means under Alternative 5 to affect how bison would use the refuge during hunting season. Because the herd would eventually be much smaller than under either baseline conditions or Alternative 1, it would be more manageable, and intrusions onto private land or the town of Jackson to the south of the refuge would likely be minimal.

As in Alternatives 3 and 4, bison hunting would be initiated on areas open to elk hunting on the refuge and would supplement continuing harvest in the national forest and on private lands. Bison could move to safer areas on the refuge, such as Poverty Flats, and to the park, where hunting would continue to be prohibited. If bison moved to private lands, WGFD personnel could exercise their prerogative to haze or destroy them because of safety or damage concerns.

Increases in cultivated forage and prescribed fire on the refuge would continue to attract bison to these areas during feeding and non-feeding years. Exclosures up to 1,600 acres for willow, cottonwood, and aspen habitat would eliminate bison use of these areas. Monitoring and adaptive management could indicate that these exclosures should be removed at some time. In addition, the shape of the aspen exclosure, wider east to west than north to south, could hinder north-south bison movements. Although the fence would be designed to minimize this effect, concave areas of fence could temporarily stop bison and direct their movements (Cole, pers. comm. 2003).

RB51 is a vaccine currently used for cattle that would be used on bison in this alternative. Biobullet delivery from short distances appears to be an effective technique for elk vaccination and might be appropriate for use in bison if further research demonstrates that ballistic delivery provides adequate immunization. Ongoing studies could also identify better materials for producing biobullets and could indicate whether increasing the vaccine dose in biobullets would improve efficacy levels further (Olsen, pers. comm. 2004).

Hand injection would also be feasible for vaccinating the Jackson bison herd although injection would require a longer period of time than would ballistic vaccination. The number treated would vary depending on associated procedures. If bison were immobilized and hand-injected, about eight could be treated per day. Winter feeding operations would help to maximize success because large numbers are concentrated at the feeding areas and would be less likely to leave due to disturbance.

Brucellosis vaccination with RB51 would cause would cause short-duration negligible to minor changes in movements and distribution similar to those described under Alternatives 3 and 4 in "Distribution and Movements of Bison."

Bison Behavior, Social Interactions, and Nutrition

The frequency of social interactions, particularly aggressive interactions with elk, would decrease as bison numbers decrease.

Nutritional status could gradually be enhanced because amounts of standing forage available would increase as bison numbers were reduced and sprinkler irrigation expanded. Improvements in forage production through changes in irrigation practices on the refuge would offset the loss of herbaceous forage to exclosures. Overall, amounts of herbaceous vegetation annually produced in areas accessible to bison on the refuge would continue to be similar to, but negligibly lower than under baseline conditions (about 2% less) and about 0.5% lower than long term conditions under Alternative 1. Because the bison herd would be dramatically smaller, available forage per bison would increase.

Vaccination activities would cause negligible to minor short-duration adverse effects to bison behavior and social interactions. If immobilization and hand injection were required, it would increase nervousness and excitability, energetic expenditures, and aggressive social interactions and displacements in some bison. Delivery of biobullets via airgun would have similar effects. Some injuries could result if bison were gored during these interactions. If oral vaccine delivery became possible and occurred outside the refuge feedground context, aggressive social interactions could increase at vaccine delivery sites because the vaccine would be delivered through a localized food source. If the oral vaccine were delivered during winter supplemental feeding, distribution and movements would remain similar to baseline conditions and Alternative 1.

RB51 vaccination activities could decrease the nutritional status in some bison to a negligible to minor extent due to increased energetic expenditure, disruption of feeding behavior, and reduced time spent eating and caloric intake.

Disease Prevalence and Transmission

Bovine Brucellosis

Prevalence in Herd — As noted above, RB51 is currently used on cattle and would be used on bison under this alternative because it is immediately available. Researchers generally agree that it would be safe for bison and non-target species (Davis and Elzer 1999, 2002). However, there is no consensus among researchers whether RB51 vaccination provide significant protection against abortion and infection in bison. Yellowstone National Park's management efforts, which recently began a vaccination program of non-pregnant yearlings and calf bison with RB51, would provide valuable information on the vaccine's effectiveness in protecting against brucellosis in a field setting, although definitive results might not be available for many years.

Compared to Alternative 1, brucellosis prevalence in the Jackson bison herd would not be altered to any large extent by vaccination in the short term under Alternative 5 if RB51 had low efficacy.

Based on modeling by Peterson, Grant, and Davis (1991b) of the Jackson bison herd, if RB51 had an efficacy of at least 25%–30% and if it was delivered to a high proportion of susceptible bison calves on the refuge every year, the prevalence of brucellosis could be expected to decline by an estimated 25%–30% (Peterson, Grant, and Davis 1991b). However, the feeding program would hinder the effectiveness of vaccination because the chance of contact with an aborted fetus or birthing materials would still be very high. Therefore, only a minor reduction in prevalence in the herd could be expected. Because the effectiveness of RB51 on free-ranging bison is unknown, prevalence could be greater or less than at present.

Transmission among Bison — Transmission potential would remain high in this alternative, because supplemental feeding would continue to provide ample opportunities for contact with infected fetuses or birthing materials. If RB51 proved to be more effective than research indicates (above 50%, for example), a minor reduction in transmission would occur because of lowered prevalence.

Transmission from Elk to Bison — If Strain 19 reduced brucellosis prevalence in elk, transmission from elk to bison would decrease by a negligible degree. This would be because (1) a high proportion of a relatively small herd (compared to Alternative 1) would still have the potential for contact with elk while on feedlines, and (2) a single abortion (which could occur even when prevalence is low) could infect a large proportion of bison in the feedground area.

Bovine Tuberculosis and Paratuberculosis

The risk that bovine tuberculosis or bovine paratuberculosis would become established would remain high because of the frequency of winter feeding. Risk would be lower than under Alternative 1, but higher than all other alternatives. The potential prevalence in the herd could be lower by a negligible to minor amount compared to Alternative 1 because bison numbers would be reduced. This reduction in numbers and hence density of bison would also reduce the potential for transmission between bison.

Malignant Catarrhal Fever

The risk of infection in the Jackson bison herd under Alternative 5 would be similar to the risk under Alternative 4, and less than under the other alternatives because the amount of forage and feeding relative to the number of bison would encourage elk and bison to remain on the refuge during winter, thus avoiding contact with potentially infected domestic sheep. The potential for impacts under Alternative 5 would be similar to those under Alternative 3 and 4, greater than under Alternatives 2 and 6, and less than under Alternative 1.

Calving, Age and Sex Ratios, and Recruitment

Continuing to feed bison during the winter would continue to result in higher-than-natural calf survival rates during winter. This would be unchanged from Alternative 1.

Although hunting could affect both age and sex ratios, the U.S. Fish and Wildlife Service and the National Park Service would work cooperatively with the Wyoming Game and Fish Department to annually adjust hunting regulations and licensing to maintain age and sex ratios similar to those in unhunted and unfed populations.

In the short term, production and recruitment would be unaffected by changes in brucellosis prevalence. As RB51 vaccination begins to take effect, there could be associated minor reductions in abortions, and recruitment could increase. This reduction in calf loss would have a negligible beneficial impact on the overall production and recruitment in the Jackson bison herd in the long term, because current production losses from brucellosis are estimated to be low.

If bovine tuberculosis or paratuberculosis became established, they would affect production and recruitment indirectly through increased mortality, although they would not affect the production rate. The number of calves produced each year would decline with a declining population size and fewer adult females. Bovine tuberculosis and paratuberculosis could affect age ratios because mortality would increase particularly in older animals.

Mortality

Non-harvest mortality would remain similar to baseline conditions because supplemental feeding would continue to occur in almost all years. Because the smaller herd would likely stay on the refuge during winter, fewer agency removals or vehicle collisions would occur than under Alternative 1.

Harvest mortality, particularly in the short term, would increase dramatically over baseline conditions and Alternative 1. The current harvest of 40–50 bison would be increased to 150–155 bison per year to achieve the target number of 350–400 in 10–15 years. This would be more than a 300% increase, and a major short-term increase in mortality. Harvest would be maintained in the long term at about 40–80 bison per year once the population objective has been reached, a moderate increase over baseline conditions.

Rates of predation would remain very low, affecting the herd to a negligible extent, and similar to baseline conditions and levels under Alternative 1. The actual number of bison preyed on would decrease because of fewer bison and fewer opportunities for predation.

If bovine tuberculosis or bovine paratuberculosis infected the Jackson bison herd, mortality would be less by a negligible to minor amount compared to Alternative 1 due to a smaller herd.

Health, Sustainability, and Naturalness

The health and sustainability of the Jackson bison herd would be similar to levels under baseline conditions and Alternative 1. High ungulate concentrations during nearly annual winter feeding would increase the potential for spread of disease. Although bison numbers would gradually be reduced to 400, Alternative 5 would concentrate thousands of elk and hundreds of bison on feedlines for several months nearly every year. These annual concentrations would provide conditions under which a new disease could spread rapidly, jeopardizing herd health and sustainability in the long term. Winter nutritional status would remain unchanged, but could improve in the summer as both elk and bison densities were reduced, particularly in the Grand Teton National Park elk segment. Brucellosis vaccination (if the RB51 vaccine was 25%–30% effective) would decrease prevalence to a minor degree in the long term.

Barring the introduction of serious non-endemic disease, the herd would continue to be genetically viable at 400 animals.

Due primarily to elevated disease risks and increased genetic contributions from less fit animals, long-term health and sustainability of the bison herd under Alternative 5 would be lower than under Alternatives 2, 3, 4, and 6, and greater than under Alternative 1.

Naturalness would remain similar to baseline conditions and Alternative 1, where several population processes would continue to operate at unnatural levels. Notably, winter mortality would be much lower than natural due to the winter feeding program on the refuge. Under natural conditions, mortality rates are different among age and sex classes, but winter feeding would tend to nullify these differences. Bison would continue to expend less energy accessing winter forage than they would without supplemental feeding, and they would continue to maintain a higher level of nutrition in winter. Also because of the winter feeding program, recruitment rates would be unnaturally high and calves that are born out of the normal calving season would continue to have a high chance of survival. Several of these factors could affect long-term fitness of the herd.

Because it is probable that at least some bison migrated out of Jackson Hole before they were extirpated in the mid-1800s, and because bison are now year-round residents, their seasonal distribution and movements would continue to be unnatural under Alternatives 5 and 1. Rather than many groups of bison roaming in search of available forage, as would have occurred naturally, the herd would now continue to be concentrated in a relatively small area for several months each winter.

Although harvest would increase under Alternative 5, harvest would continue to have a minimal influence on the sex ratio because annual adjustments would be made to maintain an approximately equal bull-to-cow ratio, typical of nonhunted herds. In addition, the size of the bison herd after herd reductions occur in the short term would be closer to the number of bison that inhabited the valley prior to Euro-American settlement, especially in winter compared to numbers under Alternative 1.

Overall, naturalness under Alternative 5 would remain similar to Alternative 1 and would be lower than under Alternatives 2, 3, 4, and 6 because of the continuation of winter feeding.

Conclusion

In the long term under Alternative 5, there would be about 400 bison in the Jackson herd, lower than baseline conditions and Alternatives 1, 3, and 4. Numbers would be higher than under Alternative 6 and could be similar to numbers under Alternative 2.

Nutritional status would remain high due to nearly annual supplemental winter feeding and recruitment, and annual survival would remain high as compared to a non-fed population. The sex ratio would likely remain near 1:1.

The risk for a non-endemic infectious disease quickly spreading through the bison population and causing major adverse impacts would be similar to Alternative 1 due primarily to the near-annual winter feeding program. However, the risk would be somewhat reduced because a smaller herd size would be maintained. The severity of potential impacts from a non-endemic infectious disease on survival, population size, and sustainability would be somewhat lower than Alternative 1, and higher than Alternatives 2, 3, 4, and 6. RB51 could reduce brucellosis prevalence by up to a minor degree.

Alternative 5 would result in levels of long-term health, sustainability, and naturalness that would be somewhat higher than Alternative 1 and lower than Alternatives 2, 3, 4, and 6.

No impairment of park bison would occur under this alternative. If the population dropped below the level considered to be genetically viable, bison would be carefully screened and imported to add diversity.

ALTERNATIVE 6

Analysis

Bison Numbers

The approximately 800–1,000 bison existing at the signing of the Record of Decision would be gradually reduced to 400 animals through hunting and the elimination of winter feeding.

Distribution and Movements of Bison

Reductions in winter feeding would take place over a 5-year period, or immediately if mild weather conditions allowed rapid program changes. Hunting would begin on the refuge, with initial harvest of about 150 animals per year. Both of these factors would change distribution and movements of bison.

As reductions in and elimination of supplemental feeding take place, winter distribution would be expected to increase due to reliance on native forage. Based on environmental conditions, results of a forage availability model (Hobbs et al. 2003) indicated that ungulates could winter best in the Gros Ventre River drainage and south of Jackson in the Snake River Valley, particularly near Alpine and including lower portions of Hoback Canyon. Habitat improvements by partner agencies would also occur east of the refuge. If conservation easements could be obtained in the analysis area, bison could move into them as well.

Bison hunting would be initiated on lands open to elk hunting on the refuge, in addition to ongoing hunting in Bridger-Teton National Forest and on private lands. Hunting could occur in the south end of the refuge as well as in traditional elk hunting areas on the northern end. In addition to a public hunt in the fall, tribal reductions would also be initiated. The prohibition on bison hunting in the park would continue. Allowing bison hunting on parts of the refuge could redistribute animals to unhunted portions of the refuge or into the park. Particularly as numbers decreased, bison would be less likely to travel south toward the town of Jackson. Some could find native forage outside the refuge and park and travel to these areas during the fall or winter, but permanent colonization would be unlikely. Because private lands are interspersed with national forest, because and elk feedgrounds are present in these areas, free-ranging bison would be hunted or removed by the state because of threats to public safety, property, or the health of domestic livestock (WGFC regulations, ch. 41 (2002) and 15 (2004)).

After numbers of elk and bison reached objective levels under Alternative 6, elk and bison hunting on the refuge might be eliminated, and/or the elk herd reduction activities in southern Grand Teton National Park could be decreased or eliminated. These closures would occur only if monitoring indicated that adequate harvest of bison could be achieved outside these areas. If closures took place, some bison would redistribute to these areas.

Bison movements on the refuge would also be negligibly altered by a variety of exclosures in the short term. Refuge exclosures protecting 100 acres of remnant cottonwood along upper Flat Creek and other exclosures of varying size sequentially protecting approximately 600 acres of aspen in different areas during three consecutive periods in the short term would prevent access to these parts of the refuge.

After bison numbers had been reduced to 400 and supplemental feeding had been eliminated, brucellosis vaccination could occur if safe vaccines were developed that had a minimum efficacy of 50% for both bison and elk and that could be delivered ballistically or orally for both bison and elk. (Ballistic delivery would not be feasible for elk in the park because they are widely distributed throughout the park in the summer.) Both forms of delivery could be administered to bison in the park (and to elk on the refuge).

Ballistic vaccination would cause negligible to minor short-duration increases in movements and distribution. Because hunting would be coincidental with vaccination, the herd would be likely to react more strongly to the use of airguns. Acclimation and therefore success in vaccinating bison could be lower than in alternatives where no hunting would be allowed. Vaccination would also be made more difficult because bison would not be concentrated along feedlines.

If a sufficiently effective oral vaccine were developed that would be safe for elk and bison as well as non-target species, and deliverable through localized food supplementation, vaccine delivery could temporarily change distribution by a negligible to minor extent.

Bison Behavior, Social Interactions, and Nutrition

Relatively rapid reductions in supplemental feeding and numbers of elk and bison would reduce competitive social interactions associated with feedlines to fewer years. However, competition for native forage and associated aggressive social interactions would increase, particularly in the short term before population sizes were reduced. In time, wider ungulate distribution would diminish forage competition.

Redistribution of elk would occur on the refuge despite lower numbers of elk and bison because of the elimination of supplemental feeding. Elk would be more likely to move to areas with less desirable forage in order to avoid conflicts with bison. Competition under Alternative 6 would be lower than what would likely occur from long-term growth of the bison herd under Alternative 1. If oral vaccine delivery became possible, aggressive social interactions could increase at vaccine delivery sites because the vaccine would be delivered through food provisioning.

The implementation of bison hunting on the refuge could temporarily cause agitation and nervousness, increased energetic expenditures associated with avoiding hunters and the sounds of weapons firing, and possibly lower nutrition because they would stop foraging when leaving these areas. In the long term, closures of the northern fifth of the refuge to bison and/or elk hunting would reduce these behaviors.

The nutritional status of bison could be reduced by the rapid phasing out of winter supplemental feeding. As supplemental feeding occurs in fewer winters and bison rely on native forage during increasingly severe winters, nutritional status could be decreased depending on winter severity and access to forage. Because bison and elk numbers would be reduced through harvest and more widely distributed, decreases in nutritional status could be negligible to minor compared to baseline conditions and Alternative 1. Nutritional status under Alternative 6 would more closely mimic free ranging, non-fed bison populations, similar to Alternative 2. Although some bison could die during above-average and severe winters because of decreased nutrition and body condition, at low numbers most might be able to maintain adequate nutritional levels on native forage. There could be more malnutrition, increased use of woody vegetation in severe winters, and moderate to major increases in mortality in severe winters compared to baseline levels.

Forage would continue to be cultivated for up to 15 years to help mitigate the loss due to exclosures to protect woody vegetation and the phase-out of supplemental feeding. Amounts of total herbaceous forage produced on the refuge would be greater than under baseline conditions (8% more) and about 11% greater than amounts under long term conditions of Alternative 1. Minor increases in available forage, combined with moderate decreases in elk numbers and moderate to major decreases in bison numbers, might provide adequate nutritional levels during most years. After 15 years, irrigation practices would be evaluated and potentially reduced if more than adequate amounts of forage were being produced for elk and bison on the refuge. Loss of supplemental feed would be partially mitigated through habitat enhancement efforts in Bridger-Teton National Forest.

If effective brucellosis vaccines were developed, vaccination activities would cause negligible to minor short-duration adverse effects due to disruption of normal bison behavior. If the vaccine were delivered ballistically, bison could experience increased nervousness and excitability. Energetic expenditures from running and aggressive social interactions and displacements of elk would increase. Delivery of an effective oral vaccine would temporarily change distribution in a nonfed herd. Changes in bison distribution and densities at vaccine delivery sites could cause short-duration, localized increases in aggressive social interactions. Additional analysis under the National Environmental Policy Act might be needed prior to implementation of an oral vaccine.

Disease Prevalence and Transmission

Bovine Brucellosis

Prevalence in Herd — As the high densities associated with feedlines would no longer occur and bison would be more widely dispersed, brucellosis seroprevalence would decrease by a moderate amount. Modeling has illustrated that bison populations as small as 200 animals can maintain brucellosis (Dobson and Meagher 1996), so brucellosis would not be eliminated from the herd.

Brucellosis Transmission among Bison — Eliminating winter feeding, and associated reductions in density and potential for contact with aborted fetuses, would result in a major reduction in transmission of brucellosis among bison on the refuge. Potential use of a vaccine in the long term, if one was developed that had an efficacy of greater than 50% and that could be administered orally or ballistically, would add to this reduction.

Brucellosis Transmission from Elk to Bison — The possibility of transmission of brucellosis from elk to bison would be reduced by a moderate to major degree as both elk and bison dispersed more widely, and numbers and chances of contact were reduced.

Bovine Tuberculosis and Paratuberculosis

The risk that either bovine tuberculosis and bovine paratuberculosis would become established would be low, and similar to risk under Alternative 2. If either were to become established, prevalence and transmission would be lower by a major amount than under Alternative 1 due to reductions in density and numbers of bison. This would also be true of the potential for transmission from elk to bison.

Malignant Catarrhal Fever

The risk of contracting malignant catarrhal fever would be greatest under Alternatives 2 and 3 because historical elk migration routes could be reestablished and elk and bison would run the highest risk of contact with infected domestic sheep. Although support for migration to other wintering areas is not part of Alternative 6, dispersal would likely increase and risk would be higher than under Alternatives 1, 4, and 5.

If malignant catarrhal fever becomes established, animal density is the primary factor that influences impacts. Hence, the potential for impacts would be lowest under both Alternatives 2 and 6.

Calving, Age and Sex Ratios, and Recruitment

Increasing reliance on native winter range would affect body condition and would likely result in the loss of older bison, calves or energetically stressed bison, including prime bulls that have just completed the rut. In the long term, this would create more natural sex and age ratios. After objectives for herd reductions were reached, hunting strategies would be designed to restore and maintain more natural age and sex ratios to minimize impacts that would otherwise occur if harvest strategies were not adaptive.

Initially, the bison hunt would focus on reducing numbers and potential productivity of the herd, as well as the risk of abortion and brucellosis transmission. Therefore, adult female bison between 2 and 4 years old would be particularly targeted. This would temporarily alter sex ratios, particularly if the harvest of young females was adequate to meet herd reduction objectives. After the bison herd was at objective and brucellosis prevalence was reduced, further adjustments to annual harvest would be made to minimize effects and achieve more natural age and sex ratios.

Recruitment under Alternative 6 would likely be lower in the long term compared to Alternative 1, although not to the extent as under Alternative 2.

The infection of the herd by bovine tuberculosis or bovine paratuberculosis would affect production and recruitment through increased mortality of reproducing adults. These diseases could also affect age ratios because they would increase mortality particularly in older animals.

If bovine tuberculosis or paratuberculosis infected the herd, the dispersion and lower numbers associated with this alternative would mean major decreases in production losses compared to Alternative 1. However, the absolute impact of these diseases on production in the herd would be low. As an example, if prevalence of bovine tuberculosis or paratuberculosis was 50%, and 5% of those developed clinical disease, then a maximum of 2.5% of the potential calf production could be retained; this would constitute a negligible increase in production and recruitment.

Mortality

Winter mortality not related to hunting would gradually increase under Alternative 6 as supplemental feeding was reduced and bison relied more on standing forage. The reduction of bison numbers, the continued cultivation of forage on the refuge, and habitat enhancements outside the park and refuge, along with possibly closing the northern fifth of the refuge to bison and elk hunting and the southern end of the park to elk herd reduction in the long term, would increase amounts of available forage.

Because bison distribution would increase in the short term due to reductions in the supplemental feeding program, the transition to native winter range, and the addition of new hunt areas, the total number of management removals would be expected to rise as more bison seek out additional food sources and more conflicts on private lands occur. These bison movements could increase the number of bison deaths from vehicle collisions.

Overall, non-harvest mortality would be greater than the low level of 5% per year under baseline conditions and Alternative 1 due to supplemental feeding but would likely be less than under Alternative 2.

Harvest mortality, particularly in the short term, would increase dramatically over baseline conditions and Alternative 1. The current harvest of 40–50 bison from Bridger-Teton National Forest and private lands would be increased to 200 bison per year to achieve the target number of 400 in five years. This would be a 300%–400% increase, and a major short-term increase in mortality. It is possible that fewer bison would need to be harvested to meet the herd objectives if enough reproductive females were taken to affect production rates. Harvest would be maintained in the long term at about 60 bison per year once the population objective was reached, a moderate increase over baseline conditions.

Predation on bison would increase negligibly but this increase would likely be compensatory. Calves and older bison would continue to be the most vulnerable to predation.

A moderate reduction in disease prevalence due to lower bison numbers and no winter feeding would decrease the number of abortions related to brucellosis.

If bovine tuberculosis or bovine paratuberculosis infected the Jackson bison herd, the potential for mortality would be less under Alternative 6 by a moderate to major degree compared to Alternative 1 because of a smaller herd. Both of these chronic diseases do not kill their host for many years, if at all.

Health, Sustainability, and Naturalness

Long-term health and sustainability of the bison herd under Alternative 6 would be similar to these qualities under Alternative 2 and higher than all other alternatives.

The health and sustainability of the Jackson bison herd would increase as supplemental feeding was eliminated and there was greater reliance on standing forage. Increased forage production on cultivated areas of the refuge while bison numbers were decreased through hunting would help prevent starvation and contribute to herd health and sustainability. Lower ungulate concentrations would also result in lower disease prevalence and transmission of current diseases, such as brucellosis, as well as the likelihood of major impacts from new diseases.

Herd health would be further improved if a safe and effective vaccine for brucellosis was developed and could be delivered to a large proportion of the population's calves.

Barring the introduction of serious, non-endemic disease, the bison herd would be self-sustaining at 400 (based on a five-year running average). Harvest levels would be adjusted to allow some natural fluctuations in herd size while maintaining this objective. Herd numbers would vary to some extent due to higher natural mortality in above-average and severe winters.

The bison herd would be more natural compared to baseline conditions and Alternative 1 due to the elimination of winter supplemental feeding and increased reliance on native forage. Natural factors such as climate and forage availability would have a much greater influence on numbers, movements, distribution, and winter mortality. Bison numbers would be closer to the low number of bison that likely inhabited the valley prior to Euro-American settlement than they would under Alternative 1. Human-related deaths (such as vehicle collisions) would likely decrease once bison numbers were at objective levels.

Production and recruitment rates would be more natural and calves born outside of the normal birthing season would be less likely to survive. Winter mortality rates would be more typical of an unfed population, and would differ among age and sex classes in a more natural way. Bison would distribute themselves more naturally, expend more energy accessing winter forage, and nutritional status would be reflective of fluctuating environmental conditions.

Bison behavior would also become more natural. Competitive social interactions associated with feedlines and displacement of elk and other bison would decrease because there would be fewer elk and bison, wider ungulate distribution, and lower densities. Competition over forage would continue to occur in localized areas and would increase in winters of greater severity.

Although harvest levels would increase under Alternative 6, the effect on health and sustainability of the herd would continue to be negligible. In the long term harvest levels would be used to maintain a 1:1 sex ratio indicative of a non-hunted herd.

Alternative 6 would result in a higher level of naturalness in the bison herd than would Alternatives 1, 3, 4, and 5. Naturalness would be similar to Alternative 2 because of the elimination of winter feeding.

Conclusion

In the long term under Alternative 6, there would be 400 bison based on a five-year running average in the Jackson herd. Numbers would be lower than under Alternatives 1, 3 (baseline conditions), and 4, and similar to numbers under Alternatives 5 and 2 (if numbers were at the higher end of the expected range under Alternative 2).

Phasing out supplemental winter feeding would cause the bison herd to disperse more widely in search of native forage. The herd would become more responsive to environmental conditions, and winter mortality would fluctuate with winter severity, precipitation regimes, and standing forage. Recruitment and annual survival would decrease compared to Alternative 1. Although intensive age-biased harvest in the short term would temporarily alter age and sex ratios, harvest would be adjusted in the long term to maintain more natural ratios. In the long term, the sex ratio and calf production and recruitment would be similar to levels found in non-fed populations in similar environments.

The risk of a non-endemic infectious disease quickly spreading through the herd would be the lowest (along with Alternative 2) of any of the alternatives due to the elimination of the nearly annual winter feeding program and fewer bison and elk. This alternative (along with Alternative 2) would have the lowest risk of such a disease having major adverse impacts to survival and population sustainability. The prevalence of brucellosis in the bison herd would be moderately lower than under Alternative 1.

Alternative 6 (along with Alternative 2) would result in higher levels of long-term health, sustainability, and naturalness in the bison herd than what would occur under Alternatives 3, 4, and 5.

No impairment of park bison would occur.

MITIGATION

Mitigating measures for impacts on bison were incorporated into the alternatives and the impact analysis.

CUMULATIVE EFFECTS

TRANSPORTATION IMPROVEMENTS

The reconstruction of U.S. 26/287 west of Togwotee Pass would likely not affect bison by decreasing available habitat or increasing vehicle collisions because Jackson bison rarely are found in this area. Under Alternative 1 the bison herd would be expected to grow to at least twice its current size (800–1,000 animals), perhaps to as large as 2,000 animals. Although bison have remained primarily within the park and the refuge, a herd of this size could expand its range, and individuals could move into the highway reconstruction area. Upgrading the existing highway would not be expected to result in extensive effects in terms of blocking movements, and it is anticipated that effects on overall herd dynamics would be minimal. Alternatives 2–6 would not result in cumulative effects that would contribute to effects of the reconstruction effort.

FEDERAL LAND MANAGEMENT ACTIVITIES

Grand Teton National Park Fire Management

Mechanical fire management treatments could result in a small reduction in bison habitat, reduce habitat quality, and create short-term disturbance effects that could displace more mobile animals in proximity to WUI areas. However, these actions are not expected to adversely affect bison at a population level because habitat effectiveness in these areas and the immediate vicinity have already been reduced. WUI areas represent a small part of habitat available to park wildlife, and the vast majority of wildlife habitat in Grand Teton National Park occurs outside developed areas.

Prescribed fire can be used to maintain and restore more diverse vegetative communities in landscapes where natural fire regimes have been disrupted. Prescribed fires could in the short and long terms alter plant communities and displace individual bison from certain portions of habitat, but the long-term effect would be to create vegetative diversity that favors native wildlife species. None of the alternatives would result in cumulative effects on bison.

Grand Teton National Park Recreation Infrastructure Improvements

Potential construction of a multi-use trail from Moose to the north Jenny Lake junction would result in site-specific, temporary impacts along planned trail routes during the summer. The finished trail would attract additional recreationists along the Snake River corridor during the summer and possibly cross-country skiers in the winter.

The trail construction phase would likely displace individual bison within or near work areas in the short term and make habitat unavailable. If pathways were separate from existing roads, long-term impacts to bison could include loss of habitat, loss of the use of habitat near the new pathways, and changes in movements and distribution. Improved human access to parts of the park could increase levels of disturbance to bison and alter distribution and habitat use. The range and specific details of the improvements are unknown at this time.

Improvements to the Gros Ventre campground would result in site-specific, temporary impacts during construction. This action could increase disturbance to bison in summer and could alter distribution and habitat use, as well as bison / human conflicts. Effects would likely be negligible because habitat effectiveness has already been reduced in this area.

The greatly increased number of bison in the Jackson herd under Alternative 1 would result in more encounters between bison and humans, in addition to impacts from park infrastructure improvements. Alternatives 2–6 would not result in cumulative effects.

Grand Teton/Yellowstone National Parks and John D. Rockefeller, Jr., Memorial Parkway Temporary Winter Use Plan

The total number of snowmobiles allowed into the park would be similar to historical levels but, because all visitors would be traveling in guided groups, oversnow vehicle users would be less likely to interact with wildlife and result in bison injuries or mortalities.

While the total number of oversnow vehicles allowed in the parks would approximate the historical average, all users would be led by professional guides, who would be trained in how to avoid causing wildlife displacement or stress, and who would be familiar with likely wildlife locations along the road system. Under such conditions oversnow vehicle users would be less likely to interact with wildlife, causing less mortality, less stress, less displacement, and fewer population-level impacts. The impacts would not be of sufficient magnitude to constitute impairment of bison.

No cumulative impacts to bison on adjacent lands outside the park units are anticipated under the alternatives. Despite the larger herd size under Alternative 1, winter distribution would largely be confined to the refuge.

Bridger-Teton National Forest Fuels Management Projects

Projects identified by the Bridger-Teton National Forest that would occur nearest to park and refuge boundaries could affect bison under Alternative 1 due to potential range expansion in seasons other than winter. These projects could temporarily diminish forage opportunities directly following various fuel reduction treatments. However, in the long term most of these projects would improve transitional and winter habitats. No cumulative impacts to bison on adjacent lands are anticipated under the alternatives.

POPULATION GROWTH AND PRIVATE LAND DEVELOPMENT

Projected population increases in Teton County in the next 15 years would continue to create a demand for private land development. Bison would be present only in the primary analysis area. Habitat loss and increased potential for bison / human encounters, conflicts, and vehicle collisions could occur.

Additional development on private lands in the Buffalo Valley area would be outside the baseline winter range for bison and would not affect them. Under Alternative 1 additional development of private parcels along the Gros Ventre River could increase conflicts between humans and bison if they moved into this area. Alternatives 2–6 would not contribute to the effects of private land development on bison.