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IMPACTS ON OTHER WILDLIFE

The project area is home to a variety of wildlife and is considered to be part of the most ecologically intact ecosystem in the lower 48 states. Bison and elk serve as food sources for predators and scavengers and compete for habitat with other ungulates. They could also alter the natural environment in ways that could either compromise or improve another species' ability to survive. Bison and elk management could impact other wildlife species, and therefore the effects of the alternatives are analyzed for threatened and endangered species, other ungulates, predators and scavengers, small mammals, large rodents, birds (Neotropical migratory birds, gallinaceous birds, waterfowl, shorebirds, rails, and cranes), and amphibians.

THREATENED, ENDANGERED, AND SPECIAL CONCERN SPECIES

The Endangered Species Act (16 USC 1531 et seq.) defines the terms and conditions of the federal status of species in a wildlife refuge or park and requires an examination of impacts on all species federally listed or proposed for listing, and designated critical habitats for threatened or endangered species. In compliance with section 7 of the Endangered Species Act, the National Elk Refuge and Grand Teton National Park are working with the U. S. Fish and Wildlife Service's Wyoming field office to determine the effects of the preferred alternative on threatened and endangered species. That determination will be completed after a final preferred alternative has been selected prior to the signing of the Record of Decision.

Both the U.S. Fish and Wildlife Service and the National Park Service are required by their policies to consider potential effects of actions on state or locally listed species. Both agencies are to perpetuate the natural distribution and abundance of these species and the ecosystems on which they depend.

As previously discussed (see page 93), the following species would not be affected by any of the alternatives considered in this document, and they

are not discussed further: lynx, wolverines, river otters, fishers, American martens, and whooping cranes.

METHODOLOGY USED TO ANALYZE EFFECTS

The process for assessing impacts to threatened, endangered, and sensitive species is essentially the same as that for other wildlife, except it is focused on the species that have been identified. The following impact intensities are intended to be consistent with the determination under section 7 of the Endangered Species Act.

- *Negligible* — Sensitive species would not be affected.

A negligible effect is intended to be consistent with a “no effect” determination under section 7 of the Endangered Species Act regulations.

- *Minor* — Impacts to sensitive species would be perceptible or measurable, but the severity and timing of changes to parameter measurements are not expected to be outside natural variability and are not expected to have effects on populations of sensitive species. Impacts would be outside critical periods.

A minor effect is intended to be consistent with a determination of “may affect, but not likely to adversely affect” under section 7 of the Endangered Species Act regulations.

- *Moderate* — Impacts to sensitive species would be perceptible and measurable, and the severity and timing of changes to parameter measurements are expected to be sometimes outside natural variability, and changes within natural variability might be long term. Populations of sensitive species might have small to moderate declines, but they are expected to rebound to pre-impact numbers. No species would be at risk of being extirpated from an area. Some impacts might occur during key time periods.

In most cases a moderate effect is intended to be consistent with a determination of “likely to adversely affect” under section 7 of the Endangered Species Act regulations.

- *Major* — Impacts to sensitive species would be measurable, and the severity and timing of changes to parameter measurements are expected to be outside natural variability for long periods of time or even be permanent; changes within natural variability might be long term or permanent. Populations of sensitive species might have large declines, with population numbers significantly depressed. In extreme cases a species might be at risk of being extirpated from an area, key ecosystem processes like nutrient cycling might be disrupted, or habitat for any species might be rendered not functional. Substantive impacts would occur during key time periods. Impacts would be long term to permanent.

A major effect is intended to be consistent with a determination that an impact would “adversely affect with/without a jeopardy opinion” under section 7 of the Endangered Species Act regulations.

IMPACTS ON GRAY WOLVES, GRIZZLY BEARS, AND BALD EAGLES

Impacts of the Alternatives

Impacts Common to All Alternatives

Disease Impacts

Elk and bison make up a substantial portion of the prey base for wolves in Jackson Hole and a portion of the prey base for grizzly bears and bald eagles.

If a new disease (e.g., bovine tuberculosis, bovine paratuberculosis, or chronic wasting disease) was introduced into the Jackson Hole area and reduced elk and/or bison numbers by a moderate to major amount, wolves, grizzly bears, and bald eagles in general could benefit in the short term due to more vulnerable prey and more carcasses available for scavenging. In the long term wolves, grizzly bears, and bald eagles could be negatively impacted due to a decrease in the numbers of available prey or carrion. The risk of this happening would increase under alternatives with high concentrations of animals and continued winter feeding.

The severity of impacts that could result from the establishment of tuberculosis or paratuberculosis

in the Jackson elk or bison herd would be greatest under Alternative 1, followed by Alternatives 5, 4, 3, with the least risk under Alternatives 2 and 6 (approximate equal risk) (HaydenWing and Olson 2003). The severity of impacts that could potentially result from the establishment of chronic wasting disease in the Jackson Hole area would be greatest under Alternatives 1 and 5 (approximately equal risk), followed by Alternatives 4 and 3, with the least risk under Alternatives 2 and 6 (approximate equal risk).

Wolves, grizzly bears, and bald eagles would not be impacted by contracting paratuberculosis, brucellosis, or chronic wasting disease under any of the alternatives because they are not known to be susceptible to these diseases (Williams 2001; Thorne et al. 1982).

If bovine tuberculosis became established in the Jackson Hole area, wolves and grizzly bears could contract the disease from elk and bison. Although individual animals could develop symptoms and die, they would not be able to sustain the disease and pass it along to other members of their species (Roffe, pers. comm. 2002). There are no documented cases of predator or scavenger species in North America maintaining the disease within their populations (Clifton-Hadley et al. 2001).

Wolf and grizzly bear populations are not likely to be impacted by bovine tuberculosis in the short term (Roffe, pers. comm. 2003). In the long term the risk for transmission of this disease from elk or bison to wolves and grizzly bears would continue to increase over time, as prevalence in elk and bison and the number of symptomatic cases increased. Those alternatives with the highest concentrations of animals (Alternatives 1, 5, and 4, in that order) would have the greatest risk of negatively impacting wolves and grizzly bears.

Human Disturbance

Bald eagles are often present on the refuge feedgrounds, and in 1999 wolves also were often present on the feedgrounds. Wolves were less visible on the refuge for the next three winters, but they have often been seen on the refuge since the winter of 2003–4. The feeding program does not appear to disturb predators and scavengers, but it appears to indirectly attract them as a re-

sult of large concentrations of elk and bison. Animals new to the feeding operations could be wary at first, but they seem to quickly habituate. Therefore, management activities associated with the supplemental feeding program for elk and bison under all alternatives in the short term and under Alternatives 1, 3, 4, and 5 in the long term would have negligible effects on threatened and endangered species. Gradually phasing out supplemental feeding under Alternatives 2 and 6 would eventually eliminate any possible disturbance effects of activities associated with winter feeding.

Wolves, grizzly bears, and bald eagles would not be negatively impacted or would be impacted to a negligible degree by activities associated with elk and bison hunting under all alternatives except 2. Hunters walking and horseback riding through the hunt zones and rifles being fired in the northern portion of the refuge and on the eastern side of the park could disturb wolves, grizzly bears, and bald eagles in the immediate area of each hunting party for a short time. Impacts on populations of threatened species would be negligible. Eliminating hunting under Alternative 2 would remove any associated disturbance to wolves, grizzly bears, and bald eagles.

Farming and irrigation management practices on the refuge in all alternatives and restoring agricultural lands to native vegetation in the park under Alternatives 2–6 could disturb wolves, grizzly bears, and bald eagles, but the effects would be minor.

Eliminating farming and irrigation practices under Alternative 2 and Option B of Alternative 3 on the refuge would reduce human disturbance on the southern part of the refuge. The benefits to wolves, grizzly bears, and bald eagles would be negligible because the negative impacts of farming and irrigation on these species are considered negligible.

Hunting Risks to Grizzly Bears

As the grizzly bear population continues to expand southward, the risk of conflicts between hunters and grizzlies could increase and could result in increased conflicts between bears and hunters under Alternatives 1, 3, 4, 5, and 6, which would continue hunting on the refuge and, when

necessary, an elk reduction program in the park. Since no grizzly bears are known to have been killed during the elk hunt on the National Elk Refuge (grizzly bears have not been seen on the refuge since 1994) or during the elk reduction program in Grand Teton National Park, and because both the elk hunt on the refuge and the reduction program in the park would remain highly managed, any increased risk for conflicts or mortality would be minimized. As a result, grizzly bears would likely not be affected or affected to a minor degree.

Other Lands

Wolves, grizzly bears, and bald eagles on other federal lands and private lands in Jackson Hole, the Green River basin, and the Red Desert would not be affected or would be affected to a minor degree by actions that are being considered in this planning process. However, Alternatives 2 and 3 and possibly 6 could result in elk spending more time on federal lands in Jackson Hole or migrating to the Green River basin. Wolves, grizzly bears, and bald eagles in these areas could benefit from more available prey and carrion.

Alternative 1

Analysis

Wolves, grizzly bears, and bald eagles could potentially benefit from the growing bison population because more animals could be dispersed outside the park and the refuge onto the national forest and private lands, making them available for hunting. If increasing bison numbers posed a threat to human safety or property and were removed by government authorities, the resulting gut piles and carcasses could benefit bald eagles, grizzly bears, and wolves by providing more food. This situation could also lure grizzly bears and wolves closer to humans in and around Jackson Hole, resulting in increased human-caused mortality of these species, but the effect on the populations would be minor.

Grizzly bears would continue to benefit by preying on elk calves in the spring, and bald eagles and grizzly bears would continue to scavenge elk carcasses opportunistically. Since the numbers of elk would remain similar to baseline conditions, grizzly bears and bald eagles would not be impacted

Nutritional Needs of Wolves

There are six known wolf packs in the Jackson Hole area and the Gros Ventre River drainage, totaling approximately 54 wolves. In areas where livestock are raised, wolves sometimes come into conflict with ranchers due to depredations, and wolf numbers are kept low by agencies or as a result of shooting by ranchers. The following analysis uses a total of 60 wolves as a maximum number for the sake of calculating elk consumption rates.

Daily wolf consumption rates vary from 6 to 14 pounds per animal, with an average of 10 pounds per day (Boyce and Guillard 1992). Nutritional needs depend on the season, with greater nutrient requirements in winter. Also, hunts in winter are likely to be more successful due to deep snow levels and poorer condition of prey species. Little is known about kill rates in the summer, but

wolves appear to select various prey species throughout the year, depending on availability. In Montana researchers found that wolf scat in the summer contained deer, bighorn sheep, and pronghorn remains, while in the winter it contained primarily elk (Jimenez, pers. comm. 2003). During the winter on the northern range of Yellowstone, approximately 90% of the wolf kills were elk (Mech et al. 2001); available information indicates that summer kill rates on elk are less. (See page 158 for more detail on wolf predation.) Multiple wolf prey makes it difficult to calculate how many elk a wolf pack could take in a year, since at certain times they could be taking few elk but still consume an average of 10 pounds of meat per day (Jimenez, pers. comm. 2003).

The average weight of an elk (including the weight of bulls, cows, and calves)

is 400 pounds, 10% of which is inedible (B. L. Smith, pers. comm. 2003). The following calculation was used to estimate the maximum number of elk kills necessary for wolves to survive for a year:

$$10 \text{ pounds meat / wolf / day} \times 90\% \text{ of kills} \times \text{number of wolves} \times 365 \text{ days} = \text{pounds of elk meat / wolf / year} \div 400 \text{ pounds} \times 110\% \text{ (to include inedible parts of an elk carcass)} = \text{number of elk killed / year.}$$

An estimated maximum of 271 elk per year, or 2% of the Jackson elk herd when it is at 11,000, would be more than sufficient to maintain a wolf population of 30 animals. An estimated maximum of 542 elk, or 5% of the Jackson elk herd at a population of 11,000, would be sufficient to maintain a wolf population of four packs with a total of 60 wolves, assuming no other prey were taken.

by elk management under Alternative 1 any more than they have been affected in the recent past.

The herd objective of approximately 11,000 elk would be enough to sustain any foreseeable numbers of wolves that would inhabit the Jackson Hole area. (See text box for calculations of number of elk necessary to feed 60 wolves.)

No grizzly bears are known to have been killed by elk hunters on the National Elk Refuge or in Grand Teton National Park. The risk of hunters killing grizzly bears while elk hunting under Alternative 1 would be similar to baseline conditions. The risk of bear/human conflicts would continue in all areas open to hunting.

Conclusion

Compared to baseline conditions, wolves, grizzly bears, and bald eagles on the refuge and in the park could see minor benefits from increased natural mortality of growing numbers of bison. These species would not be affected by elk numbers and distribution any more than they have been in the recent past. Overall, impacts in the long term would be similar to baseline conditions.

This alternative would not result in the impairment of wolves, grizzly bears, and bald eagles in the park.

Alternative 2

Analysis

Under Alternative 2 annual winter mortality for elk is estimated to range between 1% and 20%. Higher winter and early spring mortality in elk and bison would make more carcasses available for scavenging by wolves, grizzly bears, and bald eagles.

Wolves, grizzly bears, and bald eagles would be positively affected in years with high numbers of bison and elk and negatively affected in years with low numbers. This would be particularly true in the park, where elk numbers could fall as low as 600 in some years.

In some years fewer elk and bison under Alternative 2 could negatively impact grizzly bears, bald eagles, and wolves. However, the winter mortality of elk and bison on the refuge and state feedgrounds is currently artificially low because of supplemental feeding. At present the most im-

portant mortality factor is hunting. Under Alternative 2 increased winter mortality during above average and severe winters would replace to some degree the elimination of hunting. Therefore, more carcasses would be available to scavengers during above-average and severe winters because, although there could be fewer elk and bison on average, more would die in these winters.

The estimated lower numbers of elk and bison under Alternative 2 would still be sufficient to feed any foreseeable number of wolves that could inhabit Jackson Hole (see calculations under Alternative 1). Furthermore, in hard winters, elk would be in poorer condition and easier to prey upon.

Eliminating refuge supplemental feeding would likely decrease wolf hunting success by eliminating elk concentrations on the refuge. Without refuge feedgrounds, wolves would either hunt elk wintering on native range in the area, or they could move to nearby state-run feedgrounds.

Although overall numbers of elk and bison could be lower than under Alternative 1, grizzly bears could benefit from more of these ungulates being on native winter range rather than concentrated on the refuge. Carcasses on the refuge are usually entirely consumed within 24–48 hours, leaving nothing for grizzly bears to scavenge in the spring. More elk on native winter range could mean that more winter-killed elk would be available as carcasses in the spring for grizzly bears. However, grizzly bears could be negatively affected by fewer calves available for predation in the spring and summer.

Impacts of bison fertility control would likely have negligible impacts on wolves and bald eagles on the refuge. If fertility control was carried out in the park, wolves, grizzly bears, and bald eagles could be temporarily disturbed to a minor degree by biologists walking through various habitats and shooting dart guns. However, their survival and reproduction would not be affected.

As described under Alternative 1, wolf, grizzly bear, and bald eagle populations in Jackson Hole would not be affected or would be affected to a minor degree by bovine tuberculosis (Roffe, pers. comm. 2003). There would be a moderate reduction in potential for transmission of bovine tuber-

culosis from elk and bison to wolves, grizzly bears, and bald eagles under Alternative 2 compared to Alternative 1 due to a lower prevalence in elk and bison.

Biochemical contraceptives approved for use in free-ranging wildlife do not enter the food chain and therefore would have no negative effects on wolves, grizzly bears, and bald eagles.

There would be no hunting on the refuge or the park under Alternative 2, with no risk of elk or bison hunters killing grizzly bears.

Conclusion

Wolves, grizzly bears, and bald eagles would benefit in years of high elk and bison mortality on the refuge and in the park and could be negatively affected in mild years after the elk and bison herd had declined in numbers compared to Alternative 1. Although the overall impacts on wolves, grizzly bears, and bald eagles could be negative, the intensity would be no more than negligible to minor. This alternative would not result in the impairment of wolves, grizzly bears, and bald eagles in the park.

Alternative 3

Analysis

In some years fewer elk under Alternative 3 could negatively affect scavengers, such as bald eagles, wolves, and grizzly bears. Gut piles and other carcass remains and wounded animals not retrieved by hunters would provide scavengers with food in the fall and winter because elk and elk hunting would be carried out on the refuge and in the national forest, and the elk reduction program would take place in the park. This food source would increase in the short term on the refuge and in the park as hunting was increased to reduce the Grand Teton elk herd segment.

Compared to Alternative 1, scavengers could be negatively impacted because the bison population would not be allowed to grow without limit under Alternative 3, resulting in fewer bison carcasses to scavenge. However, during the hunting season there could be more gut piles on the refuge and since supplemental feeding would occur only in severe winters, there could be more winter-killed

elk and bison throughout Jackson Hole in non-feeding years.

The estimated lower numbers of elk under Alternative 3 would still be sufficient to feed any foreseeable number of wolves that could inhabit Jackson Hole (see calculations under Alternative 1).

Reducing refuge supplemental feeding to severe winters only would likely decrease wolf hunting success by eliminating elk concentrations on the refuge in most years. During non-feeding years on the refuge, wolves would either hunt elk wintering on native range in the area or they could move to nearby state-run feedgrounds.

Even though overall numbers of elk could be lower in some years, grizzly bears could benefit from more elk being on native winter range rather than concentrated on the refuge. This could mean that more winter-killed elk and bison would be available as carcasses in the spring for grizzly bears. Grizzly bears could also be negatively impacted by the reduction in elk numbers to 500–1,000 in the park, which would result in fewer elk calves as potential prey in the spring.

If large numbers of elk migrated in the long term to the Green River basin and the Red Desert in the winter (assuming that supplemental feeding by the state on the Gros Ventre feedgrounds would end in the future), there could be fewer prey animals for wolves, grizzly bears, and bald eagles in the Jackson Hole area compared to baseline conditions and Alternative 1. However many elk would remain on the refuge in the Gros Ventre, Buffalo Valley, and other areas of Jackson Hole that contain winter range. Therefore, wolves, grizzly bears, and bald eagles could be negatively affected, but only to a minor degree compared to baseline conditions and Alternative 1. Scavengers in the Green River basin and the Red Desert would benefit, but only to a minor degree due to the larger number of wintering ungulates and more carcasses.

Effects of disturbance to wolves, grizzly bears, and bald eagles due to elk and bison brucellosis vaccination would be minor and temporary.

As described under Alternative 1, wolf, grizzly bear, and bald eagle populations in Jackson Hole would not be affected or would be affected to a

minor degree by bovine tuberculosis (Roffe, pers. comm. 2003). There would be a moderate reduction in the potential for transmission of this disease from elk and bison to wolves, grizzly bears, and bald eagles under Alternative 3 compared to Alternative 1 due to reduced prevalence. However, the potential for transmission from bison would be slightly higher than under Alternative 2 because more bison would be present in the herd.

Compared to baseline conditions and Alternative 1, there would be a decreased risk for hunters killing grizzly bears on the National Elk Refuge. Although there would be both an elk hunt and a bison hunt, fewer elk would be coming to the refuge in the long term, and therefore fewer hunters. Grizzly bears would also have to begin to frequent the refuge in the future in order for there to be any risk.

In the park the risk of hunters killing grizzly bears would be much less than under baseline conditions and Alternative 1 because the Grand Teton elk herd segment would be smaller, requiring fewer hunters deputized for the elk reduction program. In some years, it might not be necessary to have a hunt, in which case the risk of killing grizzly bears would be zero.

Conclusion

Most wolves, grizzly bears, and bald eagles on the refuge and in the park would benefit in years of high elk and bison mortality and could be negatively affected in mild years after the elk and bison herds had declined in numbers compared to Alternative 1. However, grizzly bears could benefit from elk and bison being more distributed over the landscape and suffering higher winter mortality. Although the overall impacts on wolves, grizzly bears, and bald eagles could be negative, the intensity would be no more than minor. This alternative would not result in the impairment of wolves, grizzly bears, or bald eagles in the park.

Alternative 4

Analysis

During winters that elk were supplementally fed on the National Elk Refuge, the effects of Alternative 4 on most wolves, grizzly bears, and bald eagles with regard to elk as a prey species would

probably be similar to baseline conditions and Alternative 1.

An estimated 2,000 more elk could be using native winter range compared to baseline conditions and Alternative 1; therefore, a larger number of elk would be subject to higher winter mortality. Grizzly bears could benefit if more winter-killed elk and bison died in areas accessible to bears after they emerged from hibernation in the spring.

If, or when, no supplemental feeding was provided, the vulnerability and mortality of elk and bison on the refuge could be higher, and wolves, grizzly bears, and bald eagles could benefit compared to baseline conditions and Alternative 1.

In the short term, as the bison herd was reduced from an estimated 1,000 animals (at the signing of the Record of Decision) to approximately 500, the food source for all predators and scavengers, including grizzly bears, bald eagles, and wolves, would be temporarily increased during the hunting season. The bison hunt would be highly managed, and the risk for increased conflicts between hunters and grizzly bears, while already low, would be minimized as necessary during the hunt. In the long term, compared to Alternative 1, scavengers would still benefit but to a lesser degree because fewer bison would be in the herd and fewer would need to be harvested, leaving fewer gut piles.

Effects of disturbance to wolves, grizzly bears, and bald eagles due to brucellosis vaccination would be similar to the effects of the feeding program and would be minor and temporary.

As described under Alternative 1, wolf, grizzly bear, and bald eagle populations in Jackson Hole would not be affected or would be affected to a minor degree by bovine tuberculosis (Roffe, pers. comm. 2003). There could be a minor reduction in potential for transmission of bovine tuberculosis from elk or bison to wolves, grizzly bears, and bald eagles under Alternative 4 due to decreased prevalence.

Wolves, grizzly bears, and bald eagles that consume elk would be exposed to brucellosis vaccine, Strain 19. No clinical trials have been conducted to determine if this vaccine is safe for non-target species. However, Cook and Rhyan (2002) noted,

“Field experience suggests that S19 is safe in many species of non-target wildlife.” The Wyoming Game and Fish Department (2002b) noted that “no disease or other problem attributable to the vaccine was seen in elk or other species,” as a result of vaccinating 23,640 elk from 1985 through 1995. Strain 19 has also been used on WGFD feedgrounds for 17 years, and no disease in non-target species has been observed. Species that had the greatest potential of being exposed include bears and many scavenging species of birds (Cook and Rhyan 2002). Therefore, Strain 19 would not be expected to have any negative effects on wolves, grizzly bears, or bald eagles in the short or long term.

Numerous studies indicate that RB51 does not effect nontarget species (Kreeger 2002). Species tested include deer mice, ground squirrels, voles, ravens, coyotes, dogs, and black bears. Therefore, RB51 would not be expected to have any negative effects on predators or scavengers in the short or long term.

The potential for elk and bison hunters killing grizzly bears on the National Elk Refuge would be less compared to baseline conditions (currently very low or nonexistent) and Alternative 1 because fewer elk would be on the refuge in the long term. There would also be a bison hunt on the refuge, but in the long term the numbers of animals that would be killed annually would be relatively small. This potential risk assumes that in the future grizzly bears would begin to frequent the National Elk Refuge.

In Grand Teton National Park the potential risk of deputized elk hunters killing grizzly bears would be less compared to baseline conditions and Alternative 1 because there would be fewer elk in the park and the elk reduction program would likely be changed as a result.

Conclusion

Most wolves, grizzly bears, and bald eagles on the refuge and in the park would benefit due to higher elk and bison mortality and wider distribution of carcasses during years when the refuge did not provide supplemental feeding. Wolves, grizzly bears, and bald eagles could benefit by a negligible amount due to higher elk mortality rates. Grizzly bears, which do not normally occur on the

refuge, would benefit from wider distribution of winter-killed elk and bison. During supplemental feeding years, the effects on wolves, grizzly bears, and bald eagles would be similar to Alternative 1. This alternative would not result in the impairment of wolves, grizzly bears, or bald eagles in the park.

Alternative 5

Analysis

The short- and long-term effects of elk numbers and distribution on wolves, grizzly bears, and bald eagles would be similar to the effects of baseline conditions and Alternative 1 with regard to elk as a prey species. Scavenging wolves, grizzly bears, and bald eagles would benefit in the short term as relatively large numbers of bison were killed to bring numbers down from an estimated 1,000 (at the signing of the Record of Decision) to 400. Hunters would leave numerous gut piles on the refuge and in the national forest in the first few years as the herd was being reduced. While providing more food for threatened species, more gut piles on the refuge could increase conflict between grizzly bears and humans, which could increase grizzly bear mortality. In the long term, compared to Alternative 1, these threatened species would still benefit but to a lesser degree because fewer bison would be in the herd and fewer would need to be harvested, leaving fewer gut piles. Furthermore, fewer would be destroyed on private lands.

Effects of disturbance to wolves, grizzly bears, and bald eagles due to brucellosis vaccination would be similar to the effects of the feeding program, which are minor and temporary.

Strain 19 and RB51 would not be expected to have any negative effects on wolves, grizzly bears, and bald eagles in the short and long terms, as discussed for Alternative 4.

The potential for elk and bison hunters to kill grizzly bears on the National Elk Refuge would be less compared to baseline conditions (currently very low or nonexistent) and Alternative 1 because there would be fewer hunters in the field. There would also be a bison hunt on the refuge, but in the long term the numbers of bison that would be killed annually would be relatively small. This potential risk assumes that in the future

grizzly bears would begin to occur on the National Elk Refuge more frequently.

In Grand Teton National Park the potential risk for deputized elk hunters to kill grizzly bears would be less compared to baseline conditions and Alternative 1 because there would be fewer elk in the park and the elk reduction program would likely be changed as a result.

Conclusion

With regard to elk numbers and distribution, the effects on wolves, grizzly bears, and bald eagles on the refuge and in the park would be similar to the effects of Alternative 1. Scavenging wolves, grizzly bears, and bald eagles would greatly benefit in the short term from gut piles left by hunters as bison numbers were reduced from about 1,000 animals to 400. While providing more food for threatened species, more gut piles on the refuge could increase conflict between grizzly bears and humans, which could increase grizzly bear mortality. Scavenging threatened species would continue to benefit in the long term from the bison hunt but to a lesser degree because fewer animals would be killed. Overall impacts on wolves, grizzly bears, and bald eagles in the long term would be similar to Alternative 1. This alternative would not result in the impairment of wolves, grizzly bears, or bald eagles in the park.

Alternative 6

Analysis

In some years fewer and more widely distributed elk and bison under Alternative 6 could negatively affect wolves, grizzly bears, and bald eagles. However, grizzly bears do not normally occur on the refuge, and therefore, carcasses that are more distributed across the landscape would be a potential benefit for bears. In severe winters scavengers both on and off the refuge would benefit by the larger number of winter-killed elk and bison because the winter mortality rate would no longer be kept artificially low by supplemental feeding.

Possible benefits of changes in carcass availability could be offset to an unknown extent by periodic reductions in elk numbers to an estimated 1,200–1,600 in the park. Fewer elk in the park would also result in fewer elk calves for grizzly bears to

prey on in the spring. If bears turned to livestock as a result of fewer elk calves in the spring, more bears could potentially be killed by government authorities and ranchers.

As numbers of elk decreased on the refuge and in the park in the long term, the number of elk killed during the hunting season would also decrease; therefore, available gut piles and other carcass remains would decline. Bison hunting would initially provide many gut piles for scavengers, but as the bison herd was reduced to the objective of an estimated 500 post-hunt, the number of gut piles available each hunting season on the refuge would be much less. Scavenging wolves, grizzly bears, and bald eagles would benefit in the short term. While providing more food for threatened species, more gut piles on the refuge could increase conflicts between grizzly bears and humans, which could increase grizzly bear mortality. In the long term these threatened species could be negatively affected by a major amount due to fewer gut piles and other remains compared to baseline conditions and Alternative 1.

Alternative 6 would not deter elk and bison hunting in Bridger-Teton National Forest. However, hunting opportunities and the resulting gut piles would fluctuate as elk herd numbers varied. Compared to baseline conditions and Alternative 1, the number of gut piles and other remains would be moderately higher when the elk herd was at the 11,000 objective because as the Grand Teton herd segment decreased, the Teton Wilderness herd segment would represent a greater proportion of the herd. After hard years, when the elk herd numbers could fall to an estimated 8,100, the number of gut piles would be moderately reduced because hunting would be reduced to allow the elk herd to rebound. Therefore, in some years scavenging threatened species would benefit by a moderate amount from more gut piles and other remains compared to baseline conditions and Alternative 1. However, more gut piles could increase grizzly bear mortality as a result of conflicts with hunters. In years when the elk herd was below objective, scavengers would be negatively affected by a moderate to major amount due to fewer available gut piles.

Gut piles would increase in Grand Teton National Park and the refuge in the short term while elk numbers were being reduced, but would eventu-

ally decrease by a major amount in the long term. If the grizzly bear population expanded southward, bears could increase their use of gut piles and other remains compared to current conditions since they do not now use gut piles on the refuge or in the southern part of the park. In the long term, whatever use grizzly bears could make of gut piles and carcass remains would be less by a major amount under Alternative 6 than under baseline conditions and Alternative 1 due to fewer elk on the refuge and in the park.

While grizzly bears and bald eagles depend on a variety of food sources, with elk and bison carcasses and/or calves serving as rich fat and protein sources, wolves in the Jackson Hole area rely on large ungulates for most of their sustenance. Major reductions in elk numbers could have negative impacts on wolf populations if other ungulates were not numerous enough to provide an alternate food source.

The estimated lower numbers of elk in some years under Alternative 6 would still be sufficient to feed the foreseeable numbers of wolves that could inhabit Jackson Hole. (See calculations under Alternative 1.) Lower elk numbers would primarily occur in the park, which could limit further expansion of wolf packs in the park.

Until recently, wolves in the Jackson Hole area have not spent much time on the National Elk Refuge, preferring to hunt in the Gros Ventre River drainage and focusing on the WGFDD feedgrounds. Since the Wyoming Game and Fish Department would likely continue to provide supplemental feeding in the Gros Ventre River drainage, wolves could continue to spend much of their time in the winter hunting elk concentrated on these feedgrounds. Therefore, wolves might not be affected by the elimination of feeding on the refuge.

If large numbers of elk migrated outside the Jackson Hole area in the winter (assuming that feeding in the Gros Ventre would end sometime in the future), fewer elk and bison would die on native winter range in the Jackson Hole area. Therefore less food would be available for wolves, grizzly bears, and bald eagles compared to a situation in which most elk remained in the Jackson Hole area. However, many elk would remain in the Gros Ventre River drainage, Buffalo Valley, and other areas of Jackson Hole that contain winter

range. Therefore wolves, grizzly bears, and bald eagles could be negatively affected, but only to a negligible degree compared to baseline conditions and Alternative 1. Wolves, grizzly bears, and bald eagles in areas outside the Jackson Hole area could benefit but only to a negligible degree due to more wintering ungulates in these areas.

If grizzly bears continued to expand their range southward and individual bears began to frequent the National Elk Refuge, the risk of hunters killing grizzly bears compared to current conditions could increase because no grizzly bears have been seen on the refuge in more than a decade. Compared to Alternative 1, the short-term risk of killing grizzly bears might also increase if grizzly bears began inhabiting the refuge because elk harvest levels would increase in order to bring the Grand Teton elk herd segment down, so more hunters would be in the field. In the long term the risk of killing grizzly bears could decrease because even though there would be both an elk hunt and a bison hunt, fewer elk would be coming to the refuge and potentially fewer hunters would acquire permits.

In the park the risk of deputized elk hunters killing grizzly bears would be higher in the short term compared to baseline conditions and Alternative 1 due to a higher harvest rate to bring the Grand Teton elk herd segment down to 1,200–1,600 elk. In the long term the risk of killing grizzly bears would be lower than Alternative 1 because the park elk herd segment would be smaller and the elk reduction program would likely be changed as a result.

Conclusion

Most wolves, grizzly bears, and bald eagles on the refuge and in the park would benefit in years of high elk and bison mortality and could be negatively affected in mild years after the elk and bison herds had declined in numbers compared to Alternative 1. Although the overall impacts on wolves, grizzly bears, and bald eagles could be negative, the intensity would be no more than minor. Grizzly bears could benefit from elk and bison being more distributed over the landscape and suffering higher winter mortality. This alternative would not result in the impairment of wolves, grizzly bears, and bald eagles in the park.

Mitigation

Mitigation measures would not be necessary.

YELLOW-BILLED CUCKOO

Yellow-billed cuckoos, a candidate species, require woody riparian habitat with dense understory. Although the cuckoo has rarely been observed in the Jackson Hole area, changes in riparian and aspen woodland habitats could potentially affect individual birds that may occasionally occur in Jackson Hole.

Impacts of the Alternatives

Impacts Common to All Alternatives

Yellow-billed cuckoos would not be adversely impacted by management activities associated with the supplemental feeding program for elk and bison under Alternatives 1, 3, 4, and 5. Supplemental feeding would be phased out under Alternative 2, Option B of Alternative 3, and Alternative 6. During the phaseout period, management activities associated with supplemental feeding would not adversely impact yellow-billed cuckoos because supplemental feeding occurs during winter when they would have migrated to their winter feeding grounds.

To the extent that yellow-billed cuckoos nest on or migrate through the refuge and the park, they would likely not be adversely impacted by activities associated with elk and bison hunting in any alternative because they would have migrated out of the area by the time hunting occurred (no hunting would be allowed under Alternative 2).

Yellow-billed cuckoos would not be adversely impacted by management activities associated with a brucellosis vaccination program for elk and bison under Alternatives 3, 4, and 5 because this would happen in winter when cuckoos would have already migrated.

Alternative 1

Analysis

Yellow-billed cuckoos could be negatively affected on the refuge in the short and long terms under Alternative 1 by a decline in the amount and condition of cottonwood and willow habitats. Heavy

browsing by large numbers of elk and growing numbers of bison would continue to reduce understory plants and prevent regeneration of cottonwood and willow plants, resulting in a loss of an estimated 50 acres of willow habitat and an estimated 220 acres of cottonwood habitat. Also, an estimated 1,450 acres of suppressed willow plants would not recover on the southern part of the refuge and would eventually disappear.

In the park and the national forest some areas of woody riparian habitat that could be yellow-billed cuckoo habitat would be negatively affected by large numbers of elk and growing numbers of bison browsing, trampling, and rubbing.

Potential yellow-billed cuckoo habitat on other federal and state lands and private lands would not be affected by actions being considered under Alternative 1 any differently than they have been affected in the recent past.

Conclusion

Yellow-billed cuckoos on the refuge and in the park could potentially be negatively affected due to a loss of acreage and a decline in the condition of woody riparian habitat compared to baseline conditions. This alternative would not result in the impairment of yellow-billed cuckoos in the park.

Alternative 2

Analysis

Yellow-billed cuckoos could potentially be negatively affected on the refuge in the short and long terms under Alternative 2 due to the continued decline in the amount and condition of woody riparian habitats. Heavy browsing by elk and bison would continue to reduce understory plants and prevent regeneration of cottonwood and willow trees, resulting in a loss of an estimated 150–230 acres of willow and cottonwood habitat. In addition, an estimated 1,400 acres of suppressed willow plants would not recover and would eventually disappear from the southern part of the refuge. Compared to Alternative 1, yellow-billed cuckoos under Alternative 2 would be positively impacted in the short and long terms due to an estimated 40–150 more acres of habitat, but the effects would likely be negligible.

In the park yellow-billed cuckoos could benefit from increased acreage and improved condition of woody riparian habitats due to fewer elk and bison summering in the park compared to baseline conditions and Alternative 1.

To the extent that yellow-billed cuckoos nested on or migrated through the refuge and the park, they would likely not be adversely impacted by activities associated with bison fertility control under Alternative 2. If fertility control took place on the refuge during winter, yellow-billed cuckoos would have already migrated out of the area. If the fertility control program was conducted in the park, any yellow-billed cuckoos present could potentially be disturbed for a short period by the presence of humans in woody riparian habitats. However, the number of people engaged in this activity would be relatively few at any given time, so the extent of disturbance would be negligible.

Yellow-billed cuckoos could be negatively impacted in the long term by the decline in condition and acreage of woody riparian habitats in localized areas of the national forest.

If large numbers of elk did not migrate outside the Jackson Hole area, yellow-billed cuckoos on BLM lands and private lands in the Jackson Hole area could be negatively impacted. Without supplemental winter feeding on the refuge, elk would likely forage more often on private lands, which could result in further habitat degradation, reduced residual vegetation, and loss of acreage in some areas.

If large numbers of elk did migrate outside Jackson Hole in the winter, yellow-billed cuckoos in the Green River basin could be negatively impacted in localized areas as a result of cottonwood and willow habitats experiencing higher levels of browsing, which could result in habitat degradation and loss of acreage in some areas.

Conclusion

Yellow-billed cuckoos on the refuge could potentially benefit under Alternative 2 due to less habitat being lost and a smaller decline in the condition of woody riparian habitat compared to Alternative 1. However, the effects would likely be minor. In the park, yellow-billed cuckoos could benefit from increased habitat and improved condition

of woody riparian habitat compared to Alternative 1. This alternative would not result in the impairment of yellow-billed cuckoos in the park.

Alternative 3

Analysis

Yellow-billed cuckoos on the refuge could potentially benefit under Alternative 3, compared to Alternative 1, due to a major increase in willow habitat and no net loss of cottonwood habitat. An estimated 1,450 acres of suppressed willow plants currently in wet meadow habitat would recover to good and fair condition willow stands, and an estimated 220 acres of cottonwood habitat would not convert to other habitat types as a result of fewer browsing elk and bison on the refuge.

Yellow-billed cuckoos in the park could potentially benefit from increased acreage and improved condition of woody riparian habitats due to fewer elk summering in the park compared to current conditions and Alternative 1.

Yellow-billed cuckoos could potentially be negatively impacted in the long term by the decline in condition and acreage of woody riparian habitats in localized areas of the national forest.

The effects of Alternative 3 on yellow-billed cuckoos on BLM lands and private lands in the Jackson Hole area and in the Green River basin would be similar to Alternative 2.

Conclusion

Yellow-billed cuckoos on the refuge and in the park could be positively affected due to the improved condition and increased acreage of woody riparian habitat compared to Alternative 1. This alternative would not result in the impairment of yellow-billed cuckoos in the park.

Alternative 4

Analysis

Yellow-billed cuckoos could benefit under Alternative 4, compared to Alternative 1, by an increase in willow habitat and a decreased loss of cottonwood habitat on the refuge. An estimated 250 acres of suppressed willow plants in the short term and an estimated 500 acres in the long term

would recover to willow stands. In addition, only an estimated 150 acres of cottonwood habitat would convert to other community types, compared to an estimated 220 acres of cottonwood habitat under Alternative 1.

In the park yellow-billed cuckoos could be positively affected by minor improvements in the condition of woody riparian habitats compared to Alternative 1.

Yellow-billed cuckoos could be negatively impacted in the long term by the decline in condition and acreage of woody riparian habitats in localized areas of the national forest.

Conclusion

Yellow-billed cuckoos on the refuge could be positively affected due to the improved condition and increased acreage of woody riparian habitat compared to Alternative 1. Yellow-billed cuckoos in the park would likely be positively affected due to minor improvements in woody riparian habitats compared to Alternative 1. This alternative would not result in the impairment of yellow-billed cuckoos in the park.

Alternative 5

Analysis

Yellow-billed cuckoos could benefit under Alternative 5, compared to current conditions and Alternative 1, by an increase in willow habitat and a decreased loss of cottonwood habitat on the refuge. An estimated 250 acres of suppressed willow plants would recover to willow stands in the short term and an estimated 500 acres in the long term. In addition, only an estimated 150 acres of cottonwood habitat would convert to other community types, compared to an estimated 220 acres of cottonwood habitat under Alternative 1.

Yellow-billed cuckoos in the park could potentially benefit by a negligible to minor degree due to improvements in the condition of woody riparian habitats, compared to current conditions and Alternative 1.

Yellow-billed cuckoos in the national forest would not be affected by Alternative 5 any differently than they have been in the recent past.

Conclusion

Yellow-billed cuckoos on the refuge could be positively affected due to the improved condition and increased acreage of woody riparian habitat compared to baseline conditions and Alternative 1. The effects of Alternative 5 on yellow-billed cuckoos in the park would likely be positive due to minor improvements in woody riparian habitats compared to Alternative 1. This alternative would not result in the impairment of yellow-billed cuckoos in the park.

Alternative 6

Analysis

Yellow-billed cuckoos could potentially benefit under Alternative 6 on the refuge, compared to Alternative 1, by an increase in willow habitat. An estimated 1,450 acres of suppressed willow plants currently in wet meadow habitat would recover to good and fair condition willow stands, and an estimated 150 acres of cottonwood habitat would not convert to other habitat types due to fewer browsing elk and bison on the refuge.

Yellow-billed cuckoos in the park could potentially benefit from increased acreage and the improved condition of woody riparian habitats due to fewer elk and bison summering in the park compared to Alternative 1.

Yellow-billed cuckoos could potentially be negatively impacted in the long term by the decline in condition and acreage of woody riparian habitats in localized areas of the national forest due to more elk browsing on native winter range.

If large numbers of elk did not migrate outside the Jackson Hole area, yellow-billed cuckoos on BLM lands and private lands in the Jackson Hole area could be negatively impacted in localized areas. Elk that were no longer being fed on the refuge in the winter would likely forage more often on private lands compared to Alternative 1, and higher levels of browsing could result in habitat degradation, reduced residual vegetation, and loss of acreage in some areas.

If large numbers of elk did migrate outside the Jackson Hole area in the winter, yellow-billed cuckoos on federal, state, and private lands in other locations could be negatively impacted in

localized areas. This could occur if cottonwood and willow communities experienced higher levels of browsing, resulting in habitat degradation and loss of acreage in some areas.

Conclusion

Yellow-billed cuckoos on the refuge and in the park could be positively affected due to the improved condition and increased acreage of woody riparian habitat compared to Alternative 1. This alternative would not result in the impairment of yellow-billed cuckoos in the park.

Mitigation

Measures to mitigate adverse effects on yellow-billed cuckoos would be the same as those for avoiding or lessening adverse impacts to riparian and aspen woodland communities (see “Impacts on Habitat”).

Cumulative Effects

Transportation Improvements

The reconstruction of 38 miles of U.S. 26/287 over Togwotee Pass would result in short-term disturbance and displacement of threatened and endangered species and could affect the movement of threatened and endangered species in the Buffalo Valley area. The total amount of habitat that could be disturbed for each threatened or candidate species is 275 acres for the grizzly bear and the gray wolf, 218 acres for the bald eagle, and 21 acres for the yellow-billed cuckoo. The potential displacement, movement barrier, and mortality impacts from highway construction for the gray wolf, the bald eagle, and the yellow-billed cuckoo would be similar to what currently occurs and is not expected to negatively affect these species. Additional retaining walls and guardrails could result in additional changes to grizzly movements but are not expected to negatively affect grizzly bear populations. By agreement with the U.S. Fish and Wildlife Service, the highway itself, with or without new construction, likely negatively affects individual grizzly bears already, and a biological opinion and incidental take permit will be required.

The planned highway improvements could disturb and displace threatened, endangered, and candi-

date species during construction. In the long term changes to the highway could decrease habitat and potentially increase mortality due to greater numbers of vehicle collisions with grizzly bears and wolves if traffic volumes increased. The highway improvement plan recommends reducing the posted speed limit from 65 to 55 mph, which might prevent at least some accidental deaths. Upgrading an existing highway is not expected to result in extensive effects in terms of blocking movement corridors.

###Cumulative effects would not occur under Alternatives 1 and 5 considered in this environmental impact statement because elk distribution, movements, and mortality rates would remain similar to baseline conditions; therefore, the effects on grizzly bears, wolves, and bald eagles would remain similar to baseline conditions. Cumulative effects on grizzly bears, wolves, and bald eagles under Alternatives 2, 3, 4, and 6 would likely be negligible. Cumulative effects on the yellow-billed cuckoo would also likely be negligible given the small amount of habitat (21 acres) affected.

Federal Land Management Activities

Grand Teton National Park Fire Management

Mechanical treatments could result in a small reduction in threatened and endangered species habitat, reduced habitat quality, and short-term disturbance effects that could displace animals near the Wildland Urban Interface (WUI) areas. However, these actions are not expected to adversely affect endangered or threatened species at a population level because habitat effectiveness in WUI areas and immediately surrounding areas has already been reduced. WUI areas represent a small part of the 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 threatened or endangered species from some habitat areas, but the long-term effects could create vegetative diversity, thus improving foraging

opportunities (grizzly bears and yellow-billed cuckoos) and nesting and migrating habitat (yellow-billed cuckoos).

Alternative 1 would not result in cumulative effects as a result of Grand Teton National Park fire management. Alternatives 2–6 would convert formerly cultivated areas in the southern portion of the park to native vegetation. These conversion activities could disturb and displace threatened or endangered species in the short term from nearby habitat and could add to short-term habitat losses caused by park fire management. These activities would likely affect few threatened or endangered species because they are widely dispersed in the park during the summer.

Grand Teton National Park Recreation Infrastructure Improvements

The proposed implementation of multi-use pathways, the realignment of portions of the Moose–Wilson Road, and other transportation improvements would result in site-specific, temporary impacts along existing transportation corridors. The finished trail would attract additional recreationists along the Snake River corridor during the summer and possibly cross-country skiers in the winter.

Any future improvements to the Gros Ventre campground would result in site-specific, temporary impacts during construction and would result in a minor increase in the number of summer campers and the potential for displacement of threatened or endangered species. These improvements would potentially increase disturbance to threatened or endangered species in summer and alter distribution and habitat use, although effects would likely be negligible because habitat effectiveness in these areas is already reduced.

Alternative 1, in combination with the effects of Grand Teton infrastructure improvements, would not result in cumulative effects. Alternatives 2–6 could result in additional displacement of threatened or endangered species as a result of greater human presence in southern portions of the park during conversion of formerly cultivated areas to native vegetation.

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

The *Temporary Winter Use Plan Environmental Assessment* identifies wolves and grizzly bears as the threatened and endangered species most likely to be affected by disturbance and displacement due to winter motorized recreation. Yellow-billed cuckoos have already migrated to their winter feeding grounds by the time that winter recreation begins. Oversnow motorized vehicles are not expected to disturb bald eagles in Grand Teton National Park or John D. Rockefeller, Jr., Memorial Parkway because the travel corridor does not closely follow the Snake River. Although most grizzly bears are in their dens by December 15 and most dens in the park are located in remote areas, grizzly bears that emerge from their dens prior to March 15 could be disturbed by winter recreational activities.

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

No impacts to threatened or endangered species on adjacent lands outside the park are anticipated. Because the selected alternative would allow a number of snowmobiles into the park that is near the historical average daily visitation, it is unlikely to result in significant visitor displacement to surrounding federal, state, or county land, except during high use periods (Christmas week and Presidents Day weekend).

Alternatives 1, 4, and 5 would not result in cumulative impacts to wolves and grizzly bears from planned winter use activities. Alternatives 2, 3, 4, and 6 would increase the number of elk on native winter range in some years and the number of winter-killed elk carcasses. Grizzly bears and wolves feeding on these carcasses could be disturbed and displaced with greater frequency due

to oversnow vehicles. Areas designated as crucial elk winter range would not be affected because closures would continue.

Bridger-Teton National Forest Fuels Management Projects

Bridger-Teton National Forest has identified a variety of fuels reduction and habitat enhancement projects in the primary and secondary analysis areas. These ongoing projects would alter about 9,400 acres of national forest lands and could temporarily disturb and displace threatened or endangered species. In the long term, however, most of these projects would improve transitional and winter habitats for ungulates, which would benefit threatened or endangered predator species that prey on elk and other ungulates. More diverse woody riparian areas would also benefit yellow-billed cuckoos. The bison and elk management alternatives considered in this environmental impact statement are not anticipated to result in cumulative effects on threatened or endangered species relative to the planned fuels management projects.

Bridger-Teton National Forest Recreation Planning / Moose-Gypsum Projects

The dispersed recreation camping site plan could result in beneficial cumulative effects to yellow-billed cuckoos due to improved nesting habitat in the Green River basin plus improved habitat on the refuge under Alternatives 3–6.

BLM Snake River Resource Management Plan

Greater public access or use in areas of sensitive wildlife habitats, including overnight camping, would likely increase the potential for more human/wildlife conflicts along the Snake River. Impacts to woody riparian habitat that yellow-billed cuckoos depend on could occur if livestock grazing was allowed by the acquiring or managing agencies or entities. The retention of conservation easements and continued management for open space and wildlife habitat would protect threatened and endangered species habitat. Pursuit of a long-term protective withdrawal to prohibit the staking and development of mining claims would also benefit yellow-billed cuckoos by preventing potential adverse impacts to foraging or nesting habitats.

Cumulative effects are not expected under Alternatives 1 and 5 because these alternatives would not affect the amount of browsing by elk in woody riparian habitats. Alternatives 2, 3, 4, and 6 would increase elk distribution in some years and the potential for heavy browsing that could reduce the quality of habitat for yellow-billed cuckoos.

Pinedale Anticline Oil and Gas Exploration and Development Project

Oil and gas development activities in the Pinedale anticline project area are not likely to adversely affect the bald eagle or the Canada lynx, provided that surveys are conducted and that reasonable and prudent protective measures are implemented. The bison and elk management alternatives are not anticipated to result in cumulative effects to bald eagles or other threatened or endangered species relative to the Pinedale anticline project.

Snake River Restoration Activities

The Snake River restoration project by the U.S. Army Corps of Engineers could impact habitat for various wildlife species, including the yellow-billed cuckoo, along the Snake River. This project would prevent further degradation of habitat and facilitate habitat recovery.

Cumulative effects are not expected under Alternatives 1 and 5 primarily because these alternatives would not increase or alter elk distribution and the potential for heavy browsing in woody riparian habitats. Alternatives 2, 3, 4, and 6 would increase elk distribution in some years, with the potential for heavy browsing in yellow-billed cuckoo habitat, which could offset the benefits of restoration.

Population Growth and Private Land Development

Projected population increases in both Teton and Sublette counties will continue to create development pressure for private land. Habitat loss, more encounters and conflicts between threatened/endangered species and humans, vehicle collisions, and changes to animal movements could occur.

The loss of woody riparian habitat under Alternatives 1 and 2, combined with loss of habitat to private development, would likely have negative cu-

mulative effects on yellow-billed cuckoos. Although the amount of woody riparian habitat on the refuge would increase under Alternatives 3–6, the beneficial cumulative effects would be negligible when combined with the negative effects of loss of habitat on private lands.

Although the continued loss of habitat on some private lands could negatively affect bald eagles, grizzly bears, and wolves, the populations of these species in the study area are currently expanding, and the specific impacts of private land development are not known. In addition, under all alternatives the refuge and the park would continue to preserve about 358,000 acres of habitat that would be available to these species. For these reasons cumulative effects on wolves, grizzly bears, and bald eagles would not occur under any alternative.

MAMMALS

OTHER UNGULATES

The analysis of potential effects of management alternatives on mule deer, moose, bighorn sheep, and pronghorn is of particular importance in this planning process because providing a refuge and grazing habitat for these other ungulate species are major purposes of the National Elk Refuge, and mule deer, moose, and bighorn sheep populations are declining in the Jackson Hole area (Minta and Campbell 1991; Brimeyer, pers. comm. 2003; Berger, pers. comm. 2004). Analyzing the potential effects on these species is generally important given the requirement to conserve all native wildlife species on national wildlife refuges and in national parks, as well as the requirement under the National Environmental Policy Act to analyze potential effects on affected resources.

The way that elk and bison are managed in Jackson Hole influences the health and viability of other ungulate species, especially mule deer and bighorn sheep. Where winter ranges overlap, elk and bison can outcompete mule deer and bighorn sheep (Murie 1951; F. K. Nelson 1982; W. Miller 2002). Habitat preferences (e.g., bighorn sheep prefer escape terrain and nearby areas) may limit the extent of competition. Improvements to refuge forage production and interagency enhancements to winter and transitional range for all ungulates on national forest lands would likely decrease competition for forage.

Impacts of the Alternatives

Impacts Common to All Alternatives

Habitat and Forage Competition Effects

The distribution of elk, bison, and other ungulates overlaps extensively during summer and fall. However, the diets of elk and bison differ from the diets of mule deer and moose during these seasons (F. K. Nelson 1982; Miller 2002), and forage and habitat resources could be partitioned among elk, bison, mule deer, bighorn sheep, moose, and pronghorn in areas where their distributions overlap (Houston 1982). Elk primarily graze on grasses during summer and fall, and mule deer and moose primarily forage on forbs and browse during these seasons. Furthermore, forage used by mule deer and moose during summer and fall is not limiting. Although the distribution of bison also overlaps with the distribution of mule deer and moose in some areas during the summer and fall, habitat use and diet are substantially different.

Elk distribution and habitat use is substantially different than that by pronghorn and bighorn sheep, and the diets of elk and pronghorn are much different during summer and fall. Therefore, direct competition for forage is minimal. Although the distribution of bison overlaps extensively with the distribution of pronghorn during summer and early fall in the park, the diet of bison overlaps little with the diet of pronghorn. Bison primarily eat grass, and pronghorn primarily eat forbs during their stay in Jackson Hole. Furthermore, bison can enhance the availability and production of forbs for pronghorn in some locations (Houston 1982; Yoakum et al. 1996), although this has not been studied in the park. Therefore, differences in bison numbers among alternatives would likely not adversely affect pronghorn in Jackson Hole. The distribution of bison and bighorn sheep do not overlap during summer and fall.

Marshland habitat is not used by other large ungulates, except moose in some locations. However, the marshland habitat used by moose would not be affected under any alternative.

The range of bighorn sheep in the park only minimally overlaps with the distribution and habitat use of elk, and there is little overlap in winter range. The distributions of bison and bighorn sheep do not overlap in the park. Therefore, none

of the alternatives would affect bighorn sheep in the park.

Disease Impacts

Effects of Documented Microparasitic Diseases — Brucellosis is not expected to directly adversely impact populations of mule deer, white-tailed deer, pronghorn, moose, or bighorn sheep because serologic surveys for brucellosis in other ungulates have only found a fraction of a percent that were seropositive, and these species are likely dead-end hosts (Thorne et al. 1982, 1997; Disease Expert Meeting 2002; Davis 1990; Adrian and Keiss 1977; Foreyt, Evermann, and Heimer 1983).

Pasteurellosis has been observed in mule deer, pronghorn, and bighorn sheep and could have substantial impacts on bighorn sheep populations in some cases (Thorne et al. 1982; Peterson 2003). However, the potential for transmission of septicemic pasteurellosis from elk to these other ungulate species is unknown, but is likely low because behaviorally these species typically segregate or occupy different types of habitat and are rarely in contact with one another.

Although other wild ungulates (bighorn sheep, mule deer, pronghorn) may be susceptible to forms of necrobacillosis (Peterson 2003), these species are not expected to be impacted under any of the management alternative as a result of necrotic stomatitis (Disease Expert Meeting 2002).

Effects of Documented Macroparasitic Diseases — Psoroptic scabies is a condition found only in mammals. Scabies is widespread in Wyoming among free-ranging populations of bighorn sheep, Rocky Mountain bighorn sheep, white-tailed deer, and elk. Transmission from species to species does not occur (Murie 1951). Hence, other non-elk ungulate species, all other wildlife species, and livestock (Hepworth and Thomas 1962) would not be impacted by the presence of psoroptic mites in the Jackson elk herd under any alternative.

Lungworm species are specific to their particular host species (Peterson 2003; Disease Expert Meeting 2002), and the risk of interspecies transmission is low. Therefore, other ungulates would not be affected by elk lungworms under any alternative.

Effects of Undocumented Viral Microparasites and Prion Diseases — As previously discussed for elk, vesicular stomatitis is not likely to cause any impacts in ungulates under any of the alternatives (Disease Expert Meeting 2002). Foot-and-mouth disease and rinderpest are also not analyzed in detail because neither disease is present in the United States, and if they were introduced, the national response would be major and very aggressive (Disease Expert Meeting 2002).

Soil conditions do not appear to be conducive to maintaining the infectious anthrax endospores in the environment, as previously discussed for elk, so anthrax is not expected to measurably affect mule deer, moose, pronghorn, or bighorn sheep populations under any alternative. Risk of anthrax becoming established in Jackson Hole appears to be low under all alternatives.

Potential for other ungulates species to become infected by malignant catarrhal fever would be highest under Alternative 1 given the higher number of bison (followed by Alternatives 5, 4, 3, 2, and 6). However, because mule deer, moose, pronghorn, and bighorn sheep would rarely develop clinical signs and would rarely die (Heuschele and Reid 2001; Zarnke, Li, and Crawford 2002; Peterson 2003), populations of these species in the Jackson Hole area would be adversely affected to a negligible to minor degree at most under any of the alternatives.

Chronic wasting disease, if it became established in Jackson Hole, could affect moose to some degree, but moose social behavior likely makes it a species that would rarely contract the disease. Bighorn sheep and pronghorn would not be directly impacted under any of the alternatives because they do not appear to be susceptible (Williams, Kirkwood, and Miller 2001).

Effects of Management Actions — Pronghorn and bighorn sheep would not be directly affected by hunting activities on the refuge or in the park, or by the elimination of hunting in the two areas, because they are not found in hunt areas during the hunting season.

Winter feeding operations and the elimination of winter feeding would not directly affect mule deer, moose, pronghorn, or bighorn sheep because they do not inhabit the feeding sites on the refuge.

Alternative 1

Analysis

National Elk Refuge — During the spring, summer, and fall a small number of mule deer can be found in the Gros Ventre Hills and along the Gros Ventre River, but this use of the northern end of the refuge appears to be depressed compared to historical use of the area. This situation would likely not change in the short term, but over the long term, as aspen stands continued to disappear, use of the northern refuge would likely decline further.

Moose have likely been most affected by the loss of more than 1,000 acres of willow habitat along lower Flat Creek on the refuge, a result of heavy annual browsing by elk in association with winter feeding. This willow habitat would not be restored under Alternative 1, and the feasibility of future restoration of willow habitat would decline substantially, permanently eliminating an estimated 1,500 acres of moose habitat. Moose numbers along the Gros Ventre River would not be affected in the short term because this habitat is not expected to change. Declining acreage of aspen on the Gros Ventre Hills over the long term could potentially negatively affect the moose population but probably only to a negligible extent due to the already poor condition of these stands. The degradation of 220 acres of cottonwood habitat along the upper portion of Flat Creek has reduced the amount of moose habitat on the refuge, but only to a negligible degree, and this would not change under this alternative.

Under Alternative 1 direct competition between elk, bison, mule deer, and moose for forage in sagebrush shrublands on the refuge would continue to be minimal or non-existent because few if any mule deer would continue to winter on the refuge and because moose use sagebrush shrublands during winter in the northern portion of the refuge where wintering use by elk and bison is minimal. The number of mule deer wintering on Miller Butte, the main wintering area on the refuge, increased to highs of about 100–110 during the mid-1960s, but steadily declined to less than 30 by 1990 (Matson 2000), and no mule deer have wintered on Miller Butte the last several years. USFWS and WGFDD biologists feel that the decline and eventual disappearance of mule deer on the butte could have been due in part to a major

decline in the condition of browse species, which has in large part been due to heavy elk browsing. As a general rule, elk outcompete mule deer on winter ranges that are limited in size and forage since elk are more opportunistic than mule deer in their diet selection, are more easily able to digest low quality forage, and are more mobile (Wisdom and Thomas 1996). Nelson noted that mule deer may leave or avoid areas that are heavily used by elk even if forage was available (Nelson and Leege 1982). Elk are fed within ½-mile of the butte. Miller Butte was identified by Minta and Campbell (1991) as one of three important mule deer wintering areas in Jackson Hole, and the only one that occurs completely on federal land.

Up to a dozen mule deer winter on Boucher Hill above the fish hatchery and along the Gros Ventre River in some winters, although in some winters no deer winter in these areas. Although browse conditions appear to be better than they are on Miller Butte, they have also been adversely affected by elk due to the proximity to the feedgrounds on the refuge.

Direct competition between elk, bison, and wintering bighorn sheep for forage under Alternative 1 would continue to be minimal because few elk graze on the eastern side of Miller Butte, especially after winter feeding operations begin each winter. An average of 31 bighorn sheep have been observed on the refuge during the last five winters. It is anticipated that the refuge could continue to support 20–36 bighorn sheep or more each winter under Alternative 1. However, bison could increase grazing pressure on Miller Butte as their population continued to grow under this alternative, which could lower the carrying capacity for bighorn sheep.

Cultivated fields on the refuge would be anticipated to continue to receive only minimal use by pronghorn and mule deer, and this low level of use would continue. Most of this use occurs during the summer when elk and bison are not on the refuge; therefore, increases in bison numbers would not affect the use of cultivated fields by ungulates during the summer unless the bison population grew so large that it was not possible to move all bison off the refuge during the summer. Under natural conditions the sagebrush shrubland and grassland habitat that occurred in areas that are now under cultivation likely contributed to a

greater extent to sustaining populations of mule deer, moose, pronghorn, and possibly bighorn sheep.

While mule deer move from summer habitat to wintering areas about the same time as the refuge hunting season, elk hunting activities on the refuge could displace mule deer from parts of the northern end of the refuge. Deer movement off the refuge appears to roughly correspond to the initiation of elk hunting on the refuge (Brock, pers. comm. 2003). It does not appear that hunting activities have more than negligible or minor effects on moose distribution, survival, and production.

The fence along U.S. 26/89, which was constructed to block the movement of elk and bison onto the highway, would continue to also block the movement of bighorn sheep to East Gros Ventre Butte (just to the west of the refuge), thereby forcing them to remain on Miller Butte. Occasionally, bighorn sheep are observed pacing up and down the fence looking for a way to cross over to East Gros Ventre Butte. The fence could also block the movement of mule deer between East Gros Ventre Butte and Miller Butte.

Grand Teton National Park — Direct competition between elk and other ungulates for forage in riparian and aspen woodlands in the park occurs seasonally in localized areas. Elk and moose distributions overlap to a small extent during winter along Buffalo Fork, Spread Creek, and Gros Ventre River, but the highest concentrations of elk are associated with upland sites (where willow and cottonwood are not present), and moose tend to concentrate in the bottoms (Singer and Zeigenfuss 2003). Although elk use some of the same areas where moose winter, competition between the two species for browse appears to be minor in most of the park. An exception is in the Elk Ranch reservoir area where elk that graze in surrounding upland areas spend much of their time in the willows. These situations would continue under Alternative 1.

A 2002 study by McCloskey and Sexton concluded that as much as half of the aspen habitat in the park could disappear in the long term, in part due to heavy browsing by elk, but primarily due to fire suppression and encroachment by conifers. The park's new *Fire Management Plan* (NPS

2004b) aims to ensure that, unless a natural result of plant succession, fire continues to play its role in influencing vegetation patterns on much of the park landscape. Under Alternative 1 it is likely that high numbers of elk would continue to be regularly sustained in Jackson Hole as a result of supplemental winter feeding, and heavy continued browsing by elk would contribute to the loss of aspen habitat for mule deer and moose. Willow and cottonwood habitats used by mule deer and moose do not appear to be heavily browsed by elk in the park; therefore, animals in these habitats would be affected to a negligible degree.

Direct competition between elk, bison, and other ungulates in agricultural, native grassland, and sagebrush shrubland habitats in the park appears to be minimal, except seasonally in localized areas. Previous agricultural lands in the park would continue to be minimally used by mule deer, moose, and pronghorn both in the short and long terms. The distribution of elk only minimally overlaps with the distributions of mule deer and moose in sagebrush shrubland and grassland habitats during winter; therefore, the opportunity for direct competition for forage would be localized and negligible. Elk do not appear to be damaging sagebrush or other shrubland habitats in the park.

The overlap between the distribution and dietary needs of bison and other ungulates during winter is even more limited; therefore, no more than a negligible amount of direct competition would occur. Overgrazing and wallowing by bison in localized areas, which would increase as the population continued to grow, could potentially affect forage availability for other ungulates, but the effects would be negligible relative to the amount of forage available in the park. For example, there is some evidence that plant species diversity is lower in bison wallows (Collins and Uno 1980, as cited in Shaw 1996).

The elk herd reduction program in the park does not appear to adversely impact mule deer and moose populations, although hunting could have short-term effects on the distribution and habitat use of mule deer. The number of deputized hunters involved and the intensity of hunting activities can be high in some park areas. To the extent that mule deer prematurely left the refuge and park for their wintering grounds, they would be more subject to harvest outside these two areas.

Bridger-Teton National Forest — On winter range in the national forest elk compete directly for browse with mule deer and moose in riparian and aspen woodlands, and many years of high levels of browsing by elk and other ungulates has depleted available browse in some areas. Under baseline conditions, an estimated 2,900–5,200 elk would winter on native winter range (as compared to 4,400–7,900 during the last 15 years), and these elk would continue to contribute to the degradation of willow, aspen, and cottonwood habitat in the national forest, which would adversely affect mule deer and moose.

Under baseline conditions on winter range in the national forest, an estimated 2,900–5,200 elk would have the potential to compete directly for forage with mule deer, moose, and bighorn sheep in grassland, sagebrush, and other upland shrubland habitats. Elk could compete with mule deer and moose for browse such as bitterbrush, serviceberry, and sagebrush in a variety of habitats and areas. Elk also compete with bighorn sheep for bunchgrasses in localized areas in low-elevation bighorn wintering areas in the Gros Ventre River drainage, such as Crystal Creek, Red Hills, Lightning Creek, and Russold Hill (Brimeyer, pers. comm. 2003). On higher elevation bighorn winter ranges there is less potential for competition. Competition between elk and bighorn sheep could also occur in Curtis Canyon, which is adjacent to the refuge. It is not clear whether or how this competition is affecting mule deer, moose, and bighorn sheep populations, but the potential impacts would continue in the long term. Bison do not appear to be competing with other ungulates for forage in the national forest, except possibly to a negligible degree on south- and west-facing slopes immediately east of the refuge and park.

Other Lands — On BLM and private lands in the Jackson Hole area there is minimal competition between elk and other ungulates for winter browse and forage in most locations. This low level of competition has been heavily influenced by supplemental feeding of elk on the refuge and state feedgrounds in the Jackson Hole area; elk would continue to be drawn away (or hazed) from private lands to the refuge (or a state feedground) under Alternative 1.

Potential Effects of Bovine Tuberculosis and Paratuberculosis — Mule deer, moose, and bighorn sheep are susceptible to paratuberculosis, and most if not all are susceptible to bovine tuberculosis (Williams 2001; Peterson 2003). If these diseases became established in the Jackson elk and bison herds, the risk of transmission to other ungulates under Alternative 1 would continue to increase over the long term as prevalence and the number of clinical cases increased, which is expected due to high concentrations of elk and bison on the refuge. Although the majority of infected animals do not develop clinical symptoms, those that do eventually die (Williams 2001). Because mule deer and moose are not unnaturally concentrated in the study area, the disease would not likely become self-sustaining in the populations. If the winter feeding of elk and bison and no population control of bison on the refuge continued after tuberculosis or paratuberculosis became established in the herds, the elevated prevalence in the herds would provide a continual source of infection for mule deer, moose, and bighorn sheep. However, occurrences of mule deer and moose developing clinical symptoms and eventually dying from the disease would likely not be high enough to markedly affect the populations. However, the more gregarious nature of bighorn sheep and a greater propensity for bighorn sheep to maintain the disease (Williams 2001), could result in bighorn sheep being adversely affected by an outbreak of these diseases in the elk and bison herds.

Potential Effects of Chronic Wasting Disease — Elk, mule deer, and white-tailed deer are susceptible to chronic wasting disease, which is always fatal (Williams and Miller 2002). In addition, infection in moose was confirmed in September 2005 (Colorado Division of Wildlife 2005). Given the current pattern and rate of spread of chronic wasting disease in Wyoming, the likelihood of the disease reaching Jackson Hole is high.

Transmission of chronic wasting disease appears to be related to the density of susceptible hosts. Environmental contamination could potentially be another key mode of transmission, which can be affected by animal density as well as duration and repetition of use. The introduction of chronic wasting disease into the mule deer population in the Jackson Hole area would have an adverse impact on the population, irrespective of elk man-

agement in Jackson Hole. The prevalence of chronic wasting disease in infected mule deer herds in southeastern Wyoming and north-central Colorado can be as high as 25%. Modeling suggests that chronic wasting disease in free-ranging mule deer associated with free-ranging, non-fed elk could have detrimental impacts to mule deer populations (M. W. Miller et al. 2000; Gross and Miller 2001). The elk population in the area of the subject population of mule deer had a prevalence of less than 1% (i.e., prevalence in elk likely had a relatively minor influence on the mule deer population). The artificially high concentrations of large numbers of elk on the same ground for several months each year under Alternative 1 would likely lead to a prevalence level somewhere between that observed in non-fed elk populations (about 4%; range 2.3%–9.6%) and that found in game farms (up to 90%). This assumes that winter feeding would continue each winter and that high elk numbers would be maintained even if chronic wasting disease was discovered in refuge elk. If the prevalence of chronic wasting disease in refuge elk approached levels recorded on infected game farms, this could result in a prevalence level in mule deer that would exceed the level that would occur if elk were not fed on the refuge. It is possible that a high prevalence of chronic wasting disease in elk could result in increased transmission from elk to mule deer and/or increased environmental contamination, which could potentially increase the prevalence in mule deer. Conversely, it is also possible that an elevated prevalence in elk would have relatively little effect on prevalence in mule deer. Alternative 1 would rank highest in the risk of potential adverse impacts to the mule deer herd and would be similar to Alternative 5 (see Table 4-6).

Conclusion

Alternative 1 would continue to limit the ability of the Jackson mule deer population to recover due to (1) continued degradation and loss of key habitats on the refuge and in the park, (2) a high level of competition for forage on the refuge, and (3) potential disease risks associated with the high concentrations of elk and bison that would occur nearly every year under this alternative (e.g., chronic wasting disease, tuberculosis). Alternative 1 would also continue to contribute to the decline in moose habitat in the Jackson Hole area, although only to a minor degree, due to the continued degradation

and loss of riparian and aspen woodland habitat on the refuge and in the park. Elk would continue to compete directly with bighorn sheep for forage on the refuge, and it is possible that bison could begin competing with bighorn sheep in the long term as the bison population continued to grow. The fence along U.S. 26/89 would continue to restrict bighorn sheep movements, but long-term impacts would likely be minor. Due to continued large concentrations of elk on refuge feedlines and growing numbers of bison on feedlines, the potential for mule deer and moose populations to be infected by a non-endemic infectious disease that was transmitted from the elk or bison herds would increase. Alternative 1 would not impair mule deer, moose, bighorn sheep, or pronghorn populations in the park.

Alternative 2

Analysis

National Elk Refuge — In the short term (within the next 15 years) under this alternative, competition between elk and other ungulates in willow, aspen, and cottonwood habitats on the northern part of the refuge and the eastern part of the park could be higher in some years soon after implementation of this alternative due to eliminating elk hunting in these areas.

If elk in the Jackson elk herd unit did not begin wintering in the Green River basin, the degradation and loss of willow, aspen, and cottonwood habitat on the refuge would be similar to Alternative 1, although slightly less riparian and aspen woodland habitat would be lost under Alternative 2. Despite lower numbers of elk in some years, the elimination of winter feeding and hunting might not result in any measurable reductions in the use of woody vegetation by elk. It is likely that the refuge would not be able to winter all of the elk and bison that could potentially migrate to the refuge in above-average and severe winters, which would result in more severe use of browse in some locations. In other years browsing pressure could be lower due to fewer animals and milder winters. On average, therefore, adverse impacts to mule deer and moose might not be substantially different than Alternative 1.

If large numbers of elk did begin wintering in the Green River basin and the Red Desert, willow

habitat on the refuge could increase by an estimated 1,500 acres in the long term, which would benefit moose on the refuge by a moderate to major amount and would benefit the Jackson Hole moose population to a negligible degree. This increase in willow habitat on the refuge would offset the adverse impacts to moose associated with the loss of aspen habitat.

In the short term (within the next 15 years) competition between elk and other ungulates in sagebrush shrubland and grassland habitat on the northern part of the refuge and the eastern part of the park could begin increasing within a few years of implementation due to the elimination of elk hunting in these areas. Otherwise, no measurable changes in competition would be anticipated in the short term.

Despite fewer elk and bison, direct competition between elk, bison, mule deer, moose, and bighorn sheep for forage in sagebrush shrubland and grassland habitats on the refuge would increase in many years over the long term due to the higher reliance of elk and bison on standing forage with the eventual elimination of winter feeding. No feeding of elk and bison (after 10–15 years), no irrigation, and no hunting on the refuge or herd reduction in the park would result in elk and bison being more widely dispersed on the refuge throughout more of the winter, which would result in a higher proportion of refuge elk and bison using sagebrush shrubland and grassland habitat in the northern portion of the refuge. In addition to increased competition for browse, Alternative 2 would probably also reduce the amount of sagebrush and other upland shrubs due to heavy browsing and hoof action in localized areas, which would further reduce the amount of browse available to mule deer and moose. However, periodic declines in elk numbers following above-average and severe winters (possibly as low as 1,200 elk) would provide periods when shrubs on Miller Butte and other areas could recover and increase production.

If large numbers of elk began wintering in the Green River basin and the Red Desert, direct competition of elk and bison with mule deer, moose, and bighorn sheep would be lower than the potential effects described above.

Converting cultivated fields on the refuge to native vegetation and eliminating flood irrigation could increase the use of these habitats by mule deer, pronghorn, and bighorn sheep in the long term as compared to Alternative 1.

To the extent that mule deer are being displaced from key habitats on the refuge and in the park under baseline conditions due to elk hunting on the refuge and the elk herd reduction program in the park, eliminating hunting in the two areas would benefit mule deer by reducing disturbance and movements. If mule deer are currently leaving the refuge and park prematurely due to harvesting activities, which could lead to increased mortality (because deer can be legally harvested outside the refuge and park), then eliminating elk hunting would reduce this mortality factor.

The fence along U.S. 26/89 would continue to block the movement of bighorn sheep to East Gros Ventre Butte, thereby forcing them to remain on Miller Butte. The fence could also continue to block the movement of mule deer between East Gros Ventre Butte and Miller Butte. Removing the fence under this alternative would allow bighorn sheep to cross over to East Gros Ventre Butte. However, elk would also be able to cross, which would result in substantial competition for forage. Furthermore, removing the fence could increase mortality of bighorn sheep due to vehicle collisions.

Grand Teton National Park — Direct competition between elk and other ungulates for forage in riparian and aspen woodlands of the park could increase in localized areas during some years in the long term as the number of elk wintering on native range in the park increased due to the eventual elimination of winter feeding on the refuge.

Direct competition between elk, bison, and other ungulates in agricultural, native grassland, and sagebrush shrubland habitats in the park during summer and fall would have the potential to decline to some degree due to the major reduction in elk numbers in some years and the major reduction in bison numbers in the park. Eliminating the elk reduction program in the park would result in elk, including elk from other segments, moving more slowly through grassland and sagebrush habitat in the park during fall and early winter.

These habitats receive little use by other ungulates during the fall, so there would be little competition. Converting agricultural lands to native vegetation would further reduce competition by increasing the amount of native grassland and sagebrush habitat.

More bison wintering in the park under this alternative, as compared to Alternative 1, would result in little or no competition with other ungulates because bison and elk would be the only grazing ungulates at lower elevations of the park during winter.

Bridger-Teton National Forest — Larger numbers of elk, as compared to Alternative 1, would use winter range in the national forest, which would increase already heavy browsing pressure on aspen, willow, cottonwood, and sagebrush shrubland habitats and would increase competition between elk and other ungulates, further contributing to the degradation and loss of these habitats. Damage to vegetation caused by higher numbers of elk on native grasslands would also reduce the amount of forage available to other ungulates. Competition could also increase on higher elevation bighorn sheep winter ranges. Therefore, there could be adverse impacts to mule deer, bighorn sheep, and moose in the national forest. These impacts would be lessened substantially over the long term if large numbers of elk migrated to the Green River basin and the Red Desert.

The presence of wolves could decrease vegetation effects to some extent by changing elk distribution, increasing elk movements, and decreasing time spent within foraging areas, thus allowing greater amounts of new growth to survive.

Other Lands — On BLM and private lands in the Jackson Hole area, direct competition between elk and other ungulates for forage would increase in localized areas after supplemental winter feeding was eliminated on the refuge. On some lands grazing and browsing pressure by elk could be heavy, which would substantially increase the competition between elk, mule deer, and moose on private lands in Buffalo Valley, Jackson Hole, and possibly Hoback Canyon. If the fence along U.S. 26/89 was removed, browsing pressure on private lands on East Gros Ventre Butte and areas to the north and west would increase markedly. Aspen and

cottonwood habitat on these private lands are already used by mule deer and moose; therefore, competition for forage would increase.

If large numbers of elk migrated to the Green River basin and the Red Desert in the long term, direct competition between elk and other ungulates for forage could increase in riparian and aspen woodland, agricultural, native grassland, and sagebrush shrubland habitats on federal, state, and private lands in the basin.

Potential Effects of Bovine Tuberculosis and Paratuberculosis — If bovine tuberculosis or paratuberculosis became established in the elk and bison herds under Alternative 2 after elk and bison numbers on the refuge and park had already declined to anticipated levels and winter feeding had been eliminated, there would be a moderate reduction in the risk of these diseases being transmitted to other ungulates compared to Alternative 1 due to reduced prevalence. Because tuberculosis and paratuberculosis would likely not pose a major problem to mule deer and moose under Alternative 1, the reduced risk under Alternative 2 (similar to Alternative 6) would result in only negligible potential benefits to these two species. Of the alternatives being considered in this process, Alternative 2 would provide the least amount of risk to other ungulate species.

Potential Effects of Chronic Wasting Disease — Alternative 2 (and Alternative 6) would have the least potential for adversely impacting mule deer in the Jackson Hole area because fewer elk would winter on the refuge, eliminating artificial concentrations of elk. If chronic wasting disease became established after Alternative 2 was fully implemented, disease prevalence would likely be representative of other infected populations of elk, such as those in southeastern Wyoming and north-central Colorado. This would result in a lower chance, as compare to Alternative 1, that the prevalence of chronic wasting disease in mule deer in Jackson Hole would exceed the prevalence in other infected mule deer populations. This alternative, as well as Alternatives 3 and 6, would have the lowest level of potential adverse impacts to mule deer in the Jackson Hole area. Regardless of how elk are managed in Jackson Hole, the mule deer population would still be adversely impacted by the introduction and spread of chronic wasting disease, but Alternatives 2, 3, and 6 would not add

to the severity of the adverse impacts, in contrast to Alternatives 1, 4, and 5, which would add to the severity.

Conclusion

Of the alternatives being considered, in the long term Alternative 2 (together with Alternatives 3 and 6, and potentially Alternative 4) would have the least amount of adverse impacts to other ungulates on the refuge, except that competition between bighorn sheep, elk, and bison could increase compared to Alternative 1. Alternative 2 (together with Alternative 6) would have the lowest risk of any of the alternatives in terms of the severity of an outbreak of a non-endemic infectious disease in elk and/or bison that could adversely impact the population health of other ungulates.

Park aspen habitat would improve in many areas that are now being heavily grazed by elk. In areas where winter use by elk increased, competition with moose for browse could increase during some winters. Because of attempts to maintain natural densities of elk and bison, Alternative 2 (and 6) would have the lowest potential for adverse impacts to other ungulate populations in the park. Alternative 2 would not result in the impairment of park resources.

Alternative 3

Analysis

National Elk Refuge — Compared to Alternative 1, elk numbers on the refuge would decline to a low enough level that willow habitat could increase by an estimated 1,500 acres in the southern part of the refuge in the long term, which would increase the amount of moose habitat by a major amount. Up to 1,000–2,000 elk on the refuge would maintain a high level of competition between elk and moose in the restored willow habitat, but there would be a net benefit to moose. Similar to Alternative 2, the degradation and loss of aspen and cottonwood habitat on the refuge would be similar to Alternative 1, although slightly less riparian and aspen woodland habitat would be lost if elk in the Jackson elk herd unit did not begin wintering in the Green River basin and the Red Desert. Even if large numbers of elk began wintering outside Jackson Hole, aspen habitat on the

northern part of the refuge would continue to decline in condition and acreage due to a major reduction in the frequency of winter feeding and the closure of the part of the hunt zone.

Under this alternative competition between elk and other ungulates in some sagebrush shrubland, native grassland, and agricultural habitats in part of the hunt zone on the refuge and in the Blacktail Butte and Kelly hayfields areas of the park (Hunt Area 76) could begin increasing within a few years of implementation due to eliminating of elk hunting or the reduction program in these areas.

Competition from elk and bison with mule deer, moose, and bighorn sheep for forage in sagebrush shrubland and grassland habitat on the refuge would increase due to the higher reliance of elk and bison on standing forage due to a major reduction in winter feeding (similar to Alternative 2). No hunting on the part of the current hunt zone on the refuge and no irrigation (Option B of Alternative 3) would also contribute to elk and bison being more widely dispersed throughout more of the winter, impacting ungulates in more areas. Because there would be far fewer elk on the refuge, competition for browse could potentially be lower than under Alternative 1. If large numbers of elk began wintering in the Green River basin, direct competition between elk and mule deer, moose, and bighorn sheep would be lower than the potential effects described above.

Under Option A of Alternative 3 cultivated fields on the refuge would probably continue to receive only minimal use by pronghorn sheep and mule deer (similar to Alternative 1). Most of this use would occur during the summer; therefore, changes in elk and bison numbers on the refuge would not affect the use of cultivated fields by ungulates.

The effects of Option B on other ungulates with respect to restored cultivated fields would be similar to the effects of Alternative 2.

Maintaining the fence along U.S. 26/89 would continue to block the movement of bighorn sheep to East Gros Ventre Butte, thereby forcing them to remain on Miller Butte. The fence would also continue to block the movement of mule deer between East Gros Ventre Butte and Miller Butte.

Grand Teton National Park — Many of the aspen stands that have been heavily browsed by elk would benefit from the major reduction in the Grand Teton segment of the elk herd. The park's new *Fire Management Plan* (NPS 2004b) aims to ensure that unless habitat change is a natural result of plant succession, fire would continue to play its role in influencing vegetation patterns on much of the park landscape. Under Alternative 3 fewer elk, and the park's fire management program, would contribute to less aspen habitat loss, with direct benefits to mule deer and moose. Direct competition between elk and other ungulates for forage in riparian and aspen woodlands in the park during winter would increase in localized areas if winter use of the park by elk increased as compared to baseline conditions and Alternative 1. The major reduction in winter feeding on the refuge could result in a larger proportion of park elk wintering off the refuge, including areas in the park. Even though there were far fewer elk in the park segment, use of the park by wintering elk could increase. This would in part be due to elk from the Yellowstone and Teton Wilderness segments, which would remain high in numbers in many years, increasing their winter use of western parts of the park such as the Spread Creek/Uhl Hill area.

Direct competition between elk, bison, and other ungulates in native grassland and sagebrush shrubland habitats in the park would likely not increase to any measurable degree despite the major reduction in winter feeding on the refuge because the number of elk in the park segment would decline by a major amount. Although the bison population would remain large and a larger number of bison would winter in the park, no other grazing ungulates (aside from elk) would winter in the same areas in the park.

To the extent that mule deer would be displaced from key habitats in the park compared to Alternative 1 due to eliminating the elk reduction program in the Blacktail Butte and Kelly hayfields areas would benefit mule deer by reducing disturbance and movements.

Bridger-Teton National Forest — Larger numbers of elk compared to Alternative 1 would use winter range in the national forest, which would increase already heavy browsing pressure on aspen, willow, cottonwood, and sagebrush shrubland

habitats, as well as competition between elk and other ungulates, further contributing to degradation and loss of these habitats. Damage to vegetation caused by higher numbers of elk on native grasslands would also reduce the amount of forage available to other ungulates. Competition could also increase on higher elevation bighorn sheep winter ranges. Therefore, mule deer, bighorn sheep, and moose in the national forest could be adversely affected. These impacts would be lessened substantially over the long term if large numbers of elk migrated to the Green River basin and the Red Desert.

The presence of wolves could decrease vegetation effects to some extent by changing elk distribution, increasing elk movements, and decreasing time spent within foraging areas, thus allowing greater amounts of new growth to survive.

Other Lands — On BLM and private lands in the Jackson Hole area the direct competition between elk and other ungulates for forage would increase in localized areas after winter feeding was reduced on the refuge. On some lands grazing and browsing pressure by elk could be heavy, which would substantially increase competition between elk, mule deer, and moose on private lands in Buffalo Valley, Jackson Hole, and possibly Hoback Canyon. Removing the fence along U.S. 26/89 would likely markedly increase the amount of browsing pressure on private lands on East Gros Ventre Butte and areas to the north and west. Aspen and cottonwood habitat on these private lands are already used by mule deer and moose; therefore, competition for forage would increase.

If large numbers of elk migrated to the Green River basin and the Red Desert in the long term, this could result in direct competition between elk and other ungulates for forage in riparian and aspen woodland, agricultural, native grassland, and sagebrush shrubland habitats on federal, state, and private lands in localized areas, resulting in degradation of habitat.

Potential Effects of Bovine Tuberculosis and Paratuberculosis — The potential effects of bovine tuberculosis or paratuberculosis on mule deer, moose, and bighorn sheep, if either disease became established in the elk and bison herds under Alternative 3, would be similar to those discussed for Alternative 2, except that the chances

and extent of effects would be somewhat higher due to a larger number of bison and winter feeding during severe winters. Under Alternative 3 there would be a moderately lower risk of the diseases being transmitted from elk or bison to other ungulate populations.

Potential Effects of Chronic Wasting Disease — Given the major reductions in elk numbers and concentrations on the refuge in the long term and the reduction of winter feeding to severe winters only, the adverse impacts associated with an outbreak of chronic wasting disease would be lower than under Alternative 1. If chronic wasting disease became established after Alternative 3 was fully implemented, the prevalence of the disease would likely be representative of other infected populations of elk, such as those in southeastern Wyoming and north-central Colorado. This would result in a lower chance, as compared to Alternative 1, that the prevalence of chronic wasting disease in mule deer in Jackson Hole would exceed the prevalence in other infected mule deer populations. Regardless of how elk are managed in Jackson Hole, the mule deer population would still be adversely impacted by the introduction and spread of chronic wasting disease, but Alternative 3 would not add to the severity of adverse impacts. The severity of impacts would be much less than under Alternatives 1, 4, and 5.

Conclusion

Of the alternatives being considered, in the long term Alternative 3 (similar to Alternatives 2 and 6, and potentially Alternative 4) would have the least amount of adverse impacts to other ungulates on the refuge, except that competition between bighorn sheep, elk, and bison could potentially increase under these alternatives compared to Alternative 1. This alternative would have the second largest amount of riparian and aspen woodland habitat available to mule deer and moose on the refuge, especially if large numbers of elk began migrating out of the Jackson Hole area. Alternative 3 would have the third lowest risk of any of the alternatives in terms of the severity of an outbreak of a non-endemic infectious disease in elk and/or bison that could adversely impact the population health of other ungulates. High bison numbers under Alternative 3 would cause a comparatively higher potential of major adverse impacts to mule deer and moose if a dis-

ease such as bovine tuberculosis became established in the elk and/or bison herds (which would increase the potential risk of other ungulates being infected).

In the park aspen habitat would improve in many areas that are now being heavily grazed by elk. In areas where winter use by elk increased, competition with moose for browse could increase during some winters. Alternative 3 would not result in the impairment of park resources.

Alternative 4

Analysis

To increase management effectiveness, increased flexibility has been added to Alternative 4. Initial implementation would occur, along with monitoring of habitat and population changes, and adaptive management actions would be incorporated to the extent possible. For example, elk numbers or supplemental feeding could be further reduced and/or, after habitat recovery in protected areas, the large, permanent exclosures initially installed could be reduced in size and rotated to decrease competition among ungulates. This analysis focuses on impacts stemming from initial implementation because the extent of adaptive changes cannot be predicted.

National Elk Refuge — Because reductions to the refuge supplemental feeding program could result in years when feeding would not occur, the level of competition in the long term would likely increase between elk, mule deer, and moose due to greater use of the northern end of the refuge by elk in years when no feeding was provided (despite a moderate reduction in elk numbers) and the exclusion of nearly 1,000 acres of aspen habitat. Excluding ungulates from the exclosure would result in more browsing by ungulates outside the exclosure, which would directly increase competition and result in a more rapid degradation and loss of aspen stands in the long term as compared to Alternative 1.

Additionally, elk would be excluded from these large areas, and migrating elk would be forced to move around the aspen exclosure, resulting in a higher level of browsing pressure by elk in nearby aspen and willow habitats and likely accelerating the rate of degradation and loss of these habitats.

Although fewer bison would slow the decline of woody plant communities outside exclosures on the refuge as compared to Alternative 1, impacts would continue to occur (primarily due to elk browsing). Therefore, the net effect on mule deer and moose would be detrimental as compared to Alternative 1. It should be noted that these are effects on habitat and potential effects on mule deer. Actual impacts to mule deer would be negligible due to the low number of deer wintering on the refuge under baseline conditions. Adverse impacts to moose using the northern end of the refuge would not be as intense as the potential impacts to mule deer because the cottonwood community along the Gros Ventre River receives proportionally more use by moose than aspen communities, and the Gros Ventre cottonwood community would not be adversely impacted to any large degree.

Elk and bison would be more widely dispersed and would make greater use of standing forage and browse during non-feeding winters and for longer periods during winters when supplemental forage was provided. This would result in a greater use of forage by elk and bison in sagebrush shrubland and grassland habitat in the northern part of the refuge.

Use of Miller Butte by elk would likely increase as compared to Alternative 1, which could adversely affect bighorn sheep and reduce the likelihood of mule deer resuming their use of Miller Butte as a wintering area. Because long-term bison numbers would be substantially lower under Alternative 4 than under Alternative 1, Alternative 4 could potentially result in less competition between bison and bighorn sheep on Miller Butte. Increased forage production in cultivated fields would help offset any increased use of Miller Butte by elk and bison under Alternative 4.

Adaptive management actions implemented after the initial implementation phase of Alternative 4 would likely decrease competition.

The increase in forage production in areas newly equipped with sprinkler irrigation systems on the refuge would not directly benefit other ungulates to any measurable degree because pronghorn generally do not use meadows and pastures that produce tall grasses, bighorn sheep do not use cultivated fields, and the vegetation that would be

encouraged in these fields is not favored by mule deer and moose. Changes in forage production would indirectly benefit other ungulates to the extent that elk and bison used cultivated forage rather than native forage, decreasing competition with other ungulates in other areas. Changes in elk and bison numbers on the refuge would not directly affect the use of cultivated fields by ungulates because most use of these fields by other ungulates occurs when elk and bison are not present. Fewer elk and bison on the refuge could decrease the amount of cultivated forage consumed by these species and increase the amount available to other ungulates in other seasons.

Disturbance effects of hunting on mule deer and moose on the northern portion of the refuge and the eastern side of the park would be similar to Alternative 1. It is possible that mule deer have been displaced from preferred habitats on the refuge and in the park and that some mule deer leave the refuge and park prematurely, which could increase the harvest of refuge and park deer. It does not appear that hunting activities have more than negligible or minor effects on moose distribution, survival, and production. Pronghorn and bighorn sheep would not be affected.

The fence along U.S. 26/89 would continue to block the movement of bighorn sheep to East Gros Ventre Butte, thereby forcing them to remain on Miller Butte. The fence would also continue to block the movement of mule deer between East Gros Ventre Butte and Miller Butte.

Grand Teton National Park — It is not clear whether Alternative 4 would have a net beneficial or detrimental effect on mule deer and moose in the park. The number of elk in the park herd segment would decline to approximately 1,600, which would reduce direct competition and heavy browsing of woody vegetation in riparian and aspen woodlands. As previously described, the park's new *Fire Management Plan* (NPS 2004b) aims to ensure that unless habitat change is a natural result of plant succession, fire would continue to play its role in influencing vegetation patterns on much of the park landscape. Under Alternative 4 fewer elk, and the park's fire management program, would contribute to less aspen habitat loss, with direct benefits to mule deer and moose.

Direct competition between elk, bison, and other ungulates on agricultural lands, native grassland, and sagebrush shrubland habitats in the park during summer and fall would decline by a negligible degree as a consequence of moderately reducing elk numbers and substantially reducing bison numbers, and because only a minor amount of competition occurs at present due to differing habitat and dietary requirements. Converting agricultural lands to native vegetation would further reduce competition by increasing native grassland and sagebrush habitat. This would primarily benefit pronghorn in the short term due to the conversion of nonnative grassland habitat to native grassland habitat, which would include a diversity of forbs. As bitterbrush, sagebrush, and other shrubs increased in cover and height, mule deer and moose would begin to benefit.

Bridger-Teton National Forest — To the extent that the refuge supplemental feeding program was reduced, larger numbers of elk would use winter range in the national forest, which would increase heavy browsing pressure on aspen stands. The increase in elk use of winter range would be less under this alternative than under Alternatives 2 and 3; therefore, the net benefits to other ungulates would be slightly higher. Larger numbers of elk using native winter range in the Buffalo Valley area and the Gros Ventre River drainage, as compared to baseline conditions and Alternative 1, would increase competition between elk and moose for browse in willow and cottonwood habitats and would contribute to further degradation and loss of these habitats, but the increase would be negligible or minor (similar to Alternatives 2 and 3). Therefore, adverse impacts to mule deer and moose using willow and cottonwood stands (as opposed to aspen stands) in the national forest would be negligible to minor.

It is possible that the presence of wolves in the Gros Ventre area could indirectly decrease potential elk impacts on vegetation by changing elk distribution. Informal observations in Bridger-Teton National Forest suggest that wolves have caused elk to move more often from one area to another, allowing a greater proportion of aspen suckers to survive (Kilpatrick, pers. comm. 2004). Improved willow growth in Yellowstone National Park since wolf reintroduction has also spawned such a theory, but other factors such as climate, recent

flooding events, and beaver activity are also being examined (D. W. Smith 2005).

Enhanced forage production on the refuge and interagency improvements to winter and transitional habitat in the forest would decrease competition with other ungulates by improving elk forage.

Competition between elk and moose might also increase in areas supporting bitterbrush and other upland shrub species in the Gros Ventre River drainage and Buffalo Valley. Damage to vegetation caused by higher numbers of elk on native winter range would also reduce the amount of forage available to other ungulates. It is not clear whether a moderate reduction in winter feeding, a moderate reduction in elk numbers on the refuge, and a major reduction in bison numbers would result in increased or decreased use of south- and west-facing slopes immediately east of the refuge.

Other Lands — On BLM and private lands in the Jackson Hole area direct competition between elk and other ungulates for forage could increase in localized areas. It is not anticipated that many elk would leave the refuge in winter because elk and bison numbers would be reduced; refuge supplemental feeding would continue, although at reduced levels; and sufficient standing forage would be available to them in average and below-average winters. Potential adverse impacts on riparian and aspen woodlands on BLM and private lands would be considerably less than the effects of Alternatives 2 and 3, but could be slightly higher than those of Alternative 1.

Potential Effects of Bovine Tuberculosis and Paratuberculosis — If bovine tuberculosis or paratuberculosis became established in the elk or bison population under Alternative 4, the potential adverse impact to other ungulates would be lower by a negligible to minor extent, as compared to Alternative 1. This would be due to the minor to moderate reduction in elk numbers, a major reduction in bison numbers, and reduced winter feeding. Potential adverse impacts to other ungulates would be higher under Alternative 4 than under Alternatives 2, 3, and 6, but less than under Alternatives 1 and 5.

Potential Effects of Chronic Wasting Disease — Alternative 4 would lower the potential adverse impacts associated with chronic wasting disease, if it became established in the Jackson Hole area, as compared to Alternative 1. However, because large numbers of elk would continue to winter on the refuge (approximately 5,000 compared to 5,000–7,500 under Alternative 1) and because winter feeding would continue, although at reduced levels, and potential adverse impacts would not be reduced nearly to the extent that they would be under Alternatives 2, 3, and 6. The prevalence of chronic wasting disease in elk would likely be between Alternatives 1 and 3, as would potential impacts to mule deer.

Conclusion

Competition with other ungulates on the refuge would likely be higher than under current conditions. Adverse effects would remain less than under Alternative 1, despite the use of exclosures and reductions to the supplemental feeding program, because the refuge would potentially sustain severe habitat damage in the long term from uncontrolled bison numbers under Alternative 1. Exclosures during the initial phase of implementation would result in a high level of potential impacts to mule deer and moose (mule deer are currently uncommon on the refuge) because it would exclude nearly 1,000 acres of aspen habitat from use by mule deer and moose, and it would accelerate the degradation of habitat and increase competition for browse outside the exclosure. Adaptive management changes after the initial implementation phase would likely decrease competition and potential adverse effects to other ungulates. Enhanced forage production on the refuge and interagency improvements to winter and transitional habitat in the forest would decrease competition with other ungulates by improving elk forage. The potential adverse impacts of some diseases (e.g., chronic wasting disease) to mule deer would only be slightly lower under Alternative 4 than under Alternative 1, but higher than under Alternatives 2, 3, and 6.

It is not clear whether Alternative 4 would have a net beneficial or detrimental effect on mule deer and moose in the park. However, the changes would be negligible to minor. Alternative 4 would not result in the impairment of other ungulate populations in the park.

Competition between elk, bison, and other ungulates on Miller Butte could potentially be higher than under baseline conditions, but would be lower than under Alternative 1 if the burgeoning bison population under that alternative began grazing on Miller Butte.

Alternative 5

Analysis

National Elk Refuge — In the long term aspen habitat outside the enclosure on the refuge would disappear at a faster rate than it would under Alternative 1 because the enclosure would concentrate browsing in other areas. As aspen habitat became more and more scarce, direct competition between elk, mule deer, and moose would increase until aspen habitat outside the enclosure was no longer available.

Similar to Alternative 4, the condition and amount of willow, aspen, and cottonwood habitat available to mule deer and moose on the refuge under this alternative would decline faster than under Alternative 1, despite the major improvement in the condition of willow and aspen stands inside enclosures on the refuge, because these areas would not be available to mule deer and moose. Elk would also be excluded from these large areas, and the aspen enclosure would force migrating elk around its periphery, causing a higher level of browsing pressure in nearby aspen and willow habitat, which would accelerate the rate of degradation and loss of these habitats. Increasing willow habitat by about 500 acres and cottonwood habitat by 100 acres on the refuge would not benefit moose because they would be excluded from these areas. Although the reductions in bison numbers would slow the decline of woody plant communities outside enclosures on the refuge to a small degree as compared to Alternative 1, impacts would continue to occur (primarily due to elk browsing). Therefore, the net effect on mule deer and moose would be adverse compared to Alternative 1. Adverse impacts to moose using the northern end of the refuge would not be as severe as the impacts to mule deer because the cottonwood community along the Gros Ventre River receives proportionally more use by moose than aspen communities, and the Gros Ventre cottonwood community would not be adversely impacted to any large degree.

The major reduction in bison numbers on the refuge (and no change in elk numbers) under Alternative 5 would result in no more than a negligible increase or decrease in direct competition between elk, bison, mule deer, moose, and bighorn sheep for forage in sagebrush shrubland and grassland habitat on the refuge, as compared to baseline conditions. The winter diets of mule deer and moose do not overlap with the winter diet of bison. Under baseline conditions bison do not graze on Miller Butte, and the reduction in bison numbers under Alternative 5 would further ensure that bison would not graze on Miller Butte in the future (as compared to Alternative 1 under which bison grazing on the butte could increase substantially). Alternative 5 would not result in any measurable changes in competition between elk, bison, and bighorn sheep.

Similar to Alternative 4, the increase in forage production in areas newly equipped with sprinkler irrigation systems on the refuge would not affect other ungulates to any measurable degree. Pronghorn under baseline conditions are few in number and the amount of forage already available to pronghorn during summer months far exceeds the needs of the population. Furthermore, pronghorn generally do not use meadows and pastures that produce tall grasses. Thus, increasing the height and density of grass in cultivated fields would tend to discourage use by pronghorn. The cultivated fields that would be sprinkler irrigated have been infrequently used by mule deer and are not used by moose or bighorn sheep. The vegetation that would be encouraged in cultivated fields is not favored by mule deer or moose. Changes in elk and bison numbers on the refuge would not affect the use of cultivated fields by ungulates because most of the use these fields receive from other ungulates occurs when elk and bison are not present.

Disturbance effects of hunting on mule deer and moose on the northern portion of the refuge and the eastern side of the park would be similar to Alternative 1. Mule deer may have been displaced from preferred habitats on the refuge and in the park, and some mule deer could leave the refuge and park prematurely, which could increase the harvest of refuge and park deer. It does not appear that hunting activities have more than negligible to minor effects on moose distribution, survival, and production. Pronghorn and bighorn

sheep would not be affected because they are not present in areas where hunting is allowed.

The fence along U.S. 26/89 would continue to block the movement of bighorn sheep to East Gros Ventre Butte, thereby forcing them to remain on Miller Butte. The fence would also continue to block the movement of mule deer between East Gros Ventre Butte and Miller Butte.

Grand Teton National Park — Alternative 5 would have negligible beneficial effects on mule deer and moose in the park as compared to baseline conditions and Alternative 1 due to the minor reduction in elk numbers in the park. This could negligibly reduce browsing pressure in riparian and aspen woodlands.

Direct competition between elk, bison, and other ungulates in agricultural, native grassland, and sagebrush shrubland habitats in the park during summer and fall would decline by a negligible degree because of a negligible to minor reduction in elk numbers and a major reduction in bison numbers, and because present competition is minimal due to differing habitat and dietary requirements. Converting agricultural lands to native vegetation would further reduce competition by increasing the amount of native grassland and sagebrush habitat. The conversion of nonnative grassland habitat to native grassland habitat, which would include a diversity of forbs, would primarily benefit pronghorn in the short term. As bitterbrush, sagebrush, and other shrubs increased in cover and height, mule deer and moose would begin to benefit.

Bridger-Teton National Forest — The downward trend in the condition of riparian and aspen woodlands in the national forest would not be altered by this alternative, as the effects would be similar to Alternative 1. Elk would continue to compete directly for browse with mule deer and moose in riparian and aspen woodlands, and continued high levels of browsing by elk and other ungulates would continue to deplete available browse in some areas.

Competition between elk and other ungulates in sagebrush shrubland and grassland habitats in the national forest would not be altered by Alternative 5, and effects would be similar to Alternative 1. Elk would continue to compete directly for

browse with mule deer and moose in riparian and aspen woodlands, and browsing by elk and other ungulates would continue to deplete available browse in some areas. Although there could be a large reduction in the amount of bison grazing on south- and southwest-facing slopes immediately east of the refuge, bison currently are not competing with other ungulates for forage on these slopes.

Other Lands — Competition between elk and other ungulates in riparian and aspen woodlands on BLM and private lands in the Jackson Hole area would continue to be minimal, as under Alternative 1.

No additional effects would be anticipated on BLM and private lands in the Green River basin and the Red Desert (similar to Alternative 1).

Competition between elk and other ungulates in sagebrush shrublands, grasslands, and agricultural habitats on BLM and private lands in the Jackson Hole area would continue to be minimal, as under Alternative 1.

Potential Effects of Bovine Tuberculosis and Paratuberculosis — If bovine tuberculosis or paratuberculosis became established in the elk or bison herd, impacts of Alternative 5 on the potential transmission to other ungulates would be lower by a minor amount due to fewer bison. The potential for the diseases to be transmitted from elk to other ungulates under Alternative 5 would be similar to that under Alternative 1. Potential adverse impacts to other ungulates would be higher than under Alternatives 2, 3, 4, and 6.

Potential Effects of Chronic Wasting Disease — Given the similarity in elk numbers and winter feeding practices on the refuge, Alternatives 1 and 5 would sustain a similar high potential for producing or facilitating high prevalence rates of the chronic wasting disease in elk and deer. If chronic wasting disease became established in Jackson Hole, the artificially high concentrations of elk would facilitate a higher prevalence of chronic wasting disease in the herd than occurs in non-fed populations. This would result in an elevated potential for transmission to mule deer and the potential for increased adverse impacts to the deer herd (see the potential effects of Alternative 1).

Conclusion

Alternative 5 would immediately exclude mule deer and moose from nearly 1,000 acres of aspen habitat and would accelerate the degradation of willow and aspen habitat outside the exclosures on the refuge as compared to Alternative 1. However, adverse impacts would not be as large as they would be under Alternative 4. Competition between elk and other ungulates would not differ appreciably from the level of competition that would occur under Alternative 1.

Alternative 5 would have negligible beneficial effects on mule deer and moose in the park as compared to baseline conditions and Alternative 1 due to the minor reduction in elk numbers in the park. This could potentially reduce browsing pressure in riparian and aspen woodlands by a negligible amount. Alternative 5 would be similar to Alternative 1 from the standpoint of an elevated potential of mule deer and moose populations being affected if a non-endemic infectious disease became established in Jackson Hole. Alternative 5 would not result in the impairment of other ungulate populations in the park.

Alternative 6*Analysis*

National Elk Refuge — In the first few years of implementing this alternative, the level of competition between elk and other ungulates in willow, aspen, and cottonwood habitat at the north end of the refuge would increase somewhat, despite declining numbers of elk, because of the erection of the first aspen exclosures (totaling up to 600 acres). After five years, winter feeding would cease completely, a second 600-acre aspen exclosure would be constructed, and the northern portion of the refuge would be closed to hunting; these actions would contribute to higher levels of browsing by elk, especially if an elk hunt at the south end of the refuge forced animals north. However, the major reduction in elk numbers and dismantling of the first aspen exclosure (estimated to occur within 10 years) would mitigate adverse effects to some extent.

Elk numbers on the refuge would decline further as a result of above-average and severe winters, which would provide periodic relief to willow, aspen, and cottonwood habitat (thereby enhancing

their health and productivity and reducing elk competition with mule deer and moose). After an estimated 25–30 years, all aspen habitat would again be available to mule deer and moose on the refuge. If good and fair condition aspen habitat was maintained in most aspen stands over the long term, it is possible that increased browse, along with elk numbers below 3,200 on the refuge, could mitigate the effects of eliminating winter feeding and closing part of the refuge to hunting.

In the short term habitat conditions within aspen stands outside exclosures would not change appreciably. In the long term most of the acreage of aspen habitat (about 1,850 acres) would be restored to Class I or II condition, which would benefit mule deer and moose. This contrasts with Alternative 1, where aspen habitat would continue to decline in condition and most stands on the refuge would eventually disappear. Alternative 6 would result in the largest amount of woody vegetation in healthy conditions and the largest amount of this habitat that would be available to mule deer and moose.

There would be few if any measurable changes in habitat conditions or competition between elk, bison, and other ungulates in sagebrush shrubland, grassland, and agricultural habitats on the refuge and park under this alternative.

Despite fewer elk and bison, direct competition between elk, bison, mule deer, moose, and bighorn sheep for forage in sagebrush shrubland and grassland habitat on the refuge would increase in many years over the long term due to the higher reliance of elk and bison on standing forage because winter feeding would be eliminated. No feeding of elk and bison (after 5–10 years) and no hunting on the northern portion of the refuge would result in elk and bison being more widely dispersed throughout more of the winter, with a higher proportion of refuge elk and bison using sagebrush shrubland and grassland habitat in the northern part of the refuge. In addition to increased competition for browse, it would also be anticipated that Alternative 6 could result in a reduction in the amount of sagebrush and other upland shrubs due to overbrowsing and hoof action, which would further reduce the amount of browse available to mule deer and moose. Actual impacts to mule deer would be negligible due to

the low number of mule deer wintering on the refuge under baseline conditions.

Once elk numbers had been reduced to a maximum of 2,400–2,700 animals, the overall use of Miller Butte by elk could be lower. While heavy use of shrubs by elk could occur in some years, the lower maximum number of elk under this alternative and periodic reductions in elk numbers after above-average and severe winters (down to as low as an estimated 1,200 elk due to higher mortality) would provide periods when shrubs could recover on Miller Butte and mule deer could winter on other areas on the refuge. Therefore, some improvement in habitat conditions on the butte and lowered competition with mule deer for browse would be possible under Alternative 6.

Use of Miller Butte by bison would be higher, which in combination with continued use by elk (albeit possibly at lower levels in some years), could adversely affect bighorn sheep in some winters, as compared to baseline conditions. In most winters, a sufficient amount of forage would likely exist in areas used by bighorn sheep on the butte. Increased forage production in cultivated fields would help offset the increased use of Miller Butte by elk and bison under Alternative 6. As compared to Alternative 1 in the long term, competition between elk, bison, and bighorn sheep for forage on Miller Butte could be lower under Alternative 6 if large numbers of bison began grazing on Miller Butte under Alternative 1 (due to refuge staff no longer being able to control the distribution of the bison herd). If large numbers of elk began wintering outside the Jackson Hole area, direct competition between elk, bison, mule deer, moose, and bighorn sheep could be lower than the potential effects described above.

Competition between elk, bison, mule deer, moose, and bighorn sheep for forage in sagebrush and grassland habitats would not reach the level that it would under Alternative 2 (where elk numbers could be higher in some years and irrigation would be eliminated), but it could be higher than all other alternatives due to higher elk and bison numbers than under Alternative 3 and the lack of winter feeding. Effects of sprinkler irrigated fields would be similar to those of Alternative 4.

To the extent that mule deer are being displaced from key habitats on the refuge and park under baseline conditions due to elk hunting on the refuge and the elk herd reduction program in the park, the eventual elimination of hunting on part of the refuge and in the Blacktail Butte and Kelly hayfields area would benefit mule deer by reducing disturbance and movements.

Maintaining the fence along U.S. 26/89 would continue to block the movement of bighorn sheep to East Gros Ventre Butte, thereby forcing them to remain on Miller Butte. The fence would also continue to block the movement of mule deer between East Gros Ventre Butte and Miller Butte.

Grand Teton National Park — Although the number of elk in the park segment would be lower than the baseline level by a major amount, winter use by elk could increase after winter feeding on the refuge was eliminated and as a larger amount of potential winter habitat in the park was converted to early seral plant communities. More elk wintering in the park could increase direct competition with moose, but because elk numbers in the summer would be considerably lower than under Alternative 1, overall competition between elk and other ungulates in willow, aspen, and cottonwood habitats would be lower. Lower elk numbers in the park following above-average and severe winters would provide periods when aspen and other habitats could recover. In most areas of the park where the condition of aspen stands has been affected by heavy elk browsing, the condition of the stands would improve somewhat due to fewer elk in the park segment. Also, the park's new *Fire Management Plan* (NPS 2004b) aims to ensure that unless habitat change is a natural result of plant succession, fire would continue to play its role in influencing vegetation patterns on much of the park landscape. Benefits on mule deer and moose would likely be greater than under Alternative 1.

Direct competition between elk, bison, and other ungulates in agricultural, native grassland, and sagebrush shrubland habitats in the park during summer and fall would have the potential to decline to some degree due to the major reduction in elk and bison numbers in the park. The closure of the Blacktail Butte/Kelly hayfields area to the elk reduction program (and possible elimination of the program in the park) would result in elk, including

elk from other segments, moving more slowly through grassland and sagebrush habitat during fall and early winter, which could offset the decline in competition to some extent. However, these habitats receive little use by other ungulates during fall. Furthermore, elk and bison have different habitat and dietary requirements than other ungulate species during winter. Converting agricultural lands to native vegetation would further reduce competition by increasing the amount of native grassland and sagebrush habitat.

Direct competition between elk, bison, and other ungulates in grassland and sagebrush shrubland habitats in the park could increase during winter in the long term due to the eventual elimination of winter feeding on the refuge and the resulting increase in winter use of park habitats. This would result in competition between elk and moose for browse (e.g., bitterbrush) in the sagebrush shrubland habitat. More bison wintering in the park under this alternative, as compared to baseline conditions and Alternative 1, would result in little or no competition with other ungulates because bison and elk would be the only grazing ungulates at lower elevations of the park during winter.

Bridger-Teton National Forest — Larger numbers of elk would use winter range in the national forest, which would increase already heavy browsing pressure on aspen stands. More elk using native winter range in the Buffalo Valley area and the Gros Ventre River drainage would increase competition between elk and moose for browse in willow and cottonwood habitats, contributing to further degradation and loss of these habitats. Therefore, there could be a net adverse impact to mule deer and moose using willow and cottonwood stands (as opposed to aspen stands) in the national forest, assuming that elk numbers in the Jackson elk herd unit remained near the herd objective of about 11,000 animals.

It is possible that the presence of wolves in the Gros Ventre area could indirectly decrease potential elk impacts on vegetation by changing elk distribution. Informal observations in Bridger-Teton National Forest suggest that wolves have caused elk to move more often from one area to another, allowing a greater proportion of aspen suckers to survive (Kilpatrick, pers. comm. 2004). Improved willow growth in Yellowstone National Park since wolf reintroduction has also spawned such a the-

ory, but other factors such as climate, recent flooding events, and beaver activity are also being examined (D. W. Smith 2005).

Potential effects on mule deer, moose, and bighorn sheep in the national forest would be similar to those under Alternative 2. Because the number of elk on native winter range in the national forest would increase under Alternative 6, direct competition would increase between elk, mule deer, moose, and bighorn sheep in grassland, sagebrush, and other upland shrubland habitats, assuming that elk numbers remained near the elk herd objective of about 11,000 animals.

Other Lands — On BLM and private lands in the Jackson Hole area direct competition between elk and other ungulates for forage would increase in localized areas after winter feeding was eliminated on the refuge. On some lands browsing and grazing pressure by elk could be heavy, which would substantially increase competition between elk, mule deer, and moose on private lands in Buffalo Valley, Jackson Hole, and possibly Hoback Canyon.

If large numbers of elk migrated to areas outside Jackson Hole, this could result in an increase in direct competition between elk and mule deer and/or moose for forage on federal, state, and private lands in areas where elk began wintering.

Potential Effects of Bovine Tuberculosis and Paratuberculosis — If bovine tuberculosis or paratuberculosis became established in the elk and bison populations after Alternative 6 was fully implemented, there would be a moderate reduction in the risk of these diseases being transmitted from elk and bison to other ungulates compared to Alternative 1 and similar to Alternative 2. Although tuberculosis and paratuberculosis are typically not sustained in free-ranging populations of ungulates that are not artificially concentrated (Williams 2001), they have been sustained in some free-ranging situations (Peterson 2003). Nonetheless, it would be much less likely that these diseases would be sustained in the elk herd, and the prevalence in the bison herd would be much less under Alternative 6. Consequently, the herds would not provide a continual source of potential transmission to bighorn sheep on winter range. Because tuberculosis and paratuberculosis would likely not pose a major problem to mule

deer and moose under Alternative 1, the reduced risk under Alternative 6 would result in only negligible potential benefits to these two species. Of the alternatives being considered, Alternative 6 would provide the least amount of risk to other ungulate species.

Potential Effects of Chronic Wasting Disease — Alternative 6 (and Alternative 2) would have the least potential for adversely impacting mule deer in the Jackson Hole area if chronic wasting disease became established because of a low number of wintering elk on the refuge and the elimination of artificial concentrations of elk on the refuge, as described for Alternative 2.

Conclusion

Of the alternatives being considered, Alternative 6 (similar to Alternatives 2 and 3) would have the least amount of adverse impacts to other ungulates on the refuge, except that competition between bighorn sheep, elk, and bison could increase under these alternatives compared to baseline conditions. Alternative 6 (along with Alternatives 2 and 3) would have the largest amount of riparian and aspen woodland habitat available to mule deer and moose on the refuge, especially if large numbers of elk began migrating out of the Jackson Hole area. Alternative 6 (along with Alternatives 2 and 3) would have the lowest risk of any of the alternatives in terms of the severity of an outbreak of a non-endemic infectious disease in the elk or bison herd that could adversely impact the population health of other ungulates.

In the park aspen habitat would improve in many areas that are now being heavily grazed by elk, but some aspen stands could potentially degrade faster (e.g., in areas where winter use by elk would increase). In areas with more winter use by elk, competition with moose for browse could increase during some winters. Prescribed fire could offset increased levels of elk grazing in aspen habitat if aspen suckers were protected from ungulate grazing. While it is difficult to determine whether changes in habitat conditions and level of competition under Alternative 6 would result in a net improvement or detriment to mule deer and moose in the park, the changes would be negligible to minor. Because of attempts to maintain natural densities of elk and bison, Alternative 6 (together with Alternative 2) would have the low-

est potential for other ungulate populations in the park to be infected by a non-endemic disease transmitted from elk or bison. Alternative 6 would not result in the impairment of park resources.

Mitigation

The following mitigation measures would require an adaptive approach, depending on the alternative and the need for mitigation. In areas where elk are limiting the recruitment of willow, aspen, and cottonwood seedlings and suckers on the refuge, exclosures could be used constructed or electric fences could be used during critical periods to allow the seedlings and suckers to reach heights that would enhance their survival. While costs could be high if this mitigation was used in conjunction with treatments in aspen habitats in the national forest (i.e., large areas), it might be necessary at least on a small scale near elk feed-grounds or on heavily used winter range. Alternatives 4–6 include long-term exclosures.

To alleviate potentially higher levels of competition between elk, bison, and bighorn sheep on Miller Butte under alternatives that would reduce the frequency of winter feeding on the refuge, exclosures or wing fences could be constructed.

To reduce the potentially significant adverse impacts on mule deer and moose from the introduction of a non-endemic infectious disease under an alternative where winter feeding continued (thereby compounding the adverse effects that would occur if a non-endemic infectious disease was introduced), winter feeding could be immediately reduced by a major amount or eliminated, and/or elk and bison numbers could be reduced in order to reduce the potential of transmission. Reducing the potential for transmission would result in a lower prevalence in elk and bison, which would reduce the extent to which the disease can be transmitted to other ungulate species, which in turn could result in a lower prevalence in these other ungulate populations. These mitigation measures are addressed in Alternatives 2 and 3, although under these alternatives the measures are intended to be preventive, rather than reactionary.

Although stopping winter feeding and reducing elk numbers if chronic wasting disease was dis-

covered in the elk population could alleviate some of the adverse impacts to mule deer, it would not be as effective as reducing winter feeding and elk numbers prior to an outbreak of chronic wasting disease. It takes more than 15 months to detect chronic wasting disease in mule deer (Williams, Kirkwood, and Miller 2001) and presumably about the same amount of time in elk. Furthermore, the prevalence would be so low during the first few years, that the chance of also detecting the disease would be low. This would give the disease at least a few years to spread, increase in prevalence, and become well established in the population before any action could be taken in response to detecting it.

As described in Chapter 2 under “Elements Common to All Alternatives,” if chronic wasting disease was discovered in one of the ungulate populations during or following implementation of the plan, actions would be taken to conduct surveillance and/or to mitigate the impacts as identified in Wyoming’s *Chronic Wasting Disease Management Plan* (WGFD 2006) or a specific USFWS or NPS plan. Those actions could include surveillance, phasing out feeding completely, reducing the population through hunting or agency culling, or depopulating the herd through agency culling. The effects of any actions, while difficult to assess, would be similar to the effects described under Alternative 6.

Cumulative Effects

Transportation Improvements

The reconstruction of U.S. Highway 26/287 would disturb about 117 acres of “crucial” moose habitat, 24 acres of moose seasonal range (Jackson herd), and 12 acres of seasonal mule deer habitat (Sublette herd) along the existing road corridor. The reconstruction might also increase ungulate mortality due to vehicle collisions as traffic volume grows. Along some portions of the highway retaining walls, guardrails, and passing lanes would create both short- and long-term barriers to movement. Upgrading the existing highway is not expected to result in extensive effects in terms of blocking migration routes or movement corridors. It is anticipated that cumulative effects on overall mule deer and moose herd dynamics would be negligible.

Federal Land Management Activities

Grand Teton National Park Fire Management

Mechanical treatments could result in a small reduction in ungulate habitat, reduced habitat quality, and short-term disturbance that could displace animals in proximity to wildland urban interface (WUI) areas. However, these actions are not expected to adversely affect ungulates at a population level because WUI areas and their immediate vicinity already have reduced habitat effectiveness. 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 could 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 ungulates from certain portions of habitat, but the long-term effects could create vegetative diversity that would benefit moose and mule deer.

Negative impacts due to the loss of habitat and inaccessible habitat on the refuge and in the park under Alternatives 1, 4, and 5 could be offset to some extent by improved habitat conditions for ungulates due to the park’s fire management program. Alternatives 2, 3, and 6 would have beneficial cumulative effects due to improved habitat on the refuge, combined with improved habitat in the park as a result of the fire management program.

Grand Teton National Park Recreation Infrastructure Improvements

The proposed implementation of multi-use pathways, the realignment of portions of the Moose–Wilson Road, and other transportation improvements would result in site-specific, temporary impacts along planned construction routes during the summer. The completed trail would attract additional recreationists along the Snake River corridor during the summer and possible cross-country skiers in the winter.

Trail construction would likely displace mule deer and moose within or near work areas in the short term and make habitat unavailable. If pathways were separate from existing roads, long-term im-

Impacts to mule deer and moose 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 mule deer and moose and could alter distribution and habitat use. Overall, the potential transportation improvements are expected to have long-term, minor, adverse impacts to mammals in the park.

Any future improvements to the Gros Ventre campground would result in site-specific, temporary impacts during construction, with a minor increase in the number of summer campers and the potential for displacement of mule deer and moose. These improvements would potentially increase disturbance to moose and mule deer in summer and alter distribution and habitat use, although effects would likely be negligible because the areas already have reduced habitat effectiveness.

Negative impacts on mule deer and moose habitats on the refuge and in the park under Alternatives 1, 4, and 5 could be compounded to some extent by the loss of habitat for mule deer and moose due to infrastructure improvements. The beneficial effects of improved habitat on the refuge under Alternatives 2, 3, and 6 could be offset by habitat being lost due to the park's infrastructure improvements, but the effects would likely be negligible.

Bridger-Teton National Forest Fuels Management Projects

Bridger-Teton National Forest has identified a variety of fuels reduction and habitat enhancement projects in the primary and secondary analysis areas. These projects would alter about 9,400 acres of national forest land and could temporarily diminish forage opportunities immediately after various fuel reduction treatments. In the long term, however, most of these projects would improve ungulate transitional and winter habitats.

Long-term, enhanced forage in fuels reduction areas would benefit all ungulates. Because of reduced or eliminated winter feeding on the refuge, Alternatives 2, 3, and 6 would result in more elk wintering on native range and potentially heavy browsing in fuel reduction areas, decreasing the

amount of forage available to mule deer and moose.

Bridger-Teton National Forest Travel Management Plan Updates / Moose-Gypsum Projects

The management projects planned in the secondary analysis area would alter existing ungulate habitat. The projects could temporarily diminish forage opportunities in some areas after various fuel reduction treatments and increased trail opportunities. In the long term, however, the projects could result in enhanced forage opportunities for ungulates due to the regeneration of nutrient-rich undergrowth. The benefits of increased forage for ungulates could be less for mule deer and moose under Alternatives 2, 3, and 6 if Jackson elk migrated to the Green River basin, increasing competition for forage that would result from the Moose-Gypsum project.

BLM Snake River Resource Management Plan

Greater public access could increase conflicts with mule deer and moose and negatively impact woody riparian habitats that provides browse for ungulates. The continued management of conservation easements for open space and wildlife habitat would help protect foraging habitat. Pursuit of a long-term protective withdrawal to prohibit the staking and development of mining claims would also benefit mule deer and moose by preventing potential adverse impacts to habitats.

Cumulative effects would not be expected under Alternatives 1 and 5 because competition between elk and other ungulates would not increase. Alternatives 2, 3, 4, and 6 would increase elk distribution in some years, resulting in greater potential for competition between elk and other ungulates and possible cumulative effects on other ungulates along the Snake River.

Pinedale Anticline Oil and Gas Exploration and Development Project

Oil and gas development activities in the Pinedale anticline project area could impact crucial winter range for deer and antelope. Seasonal and locational restrictions would protect wintering big game. Cumulative effects would not be expected under Alternatives 1 and 5 because these alternatives would not affect competition between elk

and other ungulates. Alternatives 2, 3, 4, and 6 would increase elk distribution in some years, resulting in greater potential for competition between elk and other ungulates in the secondary analysis area and increasing the possibility for cumulative effects on other ungulates in the Pine-dale anticline study area.

Jonah Infill Drilling Project

The pronghorn antelope is the only big game species that regularly inhabits the Jonah infill project area. The degree of habitat fragmentation within the project area at current levels is high and is expected to increase with the proposed project under any of the action alternatives. The proposed action for the Jonah infill drilling project would result in an estimated increase (over present conditions) of 16,200 acres of new initial disturbance, for a total of 20,409 acres of project-related surface disturbance. Cumulative effects would not be expected to occur under Alternatives 1 and 5 for bison and elk management because these alternatives would not affect competition between elk and other ungulates. Alternatives 2, 3, 4, and 6 would increase elk distribution in some years, raising potential competition between elk and other ungulates in the secondary analysis area and increasing the possibility for cumulative effects on other ungulates in the Jonah infill project area.

Snake River Restoration Activities

Restoration of the Snake River channel by the U.S. Army Corps of Engineers could affect woody riparian habitat for a variety of wildlife species, including mule deer and moose along the Snake River. This environmental restoration project would prevent further degradation of habitat and facilitate habitat recovery.

Cumulative effects as a result of bison and elk management alternatives would not be expected under Alternatives 1 and 5 because these alternatives would not affect competition between elk and other ungulates. Alternatives 2, 3, 4, and 6 would increase elk distribution in some years, raising potential competition for forage between elk and other ungulates along the Snake River and lessening the benefits of improved habitat.

Population Growth and Private Land Development

Primary Analysis Area

Projected population increases in both Teton and Sublette counties would continue to create a demand for private land development in these areas. Habitat loss, increases in other ungulate/human encounters and conflicts, vehicle collisions with mule deer and moose, and changes to movements could occur.

Some of the most important wintering area in Jackson Hole (East and West Gros Ventre buttes) occurs on private lands. This area is immediately adjacent to major developments such as residential and commercial areas that continue to grow. Furthermore, the encroachment of private development continues to be the largest threat to mule deer winter range on East and West Gros Ventre buttes (Clark and Campbell 1981; Minta and Campbell 1991). Few parts of this winter range complex are protected by conservation easements and by out-holdings of the National Elk Refuge (across the highway from the refuge on East Gros Ventre Butte), which would provide long-term protection to small portions of the winter range.

Proximity to high-density housing areas and highways has resulted in indirect harassment by people, disturbance and mortality caused by dogs, and vehicle-caused mortality along highways and roads (Clark and Campbell 1981; Minta and Campbell 1991). Ongoing home construction on top of East Gros Ventre Butte could increasingly affect use of east-facing slopes by mule deer. It is possible that residential development in Jackson Hole has cut off migration routes of mule deer between summer and traditional winter areas.

Another key factor affecting mule deer wintering in Jackson Hole is that habitat quality of winter ranges is in a deteriorated condition. Because most of the winter range for mule deer in Jackson Hole is close to the town of Jackson and residential developments, and because the majority of winter range on East and West Gros Ventre buttes is privately owned, there is a low probability that the habitat would be burned or otherwise treated in the future. Without such treatment, habitat would continue to decline in condition.

Additional development near or adjacent to the Snake River is subject to the Natural Resource

Overlay (NRO) zoning district requirements (see Chapter 1, “Reasonably Foreseeable Actions”), which will help sustain migration in these areas by protecting migration routes and crucial winter ranges. Residential development of platted and zoned parcels to the south and west of the Jackson Hole Airport, within the primary analysis area, has greatly reduced the potential for ungulate migration between Grand Teton National Park and habitat on private lands.

Two narrow corridors of open land near Gros Ventre Junction could sustain the major east-west migration in the Jackson Hole Airport area. The northernmost area is protected by conservation easements, while the narrow corridor to the south is partially included in the NRO district and appears to be a private open space component of the Bar-B-Bar Meadows subdivision. These protected lands could continue to support a migration corridor through the area, although it is not known whether there is sufficient habitat to sustain such a corridor for the long term.

Additional development on private lands in the Buffalo Valley area would be outside or on the perimeter of the winter range for ungulates and is subject to the NRO district requirements. Such development, if it occurred, is not expected to adversely affect ungulate use of the winter range in the area.

Because elk would continue to be fed on the refuge under Alternatives 1 and 5, and under Alternative 4 in some winters, competition between elk and other ungulates would not increase on native winter range. Alternatives 2, 3, 4, and 6 would increase elk distribution in some years. This, combined with human population growth and development, would likely increase competition between mule deer, moose, and elk.

Secondary Analysis Area

Within the secondary analysis area in Sublette County, ongoing and future subdivision and development of agricultural lands could disrupt migration routes and reduce the availability of ungulate winter range in the upper Green River valley. Many of the mule deer that summer in the Jackson Hole area winter in the Green River basin, and parts of the migration route are threatened by residential development in the Pinedale area

(Madson 2001). Development or activities in these areas would not increase competition between other ungulates and Jackson elk under Alternatives 1, 4, and 5 because elk movements and distribution either would not increase from current distribution (Alternatives 1 and 5) or would increase to a limited extent in some years (Alternative 4). Under Alternatives 2, 3, and 6 the combination of Jackson elk potentially migrating to the Green River basin and increased development in Sublette County would result in greater competition between elk and other ungulates for winter range.

Potential Jackson elk migration to the Green River basin under Alternatives 2 and 3 would help protect the corridor and would bring added recognition to the importance of the corridor, which would benefit mule deer. However, a large influx of elk would increase competition for browse. Under Alternative 4 no effort would be made to restore elk migrations to the Green River basin, but the protection of migration corridors for pronghorn and mule deer would be supported, which would benefit mule deer.

PREDATORS AND SCAVENGERS

In the study area elk are the primary prey of large predators, such as black bears, cougars, and coyotes. Scavengers such as coyotes, ravens, and magpies feed on dead elk and bison when carcasses are available. Therefore, predators and scavengers would be affected by changes in the number of elk and bison and their mortality rates. Factors that affect elk and bison numbers and distribution include a change in the population objectives of elk and bison on the refuge and in the park that would redistribute animals to other areas, a reduction in winter supplemental feeding on the refuge (which would also redistribute elk and bison to other areas and possibly increase winter mortality), and the introduction of new diseases, such as chronic wasting disease or tuberculosis.

Impacts on gray wolves, grizzly bears, and bald eagles are discussed under “Threatened, Endangered, and Species of Special Concern.” Lynx and wolverines are not expected to be affected by bison and elk management, and therefore, are not analyzed. The effects of each alternative on black bears are expected to be generally similar to ef-

fects on grizzly bears, and the effects on coyotes similar to the effects on wolves.

Impacts of the Alternatives

Impacts Common to All Alternatives

Long-tailed Weasels, Mink, Red Foxes, Striped Skunks, and Bobcats

Red foxes and striped skunks are common predators that can thrive in a variety of habitats and feed on a variety of food sources. Bobcats and long-tailed weasels, although less common, can also live in various habitats and feed on numerous food sources, but tend to focus on small mammals and birds. Mink occur in marshes and along watercourses and feed on fish and small mammals. Accurate data on population numbers for these species are not available. They could feed on elk or bison carrion opportunistically, but ungulate carrion is probably a negligible to minor part of their diets. Long-tailed weasels, mink, red foxes, striped skunks, and bobcats are not addressed in detail because actions being considered in the alternatives would have negligible to minor effects on their population numbers if there were any effects at all.

Disease Impacts

If a new disease (e.g., bovine tuberculosis, paratuberculosis, or chronic wasting disease) was introduced into the Jackson Hole area and caused a moderate to major reduction in elk and/or bison numbers, predators and scavengers in general would benefit in the short term due to more vulnerable prey and more carcasses available for scavenging. In the long term predators and scavengers could be negatively impacted due to a decrease in available prey. The risk of this happening would increase in alternatives with high concentrations of animals, which would tend to foster the spread of an infectious disease.

The severity of impacts on predators and scavengers that could result from bovine tuberculosis or paratuberculosis substantially decreasing the Jackson elk and bison populations would be greatest under Alternative 1, followed by Alternatives 5, 4, and 3, with the least risk under Alternatives 2 and 6 (approximately equal risk) (HaydenWing and Olson 2003). The severity of impacts from chronic wasting disease would be greatest under

Alternatives 1 and 5 (approximately equal risk), followed by Alternatives 4 and 3, with the least risk under Alternatives 2 and 6 (approximately equal risk).

Predators and scavengers would not be impacted by contracting paratuberculosis, brucellosis, or chronic wasting disease under any of the alternatives because they are not known to be susceptible to these diseases (Williams 2001; Thorne et al. 1982).

If bovine tuberculosis became established in the Jackson Hole area, predators and scavengers might be able to contract the disease from elk and bison. Although individual animals might develop symptoms and die directly, the disease could not be sustained within the population and passed along to other members of the species (Roffe, pers. comm. 2002). There are no documented cases of predator and scavenger species in North America maintaining the disease within their populations (Clifton-Hadley et al. 2001).

Direct Effects of Human Disturbance

Some species of predators and scavengers, such as coyotes, ravens, and magpies, are attracted to the feedgrounds as a result of large concentrations of elk and bison. Animals new to the feeding operations might be wary at first, but they seem to habituate quickly. Therefore, predators and scavengers would be negligibly impacted by management activities associated with the supplemental feeding program in all alternatives in the short term and Alternatives 1, 3, 4, and 5 in the long term. Supplemental feeding on the refuge would be gradually phased out under Alternatives 2 and 6, which would eventually eliminate any possible disturbance effects of activities associated with winter feeding. Under Alternative 3 feeding would only occur in the severest winters.

Predators and scavengers would be impacted to a negligible degree by activities associated with elk and bison hunting in all alternatives except 2. Hiking and horseback riding and the firing of rifles in the northern portion of the refuge and the eastern side of the park could temporarily disturb predators and scavengers in the immediate area. However, these impacts would not affect survival and reproduction. The long-term net effect of adding a bison hunt and reducing elk hunting opportunities

would be a reduction in human disturbance during the hunting season under Alternatives 3, 4, and 6.

Under Alternative 2 no hunting on the refuge or an elk herd reduction program in the park would be allowed. Therefore, predators and scavengers would not be disturbed by associated human activities.

Alternatives 1, 3, 4, 5, and 6 include cultivation of 2,400 acres on the refuge, with either flood irrigation or flood and sprinkler irrigation. Under Alternatives 2 through 6, 4,500 acres of agricultural lands in the park would be restored to native vegetation, which could take up to 30 years to complete. Farming and irrigation management practices on the refuge and restoration activities on the agricultural lands in the park could disturb predators and scavengers during the day, but impacts would be negligible in the short and long terms.

Under Alternative 2 and Option B of Alternative 3 farming and irrigation practices would be eliminated on the refuge, so less human disturbance would occur on the southern part of the refuge, with negligible, beneficial impacts.

Impacts on Other Lands

Predators and scavengers on other federal and private lands in Jackson Hole and the Green River basin would not be affected or would be affected to a negligible degree by actions that are being considered in this planning process. An exception to this could occur under Alternatives 2, 3, and 6. If elk spent more time on BLM lands in Jackson Hole or if large numbers of elk migrated to the Green River basin and the Red Desert, predators and scavengers in these areas could benefit from more available prey animals and more winter-killed carcasses.

Alternative 1

Analysis

Black bears scavenge ungulate carcasses and prey on elk calves. They occur in the park and may rarely be seen on the refuge. While black bear numbers are unknown, their population is considered stable.

Cougar numbers are estimated at 28 resident adults, and cougars have been regularly sighted on the refuge and in the park. They prey primarily on large ungulates and could be affected by changes in elk numbers.

The most common predators and scavengers on the refuge and in the park are ravens, magpies, coyotes, and badgers. They prey on small mammals and birds, as well as scavenge elk and bison carcasses and gut piles left by hunters. Coyotes also prey on elk calves. Ravens, magpies, and coyotes often occur in large concentrations on the refuge feedgrounds in the winter and would be affected by changes in supplemental feeding and hunting. Badgers could be affected by habitat changes in native grassland and sagebrush shrubland communities. Golden eagles are also occasionally seen scavenging on ungulate carcasses.

Elk and Bison Numbers and Distribution — Predators and scavengers could potentially benefit from a growing bison population, and eventually bison would become so numerous that at some point they could disperse outside the park and the refuge into the national forest or private lands, making them available for hunting. The resulting gut piles and carcass remains could benefit coyotes, ravens, golden eagles, magpies, and black bears. This situation could also lure bears and coyotes closer to people, resulting in increased human-caused mortality; however, the effect on a species population would be negligible.

Black bears and coyotes would continue to benefit by preying on elk calves in the spring and scavenging elk carcasses opportunistically. Since the number of elk would remain similar to baseline conditions, these predator species would not be impacted by elk management under Alternative 1 any more than they have been affected in the recent past.

Cougars would not be affected by elk management in the short or long terms anymore than they have been affected in the recent past. Baseline elk numbers are considered sufficient to sustain a healthy population of cougars. A study in Yellowstone National Park and Gardner Basin analyzed kills by cougars, with an ungulate killed on average every 9.4 days (Murphy 1998). Annual predation rates ranged from a combined total of 34 elk and mule deer killed by adult female cou-

gars without cubs to 52 elk and mule deer killed by family groups. Elk were the most important prey item, comprising approximately 61% of 302 confirmed and probable cougar kills. Approximately 68% of the elk killed were calves.

Effects of Habitat Changes — Badgers on the refuge could benefit compared to baseline conditions because their native grassland and sagebrush shrubland habitats would expand by a negligible amount in the short term and a minor amount in the long term. Badgers in the park and on other federal and private lands in Jackson Hole would not be affected by actions under Alternative 1.

Conclusion

Compared to baseline conditions, many predators and scavengers on the refuge and in the park could benefit from increased mortality of growing numbers of bison due to natural mortality. Predators and scavengers would not be affected by elk numbers and distribution any more than they have been in the past. Badgers could benefit from the expansion of native grassland and sagebrush shrubland habitats on the refuge but would not be affected in the park any more than they have been in the past. This alternative would not result in the impairment of predators and scavengers in the park.

Alternative 2

Analysis

Elk and Bison Numbers and Distribution — After cessation of bison fertility control and without hunting on the refuge or the elk reduction program in the park, elk and bison populations would likely go through cycles, increasing in mild years and experiencing high mortality during severe winters. Under Alternative 2 annual winter mortality for elk is estimated to range between 1% and 20%. The higher the mortality, the more carcasses would be available for scavenging. If fertility control was not successful in reducing bison numbers to levels that the habitat could support, reductions in winter feeding (and higher mortality) would be used to reduce their numbers on the refuge, which would greatly benefit scavengers in the short term.

Many predators and scavengers would be positively impacted in years when bison and elk numbers rose and negatively impacted in years when they fell. This would be particularly true in the park where elk numbers could fall to as low as 600 in some years. Elk and bison numbers would be lower than under baseline conditions after severe winters and lower than the short- and long-term projections for this alternative initially as a result of bison fertility control and stopping supplemental feeding and farming on the refuge. The bison and elk herds would also be more distributed throughout winter range than under Alternative 1.

In some years fewer elk and bison under Alternative 2 could affect scavengers, such as coyotes, black bears, golden eagles, magpies, and ravens. In the long term scavengers might be adversely affected in mild winters because even though the mortality rate could be comparable to baseline conditions, there could be fewer elk and bison, and they would be distributed more widely throughout the Jackson Hole area, making carcasses harder to find compared to baseline conditions and Alternative 1. However, winter mortality of the elk and bison on the refuge and the WGFD feedgrounds is currently artificially low because of supplemental feeding. At present, the most important mortality factor is hunting. Under Alternative 2 increased winter mortality during above-average and severe winters would make more carcasses available to scavengers. Because hunting on the refuge and the elk reduction program in the park would be eliminated, no gut piles or other carcass remains would be left for scavengers. Black bears could be negatively impacted through the loss of a rich source of protein and fat for bears preparing for hibernation.

Although overall numbers of elk and bison could be reduced, some predators could benefit from more of these ungulates being on native winter range rather than concentrated on the refuge. This could mean that more winter-killed elk would be available as carcasses in the spring for black bears, which do not normally occur on the refuge. However, black bears and coyotes could be negatively affected by fewer calves available for predation in the spring and summer. If bears turned to livestock due to lower numbers of elk calves in the spring, more bears could potentially be killed by government authorities and ranchers. The im-

pect of fewer calves on coyotes would probably be negligible because coyotes eat a large variety of foods and are more adaptable than many other predators.

Fewer elk in some years in the long term could mean reduced prey for cougars compared to baseline conditions and Alternative 1. Fewer elk could either increase the amount of time cougars spent hunting, increase reliance on other prey species, or reduce cougar numbers. The number of elk under Alternative 2 might be able to support the existing cougar population, similar to baseline conditions. In addition, elk in winter would be more widely distributed on native range, which could mean that more prey would be available, increasing winter survival for cougars whose territories do not include the refuge.

In the long term, if large numbers of elk migrated to the Green River basin and the Red Desert, there might be fewer prey animals for predators and scavengers in the Jackson Hole area compared to baseline conditions and Alternative 1. However many elk would remain in the Gros Ventre, Buffalo Valley, and other areas of Jackson Hole. Therefore, predators and scavengers might be negatively affected, but to a negligible degree compared to baseline conditions and Alternative 1. Predators and scavengers in the Green River basin and the Red Desert would benefit but only to a negligible degree due to more wintering ungulates and increased numbers of carcasses.

Direct Effects of Human Disturbance — Under Alternative 2 fertility control would be used to help reduce bison numbers in the short term. Bison would likely be contracepted on feedlines. Predators and scavengers, such as coyotes, ravens, and magpies have become accustomed to human activities associated with feeding elk and bison, so it is likely that they would eventually become accustomed to contraception activities carried out simultaneously. If fertility control was carried out in the park, predators and scavengers could be temporarily disturbed to a negligible degree by humans walking through various habitats searching for bison and shooting dart guns. Predators and scavengers on other federal lands and private lands in Jackson Hole would not be affected by fertility control activities because they would only be carried out on refuge and park lands.

On the refuge, an estimated 2,400 acres of cultivated fields would be restored to native vegetation under Alternative 2. Predators and scavengers could be temporarily disturbed by associated activities; impacts would be negligible.

Effects of Habitat Changes — Under Alternative 2 badgers on the refuge could benefit, compared to baseline conditions, because native grassland and sagebrush shrubland habitats would expand by a minor amount in the short term and a moderate amount in the long term. In the park badgers could benefit in the long term because 4,500 acres of agricultural lands would be converted to sagebrush shrubland and native grassland habitats.

If large numbers of elk did not migrate outside Jackson Hole, badgers on private lands in Jackson Hole could experience negative impacts in localized areas. Elk that were no longer being fed on the refuge in the winter would likely forage more often on private lands compared to baseline conditions, resulting in further habitat degradation, reduced residual vegetation, and loss of acreage in some areas.

If large numbers of elk did migrate outside Jackson Hole, badgers on BLM lands and private lands in the Green River basin could be negatively affected in localized areas as a result of native grassland and sagebrush shrubland communities experiencing higher levels of grazing and browsing. This could result in habitat degradation and loss of acreage in some areas, negatively affecting small mammals that badgers prey on.

Biosafety of Wildlife Contraceptives — A fertility control program would be carried out on bison involving surgical sterilization or biochemical contraceptives. Biochemical contraceptives approved for use in free-ranging wildlife do not enter the food chain and therefore would have no adverse effects on predators and scavengers.

Conclusion

Many predators and scavengers would benefit in years of high elk and bison mortality on the refuge and in the park and would likely be adversely affected in mild years after the elk and bison herd had declined, compared to Alternative 1. Some predators and scavengers such as black bears and cougars could benefit from elk and bison being

more widely distributed over the landscape and suffering higher winter mortality. Fewer calves born in the spring due to fertility control could adversely affect some predators and scavengers, such as bears and coyotes. Badgers on the refuge and in the park could benefit due to the expansion of their preferred habitats. This alternative would not result in the impairment of predators and scavengers in the park.

Alternative 3

Analysis

Elk and Bison Numbers and Distribution — In some years fewer elk under Alternative 3 could affect scavengers, such as golden eagles, coyotes, black bears, magpies, and ravens. In the long term, scavengers might be adversely affected during mild and average winters because even though the mortality rate might be comparable to baseline conditions, there would be fewer elk. However, the winter mortality of elk and bison on the refuge and state feedgrounds is currently artificially low because of supplemental feeding. At present, the most important mortality factor is hunting. Under Alternative 3 gut piles and other carcass remains and wounded animals not retrieved by hunters would provide scavengers with food in the fall and winter. This food source would increase in the short term as hunting increased in order to reduce the Grand Teton elk herd segment. However, gut piles would decline in the long term due to a reduced elk harvest.

Compared to Alternative 1, scavenger numbers could be lower because the bison population would not be allowed to grow without limit under Alternative 3 and there could be fewer bison carcasses to scavenge. However, during the hunting season there could be more gut piles on the refuge, and since supplemental feeding would occur an estimated 2 out of 10 winters, there could be more winter-killed elk and bison throughout Jackson Hole in non-feeding years.

Although overall numbers of elk could be lower in some years, some predators and scavengers could benefit from more of these ungulates being on native winter range rather than concentrated on the refuge. This could mean that more winter-killed elk and bison would be available as carcasses in the spring for black bears, which do not

normally occur on the refuge. The impact on coyotes of fewer calves would probably be negligible, because coyotes eat a large variety of foods and are more adaptable than many other predators.

Fewer elk in some years in the long term could reduce potential prey for cougars in the Jackson Hole area compared to baseline conditions and Alternative 1. This means that fewer elk in some years could either increase the amount of time spent hunting, increase reliance on other prey species, or reduce cougar numbers. Elk numbers under Alternative 3 might be able to support the existing cougar population to a similar extent as baseline elk numbers. In addition, elk would be more widely distributed on native winter range, which could mean more prey and increased winter survival for cougars whose territories do not include the refuge.

In the long term, if large numbers of elk migrated to the Green River basin and the Red Desert, there could be fewer prey animals for predators and scavengers in the Jackson Hole area compared to baseline conditions and Alternative 1. However many elk would remain in the Gros Ventre, Buffalo Valley, and other areas of Jackson Hole that contain winter range. Therefore, predators and scavengers could be negatively affected, but to a negligible degree. Predators and scavengers in the Green River basin and the Red Desert would benefit to a negligible degree due to more wintering ungulates and carcasses.

Direct Effects of Human Disturbance — Disturbance effects of a brucellosis vaccination program would be similar to the effects of a fertility control program carried out on the feedlines or in the park. These effects would be negligible and temporary.

Effects of Habitat Changes — Compared to Alternative 1, badgers could be negligibly affected under Option A by changes in native grassland and sagebrush shrubland habitats. Under Option B badgers would benefit by a minor amount due to more acres in native grassland and sagebrush shrubland habitats. Badgers in the park could benefit due to the restoration of 4,500 acres of agricultural lands to native grassland and sagebrush shrubland communities.

The effects of Alternative 3 on badgers on BLM lands and private lands in Jackson Hole and the Green River basin would be similar to the effects of Alternative 2.

Conclusion

Most predators and scavengers on the refuge and in the park would benefit in years of high elk and bison mortality and would likely be adversely affected in mild years after the elk and bison herds had declined in numbers compared to Alternative 1. However, some predators and scavengers, such as black bears, could benefit from elk and bison being more distributed over the landscape and suffering higher winter mortality. Badgers could be negligibly adversely impacted on the refuge by a slight decline in their preferred habitats. Badgers in the park could be positively affected due to an expansion of their preferred habitats. This alternative would not result in the impairment of predators or scavengers in the park.

Alternative 4

Analysis

Elk and Bison Numbers and Distribution — In years when the refuge would continue to supplementally feed elk and bison, the effects on predators and scavengers would be similar to baseline conditions and Alternative 1.

During some winters elk would rely more on native winter range, and elk and bison mortality and vulnerability would likely be higher than under baseline conditions and Alternative 1. Some predators and scavengers could benefit from more widely distributed and vulnerable prey. Black bears could benefit if more winter-killed elk and bison died in areas that are accessible to bears after they emerge from hibernation in the spring. Cougars whose territories do not include the refuge could also benefit from more widely distributed and vulnerable prey.

Scavengers would benefit in the short term as relatively large numbers of bison were killed to bring numbers down from an estimated 1,000 (at the signing of the Record of Decision) to approximately 500. Hunters would leave numerous gut piles on refuge and national forest lands in the first few years as the herd was being reduced. In

the long term, compared to Alternative 1, scavengers would still benefit but to a lesser degree because fewer bison would be in the herd and fewer would need to be harvested, leaving fewer gut piles.

Direct Effects of Human Disturbance — Brucellosis vaccination disturbance effects to predators and scavengers would be similar to the effects of the feeding program, which are negligible and temporary.

Effects of Habitat Changes on Predators and Scavengers — Changes in sagebrush shrubland and native grassland habitat acreage on the refuge would have minor, negative effects on badgers in the long term compared to baseline conditions and Alternative 1. Badgers could benefit from farming practice changes under Alternative 4 because the improved irrigation system, together with increased forage production in cultivated fields, could result in more small mammals for badgers to prey upon. Badgers in the park would likely benefit from the restoration of 4,500 acres of agricultural lands to native grassland and sagebrush shrubland communities.

All predators that feed on small mammals, such as hawks, badgers, and coyotes, could benefit if more small mammals inhabited the cultivated fields due to changes in the irrigation system and higher forage production.

Biosafety of Strain 19 Vaccination for Brucellosis — Predators and scavengers would be exposed to Strain 19 and RB51 after consuming elk and bison but would not be expected to experience any negative effects (Cook and Rhyan 2002; WGF D 2002b).

Conclusion

Most predators and scavengers on the refuge and in the park would benefit from higher elk and bison mortality and wider distribution of carcasses and prey if there were years when the refuge did not provide supplemental feed. In particular, black bears, which do not normally occur on the refuge, would benefit from a wider distribution of winter-killed elk and bison. In years when the refuge did feed, there would be no effect on most predators and scavengers compared to Alternative 1. Badgers could be adversely impacted by a minor decline in the amount of their preferred

habitat on the refuge. Badgers in the park could be positively affected due to expansion of their preferred habitats because of habitat restoration. This alternative would not result in the impairment of predators and scavengers in the park.

Alternative 5

Analysis

Elk and Bison Numbers and Distribution — The effects of elk numbers and distribution on predators and scavengers under Alternative 5 would be similar to the effects under baseline conditions and Alternative 1.

Scavengers would benefit in the short term as relatively large numbers of bison were killed to bring numbers down from an estimated 1,000 (at the signing of the Record of Decision) to 400. Similar to Alternative 4, hunters would leave numerous gut piles on refuge and national forest lands in the first few years as the herd was being reduced. In the long term, compared to Alternative 1, scavengers would still benefit, but to a lesser degree because fewer bison would be in the herd and fewer would need to be harvested, leaving fewer gut piles. Furthermore, fewer bison would be harvested on private lands.

Direct Effects of the Human Disturbance — Elk would be vaccinated against brucellosis on feedlines by means of biobullets. Effects of disturbance to predators and scavengers would be similar to the effects of the feeding program, which appear to be minimal. Therefore, any disturbance of predators and scavengers due to the vaccination program would be negligible and temporary.

Effects of Habitat Changes — The effects of habitat changes on predators and scavengers due to changes in farming practices on the refuge and restoration activities in the park would be similar to the effects of Alternative 4.

Biosafety of Strain 19 and RB51 Vaccination for Brucellosis — Predators and scavengers would be exposed to Strain 19 and RB51 after consuming elk and bison but would not be expected to experience any negative effects (Cook and Rhyan 2002; WGFD 2002b; Kreeger 2002).

Conclusion

With regard to elk numbers and distribution, the effects on predators and scavengers on the refuge and in the park would be similar to the effects of Alternative 1. Most scavengers would greatly benefit in the short term from gut piles left by hunters as bison numbers were reduced from 1,000 to 400 animals. Scavengers would continue to benefit in the long term from the bison hunt but to a lesser degree because fewer animals would be killed. Badgers on the refuge could be adversely impacted in the long term by a minor decline in the amount of their preferred habitat. Badgers in the park could be the positively affected due to habitat restoration. This alternative would not result in the impairment of predators and scavengers in the park.

Alternative 6

Analysis

Elk and Bison Numbers and Distribution — In some years, fewer and more widely distributed elk and bison under Alternative 6 could affect predators and scavengers, such as golden eagles, magpies, ravens, coyotes, cougars, and black bears. In the long term some species of scavengers might be adversely affected in mild and average winters compared to baseline conditions and Alternative 1 because they would be distributed more widely throughout the Jackson Hole area, making carcasses harder to find. However, black bears do not normally occur on the refuge, so the wider distribution of carcasses would be a potential benefit. In hard winters scavengers both on and off the refuge would benefit from a larger number of winter-killed elk and bison because the winter mortality rate would no longer be kept artificially low by supplemental feeding.

Possible benefits of changes in carcass availability could be offset to an unknown extent by periodic reductions in elk numbers to an estimated 600–1,600 in the park and an estimated minor reduction in elk numbers in the Yellowstone and Teton Wilderness herd segments. Fewer elk in the park would also result in fewer elk calves for black bears, cougars, and coyotes to prey on in the spring. If black bears turned to livestock as a result of fewer elk calves in the spring and fewer winter-killed elk, more bears could potentially be killed by government authorities and ranchers.

The impact on coyotes of fewer calves and carcasses would probably be negligible because coyotes prey on a large variety of species and are more adaptable than many other predators. Although black bears greatly benefit from the protein that elk provide, the degree to which black bears would be impacted by reduced numbers of calves and carcasses is unknown. Cougars would not likely be affected by fewer elk calves and carcasses because they are capable of taking healthy adult elk.

Gut piles and carcass remains left by hunters and wounded animals not retrieved by hunters could be an important source of protein for scavengers, such as ravens, coyotes, and black bears. Under Alternative 6 elk hunting would continue on the refuge and the elk herd reduction program in the park (which could be discontinued if not needed in the long term), and bison hunting would begin on the refuge. As numbers of elk decreased on the refuge and in the park in the long term, the number of elk killed during the hunting season would also decrease; therefore, available gut piles would decrease. Bison hunting would initially provide many gut piles for scavengers, but as the bison herd was reduced to the objective of an estimated 500 post-hunt, the number of gut piles available each hunting season would be much less. Scavengers on the refuge and in the park would benefit in the short term, but in the long term scavengers would be negatively affected by a major amount due to fewer gut piles and other remains compared to baseline conditions and Alternative 1.

Elk and bison hunting would continue in the national forest. However, hunting opportunities and the resulting gut piles would fluctuate depending on the size of the herd and hunting quotas. Compared to baseline conditions and Alternative 1, the number of gut piles and other remains would be moderately higher when the elk herd was at the 11,000 objective because as the Grand Teton herd segment decreased, the Teton Wilderness herd segment would represent a greater proportion of the herd. After hard years, when elk herd numbers could fall to an estimated 8,100, the number of gut piles would decline moderately because hunting would be reduced to allow the elk herd to rebound. Therefore, in some years scavengers would benefit to a moderate degree from the increase in gut piles and other remains, and in years when the elk herd was below objective, they

would be negatively affected to a moderate to major degree due to fewer available gut piles.

Fewer elk in some years in the long term could mean less prey for cougars in the Jackson Hole area compared to baseline conditions and Alternative 1. Fewer elk in some years could also increase the amount of time spent hunting, increase predation on other prey species, or reduce cougar numbers. It is also possible that elk numbers under Alternative 6 would be able to support the existing cougar population to a similar extent as baseline elk numbers. In addition, elk in the winter would be more widely distributed on native winter range, so more prey could be available to cougars, and winter survival for cougars whose territories do not include the refuge would increase. However, elk number reductions of up to 80% in some years in the park would likely reduce cougar numbers in that area.

If large numbers of elk migrated outside the Jackson Hole area in the winter, fewer elk and bison would die on native winter range in this area, so less food would be available for predators and scavengers compared to a situation in which most elk remain in the Jackson Hole area. However, many elk would remain on the Gros Ventre feedgrounds or on winter range in the Gros Ventre River drainage, Buffalo Valley, and other areas of Jackson Hole that contain winter range. Therefore predators and scavengers could be negatively affected, but only to a negligible degree compared to baseline conditions and Alternative 1. Predators and scavengers in areas outside the Jackson Hole area could benefit to a negligible degree due to larger numbers of wintering ungulates in those areas.

Effects of Habitat Changes on Predators and Scavengers — The effects of habitat changes on predators and scavengers due to changes in farming practices on the refuge and restoration activities in the park would be similar to the effects under Alternatives 4 and 5.

Badgers on BLM lands and private lands in Jackson Hole, the Green River basin, and the Red Desert would not be affected by actions that are being considered under Alternative 6.

Conclusion

Most predators and scavengers on the refuge and in the park would benefit in years of high elk and bison mortality and would likely be adversely affected in mild years after the elk and bison herds had declined in numbers compared to Alternative 1. However, some predators and scavengers, such as black bears and cougars, could benefit from elk and bison being more distributed over the landscape and suffering higher winter mortality. Badgers on the refuge could be adversely impacted in the long term due to a minor decline in their preferred habitats. Badgers in the park could be positively affected due to habitat restoration on former agricultural lands. This alternative would not result in the impairment of predators and scavengers in the park.

Mitigation

Mitigation measures would not be necessary.

Cumulative Effects

No cumulative effects on predators and scavengers are expected as a result of impacts of the alternatives in combination with the impacts of reasonably foreseeable actions.

SMALL MAMMALS

Methodology Used to Analyze Effects

Composition of Small Mammal Communities

The analysis of potential effects of alternatives on small mammal populations is based primarily on the relationship of small mammal communities to different habitat types. Many small mammal species occur in several different habitats. However, an individual species tends to do better in some plant communities, where it will occur at higher densities, than in less optimal habitats, where it will occur at lower densities. Therefore, the composition of the small mammal community in one habitat type will differ from that in another habitat type, although both habitats will contain many of the same small animal species (See “Small Mammals” in Chapter 3). Small mammal populations also vary seasonally and annually, depending on factors such as precipitation, grazing pressure, and predation (Douglass, pers. comm. 2003).

Some Generalities about Habitat Relationships of Small Mammals

Small-mammal population research is complex and may at times be contradictory because small mammal communities are extremely dynamic, and research findings can be influenced by the timing of the study.

Therefore, general principles pertaining to small mammal populations and habitat relationships are given below, based on the professional opinion of Dr. Rick Douglass (biologist with Montana Tech of the University of Montana in Butte):

- Deer mice persist in a large variety of habitats. They could decline if sedges and grasses became very thick.
- Voles are most abundant where litter cover is high. In areas where grasses remain ungrazed and litter builds, a threshold phenomenon could occur, where numbers of voles begin to fluctuate, while below that threshold, numbers remain low. Above the threshold, vole numbers could become very high, but would still crash at times.
- Shrews tend to occur in wet environments, but also occur on dry sites.
- When some types of grasslands are heavily grazed, the density of small mammals might not change, but the turnover rate of individual animals might be completely altered (i.e., the mortality rate is high). This probably occurs because predation increases, but reproduction and immigration keep up with the removal.

The following summary of the possible changes in small mammal populations due to habitat conversions is based on the professional opinion of Mitchell Hannon (Yellowstone Ecological Research Center and the University of Nevada in Reno). His opinions are based on a knowledge of species distributions and data collected during small mammal surveys conducted in Yellowstone in 1992–93 and again in 2001–2. Data from the 1992–93 season can be found in Johnson and Crabtree (1999).

- Generally speaking, wetter environments with more herbaceous vegetation would have greater small mammal diversity.

- All species of small mammals that occur in native grasslands in Jackson Hole can also occur in sagebrush shrublands. When native grassland communities convert to sagebrush shrubland communities and vice versa, the effects on the small mammal community would depend on the quality of the grass understory. Lush grasses growing beneath shrubs promote vole and ground squirrel populations. Sparsely growing grasses would result in low densities of small mammal species.
- Deer mice, meadow voles, montane voles, and ground squirrels tend to live at high densities in lush grassland. As grasses become sparser in native grassland habitat and sagebrush shrubland habitat, deer mice, meadow vole, montane vole, and ground squirrel populations would become less dense and, therefore, more dramatically affect the total numbers of animals present in the area. Shrews and jumping mice tend to live at low population densities wherever they are found. Therefore, total numbers of small mammals in sagebrush shrublands or native grasslands would not be greatly affected by changes in numbers of shrews and jumping mice.
- Conversion between native grassland habitat and sagebrush shrubland habitat can affect the level of cover available. Small mammal species that use sagebrush as cover would tend to increase in abundance when sagebrush shrubland habitat increases. Species that need open areas to view approaching predators tend to decrease in abundance when sagebrush shrubland increases.
- Between native grassland and sagebrush shrubland habitats, the highest species diversity is likely to be in a sagebrush shrubland habitat that has a patchy distribution of intermingling grassland and sagebrush. Conversion of dry native grassland to a more or less homogenous sagebrush shrubland habitat that has a good grass understory is likely to result in an increase in small mammal diversity. However the densities of each species would be affected in different ways. Deer mice, rabbit, and vole (meadow, montane and long-tailed) populations might not change much in density. Shrew, chipmunk, and sagebrush vole populations would likely increase in density, while gopher and ground squirrel populations would probably decrease in density.
- Conversion of aspen woodland communities to native grassland and sagebrush shrubland habitats would likely change the small mammal community in major ways. There would be increases in deer mouse and ground squirrel population densities but a loss of flying and red squirrel densities. Overall species diversity would decrease.

Impacts of the Alternatives

Impacts Common to All Alternatives

Direct Effects of Human Disturbance

Small mammals on the refuge would not be adversely impacted or would be impacted to a negligible degree by management activities associated with the supplemental feeding program for elk or bison under Alternatives 1, 3, 4, and 5. Supplemental feeding would be phased out under Alternatives 2 and 6, and supplemental feeding would be reduced under Alternative 4 through adaptive management. During the phaseout period, management activities associated with supplemental feeding would not adversely impact small mammals or would impact them to a negligible degree. The effects would be negligible or nonexistent because supplemental feeding would occur during winter in the cultivated fields where there are a low number of small mammal species (Swanekamp, pers. comm. 2002). The reasons that there are few small mammals on cultivated fields probably relates to soil compaction from 90 plus years of thousands of ungulates on feedlines for an average of 70 days per year. In alternatives where supplemental feeding would be reduced or eliminated, small mammals might be able to colonize these areas in the long term.

Small mammals on the refuge would not be adversely impacted or would be impacted to a negligible degree by activities associated with elk and bison hunting in all alternatives except 2, which would not allow hunting on the refuge or an elk reduction program in the park. Hiking and horseback riding and the firing of rifles could temporarily disturb small mammals in the immediate area.

However, these effects would not affect survival or reproduction.

Small mammals on the refuge would not be adversely impacted or would be impacted to a negligible degree by management activities associated with a brucellosis vaccination program for elk and bison under Alternatives 3, 4, and 5. Elk and bison would be vaccinated on the feedlines. Small mammals would not be affected beyond those effects already associated with supplemental feeding.

Impacts on Marshland Habitats

Small mammal communities that are associated with marshlands in the Jackson Hole area and the Green River basin would not be affected under any of the alternatives any more than they have been affected in the recent past; any effects would be negligible.

Impacts on Conifer Forest Habitats

Small mammal communities that tend to do better in conifer forests habitats in the Jackson Hole area and the Green River basin would not be affected under any of the alternatives or would be affected to a negligible degree.

Alternative 1

Analysis

National Elk Refuge — The composition of small mammal communities associated with willow, cottonwood, and aspen habitats on the refuge would shift toward a composition of small mammal species that tend to do better in wet meadow, native grassland, and sagebrush shrubland habitats as riparian and aspen woodland habitats decline by an estimated 360 acres in the short term and by an estimated 2,120 acres in the long term compared to baseline conditions. Woodland riparian and aspen zones support a greater diversity of small mammals than other habitat types. As a result of an estimated minor acreage decline in the short term in riparian and aspen woodland habitats and a major acreage decline in the long term (Cole, pers. comm. 2003), small mammal diversity would likely decline. Red squirrels and flying squirrels would be lost due to the eventual

disappearance of aspen woodland habitat over the long term.

Small mammal communities associated with refuge sagebrush shrubland and native grassland habitats would expand as their habitats increased by an estimated 310 acres in the short term and an estimated 2,070 acres in the long term compared to baseline conditions. Both of these habitat types would increase as riparian and aspen woodland communities converted to sagebrush shrubland and native grassland communities. Grazing by unlimited numbers of bison in this alternative could reduce residual grass cover in localized areas, which would adversely affect some small mammal species that depend on tall grass cover to avoid predators.

Impacts to small mammal communities associated with cultivated fields on the refuge would remain similar to baseline conditions in the short and long terms. Because plant species diversity and vegetation structure is much lower in cultivated fields, the diversity of small mammals would remain low compared to the diversity in sagebrush shrubland and native grassland habitats under natural conditions. Heavy grazing in the fall and winter and hoof action of large concentrations of ungulates associated with feeding activities further reduces vegetation structure. Uinta ground squirrels and other small mammals would continue to be adversely impacted by flood irrigation that filled their burrows.

Small mammal communities associated with wet meadow habitats on the refuge would expand slightly as their habitat increased by an estimated 50 acres in the short and long terms compared to baseline conditions due to reductions in willow habitat. However, increasing numbers of bison in this alternative would likely cause adverse effects to wet meadow environments through hoof damage and reduction of residual grass cover, which would affect some small mammal species that depend on tall grass cover to avoid predators.

Grand Teton National Park — The composition of small mammal communities that are associated with riparian and aspen habitats in the park would shift towards those that tend to do well in sagebrush shrubland habitats because elk and bison are contributing to a minor decline in riparian and aspen woodland habitats.

Small mammal communities associated with agricultural lands and wet meadow habitats would likely not be affected under Alternative 1. However, if a substantial amount of wet meadow plant communities shifted to nonnative plant species due to heavy grazing by ungulates, small mammal diversity could decline.

Bridger-Teton National Forest — Small mammal communities that tend to do well in wet meadow, riparian and aspen woodland, sagebrush shrubland, and native grassland habitats in the national forest would not likely be affected under Alternative 1. However, to the degree that elk are contributing to the decline in riparian and aspen woodland habitats in localized areas, that trend would continue. Small mammals that tend to do well in riparian and aspen woodland communities would be negatively affected, and those that tend to do well in sagebrush shrubland communities could expand due to habitat conversion.

Conclusion

Elk management on the refuge over the last 90 years (e.g., winter feeding and cultivation and flood irrigation of nonnative plant species), and more recently bison management, has resulted in moderate to major changes in habitats in some areas of the refuge and park and could have substantially altered the composition of small mammal communities in some areas. Small mammal communities associated with sagebrush shrubland, native grassland, and wet meadow communities on the refuge would expand compared to baseline conditions, while small mammal communities associated with riparian and aspen woodlands would be reduced by a negligible amount. Overall diversity of small mammal species on the refuge could decline further, but the change would likely be negligible.

Overall diversity of small mammal species in the park could decline because some riparian and aspen woodlands would convert to conifer forest and sagebrush shrubland communities. This alternative would not result in the impairment of small mammal communities in the park.

Alternative 2

Analysis

National Elk Refuge — Under Alternative 2 the composition of small mammal communities on the refuge associated with good and fair condition willow, cottonwood, and aspen habitats would shift toward a composition of small mammal species that tend to do better in wet meadow, native grassland, and sagebrush shrubland habitats as riparian and aspen woodland habitats decreased by an estimated 310 acres (10%) in the short term and an estimated 1,980 acres (60%) in the long term compared to baseline conditions. Woodland riparian and aspen zones support a greater diversity of small mammals; therefore, Alternative 2 would cause a decrease in small mammal diversity in the short and long terms. Red squirrels and flying squirrels would disappear from the estimated 1,850 acres of aspen habitat that would convert to sagebrush shrubland and native grassland communities. Alternative 2 would have more small mammal diversity on the refuge than Alternative 1 because it would contain an estimated 150 more acres of riparian and aspen woodland habitat in the short term and an estimated 40 more acres in the long term. However, a 40-acre difference in habitat would result in a negligible difference in the composition of small mammal communities in the long term.

Small mammal communities on the refuge associated with sagebrush shrubland and native grassland habitats would expand as these habitats increased to an estimated 18,810 acres (17%) in the short term and an estimated 20,680 acres (28%) in the long term from the current estimated 16,100 acres. In the long term an estimated 85% of this 20,680 acres would be sagebrush shrubland habitat. Whether small mammal diversity increased as a result would depend on the lushness of the grass understory, which would depend on aspect and the amount of utilization by elk and bison. Grazing by elk and bison reduces residual grass cover. Fewer elk and bison under this alternative would leave taller vegetation, which would benefit small mammal species that rely on vegetation cover to avoid predators.

The diversity of small mammals on the refuge would increase with the conversion of cultivated fields (approximately 2,400 acres) to native grassland communities in the short term and to sage-

brush shrubland habitats in the long term as compared to Alternative 1. Habitat changes under Alternative 2 would probably result in more small mammal species due to the greater variety of plant life and reduced concentrations of elk and bison for long periods. Cessation of flood irrigation would also benefit small mammals, such as Uinta ground squirrels, because their burrows would no longer be flooded.

Compared to Alternative 1, Alternative 2 would have an estimated 100 fewer acres of wet meadow habitats, resulting in slightly fewer small mammals who are dependent on this habitat type. Lower numbers of elk and bison in this alternative would likely benefit wet meadow environments and the small mammals that depend on them, as there would be less bison hoof damage and more residual grass cover.

If large numbers of elk migrated out of Jackson Hole in winter, riparian and aspen woodlands on the refuge could improve in condition and increase by an estimated 1,720 acres (53%). This would benefit small mammals that tend to do better in woody habitats. Also, riparian and aspen woodland habitats would not convert to native grassland and sagebrush shrubland, which would adversely affect small mammal communities that tend to do well in these habitats.

With a large elk migration out of Jackson Hole, an estimated 1,450 acres of wet meadow habitat would convert to willow habitat, and small mammal communities that tend to do well in wet meadows would be negatively impacted.

Small mammals on the refuge would not be adversely impacted or would be impacted to a negligible degree by management activities associated with a fertility control program for bison under Alternative 2. If the program was conducted on the refuge feedlines, small mammals would not be affected beyond those effects already associated with supplemental feeding.

Grand Teton National Park — Small mammal communities associated with good and fair condition willow, cottonwood, and aspen habitats in the park would likely benefit as good and fair condition riparian and aspen habitat increased by a negligible to minor amount compared to Alternative 1.

Small mammal species that tend to do well in sagebrush shrubland and native grassland habitats would benefit as an estimated 4,500 acres of agricultural lands were restored to native communities, and small mammal communities that tend to do well in agricultural lands would be negatively affected. However, small mammal diversity would likely increase compared to baseline conditions and Alternative 1.

Small mammal communities associated with wet meadow habitats in the park would not be affected under Alternative 2. However, if a substantial amount of wet meadow plant communities shifted to nonnative species in those years when elk numbers were high, small mammal diversity could decline.

If the bison fertility control program under Alternative 2 was conducted in the park, probably in the spring and summer (while most small mammals are breeding and raising young), small mammals would be disturbed for a short period of time by individuals hiking through a variety of habitats. However, few people would be engaged in this activity at any given time, with a negligible impact, especially since many areas of the park are already open to hiking.

Bridger-Teton National Forest — In the long term larger numbers of elk would graze and browse in the national forest, which could lead to reduced residual vegetation and decline of willow, cottonwood, and aspen woodland, as well as sagebrush shrubland, native grassland, and wet meadow habitats in some locations. This conversion would negatively affect small mammal communities in these areas. In contrast, if large numbers of elk migrated out of Jackson Hole, habitats in the national forest would improve in condition and grasses would remain tall, with benefits to small mammals.

Other Lands — If large numbers of elk did not migrate outside Jackson Hole, small mammal communities on riparian and aspen woodland, sagebrush shrubland, native grassland, and wet meadow habitats on BLM lands and private lands in Jackson Hole could experience negative impacts in localized areas. Elk that were no longer being fed in the winter would likely forage more often in habitats outside the refuge. Higher levels of browsing and grazing on BLM and private

lands could result in habitat degradation and reduced residual vegetation, which would negatively affect small mammal communities associated with these habitats.

If large numbers of elk did migrate outside Jackson Hole, small mammal communities that tend to do well on riparian and aspen woodland, sagebrush shrubland, native grassland, and wet meadow habitats on BLM lands and private lands in the Green River basin could experience negative impacts in localized areas. Small mammal communities associated with these habitats in the Green River basin could be negatively impacted as a result of higher levels of grazing and browsing, which could result in habitat degradation and reduced residual vegetation.

Conclusion

Small mammal communities associated with sagebrush shrubland communities and riparian and aspen woodlands (where there would be a negligible change) would expand on the refuge in the long term compared to Alternative 1, while small mammal communities associated with cultivated fields and native grasslands would be reduced. It is unclear how overall small mammal diversity on the refuge would be affected. If large numbers of elk migrated to wintering areas outside Jackson Hole, small mammal diversity on the refuge would likely more closely approximate natural diversity under Alternative 2 compared to Alternative 1 because more habitat would remain in healthier riparian and aspen woodland habitats and because cultivated fields would be converted to native vegetation.

Small mammal communities in the park would more closely approximate a natural level of diversity as under Alternative 1 due to converting agricultural lands to native vegetation and a potential increase in the health of riparian and aspen woodland habitat. This alternative would not result in the impairment of small mammal communities in the park.

Alternative 3

Analysis

National Elk Refuge — Small mammal diversity under Alternative 3 would likely be greater than

under Alternative 1 because Alternative 3 would have an estimated 1,000 more acres (31%) of riparian habitat in the short term and an estimated 1,720 more acres (50%) in the long term. Despite the reduction of aspen habitat on the refuge, small mammal communities associated with cottonwood and willow habitats would benefit in the lower and upper Flat Creek areas, where willow habitat would recover and cottonwood habitat would persist. Adverse impacts would primarily be associated with the disappearance of aspen. Red squirrels and flying squirrels would disappear from aspen woodland communities that would convert to sagebrush shrubland habitat.

Compared to Alternative 1, Option A of Alternative 3 would likely have a slightly lower abundance of small mammals on the refuge that tend to do well in native grassland and sagebrush shrubland habitats in the short and long terms because there would be an estimated 220 fewer acres (1%) of native grassland and sagebrush shrubland habitats. The difference would likely be negligible. Under Option B the effects on small mammals in sagebrush shrubland and native grassland habitats on the refuge would be similar to the effects of Alternative 2 because forage production would be phased out.

Under Option A small mammal communities associated with cultivated fields on the refuge would remain similar to baseline conditions and Alternative 1 in the short and long terms. Because of lower plant species diversity in cultivated fields, small mammal diversity would remain low compared to the diversity in sagebrush shrubland and native grassland habitats under natural conditions. Uinta ground squirrels and other small mammals would continue to be adversely affected by flood irrigation activities. Under Option B the effects on small mammals in cultivated fields on the refuge would be similar to the effects of Alternative 2.

Compared to Alternative 1, wet meadow habitat under Alternative 3 would decrease by an estimated 780 acres (45%) in the short term and an estimated 1,500 acres (87%) in the long term, resulting in a reduced small mammal community dependent on wet meadow habitats. Lower numbers of elk in this alternative would likely result in more residual grass cover on the remaining 270 acres of wet meadows, which would benefit small

mammal species that depend on tall grass cover to avoid predators.

Grand Teton National Park — Small mammal communities associated with good condition willow, cottonwood, and aspen habitats in the park would likely benefit as good condition riparian and aspen woodland habitat increased by a minor amount compared to baseline conditions and Alternative 1.

Small mammal species that tend to do well in sagebrush shrubland and native grassland habitats would benefit, as an estimated 4,500 acres of agricultural lands would be restored to native communities. Small mammal diversity would likely increase compared to baseline conditions and Alternative 1.

In the park small mammal communities in wet meadows would not be affected due to actions being considered under Alternative 3.

Bridger-Teton National Forest — The effects of Alternative 3 on small mammal communities in the national forest would be similar to the effects of Alternative 2.

Other Lands — If large numbers of elk did not migrate outside Jackson Hole, small mammal communities on riparian and aspen woodland, sagebrush shrubland, native grassland, and wet meadow habitats on BLM lands and private lands in Jackson Hole could experience negative impacts in localized areas. Elk that are no longer being fed in the winter would likely forage more often in habitats outside the refuge. Higher levels of browsing and grazing on BLM and private lands could result in habitat degradation and reduced residual vegetation, which could negatively affect associated small mammal communities.

If large numbers of elk did migrate outside Jackson Hole, small mammal communities that tend to do well on riparian and aspen woodland, sagebrush shrubland, native grassland, and wet meadow habitats on federal, state, and private lands the Green River basin could experience negative impacts in localized areas. Small mammal communities associated with these habitats could be negatively impacted as a result of higher levels of grazing and browsing, which could result in

habitat degradation and reduced residual vegetation.

Conclusion

Small mammal diversity on the refuge would likely be greater under Option A of Alternative 3 compared to Alternative 1 because there would be more acreage and improved condition of riparian and aspen woodland habitats, which tend to have more diverse small mammal communities (and because this has been the habitat most impacted by large concentrations of elk). Small mammal communities associated with wet meadows and native grasslands would be reduced and small mammal communities associated with sagebrush shrubland would expand. Impacts of Option B would be similar to Alternative 2 with regard to expanded sagebrush shrubland and native grassland habitats and reduced cultivated fields.

Small mammal communities in the park would more closely approximate a natural level of diversity than Alternative 1 due to conversion of agricultural lands to native vegetation and a potential increase in the health of riparian and aspen woodland habitats. Alternative 3 would not result in the impairment of small mammal communities in the park.

Alternatives 4 and 5

Analysis

National Elk Refuge — Compared to Alternative 1, Alternatives 4 and 5 would have an estimated 340 more acres (10%) of riparian and aspen woodlands in the short term and an estimated 1,590 more acres (50%) in the long term. Because woodland riparian and aspen zones support a greater diversity of small mammals than do other habitat types, Alternatives 4 and 5 would have a more diverse small mammal community than under Alternative 1. Red squirrels and flying squirrels found in aspen stands outside the enclosure could disappear because this unprotected aspen habitat would convert to a sagebrush shrubland community.

Small mammal communities on the refuge that are associated with sagebrush shrubland and native grassland habitats under Alternatives 4 and 5 would likely remain similar to baseline conditions

and Alternative 1 in the short and long terms because changes in these habitats would be negligible to minor.

Cultivated fields on the refuge would produce an estimated 50% more vegetation than under baseline conditions and Alternative 1, and approximately 1,100 acres would be sprinkler irrigated rather than flood irrigated. This increase in vegetation production and reduction in flood irrigation, which can fill burrows, would likely result in more rodents and insectivores in the cultivated fields compared to baseline conditions and Alternative 1.

The composition of small mammal communities associated with wet meadow habitats on the refuge would shift toward those that do better in willow habitats, as an estimated 270 acres (16%) of wet meadow habitat would convert to willow habitat in the short term, and an estimated 520 acres (30%) in the long term. In wet meadow habitat outside the enclosure the numbers of elk and bison in these alternatives would likely reduce the amount of residual cover, which would adversely affect small mammals that depend on tall grass cover to avoid predators.

Grand Teton National Park — In the park small mammal communities associated with good and fair condition aspen communities could benefit by a negligible to minor degree due to fewer browsing elk in Alternatives 4 and 5 compared to baseline conditions and Alternative 1. Small mammal species that tend to do well in sagebrush shrubland and native grassland habitats would benefit under these alternatives, as an estimated 4,500 acres of agricultural lands would be restored to native communities. Small mammal diversity would likely increase compared to baseline conditions and Alternative 1.

Small mammal communities associated with wet meadows would likely not be affected under Alternatives 4 and 5. However, under Alternative 5 if a substantial amount of wet meadow plant communities shifted to nonnative species due to large numbers of ungulates grazing in these areas, small mammal diversity could decline.

Bridger-Teton National Forest — Small mammal communities in the national forest would not be affected in the short term under Alternative 4 because elk grazing and browsing would be simi-

lar to baseline conditions and Alternative 1. However, in the long term larger numbers of elk could remain in the national forest throughout the winter, and increased grazing and browsing pressure might reduce residual vegetation and degrade habitat in localized areas, negatively affecting small mammals dependent on these habitats.

Small mammal communities in the national forest would not be affected under Alternative 5 any more than they have been in the recent past.

Conclusion

Alternatives 4 and 5 would have a higher level of small mammal diversity than Alternative 1 because riparian and aspen woodland habitats would be larger and in improved condition. Small mammal communities associated with wet meadow and native grassland habitats would be reduced.

Under Alternatives 4 and 5 the park would more closely approximate natural small mammal diversity due primarily to conversion of agricultural lands to native vegetation. This alternative would not result in the impairment of small mammal communities in the park.

Alternative 6

Analysis

National Elk Refuge — Compared to Alternative 1, Alternative 6 would have an estimated 1,090 more acres (34%) in riparian and aspen woodland habitats in the short term and an estimated 3,420 more acres (105%) in the long term. Therefore, Alternative 6 would result in a more diverse small mammal community on the refuge because riparian and aspen zones support a greater diversity of small mammals than do other habitat types.

Compared to Alternative 1, Alternative 6 would likely have a slightly lower abundance of small mammals on the refuge that tend to do well in native grassland and sagebrush shrubland habitats in the short and long terms because there would be an estimated 220 fewer acres (1%) of native grassland and sagebrush shrubland habitats. The difference would likely be negligible. Fewer elk in this alternative could leave taller vegetation that would benefit small mammals that rely on vegetation cover to avoid predators.

Cultivated fields on the refuge would produce an estimated 50% more vegetation than cultivated fields under baseline conditions and Alternative 1, and approximately 1,100 acres would be sprinkler irrigated rather than flood irrigated. This increase in vegetation production and reduction in flood irrigation, which can fill burrows, would likely result in more rodents and insectivores in the cultivated fields compared to baseline conditions and Alternative 1.

Compared to Alternative 1, there would be an estimated 780 fewer acres of wet meadow habitat in the short term and an estimated 1,500 fewer acres in the long term under Alternative 6. Therefore, even fewer small mammal communities could depend on wet meadow habitats. Lower numbers of elk under this alternative in the long term would likely result in more residual grass cover on the remaining 270 acres of wet meadows, which would benefit those small mammal species that depend on tall grass cover to avoid predators.

Grand Teton National Park — In the park an improvement in the condition and acreage of riparian and aspen woodland habitats would benefit associated small mammal communities by a negligible to minor degree under Alternative 6. Small mammal species that tend to do well in sagebrush shrubland and native grassland habitats would benefit from the restoration of an estimated 4,500 acres of agricultural lands to native communities. Small mammal diversity would likely increase compared to baseline conditions and Alternative 1, and small mammal communities in wet meadows would not be affected under Alternative 6.

Bridger-Teton National Forest — Compared to Alternative 1, larger numbers of elk would graze and browse in the national forest, which could lead to reduced residual vegetation and the decline of willow, cottonwood, and aspen woodland, sagebrush shrubland, native grassland, and wet meadow habitats in some locations. This would negatively affect small mammal communities in these areas. In contrast, if large numbers of elk migrated out of Jackson Hole in winter, habitats in the national forest would improve and grasses would remain tall, benefiting small mammals.

Other Lands — If large numbers of elk did not migrate outside Jackson Hole, small mammal communities on riparian and aspen woodland,

sagebrush shrubland, native grassland, and wet meadow habitats on BLM and private lands in Jackson Hole could experience negative impacts in localized areas. Elk that are no longer being fed in the winter would likely forage more often in habitats outside the refuge. Higher levels of browsing and grazing on BLM and private lands could result in habitat degradation and reduced residual vegetation, negatively affecting associated small mammal communities.

If large numbers of elk did migrate outside Jackson Hole, small mammal communities that tend to do well on riparian and aspen woodland, sagebrush shrubland, native grassland, and wet meadow habitats on federal, state, and private lands in other locations could be negatively affected in localized areas. This would occur as a result of higher levels of grazing and browsing degrading habitat and reducing residual vegetation.

Conclusion

Small mammal diversity on the refuge would likely be greater under Alternative 6 compared to Alternative 1 because the size and condition of riparian and aspen woodland habitats would be improved, and this habitat has been most impacted by large concentrations of elk. Small mammal communities associated with wet meadows and native grasslands would be reduced, and small mammal communities associated with sagebrush shrubland would expand.

Small mammal communities in the park would more closely approximate a natural level of diversity than under Alternative 1 due to the conversion of agricultural lands to native vegetation and a potential increase in the health of riparian and aspen woodland habitats. This alternative would not result in the impairment of small mammal communities in the park.

Mitigation

Measures to mitigate adverse effects of the alternatives on small mammal communities would be the same as those addressed in the mitigation discussions for pertinent habitats in the “Impacts on Habitat” section.

Cumulative Effects

No cumulative effects on small mammals are expected as a result of impacts of the alternatives in combination with the impacts of reasonably foreseeable actions.

LARGE RODENTS

Methodology Used to Analyze Effects

Although beaver feed on aspen trees, most aspen communities on the refuge show no signs of beaver use (Cole, pers. comm. 2002). Therefore the decline of aspen communities under Alternatives 1–5 over the long term would not greatly affect beavers.

Beavers historically occurred along Flat Creek on the refuge but have not been present for many years. Beavers prefer aspen, willow, and cottonwood habitats, and any actions in other plant communities would have negligible effects on them. Woody riparian habitat on the refuge currently consists of approximately 1,390 acres of willow and cottonwood communities. Beavers would primarily be affected by changes in these two communities, and impacts have been estimated based on acreage changes only within willow and cottonwood habitats. Thus, impacts to beavers have been predicted based on the likelihood that they could re-colonize an area given anticipated habitat changes under each alternative.

Total woody vegetation on the refuge consists of approximately 3,240 acres of willow, cottonwood, and aspen communities. Porcupines occur in all of these habitats. Impacts have been estimated for porcupines based on acreage changes within willow, cottonwood, and aspen habitats.

Impacts of the Alternatives

Impacts Common to All Alternatives

Yellow-bellied Marmots

Marmots in Jackson Hole, the Green River basin, and the Red Desert would not be affected by any actions being considered in this planning process.

Direct Effects of Human Disturbance

Large rodents would not be adversely impacted or would be impacted to a negligible degree by management actions associated with the supplemental feeding program for elk and bison in Alternatives 1, 3, 4, and 5. Supplemental feeding would be phased out under Alternatives 2 and 6. During the phaseout period, management actions associated with supplemental feeding would not adversely impact large rodents or would impact them to a negligible degree. The effects would be negligible or nonexistent because large rodents do not normally occur in the cultivated fields, where supplemental feeding takes place.

Large rodents would not be adversely impacted or would be impacted to a negligible degree by activities associated with elk and bison hunting in all alternatives except 2. Hiking and horseback riding and the firing of rifles could disturb large rodents in the immediate area for a short time. However, these effects would not affect survival and reproduction.

Large rodents would not be adversely impacted or would be impacted to a negligible degree by management activities associated with a brucellosis vaccination program for elk and bison under Alternatives 3, 4, and 5. Elk and bison would be vaccinated on the feedlines in the cultivated fields, where large rodents do not normally occur.

Alternative 1

Analysis

National Elk Refuge — Under Alternative 1 beavers on the refuge would be negatively impacted because woody riparian communities along Flat Creek would decrease by an estimated 270 acres in the short and long terms compared to baseline conditions. This would be 19% of the current 1,390 acres of willow and cottonwood habitat. However, suppressed willow plants that occur on approximately 1,450 acres of wet meadow habitat would not be able to recover due to continued heavy browsing by elk. Therefore, beavers would not be able to return to the southern portion of the refuge in the future.

As the acreage of aspen stands and woody riparian areas decreased, porcupines would likely be negatively impacted to a minor degree in the short

term. Due to the disappearance of aspen woodland habitat in the long term, porcupines on the refuge would likely be negatively impacted by a major amount compared to baseline conditions. Porcupines feed on conifers, as well as aspen and willow, but conifer forest habitat would not change.

Grand Teton National Park — Beavers and porcupines in the park could be negatively impacted by the gradual and long-term decline of riparian and aspen woodlands compared to baseline conditions.

Bridger-Teton National Forest — Large rodents in the national forest would not be affected under Alternative 1 any more than they have been affected in the recent past.

Conclusion

Under Alternative 1 beavers would continue to experience negative impacts because of the loss of willow and cottonwood habitat on the refuge. Beaver habitat at the south end of the refuge would likely become permanently lost. This loss of habitat combined with historical loss of habitat and lethal removal from the northern part of the refuge could result in the lack of a permanent beaver population on the refuge. Porcupines would experience negative impacts to a minor degree in the short term and would likely suffer major adverse impacts in the long term due to the disappearance of aspen woodland habitat and the permanent loss of willow habitat at the south end of the refuge.

Beavers and porcupines in the park could be negatively impacted by the decline in condition of riparian and aspen woodlands compared to baseline conditions. This alternative would not result in the impairment of large rodent communities in the park.

Alternative 2

Analysis

National Elk Refuge — Compared to Alternative 1, beavers could benefit to a minor to negligible degree due to 150 more acres of willow habitat under Alternative 2 in the short term and 40 more acres in the long term if beavers moved into what

is now unoccupied habitat in the southern portion of the refuge.

Alternative 2 would result in an estimated 150 more acres of riparian and aspen woodland habitat in the short term and 40 more acres in the long term, which would likely result in negligible to minor positive effects on porcupines.

Beavers and porcupines would potentially benefit by a moderate to major amount if large numbers of elk migrated out of Jackson Hole in the winter because impacts on 1,720 acres of riparian and aspen woodland habitats would be reduced in the long term compared to Alternative 1.

Large rodents would not be adversely impacted or would be impacted to a negligible degree by management activities associated with a fertility control program for bison under Alternative 2. If the fertility control program was conducted on refuge feedlines, large rodents would not be affected because they do not normally occur in cultivated fields, where feeding takes place.

Grand Teton National Park — Beavers and porcupines in the park could benefit from a negligible to minor increase in riparian and aspen habitats compared to Alternative 1.

If the bison fertility control program was conducted in the park in the spring and summer (while most large rodents are breeding and raising young), effects would likely be minimal. Large rodents could be temporarily disturbed by humans hiking through a variety of habitats; however, relatively few people would be involved at any given time, and many areas of the park are already open to hiking.

Bridger-Teton National Forest — In the long term larger numbers of elk would browse in the national forest, which could negatively affect beavers and porcupines if this increased browsing pressure caused willow, cottonwood, and aspen habitats to decline in some areas. In contrast, if large numbers of elk migrated out of Jackson Hole in the winter, riparian and aspen woodlands in the national forest would improve in condition, and porcupines and beavers could benefit from improved woody habitats as a result of less browsing pressure.

Other Lands — If large numbers of elk did not migrate outside the Jackson Hole area, beavers and porcupines on BLM lands and private lands in Jackson Hole could experience negative impacts in some areas. Elk that are no longer being fed in the winter would likely forage more often in riparian and aspen woodland habitats outside the refuge. Higher levels of browsing on BLM lands and private lands could result in further habitat degradation and the loss of acreage in some areas, negatively affecting beavers and porcupines.

If large numbers of elk did migrate outside Jackson Hole, beavers and porcupines on BLM lands and private lands in the Green River basin could experience negative, localized impacts as a result of higher levels of browsing in riparian and aspen woodland habitats. This could result in habitat degradation and loss of acreage in localized areas.

Conclusion

If large numbers of elk did not migrate outside Jackson Hole, beavers and porcupines would likely benefit by a negligible to minor degree in the short and long terms due to negligible to minor changes in woody habitat. If large numbers of elk did migrate out of the Jackson Hole area, and if beavers moved into unoccupied habitat in the southern part of the refuge, large rodents could benefit by a major degree.

Beavers and porcupines in the park could benefit from a negligible to minor increase in riparian and aspen woodland habitats and improved habitat conditions compared to Alternative 1. This alternative would not result in the impairment of large rodent communities in the park.

Alternative 3

Analysis

National Elk Refuge — Compared to Alternative 1, beavers that migrated into the southern portion of the refuge would benefit by a major amount in the short and long terms due to an estimated increase of 1,000 acres of woody riparian habitat in the short term and 1,720 acres in the long term. Beavers that moved into the Flat Creek area before willow plants fully recovered would likely be lethally removed until willow habitat became firmly reestablished.

Compared to Alternative 1, the effects of Alternative 3 would result in an estimated 1,720 more acres of riparian and aspen woodland habitat, which would likely have major positive effects on porcupines in the short and long terms.

Grand Teton National Park — Beavers and porcupines in the park could benefit by a minor increase in riparian and aspen habitats compared to Alternative 1.

Bridger-Teton National Forest — The effects of Alternative 3 on beavers and porcupines in the national forest and BLM lands and private lands in Jackson Hole and the Green River basin would be similar to the effects of Alternative 2.

Conclusion

Under Alternative 3 beavers and porcupines could benefit by a major degree due to a major increase in the amount and quality of riparian and aspen woodland habitats in the short and long terms compared to Alternative 1.

Beavers and porcupines in the park could benefit by a minor increase in the amount and quality of riparian and aspen habitats compared to Alternative 1. This alternative would not result in the impairment of large rodent communities in the park.

Alternatives 4 and 5

Analysis

National Elk Refuge — Compared to Alternative 1, beavers that migrated into the southern portion of the refuge would benefit to a moderate degree in the short term due to an estimated 370 more acres of riparian habitats and to a major degree in the long term due to an estimated 690 more acres. However, beavers that moved into the Flat Creek area before suppressed willow plants in the wet meadow habitat had fully recovered would likely be lethally removed until willow habitat became firmly reestablished.

Compared to Alternative 1, porcupines would benefit to a minor degree in the short term due to 340 more acres of riparian and aspen woodland habitat and by a moderate amount in the long term due to 1,590 more acres.

Grand Teton National Park — Beavers and porcupines in the park could benefit by a negligible to minor increase in riparian and aspen habitats compared to Alternative 1.

Bridger-Teton National Forest — Under Alternative 4 beavers and porcupines in the national forest would not be affected in the short term. In the long term more elk would browse in the national forest, which could adversely affect willow, cottonwood, and aspen habitats, along with porcupines and beavers that depend on woody vegetation.

Beavers and porcupines in the national forest would not be affected under Alternative 5.

Conclusion

Compared to Alternative 1, Alternatives 4 and 5 would negatively affect beavers in the near short term if they were lethally removed from recovering willow habitat. After large willow plants were reestablished, beavers and porcupines would benefit by a moderate increase in the amount and quality of riparian and aspen woodland habitats in the long term.

Beavers and porcupines in the park could benefit by a negligible to minor increase in the amount and quality of riparian and aspen habitats compared to Alternative 1. This alternative would not result in the impairment of large rodent communities in the park.

Alternative 6

Analysis

National Elk Refuge — Compared to Alternative 1, beavers that migrated into the southern portion of the refuge would benefit by a major amount due to an estimated 900 more acres of woody riparian habitat, especially willow habitat, in the short term, and an estimated 1,470 more acres in the long term. Beavers that moved into the Flat Creek area before willow plants had fully recovered would likely be lethally removed until willow habitat became firmly reestablished.

Porcupines would benefit by a moderate amount in the short term due to an estimated 1,090 more

acres of riparian and aspen woodland habitat. In the long term porcupines would benefit by a major amount due to an estimated 3,420 more acres of riparian and aspen woodland habitat compared to Alternative 1.

Grand Teton National Park — Beavers and porcupines in the park could benefit by a minor increase in riparian and aspen woodland habitats compared to Alternative 1.

Bridger-Teton National Forest — Beavers and porcupines in the national forest would not be affected in the short term. In the long term more elk would browse in the national forest, which could adversely affect willow, cottonwood, and aspen habitats and porcupines and beavers that depend on woody vegetation.

Conclusion

Under Alternative 6 beavers that moved to the southern portion of the refuge would be negatively affected in the near short term if they were lethally removed from recovering willow habitat. After large willow plants were reestablished in the long term, beavers and porcupines on the refuge would benefit by a major degree, compared to Alternative 1, due to increased and improved riparian and aspen woodland habitat.

Beavers and porcupines in the park could benefit by a minor increase in riparian and aspen habitats compared to Alternative 1. This alternative would not result in the impairment of large rodent communities in the park.

Mitigation

Measures to mitigate adverse effects of the alternatives on beavers and porcupines would be similar to those identified for riparian and aspen woodland communities in the “Impacts on Habitat” section.

Cumulative Effects

No cumulative effects on large rodents are expected as a result of impacts of the alternatives in combination with the impacts of reasonably foreseeable actions.

BIRDS

NEOTROPICAL MIGRATORY BIRDS

The analysis of potential effects of management alternatives on Neotropical migratory birds and other birds is of particular importance in this planning process because providing a refuge and breeding habitat for birds is a major purpose of the refuge, and the management of elk and bison has such a pervasive influence on the amount and condition of breeding bird habitat. Analyzing the potential effects on birds is generally important given the requirement to conserve all native wildlife species on national wildlife refuges and national parks, as well as NEPA requirements. Furthermore, Executive Order 13186 requires that federal agencies pay particular attention to potential effects on migratory birds in developing resource management plans.

The role that the refuge plays in conserving breeding bird habitat in the Jackson Hole area will be assessed in the upcoming comprehensive conservation planning process for the refuge. The assessment will involve factors such as the capacity of the refuge to provide high quality and secure breeding habitat; and the importance of providing high-quality habitat for breeding birds relative to the amount and quality of breeding bird habitat throughout the study area. Because the outcome of the bison and elk management planning process will have a large influence on the options that will be considered for managing other ungulates on the refuge, a comprehensive analysis is needed in the elk and bison planning process.

Methodology Used to Analyze Effects

Approximately 175 species of birds occur on the refuge and over 300 species of birds occur in the park. Many of these species are Neotropical migratory birds that spend the winter in South and Central America and breed and raise young in North America. Some of these species are highly dependent on particular habitat types and could require that their habitats be in a particular stage of succession or condition. Other species might use more than one habitat type and might be more tolerant of habitat degradation. Neotropical migratory species vary greatly in their seasonal distribution and in their life histories (Dobkin 1994). In addition, Neotropical migratory birds are being

affected by habitat changes that are occurring in both the northern and southern hemispheres. Therefore, potential effects of alternatives on Neotropical migratory birds are discussed in terms of the effects that changes in the amount and condition of habitats in Jackson Hole could have on the abundance of birds while in the study area. Although there might be instances in which increased habitat might not result in an increase in the abundance of a particular species in Jackson Hole (due to factors outside the Greater Yellowstone Area), assessments made in this planning document assume that increases in suitable habitat acreage would result in increased numbers, unless otherwise noted. Estimates are not made about how populations might be affected.

Impacts of the Alternatives

Impacts Common to All Alternatives

Neotropical migratory birds dependent on conifer forests and marshland habitats in Jackson Hole, the Green River basin, and the Red Desert are not expected to be affected by the alternatives because their habitats would not be altered to any measurable degree by any of the management actions being considered.

Neotropical migratory birds would not be adversely impacted by management actions associated with the supplemental feeding program for elk or bison under Alternatives 1, 3, 4, and 5. Supplemental feeding would be phased out under Alternatives 2 and 6. During the phaseout period, actions associated with supplemental feeding would not adversely impact Neotropical migratory birds because supplemental feeding occurs during winter when Neotropical migratory birds have already migrated to their winter feeding grounds.

Neotropical migratory birds would not be adversely impacted by activities associated with elk and bison hunting (under all alternatives except 2) or a brucellosis vaccination program for elk and bison (Alternatives 3, 4, and 5) because they would have already migrated to their winter feeding grounds by the time these activities would occur.

Alternative 1Analysis

National Elk Refuge — The abundance of some species of Neotropical migratory birds that use wet meadow habitats on the refuge could increase in the short and long terms by a negligible amount due to a 50-acre (5%) increase in wet meadow habitat compared to baseline conditions. While the overall wet meadow plant community on the refuge is in good condition, some areas where grazing by elk and bison is heavy have little residual vegetation. Bird species dependent on residual vegetation for nesting could be adversely impacted by a negligible to minor amount in the short term. Increasing numbers of bison in the long term would moderately increase the negative impacts on these bird species.

The bird community associated with sagebrush shrublands and native grasslands appears to be in satisfactory condition, although few data exist to verify assessment. Neotropical migrants that require sagebrush habitat and native grassland habitat would likely increase in abundance by a negligible amount in the short term due to an estimated 310-acre (2%) increase in these habitats compared to baseline conditions. In the long term Neotropical migratory birds that depend on sagebrush shrubland and native grassland habitats would likely increase in abundance by a minor amount due to an estimated 2,070 acres (13%) of riparian and aspen woodlands converting to sagebrush shrubland and native grassland habitats. Conversely, growing bison numbers could increase grazing pressure on these habitats, resulting in localized negative impacts to some bird species.

Neotropical migratory birds dependent on willow habitat are already at a very low abundance on the refuge due to a historical loss of 1,450 acres that now are classified as wet meadow habitat. An additional 50 acres of willow would convert to wet meadow habitat due to heavy browsing by elk. This would have minor negative effects on the current abundance of Neotropical migratory birds that use willow communities. In addition, suppressed willow plants on 1,500 acres of wet meadow habitat would not recover in the future due to the numbers of browsing ungulates that would continue to suppress willow plants. As a result, abundances of birds that depend on willow

communities would remain at a low level on the refuge.

Neotropical migratory birds on the refuge that are dependent on cottonwood habitat are in very low abundance on 20% of the existing cottonwood acreage because of their poor condition. The remaining 80% of cottonwood habitats on the refuge are in fair to good condition and continue to support an abundance of Neotropical migrants. Neotropical migratory birds that depend on healthy cottonwood habitat would probably not be affected by the conversion of 220 acres of poor condition cottonwood habitat to sagebrush shrubland and native grasslands because they no longer occur in this area. However, Neotropical cavity nesters can use poor condition cottonwood habitat, and these species would likely decline by a minor (20%) amount in the short and long terms.

Neotropical migratory birds on the refuge that depend on good condition aspen woodland habitats are already in very low abundance because 80%–90% of aspen woodland stands are in poor condition. Neotropical birds that nest in good condition aspen woodland habitat would not be affected in the short term by an estimated 90-acre (5%) decline in aspen woodland communities because they do not occupy such poor condition habitat. However, Neotropical cavity nesters would likely decline by a negligible to minor amount in the short term due to this 5% decline in aspen woodland habitat. In the long term Neotropical migratory birds that are dependent on good, fair, or poor condition aspen woodland habitat would eventually disappear with the loss of aspen woodland communities on the refuge.

Alternative 1 would not affect Neotropical migratory bird species that use cultivated fields because farming activities would remain similar to baseline conditions.

Grand Teton National Park — Neotropical birds dependent on wet meadow habitats would not be affected by Alternative 1 any differently than they have been in the recent past unless nonnative plants began to dominate many wet meadow areas due to heavy ungulate grazing. A shift to nonnative species could adversely impact Neotropical migratory birds dependent on wet meadows.

Increased grazing pressure and reduced residual vegetation due to an unlimited number of bison grazing in the park in the summer would adversely affect Neotropical migratory birds dependent on native grassland and sagebrush shrubland habitats in the park.

Neotropical birds dependent on agricultural lands in the park could be affected by increasing numbers of bison that could accelerate the invasion of noxious weeds in an area that is already dominated by nonnative weed species. Bison wallowing would also increase the amount of bare ground, which would adversely affect Neotropical migratory birds that could still inhabit the agricultural fields.

In the park Neotropical birds dependent on willow habitat would not be affected under Alternative 1 any differently than they have been in the recent past.

Neotropical migratory birds dependent on cottonwood habitat in the park could be adversely affected to a negligible degree by a loss of this habitat type due to elk browsing and bison trampling, while birds that are dependent on aspen habitat could be affected to a minor degree by decreases in aspen habitat due to elk browsing.

Bridger-Teton National Forest — Neotropical birds dependent on wet meadow, native grassland, sagebrush shrubland, willow, cottonwood, and aspen habitats in the national forest would not be affected by Alternative 1 any more than they have been in the recent past. However, elk browsing in the national forest is negatively affecting some riparian and aspen woodland stands, which could adversely affect birds that breed in this habitat. This trend would likely continue in the future.

Conclusion

Under Alternative 1 there would be a moderate loss in the diversity of Neotropical migratory bird species on the refuge due to a major, long-term decline in the amount and condition of willow, cottonwood, and aspen habitats compared to baseline conditions (in addition to the reduction that has already occurred due to actions under Alternative 1). Neotropical migratory bird communities in wet meadow, sagebrush shrubland, and native grass-

land habitats would expand, but this would not make up for the decline in diversity associated with willow, cottonwood, and aspen habitats.

Neotropical migratory bird diversity would likely decline in small, localized areas in the park due to a minor decrease in aspen habitats in the long term. In addition, there would be a reduction of residual vegetation in native grassland and sagebrush shrubland habitats and an increase in nonnative invasive weeds on wet meadows and agricultural lands due in part to a growing bison population and continued heavy grazing by a large elk population. This alternative would not result in the impairment of Neotropical migratory bird communities in the park.

Alternative 2

Analysis

National Elk Refuge — Compared to Alternative 1, the abundance of Neotropical migratory birds dependent on wet meadow habitat would likely be less under Alternative 2 by a negligible to minor degree due to 150 fewer acres (9%) of wet meadow habitat. Any benefits to bird communities in wet meadow habitat stemming from reduced numbers of elk and bison could be offset by an increased reliance of remaining animals on native winter habitat. Substantial increases in herbaceous cover might not occur.

Neotropical migratory birds that are dependent on sagebrush shrubland and native grassland communities could be more abundant under Alternative 2 by a minor amount compared to Alternative 1 due to restoring approximately 2,400 acres of cultivated fields to native grassland habitats in the short term and sagebrush shrubland in the long term. Conversely, any benefits to bird communities in sagebrush shrubland and native grassland habitats stemming from reduced numbers of elk and bison could be offset by increased reliance of remaining animals on native winter habitat. Substantial increases in herbaceous cover might not occur.

The abundance of Neotropical migratory birds that use willow habitat could be greater than the abundance of Neotropical birds under Alternative 1 but only by a negligible amount in the short and long terms. Although there would be an estimated

150 more acres (50%) of willow habitat, this recovery would primarily occur in swales and other areas of heavy snow accumulation. These individual clumps of willow habitat might be too small to provide sufficient nesting habitat for Neotropical migratory birds dependent on willow communities. In addition, compared to the potential willow habitat (1,450 acres) that could exist with less ungulate browsing, 150 acres is a minor amount.

If most elk migrated out of Jackson Hole in winter over the long term, Neotropical birds dependent on refuge willow communities would benefit to a major degree because potentially 1,450 acres of suppressed willow plants in wet meadows would recover to good condition habitat.

Alternative 2 and Alternative 1 would have similar abundances of Neotropical migratory birds that use cottonwood habitat in the short term. Under Alternative 2 cottonwood habitat would decrease by an estimated 110 acres (10%) in the long term, potentially resulting in fewer birds that use this habitat, but the difference would be negligible.

The effects of Alternative 2 on Neotropical migratory birds dependent on aspen habitat would be similar to the effects under Alternative 1. In the long term birds reliant on aspen woodland habitat would disappear as this habitat type disappeared from the refuge.

Restoring 2,400 acres of cultivated fields would likely result in a more diverse composition of Neotropical bird species on the refuge compared to Alternative 1.

Neotropical migratory birds would not be adversely impacted or would be impacted to a negligible degree by management activities associated with a fertility control program for bison under Alternative 2. If the fertility control program was conducted in the winter on the refuge feedlines, Neotropical birds would be absent from the area.

Grand Teton National Park — Neotropical migratory birds dependent on wet meadow habitats are not expected to be affected under Alternative 2 unless nonnative invasive plants began to dominate many wet meadow areas due to heavy elk grazing in some years. Neotropical migrants dependent on wet meadows could be adversely af-

ected by nonnative plants becoming dominant in localized areas.

Neotropical migratory birds dependent on riparian and aspen woodland habitats in the park would likely benefit in the long term as willow, cottonwood, and aspen communities improved in condition and increased in acreage by a negligible to minor amount due to less browsing and trampling by elk and bison.

The restoration of 4,500 acres, which would occur over 15 years, could involve activities such as disking, seeding, irrigation, prescribed fire, fertilizing, and weeding. The effects that disturbance would have on birds in restored areas would be variable and difficult to quantify. Factors such as species, sex, and age of individuals, as well as the time of year, magnitude, and type and duration of human activities would affect responses. The restoration activities in Alternatives 2–6 would be limited in time and space; therefore, disturbance to birds would result in short-term, localized, negligible to moderate impacts. Depending on the bird species, in the long term the restoration of native grasslands would benefit species associated with grassland and sagebrush habitats, but would result in long-term changes in abundance and distribution of other species. Compared to Alternative 1, restoring approximately 4,500 acres of agricultural lands to native grassland and sagebrush shrubland communities would likely increase the diversity of Neotropical migratory bird species in these formerly cultivated areas, similar to Alternatives 3 through 6.

If the bison fertility control program was conducted in the park in the spring and summer, Neotropical migratory birds would be temporarily disturbed by the presence of a few people hiking through a variety of habitats. Even though a fertility control program in the park would be conducted while birds were breeding and raising young, effects would likely be minimal, especially since many areas of the park are already open to hiking.

Bridger-Teton National Forest — Neotropical migratory birds in the national forest that depend on wet meadow, sagebrush shrubland, native grassland, and riparian and aspen woodland habitats would not be affected in the short term because elk grazing in these habitats would be simi-

lar to baseline conditions and Alternative 1. In the long term larger numbers of elk might remain in the national forest, and this increased grazing and browsing pressure could reduce residual vegetation and damage woody vegetation, negatively affecting Neotropical migratory birds that depend on tall vegetation and canopy cover for nesting.

If large numbers of elk migrated to the Green River basin, grasses in the national forest would remain tall, and woody vegetation would remain healthy, benefiting birds dependent on tall vegetation and canopy cover.

Other Lands — If large numbers of elk did not migrate out of Jackson Hole, Neotropical migratory birds associated with wet meadow, sagebrush shrubland and native grassland habitats on BLM and private lands in Jackson Hole could experience negative impacts in localized areas. Elk that are no longer being fed on the refuge in the winter would likely forage more often on private lands compared to baseline conditions, and higher levels of grazing and browsing could result in further habitat degradation, reduced residual vegetation, and loss of acreage in some areas.

If large numbers of elk migrated outside Jackson Hole, Neotropical migratory birds associated with wet meadow, native grassland, sagebrush shrubland, and riparian and aspen woodland communities on BLM lands and private lands in the Green River basin and the Red Desert could be negatively affected in localized areas as a result of higher levels of grazing and browsing. This could result in habitat degradation and loss of acreage in some areas. Neotropical birds that need residual vegetation or a high percentage of canopy cover would be negatively impacted the most.

Conclusion

Under Alternative 2 Neotropical migratory bird diversity on the refuge could be greater than under Alternative 1 by a negligible amount because of more acres of willow habitat in healthier condition in the short and long terms. Neotropical migratory bird species dependent on aspen habitat would eventually disappear from the refuge as this habitat type was lost under Alternative 2 (similar to Alternative 1). Neotropical migratory bird communities associated with wet meadow and cottonwood habitats would be reduced by a

negligible to a minor amount, and bird communities associated with sagebrush shrublands and native grasslands would expand by a minor amount. However, if large numbers of elk migrated out of the Jackson Hole area for the winter, a major increase in willow habitat would greatly enhance Neotropical migratory bird communities dependent on this habitat type. Some aspen communities could also survive and improve in condition, which would support small communities of Neotropical migratory birds that depend on good condition aspen habitat.

In the park a minor increase in the condition and amount of riparian and aspen woodland habitat and restoring 4,500 acres of agricultural lands to native plant communities would likely increase the diversity and abundance of Neotropical migratory birds, more closely approximating natural conditions compared to Alternative 1. This alternative would not result in the impairment of Neotropical migratory bird communities in the park.

Alternative 3

Analysis

National Elk Refuge — Compared to Alternative 1, wet meadow habitat under Alternative 3 would decrease by an estimated 780 acres (45%) in the short term and 1,500 fewer acres (87%) in the long term. This would affect Neotropical birds dependent on wet meadow habitats by a moderate to major degree. Fewer elk under this alternative could result in more residual grass cover on those wet meadow acres that remain, which would benefit bird species dependent on tall grass cover to avoid predators. Conversely, any benefits to bird communities in wet meadow habitats stemming from large reductions in elk numbers (bison numbers would remain unchanged) could be offset by increased reliance of remaining animals on native winter habitat. Substantial increases in herbaceous cover might not occur.

Under Option A sagebrush shrubland and native grassland habitats on the refuge would decrease by an estimated 220 acres (1%) in the short and long terms. This small change in habitat would have a negligible effect on the abundance of Neotropical migratory birds dependent on these habitat types compared to Alternative 1.

Under Option B the effects on Neotropical migratory birds in sagebrush shrubland and native grassland habitats would be similar to the effects of Alternative 2.

Under Alternative 3 an estimated 780 more acres (260%) of willow habitat in the short term and an estimated 1,500 more acres (500%) in the long term could result in a major increase in Neotropical migratory birds dependent on this habitat compared to Alternative 1. This increase in willow habitat would be due to the recovery of suppressed willow plants in wet meadow habitats. As these plants grew outside the browse zone, they would provide birds with robust, multi-layered, and dense thickets that offer a variety of niches for birds that are habitat specialists.

Compared to Alternative 1, an estimated 220 more acres (20%) of cottonwood habitat under Alternative 3 could result in a minor increase in Neotropical migratory birds dependent on this habitat in the short and long terms. All cottonwood habitats would be in good or fair condition under Alternative 3, compared to 80% of cottonwood communities in good or fair condition under Alternative 1.

The effects of Alternative 3 on Neotropical migratory birds dependent on aspen habitat would be similar to the effects of Alternative 1. In the long term birds reliant on aspen woodland habitat would disappear as this habitat type was lost from the refuge.

If large numbers of elk migrated outside Jackson Hole, some aspen stands on the refuge could survive, and Neotropical migratory birds that depend on this habitat would benefit. These aspen stands would have to be large enough to provide birds with interior forest as protection against nest predators and parasites.

Option A of Alternative 3 would not affect Neotropical migratory birds on the refuge in cultivated fields because acreage and management of these areas would be similar to baseline conditions and Alternative 1. Option B would phase out cultivated fields, which would result in effects similar to Alternative 2.

Grand Teton National Park — Neotropical migratory birds dependent on wet meadow habitats

in the park are not expected to be affected under Alternative 3 unless large numbers of bison negated, to some extent, the lower numbers of elk and resulted in more invasions by nonnative plant species. If nonnative invasive plant communities became dominant in localized areas, Neotropical migratory birds dependent on wet meadow habitat could be adversely affected.

The restoration of 4,500 acres, which would occur over 15 years, could involve activities such as disking, seeding, irrigation, prescribed fire, fertilizing, and weeding. The effects that disturbance would have on birds in restored areas would be variable and difficult to quantify. Factors such as species, sex, and age of individuals, as well as the time of year, magnitude, and type and duration of human activities would affect responses. The restoration activities in Alternatives 2–6 would be limited in time and space; therefore, disturbance to birds would result in short-term, localized, negligible to moderate impacts. Depending on the bird species, in the long term the restoration of native grasslands would benefit species associated with grassland and sagebrush habitats, but would result in long-term changes in the abundance and distribution of other species. Compared to Alternative 1, Neotropical migratory birds that are dependent on native grassland and sagebrush shrubland habitats could benefit from the restoration of approximately 4,500 acres of agricultural lands to native grassland and sagebrush shrubland communities, similar to Alternatives 2 and 4–6.

Compared to Alternative 1, Neotropical migratory birds that are dependent on willow, cottonwood, and aspen habitats could benefit as a result of minor improvements in these communities and additional acreage due to fewer ungulates browsing in the park.

Bridger-Teton National Forest — The effects of Alternative 3 on Neotropical migratory birds that are dependent on wet meadow, sagebrush shrubland, native grassland, and riparian and aspen woodland habitats in the national forest would be similar to the effects of Alternative 2.

Other Lands — The effects of Alternative 3 on Neotropical migratory birds that are dependent on wet meadow, sagebrush shrubland, native grassland and riparian and aspen woodland habitats on BLM lands and private lands in Jackson

Hole, the Green River basin, and the Red Desert would be similar to the effects of Alternative 2.

Conclusion

Neotropical migratory bird diversity under Alternative 3 could be greater than under Alternative 1 due to a major increase in willow habitat and a minor increase in cottonwood habitat on the refuge. Neotropical migrants dependent on aspen habitat would eventually disappear from the refuge as this habitat type could disappear under Option A, similar to Alternative 1. Option B would phase out cultivated fields, which would result in effects similar to Alternative 2. Neotropical migratory bird communities associated with wet meadows would be reduced by a moderate to major amount, and those associated with sagebrush shrublands and native grasslands would be reduced by a negligible amount compared to Alternative 1.

In the park more riparian and aspen woodland habitats in healthy condition and the conversion of agricultural lands to native plant communities would likely increase Neotropical migratory bird diversity, more closely approximating natural conditions, as compared to Alternative 1. This alternative would not result in the impairment of Neotropical migratory bird communities in the park.

Alternatives 4 and 5

Analysis

National Elk Refuge — Compared to Alternative 1, an estimated 270 fewer acres (16%) of wet meadow habitat in the short term would have a minor negative effect on Neotropical migratory birds that use this habitat type. An estimated 520 fewer acres (30%) in the long term would have a moderate negative effect. In the short term the construction of a 500-acre willow enclosure in wet meadow habitat on the refuge would result in a major increase in the amount of residual cover within the enclosure, benefiting those species requiring tall vegetation. However, over time the quality of wet meadow habitat would decline as willows increased within the enclosure. Outside the enclosure little residual cover would remain because elk and bison would graze heavily on the wet meadow habitat that was still accessible.

An estimated 70 fewer acres (0.4%) of sagebrush shrubland and native grassland habitat on the refuge in the short term would have a negligible effect on the abundance of Neotropical migrants dependent on these habitat types. An estimated 1,070 fewer acres (7%) in the long term would have a minor negative effect.

An estimated 270 more acres (90%) of willow habitat in the short term and an estimated 520 more acres (173%) in the long term would have beneficial effects on the abundance of Neotropical migratory birds that use this habitat type compared to Alternative 1. Compared to the potential amount of willow acreage on the refuge of 1,750 acres, this habitat increase would be minor, and the benefit to Neotropical birds would likely be minor.

Compared to Alternative 1, an increase of 70 acres (6%) of cottonwood communities would have negligible short- and long-term impacts on Neotropical migratory birds that use good and fair condition cottonwood habitat.

In the short term the recovery of approximately 500 acres of poor condition aspen woodland habitat within an enclosure would have a moderate impact on the abundance of Neotropical migratory birds that use good and fair condition aspen woodland habitat, as compared to Alternative 1. In the long term the recovery of approximately 1,000 acres of aspen woodland habitat would have a major beneficial effect on Neotropical birds, as compared to Alternative 1, where all aspen woodland communities would eventually disappear.

In the long term under Alternative 4 monitoring of habitat improvements could indicate the need for adaptive management changes to planned enclosures. Large, permanent enclosures could be made smaller, temporary, and rotated, similar to enclosures described under Alternative 6. If these changes were made, impacts to Neotropical migratory birds due to enclosures under Alternative 4 would be similar to those under Alternative 6.

Grand Teton National Park — Neotropical migratory birds dependent on wet meadow habitats in the park would not be affected under Alternative 4.

Neotropical birds dependent on wet meadow habitats would not be affected under Alternative 5 unless nonnative invasive plants began to dominate many wet meadow areas as a result of heavy elk grazing. Neotropical migratory birds dependent on wet meadows could be adversely affected by nonnative plant species becoming dominant in localized areas.

The restoration of 4,500 acres, which would occur over 15 years, could involve activities such as disking, seeding, irrigation, prescribed fire, fertilizing, and weeding. The effects that disturbance would have on birds in the restoration areas would be variable and difficult to quantify. Factors such as species, sex, and age of individuals, as well as the time of year, magnitude, and type and duration of human activities would affect responses. The restoration activities in Alternatives 2–6 would be limited in time and space; therefore, disturbance to birds would result in short-term, localized, and negligible to moderate impacts. Depending on the bird species, in the long term the restoration of native grasslands would benefit species associated with grassland and sagebrush habitats, but would result in long-term changes in the abundance and distribution of other species. Compared to Alternative 1, the composition of the Neotropical bird community in native grasslands and sagebrush shrublands would likely be more diverse under Alternatives 4 and 5 due to the restoration of 4,500 acres of agricultural lands to native vegetation, similar to Alternatives 2, 3, and 6.

Neotropical migratory birds dependent on willow, cottonwood, and aspen habitats could benefit by a negligible to minor degree due to less intense browsing compared to baseline conditions and Alternative 1.

Bridger-Teton National Forest — Neotropical migratory birds in the national forest that depend on wet meadow habitats would not be affected in the short term because elk grazing in wet meadow habitats would be similar to baseline conditions and Alternative 1. However, in the long term larger numbers of elk could remain on national forest lands in the winter, increasing grazing pressure and reducing residual vegetation in wet meadow communities. This could negatively affect Neotropical migratory birds that depend on tall vegetation for cover.

In the short term there would be few, if any, changes to the Neotropical migratory bird communities that depend on sagebrush shrubland and native grassland communities. In the long term larger numbers of elk grazing in the forest could have adverse impacts to vegetation in some areas, with negative impacts on Neotropical migratory birds that rely on tall grasses for cover.

There would be few, if any, changes to the Neotropical migratory bird community that depends on riparian and aspen woodland habitats in the short term as a result of elk browsing pressure. but more elk browsing in the long term could adversely affect willow, cottonwood, and aspen habitats and the Neotropical bird communities that depend on woody vegetation.

Neotropical migratory birds in the national forest would not be affected under Alternatives 5 compared to baseline conditions and Alternative 1. However, elk browsing in the national forest would continue to negatively affect some willow, cottonwood, and aspen stands.

Conclusion

Compared to Alternative 1, the diversity of Neotropical migratory birds would be higher on the refuge under Alternatives 4 and 5 by a minor to moderate amount in the long term due to a moderate increase in riparian and aspen woodland habitat in good and fair condition. After the initial implementation phase of Alternative 4, adaptive management changes could be made that would further increase benefits to Neotropical migratory birds. Impacts would be similar to those under Alternative 6. Neotropical migratory bird communities associated with wet meadows would be reduced by a minor to moderate amount compared to Alternative 1, while birds dependent on sagebrush shrubland and native grasslands would be reduced by a negligible to minor amount.

In the park Neotropical bird diversity could be greater than under baseline conditions and Alternative 1 due to more riparian and aspen woodland habitat in healthier condition and the conversion of 4,500 acres of agricultural lands to native plant communities. The benefits would be less under Alternative 5 due to relatively high numbers of elk browsing on woody vegetation. Alternatives 4

and 5 would not result in the impairment of Neotropical migratory bird communities in the park.

Alternative 6

Analysis

National Elk Refuge — The effects of Alternative 6 on Neotropical migratory birds dependent on wet meadow habitats on the refuge would be similar to the effects of Alternative 3.

An estimated 310 fewer acres (2%) of sagebrush shrubland and native grassland habitats on the refuge in the short term could have a negligible adverse effect on Neotropical migrants that depend on these habitat types. An estimated 1,920 fewer acres (12%) in the long term could have a minor adverse effect. Although ungulate numbers would be lower on the refuge, any benefits to some bird species stemming from large reductions in elk and bison numbers could be offset by a greater reliance of remaining animals on native winter habitat. Substantial increases in herbaceous cover might not occur.

The effects of Alternative 6 on Neotropical migratory birds that are dependent on willow habitat on the refuge would be similar to Alternative 3.

An increase of 70 to 220 acres (6%–20%) of cottonwood communities in the short and long terms would have negligible to minor beneficial impacts on Neotropical migratory birds that use good and fair condition cottonwood habitat compared to Alternative 1.

The recovery of approximately 600 acres of poor condition aspen woodland habitat in the short term within rotating exclosures would have a moderate beneficial impact on the abundance of Neotropical migratory birds that use this habitat type. In the long term the restoration of 1,850 acres of aspen woodland habitat to good condition habitat would have a major beneficial impact on Neotropical birds compared to Alternative 1, where all aspen woodland communities would eventually disappear.

Neotropical migratory birds in the cultivated fields would likely not be affected by management activities any more than under Alternative 1.

Grand Teton National Park — Lower numbers of elk grazing on wet meadows would likely result in fewer invasions by nonnative weeds, and Neotropical migratory birds dependent on wet meadows could benefit from native plant communities remaining dominant.

The restoration of 4,500 acres, which would occur over 15 years, could involve activities such as disking, seeding, irrigation, prescribed fire, fertilizing, and weeding. The effects that disturbance would have on birds in restored areas would be variable and difficult to quantify. Factors such as species, sex, and age of individuals, as well as the time of year, magnitude, and type and duration of human activities would affect responses. The restoration activities in Alternatives 2–6 would be limited in time and space; therefore, disturbance to birds would result in short-term, localized, negligible to moderate impacts. Depending on the bird species, in the long term the restoration of native grasslands would benefit species associated with grassland and sagebrush habitats, but would result in long-term changes in the abundance and distribution of other species. Compared to Alternative 1, the composition of the Neotropical bird community in native grasslands and sagebrush shrublands would likely be more diverse due to the restoration of 4,500 acres of agricultural lands to native vegetation, similar to Alternatives 2 through 5.

Neotropical migratory birds dependent on riparian and aspen woodland communities in the park could benefit by a negligible to minor amount due to the reduced numbers of elk browsing on woody vegetation.

Bridger-Teton National Forest — The effects of Alternative 6 on Neotropical migratory birds dependent on wet meadow habitat in the national forest would be similar to the effects of Alternatives 2 and 3.

If larger numbers of elk grazed in sagebrush shrubland and native grassland habitats in the national forest, residual vegetation could be reduced, with adverse effects on migratory bird species that rely on tall grasses for cover. Conversely, if large numbers of elk migrated out of Jackson Hole in winter, grasses in the national forest would remain tall and birds dependent on tall vegetation would not be affected.

In the long term more elk in the national forest could increase browsing pressure on riparian and aspen woodland habitats and damage woody vegetation, which could negatively affect Neotropical migratory birds that breed and nest in willow, cottonwood, and aspen habitats.

If large numbers of elk did migrate out of the Jackson area, Neotropical migratory birds dependent on riparian and aspen woodland habitat in the forest would benefit from the improved condition of these habitats.

Other Lands — If large numbers of elk did not leave the Jackson Hole area in the winter, Neotropical migratory bird communities associated with wet meadow, sagebrush shrubland, native grassland, and riparian and aspen woodland habitats on BLM and private lands in the Jackson Hole area could experience negative impacts in localized areas. Elk would likely forage more often in these habitats outside the refuge since no supplemental feed would be provided. Higher levels of browsing and grazing on BLM lands and private lands could result in further habitat degradation and loss of acreage in some areas, which would negatively affect associated Neotropical migratory birds.

If large numbers of elk did migrate out of Jackson Hole, Neotropical migratory bird communities associated with wet meadow, sagebrush shrubland, native grasslands, and riparian and aspen woodland habitats on federal, state, and private lands in other locations could experience negative impacts in localized areas. Birds that need residual vegetation or a high percentage of canopy cover would be negatively affected the most.

Conclusion

Neotropical migratory bird diversity under Alternative 6 would be greater than under Alternative 1 in the short and long terms due to a major increase in good condition woody vegetation. Bird communities associated with wet meadows would be smaller than under Alternative 1 by a moderate to major amount, and Neotropical migrants dependent on sagebrush shrubland and native grassland habitats would be smaller by a negligible to minor amount.

In the park Neotropical migratory bird diversity would likely be greater than under Alternative 1 due to more riparian and aspen habitats in healthier condition and the conversion of agricultural lands to native plant communities. This alternative would not result in the impairment of Neotropical migratory bird communities in the park.

Mitigation

Measures to mitigate adverse effects of the alternatives on Neotropical migratory birds would be the same as those for riparian and aspen woodland, wet meadow, sagebrush shrubland, and native grassland habitats in the “Impacts on Habitat” section.

To minimize the potential for “taking” a nest or egg of a migratory bird species during restoration activities on the National Elk Refuge and in Grand Teton National Park under Alternatives 2–6, either (1) any activity that would destroy a nest or egg would occur outside the primary nesting season), or (2) a survey for any nests in the project area would be conducted prior to conducting these activities.

Cumulative Effects

Federal Land Management Activities

Grand Teton National Park Fire Management

The park’s fire management plan could have short-term adverse effects on some Neotropical migratory birds by disturbing and displacing individuals and reducing foraging and nesting habitat or habitat quality. Fire management actions are not expected to affect species at a population level. Prescribed fire can be used to maintain and restore more diverse vegetative communities in landscapes where natural fire regimes have been disrupted. The long-term effects of prescribed fire could create vegetative diversity that would improve foraging and nesting habitat for many Neotropical migratory bird species.

The decrease in diversity of Neotropical migratory birds under Alternative 1 due to the loss of riparian and aspen woodland habitat on the refuge could be offset to some extent by the beneficial effects of Grand Teton National Park’s fire management plan. Alternatives 2–6 would increase

riparian and aspen woodland habitat on the refuge and convert formerly cultivated areas in the southern portion of the park to native vegetation. Improved native habitat on the refuge and in the park, combined with improved habitat as a result of fire management activities, would have long-term, cumulative, beneficial effects on Neotropical migratory birds.

Grand Teton National Park Recreation Infrastructure Improvements

The construction of multi-use pathways, the realignment of portions of the Moose–Wilson Road, and other transportation improvements would result in site-specific, temporary impacts along planned improvement routes during the summer. The trail construction phase would likely displace Neotropical birds within or near work areas in the short term and make habitat unavailable. If pathways were separate from existing roads, long-term impacts to birds could include loss of habitat along the new pathways.

The decrease in Neotropical migratory bird diversity under Alternative 1 due to the loss of riparian and aspen woodland habitat on the refuge could have cumulative effects when combined with the effects of habitat loss in the park due to infrastructure improvements. Alternatives 2–6 would increase riparian and aspen woodland habitat on the refuge and would convert formerly cultivated areas in the southern portion of the park to native vegetation. These actions could offset the loss of habitat due to infrastructure improvement in the park over the long term.

Bridger-Teton National Forest Fuels Management Projects

Bridger-Teton National Forest has identified various fuels reduction and habitat enhancement projects in the primary and secondary analysis areas. These projects would alter about 9,400 acres of national forest land and could temporarily reduce Neotropical migratory bird habitat immediately after various fuel reduction treatments. However, in the long term, most of these projects would improve nesting and foraging habitats for Neotropical birds.

The negative effects on the diversity of Neotropical migratory birds due to the loss of riparian and aspen woodland habitat on the refuge and in the

park under Alternative 1 could be offset to some extent by improved nesting and foraging habitat within the forest over the long term. Beneficial cumulative effects would result under Alternatives 2–6 due to increased riparian and aspen woodland habitats on the refuge and in the park, combined with improved habitats in the national forest. However, under Alternatives 2, 3, and 6, and to some extent under Alternative 4, more elk would winter on native winter range and might heavily browse riparian and aspen woodland habitats in the forest, decreasing the benefits to Neotropical birds.

Bridger-Teton National Forest Recreation Planning / Moose-Gypsum Projects

The dispersed recreation camping site plan would decrease the potential for interactions that could disturb and displace Neotropical birds from more critical habitat. In the long term these projects could result in beneficial effects to migratory birds, but the effects would likely be negligible.

BLM Snake River Resource Management Plan

Greater public access would have the potential to increase conflicts with Neotropical migratory birds and negatively impact woody riparian habitats that support a more diverse bird community. Continued management of conservation easements for open space and wildlife habitat would help protect foraging and nesting habitat. Pursuit of a long-term protective withdrawal to prohibit the staking and development of mining claims would also benefit birds by preventing potential adverse habitat impacts.

Cumulative effects are not expected under Alternatives 1 and 5 because the amount of browsing by elk in woody riparian habitats would not be affected. Alternatives 2, 3, 4, and 6 would increase elk distribution in some years and increase the potential for heavy browsing that could reduce the quality of habitat for Neotropical migratory birds.

BLM Upper Green River Special Recreation Management Area

Proposed improvements to sensitive riparian vegetation zones would benefit a diversity of Neotropical birds. Cumulative impacts under all the

alternatives would likely be negligible because of the small amount of acreage (16.5 acres) that would be directly impacted by the plan.

Snake River Restoration Activities

Restoration of the Snake River channel by the U.S. Army Corps of Engineers could impact riparian habitat for a variety of wildlife species, including Neotropical birds. This environmental restoration project will prevent further degradation of riparian habitat and facilitate habitat recovery.

The negative effects on the diversity of Neotropical migratory birds due to the loss of riparian and aspen woodland habitat on the refuge and the park under Alternative 1 could be offset to some extent by increased woody riparian habitat along the Snake River. Beneficial cumulative effects would result in the long term under Alternatives 2–6 due to increased riparian and aspen woodland habitats on the refuge and in the park, combined with increased woody riparian habitat along the Snake River. Increased browsing by elk along the Snake River under Alternatives 2, 3, 4, and 6 in some years could offset some of the beneficial cumulative effects.

Population Growth and Private Land Development

Primary Analysis Area

Projected population increases in both Teton and Sublette counties would continue to create a demand for private land development in these areas. Neotropical migratory birds would encounter increased habitat loss, conflicts with humans, and vehicle collisions. Development in riparian and aspen woodland habitats would have the most negative impacts on bird diversity. The loss of riparian and aspen woodland habitats on the refuge and in the park under Alternative 1, combined with the loss and degradation of this habitat type on private lands, would have cumulative negative impacts on Neotropical bird diversity. Increased riparian and aspen woodland habitat and improved habitat quality on the refuge and in the park under Alternatives 2–6 would offset to some extent the loss of habitat on private lands, but the effects would likely be negligible.

GALLINACEOUS BIRDS

Methodology Used to Analyze Effects

Estimates of an alternative's potential beneficial or adverse effects on populations of gallinaceous birds have been based on changes in the amount and condition of preferred habitats. Increases in the amount and/or condition of preferred habitats are viewed as benefits to populations, and decreases are viewed as detrimental effects, even though neither increases nor decreases could translate directly into increased population or production levels. For example, the effect that changes in the amount of sagebrush shrubland habitat would have on sage grouse would depend on the location of changes, existing sage grouse habitat use patterns, size and quality of adjacent sagebrush and native grassland habitats, and many other factors. Nonetheless, increases in the amount and quality of sagebrush habitat are beneficial to sage grouse populations, and reductions are generally detrimental. Due to the numerous factors that may influence grouse populations, no attempt has been made to quantify the degree of impact in terms of negligible, minor, moderate, or major that grouse populations could benefit from or be adversely affected by potential habitat changes.

Impacts of the Alternatives

Impacts Common to All Alternatives

Gallinaceous birds would not be adversely impacted or would be impacted to a negligible degree by management activities and other human disturbances under all alternatives. Activities associated with the supplemental feeding program (Alternatives 1, 3, 4, 5, and 6), fertility control on the refuge (Alternative 2), and brucellosis vaccination on the refuge (Alternatives 4, 5, and possibly 3) would not disturb grouse because the activities would take place in cultivated fields and grassland habitat where gallinaceous birds do not normally occur.

Gallinaceous birds would not be adversely impacted or would be impacted to a negligible degree by activities associated with elk and/or bison hunting in all alternatives except 2. Hiking and horseback riding and the firing of rifles could temporarily disturb gallinaceous birds in the im-

mediate area; however, these effects would not affect survival and reproduction.

Alternative 1

Analysis

National Elk Refuge — Under Alternative 1 sage grouse on the refuge would not be impacted in the short term any more than they have been in the recent past because there would be little or no change in sagebrush shrubland communities. Sage grouse could potentially benefit in the long term as sagebrush shrubland habitat on the refuge increased by an estimated 1,160 acres (15%), in large part due to the loss of aspen habitat. In addition to increased acreage of sagebrush shrubland habitat, sage grouse could also benefit from the loss of aspen habitat because it would eliminate many tall perches used by common ravens, which are key nest predators. Conversely, continued heavy grazing in some areas by elk and a growing population of bison, trampling of sagebrush in localized areas, and maintenance of higher-than-natural densities of common ravens and coyotes on the refuge (due in part to the large concentration of wintering elk and bison) could adversely affect the local sage grouse population. It is not clear whether potential beneficial or adverse effects of elk and bison management would have a net beneficial or adverse effect on the sage grouse population in the long term.

Ruffed grouse and blue grouse are rare on the refuge because suitable habitat is limited. A decrease in aspen woodlands by an estimated 90 acres (5%) in the short term would not measurably affect ruffed and blue grouse populations. However, the eventual loss of a major amount of riparian and aspen woodland habitat (an estimated 1,850 acres, or 100%, of aspen habitat, an estimated 50 acres or 16% of willow habitat, and an estimated 220 acres or 20% of cottonwood habitat) under this alternative would have a negative impact on ruffed and blue grouse.

Grand Teton National Park — A growing number of bison under this alternative could result in increased use of sagebrush shrubland habitat and reduced residual vegetation, potentially adversely affecting sage grouse nesting and brooding habitat. In addition, continued encroachment of conifers into some areas formerly dominated by sage-

brush could reduce the amount of suitable habitat in some areas and increase the number of widely spaced conifer trees that may provide perches for nest predators.

Ruffed grouse and blue grouse in some places in the park could be negatively impacted in localized areas by the loss of aspen and cottonwood habitat in the long term due in part to heavy browsing by elk and other ungulates.

Bridger-Teton National Forest — Sage grouse in the national forest would not be affected under Alternative 1 any more than they have been in the recent past, which includes localized adverse impacts due to heavy elk grazing and browsing.

Ruffed grouse and blue grouse could be negatively impacted in areas where aspen and cottonwood habitat was lost in the long term due in part to heavy browsing by elk and other ungulates.

Conclusion

Under Alternative 1 sage grouse populations on the refuge could potentially benefit as sagebrush shrubland communities increased by a minor amount in the long term due primarily to a loss of aspen habitat compared to baseline conditions. However, large numbers of bison could negate any beneficial effects of more habitat by reducing residual cover and degrading habitat condition. Ruffed grouse numbers would likely decline in the short and long terms as aspen habitat eventually disappeared, and the potential for increasing blue grouse numbers would disappear.

Sage grouse in the park could be adversely affected by growing numbers of bison in sagebrush shrubland habitat compared to baseline conditions. Ruffed grouse and blue grouse could experience adverse impacts due to reductions in the amount and condition of aspen and cottonwood habitats in localized areas in the long term compared to baseline conditions. This alternative would not result in the impairment of grouse communities in the park.

Alternatives 2 and 3 (Option B)Analysis

National Elk Refuge — Under Alternative 2 and option B of Alternative 3, an estimated 200 additional acres (2%) of sagebrush shrubland habitat would likely not affect sage grouse on the refuge in the short term, but an estimated 9,420 more acres (117%) of this habitat type in the long term compared to Alternative 1 could result in beneficial impacts. However, the immediate discontinuation of hunting and the eventual elimination of winter feeding on the refuge under Alternative 2 could result in higher levels of grazing by elk and bison in sagebrush shrubland habitats, which could offset some of the benefits of increased acreage.

Compared to Alternative 1, in the short and long terms, Alternative 2 and Option B of Alternative 3 would have an estimated 150 more acres (5%) of woody vegetation, which could benefit ruffed and blue grouse on the refuge but only to a negligible degree.

Increased ungulate browsing caused by reduced feeding and the elimination of hunting under Alternative 2 could also negate any beneficial effects of increased habitat and possibly result in overall negative impacts to forest grouse.

If large numbers of elk migrated out of the Jackson Hole area, ruffed and blue grouse could benefit with the recovery of an estimated 1,600 acres of riparian and aspen woodland habitat to good and fair conditions in the long term.

Even if the fertility control program was conducted in the park in the spring and summer under Alternative 2, gallinaceous birds would not be disturbed more than a negligible degree and only for a short period of time by biologists hiking through a variety of habitats.

Grand Teton National Park — An estimated 2,250 additional acres of sagebrush shrubland habitat would potentially benefit sage grouse in the park in the long term compared to baseline conditions and Alternative 1. A major reduction in bison numbers, which could result in larger amounts of residual grass cover in some areas, could also benefit sage grouse.

Negligible to minor increases in the amount and condition of riparian and aspen woodland habitats as a result of less browsing and trampling by elk and bison could benefit ruffed and blue grouse in the park.

Bridger-Teton National Forest — Compared to Alternative 1, increased grazing and browsing pressure by elk in localized areas on sagebrush shrubland and riparian and aspen woodland habitats in the national forest could negatively affect sage grouse, ruffed grouse, and blue grouse nesting or other aspects of their ecology.

Other Lands — If large numbers of elk did not migrate outside the Jackson Hole area, sage grouse and ruffed grouse on private lands in Jackson Hole could be negatively affected in localized areas from elk foraging more often on private lands compared to baseline conditions and Alternative 1. Higher levels of grazing and browsing could result in further habitat degradation, reduced residual vegetation, and loss of acreage in localized areas.

If large numbers of elk did migrate outside the Jackson Hole area, sage, ruffed, and blue grouse on federal, state, and private lands in the Green River basin could be negatively affected in localized areas as a result of sagebrush shrubland and riparian and aspen woodland habitats being degraded and possibly lost because of higher levels of browsing and grazing.

Conclusion

Sage grouse on the refuge would potentially benefit in the long term as a result of a major increase in sagebrush habitat being available compared to Alternative 1. Increased grazing by elk and bison could offset the benefits of more sagebrush shrubland habitat. Forest grouse on the refuge could be beneficially affected in the long term by a negligible increase in woody vegetation, but increased grazing and browsing by ungulates would likely negate this habitat increase and possibly result in overall negative impacts. If large numbers of elk migrated out of Jackson Hole, ruffed and blue grouse on the refuge would benefit from the recovery of an estimated 1,600 acres of riparian and aspen woodland habitats.

Sage grouse in the park would potentially benefit in the long term from 2,250 additional acres of sagebrush shrubland habitat and a major reduction in bison numbers compared to Alternative 1. Ruffed and blue grouse could benefit due to a negligible to minor increase in the condition of cottonwood and aspen habitat. This alternative would not result in the impairment of grouse communities in the park.

Alternative 3 (Option A)

Analysis

National Elk Refuge — Under Option A of Alternative 3 an estimated 90 additional acres (1%) of sagebrush shrubland habitat in the short term would likely have negligible impacts on sage grouse. An estimated 5,690 more acres (71%) of sagebrush shrubland habitat in the long term could benefit sage grouse. However, a major reduction in winter feeding and closing part of the hunt zone on the refuge could result in increased grazing pressure, which could offset some of the benefits of increased acreage.

Ruffed grouse could benefit from the estimated 1,720 more acres (53%) of riparian and aspen woodland habitat remaining on the refuge in the long term, compared to Alternative 1. However, benefits would be minimal because most of the difference in habitat would involve willow habitat, which is not used to the same extent as aspen habitat. Most or all of the aspen habitat on the refuge would be lost under both Alternatives 3 and 1. Blue grouse would become increasingly rare on the refuge.

Grand Teton National Park — An estimated 2,250 additional acres of sagebrush shrubland habitat, compared to baseline conditions and Alternative 1, could benefit sage grouse in the park in the long term. A major long-term reduction in bison could also potentially benefit sage grouse.

Ruffed grouse and blue grouse in the park could potentially benefit from a minor increase in the amount and condition of riparian and aspen woodland communities because of fewer elk browsing in the park compared to baseline conditions and Alternative 1.

Bridger-Teton National Forest — Compared to Alternative 1, increased grazing and browsing pressure by elk in localized areas on sagebrush shrubland and riparian and aspen woodland habitats in the national forest could negatively affect sage, ruffed, and blue grouse nesting or other aspects of their ecology.

Other Lands — If most elk remained in the Jackson Hole area during winter, ruffed grouse on BLM and private lands in Jackson Hole could be negatively affected in localized areas due to higher levels of browsing in willow, aspen, and cottonwood habitats.

If large numbers of elk did migrate outside the Jackson Hole area, sage and forest grouse on federal, state, and private lands in the Green River basin could be negatively impacted in localized areas due to higher levels of grazing and browsing in sagebrush shrubland and riparian and aspen woodland habitats.

Conclusion

Under Option A of Alternative 3 sage grouse on the refuge could benefit due to negligible habitat changes on the refuge in the short term and major habitat changes in the long term compared to Alternative 1. Increased grazing and browsing by elk and bison could offset potential benefits of more sagebrush shrubland habitat. Ruffed grouse and blue grouse could be slightly better off than under Alternative 1 because willow habitat would recover under this alternative. Blue grouse would become increasingly rare on the refuge.

Sage grouse in the park would potentially benefit in the long term from 2,250 additional acres of sagebrush shrubland habitat compared to baseline conditions and Alternative 1. Ruffed grouse and blue grouse could benefit by a minor increase in the condition of riparian and aspen woodland communities. This alternative would not result in the impairment of grouse communities in the park.

Alternative 4

Analysis

National Elk Refuge — An estimated 170 additional acres (2%) of sagebrush shrubland habitat

in the short term and an estimated 230 more acres (3%) in the long term, compared to Alternative 1, would have negligible effects on sage grouse on the refuge. Reductions in winter feeding could result in increased grazing pressure in some sagebrush shrubland habitats, which could negatively impact sage grouse populations, although fewer elk and bison grazing on the refuge would reduce potential effects.

Compared to Alternative 1, ruffed grouse and blue grouse on the refuge would benefit from an estimated 1,590 additional acres (49%) of woody vegetation in the long term and greatly improved habitat conditions. Improved habitat conditions could result in increased use of the refuge by forest grouse.

Grand Teton National Park — An estimated increase of 2,250 additional acres of sagebrush shrubland habitat in the long term and a major reduction in bison numbers could potentially benefit sage grouse populations in the park.

Ruffed and blue grouse in the park would not be affected or would be beneficially affected to a negligible degree under Alternative 4.

Bridger-Teton National Forest — Compared to Alternative 1, increased grazing and browsing pressure by elk in localized areas on sagebrush shrubland and riparian and aspen woodland habitats in the national forest could negatively affect sage, ruffed, and blue grouse nesting or other aspects of their ecology.

Conclusion

Increased browsing and grazing on sage grouse habitat due to reductions in winter feeding could negatively affect sage grouse populations compared to Alternative 1, although fewer elk and bison grazing on the refuge would reduce potential effects. Ruffed and blue grouse could benefit in the long term compared to Alternative 1 because good and fair condition riparian and aspen woodland habitats would increase by a moderate amount.

Sage grouse in the park would potentially benefit in the long term from 2,250 additional acres of sagebrush shrubland habitat and from a major reduction in bison numbers compared to Alterna-

tive 1. Ruffed grouse would not be affected or would be beneficially affected to a negligible degree due to fewer ungulates browsing on woody vegetation. This alternative would not result in the impairment of grouse communities in the park.

Alternative 5

Analysis

National Elk Refuge — The potential effects of Alternative 5 on sage grouse on the refuge would be similar to the effects of Alternative 4, except that grazing pressure could be somewhat less in sagebrush shrubland habitats because supplemental feeding would make it unnecessary for elk to use native forage. More residual vegetation would benefit sage grouse.

Exclosures under Alternative 5 would result in an estimated 340 additional acres (10%) of riparian and aspen woodland habitat in the short term and 1,590 more acres (49%) in the long term and much of this habitat would be in good and fair condition. This would benefit ruffed and blue grouse, and it could result in increased use of the refuge by these grouse species compared to Alternative 1.

Grand Teton National Park — Sage grouse in the park would potentially benefit in the long term from an estimated 2,250 additional acres of sagebrush shrubland habitat compared to baseline conditions and Alternative 1. A major reduction in bison numbers could result in larger amounts of residual grass cover in some areas, which could benefit nesting sage grouse.

Ruffed and blue grouse would not be affected or would be beneficially affected to a negligible degree under Alternative 5.

Bridger-Teton National Forest — Sage, ruffed, and blue grouse in the national forest would not be affected under Alternative 5 any more than they have been in the recent past.

Conclusion

The effects of Alternative 5 on sage grouse on the refuge would be similar to the effects of Alternative 4 except that grazing pressure would be somewhat less on native winter range because of

supplemental feeding, and sage grouse would benefit from more residual vegetation. Compared to Alternative 1, ruffed and blue grouse on the refuge could benefit because a moderate amount of good and fair condition riparian and aspen woodland habitats would be available in the long term.

Sage grouse in the park would potentially benefit in the long term by 2,250 additional acres of sagebrush shrubland habitat and a major reduction in bison numbers compared Alternative 1. Ruffed and blue grouse would not be affected or would be beneficially affected to a negligible degree under Alternative 5. These alternatives would not result in the impairment of grouse communities in the park.

Alternative 6

Analysis

National Elk Refuge — In the short term Alternative 6 would not affect sage grouse compared to Alternative 1 due to little change in sagebrush shrubland habitat. In the long term, sage grouse could potentially benefit by an estimated 3,990 more acres (50%) in sagebrush shrubland habitat compared to Alternative 1. However, the eventual elimination of winter feeding on the refuge and possible closure of part of the hunt zone on the refuge could result in higher levels of grazing by elk in sagebrush shrubland habitats, which could offset some of the benefits of increased sagebrush shrubland.

Compared to Alternative 1, ruffed and blue grouse would likely benefit from an estimated 1,720 additional acres (53%) of riparian and aspen woodland habitat in the long term and greatly improved habitat conditions. Ruffed and blue grouse could increase their use of the refuge after habitat conditions improved.

Grand Teton National Park — An estimated increase of 2,250 additional acres of sagebrush shrubland habitat and a major reduction in bison numbers could potentially benefit sage grouse populations in the park.

Ruffed and blue grouse could potentially benefit by a minor increase in riparian and aspen wood-

land communities due to fewer elk browsing in the park compared to Alternative 1.

Bridger-Teton National Forest — Compared to Alternative 1, increased grazing and browsing pressure by elk in localized areas on sagebrush shrubland and riparian and aspen woodland habitats in the national forest could negatively affect sage, ruffed, and blue grouse nesting or other aspects of their ecology.

Other Lands — To the extent that elk increased their use of private lands in the Jackson Hole area (due to a cessation of winter feeding on the refuge), sage grouse and ruffed grouse on these lands could experience negative impacts in localized areas (similar to Alternatives 2 and 3).

If large numbers of elk migrated outside Jackson Hole, sage, ruffed, and blue grouse on federal, state, and private lands in other locations could experience negative impacts in localized areas due to sagebrush shrubland and riparian and aspen woodland habitats experiencing higher levels of grazing and browsing. This could result in habitat degradation and loss of acreage in some areas.

Conclusion

Sage grouse on the refuge could benefit due to major, long-term habitat changes compared to Alternative 1. Ruffed and blue grouse would benefit in the short and long terms due to moderate to major habitat changes.

Sage grouse in the park could benefit in the long term from 2,250 additional acres of sagebrush shrubland habitat and a major reduction in bison numbers compared to Alternative 1. Ruffed and blue grouse in the park could benefit by a minor increase in the condition of riparian and aspen woodland communities. This alternative would not result in the impairment of grouse communities in the park.

Cumulative Effects

No cumulative effects on gallinaceous birds are anticipated as a result of impacts of the alternatives in combination with impacts of reasonably foreseeable actions.

WATERFOWL, SHOREBIRDS, RAILS, AND CRANES

Most waterfowl, shorebirds, rails, and cranes in Jackson Hole depend on marshland and wet meadow habitats for feeding, nesting, and other activities. Both of these habitats are generally in good condition on the refuge and in the park, but the amount of grazing that occurs on the refuge can affect the amount of residual, or standing, vegetation that persists into spring when migrants use the refuge as a stopover point and when waterfowl, shorebirds, rails, and cranes nest on the refuge.

Methodology Used to Analyze Effects

The nesting requirements of waterfowl and other waterbirds vary greatly; therefore, the effects of ungulate grazing in meadow and marsh communities differ. Species that prefer low stature vegetation for feeding, such as sandhill cranes, or are able to successfully nest in low stature vegetation, such as long-billed curlews, would likely benefit from or would not be adversely affected by moderate to heavy grazing. Rails and other secretive birds would be adversely affected by heavy grazing that reduces residual vegetation while the effects of ungulate grazing might be neutral to other species.

Some bird species using meadow habitats on the refuge need dense, rank vegetation for successful nesting, and the high level of grazing by elk in some wet meadow areas could be adversely affecting the nesting success of these species (e.g., ducks such as the cinnamon teal). Although information on the effects of elk grazing on duck nesting on the refuge is not available, the large volume of information on the effects of livestock grazing on duck production indicates there is a high probability that heavy grazing by elk adversely affects duck production on the refuge.

Impacts of the Alternatives

Impacts Common to All Alternatives

Impacts on Marshlands

Most waterfowl and other waterbirds that occur in Jackson Hole, the Green River basin, and the Red Desert and that depend on marshland habitat would not be affected or would be affected to a negligible degree by actions considered in this

planning process. Although localized areas of marsh habitat on the refuge have been heavily grazed, the good condition and amount of acreage under all alternatives is expected to remain the same as under baseline conditions.

Direct Effects of Human Disturbance

Waterfowl, shorebirds, rails, and cranes would not be adversely impacted or would be impacted to a negligible degree by management activities associated with the supplemental feeding program for elk or bison under Alternatives 1, 3, 4, and 5. The effects would be negligible or nonexistent because supplemental feeding occurs during winter after most waterfowl, shorebirds, rails, and cranes have migrated to their winter feeding grounds. Those birds that remain for the winter primarily feed in the marshland areas, which are far enough away from feeding areas to not be affected by elk and bison feeding activities.

Waterfowl, shorebirds, rails, and cranes would not be adversely impacted or would be impacted to a negligible degree by activities associated with elk and bison hunting in all alternatives except 2. Hiking and horseback riding and the firing of rifles could temporarily disturb waterfowl, shorebirds, rails, and cranes in the immediate area. However, these effects would not affect survival and reproduction.

Waterfowl, shorebirds, rails, and cranes would not be adversely impacted or would be impacted to a negligible degree by management activities associated with a brucellosis vaccination program for elk and bison in Alternatives 3, 4, and 5 for the same reasons as described above for winter feeding activities.

Alternative 1

Analysis

National Elk Refuge — Under Alternative 1 waterfowl, shorebirds, rails, and cranes that use wet meadow habitats on the refuge could benefit from a negligible increase in wet meadow acreage (50 acres or 3%) in the short and long terms, as compared to baseline conditions. However a reduction in the overall condition of wet meadow habitats from the current good condition to fair or poor condition could negatively affect foraging habitat

for waterfowl, shorebirds, and cranes, as well as nesting habitat for rails. The fair to poor condition of wet meadow communities would likely more than offset any benefit from increased acreage.

The potential for adversely impacting duck production through depletion or degradation of nesting cover would continue in the short and long terms due to continued heavy grazing by elk and bison in some wet meadow communities.

Disking, plowing, and cultivation would have minimal effects on duck production because irrigated areas are usually drier sites where few ducks typically nest. Flood irrigation would continue to benefit sandhill cranes by providing water in areas that would otherwise be dry. As a result, sandhill cranes would continue to use cultivated fields and wet meadow areas maintained by flood irrigation seepage much more than they would have used native grasslands or sagebrush shrublands that existed prior to Euro-American settlement.

Grand Teton National Park — Three wet meadow sites in the park were studied by McClosky and Sexton (2002) and are currently dominated by nonnative plant communities (Haynes, pers. comm. 2005). High numbers of elk and growing numbers of bison grazing in wet meadows in the park could cause plant communities in some areas to shift from native to nonnative communities, negatively affecting birds dependent on wet meadows. High levels of grazing could also reduce residual vegetation and limit the amount of cover and nesting habitat for some species of birds in localized areas.

Bridger-Teton National Forest — Waterfowl, shorebirds, rails, and cranes in the national forest would not be affected by Alternative 1 any more than in the recent past. Although elk browsing could reduce nesting cover in some areas, effects would likely be negligible at most.

Conclusion

As compared to baseline conditions, Alternative 1 could result in negative impacts to waterfowl on the refuge due to heavy grazing by elk in areas used for nesting. In the long term as more bison grazed in the southern part of the refuge, adverse effects on nesting waterfowl could increase, and the condition of wet meadow habitat could decline.

However, cranes would likely not be impacted to any measurable degree.

High levels of bison and elk grazing on wet meadow habitats in the park could cause plant communities in some areas to shift from native to nonnative communities. High levels of grazing could also reduce residual vegetation and limit the amount of cover and nesting habitat for some species of birds in localized areas. This alternative would not result in the impairment of waterfowl, shorebird, rail, or crane populations in the park.

Alternative 2

Analysis

National Elk Refuge — As compared to Alternative 1, an estimated 100 fewer acres (6%) of wet meadow habitat under Alternative 2 could adversely affect waterfowl, shorebirds, rails, and cranes to a negligible to minor degree in the short and long terms. However, Alternative 2 could also provide benefits to waterfowl and rails because fewer grazing elk and bison would result in denser, taller vegetation for nesting cover. However, elk and bison, even though fewer in number, could graze for longer periods of time in wet meadow areas as a result of phasing out supplemental feeding. In addition, the cessation of forage production could cause greater utilization of forage in wet meadow communities by elk and bison. Therefore, it is unclear whether waterfowl, rails, and shorebirds would experience a net benefit or adverse impact.

The phaseout of cultivated fields would have minimal direct effects on duck, rail, and most shorebird production because these birds do not use cultivated fields for nesting or feeding. The native grasslands and sagebrush shrublands that would replace the cultivated fields also would not provide nesting or feeding habitat for these species. The cessation of flood irrigation would have adverse impacts on sandhill cranes by eliminating water in areas that would otherwise be dry. As a result, cranes might stop using much of the area that is now cultivated.

Waterfowl, shorebirds, rails, and cranes would not be adversely impacted or would be impacted to a negligible degree by activities associated with a bison fertility control program under Alternative

2. If the fertility control program was conducted on the refuge feedlines, most of these bird species would have already migrated to their winter feeding grounds, and overwintering birds spend most of their time in the marshland areas.

Grand Teton National Park — Waterfowl, shorebirds, rails, and cranes in the park could benefit from fewer elk grazing in wet meadow habitats. Residual vegetation could remain high and provide cover for nesting. In addition, nonnative species might not dominate plant communities as they could in heavily grazed areas.

Restoring agricultural fields to native vegetation could reduce the number of cranes that feed in those areas (Cole, pers. comm. 2005), but cranes do well with native meadow vegetation throughout the greater Yellowstone ecosystem.

If the bison fertility control program was conducted in the park during the spring and summer, waterfowl, shorebirds, rails, and cranes could be temporarily disturbed by human presence in a variety of habitats. However, few people would be engaged in this activity, and the extent of disturbance would be small, especially since many areas of the park are already open to hiking. Although a fertility control program in the park would likely be conducted while most birds are breeding and raising young, effects would be minimal.

Bridger-Teton National Forest — More elk grazing on wet meadows in native winter range could negatively affect waterfowl, shorebirds, rails, and cranes that use this habitat type in the national forest. Bird species that need residual vegetation for nesting and cover could be especially impacted.

Other Lands — If large numbers of elk did not migrate to the Green River basin and the Red Desert, waterfowl, shorebirds, rails, and cranes on wet meadow habitat on private lands in the Jackson Hole area could experience negative impacts in localized areas. Elk that were no longer being supplementally fed on the refuge would likely forage more often on private lands, and higher levels of grazing could result in further habitat degradation and reduced residual vegetation in some areas. BLM lands in Jackson Hole contain a limited amount of wet meadow habitat; therefore, effects

on waterfowl, shorebirds, rails, and cranes would be minimal.

If large numbers of elk did migrate outside Jackson Hole, waterfowl, shorebirds, rails, and cranes on BLM lands in the Green River basin could be negatively affected in localized areas. Wet meadow communities in the Green River basin are already heavily grazed by livestock, and the addition of grazing by elk from the Jackson herd could adversely affect ecological conditions in some areas, with negative impacts on waterfowl, shorebirds, rails, and cranes in those areas.

Conclusion

As compared to baseline conditions and Alternative 1, waterfowl and rails could benefit under Alternative 2 from a possible increase in nesting cover; shorebirds would likely not be affected to any measurable extent. Sandhill cranes could decrease on the refuge due to cessation of irrigation.

Waterfowl, shorebirds, rails, and cranes in the park could benefit in some areas from fewer elk and bison grazing in wet meadow habitats. Residual vegetation might remain high enough to provide cover for nesting birds. In addition, the condition of wet meadow habitats might not decline to the same degree as under Alternative 1. Alternative 2 would not result in the impairment of waterfowl, shorebird, rail, or crane populations in the park.

Alternative 3

Analysis

National Elk Refuge — The conversion of an estimated 780 acres (45%) of wet meadow habitat to willow habitat in the short term and an estimated 1,500 acres (87%) in the long term, compared to Alternative 1, would limit the amount of foraging and nesting habitat available to waterfowl, shorebirds, rails, and cranes. This could reduce the number of birds that feed and nest on the refuge. However, because the affected area naturally produced willow habitat in the past, the resulting bird community would more closely approximate a native diversity of birds.

In the wet meadow habitat that remains under Alternative 3, the potential for adverse impacts to

duck and rail production through reduction or degradation of nesting cover could decrease in the short and long terms as compared to baseline conditions because fewer elk would browse on the refuge, but bison numbers would remain relatively high (approximately 1,000). Elk and bison could also graze for longer periods of time in wet meadow areas as a result of elk and bison only being fed in the most severe winters. In addition, stopping forage production under Option B could cause greater utilization of forage in wet meadow communities. If bison grazed heavily in wet meadow communities in the future, impacts to duck and rail production due to the removal of residual cover in wet meadows and hoof damage would be increasingly negative.

Disking, plowing, and other cultivation practices and the continuation of flood irrigation under Option A would have similar effects on duck and rail production and sandhill cranes as Alternative 1. However, a major loss of wet meadow habitat would likely result in overall adverse impacts to waterfowl, shorebirds, rails, and cranes in the short and long terms as compared to baseline conditions and Alternative 1.

Grand Teton National Park — Waterfowl, shorebirds, and rails in the park could benefit from the reduction in elk numbers grazing in wet meadow habitats. Residual vegetation could remain high enough to provide cover for nesting. In addition, nonnative species might not dominate plant communities as they could in heavily grazed areas.

Restoring agricultural fields to native vegetation could reduce the number of sandhill cranes that feed in those areas (Cole, pers. comm. 2005), but cranes do well with native meadow vegetation throughout the greater Yellowstone ecosystem.

Bridger-Teton National Forest — More elk grazing on wet meadows in native winter range could negatively affect waterfowl, shorebirds, rails, and cranes that use this habitat type in the national forest. Bird species that need residual vegetation for nesting and cover could be especially impacted.

Other Lands — The effects of Alternative 3 on waterfowl, shorebirds, rails, and cranes on BLM lands in the Jackson area and in the Green River

basin and private lands in the Jackson Hole area would be similar to the effects of Alternative 2.

Conclusion

Under Alternative 3 the conversion of wet meadow habitat to willow habitat on the refuge would likely result in overall adverse impacts to waterfowl, shorebirds, rails, and cranes in the short and long terms as compared to Alternative 1. However, because the area naturally produced willow habitat in the past, the resulting bird community would more closely approximate a native diversity of birds.

Waterfowl, shorebirds, rails, and cranes in the park could benefit in some areas from fewer elk grazing in wet meadow habitats. Residual vegetation might remain higher and provide better cover for nesting in these areas, as compared to Alternative 1. This alternative would not result in the impairment of waterfowl, shorebird, rail, or crane populations in the park.

Alternative 4

Analysis

National Elk Refuge — The reduced acreage of wet meadow habitats on the refuge under Alternative 4 would reduce the amount of nesting and foraging habitat available for waterfowl, shorebirds, rails, and cranes, possibly leading to reduced numbers of birds feeding or nesting in these habitats on the refuge. As compared to Alternative 1, Alternative 4 would result in an estimated 270 fewer acres (25%) of wet meadow habitat in the short term and an estimated 520 fewer acres (48%) in the long term. The conversion of wet meadow communities to willow habitat would reduce foraging opportunities for shorebirds, rails, and cranes, and it would reduce nesting opportunities for waterfowl, shorebirds, and rails.

A 500-acre willow enclosure would initially protect wet meadow from grazing by elk and bison. In the short term residual cover in the 500-acre willow enclosure would be higher than under Alternative 1. But in the long term the recovery of willow habitat would eliminate much of the potential nesting habitat for waterfowl, shorebirds, rails, and cranes. The enclosure could also increase grazing pressure on wet meadow commu-

nities outside the enclosure, resulting in a decline in tall, dense vegetation that serves as cover for grass nesting birds, such as rails, snipe, willet, and curlew. However, much of this area naturally produced willow habitat in the past, so the resulting bird community would more closely approximate a native bird diversity.

Potential adaptive management changes to enclosures after the initial implementation phase of Alternative 4 could make impacts more similar to those under Alternative 6. Biological monitoring would determine whether enclosures could be made smaller and rotated instead of remaining larger and permanent.

The continuation of farming practices under Alternative 4 would have similar effects as under Alternative 1 in terms of disking, plowing, and sowing seeds. Converting an estimated 1,100 acres from flood irrigation to sprinkler irrigation would adversely affect waterfowl, shorebirds, rails, and cranes because standing water would be eliminated.

Under Alternative 4 the loss of wet meadow habitat, combined with the conversion from flood irrigation to sprinkler irrigation, would likely result in overall adverse impacts to waterfowl, shorebirds, rails, and cranes in the short and long terms as compared to baseline conditions and Alternative 1.

Grand Teton National Park — Waterfowl, shorebirds, rails, and cranes in the park could benefit from fewer elk grazing on park wet meadow habitats, although not as much as under Alternatives 2 and 3. Residual vegetation could remain high enough to provide cover for nesting. In addition, nonnative species might not dominate plant communities as they could in heavily grazed areas.

Restoring agricultural fields to native vegetation could reduce the number of sandhill cranes that feed in those areas (Cole, pers. comm. 2005), but cranes do well with native meadow vegetation throughout the greater Yellowstone ecosystem.

Bridger-Teton National Forest — More elk grazing on wet meadows in native winter range could negatively affect waterfowl, shorebirds, rails, and cranes that use wet meadow habitat in the national forest. Bird species needing residual vegetation for nesting and cover could be affected the most.

Conclusion

The conversion of a moderate amount of wet meadow habitat to willow habitat on the refuge, combined with a change from flood irrigation to sprinkler irrigation, would likely result in overall adverse impacts to waterfowl, shorebirds, rails, and cranes in the short and long terms as compared to baseline conditions and Alternative 1. However, because the area naturally produced willow habitat in the past, the resulting bird community would more closely approximate a native diversity of birds.

Waterfowl, shorebirds, rails, and cranes in the park could benefit from fewer elk and bison grazing on wet meadow habitats in some areas of the park, although not to the same extent as under Alternatives 2 and 3. Residual vegetation could remain higher and provide better cover for nesting birds in these areas, as compared to Alternative 1. This alternative would not result in the impairment of waterfowl, shorebird, rail, and crane populations in the park.

Alternative 5

Analysis

National Elk Refuge — The conversion of wet meadow habitat to willow habitat on the refuge under Alternative 5 would decrease the amount of foraging and nesting habitat available for waterfowl, shorebirds, rails, and cranes, possibly reducing the number of birds that feed or nest on the refuge. As compared to Alternative 1, Alternative 5 would result in an estimated 270 fewer acres (25%) of wet meadow habitat in the short term and an estimated 520 fewer acres (48%) in the long term. However, because the area naturally produced willow habitat in the past, the resulting bird community would more closely approximate a native diversity of birds.

The potential for adverse impacts to duck and rail production due to the reduction or degradation of nesting cover would continue in the short and long terms because of continued heavy grazing by elk in some wet meadow communities outside the 500-acre willow enclosure. This would result in a decline in tall, dense vegetation that serves as cover for grass-nesting birds, such as rails, snipes, willet, and curlews. In the short term residual cover within the enclosure would be higher than under

Alternative 1, and this would potentially benefit shorebirds and rails. In the long term the recovery of willow habitat would eliminate much of the potential nesting habitat for grass-nesting birds.

Converting an estimated 1,100 acres from flood irrigation to sprinkler irrigation would adversely affect waterfowl, shorebirds, rails, and cranes due to the elimination of standing water.

The combination of reduced wet meadow habitat and changing from flood to sprinkler irrigation would likely result in overall adverse impacts to waterfowl, shorebirds, rails, and cranes in the short and long terms as compared to baseline conditions and Alternative 1.

Grand Teton National Park — Waterfowl, shorebirds, rails, and cranes in the park would not be affected by actions under Alternative 5. High levels of elk and bison grazing on wet meadows in the park could cause plant communities in some areas to shift from native to nonnative communities.

Restoring agricultural lands to native vegetation could reduce the number of sandhill cranes that feed in those areas (Cole, pers. comm. 2005), but cranes do well with native meadow vegetation throughout the greater Yellowstone ecosystem.

Bridger-Teton National Forest — Waterfowl, shorebirds, rails, and cranes in the national forest would not be affected under Alternatives 5 any more than in the recent past.

Conclusion

The conversion of a moderate amount of wet meadow habitat to willow habitat on the refuge, combined with a change from flood irrigation to sprinkler irrigation, would likely result in overall adverse impacts to waterfowl, shorebirds, rails, and cranes in the short and long terms as compared to baseline conditions and Alternative 1. However, because the area naturally produced willow habitat in the past, the resulting bird community would more closely approximate a native diversity of birds.

Waterfowl, shorebirds, rails, and cranes in the park would not be affected under Alternative 5 any more than under Alternative 1. High levels of elk and bison grazing on wet meadows could cause

plant communities in some areas to shift from native to nonnative communities. This alternative would not result in the impairment of waterfowl, shorebird, rail, or crane populations in the park.

Alternative 6

Analysis

National Elk Refuge — Under Alternative 6 effects on waterfowl, shorebirds, rails, and cranes would be similar to the effects under Alternative 3. The reduced acreage of wet meadow habitats on the refuge would limit the amount of foraging and nesting habitat available for waterfowl, shorebirds, rails, and cranes, possibly reducing the number of birds that feed and nest on the refuge.

Grand Teton National Park — Waterfowl, shorebirds, rails, and cranes in the park could benefit from fewer elk grazing on park wet meadow habitats. Residual vegetation could remain high enough to provide cover for nesting. In addition, nonnative species might not dominate plant communities, as they could in heavily grazed areas.

Restoring agricultural fields to native vegetation could reduce the number of sandhill cranes that feed in those areas (Cole, pers. comm. 2005), but cranes do well with native meadow vegetation throughout the greater Yellowstone ecosystem.

Bridger-Teton National Forest — More elk grazing on wet meadows in native winter range could negatively affect waterfowl, shorebirds, rails, and cranes that use wet meadow habitat in the national forest. Bird species that need residual vegetation for nesting and cover could be negatively impacted the most.

Other Lands — If large numbers of elk did not migrate outside Jackson Hole, waterfowl, shorebirds, rails and cranes on wet meadow habitats on private lands in Jackson Hole could experience negative impacts in localized areas. Elk that are no longer being fed on the refuge in the winter would likely forage more often on private lands compared to Alternative 1, and higher levels of grazing could result in further habitat degradation and reduced residual vegetation in some areas. BLM lands in Jackson Hole contain a limited amount of wet meadow habitat; therefore, effects on birds would be minimal.

If large numbers of elk did migrate outside the Jackson Hole area, waterfowl, shorebirds, rails and cranes on federal, state, and private lands in other locations could experience negative impacts in localized areas. Waterfowl, shorebirds, rails and cranes in these areas could be negatively impacted as a result of wet meadow communities experiencing higher levels of grazing from a combination of livestock and elk, which could result in reduced ecological condition.

Conclusion

The conversion of a major amount of wet meadow habitat to willow habitat on the refuge, combined with the change from flood irrigation to sprinkler irrigation, would likely result in overall adverse impacts to waterfowl, shorebirds, rails, and cranes in the short and long terms, as compared to baseline conditions and Alternative 1. However, because the area naturally produced willow habitat, the resulting bird community would more closely approximate a native diversity of birds.

Waterfowl, shorebirds, rails, and cranes in the park could benefit from the reduction in elk and bison numbers grazing on park wet meadow habitats as compared to Alternative 1. Residual vegetation could remain high enough to provide cover for nesting. This alternative would not result in the impairment of waterfowl, shorebird, rail, and crane populations in the park.

Mitigation

Measures to mitigate adverse effects of the alternatives on waterfowl, shorebirds, rails, and cranes would parallel those addressed in mitigation discussions for wet meadow habitats in the “Impacts on Habitat” section.

Cumulative Effects

Several reasonably foreseeable actions, including the reconstruction of U.S. 26/287, the Bureau of Land Management’s *Snake River Resource Management Plan* and the *Upper Green River Special Recreation Management Area Project Plan*, and private land development would all likely result in short- and long-term impacts to waterbird habitat. Additionally, some of the actions associated with the upper Green River project plan and the Snake River restoration project could benefit wa-

terbird habitat. Overall, the cumulative effects of the alternatives on waterbird habitat would be negligible. The extent of these effects is unclear due to the varied and conflicting negative and positive impacts that would simultaneously occur on the refuge and in the park.

AMPHIBIANS

IMPACTS OF THE ALTERNATIVES

Impacts Common to All Alternatives

Amphibians would not be adversely impacted or would be impacted to a negligible degree by management activities associated with the supplemental feeding program for elk and bison under Alternatives 1, 3, 4, and 5 because supplemental feeding occurs during winter in cultivated fields where amphibians do not generally occur. Furthermore, amphibians would be hibernating in the winter. Supplemental feeding would be phased out under Alternatives 2 and 6; impacts on amphibians during the phaseout period would be negligible or nonexistent.

Amphibians would not be adversely impacted or would be impacted to a negligible degree by activities associated with elk and bison hunting under all alternatives except 2. Hiking and horseback riding and the firing of rifles could temporarily disturb amphibians in the immediate area. However, these effects would not affect survival and reproduction. In addition, amphibians would be hibernating during most of the hunting season.

Amphibians would not be adversely impacted or would be impacted to a negligible degree by management activities associated with a brucellosis vaccination program for elk and bison in Alternatives 3, 4, and 5. Elk and bison would be vaccinated in the winter on the refuge feedlines, where amphibians do not generally occur and when they are hibernating.

Alternative 1

Analysis

National Elk Refuge — Under Alternative 1 the irrigation system on the refuge would remain essentially the same as current conditions, and standing water would remain available for amphibian habitat. The diversion of water from ref-

uge streams could adversely affect some amphibians, but the diversions would continue to provide a net benefit by providing wet areas associated with flood irrigation. In general, amphibians are not greatly affected by elk and bison (D. Patla, pers. comm. 2003). However, if growing numbers of bison congregated along the banks of Nowlin and Flat creeks in the winter and trampled the underbank cavities that are important shelters for toads, boreal toads could be adversely affected.

Willows provide important shelter areas that protect amphibians from predation and that provide thermal cover. Historical loss of willow and especially the accompanying loss of beaver are probably a limiting factor for amphibians on the refuge (D. Patla, pers. comm. 2003). Willow habitat would decline by an estimated 50 acres, and 1,450 acres of suppressed willow plants that currently occur in wet meadow habitat would not be able to recover. Under Alternative 1 amphibians reliant on willow habitat would be adversely affected to a negligible degree as compared to baseline conditions.

Grand Teton National Park — Amphibians in the park could be affected to a minor degree by the loss of woody riparian habitats due to high levels of browsing or trampling by elk and bison.

Bridger-Teton National Forest — Amphibians in the national forest would not be affected under Alternative 1 any more than in the recent past.

Conclusion

Compared to baseline conditions, Alternative 1 could negatively impact amphibians on the refuge in the short and long terms due to the continued loss of riparian and aspen woodland habitat (including lost opportunities to recover healthy willow habitat) and possible trampling of stream banks by elk and bison (i.e., loss of undercut banks). Although the diversion of water from refuge streams could adversely affect some amphibians, the diversions would continue to provide a net benefit by providing wet areas associated with flood irrigation.

Amphibians in the park could experience adverse impacts due to a loss of woody riparian habitat in localized areas from heavy browsing and trampling by elk. This alternative would not result in

the impairment of amphibian populations in the park.

Alternative 2

Analysis

National Elk Refuge — Alternative 2 would eliminate irrigation on the refuge, and this could negatively affect amphibians because there would be less standing water in some areas, and potentially fewer amphibians would survive due to elimination of this excess water. The Nowlin area has soil conditions that allow water to pool when flood irrigation is used, and amphibians in this area could be negatively impacted as compared to baseline conditions and the Alternative 1 due to elimination of flood irrigation (D. Patla, pers. comm. 2003).

Bison numbers under Alternative 2 are not likely to grow large enough that they would impact the banks of Nowlin and Flat creeks by trampling the underbank cavities that are important to boreal toads. Compared to Alternative 1, Alternative 2 would result in an additional 150 acres of willow habitat, which could benefit amphibians in the short and long terms.

Amphibians would not be adversely impacted or would be impacted to a negligible degree by management activities associated with a fertility control program for bison under Alternative 2. If the fertility control program was conducted in the winter on refuge feedlines, amphibians would be hibernating.

Grand Teton National Park — Amphibians in the park could benefit from additional woody riparian habitats due to fewer elk and bison browsing and trampling woody vegetation.

If a bison fertility control program was conducted in the park in spring and summer, amphibians could be temporarily disturbed by humans hiking through a variety of habitats. However, few people would be engaged in this activity, and many areas of the park are already open to hiking; therefore, the extent of disturbance would be small. Although a fertility control program in the park would likely be conducted while most amphibians are breeding and raising young, effects would be minimal.

Bridger-Teton National Forest — Amphibians could be adversely affected by larger numbers of elk browsing in cottonwood and willow habitats on native winter range in the national forest, potentially causing a decline in these riparian communities and reducing cover for amphibians.

Other Lands — If large numbers of elk did not migrate outside the Jackson Hole area, amphibians on BLM lands and private lands in Jackson Hole could experience negative impacts in localized areas. Elk that are no longer being fed in the winter would likely forage more often in riparian woodland habitats outside the refuge. Higher levels of browsing on BLM and private lands could result in further habitat degradation and loss of acreage in some areas, negatively affecting amphibians.

If large numbers of elk did migrate outside Jackson Hole, amphibians on BLM lands and private lands in the Green River basin and the Red Desert could experience negative impacts in localized areas as a result of higher levels of browsing in riparian woodland habitats, which could result in habitat degradation and loss of habitat in some areas. In addition, on BLM wet meadows, grazing by both livestock and elk could result in reduced ecological condition, which could negatively affect amphibians.

Conclusion

Amphibians on the refuge would likely be negatively impacted as compared to Alternative 1 due to elimination of the flood irrigation system, although more acres of good and poor condition willow habitat (as compared to Alternative 1) could mitigate this impact to some degree. The loss of habitats produced by flood irrigation would limit the refuge's ability to mitigate habitat losses in surrounding areas.

Amphibians in the park could benefit from more woody riparian habitat (as compared to Alternative 1) due to fewer elk browsing and trampling woody vegetation, although effects would be negligible. This alternative would not result in the impairment of amphibian populations in the park.

Alternative 3

Analysis

National Elk Refuge — Flood irrigation would continue under Option A of Alternative 3, and the beneficial effects on amphibians would be similar to baseline conditions and Alternative 1. Under Option B irrigation would be eliminated on the refuge, and the effects on amphibians would be similar to the effects of Alternative 2. Compared to Alternative 1, amphibians would benefit due to an additional estimated 1,500 acres of willow habitat.

There would be a large number of bison under this alternative, some of which could congregate along the banks of Nowlin and Flat Creeks in the winter and trample the underbank cavities that are important shelters for boreal toads. Compared to Alternative 1, the negative impacts of Alternative 3 on toad survival would likely be less because there would be fewer bison under Alternative 3 than Alternative 1.

Grand Teton National Park — Amphibians in the park could benefit by additional woody riparian habitats due to fewer elk browsing in the park as compared to baseline conditions and Alternative 1.

Bridger-Teton National Forest — Amphibians could be adversely affected by larger numbers of elk browsing in cottonwood and willow habitats on native winter range in the national forest, potentially causing a decline in these riparian communities and reducing cover for amphibians.

Other Lands — The effects of Alternative 3 on amphibians on BLM lands and private lands in Jackson Hole, the Green River basin, and the Red Desert would be similar to the effects of Alternative 2.

Conclusion

Under Option A of Alternative 3 amphibians would likely benefit from a larger amount of willow habitat than under Alternative 1 and from the continuation of flood irrigation. Under Option B amphibians would likely benefit from a greater amount of good and fair condition willow habitat, but they would be adversely affected by the elimination of flood irrigation. The potential would exist for large numbers of bison to trample stream

banks along Nowlin and Flat creeks and causing a loss of undercut banks, which could adversely affect boreal toads.

Amphibians in the park could benefit from more woody riparian habitat (compared to Alternative 1) as a result of fewer elk browsing in the park. This alternative would not result in the impairment of amphibian populations in the park.

Alternatives 4 and 5

Analysis

National Elk Refuge — Approximately 1,100 acres of flood irrigation on the refuge would be converted to sprinkler irrigation under Alternatives 4 and 5. Sprinkler irrigation uses less water and spreads it evenly over the cultivated fields. As a result, there would be much less standing water or no standing water in areas where the soil is normally conducive to pooling (such as in the Nowlin area), so potentially fewer amphibians would survive (D. Patla, pers. comm. 2003).

Under Alternatives 4 and 5 there would be an estimated 270 more acres of willow habitat in the short term and an estimated 520 more acres in the long term. As a result, amphibians would benefit compared to baseline conditions and Alternative 1.

Grand Teton National Park — Amphibians in the park would not be affected or would be beneficially affected to a negligible degree by actions being considered under Alternatives 4 and 5 as compared to baseline conditions and Alternative 1.

Bridger-Teton National Forest — Under Alternative 4 amphibians could be adversely affected by larger numbers of elk browsing in cottonwood and willow habitats in the national forest, potentially causing a decline in these riparian communities and reducing cover for amphibians. Amphibians in the national forest would not be affected by actions being considered in Alternative 5 any more than in the recent past.

Conclusion

Amphibians on the refuge would likely be positively impacted under Alternatives 4 and 5 compared to Alternative 1 due to the moderate to major increase in good and fair condition willow habi-

tat. However, the elimination of flood irrigation on most fields would offset this benefit to some extent. Converting to sprinkler irrigation in most fields would result in a closer approximation of a natural diversity of amphibians on the refuge, but the loss of amphibian habitat produced by flood irrigation would limit the refuge's ability to offset habitat losses in surrounding areas.

Amphibians in the park would not be affected or would be beneficially affected to a negligible degree under Alternatives 4 and 5 as compared Alternative 1. Neither alternative would result in the impairment of park amphibian populations.

Alternative 6

Analysis

National Elk Refuge — Approximately 1,100 acres of flood irrigated fields on the refuge would be converted to sprinkler irrigation under Alternative 6, and the effects would be similar to the effects described under Alternatives 4 and 5.

Under Alternative 6 an estimated 1,500 additional acres of willow habitat would be provided in the long term, more than under Alternatives 4 and 5. Amphibians would benefit as a result.

Grand Teton National Park — Amphibians in the park could benefit from a larger amount of woody riparian habitat (compared to Alternative 1) due to fewer elk browsing in the park.

Bridger-Teton National Forest — Amphibians could be adversely affected by larger numbers of elk browsing in cottonwood and willow habitats on native winter range in the national forest, potentially causing a decline in these riparian communities and reducing cover for amphibians.

Other Lands — If large numbers of elk did not migrate outside the Jackson Hole area, amphibians on BLM lands and private lands in Jackson Hole could be adversely affected in localized areas. Elk that are no longer being fed in the winter would likely forage more often in riparian woodland habitats outside the refuge on BLM and private lands. This could result in further habitat degradation and the loss of acreage in some areas, which would negatively affect amphibians.

If large numbers of elk did migrate outside the Jackson Hole area, amphibians on federal, state, and private lands in other locations could be negatively affected in localized areas as a result of more intense browsing in riparian woodland habitats, which could result in habitat degradation and loss in some areas. In addition, grazing by both livestock and elk on wet meadows could result in reduced ecological condition, negatively affecting amphibians.

Conclusion

Amphibians on the refuge are likely to be positively impacted under Alternative 6 as compared to Alternative 1 due to an increase in the amount and condition of willow habitat. However, the elimination of flood irrigation would offset some of these benefits.

Amphibians in the park could benefit from a larger amount of woody riparian habitat (compared to Alternative 1) due to fewer elk browsing in the park. This alternative would not result in the impairment of amphibian populations in the park.

Mitigation

Many of the potential measures to mitigate adverse effects of the alternatives on amphibians would parallel those described in the mitigation discussion for riparian and aspen woodland and wet meadow communities in the “Impacts on Habitat” section and for water quantity and water quality in the “Impacts on the Physical Environment” section.

For alternatives that would convert flood irrigation to sprinkler irrigation (Alternatives 4, 5, and 6), one option would be to install spigots along pipelines, which could be used to disperse water in designated areas in order to re-create wet areas for amphibians.

Cumulative Effects

No cumulative effects on amphibians are expected as a result of impacts of the alternatives in combination with impacts of reasonably foreseeable actions.

IMPACTS ON ARCHEOLOGICAL AND ETHNOGRAPHIC RESOURCES

The National Environmental Policy Act requires that effects be analyzed for the cultural resources that could be affected by federal actions. Cultural resources include historic structures, cultural landscapes, archeological sites, ethnographic resources, and museum objects. Native American tribes define cultural resources very broadly as the resources necessary for the survival and maintenance of their way of life.

Ethnographic resources include plants and animals, ceremonial sites, tribal historic sites, cultural landscapes, and areas of sacred geography possessing mythic/ spiritual significance (Walker in prep.). Many tribes view elk and bison, in particular, not just as a “natural” resource but as integral to their culture, traditions, and lifeways (USIECR 2000; Walker in prep.). Bison were used for fresh meat, cached (stored) meat, clothing, shelter, and trade, and their spirits were asked to assist in healing and other ceremonies. Bison were hunted through the 1870s (Walker, pers. comm. 2005).

As previously discussed, no impacts are expected on historic structures, cultural landscapes, or museum objects (see page 94), and these topics have been dismissed from further analysis.

IMPACTS ON ARCHEOLOGICAL RESOURCES

METHODOLOGY FOR ANALYZING IMPACTS

Analysis was primarily based on previous archeological inventories of portions of the National Elk Refuge and the surrounding area. Resource inventories of all regions that may be potentially impacted by this project must be conducted prior to initiating any activities being considered in the alternatives to ensure that unknown archeological sites would not be inadvertently destroyed. Should archeological resources be discovered, appropriate measures must be taken to accurately delineate the area encompassing the resource, and the appropriate tribal and regulatory agencies must be notified.

Under section 106 of the National Historic Preservation Act, if a project changes in any way the characteristics that enabled the cultural resource to qualify for listing on the National Register of Historic Places, the project is considered to have an “effect” on the resource. There are three possible ways an undertaking can affect a cultural resource:

- *No effect* — There would be no effect of any kind (that is, neither harmful nor beneficial) on the historic property.
- *No adverse effect* — There could be an effect, but the effect would not be harmful to those characteristics that qualify the property for inclusion on the national register.
- *Adverse effect* — There could be an effect, and that effect could diminish the integrity of such characteristics.

Since farming and grazing activities have occurred within the assessment area for an extended period of time, the potential for adverse effects to archeological resources is low. The impact analysis is focused on prehistoric sites within high-use areas, which is where effects would likely occur.

IMPACTS OF THE ALTERNATIVES

Alternatives 1 and 3 (Option A)

Analysis

Under Alternative 1 and Option A of Alternative 3 farming of about 2,400 acres on the refuge would continue. Disking, plowing, and other activities that disturb the soil surface have been ongoing in cultivated fields on the refuge since the late 1800s, and continuing these activities would have no additional adverse effect.

While the average number of elk on the refuge and park would not differ substantially from baseline conditions under Alternative 1, the already large number of bison would continue to increase well beyond natural population levels for Jackson Hole. Alternative 1 would lead to further adverse

impacts caused by increased trailing, trampling, wallowing, and erosion on the refuge and park, which could expose subsurface archeological resources, such as fire hearths, and could potentially adversely affect them, particularly in areas near water. Under section 106, this could result in an adverse effect.

Bison numbers and associated impacts on soils and potentially to archeological resources would remain similar to baseline numbers under Alternative 3. This could maintain an elevated potential for archeological resources to be adversely impacted. However, because it is part of baseline conditions, there would be no additional adverse effect. Elk numbers would decline substantially, which would result in a net decline in soil disturbance and erosion.

Under Alternative 3 increased use of native winter range in the Bridger-Teton National Forest and potential increased use of the Green River basin by elk (if large numbers of elk began migrating there) could increase soil erosion in localized areas, with no more than negligible adverse impacts on archeological resources.

Conclusion

Alternative 1 could result in a negligible adverse effect on archeological resources due to growing bison numbers. Option A of Alternative 3 would have beneficial effects as compared to Alternative 1. Archeological resources in the park would not be impaired under these alternatives.

Alternatives 2 and 3 (Option B)

Analysis

Restoring native vegetation on 2,400 acres on the refuge and on 4,500 acres in the park under Alternative 2 and Option B of Alternative 3 would likely include disturbance of soils prior to seeding. These alternatives likely would not have an adverse impact on archeological resources since all of the land was previously farmed throughout most of the 20th century. Under section 106 of the National Historic Preservation Act, there would be no adverse effect.

Bison and elk numbers would decline substantially under Alternative 2, as compared to base-

line conditions and Alternative 1, which could result in less soil disturbance and erosion in use areas, and potentially less disturbance to archeological resources. Bison numbers under Alternative 3 would remain similar to baseline numbers, which could lead to negligible, localized adverse impacts to archeological resources. Elk numbers would decline substantially, resulting in a net decline in soil disturbance and erosion. In the long term there would be a net decline in soil disturbance and erosion under both alternatives, as compared to baseline conditions and Alternative 1, with no adverse effect.

Increased use of native winter range in Bridger-Teton National Forest and the Green River basin, resulting from reduced winter feeding on the refuge, could possibly result in increased soil erosion, which in turn could expose archeological resources.

Conclusion

Alternatives 2 and 3 (Option B) would have negligible adverse impact on archeological resources. No archeological resources in Grand Teton National Park would be impaired.

Alternatives 4, 5, and 6

Analysis

In addition to continued farming on about 2,400 acres of cultivated fields on the refuge (as described under Alternative 1), Alternatives 4, 5, and 6 call for enhanced forage production on the refuge, which would require additional irrigation. Installing new irrigation systems would include ditch digging and the addition of fencing, sprinklers, and pipes, and some of the pipe would be constructed outside cultivated fields on the refuge. Furthermore, approximately 4,500 acres of agricultural lands within Grand Teton National Park would be restored to native vegetation, similar to Alternatives 2 and 3. Installing irrigation pipes and restoring native vegetation in the park would have negligible adverse impacts on archeological resources because most of the land that would be disturbed has already been cultivated.

Alternative 5 would not affect the distribution and abundance of elk any more than what would occur under Alternative 1. Moderate to major reduc-

tions in elk numbers under Alternatives 4 and 6 would reduce the potential for impacts to archeological resources. Bison numbers under all alternatives would decline substantially, resulting in less soil disturbance and erosion in localized areas and the reduced potential for adverse impacts to archeological resources.

Under Alternatives 4 and 6 increased use of native winter range in Bridger-Teton National Forest could increase soil erosion in localized areas, with negligible adverse impacts on archeological resources, similar to Alternatives 2 and 3.

Conclusion

Impacts related to elk and bison numbers would be negligible, similar to Alternative 1. Constructing a sprinkler irrigation system on the refuge could result in negligible adverse effects. Archeological resources in the park would not be impaired under these alternatives.

MITIGATION

Prior to any soil disturbance from new projects, archeological resources within the proposed project area will be assessed for potential effects as well as their significance in accordance with section 106 of the National Historic Preservation Act. Mitigation of adverse effects would be coordinated with the Wyoming State Historic Preservation Office and may include avoidance of the site or data recovery efforts. Significant sites located within the assessment area would be monitored following project implementation to ensure protection from future cumulative effects.

CUMULATIVE EFFECTS

No cumulative effects on archeological resources have been identified.

IMPACTS ON ETHNOGRAPHIC RESOURCES

IMPACT ANALYSIS

The alternatives could impact American Indian tribes in terms of how they view bison and elk in the context of their culture and traditions. Currently, an ethnographic resource study is being

conducted that pertains to past treaties and traditional cultural activities that occurred within Grand Teton National Park, Yellowstone National Park, and the National Elk Refuge (Walker in prep.). The final report could influence future cultural resource surveys and management on the National Elk Refuge and in Grand Teton National Park, and it could yield additional information on how tribes used these areas.

Hunting was a tradition practiced by the tribes, who likely used the lands within Grand Teton National Park and the National Elk Refuge as part of their traditions and culture (Walker in prep.). No bison hunting on the National Elk Refuge would be allowed under Alternative 1, and no hunting for elk or bison would be allowed under Alternative 2. Under Alternatives 3 and 6, and potentially under Alternative 4, a ceremonial removal of bison by Native Americans would be allowed on the refuge in recognition of the cultural significance of bison to various tribes. Under Alternatives 2 and 3 efforts to support elk migration to alternative winter range outside Jackson Hole would be consistent with tribal views to let the herds behave naturally (USIECR 2000). Impacts of the alternatives on bison are covered in detail in the "Impacts on the Jackson Bison Herd" section.

The U.S. Fish and Wildlife Service and the National Park Service are required to consult with American Indian tribes on actions that may affect ethnographic resources, such as the specific means by which tribal reductions would occur. Regardless of whether alternatives call for tribal removal, tribes and individual members of tribes have previously made requests to collect bison and/or bison skulls throughout the year, to collect plants or other ethnographic resources, and to conduct ceremonies on park and/or refuge lands. These requests will continue to be addressed on a case-by-case basis in accordance with the respective agency policies, and consultation on these and other activities will occur in keeping with federal law and agency policies.

CONCLUSION

To date, the ethnographic study (Walker in prep.) has not been finalized. While the study may provide useful information regarding the cultural significance of the National Elk Refuge and Grand Teton National Park, management alternatives

for bison and elk are unlikely to affect to a significant degree existing cultural traditions that are practiced on the refuge and in the park. Alternatives that allow for a small removal of bison by the tribes for ceremonial purposes (Alternatives 3 and 6 and potentially Alternative 4) would enable the tribes to celebrate cultural traditions. Other management actions such as reducing or eliminating supplemental feeding (Alternatives 2, 3, 4, 6), improving habitat and forage conditions (Alterna-

tives 2–6) or reducing the potential risk for adverse effects of non-endemic diseases (Alternatives 2, 3, 4, and 6) would indirectly benefit the tribes.

CUMULATIVE EFFECTS

No cumulative effects on ethnographic resources have been identified.

IMPACTS ON HUMAN HEALTH AND SAFETY

Potential threats to human health and safety include vehicle collisions with animals, encounters with elk and bison, hunting accidents, and disease transmission to humans. Brucellosis is currently present in the Jackson elk and bison herds. Bovine tuberculosis and paratuberculosis currently do not affect the herds but are discussed in terms of potential effects if infection occurred. Current evidence does not suggest that chronic wasting disease causes infection in humans, and the risk appears to be low (Belay et al. 2004), but it is discussed here because of human health concerns caused by similar types of diseases (Demarais et al. 2002). To be safe, the Centers for Disease Control and Prevention and wildlife officials in a number of states recommend that hunters do not consume meat from animals that appear sick or test positive for the disease. Research using transgenic mice indicated that a substantial species barrier exists between humans and elk (Kong et al. 2005). Other diseases of elk and bison analyzed in other sections of this document would likely not cause impacts to humans and are not discussed here.

IMPACTS OF THE ALTERNATIVES

ALTERNATIVE 1

Analysis

Traffic Accidents Caused by Bison and Elk

The potential for traffic accidents caused by elk under Alternative 1 would continue to be low (107 collisions with elk occurred from 1997 to 2001, 97 of which were in Grand Teton National Park). A growing bison population could result in more accidents compared to baseline levels (14 from 1997 to 2001, all in the park) because the population is expected to grow from approximately 1,000 bison to 2,000 or more. It is possible that the number of accidents would not change measurably despite higher bison numbers. In Yellowstone National Park, where the bison herd averaged about 3,200 animals from 1997 to 2004, vehicle collisions killed less than 0.5% (0.0047) annually during that period. During the same period, there were about 500 bison in the Jackson herd on average yet ap-

proximately the same percentage (0.6%) of accidents.

Encounters with Elk and Bison

The number of potential human encounters with elk and bison would remain low, similar to what occurs under baseline conditions because of similar elk numbers and winter feeding levels. However, as bison numbers continued to grow under Alternative 1, more bison in the park and the national forest would likely lead to more encounters with people, particularly recreationists. Encounters could also increase because more bison might wander onto private lands and perhaps into the town of Jackson and nearby subdivisions.

Hunting Accidents

Hunting accidents in both the park and the refuge have been relatively low over the last two decades (Griffin, pers. comm. 2003; Campbell, pers. comm. 2003). Only four non-fatal hunting firearm accidents were reported in Wyoming in 2003 out of 205,000 Wyoming hunting licenses sold. The potential for hunting accidents due to elk hunting under Alternative 1 would remain similar to baseline levels.

Bison hunting would continue to occur outside the refuge and the park. To the extent that bison distribution increased due to higher bison numbers in the long term and more bison leaving the refuge and the park, the potential for hunting accidents would increase.

Disease Transmission to Humans

Brucellosis

Only two cases of brucellosis have been reported where hunters contracted the disease from an elk (Thorne 2001). During the fall when most hunting occurs, the disease is localized in tissues that are removed during field dressing, and under normal circumstances, the risk that humans would contract brucellosis from elk is low (Thorne et al. 1982; HaydenWing and Olson 2003).

The current low risk of brucellosis being transmitted from bison to people would not change in the short or long term under Alternative 1 because no bison hunting or other direct handling of bison would occur on the refuge or in the park any more than in the past. Some elk and bison would likely continue to be periodically tranquilized and handled. A negligible increased risk of brucellosis transmission could occur in the long term due to possible increases in seroprevalence and possible increases in hunter harvest.

Bovine Tuberculosis and Paratuberculosis

Neither tuberculosis nor paratuberculosis is present in the Jackson elk and bison herds. The following analysis discusses risk of transmission if the herds became infected. Aerosol transmission is the primary route for transmission of bovine tuberculosis from animals to humans, and direct handling of live elk and bison by people would pose the greatest risk for transmission to humans. No management activities that would require direct handling of elk are proposed under Alternative 1, but monitoring and periodic tranquilizing and handling of some elk and bison would likely continue.

Although bovine paratuberculosis is found in the animal feces and is not transmitted by aerosols, humans could contract either disease during the hunting season because of direct contact with elk and internal tissues. Hunters would not necessarily be able to identify infected elk because these are chronic, slow-developing diseases, and an infected animal may not exhibit any clinical signs. However, the probability that a hunter would be infected is likely low (Demarais et al. 2002).

Risk of transmission would increase during relatively rare immobilization procedures that would require direct contact by USFWS and/or NPS personnel.

There could be a slight risk that humans could contract bovine tuberculosis or paratuberculosis during winter feeding because of close but not direct contact between refuge personnel and animals. Because the feeding program under Alternative 1 would continue at existing levels, levels of risk would be unchanged.

Conclusion

The number of traffic accidents potentially caused by elk and human encounters with elk under Alternative 1 would remain low due to similar elk numbers, winter feeding levels, and distribution. The number of accidents caused by bison, as well as human encounters, would likely increase to some extent from very low baseline levels because a larger bison herd would likely be more widely dispersed.

The risk for elk hunting accidents would remain similar to existing conditions. Bison hunting would occur outside the refuge and the park. Higher bison numbers in the long term could increase the potential for hunting accidents.

The potential risk of disease transmission from elk to humans, and primarily to hunters because they would have direct contact with animal tissues, could increase in the long term with present numbers of elk and a substantial increase in bison (2,000+). If prevalence remained unchanged, there would be no change in potential risk.

The risk of brucellosis transmission from bison to people would remain low on the refuge and in the park because there would be no direct contact with bison any more than has occurred in the past. The risk of brucellosis transmission from bison to humans could occur in the long term outside the refuge and the park if seroprevalence increased and more bison were harvested.

If bovine tuberculosis or bovine paratuberculosis infected the Jackson elk and bison herds, there might be a low risk that humans could contract these diseases during winter feeding because of close but not direct contact between refuge personnel and animals.

ALTERNATIVE 2

Analysis

Traffic Accidents Caused by Bison and Elk

The potential for traffic accidents caused by elk under Alternative 2 could increase in the winter compared to existing conditions and Alternative 1 due to the gradual elimination of the refuge winter feeding program. Less feeding would force elk to rely on standing forage, resulting in greater elk

distribution and movements, and increasing the potential for traffic accidents, particularly during severe winters. Removing the fence along the southern and western boundaries of the refuge to allow elk to wander more widely could also increase the risk of accidents. Initially elk numbers would be similar to baseline conditions (7,500 at most, with an estimated average of 5,600), but in the long term numbers would range between 1,200 and 6,000.

The potential for traffic accidents caused by elk summering in the park would remain similar to current conditions or could decrease if elk numbers decreased in some years in the park. Park elk numbers would range from an estimated 600–3,000 compared to 2,500–3,200 under baseline conditions and Alternative 1.

Eliminating the elk herd reduction program in the park and hunting on the refuge would likely alter elk movements and distribution in the fall. Elk would likely spend more time in former hunt areas, and night movements would likely become less common compared to baseline conditions and Alternative 1. The potential for traffic accidents in the fall would likely decrease because of the absence of hunting pressure, although elk could stay in the park longer, partially offsetting a lower accident potential.

The number of traffic accidents caused by bison during some winters could increase to some extent as some bison, like elk, could increase movements in search of forage the refuge, particularly in severe winters. Lower bison numbers (an estimated 250–500 animals) would reduce overall risk during other seasons.

Human Encounters with Elk and Bison

Compared to Alternative 1, the number of potential encounters with elk and bison under Alternative 2 could increase in the winter because of the gradual elimination of the refuge winter feeding program and greater distribution of animals, particularly in severe winters, as described above.

Potential human encounters in the summer could decrease because fewer elk and bison would be present in the park and the national forest.

The elimination of the elk herd reduction program in the park and elk hunting on the refuge could increase the potential for human encounters with elk in the fall because more elk could remain in the park in former hunt areas rather than moving quickly to safe areas on the southern part of the refuge.

Hunting Accidents

The potential for hunting accidents occurring on the refuge and in the park would be eliminated. The potential for accidents in the national forest would remain similar to Alternative 1 because the number of hunters outside the refuge and the park could increase negligibly.

Disease Transmission to Humans

Brucellosis

Brucellosis transmission risk under Alternative 2 would be lower than under Alternative 1 because hunting would be eliminated on the refuge and in the park. Transmission risk to elk hunters in the national forest would be lower by a negligible amount because fewer elk would be harvested.

There would be no change in the risk for transmission of brucellosis from bison to humans under Alternative 2 because no hunting in the park or the refuge is permitted now. Transmission risk in the national forest could increase if more bison were harvested. There could be a negligible increase in risk to humans handling bison during the contraception program.

Bovine Tuberculosis and Paratuberculosis

As described for Alternative 1, the following analysis discusses the risk of disease transmission if either bovine tuberculosis or paratuberculosis became established in the Jackson herds. Stopping elk hunting would eliminate the transmission risk to elk hunters on the refuge and in the park, while the transmission risk in the national forest could decrease or increase slightly depending on harvest numbers.

Any risk that humans could contract bovine tuberculosis or paratuberculosis during winter feeding operations in the short term would be similar to Alternative 1. However, stopping the feeding

program would eliminate this risk in the long term.

Conclusion

Eliminating the winter feeding program would increase the distribution of elk and bison, which could raise the potential for traffic accidents and human encounters in the winter compared to baseline conditions and Alternative 1 despite lower elk and bison numbers in some years.

The potential for traffic accidents caused by elk summering in the park could remain similar to baseline conditions or decrease in some years if elk numbers fell. The potential for traffic accidents in the fall could also decrease because there would be no hunting pressure, although elk could stay in the park longer, partially diminishing this decreased risk. Fewer bison would reduce the potential for traffic accidents in spring, summer, and fall.

Potential human encounters with elk and bison in the summer would decrease primarily because of fewer animals. Eliminating the elk herd reduction program in the park and hunting on the refuge could increase the potential for human encounters with elk in the fall.

The potential for hunting accidents on the refuge and the park would be eliminated. However, the potential for hunting accidents in the national forest would remain similar to Alternative 1 or could increase slightly.

In the long term the potential risk of disease transmission to humans would be lower under Alternative 2 than any other alternative because of eliminating hunting and winter feeding. Brucellosis and the potential prevalence of other potential diseases would be low with no winter feeding concentrations and fewer elk and bison. The potential transmission risk in the national forest would be reduced compared to Alternative 1.

ALTERNATIVE 3

Analysis

Traffic Accidents Caused by Bison and Elk

The potential for traffic accidents caused by elk under the Alternative 3 could increase in the winter compared to Alternative 1, although not to the same degree as Alternative 2. Reducing the winter feeding program to severe winters (an estimated 2 years out of 10) would cause elk to use standing forage, increasing elk movements, distribution, and the potential for traffic accidents. In the long term fewer elk would winter on the refuge and more elk would winter on native range outside the refuge and the park. The Jackson elk herd size could decrease in some years to 8,000, but numbers would rebound during other years.

The potential for traffic accidents caused by elk summering in the park would decrease because of fewer elk (500–1,000 compared to approximately 2,500 under Alternative 1). Closing hunt areas in the Blacktail Butte / Kelly hayfields area of the park and the northern portion of the refuge would alter elk movements and distribution in the fall and possibly the potential for traffic accidents. Similar to Alternative 2, elk would no longer attempt to move quickly toward safe areas on the refuge and would spend more time in former hunt areas. However, the presence of more elk in the park for a longer time could continue the possibility of accidents in the fall.

The number of traffic accidents caused by bison could increase from existing levels because 1,000+ bison would rely on standing forage 8 out of 10 winters and would wander more widely in search of available forage. Bison hunting on the refuge could increase the potential for traffic accidents in the fall if bison increased their movements to avoid hunters.

Human Encounters with Elk and Bison

The number of potential human encounters with elk and bison under Alternative 3 could increase in the winter because reductions of the winter feeding program on the refuge, similar to Alternative 2, but winter feeding would occur on the refuge about 2 out of 10 years. The number of bison would be similar to baseline numbers, but elk

numbers on the refuge would be substantially lower than baseline conditions.

Potential encounters with elk in the summer would decrease compared to baseline conditions and Alternative 1 because there would be fewer elk. The potential for bison encounters in summer would remain the same as baseline conditions because of similar bison numbers and summer distribution, but probably lower than under Alternative 1.

Closing hunt areas in the Blacktail Butte / Kelly hayfields area of the park and the northern portion of the refuge would alter elk movements and distribution in the fall, possibly increasing the potential for human encounters. Despite fewer elk summering in the park, more elk could remain in the park during the fall in former hunt areas.

Hunting Accidents

Under Alternative 3 the potential for elk hunting accidents would decrease on the refuge and in the park because of reduced hunting compared to Alternative 1, but the potential for accidents in the national forest would increase due to minor increases in the number of hunters. One option under Alternative 3 instead of allowing hunting in the southern portion of the refuge would be to open this area to limited public use in the fall; such use would tend to force elk to other areas of the refuge and into hunting areas. This option would further reduce the potential for hunting accidents on the refuge.

Allowing bison hunting on the refuge would increase the potential for hunting accidents. The number of bison hunters would be somewhat higher than the estimated number of bison to be harvested. Initially an estimated 85 bison would need to be harvested on the refuge, decreasing in the long term to an estimated average of 70 annually. No bison hunting would occur in the park; therefore, there would be no potential for hunting accidents in the park.

Disease Transmission to Humans

Brucellosis

In the short term there would be no impact on the risk of transmission with or without implementa-

tion of the vaccination program. In the long term and in the absence of a vaccination program, risk would decrease moderately due to reduced prevalence, fewer elk on the refuge, and fewer elk being harvested. With a vaccination program (with a vaccine efficacy of 50% or greater), transmission risk would be substantially lower, even though the risk for transmission from elk to humans is currently very low (Thorne et al. 1982; Hayden-Wing and Olsen 2003). Potential transmission to elk hunters would be lower than under Alternative 1 because fewer elk would be harvested in the park and on the refuge. Transmission risk in the national forest would remain similar to Alternative 1.

In the short term the transmission risk of brucellosis from bison to humans under Alternative 3 would increase to a minor degree because of bison hunting on the refuge. If a vaccination program was successfully implemented, the transmission risk to humans would be reduced. If remote methods of vaccine delivery were used, there would be no risk to humans, but if direct handling of bison was required, the risk to humans would increase compared to Alternative 1.

Bovine Tuberculosis and Paratuberculosis

As described for Alternatives 1 and 2, the following analysis discusses the risk of disease transmission if either tuberculosis or paratuberculosis became established in the Jackson herds. Under Alternative 3 the risk of transmission of either disease to humans would be lower by a minor to moderate amount compared to Alternative 1 because of fewer animals and a reduced feeding program. Transmission risk to hunters would be lower because fewer elk would be harvested in the park and on the refuge. Transmission risk in the national forest would remain similar to Alternative 1.

Transmission risk from bison would be higher by a minor amount compared to Alternative 1 because of hunting on the refuge. If bison were vaccinated by hand, the risk for transmission would be increased by a moderate amount compared to Alternative 1.

The risk of transmission to humans during periodic tranquilizing and handling of some animals would be lower under Alternative 3 compared to

Alternative 1 because of smaller herds. Prevalence under Alternative 3 would likely be higher than under Alternatives 2 and 6 and lower than under Alternatives 1, 4, and 5.

Any risk that humans could contract bovine tuberculosis or paratuberculosis during winter feeding through close contact between agency personnel and elk or bison would be greatly reduced because feeding would only occur in an estimated 2 years of 10.

Conclusion

The potential for traffic accidents caused by elk and bison under the Alternative 3 could increase in the winter compared to low baseline levels and Alternative 1 because of reducing winter feeding to severe winters (an estimated 2 out of 10 winters), forcing the herds to rely more on standing forage and resulting in a wider distribution. Approximately 1,000 bison relying on standing forage in most years could increase winter accident potential if they left the refuge.

Fewer elk in the park would lower the potential for accidents in the summer and fall, although elk could stay in the park longer as a result of smaller hunt areas, partially offsetting the decreased accident potential.

The potential for accidents caused by bison in the summer would likely remain similar to baseline conditions and lower than under Alternative 1. Bison hunting on the refuge could increase the potential for traffic accidents if bison increased their movements to avoid hunters.

Potential human encounters with elk and bison under Alternative 3 could increase in the winter due to reduced winter feeding and wider and bison distribution. Potential for encounters with elk in the summer would likely be lower than any other alternative because of fewer elk in the park, although closing hunt areas in the southern part of the park and the northern portion of the refuge could increase potential encounters in the fall. The potential for bison encounters in summer would remain similar to baseline conditions but would likely be lower than under Alternative 1 because the herd would not be allowed to grow.

Under Alternative 3 the potential for elk hunting accidents would decrease on the refuge and in the park. The potential for hunting accidents in the national forest could increase because of slightly more hunters.

Implementing bison hunting on the refuge would increase the potential for hunting accidents.

The prevalence of brucellosis and the potential prevalence of other diseases would be lower than under Alternative 1 but not as low as under Alternatives 2 and 6. A reduced elk hunt under Alternative 3 would lower the transmission risk compared to Alternative 1. If a brucellosis vaccination program (with efficacy of 50% or better) was implemented, transmission risk would be decreased further. If introduced, bovine tuberculosis, paratuberculosis, or chronic wasting disease, potential risk of transmission to humans would be low (although not as low as under Alternatives 2 and 6) because of reduced winter feeding and fewer elk on the refuge.

ALTERNATIVE 4

Analysis

Traffic Accidents Caused by Bison and Elk

The potential for traffic accidents caused by elk in winter under the Alternative 4 could increase compared to Alternative 1, but less than under Alternative 2 because winter feeding would be reduced. This would cause animals to rely more on standing forage, potentially increasing distribution and the potential for traffic accidents. However, greater forage production on the refuge would partially offset the need to search outside the refuge for forage. Fewer elk (approximately 5,000 compared to an estimated average of 5,600 and a maximum of 7,500 under Alternative 1) would winter on the refuge, and more elk would winter on native range outside the refuge and the park, raising the potential for accidents in other areas.

In summer the potential for traffic accidents caused by elk in the park would decrease because of fewer elk (an estimated 1,600 compared to approximately 2,500 under Alternative 1).

In winter the potential number of traffic accidents caused by bison could increase somewhat from low existing levels. Even though bison numbers would be lower (about 500 compared to 1,000 or more at baseline levels and possibly 2,000+ under Alternative 1) and forage production on the refuge would be increased, less winter feeding would encourage bison to search for forage in some non-feeding years. However, it is likely that a smaller bison herd could subsist on standing forage on the refuge and that their movements and distribution would remain similar to baseline conditions.

In summer the potential for traffic accidents caused by bison could remain similar to baseline conditions (although bison numbers would be lower) and less than under Alternative 1. Bison hunting on the refuge in the fall could increase accident potential if animals increased their movements to avoid hunters.

Human Encounters with Elk and Bison

The number of potential winter encounters with elk and bison under Alternative 4 could increase due to fewer years of winter feeding on the refuge, increased reliance on standing forage, and increased elk and bison distribution compared to Alternative 1, but potential increases would not be as great as under Alternative 2. Potential summer encounters with elk would decrease because fewer elk would be present in the park.

Bison hunting on the refuge could increase the potential for encounters with bison in the fall if bison increased their movements to avoid hunters.

Hunting Accidents

Reduced numbers of elk to be harvested under Alternative 4 would lower the potential for hunting accidents. However, the potential for accidents in the national forest would be moderately higher.

Implementing bison hunting on the refuge would increase hunter numbers and the potential for hunting accidents. Initially, hunters would need to harvest an estimated 100 bison annually, which would decrease to an average of 21 annually in the long term.

Disease Transmission to Humans

Brucellosis

In the short term there would be no impact on the risk of brucellosis transmission with or without a vaccination program under Alternative 4. In the long term using Strain 19 to vaccinate elk and RB51 to vaccinate bison on the refuge would lower the risk of disease transmission. If a more effective vaccine was found and used, transmission risk would be further reduced. In addition, the risk of transmission to hunters would be lower because of reduced harvest numbers. Although the number of elk harvested in the national forest would be somewhat higher than under Alternative 1, the risk of transmission would continue to be lower because of reduced prevalence.

Because bison hunting would increase direct contact by humans, the transmission risk under Alternative 4 would likely be higher than under Alternative 1. In the absence of a vaccination program, the transmission risk would be higher by a minor degree. It is possible that a vaccination program could increase the potential for transmission to humans compared to Alternative 1 if direct handling of animals was required. If remote methods of vaccine delivery were used, there would be no risk to humans.

Bovine Tuberculosis and Paratuberculosis

As described for the other alternatives, the following analysis discusses the risk of disease transmission if either tuberculosis or paratuberculosis became established in the Jackson herds. Under Alternative 4 the risk of transmission to humans would be lower by a minor to moderate amount compared to Alternative 1 because the number of animals would be reduced. Cutting back the feeding program would also reduce risk to personnel on the refuge. Potential prevalence would likely be greater than under Alternatives 3, 2, and 6 but less than under the Alternatives 1 and 5.

The risk of transmission to hunters would be lower under Alternative 4 because fewer animals would be harvested. Although moderate increases in the number harvested in the national forest compared to Alternative 1 would increase the risk of transmission to hunters, reduced prevalence under this alternative would decrease the risk.

The prevalence of these diseases in the bison herd under Alternative 4 would likely be intermediate among the alternatives because winter feeding would counteract the benefits of reduced numbers, similar to Alternative 3. Transmission risk would be somewhat higher than under Alternative 1 because of bison hunting. If bison were vaccinated for brucellosis by hand, the transmission risk would be increased by a moderate amount because of direct contact with live bison.

Any risk that humans could contract either disease during winter feeding would be reduced with less frequent feeding over the long term.

Conclusion

In winter the potential for traffic accidents caused by elk and bison under the Alternative 4 could increase compared to low baseline levels and Alternative 1 because of reduced winter feeding, but not to the same degree as Alternatives 2, 3, and 6. With enhanced forage production on the refuge more animals would be able to remain on the refuge rather than move elsewhere, reducing the accident potential. In the long term fewer elk and bison wintering on the refuge would raise the potential for accidents elsewhere.

In summer the potential for traffic accidents caused by elk in the park could be lower compared to baseline conditions and Alternative 1 because of fewer elk. The potential for traffic accidents caused by bison could remain similar to baseline conditions (although there would be fewer bison) and less than under Alternative 1. Bison hunting on the refuge in the fall could cause more accidents if bison increased their movements to avoid hunters.

Potential human encounters with elk and bison in the summer could decrease compared to baseline conditions and Alternative 1 due to fewer elk summering in the park and a smaller bison herd. Bison hunting on the refuge could increase the potential for encounters in the fall if bison traveled farther to avoid hunters.

The potential for elk hunting accidents under Alternative 4 would decrease over the long term because of lower hunting quotas. The potential for elk hunting accidents in the national forest would be somewhat higher. Implementing bison hunting

on the refuge would increase the potential for hunting accidents.

Smaller elk and bison herds would reduce the prevalence of brucellosis and other infectious diseases, with an intermediate risk compared to other alternatives (higher than Alternatives 2, 3, and 6, but lower than Alternatives 1 and 5). Any risk that humans could contract bovine tuberculosis or paratuberculosis during winter feeding would be reduced somewhat with less intensive feeding.

ALTERNATIVE 5

Analysis

Traffic Accidents Caused by Bison and Elk

In winter the potential for traffic accidents caused by elk and bison under Alternative 5 would remain similar to Alternative 1. The feeding program would continue to restrict elk and bison distribution to the refuge during winter.

In summer the potential for traffic accidents caused by elk would remain similar to Alternative 1 or decrease slightly in some areas. Although bison movements and summer distribution would likely remain similar to Alternative 1, the potential for traffic accidents could be lower because fewer bison would be present under Alternative 5. The potential for accidents in the fall could also be lower. Bison hunting on the refuge could partially offset these decreases if bison increase their movements to avoid hunters.

Human Encounters with Elk and Bison

In winter the number of potential encounters with elk and bison under Alternative 5 would remain similar to Alternative 1 as a result of continuing the feeding program, which would encourage elk and bison to stay on the refuge.

In summer potential encounters with elk would be similar or decrease slightly compared to Alternative 1. Although bison movements and summer and spring distribution would likely remain similar to baseline conditions and Alternative 1, fewer bison could decrease the potential for encounters. Bison hunting on the refuge could cause bison to

alter their movements in the fall, somewhat increasing the potential for encounters.

Hunting Accidents

Reduced hunting quotas could decrease the potential for elk hunting accidents on the refuge and in the park. The accident potential in the national forest could be higher because of more elk hunters in these areas.

Implementing bison hunting on the refuge would increase hunter numbers and the potential for accidents. The number of bison hunters would be somewhat higher than the estimated number of bison that would need to be harvested. For the first few years hunters would need to harvest an estimated 100 bison annually on the refuge, but over the long term this would decrease to an estimated average of 10 annually.

Disease Transmission to Humans

Brucellosis

The risk for transmission of brucellosis from elk to humans would continue to be very low. Vaccinating elk with Strain 19 or a more efficacious vaccination on the refuge would lower the prevalence of the disease and the risk of transmission. The risk of transmission to hunters on the refuge and in the park would also be reduced because fewer elk would be harvested in these areas and disease prevalence would be lower. The risk of transmission to hunters in the national forest would likewise be lower.

The risk for brucellosis transmission from bison would be higher by a minor amount due to bison hunting on the refuge compared to Alternative 1 and similar to Alternatives 3, 4, and 6. This higher risk would be reduced to negligible in the long term if a vaccination program successfully reduced disease prevalence in bison. A vaccination program could increase the potential for transmission to humans if direct handling of animals was required. If remote methods of vaccine delivery were used, there would be no risk to humans.

Bovine Tuberculosis and Paratuberculosis

As described for the other alternatives, the following analysis discusses the risk of disease

transmission if either tuberculosis or paratuberculosis became established in the Jackson herds. Potential prevalence of bovine tuberculosis or paratuberculosis in the Jackson elk herd under Alternative 5 would likely be less than under Alternative 1. Although elk numbers and the winter feeding program would be similar under both alternatives, disease prevalence in elk wintering on the refuge would likely be higher under Alternative 1 due to a much larger bison herd. The risk of transmission to hunters on the refuge and in the park would be lower because fewer elk would be harvested in these areas, and disease prevalence could be somewhat lower. Risk of transmission to hunters in the national forest would be lower for the same reasons.

Implementing bison hunting on the refuge would increase the potential risk of transmission to humans by a minor amount. However, because disease prevalence in bison would likely be lower because of fewer bison, the risk of transmission would only be negligibly higher. If bison were vaccinated by hand, the risk of transmission would be moderately higher compared to Alternative 1 because of direct human contact. The possibility of humans contracting either disease during winter feeding operations would be similar to Alternative 1.

Conclusion

The potential for winter traffic accidents caused by elk and bison under Alternative 5 would likely remain similar to baseline conditions and Alternative 1 because of the nearly annual winter feeding program and similar numbers of elk and fewer bison. As a result of the feeding program, elk and bison distribution would likely be restricted to the refuge during winter.

The potential for summer traffic accidents would be similar or could decrease in some areas because of slightly fewer elk and bison. However, bison hunting on the refuge could increase the potential if bison increased their movements to avoid hunters.

The number of potential encounters with elk and bison in the winter would likely remain similar to baseline conditions and Alternative 1 because of the feeding program. Potential summer encounters with elk could decrease if there were fewer

elk in the park. Fewer bison in all seasons would decrease potential encounters.

Lower elk hunting quotas on the refuge and in the park would reduce the potential for hunting accidents by a minor amount compared to Alternative 1. Potential hunting accidents in the national forest would be slightly higher. Bison hunting on the refuge would increase the potential for hunting accidents under Alternative 5.

The risk of disease transmission to humans would be lower than under Alternative 1, and higher than under the other alternatives. Reduced levels of brucellosis prevalence due to vaccination, lower potential prevalence of the other non-endemic diseases if herd infection occurred, and fewer elk harvested under Alternative 5 would reduce transmission risk. Transmission risk in the national forest could be slightly higher because of more elk hunters. The low risk of humans contracting bovine tuberculosis or paratuberculosis during winter feeding operations would be similar to Alternative 1.

ALTERNATIVE 6

Analysis

Traffic Accidents Caused by Bison and Elk

Similar to Alternative 2, the potential for traffic accidents caused by elk under Alternative 6 could increase in the winter compared to existing conditions and Alternative 1 due to eliminating the refuge winter feeding program. Elk numbers wintering on the refuge would be reduced from a maximum of 7,500 to 1,200–3,200 in the long term. Eliminating supplemental feeding and forcing reliance on standing forage would increase elk movements and the potential for accidents.

The potential for traffic accidents caused by elk in summer in the park would decrease because fewer elk would be present. Elk numbers would range from an estimated 600–1,300 in the short term to 600–1,500 in the long term compared to approximately 2,500 under Alternative 1.

The potential closure of hunt areas in the Blacktail Butte / Kelly hayfields area of the park and the northern portion of the refuge in the long term could alter elk movements and distribution in the fall and possibly the potential for traffic

accidents. As under Alternative 3, elk would likely spend more time in former hunt areas and move more rarely at night, decreasing the potential for traffic accidents. However, more elk in the park for a longer period of time and the continued possibility of accidents would offset this decrease.

Similar to Alternative 2 but to a lesser extent, the potential for traffic accidents caused by elk wintering on and near the refuge could increase in some years because of wider distribution as they searched for standing forage. But increased forage production on the refuge would help reduce movements and accident potential.

The number of traffic accidents caused by bison could increase to some extent from baseline levels because winter feeding would not occur on the refuge. The herd, on average about 500 animals, would increase their winter movements as animals searched for additional forage in some years.

If the fence along the southern and western boundaries of the refuge was removed so elk and bison could more easily leave the refuge to find alternate sources of forage, the potential for traffic accidents would increase in some years, similar to Alternative 2, but the potential would be lower due to greater forage production on the refuge.

Human Encounters with Elk and Bison

Eliminating the refuge winter feeding program could increase human encounters with elk and bison as they searched larger areas for standing forage, particularly in severe winters.

If the refuge fence was removed, encounters could increase in some years because of movements into the town of Jackson and across highways and busy roads.

Potential encounters with elk and bison in the summer could decrease compared to baseline conditions and Alternative 1 because fewer elk and bison would be present in the park and the national forest.

Potentially closing hunt areas in the Blacktail Butte / Kelly hayfields area of the park and the northern portion of the refuge could increase the potential for human encounters in the fall because

more elk could remain in the park in former hunt areas.

Fewer bison could decrease the potential for human encounters in the summer and fall. But bison hunting on the refuge could partially offset these decreases if bison increased their movements to avoid hunters.

Hunting Accidents

Over the long term the potential for elk hunting accidents could decrease on the refuge and in the park because of reduced harvest levels and fewer hunters. The potential for hunting accidents in the national forest could increase because the estimated number of elk hunters in areas outside the refuge and the park would be slightly higher.

Implementing bison hunting on the refuge would increase the potential for hunting accidents. The number of bison hunters would likely be somewhat higher than the number of bison to be harvested. In the first few years an estimated 150 bison would be harvested annually on the refuge, plus 50 in the forest. This would decrease in the long term to an average of 10 animals annually. No bison hunting would occur in the park.

Disease Transmission to Humans

Brucellosis

Brucellosis prevalence in elk would be similar to Alternative 2 because of the gradual elimination of the winter feeding program. However, the transmission risk under Alternative 6 would likely be lower because fewer elk would be harvested. Transmission risk in the national forest could also be lower.

Transmission risk of brucellosis from bison under Alternative 6 would increase with a bison hunt on the refuge. This risk could be reduced to negligible with a vaccination program (the vaccine would have to have 50% efficacy or better). If direct handling of animals was required for vaccination, the risk of transmission would increase. If remote methods of vaccine delivery were used, there would be no risk to humans.

Bovine Tuberculosis and Paratuberculosis

As described for the other alternatives, the following analysis discusses the risk of disease transmission if either tuberculosis or paratuberculosis became established in the Jackson herds. Transmission risk under Alternative 6 would be lower than under Alternative 1 because of lower numbers of elk and bison, no winter feeding, and increased dispersal. Also, lowering the number of elk harvested on the refuge and in the park and national forest would reduce the risk to hunters. Eliminating the winter feeding program would stop any risk that humans could contract these diseases through close contact with elk and bison.

Conclusion

Similar to Alternative 2, the potential for traffic accidents caused by elk and bison under Alternative 6 could increase in the winter due to the elimination of the winter feeding program, forcing animals to increase their movements and distribution in some years as they searched for forage. Possible removal of the refuge boundary fence could also increase the potential for traffic accidents. However, greater forage production on the refuge would alleviate the need for animals to search extensively.

The potential for traffic accidents caused by elk summering in the park could decrease with fewer elk. In the fall possibly closing hunt areas in the southern part of the park and the northern portion of the refuge could lower the potential for accidents during the time that elk are moving into safe areas; but if more elk stayed in the park for a longer period, the possibility of accidents in the park could offset this decrease.

Stopping winter feeding could increase the potential for human encounters with elk and bison as animals searched for forage over a wider area, particularly in severe winters, similar to Alternative 2. However, greater forage production on the refuge and lower elk and bison numbers in some years, would reduce the potential. If the refuge fence was removed, encounters in the town of Jackson and elsewhere could increase.

Potential encounters with elk and bison in summer and fall could decrease because of fewer elk and bison in the park. But encounters in fall could

increase if hunt areas in the southern part of the park and the northern portion of the refuge were closed, and more elk remained in the park in former hunt areas rather than moving quickly to safe areas.

The potential for elk hunting accidents would be lower on the refuge and in the park compared to Alternative 1 because of fewer hunters and reduced hunting quotas. The potential for hunting accidents in the national forest could increase because of slightly more hunters.

Implementing bison hunting on the refuge would increase the potential for hunting accidents on the refuge and possibly in the national forest. No bison hunting would occur in the park.

The potential risk of disease transmission to humans would be lower under Alternative 6 compared to all alternatives except for Alternative 2 due to the elimination of winter feeding concentrations and fewer elk and bison. A brucellosis vaccination program could further decrease the transmission risk. Because hunting would occur on the refuge and the elk herd reduction program in the park under Alternative 6, the risk of disease transmission would be higher than under Alternative 2. Transmission risk in the national forest would also be lower for the same reasons. Stopping winter feeding would eliminate any risk that humans could contract diseases during feeding operations.

MITIGATION

Guidelines that encourage hunters not to take animals that appear sick, to report any animals that appear sick, and to wear rubber or latex gloves when field dressing game animals would reduce the risk of hunters becoming infected by any diseases.

If it was determined that humans could contract chronic wasting disease from wild ungulates, extreme precautions would be taken to avoid infection. Currently, people hunting in disease-infected herds are encouraged to reduce their risk of infection by (1) not harvesting an animal that appears to be sick, (2) using rubber gloves when field dressing an animal, (3) avoiding contact with the brain and spinal cord tissue, (4) thoroughly wash-

ing hands and knives, and (5) deboning meat from the carcass (Williams et al. 2002). If these precautions were taken, the risk to people who harvest animals in chronic wasting disease infected areas would be minimized.

CUMULATIVE EFFECTS

TRANSPORTATION IMPROVEMENTS

The reconstruction of 38 miles of U.S. 26/287 (Togwotee Pass) could increase the number of human injuries due to vehicle collisions with wildlife as traffic volume grows. Upgrading the highway would allow some drivers to exceed the speed limit more easily than occurs now. Special design features to reduce the potential for vehicle collisions with wildlife include oversized culverts, wildlife underpasses, and seasonal speed restrictions. It is anticipated that effects on human safety would be minimal.

Alternatives 1 and 5 would not result in additional cumulative effects because wildlife distribution, seasonal movements, and mortality rates would remain similar to baseline conditions. Under Alternatives 2, 3, and 6, and to a lesser degree under Alternative 4, elk would increase their winter distribution while on native range and more collisions could occur.

Grand Teton National Park Recreation Infrastructure Improvements

The proposed use of transit and pathways to serve visitor transportation and access needs could result in fewer vehicles on the roads and decreased potential for collisions with elk or bison in the park. Improved human access to parts of the park could increase the potential for encounters with wildlife. The proposed multi-use trail from Moose to the north Jenny Lake junction could attract additional recreationists along the Snake River corridor during the summer and possible cross-country skiers in the winter. The construction phase would result in site-specific, temporary impacts along planned trail routes during the summer and an increased potential for human/wildlife encounters in the short term.

Any future improvements to the Gros Ventre campground would result in site-specific, tempo-

rary impacts during construction, resulting in a minor increase in the number of summer campers. These improvements would potentially increase human encounters with wildlife.

Alternatives 1 and 5, in addition to the effects of Grand Teton infrastructure improvements, would not result in cumulative effects. Increased human presence in parts of the park under Alternatives 2–6 during conversion of formerly cultivated areas to native vegetation could increase encounters between humans and elk.

It is possible that the elimination of the elk reduction program in the park under Alternative 2 could result in more elk remaining in the southern portion of the park, increasing the potential for human/elk encounters or vehicle collisions. Closing the Antelope Flats / Blacktail Butte elk reduction area in the park under Alternative 3, and potentially under Alternative 6, could result in this effect but to a lesser extent. Also, because fewer elk would be present in the park during the summer under these alternatives than under Alternatives 1, 4, and 5, encounters and collisions might not increase.

FEDERAL LAND MANAGEMENT ACTIVITIES

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 collisions with elk or bison would be less likely, and the potential for human injuries would be reduced. Professional guides would be trained in how to avoid causing wildlife displacement or stress, and they would be familiar with likely wildlife locations along the road system.

No changes in the number of vehicle collisions with wildlife on lands outside the parks are anticipated. Because the selected alternative would allow a number of snowmobiles into the parks that are near the historical average daily visitation, it would be unlikely to result in significant visitor displacement to surrounding federal, state, or county land, except during high use periods (Christmas week and Presidents Day weekend).

Alternatives 1 and 5, as well as Alternative 4 based on adaptive management, would not result in cumulative impacts to elk from planned winter use activities. Alternatives 2, 3, and 6, as well as Alternative 4 in some years, would increase the number of elk on native winter range, with a greater potential for elk/human conflicts and displacements of elk from winter habitat. Winter closures in areas designated as crucial elk winter range would continue to prevent potential encounters and collisions.

Bridger-Teton National Forest Travel Management Plan Updates / Moose-Gypsum Projects

The proposed projects in the secondary analysis area would increase off highway vehicle trail opportunities and the potential for human/wildlife encounters. No additional cumulative effects would result from any of the bison and elk management alternatives.

The dispersed recreation camping site element of the Moose-Gypsum projects includes establishing new campsites while closing some campsites that are in sensitive areas, such as next to stream and river banks. Establishing new campsites could increase the potential for human/elk interactions in the short term, while closing other sites would decrease interactions in the long term, particularly in sensitive wildlife areas. Cumulative effects from the bison and elk management alternatives would not occur.

BLM Snake River Resource Management Plan

Increases in public access or use in areas of sensitive wildlife habitats could result in adverse human/wildlife interactions. While signing or efforts to make the public aware of wildlife issues could help reduce conflicts, the potential for impacts would remain. Maintaining public access to the parcels would continue to increase human/wildlife interactions. Seasonal closures or restrictions would minimize adverse impacts. Cumulative effects would not be expected to occur under Alternatives 1 and 5. Alternatives 2, 3, and 6, as well as Alternative 4 in some years, would increase elk distribution and the potential for disturbance due to human encounters.

BLM Upper Green River Special Recreation Management Area Recreation Project Plan

The proposed *Recreation Project Plan* would be within the secondary analysis area and could contribute to slight increases in human/elk interactions. Campsite relocation would be relatively close to existing facilities, minimizing the expansion of human activity.

No alternatives would result in cumulative effects that could be expected to increase human wildlife encounters with Jackson elk in these areas. Although some elk could potentially move into the upper Green River area to winter under Alternatives 2, 3, and possibly 6, these animals would not be expected to remain in other seasons.

POPULATION GROWTH AND PRIVATE LAND DEVELOPMENT

Primary Analysis Area

Projected population increases in both Teton and Sublette counties and potential private land development in these areas could lead to more human/wildlife encounters and vehicle collisions with wildlife.

Alternatives 1 and 5, as well as Alternative 4 (based on adaptive management), would not result

in cumulative effects with private land development because supplemental feeding would keep elk and bison on the refuge. Under Alternatives 2, 3, 4, and 6 elk distribution would likely be increased in some or all years, and more human/wildlife encounters could be expected due to human population growth and development.

Additional development of the private parcels along the Gros Ventre River could affect the movement of elk between Jackson Hole and existing feedgrounds to the east. Under Alternatives 2, 3, and potentially 6, this corridor would also support the movement of elk between Jackson Hole and the upper Green River basin to the southeast, and there would be greater potential for human/elk encounters and vehicle collisions with elk.

Secondary Analysis Area

Within the secondary analysis area in Sublette County, ongoing and future subdivision and development of agricultural lands could increase human/elk encounters and vehicle collisions with elk. Development or activities in these areas would not affect Jackson elk under Alternatives 1, 4, and 5 because elk movements and distribution either would not increase from current distribution (Alternatives 1 and 5) or would increase to a limited extent in some years (Alternative 4).

SOCIAL AND ECONOMIC IMPACTS

IMPACTS ON RECREATIONAL OPPORTUNITIES

Hunting, wildlife viewing and photography, and environmental education and interpretation are five of the six priority public uses of the National Wildlife Refuge System and opportunities for all of these activities are provided on the National Elk Refuge. Providing opportunities for people to view and photograph natural features of the landscape and wildlife, and to learn about nature and cultural resources is also an important part of national parks, and many opportunities are provided in Grand Teton National Park. In some years in the park hunters are deputized to help manage the elk herd when biologists determine it is necessary as a wildlife management tool, and any associated recreational opportunities are a byproduct. Changes in elk and bison management on the refuge and in the park could affect the need for this management activity and perceived recreational opportunities associated with it.

Changes in elk and bison management on the refuge and in the park could potentially affect recreational opportunities in the Bridger-Teton National Forest, possibly including the Pinedale and Big Piney ranger districts (Alternatives 2, 3, and 6), and on private lands in the Jackson Hole area. Alternatives 2 and 3 could also affect recreational opportunities on BLM, other federal and state lands, and private lands in the Green River basin.

WILDLIFE VIEWING AND ENVIRONMENTAL EDUCATION OPPORTUNITIES

Methodology for Analyzing Impacts

The evaluation of potential effects of elk and bison management on wildlife viewing and environmental education opportunities relied heavily on the results of a visitor survey conducted in 2002 by Loomis and Koontz (2004), but assessments based on other surveys, monitoring data, and recreation specialists were also used.

The 2002 visitor survey focused on visitor groups (wildlife viewers) who could be affected by bison and elk management actions — sleigh ride visitors

on the refuge and summer visitors in Grand Teton National Park. Visitors were asked if they would change the number of trips they would make to the refuge or park if a particular management scenario was implemented. These changes in trip responses were applied to the reported current refuge/park annual visitation to develop an average percentage change in visitation. The changes in number of trips and visitor days under each alternative were then calculated.

Alternatives for managing elk and bison on the refuge and in the park would likely not result in measurable changes in the number of people visiting Grand Teton National Park during summer months. From 1992 to 2001 bison numbers nearly tripled, from about 150 to almost 550, but there was no corresponding increase in summer visitors in the park.

As with bison, most of the changes in elk numbers occurred when visitor numbers in the park were fairly constant (e.g., 1984–89 and 1996–2002). During these two periods, visitor numbers fluctuated somewhat, but there were no increasing or decreasing trends, in contrast to major increases and declines in elk numbers on the refuge.

There is no indication that potential visitors base a decision to visit Grand Teton National Park, Yellowstone National Park, and other destinations on elk numbers in Jackson Hole. However, the visitor survey suggests that visitation to Grand Teton National Park could be measurably affected by a moderate to major change in elk and bison numbers (Loomis and Koontz 2004). Therefore, potential reductions in visitation are included as “worst-case” scenarios to address this possibility.

Impacts of the Alternatives

Impacts Common to All Alternatives

Under baseline conditions, there would be an average of 93,394 visits to the National Elk Refuge for recreational activities, including an average of about 30,000 visits by people walking, hiking, jogging, and biking on refuge roads. Because these

TABLE 4-7: ESTIMATED VISITATION — NATIONAL ELK REFUGE AND GRAND TETON NATIONAL PARK

	Baseline Conditions	Alternative 1	Alternatives 2, 3, and 6	Alternative 4	Alternative 5
Total Sleigh Ride Visitation	24,367/year	No change	41%–100% reduction	29%–100% reduction	No change ¹
Park Visitation (May-October)	2,349,069/year	No change	No change ²	No change	No change

1. Survey results indicate up to a 14% increase in sleigh ride visitation for Alternative 5. However, elk would not change appreciably, and this would be the only factor that could affect sleigh ride visitation under the alternatives.

2. As explained in the methodology section, it is likely that May-October visitation to Grand Teton National Park would not measurably change under any of the alternatives.

visits are likely not influenced to any large degree by the numbers of elk and bison and management activities, numbers would likely not change among alternatives.

For the alternatives that include elk and bison hunting, these activities would not be observable by most refuge visitors during the hunting season because hunting occurs well away from the highway and other major roads and in the early morning. Therefore, there would be little difference among the alternatives in the ability of visitors to see hunting activities, including Alternative 1 (which includes no bison hunting) and Alternative 2 (which includes no elk or bison hunting).

Alternative 1

Analysis

National Elk Refuge — Under existing conditions an estimated 440,000 people annually use vehicle turnouts along U.S. 26/89 to observe elk and other wildlife, an average of 24,367 visitors (including an estimated 22,320 from outside the local area) participate in sleigh rides, and about 2,000 people take part in other environmental education activities conducted by refuge personnel. These numbers of visitors and visits represent baseline conditions and would continue under Alternative 1.

The quality of the viewing experience on sleigh rides would be similar to the recent past. From mid-December until winter feeding operations begin and after winter feeding operations end until the beginning of April (approximately 45 days each year), viewing opportunities vary from day to day and throughout the day. Typically, there are 500–2,000 elk in the viewing area early and late in the season. During feeding operations (about 70 days per year) approximately 1,000–2,000 elk are typically present in the sleigh ride touring area, and large numbers of elk are consistently viewable at close range. On the rare days

when no elk are present in the sleigh ride touring area, sleigh rides might be canceled.

Continued increases in the number of bison on the refuge would affect viewing opportunities in at least two ways. In the short term, bison viewing opportunities on the refuge would be limited for most visitors because most to nearly all of the bison occupy the McBride and Poverty Flats areas and the Gros Ventre Hills, which cannot be seen from the highway or the main refuge road. Over the long term bison viewing opportunities on the refuge could increase with a larger bison population that roams over a wider area.

If a non-endemic infectious disease became established in the Jackson elk and/or bison herds under Alternative 1, disease-caused population declines would reduce viewing opportunities. For some parts of the Jackson Hole area, the declines could be more severe because artificially high concentrations of animals due to winter feeding would allow a disease to spread faster. Therefore, the overall decline in elk numbers would likely be more severe than under Alternative 1 than under Alternatives 2, 3, and 6. If winter feeding on the refuge was greatly reduced (with or without concurrent depopulation efforts), sleigh rides might have to be canceled. Any introduction of a disease transmissible to bison (e.g., bovine tuberculosis) would not affect bison viewing opportunities under this alternative because they are not viewable to any large degree now.

Grand Teton National Park — Under baseline conditions about 92% of the visits to Grand Teton National Park, or 2,163,493 visits, are by nonlocal visitors. It is assumed that under Alternative 1 visitation would not differ measurably from baseline conditions in the short or long term.

Despite more elk than bison in the park under baseline conditions, bison provide better viewing opportunities because they congregate in areas

along major roadways, and large numbers of bison are commonly seen at the Elk Ranch, Antelope Flats, and Kelly hayfields areas throughout the spring, summer, and fall. Under Alternative 1 a growing bison population would not create any additional viewing opportunities.

In contrast to bison, elk are more solitary and viewing opportunities would continue to be much more limited. Relatively few visitors see elk in the park, and this would continue under Alternative 1. Two exceptions are in the spring when large numbers of elk move northward and northwestward from the refuge and in the fall when bull elk are bugling and gathering and defending harems. However, even during these limited periods, elk are not nearly as viewable as bison.

Hunting would continue to detract from the viewing experience of some fall visitors not accustomed to seeing hunters or hunting in a national park.

Elk and bison viewing opportunities in the park would decline if a non-endemic disease became established under Alternative 1. If a disease was introduced that affected bison (e.g., bovine tuberculosis, paratuberculosis), viewing opportunities in the park could decline over time. If elk became infected with chronic wasting disease, viewing opportunities during the spring migration and fall rut could decline substantially in localized areas, although this would affect relatively few park visitors.

Other Areas — Seeing wildlife, especially large species, is an important part of the outdoor experience for nearly half of the people recreating in Bridger-Teton National Forest and the southern part of Yellowstone National Park. Alternative 1 would not change the quality of the outdoor experiences of people horseback riding, hiking, backpacking, wildlife viewing, fishing, camping, gathering berries, and engaged in other outdoor recreational activities in the national forest and Yellowstone National Park.

Recreational use in the national forest increased by 92% from 1985 to 1996 (from about 1.9 million visitor-days to 3.6 million visitor-days), and this trend would continue under Alternative 1. Total use estimates (as opposed to visitor days) track well with this information; in 2002, the national

forest's estimated total use was approximately 3 million visits.

As stated in Chapter 3, nearly half of the forest's 3 million annual visitors a year enjoy seeing wildlife, but it is only one of many activities they participate in. Only 2% (about 60,000 people) said that viewing wildlife was the primary reason for visiting the national forest. Under Alternative 1 wildlife viewing and hunting opportunities would not be expected to change.

Elk and bison viewing opportunities also exist on private lands, but opportunities are more limited.

Wildlife viewing trends described for Bridger-Teton National Forest would also apply to areas south of Jackson and to the Pinedale and Big Piney ranger districts of the national forest. South of Jackson and in the lower Hoback River drainage, elk can occasionally be seen during migration and on south and west-facing slopes during winter. Throughout most of the Green River basin and the Red Desert elk viewing opportunities are very limited or non-existent.

Conclusion

Under Alternative 1 about the same number of people (about 24,367 people per year) would continue to participate in sleigh rides on the refuge each year. An abundance of elk would be observable each day during a large part of each winter due to continued supplemental feeding. Bison would not be observable to most visitors.

Elk would continue to be readily observable in some park areas during the fall rut and spring migration, but most park visitors from May through October would not see elk. There would be an abundance of bison viewing opportunities, and they would continue to increase. No changes to park visitation numbers are expected.

Alternatives 2, 3, and 6

Analysis

National Elk Refuge — It is estimated that under Alternatives 2, 3, and 6 up to 2,400 elk would be viewable on the refuge within the sleigh ride touring area (an average of an estimated 700 elk). However, under these alternatives the number of

days when no elk are present in the viewing area could be substantially higher than under Alternative 1.

A major reduction in the number of elk wintering on the refuge over the long term could result in a decline in the number of people participating in sleigh rides by 41%. The decrease in sleigh rides in 2002–3, when use fell by 32% because of mild winter conditions and low numbers of elk in the viewing area, could indicate use levels without supplemental feeding.

It is also possible that the inconsistency and unpredictability of elk presence in the sleigh ride touring area could shorten the sleigh ride season or force its cancellation. On days when sleigh rides were offered, the quality of the viewing experience would be similar to what is experienced by visitors now before winter feeding begins and after it has stopped.

Reducing sleigh rides or stopping them altogether would reduce environmental education opportunities for an estimated 225 visitors per day, compared to Alternative 1. If sleigh ride operations ceased altogether, a total of 24,367 visitors would be affected.

For some people stopping along U.S. 26/89 to view elk, the absence of elk or very few elk would adversely affect their experiences. However, for other people the experience might be better because the sight of elk would be more natural without supplemental feeding. Bison could be viewable at close to moderate distances on some days.

If vaccination activities were conducted on the feedlines during years when elk were fed under Alternatives 3 and 6, elk in the Nowlin area could be disturbed to the point that they would leave the area, which could also adversely impact the sleigh ride operation and recreational opportunities. Under Alternative 3 a reduced winter feeding program (2–3 of every 10 winters) could make elk more likely to leave the feeding area if attempts were made to remotely vaccinate elk and bison.

If large numbers of elk began migrating to the Green River basin and the Red Desert, the number of elk wintering on the refuge would result in additional adverse effects on viewing opportuni-

ties and would increase the probability that sleigh ride operations would be discontinued.

Under Alternative 2 stopping hunting would potentially increase elk viewing opportunities on the refuge because elk would no longer avoid hunting areas.

Under Alternative 3 potentially opening the southern end of the refuge to elk hunting could affect the viewing experiences of some people if elk were being killed near the highway. The effects would be negligible because hunting would occur early in the morning when traffic along the highway is light and relatively few nonlocal visitors are present. Over the long term elk hunting on the southern part of the refuge could adversely affect elk viewing opportunities on the day of the hunt and during the limited hunting season, and possibly beyond because elk would likely leave this part of the refuge on hunting days. Alternatively, opening the southern portion of the refuge to public recreation during the fall and not allowing hunting in this area would enhance opportunities for some visitors, although elk would still tend to avoid the presence of humans.

While winter feeding was being phased out under Alternatives 2 and 6 and reduced under Alternative 3, bison viewing opportunities on the refuge would continue to be limited for most visitors because nearly all bison occupy the McBride and Poverty Flats management areas and the Gros Ventre Hills, which are not easily seen from the highway or the main refuge road (similar to Alternative 1). Over the long term, viewing opportunities on the refuge would improve as bison roamed farther in search of forage. Despite lower numbers of bison, there could be more bison viewing opportunities due to the lack of winter feeding and increased difficulty of keeping bison farther north on the refuge. Another complicating factor in the long term would be the occasional or possibly common presence of bison in the sleigh ride touring area, which would increase visitor safety concerns.

If a non-endemic infectious disease became established in the Jackson elk and/or bison herds after winter feeding had been completely phased out (Alternatives 2 and 6), disease-caused declines would reduce viewing opportunities, but probably not to the extent of Alternatives 1, 4, and 5. De-

clines in elk numbers would likely occur more slowly because animals would not be artificially concentrated.

Grand Teton National Park — Elk numbers in the park would fluctuate much more widely than they do now, which could reduce the quality of outdoor experiences for a few people; most visitors from May through October, however, do not see elk now. In some years elk numbers would be similar to baseline conditions and Alternative 1, but in other years, they could drop below 600 (78% less than the baseline figure of 2,676 elk). Under Alternative 2 elk numbers would range between 500 and 1,000.

During many years large numbers of elk would continue to be observable for several weeks during the spring migration and the fall rut. In other years the number of migrating elk could be reduced by a moderate to major degree, affecting the quality of the experience for some people. Elk viewing opportunities during the fall migration from Blacktail Butte and the Kelly hayfields area south to the Gros Ventre River drainage could increase with the elimination of the elk reduction program in this area under Alternative 2 and potentially under Alternative 6. Also, the absence of hunters in the park would enhance the experience for some visitors. In the long term more elk from the Yellowstone and Teton Wilderness segments could migrate through the Blacktail Butte and Kelly hayfields area.

At present few if any potential visitors have inquired about elk numbers before visiting the park, and it is unlikely that changes in the park elk population would affect park visitation because most summer visitors do not see elk, and this does not affect their decision to visit.

Bison viewing opportunities could decrease in the park compared to baseline conditions due to an estimated 50%–75% decline in bison numbers under Alternative 2 and an estimated 50% decline under Alternative 6; the declines would be even greater in the long term when compared to Alternative 1. However, viewing opportunities would be similar to those in the late 1990s when about 250–490 bison summered in the park. Fewer bison would likely not affect visitation to any measurable degree because most visitors would not be aware of the change.

Bison viewing opportunities in the park under Alternative 3 would remain similar to baseline conditions. In the long term, however, fewer bison would be observable because reduced supplemental feeding would keep the herd from growing at the same rate as now.

While elk and bison viewing opportunities in the park would decline if a non-endemic disease became established under Alternatives 2, 3, and 6, they would likely not decline to the level that could occur under Alternative 1.

Other Areas — In the long term the number of elk summering in other elk herd segments (e.g., the Yellowstone, Teton Wilderness, and Gros Ventre segments) could be higher or lower than baseline conditions depending on the effects of winter weather on herd sizes. However, seeing elk is only part of the outdoor experience in these other areas, and other wildlife may be just as important as elk to visitor experiences. Fewer elk could reduce the experiences of some visitors, but it is unlikely that this would keep them from deciding to visit at all (Marsh, pers. comm. 2004), and overall effects on national forest visitors would be negligible.

In the long term elk and bison viewing opportunities during winter and early spring could potentially increase in the Jackson area outside the refuge and park, especially during above average and severe winters when elk and bison increased their distribution in search of forage.

Allowing elk to better use their native winter ranges through habitat manipulation in the national forest would also require careful management of recreational uses to prevent displacement, similar to current management of winter uses. For example, some areas in the Gros Ventre River drainage and Buffalo Valley are already closed, and visitors are required to stay on trails or within a defined corridor while passing through these areas.

If larger numbers of elk began wintering south of Jackson and in the lower Hoback River drainage, it is possible that elk viewing opportunities in these areas would increase. However, most of these elk could end up on a state feedground, offsetting any potential increases in viewing opportunities.

If large numbers of elk began migrating to the Green River basin and the Red Desert, elk viewing opportunities would likely increase in these areas in the winter and during fall and spring migrations, assuming that elk moved beyond the state feedgrounds. For some people, this could improve the quality of the outdoor experience, and it is possible that visitation could increase in areas where elk winter.

Conclusion

The number of people participating in sleigh rides on the refuge could potentially decline by up to 41% under Alternatives 2, 3, and 6. Elk viewing opportunities during winter on the refuge would become much more variable, with no elk within view on some days to well over 2,000 on other days. Consequently, sleigh ride operations could be discontinued due to the unpredictability of elk viewing opportunities. Bison viewing opportunities during winter would likely increase as bison expanded their search for forage, particularly in the southern portion of the refuge.

Based solely on the estimated reduction in elk numbers in Grand Teton National Park, elk viewing opportunities could decline. However, because relatively few visitors currently see elk in the park, reduced elk numbers would likely only affect a small percentage of visitors. Furthermore, eliminating the elk reduction program in the park under Alternative 2 and potentially under Alternative 6, and in the Blacktail Butte / Kelly hayfields area under Alternative 3, could in the long term increase viewing opportunities in these areas. Bison viewing opportunities during spring, summer, and fall would remain similar to baseline conditions. Bison viewing opportunities in the park during spring, summer, and fall could decline somewhat, but the reduction would be similar to levels in the late 1990s, and most visitors would not notice because large numbers of bison would continue to be viewable. It is unlikely that park visitation would change more than a negligible amount due to reductions in elk and bison numbers and changes/elimination of the herd reduction program.

Alternative 4

Analysis

National Elk Refuge — In the first few years elk and bison viewing opportunities on the refuge could change minimally, with the following potential changes. Similar to Alternative 3, possibly opening the southern end of the refuge to a limited elk hunt could directly detract from the viewing experience of some people. The overall level of direct effects would be negligible because hunting would only be allowed a few days a year and could occur early in the morning when traffic along the highway is light and relatively few nonlocal visitors are present.

As described for Alternative 3, hunting on the southern part of the refuge over the long term could adversely affect elk viewing opportunities during the limited hunting season. On hunting days elk would likely leave this part of the refuge. Elk that attempted to stay would probably be more wary of humans, including sleighs, and could remain farther from the highway. Elk migrating later in the season would not be affected to the same degree.

Conducting vaccinations with Strain 19 or another more effective vaccine in association with winter feeding activities could cause some or many elk to vacate the Nowlin feeding area in the short term. However, if the vaccine could be administered remotely through the use of biobullets or orally, there would be little or no disturbance of viewing opportunities.

In the long term the number of people participating in sleigh rides could decline by about 29% compared to baseline conditions (Loomis and Koontz 2004). It is estimated that up to 2,400 elk would be viewable within the sleigh ride touring area (an average of 700 elk), with a low chance of not seeing any elk on some days. When supplemental food was provided, several hundred to more than 1,000 elk would likely be present in the viewing area for about 70 days each winter. The number of days when no elk were present would be higher than under Alternative 1, but lower than under Alternatives 2 and 3. If there were no elk in the sleigh ride touring area on a particular day, sleigh ride operations would likely be halted, as described for Alternatives 2 and 3.

On days when sleigh rides were offered, the quality of the viewing experience would be similar to what visitors experience now. However, if or when no supplemental food was provided, elk would be more widely distributed and chances of no elk being in the sleigh ride touring area would be higher than under baseline conditions. Consequently, the quality of viewing experiences would be adversely affected to a major degree at times.

Reduced opportunities for viewing elk at close range and learning about elk and wildlife conservation could affect up to 225 people per day when no tours were offered. If the sleigh rides ceased completely, an estimated 17,879 visitors per year under this alternative would lose this recreational and educational opportunity.

For some people stopping along U.S. 26/89 to view elk, the absence of elk or very few elk on some winter days would adversely affect their experience more often than under Alternative 1 and less often than under Alternatives 2 and 3. However, for other people, the quality of the viewing experience could be better because elk would behave more naturally in the absence of supplemental feeding operations.

In the short term bison viewing opportunities on the refuge would continue to be limited because most bison inhabit areas that are not readily viewable from the highway or the main refuge road (similar to Alternative 1). Over the long term viewing opportunities on the refuge would likely increase as animals searched for forage, particularly during periods when supplemental feeding was not conducted. However, feeding bison would tend to keep them concentrated in feeding areas, reducing viewing opportunities in these years as compared to Alternatives 2 and 3. The occasional or possibly common presence of bison in the sleigh ride touring area during periods of no supplemental feeding could increase visitor safety concerns.

Using RB51 for bison would likely not affect viewing opportunities on the refuge because bison are not currently fed in areas that are readily seen by the public and this would not change.

Disease-caused declines in elk and/or bison numbers would reduce viewing opportunities, but possibly not to the extent of Alternatives 1 and 5. Declines in elk numbers might occur somewhat

more slowly and might not decline to the same level as under Alternatives 1 and 5.

Grand Teton National Park — A major reduction in elk numbers (from an estimated baseline of 2,676 to approximately 1,600) could result in fewer viewing opportunities for a minority of park visitors, potentially reducing the quality of the outdoor experience for some people. The adverse effects would be relatively minor because most visitors from May through October do not see elk. During most years, a moderate to large number of elk (but fewer than under baseline conditions and Alternative 1) would continue to be observable during spring and fall migrations, so viewing opportunities might not change substantially. Furthermore, although elk numbers would be lower than Alternative 1, bull-to-cow ratios could be higher, which means that opportunities for seeing and hearing bugling elk during the fall rut would not decline proportionally. Even with a major reduction in elk numbers, opportunities to see and hear elk during the fall rut would continue to be higher than opportunities in other areas in the Jackson elk herd unit due to hunting pressure.

Hunting in the park would continue to adversely affect the experiences of some visitors during the fall and early winter. Initially the number of elk harvested in the park would be higher than now, but in the long term fewer elk would be taken.

As described for Alternatives 2 and 3, no effect on park visitation is expected as a result of changes in the size of the elk herd. Most visitors from May to October do not see elk, and this does not seem to affect the quality of their visits.

Few changes in viewing opportunities would occur in the park during the first few years. An estimated 50% decline in bison numbers within 10–15 years, as compared to baseline conditions, would decrease bison viewing opportunities somewhat. However, large numbers of bison would continue to be viewable over the long term during spring, summer, and fall. Viewing opportunities would be similar to those in 1999–2000 when about 440–490 bison summered in the park. As discussed in Alternative 2, reductions in bison numbers would likely not affect visitation to any measurable degree.

While elk and bison viewing opportunities in the park would decline if a non-endemic disease became established under Alternative 4, they might not decline to the level that could occur under Alternative 1.

Other Areas — In the long term the number of elk summering in the Yellowstone, the Teton Wilderness, and the Gros Ventre segments could be similar to or moderately higher than baseline conditions. The opportunity for viewing elk could increase for some national forest visitors off the main highways during winter, but not to the extent of Alternatives 2, 3, and 6. Auto-based elk and bison viewing opportunities in winter and early spring would remain limited in the national forest due to winter closures and the lack of plowing on forest access roads.

Allowing elk to better use native winter ranges through habitat manipulation in the national forest, as described for Alternatives 2 and 3, would require careful management of recreational uses to prevent displacement.

It is unlikely that elk and bison viewing opportunities in the Jackson area outside the refuge and park would increase to any measurable degree, even during periods when no supplemental feeding was provided on the refuge, as compared to baseline conditions and Alternative 1.

Conclusion

The number of people participating in sleigh rides on the refuge could potentially decline by 29% compared to Alternative 1. Sleigh ride operations could also be terminated due to too much variability in elk numbers and movements. Elk viewing opportunities during winter on the refuge would be much more variable in some years, ranging from no elk within view on some days to over 2,000 on other days.

Bison and elk viewing opportunities in the park during spring, summer, and fall would decline somewhat, but it is unlikely that park visitation would decline by more than a negligible amount as a result. Large numbers of bison would continue to be viewable in the park during these seasons. Fewer elk in the park could reduce the quality of the experience for some park visitors, but would

not affect the majority of park visitors since most do not see elk during their time in the park.

Alternative 5

Analysis

National Elk Refuge — In the short and long terms there would be few changes in elk and bison viewing opportunities on the refuge compared to baseline conditions and Alternative 1. Bison viewing opportunities on the refuge would continue to be limited for most visitors because most bison would continue to occupy the McBride and Poverty Flats management areas and the Gros Ventre Hills, away from the highway and the main refuge road.

As described for Alternatives 3 and 4, vaccinating elk with Strain 19 in association with winter feeding activities could cause some or many elk to vacate the Nowlin feedground in the short term. If a large number of elk left on a particular day, sleigh ride operations could be halted for the day, reducing viewing opportunities. This could affect an average of 225 visitors per day, the same as baseline conditions. If a new vaccine could be administered remotely or orally, there would be little to no disturbance of viewing opportunities.

If an effective way was found to remotely administer RB51 to bison, it would likely be administered during winter feeding operations primarily at the McBride feeding area and at the Poverty Flats feeding area as needed. Viewing opportunities on the refuge would not be affected, and the safety of sleigh riders would not become an issue. If large numbers of bison vacated the McBride feeding area as a result of the vaccination program, they would be hazed or bated back to the McBride area.

Alternative 5 would not affect participation in sleigh rides any more than under Alternative 1. However, results of the economic survey indicate that participation could increase by 14% (Loomis and Koontz 2004).

For people stopping along U.S. 26/89 to view elk, the quality of the experience would be similar to Alternative 1.

The effect of disease-caused declines in elk and/or bison numbers would reduce viewing opportunities similar to Alternative 1. Greatly reducing winter feeding on the refuge as a result of chronic wasting disease could decrease elk numbers and wildlife viewing opportunities similar to Alternatives 2, 3, and 6. As a result, sleigh rides could decrease or be stopped completely. Any introduction of a disease transmissible to bison (e.g., bovine tuberculosis) would not affect bison viewing opportunities because of their location.

Grand Teton National Park — Few changes in viewing opportunities would initially occur in the park under Alternative 5. A minor reduction in elk numbers in the Grand Teton herd segment (from an estimated baseline of 2,676 to 2,500) would likely have no effect on elk viewing opportunities because the change would not be large enough to be discernible to most visitors. Furthermore, Alternative 5 would result in a negligible to minor increase in elk numbers in the Yellowstone and Teton Wilderness herd segments. A large number of elk would continue to be observable during spring and fall migrations, as well as during the fall rut. Hunting on the west side of the park would continue to limit elk viewing opportunities during the fall migration.

The elk herd reduction program in the park would continue to detract from the viewing experience of some visitors not accustomed to seeing hunting in a national park.

Changes in elk numbers in the park resulting from Alternative 5 would likely not result in any discernible changes in the number of visitors to the park from May through October.

Reducing bison numbers in the park to 350–400 animals within 10–15 years, as compared to baseline conditions, would decrease bison viewing opportunities. Opportunities would be similar to what they were in the late 1990s.

Elk and bison viewing opportunities in the park would decline if a non-endemic disease became established under Alternative 5, and viewing opportunities could decline over time.

Other Areas — In the long term the number of elk summering in other elk herd segments could be similar to or higher than baseline conditions by a

negligible to minor amount. The probability of seeing elk and the quality of outdoor experiences would be similar to baseline conditions and Alternative 1.

Elk viewing opportunities in the Green River basin and deserts would not increase above baseline conditions.

Conclusion

The number of elk that would be viewable to visitors on the National Elk Refuge would be similar to Alternative 1, and the number of people participating in sleigh rides would change little if any. Bison viewing opportunities on the refuge would continue to be limited for most visitors.

Bison viewing opportunities in the park during spring, summer, and fall could decline somewhat, but large numbers of bison would still be viewable during these seasons. Elk viewing opportunities would be similar to Alternative 1. It is unlikely that park visitation would decline more than a negligible amount due to reductions in bison numbers, and no changes would be expected in response to possible negligible to minor reductions in elk numbers.

Mitigation

If sleigh ride operations were discontinued, additional vehicle pullouts with covered viewing platforms (with spotting scopes and binoculars) and interpretive signs could be developed along U.S. 26/89 as partial mitigation. This could be supplemented with one or more roving interpreters. Elk and bison ecology and management could potentially be interpreted at the National Wildlife Art Museum, and interpretation of elk and bison ecology and management at the visitor center could be expanded. Audio tours could also help mitigate the discontinuation of sleigh rides. Another possible mitigation measure would be vehicle-based wildlife tours, which could be more flexible, cover greater distances and habitat types, and include other wildlife species (e.g., bison and bighorn sheep). However, this could potentially disturb elk, reducing viewing experiences of visitors along the highway and the main refuge road, damaging habitat, and accommodating relatively few visitors.

Reduced elk viewing opportunities on the refuge under Alternatives 2, 3, 4, and 6 could also be mitigated in part by providing educational and interpretive materials to explain the positive aspects related to lower elk and bison numbers on the refuge. For example, the long-term health benefits to the herds and ability of habitat to recover could be explained in interpretive signs at pullouts and at the visitor center, in pamphlets, and in articles in newsletters and local newspapers.

ELK HUNTING

Methodology for Analyzing Impacts

The U.S. Fish and Wildlife Service and the National Park Service would work cooperatively with the Wyoming Game and Fish Department to determine herd segment objectives, bull-to-cow ratios, hunting permits, etc. The following section calculates the number of elk that would need to be harvested and the number of hunters necessary to accomplish herd objectives as outlined in each alternative, given certain hunter success rates.

Potential effects of alternatives on hunting in the Jackson elk herd unit were based on a series of calculations, beginning with estimations of post-hunt numbers of elk on the refuge and in the Grand Teton herd segment and in other parts of the Jackson elk herd unit. The baseline figure was an average of 2,000 elk harvested each year ($\pm 10\%$) (Brimeyer, pers. comm. 2003). The number of hunters under baseline conditions was calculated based on a proportional reduction from the average number of hunters during 1997–2001 to a

level that would be allowed when the Jackson elk herd was at the WGFD objective level of 11,000. Table 4-8 summarizes how many elk would be harvested under each alternative, and Table 4-9 the number of hunters.

For the other alternatives the number of elk harvested in each area under each alternative was estimated, and then hunter numbers were calculated. Calculations accounted for the following factors, among others:

- changes in distributions of elk among herd units, or alterations to proportions of elk among segments
- a lower harvest rate (8% of the pre-hunt population) when the population is at a low point and a lower hunter success rate (20%) to allow the population to increase
- a higher harvest rate (15% of the pre-hunt population) and a higher hunter success rate (30%) when the population is near objective to keep it from increasing further

Calculations of hunter numbers, numbers of elk harvested, and other parameters assumed that a portion of the elk herd that traditionally wintered on the refuge would, as a consequence of reduced winter feeding under Alternatives 2, 3, and 6, and a major reduction in elk population objectives on the refuge under Alternatives 3 and 6, find adequate winter range to carry them through the winter. Calculations assume that a minimum of 4,400 elk would continue to winter on native range. This number is the lowest number of elk estimated to have used native winter range during the last 15 years (WGFD population esti-

TABLE 4-8: ESTIMATED NUMBER OF ELK HARVESTED — JACKSON HERD ELK UNIT

	1997–2001 (average)	Alternative 1 and Baseline	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Refuge	308	198–242	0	19–105	126–146	<200	24–121
Park	665	432–528	0	43–179	232–287	<448	52–269
Other Areas	1,759	1,170–1,430	655–1,662	624–1,895	1,680–1,761	>1,378	574–1,783
Total Herd	2,732	1,800–2,200	655–1,662	686–2,179	2,038–2,194	2,028 (avg.)	650–2,173

TABLE 4-9: ESTIMATED NUMBER OF HUNTERS — JACKSON ELK HERD UNIT

	1997–2001 (average)	Alternative 1 and Baseline	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Refuge	975	660–806	0	100–525	420–487	<670	120–403
Park	2,484	1,440–1,760	0	215–895	773–957	<1,494	260–897
Other Areas	6,173	3,900–4,767	3,275–5,540	3,120–6,247	5,600–5,870	>4,593	2,870–5,767
Total Herd	9,632	6,000–7,333	3,275–5,540	3,435–7,667	6,793–7,314	6,757 (avg.)	3,250–7,067

mates) and is supported by modeling completed by Hobbs et al. (2003). It is also assumed that a minimum of 1,200 elk could winter on the refuge and that 2,500 elk would continue to winter on state feedgrounds, for a total of about 8,100 elk as a minimum population under Alternatives 2 and 6. Under Alternative 3, the minimum population could be slightly less in some years due to a possible minimum of 1,000 elk on the refuge in some winters (based on the refuge objective of 1,000–2,000 elk).

The Wyoming Game and Fish Department tries to manage elk herds within 10% of objectives, so a range of plus and minus 10% is presented in the tables in this section, but comparisons were based on *average* baseline conditions.

Impacts of the Alternatives

Alternative 1

Analysis

It is estimated that, when the Jackson elk herd is at about 11,000 animals, an average of about 6,667 elk hunters would hunt in the Jackson elk herd unit each year, and they would harvest an average of 2,000 elk each year over the long term (Brim-eyer, pers. comm. 2004). A long-term average hunter success rate of 30% was assumed for these calculations.

Continued protection of refuge and park lands, the winter feeding program, and flood irrigation on the refuge, in addition to continued protection of other national forest land and the state's feedgrounds in the Gros Ventre River basin, would continue to provide for a large harvestable surplus of elk in the Jackson Hole area.

If a non-endemic infectious disease caused declines in elk numbers, it would likely result in fewer hunters in all areas. If winter feeding was greatly reduced on detecting a new disease, it is possible that the disease would have already reached an elevated level. Under Alternative 1 prevalence would be higher and elk numbers would decline more rapidly and to lower levels than under Alternatives 2, 3, and 6.

Fewer elk would result in lower harvest quotas and more restrictive hunting regulations in some hunt areas. Low elk numbers could also mean a

lower success rate, which could result in hunters going elsewhere. Hunter participation might decline further if there was a perception that diseases could be transmitted to people. Therefore, under Alternative 1 the reduction in the number of elk hunters in the Jackson elk herd unit would be larger than under Alternatives 2, 3, and 6.

National Elk Refuge — An estimated average of about 733 elk hunters would use the refuge under this alternative, 638 of whom would be residents and the remainder nonresidents. An estimated average of about 1,500 permits would be issued to hunters each year. It is estimated that an average of 220 elk would be killed each year.

Up to 70 hunters could continue to potentially hunt the open area of the refuge each day during the hunting season, based on the number of permits provided to hunters, which would result in a potential density of approximately 215 acres per hunter. However, fewer hunters would likely hunt the refuge on most days, and many hunters could remain in or near the parking lots, meaning that the density of hunters beyond 0.5–1 mile beyond the parking lots would be much less than 215 acres per hunter.

Grand Teton National Park — Hunters have an unusual opportunity to hunt elk in Grand Teton National Park as part of a legislatively permitted elk herd reduction program when necessary for proper herd management. An estimated 1,600 elk hunters (1,072 of whom would be residents and 528 nonresidents) would use the park under Alternative 1, and it is estimated that they would harvest an average of 480 elk per year.

Other Areas — An estimated average of about 4,334 hunters using all other areas in the Jackson elk herd unit (primarily Bridger-Teton National Forest). An estimated average of about 1,300 elk would be harvested each year. According to a survey of elk hunters within the Jackson herd unit in 2001, local residents spent an average of 3.1 days per hunting trip in the national forest, nonlocal Wyoming residents 5.9 days per trip, and nonresidents 6.3 days per trip.

Alternative 1 would not affect elk hunting opportunities in the Pinedale and Big Piney ranger districts of Bridger-Teton National Forest or within the Pinedale and Green River resource manage-

ment areas in the Green River basin and the Red Desert.

Conclusion

An estimated average of about 733 hunters would hunt elk on the refuge each year under Alternative 1, about 25% less than the 1997–2001 average when elk numbers in the Jackson herd unit were considerably higher than the herd objective. An estimated annual average of 1,600 hunters would participate in the elk reduction program in the park when needed, which is 36% less than the 1997–2001 average. An estimated annual average of 4,334 hunters would hunt elk in the national forest and on other lands. The total number of elk hunters each year would be 6,667 throughout the entire elk herd unit.

Alternative 2

Analysis

No elk hunting would be allowed on the National Elk Refuge or no elk herd reduction program would take place in Grand Teton National Park under Alternative 2; most hunting would take place in Bridger-Teton National Forest.

The number of hunters in the Jackson elk herd unit would decline sharply because hunting would only occur in the national forest and on private and state lands. In years when the number of elk in the herd unit was at or near the objective level, an estimated 5,540 hunters could be accommodated, but when the elk population declined to anticipated lows (due to severe winters and no feeding on the refuge), only 3,275 hunters could hunt in the herd unit, compared to about 6,667 hunters under Alternative 1. Under this alternative the Wyoming Game and Fish Department would likely increase the number of limited quota licenses and reduce the period of time that certain hunt areas were open to general license holders. Hunter success would vary from year to year, and during years when the population was near the estimated low of 8,100 elk, hunter success could decline to 20%, although it could be lower in some hunt areas (based on information in Boyce 1989:184). However, hunter participation in the Jackson herd unit might drop substantially in years when elk numbers and hunter success declined markedly and the proportion of limited

quota licenses increased (Brimeyer, pers. comm. 2003; Boyce 1989:185).

The number of elk harvested annually by hunters would be reduced to 1,662 in the short term (17% less than the baseline figure of 2,000) and to 655 in the long term (a 67% reduction).

If large numbers of elk began wintering in the Green River basin and the Red Desert, elk hunting opportunities and harvested elk in the Jackson elk herd unit might not decline to the extent described above because of more winter range being available, lower winter mortality, and larger numbers being maintained.

If large numbers of elk did not begin migrating to other areas, elk hunting opportunities in these areas would be similar to current conditions. However, if large numbers of elk did begin wintering in the Green River basin and the Red Desert, hunting opportunities could be expanded in these areas.

A non-endemic infectious disease would reduce hunting opportunities, but likely not to the extent that would occur under Alternatives 1, 4, and 5 in the long term. Elk numbers would likely decline more slowly and probably would not to the same level as under Alternatives 1 and 5. In the long term hunting opportunities in the Jackson elk herd unit might not be substantially different than under Alternative 1.

Several factors could contribute to possible higher hunter opportunities in the long term than under Alternative 1. A key factor would be considerably lower prevalence of infected animals. Also, there would be a lower level of environmental contamination. A lower mortality rate (as compared to Alternative 1) would allow for relatively higher harvest quotas. A much lower prevalence might also cause fewer hunters to not hunt in the Jackson elk herd unit due to health concerns.

Conclusion

Opportunities for elk hunting on the refuge and the elk herd reduction program in the park would be immediately eliminated. Although this would result in fewer opportunities in the Jackson elk herd unit, reduced numbers of elk in the park would allow for an increase in hunting opportuni-

ties in the national forest in some years (an estimated increase to 5,540 hunters per year, a 28% increase over average baseline conditions). However, after a series of above-average or severe winters, resulting in fewer elk, the number of elk hunters outside the refuge and park could decline to an estimated 3,275, 24% lower than the average baseline figure of 4,334.

Alternative 3

Analysis

The number of hunters that could hunt each year in the Jackson elk herd unit would become much more variable under this alternative, similar to Alternative 2. In the first few years the number of hunting opportunities in the Jackson elk herd unit would be higher than under baseline conditions, with an estimated 700 additional hunters than average baseline conditions (possibly 7,400 hunters as compared to the average baseline figure of 6,667 hunters per year), assuming an additional 200 or more elk would be harvested each year, for a total harvest of 2,200 or more elk in the herd unit as compared to 2,000 under baseline conditions and Alternative 1. Harvest strategies would include reducing the Grand Teton National Park herd segment to a maximum of 1,000 elk within 10–15 years.

In the long term an estimated average of 7,667 hunters could be accommodated in the herd unit in years when the elk herd was at or near the herd objective of 11,000. This estimate assumes a lower success rate in Grand Teton National Park, due to the very low elk population in the park, which would allow more hunters, assuming a success rate similar to baseline conditions. However, following a severe winter or series of above-average and severe winters, the estimated number of hunters would decline to about 3,435, which is 48% lower than average baseline conditions and Alternative 1. This would be a consequence of reducing the frequency of winter feeding to an estimated 2 years out of 10, reducing the Grand Teton National Park segment to 500–1,000, and reducing elk numbers on the refuge to 1,000–2,000. Hunter success would become much more variable from year to year and, during years when the population was near 7,900 elk, hunter success would decline to an estimated average of 20%, although it could be lower in some hunt areas (Boyce 1989).

The number of elk killed by hunters in the herd unit would fluctuate more than it would under Alternative 1. In years when the herd is at or near the herd objective, the number of elk harvested in the herd unit could potentially increase to an estimated 2,158 (8% over the baseline of 2,000 elk), but after a series of above-average and severe winters, elk harvest could decline to a low of 687 elk per year (a 66% decrease), and it could take 5–10 years to recover from this low.

If a non-endemic infectious disease caused declines in elk numbers, hunting opportunities would be reduced, but probably not to the extent that would occur in the long term under Alternatives 1, 4, and 5. Elk numbers would likely decline more slowly and not to the same level as under Alternatives 1 and 5. Although the number of hunters on the refuge and in the park would decline by a major amount, hunting opportunities in the Jackson elk herd unit as a whole in the long term might not be substantially different than under Alternative 1. It is also possible that the number of hunting opportunities would remain higher under Alternative 3 in the long term.

National Elk Refuge — In the first several years of implementation, it is estimated that the number of hunting opportunities on the refuge (as well as the elk reduction program in the park and possibly Hunt Area 80) would be higher than under baseline conditions and Alternative 1. The purposes of allowing larger harvests would be to reduce the Grand Teton herd segment from the baseline estimate of 2,676 elk to a maximum of 1,000 elk, so the increase in opportunities would only occur early in the hunting season. It is possible that 300 or more elk would be harvested on the refuge each year for several years (as compared to 220 elk per year harvested under baseline conditions). This would mean an estimated 1,000 hunters on the refuge (compared to 733 hunters under baseline conditions). The possible initiation of a hunt at the south end of the refuge would be important in being able to obtain the estimated harvest rates during the early part of the hunting season. Alternatively, allowing public use in the southern portion of the refuge would cause elk to move back into hunt areas (and in subsequent years elk might not move as quickly to the south end of the refuge).

In the long term elk hunting opportunities on the refuge could decline from an average of 733 hunters to 100–525 hunters per year, primarily due to a much smaller Grand Teton segment, closing the northern portion of the refuge, and fewer elk due to the major reduction in winter feeding. The number of elk killed by hunters would decline from an estimated average of 220 to 20–105.

After the park segment had been reduced to 500–1,000 elk, the size of the hunt area would likely be cut in half, which would be viewed adversely by some hunters. However, most hunters on the refuge hunt at or near the parking lots, so reducing the size of the hunt area would not have more than a minor adverse affect on the quality of the hunting experience. A small hunt area would potentially be added to the south end of the refuge. Only a small number of hunters would hunt in this area. Whereas hunter success would likely be high initially, hunter success would be sporadic after elk became accustomed to hunting in this area.

If large numbers of elk began migrating to the Green River basin and beyond, this would not affect hunting opportunities on the refuge any more than a negligible degree.

Grand Teton National Park — To reach a herd objective of 1,000 elk maximum in the park (compared to a baseline estimate of 2,676), the need for deputized hunters to help with elk reduction could be higher than under baseline conditions and Alternative 1. Increased opportunities would only occur early in the season, and 650 or more elk could be harvested in the park each year for the first several years (as compared to 480 under baseline conditions). The number of hunters would increase from 1,600 hunters under baseline conditions to an estimated 2,200. The park elk reduction program would be managed adaptively, based on a need and reduction strategy. An elk hunt at the south end of the refuge would be important in being able to obtain the estimated harvest rates. Alternatively, allowing public use in the southern portion of the refuge would also cause some elk to move back into hunt areas (and in subsequent years elk in the park might not move as quickly to the south end of the refuge). Hunting regulations in the park would be geared toward increasing the harvest of cows. Therefore, the harvest of bulls would not be higher than baseline estimates and could be lower.

In the long term it is estimated that approximately 215–895 elk hunters would hunt in the park on average under Alternative 3, compared to the baseline figure of 1,600 hunters. An estimated 43–179 elk would be harvested from the park each year.

After 5–10 years the Blacktail Butte and Kelly hayfields area would no longer be open to elk reduction activities.

If large numbers of elk began migrating to the Green River basin and beyond, this would have a negligible effect on reduction opportunities in the park.

Other Areas — For the first several years of implementation, hunting opportunities and the quality of hunting experiences would not differ substantially from baseline conditions and Alternative 1. Hunting opportunities could be higher immediately east of the refuge in the first few years. Because a primary purpose of allowing larger harvests would be to reduce the Grand Teton herd segment, the increase in opportunities would occur early in the hunting season. At the outset of the hunting season, hunting activity or public use at the south end of the refuge would cause some elk to move into the national forest, where they could be harvested.

When elk numbers were at a high point under this alternative, the number of hunters outside the refuge and the park would increase to an estimated 6,247, 44% higher than the baseline figure of 4,334. An estimated 1,895 elk would be harvested, also a 44% increase from baseline conditions 1,315 elk. This increase would primarily be due to the major reduction in the park segment, which would allow elk numbers in the Yellowstone, Teton Wilderness, and Gros Ventre segments to grow. However, elk in these units would need to rely more heavily on native winter range, which could result in elk numbers declining to a point where only about 3,120 hunters could hunt in areas outside the refuge and park (28% below the baseline figure of 3,900), and an estimated 624 elk would be harvested.

In years when elk numbers in the herd unit were at the low end of the estimated range, hunting regulations would likely become more restrictive in Hunt Areas 70, 71, 74, and 80 (e.g., a much greater reliance on limited quota licenses). The

Wyoming Game and Fish Department would likely increase the number of limited quota licenses and reduce the period of time that the areas were open to general license holders. Hunt Areas 78, 81, 82, and 83 would be much less affected (Brimeyer, pers. comm. 2003).

If large numbers of elk began migrating to the Green River basin and beyond, hunters in the Jackson elk herd unit would continue to have opportunities to harvest them within the Jackson elk herd unit. But because they would also be harvested outside the herd unit, hunting regulations within the herd unit boundaries might become more restrictive.

If large numbers of elk did not begin migrating to the Green River basin and the Red Desert, this alternative would have a negligible effect on hunting opportunities in these areas. However, if large numbers of elk did begin wintering in the Green River basin and the Red Desert, hunting opportunities could be expanded there. A more detailed assessment of potential effects has not been undertaken at this time.

Conclusion

In the long term the number of elk hunters on the refuge would decline from an annual average of 733 to 100–525. In the park the number of deputized hunters would decline from an average of 1,600 to an estimated 215–895 per year. The number of elk hunters in the national forest and other areas would range from 3,120 to 6,247 per year. There could in the long term be less need for elk reduction in the park in some or all years. Managers would use adaptive management strategies in response to reviewing data on elk numbers, distribution, and objectives agreed upon by the interagency working group. Although the average might not be substantially different than baseline conditions, periodic drops in hunting opportunities would be an adverse impact. Throughout the herd unit, the number of elk hunters could range from an estimated 3,430 to 7,667 per year.

Alternative 4

Analysis

In the short term few changes would occur in hunting opportunities in the Jackson elk herd

unit, except that a higher number of cows would be available for harvest in the park and refuge early in the season. Under this alternative an additional 330–700 hunters could be allowed (possibly 7,000–7,400 hunters as compared to the baseline figure of 6,667 hunters). This is based on allowing 100–200 or more elk to be harvested each year, for a total harvest of 2,100–2,200 elk, as compared to 2,000 under baseline conditions and Alternative 1. The higher level of harvest would be directed at reducing the Grand Teton herd segment to approximately 1,600 elk within 10–15 years. Additional details are provided below, in the discussions on each area.

In the long term the number of hunters and the number of elk harvested each year would be similar to baseline conditions and Alternative 1, although the distribution of hunters could change to a minor extent.

If a non-endemic infectious disease caused declines in elk numbers, hunting opportunities would be reduced, but probably not to the same extent as under Alternatives 1 and 5 in the long term. Because winter feeding would continue, although at a reduced level, the number of elk hunters could possibly decline further than under Alternatives 2, 3, and 6 because of animals being concentrated and at risk for higher impacts from disease.

National Elk Refuge — In the first several years the number of hunting opportunities on the refuge would be higher than under baseline conditions and Alternative 1. The purpose would be to reduce the Grand Teton National Park herd segment from 2,676 elk to approximately 1,600 elk, so the increased opportunities would only occur early in the hunting season. As many as 300 elk would have to be harvested on the refuge each year for several years (as compared to 220 elk per year harvested under baseline conditions and similar to Alternative 3). This would mean as many as 1,000 hunters on the refuge (compared to 733 hunters under baseline conditions). The possible initiation of an elk hunt at the south end of the refuge could be important in attaining the estimated harvest rates during the early part of the hunting season. Alternatively, allowing public use in the southern portion of the refuge would cause elk to move back into hunt areas (and in subse-

quent years elk might not move as quickly to the south end of the refuge).

In the long term elk hunting opportunities on the refuge could decline from an average of 733 to 420–487 hunters per year. The number of harvested elk would decline from an estimated average of 214 to 126–146 elk.

The location and size of the hunt area at the northern end of the refuge would remain the same. A small hunt area would potentially be added to the south end of the refuge. Only a small number of hunters would hunt in this area. Whereas hunter success would likely be high initially, hunter success would be sporadic after elk became accustomed to hunting in this area.

If elk from other herd segments attempted to winter on the refuge, and if elk numbers on the refuge rose above 5,000, more elk might have to be harvested on the refuge, but harvest rates would not be higher than baseline levels for the refuge.

Grand Teton National Park — In the first several years the number of opportunities for deputized hunters for the park elk reduction program would be higher than under baseline conditions and Alternative 1 in order to reduce the park herd segment from 2,676 elk to approximately 1,600 elk. It is possible that up to as many as 650 elk would be harvested each year (as compared to 480 elk under baseline conditions). This would mean as many as 2,200 deputized hunters in the park (compared to 1,600 hunters under baseline conditions). A potential elk hunt at the south end of the refuge would be important in causing some elk to move back into areas where they could be hunted. Alternatively, allowing public use in the southern portion of the refuge would cause elk to move back into hunt areas (and in subsequent years elk might not move as quickly to the south end of the refuge).

In the long term an estimated average of 232–287 elk per year would be harvested by 773–957 deputized hunters, compared to baseline figures of 1,600 hunters and 480 elk per year.

The location and size of the hunt area would remain the same. Although the quality of the experience would be similar, it could improve for

some people if there were fewer deputized hunters in the park on any given day.

Other Areas — In the first several years hunting opportunities and the quality of hunting experience would not differ substantially from baseline conditions and Alternative 1. However, hunting opportunities could initially be higher immediately east of the refuge if a hunt on the southern end of the refuge or public use caused elk to move into this area.

In the long term, there would be an estimated 5,600–5,870 hunters per year outside the refuge and park, compared to a base figure of 4,227 hunters. An estimated 1,680–1,761 elk would be harvested each year in this area, compared to a baseline figure of 1,268 elk. The reduction of elk in the park segment would allow proportionally more elk to be sustained in other herd segments, which would in turn result in an increase in the number of elk that could be harvested.

Similar to Alternative 1, Alternative 4 would not affect elk hunting opportunities in the Green River basin any more than current management of the refuge and park is having on these opportunities.

Conclusion

In the long term hunting opportunities on the refuge would decline from an average of 733 hunters per year to 420–487. In the park it is estimated that the number of deputized hunters would decline from an average of 1,600 hunters per year to 773–957. The number of elk hunters in the national forest and other areas outside the refuge and park would increase to an estimated 5,600–5,870 hunters per year, an increase of 29%–35%. For the herd unit as a whole, the number of elk hunters could range from an estimated 6,793 to 7,314 per year, which is an increase of 2%–10% compared to average baseline conditions.

Alternative 5

Analysis

Alternative 5 would maintain winter feeding in nearly every winter, with the same population objectives for the park and refuge as Alternative 1. Consequently, hunting opportunities and numbers of elk harvested in the Jackson elk herd unit

and individual areas within the herd unit would be the same as Alternative 1.

Continued protection of refuge and park lands, the winter feeding program, and enhanced irrigation on the refuge, in addition to continued protection of other national forest land and the state's feedgrounds in the Gros Ventre River basin, would continue to provide for a large harvestable surplus of elk in the Jackson Hole area (similar to Alternative 1).

The effects of a potential non-endemic infectious disease under Alternative 5 would likely be similar to those described for Alternative 1. Disease-caused declines in elk would likely result in lower hunting quotas and fewer hunters. Because of a likely higher disease prevalence, elk numbers would decline more rapidly than under Alternatives 2, 3, and 6. Therefore, there would probably be a larger reduction in the number of elk hunters in the long term under Alternative 5 than under these other alternatives. Differences would be especially apparent in hunt areas outside the refuge and park because hunter numbers under Alternatives 2, 3, and 6 would not decline as markedly in these areas.

National Elk Refuge — In the short term slightly more elk could be harvested early in the season to reduce the number of elk in the park segment, but the difference would be minor. Otherwise, hunting opportunities would be similar to Alternative 1.

In the long term hunting opportunities would decline by a minor amount once the Grand Teton herd segment had been reduced to objective levels. The number of hunters on the refuge could decline from an average of 733 to 670. The number of harvested elk would decline from an average of 220 to less than 200. The majority of elk taken on the refuge would continue to be cows and calves, but a small number of bulls could continue to be harvested during the youth hunt.

Grand Teton National Park — In the short term slightly more elk could be harvested early in the season to reach objective numbers for the park segment, but the difference would be minor. Otherwise, reduction opportunities would be similar to Alternative 1.

There would be approximately 1,494 elk hunters in the park under Alternative 5, and these hunters would harvest an average of 448 or fewer elk per year, compared to 1,600 hunters harvesting 480 elk per year under Alternative 1.

Other Areas — In the short and long terms there would be an estimated average of 4,593 or more hunters per year outside the refuge and park, compared to the baseline figure of 4,334. An average of 1,378 elk would be harvested each year in this area, compared to the baseline figure of about 1,300 elk per year. This negligible increase in the estimated number of hunters and harvested elk would primarily be due to the minor reduction in elk numbers in the Grand Teton segment.

Similar to Alternative 1, Alternative 5 would not affect elk hunting opportunities in the Green River basin any more than under current management.

Conclusion

In the long term the number of elk hunting opportunities on the refuge would decline from an average of 733 hunters to less than 670 hunters per year. In the park the number of hunters would decline from an average of 1,600 to 1,494 per year. The number of elk hunters in the national forest and other areas would increase to an estimated average of 4,593 hunters per year from 4,334. For the herd unit as a whole, the number of elk hunters could range from an estimated average of 6,757 per year, a slight increase over average baseline conditions.

Alternative 6

Analysis

The number of hunters in the Jackson elk herd unit under Alternative 6 would be similar to Alternative 2. In the first several years hunting opportunities would be higher than under baseline conditions. Similar to Alternative 3, this alternative could result in 700 additional hunters or more than baseline conditions (possibly 7,400 hunters compared to the baseline figure of 6,667) to harvest an additional 200 elk or more each year, for a total harvest of 2,200 or more elk in the herd. The higher harvest would be directed at reducing the

Grand Teton herd segment to a maximum of 3,200 elk within five years.

Once herd objectives had been reached and winter feeding was stopped on the refuge, the estimated number of hunters would decline to about 3,250. Hunter success would vary more from year to year and, during years when the population was near 8,100 elk, hunter success would decline to an estimated average of 20%, although it could be lower in some hunt areas (Boyce 1989).

The number of elk harvested in the herd unit would fluctuate more than under Alternative 1. In years when the herd was at or near the herd objective, the number of elk harvested in the herd unit could potentially increase to an estimated 2,173, but after a series of above-average and severe winters, elk harvest could decline to a low of 650 elk per year (compared to the baseline figure of 2,000), and it could take 5–10 years to recover from this low.

A non-endemic infectious disease could cause declines in elk numbers and reduce hunting opportunities, but likely not to the extent that would occur in the long term under Alternatives 1, 4, and 5. With a smaller herd and no supplemental feeding, elk numbers would likely decline more slowly and not to the same level as under Alternatives 1 and 5. Although the number of hunters on the refuge and in the park would decline by a major amount under Alternative 6, hunting opportunities in the Jackson elk herd unit in the long term might not be substantially different than under Alternative 1. Hunting opportunities could also remain higher under Alternative 6 in the long term, similar to Alternatives 2 and 3.

National Elk Refuge — In the first several years hunting opportunities on the refuge would be higher than under baseline conditions and Alternative 1 in order to reduce elk wintering on the refuge to a maximum of 2,700 animals (until willow habitat recovered) then increase to 3,200. It is possible that 300 or more elk could be harvested on the refuge each year for several years (as compared to 220 elk per year under baseline conditions). This would mean an estimated 1,000 hunters on the refuge (compared to 733 hunters under baseline conditions). A potential elk hunt at the south end of the refuge, as described for Alternatives 3 and 4, would be important for obtaining

the needed harvest rates during the early part of the hunting season when elk from the park make up the majority of elk on the refuge. Alternatively, allowing public use in the southern portion of the refuge would cause elk to move back into hunt areas (and in subsequent years elk might not move as quickly to the south end of the refuge).

Once herd objectives had been achieved and winter feeding discontinued, elk hunting opportunities on the refuge would potentially decline from an average of 733 hunters to 120–403. The number of harvested elk would decline from an average of 220 to 24–121 elk. If the elk reduction program in the park was completely eliminated in the long term and elk were instead harvested on the refuge, the number of hunters would vary from an estimated 380 hunters when elk numbers were low to about 1,000 when elk numbers were at or near 11,000.

Once the elk population objective for the refuge was met, the size of the hunt area on the refuge would be reduced in size, which could adversely affect some hunters, but not hunters staying in or near the parking lots.

Grand Teton National Park — In order to reduce elk numbers in the park segment, possibly more than the existing annual average of 665 elk would need to be harvested for the first several years (as compared to 480 elk under baseline conditions). This would mean more than an estimated 2,500 hunters in the park (compared to 1,600 hunters under baseline conditions). It might be necessary to have 100% of the increased harvest level be made of up antlerless tags in order to more quickly reduce the number of elk in the park segment. At the outset of the season, hunting activity at the south end of the refuge or public use could cause some elk to move back into hunt areas (and in subsequent years elk in the park might not move as quickly to the south end of the refuge).

Until the park segment reached its objective, all of the area east of the Snake River currently open for elk herd reduction activities would remain open. After 5–10 years biologists and managers would determine if the Blacktail Butte and Kelly hayfields should be closed to elk reduction activities. If herd management did not require elk reduction in these areas, they would be closed. The elk reduction program would continue to be adap-

tively managed, and whether it occurred in any given year would be based on need.

In the long term it is estimated that 260–897 elk hunters would hunt in the park under Alternative 6 compared to the baseline figure of 1,600 hunters. An estimated 52–269 elk would be harvested each year.

Other Areas — In the first several years hunting opportunities and the quality of hunting experiences would be similar to baseline conditions and Alternative 1. However, hunting opportunities could be higher in Bridger-Teton National Forest east of the refuge in the first few years. At the outset of each hunting season, hunting at the south end of the refuge or public recreation would cause some elk to move into areas where they could be harvested.

Initially the number of hunters primarily in Bridger-Teton National Forest would increase to an estimated 5,767, compared to the baseline figure of 4,334, and 1,783 elk would be harvested. Once elk numbers were reduced and elk in these units were relying more heavily on native winter range, then only about 2,870 hunters would be allowed to hunt in areas outside the refuge and park, and an average of 574 elk would be harvested.

In years when elk numbers in the herd unit were at the low end of the estimated range, hunting regulations would likely become more restrictive in the national forest (Hunt Areas 70, 71, 74, and 80). The Wyoming Game and Fish Department would likely increase the number of limited quota licenses and reduce the period of time that the areas were open to general license holders. Other hunt areas (78, 81, 82, and 83) would be much less affected (Brimeyer, pers. comm. 2003).

If large numbers of elk began migrating outside the Jackson Hole area, hunters could harvest them before they left, but because they could also be harvested outside the herd unit, hunting regulations within Jackson Hole could become more restrictive to account for this.

If large numbers of elk did not begin migrating out of the Jackson Hole area, hunting opportunities outside the Jackson elk herd unit would be similar to current conditions and Alternative 1 (at

most a negligible effect). However, if large numbers of elk did migrate outside the Jackson Hole area, hunting opportunities could be expanded in surrounding areas. A more detailed assessment of potential effects has not been undertaken at this time.

Conclusion

In the long term the number of elk hunting opportunities on the refuge would decline from an average of 733 hunters to an estimated 120–403 hunters per year. In the park the number of hunters would likely decline from an average of 1,600 to 260–897. The number of elk hunters in the national forest and other areas would range from 2,870 to 5,767 per year, compared to the average baseline of 4,334. Throughout the herd unit, the number of elk hunters could range from an estimated 3,250 to 7,067 per year, compared to average baseline conditions of 6,667 hunters.

BISON HUNTING OPPORTUNITIES

No bison hunting would be allowed in Grand Teton National Park under any alternative.

Methodology for Analyzing Impacts

The numbers of bison harvested under each alternative in the short and long terms were estimated assuming a 15% growth rate in the absence of hunting. No bison hunting is currently allowed on the National Elk Refuge.

Impacts of the Alternatives

Alternative 1

Analysis

Bison hunting opportunities in Bridger-Teton National Forest immediately east of the refuge would continue to be affected by elk and bison management on the refuge and park. The refuge's winter feeding program results in low winter mortality, which has allowed the bison population to grow and provide the potential for hunting. During 2001–3, an average of 42 bison were harvested each year by about 50 hunters.

Although the number of bison would continue to grow under Alternative 1, hunting opportunities would not increase correspondingly because most

bison would remain on the refuge and in the park during hunting season. Potentially the average number of bison harvested each year could increase to 50 animals per year, allowing approximately 60 hunters in the national forest (Brimeyer, pers. comm. 2002). It is anticipated that the success rate on bull bison would be approximately 80%–90% and the success rate on cows would be about 60%–70%.

Conclusion

An average of 50 bison could be harvested in the national forest each year by approximately 60 hunters, a minor change compared to baseline conditions.

Alternative 2

Analysis

In the short term the harvest of bison in Bridger-Teton National Forest would not be affected under this alternative. In the long term bison hunting opportunities and the number of bison harvested might not decline, even though bison numbers could drop considerably. Without winter feeding on the refuge, bison would likely wander farther during the fall and winter, making them available for hunting in the national forest. If bison roamed onto private lands, they could be harvested or culled. Therefore, for the purposes of this analysis, it is estimated an average of 50 bison would continue to be harvested each year.

Conclusion

Because bison would likely wander onto national forest and private lands searching for forage, opportunities for hunting would be similar to Alternative 1. An average of 50 bison would continue to be harvested each year.

Alternative 3

Analysis

A larger bison herd (approximately 1,000 animals, depending on the population when the Record of Decision is signed) would greatly expand bison hunting opportunities under this alternative and allow a larger number of hunters in Jackson Hole. For the first several years an estimated 120–135 bison would be harvested each year to keep the

bison population from growing. It is anticipated that an average of about 50 bison would be harvested in the national forest and 70–85 bison on the refuge. This would allow an average of about 155–170 hunters each year in the short term.

In the long term the yearly harvest would decline to about 120 bison. It is anticipated that as many as 50 bison would continue to be harvested in the national forest and about 70 on the refuge. This would allow an average of about 150 hunters each year in Jackson Hole.

In addition to the public hunt, this alternative would allow a bison reduction program for American Indians, which would recognize and respond to the cultural significance that bison have for many American Indian tribes. The tribes would remove a minimum of five bison per year, potentially more in some years, depending on a WGFD need assessment.

Conclusion

Alternative 3 would triple bison hunting opportunities on the refuge and in the national forest. An estimated average of 150 bison hunters could be accommodated in Jackson Hole under this alternative because of a larger herd, a major change compared to Alternative 1.

Alternative 4

Analysis

In the short term an estimated 140–150 bison would be harvested each year to reduce bison numbers to a herd of approximately 500 animals. An average of about 50 bison would continue to be harvested in the national forest and the remaining 90–100 bison on the refuge. This would allow an average of about 175–190 hunters in Jackson Hole each year.

In the long term the number of bison harvested each year would decline to about 70 bison. The number of bison harvested on the refuge and the national forest could be equally split, or up to 50 bison could be harvested in the national forest. This would allow an average of about 90 hunters in Jackson Hole each year.

Similar to Alternatives 3 and 6, this alternative could allow for no more than five bison to be removed by American Indians during ceremonial events, in recognition of the cultural significance that bison have for many tribes.

Conclusion

In the long term bison hunting opportunities in Jackson Hole would increase to an average of 90 hunters per year, a major increase compared to baseline conditions and Alternative 1.

Alternative 5

Analysis

For the first several years an estimated 150–155 bison would be harvested annually to reduce bison numbers to 350–400 animals under this alternative. About 50 bison would probably continue to be harvested in the national forest and the remaining 100–105 bison on the refuge. This would allow an average of about 190–195 hunters in Jackson Hole each year.

In the long term the annual bison harvest would decline to 60 animals. The number of bison harvested on the refuge and in the national forest could be equally split, or as many as 50 bison could continue to be harvested in the national forest. This would allow an average of 75 hunters in Jackson Hole each year.

No opportunities for a bison reduction program would be specifically provided for American Indians under this alternative. Individual tribal members would have to apply for licenses through the Wyoming Game and Fish Department.

Conclusion

In the long term bison hunting opportunities in Jackson Hole would increase to an estimated average of 75 hunters per year, a moderate increase over baseline conditions and Alternative 1.

Alternative 6

Analysis

For the first several years an estimated 200 bison could be harvested each year to reduce numbers down to an average of 500 bison within five years.

About 50 bison would continue to be harvested in the national forest and the remaining 150 bison on the refuge, although greater bison distribution during the fall and winter could allow a larger harvest in other areas. This would allow an average of about 250 hunters in Jackson Hole each year.

In the long term the number of bison harvested each year would decline to about 70 bison, which is similar to Alternative 4. The bison harvest on the refuge and in the national forest could be equally split, or as many as 50 bison could be harvested in the national forest. This would allow an average of about 90 hunters in Jackson Hole each year. If bison numbers declined below 350 after a series of above-average and severe winters, hunting quotas would have to drop until the bison population had rebounded.

Similar to Alternatives 3 and 4, this alternative would allow a bison reduction program for American Indians in addition to the public hunt. Tribes would be allowed to remove five bison per year or more, depending on a WGFD need assessment.

Conclusion

Similar to Alternative 5, bison hunting opportunities in Jackson Hole would increase to an estimated average of 90 hunters per year, a moderate increase compared to baseline conditions and Alternative 1. In contrast to Alternative 5, however, hunting opportunities could decline after a series of above-average and severe winters if the bison herd fell below 350 animals.

CUMULATIVE EFFECTS

No cumulative effects for recreational opportunities (wildlife viewing, elk and bison hunting) are anticipated as a result of impacts of the alternatives in combination with impacts of reasonably foreseeable actions.

ECONOMIC IMPACTS ASSOCIATED WITH RECREATION

METHODOLOGY FOR ANALYZING IMPACTS

The impact analysis is based on work done at Colorado State University and at the Policy Analysis and Science Assistance program of the

Biological Resources Division of the U.S. Geological Survey. Funded by the U.S. Fish and Wildlife Service and the National Park Service, researchers conducted visitor surveys to assess the economic effects related to the bison and elk management plan. The 2002 visitor surveys conducted by Loomis and Koontz (2004) focused on visitor groups (wildlife viewers) that could possibly be affected by activities related to the management plan. Surveys were handed out to 648 sleigh ride visitors during February and March 2002, and the response rate was 78%. Surveys were handed out to 963 park visitors during June and July 2002, and the response rate was 87%. Researchers also worked with the Wyoming Game and Fish Department to survey Jackson herd elk hunters during the 2001 hunting season to assess the economic effects related to elk hunting.

The assessment of potential impacts focuses on long-term effects.

WILDLIFE VIEWING

Methodology for Analyzing Impacts

Economic impacts are typically measured in terms of number of jobs lost or gained, and the associated result on employment income. Economic input-output models are commonly used to predict the total level of regional economic activity that would result from a change in visitor spending. The IMPLAN input-output modeling software was used to analyze the economic impacts associated with visitor and hunter spending.

The local region (and its economy) is typically defined as all counties within a 30–60 mile radius of the travel destination. However, as explained in Chapter 3, to accurately portray the spending of tourists and the respending of local workers' salaries, the local area was determined to include Teton County in both Wyoming and Idaho. For the *local* Jackson area analysis, only spending by nonlocal persons (living outside Teton County, Wyoming and Idaho) is considered an infusion of new money into the local economy. This includes the spending of nonlocal Wyoming residents and out-of-state visitors (nonresidents).

Because spending by out-of-state visitors also generates economic benefits in the larger regional statewide economy as they travel to the Jackson

area, Wyoming was selected for the *regional* economic impact area to capture this nonresident spending in the state. Spending amounts in Wyoming are the summed expenditures that out-of-state visitors reported spending in the Jackson Hole area plus en route to the Jackson Hole area. Because spending by nonlocal Wyoming residents was included in the local Jackson area impact analysis but was not included in the regional impact analysis, the total spending within the local economy by nonlocal visitors is greater than what is spent regionally by nonresidents.

Over the past five years an average of 24,367 visitors have annually participated in the winter sleigh rides. Based on the survey, approximately 92% are nonlocal Wyoming residents and out-of-state visitors (Loomis and Koontz 2004). Therefore, the baseline for the economic impact analysis was an estimated 22,320 nonlocal sleigh ride visitors. As discussed in Chapter 3, survey results show that on average nonlocal Wyoming and nonresident sleigh ride visitors spent approximately \$98 per person per day locally in the Jackson Hole area (Loomis and Koontz 2004). Surveys also show that 80% of refuge sleigh ride visitors are from out of state and that they spent on average approximately \$108 per person per day in the Jackson Hole area and elsewhere in the state en route to Jackson (Loomis and Koontz 2004). Impacts of sleigh ride visitors are summarized in Table 4-10 and Table 4-11.

Results from the park summer visitor survey indicate that 2,163,493 of the visitors (92.1%) are nonlocal Wyoming residents and nonresidents (Loomis and Koontz 2004), which was used as the annual baseline. Survey results show that on average nonlocal resident and out-of-state visitors spent approximately \$83 per person per day locally in the Jackson Hole area. Out-of-state visitors spent approximately \$110 per person per day in the Jackson Hole area and elsewhere in the state en route to the Jackson area (Loomis and Koontz 2004).

Because the overall effects of changes in elk and bison numbers and distribution in Bridger-Teton National Forest and other parts of the Jackson elk herd unit would be no more than negligible under the action alternatives, baseline estimates of the contribution of elk and bison viewing in these areas to the local economy was not necessary.

**TABLE 4-10: POTENTIAL LOCAL ECONOMIC IMPACTS OF SLEIGH RIDE VISITORS
(NONLOCAL WYOMING RESIDENTS AND OUT-OF-STATE VISITORS)**

	Alternative 1	Alternatives 2, 3, and 6	Alternative 4	Alternative 5
Percentage Change from Nonlocal Base Visitation	Baseline	-100%--41%	-100%--29%	0%--14%
Total Spending (millions)	\$1.96	\$0--\$1.09	\$0--\$1.29	\$1.96--\$2.34
Total Economic Effects (direct and secondary)				
Income (million/year)	\$1.01	\$0--\$0.56	\$0--\$0.67	\$1.01--\$1.19
Number of Jobs	49	0-27	0-33	49-58
Percentage of Total Jackson Area Income	0.10%	0.00%--0.05%	0.00%--0.07%	0.10%--0.12%
Percentage of Total Jackson Area Employment	0.19%	0.00%--0.11%	0.00%--0.13%	0.19%--0.23%

SOURCE: Loomis and Koontz 2004.

TABLE 4-11: STATEWIDE ECONOMIC IMPACTS OF OUT-OF-STATE SLEIGH RIDE VISITORS

	Alternative 1	Alternatives 2, 3, and 6	Alternative 4	Alternative 5
Percentage Change from Base Visitation	Baseline	-100%--41%	-100%--29%	0%--14%
Total Spending (millions)	\$1.75	\$0--\$1.03	\$0--\$1.24	\$1.75--\$3.76
Total Economic Effects (direct and secondary)				
Income (million/year)	\$0.96	\$0--\$0.57	\$0--\$0.64	\$0.96--\$1.13
Number of Jobs	55	0-33	0-37	55-65
Percentage of Total State Income	0.01%	0.00%	0.00%	0.01%
Percentage of Total State Employment	0.02%	0.00%--0.01%	0.00%--0.01%	0.02%

SOURCE: Loomis and Koontz 2004.

Impacts of the Alternatives

Alternative 1

Analysis

National Elk Refuge — It is assumed that the high proportion (92%) of nonlocal Wyoming residents and out-of-state sleigh ride visitors would continue under Alternative 1. This means that of the average 24,367 visitors participating in sleigh rides on the refuge each year, an estimated 22,320 would be from outside the Jackson Hole area. Spending by this group of visitors is summarized in Table 4-10. Under Alternative 1 these visitors would spend an estimated \$1.96 million in the Jackson Hole area annually. Direct and secondary effects would generate over \$1.01 million in personal income and 49 jobs annually in the Jackson area economy, representing 0.1% of total local income and 0.19% of employment.

Spending by out-of-state sleigh ride visitors under Alternative 1 would generate approximately \$957,000 per year in personal income and 55 jobs in Wyoming, representing 0.01% of total state income and 0.02% of employment. Nonresident visitor spending impacts on the state economy are presented in Table 4-11.

If a non-endemic infectious disease (e.g., chronic wasting disease, bovine tuberculosis) became established in the Jackson elk and/or bison herds under Alternative 1 and caused large declines in herd numbers, sleigh ride visitation would likely be reduced, affecting personal income and jobs in the Jackson Hole economy. Reductions could approach or exceed those under Alternatives 2, 3, and 6 without a non-endemic disease.

Grand Teton National Park — Under baseline conditions about 92% of park visits (2,163,493 visits) are by nonlocal visitors (nonlocal Wyoming residents and nonresidents). This alternative would not result in any additional effects on park visitation. Although bison numbers would continue to grow annually by an estimated 10%–14%, this is not expected to affect park visitation. Potential effects on the Jackson area economy of spending by nonlocal resident and out-of-state summer park visitors are presented in Table 4-12. Under Alternative 1 these visitors would spend approximately \$589.91 million annually in the local Jackson Hole area, directly accounting for \$200.7 million in personal income and 10,658 jobs, representing 19% of total local income and 42% of local employment. As shown in Table 4-12, including the direct and secondary effects, visitor spending accounts for over \$306.4 million annually in personal income and 14,200 jobs in the local economy.

Current summer visitation to Grand Teton National Park accounts for almost 30% of total personal income and 56% of total employment in the Jackson Hole area (including direct and secondary effects), a substantial impact on the local economy.

Spending by out-of-state summer park visitors in Wyoming would generate annually approximately \$391.77 million in personal income and 21,588 jobs in the state, accounting for almost 3% of total annual personal income and 6.6% of total annual employment in the state (see Table 4-13).

A decline in elk and/or bison numbers as a result of a non-endemic infectious disease would likely not cause park visitation to decline. If elk and bison numbers did affect visitation, then fewer people visiting the park would contribute to lower amounts of personal income and jobs in Jackson Hole. This effect could potentially approach or exceed what is projected under Alternatives 2, 3, and 6 without a non-endemic disease.

Other Areas — Estimates are unavailable on the economic contributions of elk viewing in Bridger-Teton National Forest. Elk likely contribute minimally to visitation, and thus the local economy, on BLM lands in the Pinedale and Green River Resource Management Areas.

Conclusion

Sleigh ride visitation under Alternative 1 would continue at baseline levels. The direct and secondary impacts of visitor spending would continue to generate an estimated \$1.01 million dollars in personal income and 49 jobs annually in the Jackson Hole economy.

Visitation to Grand Teton National Park from May through October would generate an estimated \$306.47 million in personal income and 14,265 jobs annually in the local economy.

Alternatives 2, 3, and 6

Impacts on the local and state economies from changes in wildlife viewing opportunities would be similar under Alternatives 2, 3, and 6, even though elk and bison numbers on the refuge and in the park would differ somewhat between the alternatives. Elk numbers would be lowest under Alternative 3 (from 1,000 to 2,000 would winter on the refuge) and potentially highest under Alternative 2 (from 1,200 to 6,000 on the refuge). Bison numbers would be lowest under Alternative 2 and potentially highest under Alternative 3. However, even when bison numbers were low, they would be similar to the number of bison in Grand Teton National Park during the late 1990s. No correla-

TABLE 4-12: POTENTIAL LOCAL ECONOMIC IMPACTS OF SPENDING BY PARK VISITORS (NONLOCAL WYOMING RESIDENTS AND OUT-OF-STATE VISITORS)

	Alternative 1	Alternatives 2, 3, and 6	Alternative 4	Alternative 5
Percentage Change in Visitation (from baseline)	baseline	-7%–0%	-3%–0%	0%
Total Spending (millions)	\$589.91	\$547.90–\$589.91	\$570.75–\$589.91	\$589.91
Total Economic Effects (Direct and Secondary)				
Income (million/year)	\$306.47	\$286.37–\$306.47	\$297.30–\$306.47	\$306.47
Jobs	14,265	13,329–14,265	13,839–14,265	14,265
Percentage of Total Local Income	29.8%	27.9%–29.8%	28.9%–29.8%	29.8%
Percentage of Total Local Employment	55.7%	52.1%–55.7%	54.0%–55.7%	55.7%

SOURCE: Loomis and Koontz 2004.

TABLE 4-13: POTENTIAL STATEWIDE ECONOMIC IMPACTS OF SPENDING BY OUT-OF-STATE SUMMER PARK VISITORS

	Alternative 1	Alternatives 2, 3, and 6	Alternative 4	Alternative 5
Percentage Change in Visitation (from baseline)		-7%–0%	-3%–0%	0%
Total Spending (millions)	\$729.82	\$677.86–\$729.82	\$706.11–\$729.82	\$729.82
Total Economic Effects (Direct and Secondary)				
Income (million/year)	\$391.77	\$365.98–\$391.77	\$380.00–\$391.77	\$391.77
Jobs	21,588	20,167–21,588	20,940–21,588	21,588
Percentage of Total State Income	2.90%	2.71%–2.90%	2.81%–2.90%	2.90%
Percentage of Total State Employment	6.57%	6.14%–6.57%	6.37%–6.57%	6.57%

SOURCE: Loomis and Koontz 2004.

tion has been established between bison numbers and park visitation, and no economic impacts are expected.

Analysis

National Elk Refuge — Alternatives 2, 3, and 6 would result in a major reduction in the number of elk wintering on the refuge in some years and would greatly increase the variability of how many elk could be seen from sleighs and other locations, as compared to baseline conditions and Alternative 1. Under these alternatives refuge visitors would be able to view bison at fairly close distances on some days, which would not be possible under Alternative 1. Sleigh ride attendance by nonlocal visitors could decline by 41% (9,215 visitors) from 22,320 nonlocal visitors under baseline conditions and Alternative 1 to 13,105 nonlocal visitors. As shown in Table 4-10, this would result in average personal income of \$560,000 (a decrease of \$450,000 compared to Alternative 1) and 27 jobs (a loss of 22 jobs compared to Alternative 1). Spending in Wyoming by out-of-state sleigh ride visitors would generate up to approximately \$565,800 in personal income and 33 jobs in the state (see Table 4-11), a decrease of approximately \$391,000 in personal income and 22 jobs, compared to Alternative 1.

The absence of elk in the sleigh ride touring area on a particular day would likely force sleigh ride operations to be halted. A small number of cancellations would be expected under Alternative 1, but under Alternatives 2, 3, and 6 there could be many more days when sleigh ride operations might not be offered due to no viewable elk. With fewer operating days, it would be more difficult for the operator to cover the costs of employee salaries and other expenses. Additionally, the inconsistency in elk numbers would likely result in a decline in people driving out to the National Museum of Wildlife Art to attempt to ride on the sleighs. The sleigh ride operator would still need to pay salaries of three to five employees (about \$400 per day) and the U.S. Fish and Wildlife Service would need to pay salaries of interpretive staff (an estimated \$240 per day). In total, it is estimated that the operator would lose about \$1,791 per day, and an estimated \$583 less per day would go to the Fish and Wildlife Service and the National Museum of Wildlife Art (USFWS 2002a).

If sleigh ride operations on the refuge had to be stopped completely (Griffin, pers. comm. 2003), no personal income or jobs would be generated. Although some of the lost sleigh ride opportunities could be replaced by other opportunities (e.g., elk viewing from platforms), this analysis assumes no replacement of opportunities. Because the economic impacts associated with sleigh ride visitation under Alternative 1 represent well under 1% of the Jackson Hole economy, even the complete cessation of sleigh ride operations would have a negligible impact on the local and state economies.

If a non-endemic infectious disease became established in the Jackson elk and/or bison herds in the long term under Alternatives 2, 3, and 6, a decline in elk and/or bison numbers could be considerably less than under Alternative 1 if winter feeding had already been eliminated under Alternatives 2 and 6 or curtailed under Alternative 3 (feeding 2 out of 10 winters). Therefore, adverse impacts to sleigh ride visitation might not be any greater than described above. If, however, a disease became established early in the implementation phase, potential impacts would be similar to those described in Alternative 1.

Grand Teton National Park — As previously discussed, it is anticipated that reductions in elk and bison numbers in Grand Teton National Park would not measurably affect visitation. Therefore, Alternatives 2, 3, and 6 would likely not reduce park visitation or to only a negligible degree, as compared to Alternative 1 (see Table 4-12 and Table 4-13).

However, if substantially fewer elk caused potential park visitors to change their travel plans, park visitation from May through October could decline by a maximum of 5%–7% compared to baseline conditions and Alternative 1 (Loomis and Koontz 2004). A 7% decline in visitation would result in an estimated average of 105,340 fewer nonlocal Wyoming residents and out-of-state visitors coming to the park during this period. Estimated spending would be \$42.0 million less than the baseline figure of \$589.91 million. Direct and secondary effects would result in a decrease of \$20.1 million in personal income and 936 jobs annually (see Table 4-12). This would be a decrease from baseline conditions of 2% in total personal income and 3.7% in total employment in the Jackson area economy.

The direct and secondary effects of visitor spending in Wyoming by out-of-state visitors under Alternatives 2, 3, and 6 would decrease by \$25.79 million in personal income and 1,421 jobs annually, as compared to baseline conditions and Alternative 1 (see Table 4-13). This represents a decrease from baseline conditions of 0.2% in total personal income and 0.4% in total employment in the state. However, a reduction of up to 7% in May-October visitation of Grand Teton National Park is likely overstated because as described under recreational opportunities, most park visitors do not see elk during this period, and this apparently does not affect their decision about coming to the park.

If large numbers of elk began migrating to areas beyond Jackson Hole, elk numbers in the park might not decline to the extent estimated because more forage would be available on the refuge for park elk, allowing higher numbers of park elk to be sustained. This would further reduce any possible reduction in visitation as a result of elk numbers.

As described for the refuge, a non-endemic infectious disease under Alternatives 2, 3, and 6 could result in considerably smaller declines in elk and bison than under Alternative 1 if winter feeding had already been eliminated or curtailed. Therefore, adverse impacts to park visitation might not be any greater than described above. If a new disease became established early in the implementation phase, potential impacts would be similar to those described in Alternative 1.

Other Areas — If large numbers of elk began migrating to the Green River basin and the Red Desert, elk-viewing opportunities during spring and fall in the Jackson and Buffalo ranger districts would likely not change enough to increase visitation. However, if large numbers of elk began moving through the Pinedale and Green River resource management areas, more visitors could be attracted to the Green River basin or people traveling through the area could stay longer. This would benefit the local economies of Pinedale and other towns. Economic impacts have not been calculated.

Conclusion

Anticipated reductions to sleigh ride operations on the National Elk Refuge as a result of fewer

elk under Alternatives 2, 3, and 6 could reduce personal income to \$560,000 per year (a loss of \$450,000 from Alternative 1) and employment to 27 jobs (from 49). If management changes resulted in the discontinuation of sleigh rides (and assuming no other viewing opportunities compensated for the loss), then the loss would amount to \$1.01 million in personal income and 49 jobs.

If reductions in elk numbers caused park visitation from May through October to decline by as much as 7%, personal income in Jackson Hole would be an estimated \$286.4 million per year (a decrease of \$20.1 million from Alternative 1) and employment would amount to 13,329 jobs (a loss of 936 jobs). However, reductions in elk numbers are not expected to affect park visitation more than negligibly.

Alternative 4

Analysis

Some effects of Alternative 4 would be similar to those described for Alternative 3 due to the major reduction in winter feeding and lower elk numbers on the refuge and in the park, although elk numbers would not be as low as under Alternative 3 (1,000 to 2,000 elk on the refuge under Alternative 3 compared to approximately 5,000 under Alternative 4 by the end of the implementation phase). Furthermore, bison numbers would be considerably lower under Alternative 4 (approximately 500 under Alternative 4 compared to 1,000 or more under Alternative 3).

National Elk Refuge — A minor to moderate reduction in the number of elk wintering on the refuge could affect how many elk would be viewable on sleigh rides, as compared to baseline conditions and Alternative 1. Based on responses to the visitor survey, Alternative 4 could result in nonlocal sleigh ride attendance declining about 29% or 6,488 visitors per year, resulting in an average of 15,832 nonlocal visitors per year (Loomis and Koontz 2004). As shown in Table 4-10, this would result in an estimated average spending of \$1.29 million in the Jackson Hole area annually (\$667,500 less than the baseline figure of \$1.96 million). This would generate \$671,900 in personal income and 33 jobs annually in the Jackson area economy (see Table 4-10), a decrease from baseline conditions of \$334,200 in personal income and

16 jobs annually. Spending in Wyoming by out-of-state visitors would generate approximately \$641,300 in personal income and 37 jobs in the state, a decrease from baseline conditions of \$315,600 in personal income and 18 jobs per year (see Table 4-11).

Similar to the other alternatives, if there were many days when sleigh rides could not be offered due to no viewable elk, it would be difficult for the operator to cover the costs of employee salaries and other expenses. Additionally, fewer people could drive to the National Museum of Wildlife Art to attempt to ride on the sleighs. However, the variability in elk numbers under Alternative 4 would not be as large as under Alternative 2, so adverse impacts would not be as great.

If sleigh ride operations had to cease, associated personal income and jobs would be lost. However, the economic impacts associated with sleigh ride visitation currently is less than 1% of the Jackson Hole economy, so stopping sleigh ride operations would have a negligible impact on the local economy.

A non-endemic infectious disease in the Jackson elk or bison herd could cause declines in animal numbers, but less than under Alternative 1 if winter feeding had already been reduced and if elk numbers on the refuge had been reduced to approximately 5,000 prior to the disease outbreak. However, adverse impacts to the local economy could approach or exceed those under Alternatives 2, 3, and 6 without the introduction of a non-endemic disease. If a new disease became established early in the implementation phase of Alternative 4, potential impacts would be similar to those described in Alternative 1.

Grand Teton National Park — Anticipated reductions in elk and bison numbers in Grand Teton National Park would not measurably affect the number of people visiting the park because they are not major criteria that nonlocal visitors use in deciding whether to travel to the park. However, if a substantial number of potential park visitors did revise their travel plans based on the number of elk, it is estimated that May-October visitation to the park could decline by an average of 2%–3% compared to baseline conditions and Alternative 1 (Loomis and Koontz 2004). As shown in Table 4-12, a maximum 3% decline in visitation would re-

sult in estimated spending in the Jackson Hole area of \$570.75 million (a decline of \$19.16 million annually compared to Alternative 1). Personal income would amount to \$297.3 million per year (a decrease of \$9.17 million or 0.9%), and employment would total 13,839 jobs (a decrease of 426 or 1.7%).

The direct and secondary effects of spending in Wyoming by out-of-state visitors would result in a statewide decrease by \$11.76 million in personal income (0.1%) and 648 jobs (0.2%) annually (see Table 4-13).

A non-endemic infectious disease in the Jackson elk or bison herd could cause declines in the number of animals, but less than under Alternative 1 if winter feeding and elk numbers had been reduced, as described for the refuge. If elk and bison numbers did in fact affect visitation, a nonnative infectious disease in the herds could result in fewer people visiting the park, reducing personal income and jobs in Jackson Hole. Under this scenario reductions could approach or exceed those under Alternatives 2, 3, and 6 without the introduction of a non-endemic disease.

Other Areas — Effects of elk viewing on the local economies of communities outside the Jackson Hole area would not be affected by elk and bison management in Jackson Hole any more than would occur under Alternative 1.

Conclusion

Anticipated changes to sleigh ride visitation on the National Elk Refuge under Alternative 4 could reduce personal income to an estimated \$671,500 (a decrease of \$334,200 per year from Alternative 1) and employment to 33 jobs (a loss of 16).

If reductions in elk numbers caused park visitation from May to October to decline by as much as 3%, annual personal income in Jackson Hole would be an estimated \$297.3 million (a decrease of \$9.17 million compared to Alternative 1) and employment would total 13,839 jobs (a loss of 426). However, reductions in elk numbers are expected to have a negligible impact on park visitation.

Alternative 5Analysis

National Elk Refuge — In the short and long terms there would be few changes in elk and bison viewing opportunities on the refuge as compared to baseline conditions and Alternative 1, and economic impacts would be similar to Alternative 1 (see Table 4-10 and Table 4-11).

However, the sleigh ride visitor survey indicated that visitation could increase with more elk. This scenario projects a 14% increase in nonlocal visitor participation in sleigh rides (Loomis and Koontz 2004). This would generate \$2.34 million in total annual spending (an increase of \$379,100 compared to Alternative 1), annual personal income of \$1.19 million (an increase of \$186,900), and 58 jobs (an increase of 9), as compared to baseline conditions and Alternative 1 (see Table 4-10). The direct and secondary effects of spending in Wyoming by out-of-state visitors would generate approximately \$1.13 million in personal income (an increase of \$173,100) and 65 jobs (an increase of 10), as compared to baseline conditions and Alternative 1 (see Table 4-11). However, these effects are likely overstated since the number of elk viewable from sleighs would likely be indistinguishable from Alternative 1 and bison would not be viewable from sleighs.

A non-endemic infectious disease in the Jackson elk and/or bison herds would have effects similar to Alternative 1.

Grand Teton National Park — It is anticipated that the number of people visiting the park from May to October would not change measurably under Alternative 5, compared to baseline conditions and Alternative 1, despite major reductions in bison numbers in the park (from an estimated 1,000 to 350–400) and minor reductions in elk numbers (from an estimated baseline of 2,676 to 2,500 or fewer). This analysis is based on data that show elk and bison numbers are not major criteria used by nonlocal visitors in deciding whether to travel to the park.

A minor reduction in elk numbers in the Grand Teton elk herd segment under Alternative 5 could be partially offset by a negligible to minor increase in the Yellowstone and Teton Wilderness segments (compared to baseline conditions). More

elk in these other two segments could potentially result in more elk migrating through Grand Teton National Park during the spring and fall.

However, if wildlife numbers were an important factor for potential park visitors in deciding whether to travel to the park, it is estimated that Alternative 5 would have a negligible impact on the local and state economies.

A non-endemic infectious disease in the Jackson elk and/or bison herd while Alternative 5 was being carried out would have potential effects similar to Alternative 1.

Other Areas — Effects of elk viewing on the local economies outside Jackson Hole would not be affected by elk and bison management in Jackson Hole any more than under Alternative 1.

Conclusion

It is anticipated that contributions of sleigh ride visitation on the refuge and visitation of the park to the local economy under this alternative would be similar to Alternative 1.

Mitigation

Applicable mitigation measures would be the same as discussed for the “Wildlife Viewing and Environmental Education Opportunities,” page 465.

ELK HUNTING**Methodology for Analyzing Impacts**

A survey of elk hunters within the Jackson elk herd units during the 2001 hunting season was conducted by the U. S. Geological Survey and Colorado State University, in cooperation with the Wyoming Game and Fish Department. Surveys were mailed to 3,747 elk hunters, and the response rate was 56%. The objective of the survey and analysis was to quantify the amount of money elk hunters spent in the local and regional economies and the associated economic impacts such as changes in income and employment (Koontz and Loomis 2005). Spending by elk hunters in the Jackson area generates considerable economic benefits for the local and regional economy. An elk hunter usually buys a wide range of

goods and services during a hunting trip. Major expenditure categories include outfitter/guide fees, hunting licenses, supplies, game processing, lodging, food, and gasoline.

Results from the elk hunter survey show that in addition to hunting license fees, nonlocal Wyoming resident elk hunters who live in Wyoming but outside Teton County spent an average of \$422 per trip and out-of-state elk hunters spent \$1,728 per trip locally in the Jackson Hole area (Koontz and Loomis 2005). Elk hunters were further classified by the federal land area where they hunted. Table 3-14 shows the average amount spent per hunter per trip (excluding hunting license fees) for each federal land area. Nonlocal Wyoming residents who hunted on the refuge spent more on in-town services (restaurants, grocery stores, and hotels) than those hunting in the park and national forest. The most noticeable difference between spending by elk hunters among federal land areas was that nonresidents hunting in the national forest spent an average of almost \$1,500 per trip on outfitter/guide fees. Wyoming hunting regulations require nonresident elk hunters to be accompanied by an outfitter or guide when hunting in national forest wilderness areas.

On average the total amount spent by nonresident hunters in the Jackson Hole area and en route to the Jackson area totaled approximately \$1,305 per trip when hunting on the refuge, \$1,201 per trip when hunting in the park, and \$2,452 per trip when hunting in other areas in the Jackson elk herd unit.

Besides local and regional expenditures, hunters also spent money purchasing WGFD hunting licenses. Fees for a 2001 WGFD hunting license were \$38 for a resident bull elk tag, \$33 for a resident cow/calf tag, \$410 for a nonresident bull elk tag, and \$160 for a nonresident cow/calf tag. Survey results show that the average amount spent on a 2001 WGFD elk hunting license was \$37 for local residents, \$43 for nonlocal Wyoming residents, and \$387 for nonresident hunters. This analysis did not incorporate hunting license fees because various types of licenses with different fee amounts would overly complicate the analysis.

Changes in hunter numbers and elk harvested for each alternative are described under recreational opportunities.

The economic impact analysis of hunter spending by Koontz and Loomis (2005) accounted for the average number of hunting trips taken per hunter to the Jackson area and the proportion of hunters by residential groups. For the analysis of each alternative, it was assumed that the proportion of hunters from the Jackson area, other parts of Wyoming, and outside Wyoming, and that the number of trips taken per hunter would stay the same. From WGFD hunter harvest records and refuge hunting permit records, it was estimated that (1) 42% of hunters on the refuge are local residents, 44% are nonlocal Wyoming residents, and 14% are from out of state; (2) 12% of hunters in the park are local residents, 50% are nonlocal Wyoming residents, and 38% are from out of state; and (3) 21% of hunters in Bridger-Teton National Forest are local residents, 54% are nonlocal Wyoming residents, and 25% are from out of state.

All of the alternatives assume that the Jackson elk herd would be at the WGFD objective level of 11,000 animals and that it would be maintained at or near this level. Economic impacts include both direct and secondary effects. Comparisons are to baseline conditions as reflected in Alternative 1.

If non-endemic diseases such as bovine tuberculosis or chronic wasting disease infected the Jackson elk herd, and the herd was reduced, hunter opportunities would also be lower to the same degree.

Impacts of the Alternatives

Alternative 1

Analysis

Under Alternative 1 an estimated average of 6,667 elk hunters would annually hunt in the Jackson elk herd unit, which is lower than the average number of hunters from 1997 to 2001. Nonlocal and nonresident hunter spending impacts on the Jackson area economy are presented in Table 4-14. The direct and secondary effects of hunter spending (nonlocal Wyoming residents and out-of-state residents) under Alternative 1 would generate an estimated \$3.39 million annually in personal income and 186 jobs in the local Jackson area economy, representing less than 1% of total local income (0.3%) and employment (0.7%).

The economic impacts at the state level from nonresident hunter spending in the Jackson Hole area

as well as elsewhere in the state (e.g., areas visited by nonresident hunters on their way to the Jackson area) are presented in Table 4-15. Under Alternative 1 spending would annually generate an estimated average of \$2.82 million in personal income and 179 jobs in the state. This represents only 0.01% of total income and 0.05% if employment in the state.

National Elk Refuge — An average of 733 elk hunters would hunt on the refuge each year under Alternative 1, based on estimated annual harvest records and hunter success. Spending by nonlocal Wyoming residents and out-of-state hunters would annually generate an estimated average of over \$272,400 in personal income and 12 jobs in the local Jackson area economy, representing about 8% of the personal income and 7% of the jobs (see Table 4-14). Spending in Wyoming by out-of-state hunters would annually generate (direct and secondary effects) an average of over \$84,000 in personal income and 4 jobs in the state.

Grand Teton National Park — An average of 1,600 deputized elk hunters would use the park annually under Alternative 1. Spending by nonlocal Wyoming residents and out-of-state hunters would annually generate an estimated \$976,800 in personal income and 45 jobs in the local Jackson

area economy. This would account for about 29% of the personal income and about 24% of the jobs generated under Alternative 1 (as shown in Table 4-14). Spending in Wyoming by out-of-state hunters would annually generate an average of \$680,000 in personal income and 39 jobs in the state.

Other Areas — An average of about 4,334 elk hunters use all other areas in the Jackson elk herd unit, primarily Bridger-Teton National Forest. Spending by nonlocal Wyoming residents and out-of-state hunters would annually generate an average of \$2.14 million in personal income and 129 jobs in the Jackson area economy. This would account for 63% of the personal income and 69% of the jobs generated by elk hunters in the Jackson elk herd unit (see Table 4-14). Of the 129 jobs generated, 59% (79 jobs) would primarily represent jobs for outfitters and hunting guides. Spending in Wyoming by out-of-state hunters would annually generate an average of \$2.06 million in personal income and 136 jobs in the state.

Conclusion

Elk hunting in Jackson Hole would continue to contribute a negligible amount to the local economy. The direct and secondary effects of spending

TABLE 4-14: POTENTIAL LOCAL ECONOMIC IMPACTS OF SPENDING BY NONLOCAL WYOMING RESIDENT AND OUT-OF-STATE ELK HUNTERS

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Estimated Number of Elk Hunters	6,667 (Average)	3,275–5,540	3,435–7,667	6,793–7,314	6,757 (Average)	3,250–7,067
Total Economic Effects (Direct and Secondary)						
Personal Income (million/year)	\$3.39	\$1.62–\$2.74	\$1.71–\$3.83	\$3.39–\$3.66	\$3.43	\$1.62–\$3.54
Number of Jobs	186	97–165	100–220	195–210	190	95–203
Percentage of Total Local Income	0.33%	0.16%–0.27%	0.17%–0.37%	0.33%–0.36%	0.33%	0.16%–0.35%
Percentage of Total Local Employment	0.73%	0.38%–0.64%	0.39%–0.86%	0.76%–0.82%	0.74%	0.37%–0.79%

SOURCE: Koontz and Loomis 2005.

TABLE 4-15: POTENTIAL STATEWIDE ECONOMIC IMPACTS OF SPENDING BY OUT-OF-STATE ELK HUNTERS

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Estimated Number of Elk Hunters	6,667 (Average)	3,275–5,540	3,435–7,667	6,793–7,314	6,757 (Average)	3,250–7,067
Total Economic Effects (Direct and Secondary)						
Personal Income (million/year)	\$2.82	\$1.55–\$2.63	\$1.58–\$3.40	\$3.03–\$3.25	\$2.89	\$1.49–\$3.16
Number of Jobs	179	103–174	104–221	197–210	184	97–205
Percentage of Total State Income	0.01%	0.01%–0.02%	0.01%–0.03%	0.02%–0.02%	0.02%	0.01%–0.02%
Percentage of Total State Employment	0.05%	0.03%–0.05%	0.03%–0.07%	0.06%–0.06%	0.06%	0.03%–0.06%

SOURCE: Koontz and Loomis 2005.

by nonlocal Wyoming residents and out-of-state hunters would annually generate an estimated \$3.39 million in personal income and 186 jobs in the local Jackson area economy, representing 0.33% of total local income and 0.73% of employment.

Alternative 2

Analysis

The number of elk hunters would decline sharply and become much more variable because elk hunting would only occur in Bridger-Teton National Forest and on private and state lands. In years when the number of elk in the herd unit was at or near the objective level, an estimated high of 5,540 hunters could be accommodated, but when the elk population declined to anticipated lows (due to severe winters and no feeding on the refuge), only an estimated 3,275 elk hunters could be accommodated, compared to 6,667 elk hunters per year now. Assuming an average number of 4,408 elk hunters per year (the midpoint of the estimated range), spending by nonlocal Wyoming residents and out-of-state hunters would annually generate an average of \$2.18 million in personal income and 131 jobs in the Jackson area economy. This would represent an annual average decrease of \$1.21 million in personal income (up to a decline of \$1.77 million in some years) and 55 jobs in the Jackson area economy, compared to Alternative 1 (see Table 4-14 and Table 4-15).

Of the estimated average 131 jobs, 59% (77 jobs) would primarily represent jobs for outfitters and hunting guides. This represents a decrease of 2 jobs from baseline conditions. In years that hunting levels dropped to the anticipated low, 97 jobs would be generated, 57 of which would be for outfitters and guides.

Average spending in Wyoming by out-of-state hunters would annually generate an estimated \$2.09 million in personal income and 138 jobs in the state each year. Compared to Alternative 1, this would be an annual decrease of \$729,000 in personal income and 41 jobs in the statewide Wyoming economy.

Conclusion

Elk hunting in Jackson Hole would contribute a negligible amount to the local economy. The average number of nonlocal Wyoming resident and out-of-state elk hunters in the Jackson elk herd unit under Alternative 2 would generate an estimated annual average of \$2.18 million in personal income and 131 jobs in the Jackson area economy. This represents an annual average decrease of \$1.21 million in personal income (or about 0.1% decline in personal income) and 55 jobs in the Jackson area economy, compared to Alternative 1.

Alternative 3

Analysis

The number of elk hunters in the Jackson elk herd unit would become much more variable under this alternative, similar to Alternative 2. In the long term the number of hunters would range from 7,667 in good years (when the elk herd was at or near the herd objective of 11,000) to 3,435 after a severe winter or series of above-average and severe winters. The associated local and statewide economic impacts stemming from this range of hunter numbers in the Jackson elk herd unit under Alternative 3 are presented in Table 4-14 and Table 4-15. An average of 5,551 hunters is used for the analysis, compared to a baseline figure of 6,667 hunters.

Spending by an average of 5,551 hunters would annually generate an estimated \$2.77 million in personal income and 160 jobs in the Jackson area economy. This represents an annual average decrease of \$621,000 in personal income and 26 jobs in the Jackson area economy, as compared to Alternative 1.

Spending in Wyoming by out-of-state hunters would annually generate an estimated annual average of \$2.49 million in personal income and 162 jobs in the state. This is an annual decrease of \$326,000 in personal income and 17 jobs in the statewide Wyoming economy, as compared to Alternative 1.

National Elk Refuge — In the long term, annual elk hunting opportunities on the refuge would decline from an average of 733 hunters per year to about 100–525 (an average of 313 hunters). Spending in the Jackson Hole area would annually gen-

erate an average of \$116,000 in personal income and 5 jobs, a decrease from baseline conditions of \$156,000 in personal income and 7 jobs. Spending in Wyoming by out-of-state hunters would annually generate \$36,000 in personal income and 2 jobs, a decrease of \$156,000 in personal income and 7 jobs in the statewide economy.

Grand Teton National Park — In the long term an estimated 215–895 deputized elk hunters (an average of 555 hunters) would participate in the park elk herd reduction program, compared to a baseline figure of 1,600 elk hunters. Spending would annually generate an estimated \$339,000 in personal income and 16 jobs in the Jackson area. This is an annual decrease from park hunter baseline conditions of \$638,000 in personal income and 30 jobs. Spending by out-of-state hunters in Wyoming would annually generate \$236,000 in personal income and 13 jobs, a decrease of \$444,000 in personal income and 25 jobs statewide.

Other Areas — The number of hunters in other areas (primarily Bridger-Teton National Forest) would range from a high of 6,247 to a low of 3,125 (an average of 4,684), compared to a baseline figure of 4,334. Spending would annually generate an average of \$2.31 million in personal income and 139 jobs in the Jackson area economy. This would be an annual increase of \$173,000 in personal income and 10 jobs, as compared to baseline conditions and Alternative 1. Of the 139 jobs, 59% (82 jobs) would be primarily for outfitters and hunting guides. This would be a 3 job increase compared to baseline conditions. If hunting levels dropped to the anticipated low due to periodic declines in the elk population, 93 jobs would be generated by elk hunters in the national forest, with 54 (a loss of 25 jobs) for outfitters and guides.

Spending in Wyoming by out-of-state hunters would annually generate an estimated \$2.22 million in personal income and 147 jobs in the state. This represents an annual increase of \$166,000 in personal income and 11 jobs in the overall Wyoming economy, compared to baseline conditions.

Conclusion

Elk hunting in Jackson Hole would contribute a negligible amount to the local economy. The average number of nonlocal Wyoming resident and nonresident elk hunters in the Jackson elk herd

unit under Alternative 3 would annually generate an estimated \$2.77 million in personal income and 160 jobs in the Jackson area economy. This represents an annual average decrease of \$621,000 in personal income (or less than 0.1% decline in personal income) and 26 jobs in the Jackson area economy, compared to Alternative 1.

Alternative 4

Analysis

In the long term the number of elk hunters and the numbers of elk harvested each year in the Jackson elk herd unit would not change substantially from baseline conditions and Alternative 1, although the distribution of elk hunters could change to a minor extent. Under this alternative there would be an estimated 6,793–7,314 elk hunters per year (an average of 7,054) in the Jackson elk herd unit. Estimates of spending impacts are summarized in Table 4-14 and Table 4-15.

An average of 7,054 elk hunters per year would annually generate an estimated \$3.53 million in personal income and 202 jobs in the Jackson area economy. This would be an annual increase of \$139,000 in personal income and 16 jobs, as compared to Alternative 1.

Estimated spending in Wyoming by out-of-state hunters would annually generate an estimated \$3.14 million in personal income and 203 jobs in the state, an annual increase of \$230,000 in personal income and 24 jobs statewide.

National Elk Refuge — In the long term the number of elk hunting opportunities on the refuge would decline by a moderate to major amount, from the baseline average of 733 to 340–487 elk hunters per year (with an average of 420). Spending would annually generate an estimated average of \$169,000 in personal income and 8 jobs in the Jackson area economy, an annual decrease of \$104,000 in personal income and 5 jobs, as compared to Alternative 1. Spending by out-of-state hunters would annually generate an estimated \$52,000 in personal income and 3 jobs in the state, an annual decrease of \$32,000 in personal income and 2 jobs.

It is possible that if elk from the Yellowstone, Teton Wilderness, and Gros Ventre segments at-

tempted to winter on the refuge, then more elk might be harvested on the refuge, but would probably not be higher than the baseline harvest level.

Grand Teton National Park — In the long term spending by 773–957 deputized elk hunters per year (an average of 865) would annually generate an average of \$528,100 in personal income and 25 jobs in the Jackson area economy. This would be an annual decrease of \$448,800 in personal income and 21 jobs compared to Alternative 1. Spending by out-of-state hunters would generate an estimated \$367,600 in personal income and 21 jobs in the state, an annual decrease of \$312,400 in personal income and 18 jobs statewide.

Other Areas — In the long term an estimated 5,600–5,870 elk hunters per year (with an average of 5,735) would hunt outside the refuge and park, compared to the base figure of 4,334 elk hunters per year. Spending in the Jackson Hole area would annually generate an estimated \$2.83 million in personal income and 170 jobs, an annual increase of \$691,600 in personal income and 42 jobs compared to Alternative 1. Of the estimated 170 jobs, 59% (100 jobs) would be primarily for outfitters and hunting guides, an increase of 21 jobs. If hunting levels dropped due to declines in the elk population, 166 jobs (a decrease of 19) would be generated, with 98 (a decrease of 2 jobs) for outfitters and guides. Even during years of estimated low elk numbers, the increase in elk hunters in the national forest would more than offset the overall reduction in elk numbers.

Estimated spending in Wyoming by out-of-state hunters would generate \$2.72 million in personal income and 180 jobs in the state, an annual increase of \$664,700 in personal income and 44 jobs statewide.

Conclusion

Elk hunting in Jackson Hole would contribute a negligible amount to the local economy. The average number of nonlocal Wyoming resident and out-of-state elk hunters under Alternative 4 would generate an estimated annual average of \$3.53 million in personal income and 202 jobs in the Jackson area economy. This represents an annual average total increase of \$139,000 in per-

sonal income in the local economy (an increase of 0.03%) and 16 jobs, as compared to Alternative 1.

Alternative 5

Analysis

Because Alternative 5 would maintain winter feeding nearly every winter, its economic effects would be nearly identical to Alternative 1.

Under Alternative 5 there would be an estimated average of 6,757 elk hunters per year in the Jackson herd unit, compared to the baseline figure of 6,667. Spending in the local economy would generate \$3.43 million in personal income and 190 jobs, nearly the same as Alternative 1. Estimated spending in Wyoming by out-of-state hunters would generate \$2.89 in personal income and 184 jobs statewide, or less than 1% of total income and employment (see Table 4-14 and Table 4-15).

National Elk Refuge — In the long term the annual number of elk hunters on the refuge could decline from an average of 733 to 670 or fewer hunters. Spending would annually generate an estimated \$249,000 in personal income and 11 jobs in the Jackson area economy, an annual decrease of \$23,400 in personal income and 1 job in the Jackson area economy compared to Alternative 1. Spending in Wyoming by out-of-state hunters would generate an estimated \$76,900 in personal income and 4 jobs, an annual decrease of \$7,200 in personal income and less than 1 job statewide.

Grand Teton National Park — Approximately 1,494 elk hunters would hunt in the park under Alternative 5 in the long term, compared to the baseline figure of 1,600. Spending would annually generate an estimated \$912,100 in personal income and 42 jobs in the Jackson area economy. This would be an annual decrease of \$45,100 in personal income and 3 jobs in the local economy. Spending in Wyoming by out-of-state hunters would annually generate an estimated \$367,600 in personal income and 21 jobs in the state, an annual decrease of \$45,100 in personal income and 3 jobs statewide.

Other Areas — In the short and long terms spending by an estimated average of 4,593 elk hunters (compared to the baseline figure of 4,334) would annually generate an estimated \$2.27 million per

year in personal income and 136 jobs in the Jackson area economy. This would be an annual increase of \$127,900 in personal income and 8 jobs in the local economy. Of the estimated average 136 local jobs, 59% (80 jobs or an increase of 1 job compared to Alternative 1) would be primarily for outfitters and hunting guides.

Spending in Wyoming by out-of-state hunters would annually generate an average of \$2.18 million in personal income and 144 jobs in the state, an annual increase of \$122,900 in personal income and 8 jobs statewide.

Conclusion

Elk hunting in Jackson Hole would contribute a negligible amount to the local economy. The number of elk hunters and the numbers of elk harvested each year in the Jackson elk herd unit under Alternative 5 would not change substantially from baseline conditions or Alternative 1, although the distribution of elk hunters could change to a negligible to minor extent. Spending in the local economy would generate \$3.43 million in personal income and 190 jobs, nearly the same as Alternative 1. Estimated spending in Wyoming by out-of-state hunters would generate \$2.89 in personal income and 184 jobs statewide, or less than 1% of total income and employment.

Alternative 6

Analysis

The number of hunters under Alternative 6 would range from a high of 7,067 to a low of 3,250, with an average of 5,192 hunters, compared to the baseline figure of 6,667. Spending by elk hunters would annually generate an estimated \$2.60 million in personal income and 150 jobs in the Jackson area economy, an annual average decrease of over \$793,100 in personal income and 36 jobs, compared to Alternative 1. Average spending in Wyoming by out-of-state hunters would annually generate an estimated \$2.35 million in personal income and 153 jobs, an annual decrease of almost \$466,400 in personal income and 26 jobs statewide (see Table 4-14 and Table 4-15).

National Elk Refuge — The number of elk hunters on the refuge could potentially decline from the baseline average of 733 to 120–403 elk hunters

per year (with an average of 234). Related spending in the Jackson Hole area would annually generate an estimated \$86,900 in personal income and 4 jobs, an annual decrease of \$793,100 in personal income and 36 jobs. Average spending in Wyoming by out-of-state hunters would generate an estimated \$26,800 in personal income and 1 job in the state, an annual decrease of \$57,200 in personal income and 3 jobs statewide.

Grand Teton National Park — In the long term approximately 260–897 elk hunters per year (with an average of 519) would hunt in the park under Alternative 6, compared to the baseline figure of 1,600. Spending would annually generate an estimated \$316,900 in personal income and 15 jobs in the Jackson area economy, an annual decrease of \$660,000 in personal income and 31 jobs in the Jackson area economy. Estimated spending in Wyoming by out-of-state hunters would generate an estimated \$220,600 in personal income and 13 jobs in the state, an annual decrease of \$459,400 in personal income and 26 jobs statewide.

Other Areas — An estimated 2,870–5,767 elk hunters per year (with an average of 4,440) would hunt primarily in Bridger-Teton National Forest, compared to a base figure of 4,334 elk hunters per year. Spending by nonlocal Wyoming residents and out-of-state hunters would annually generate an estimated \$2.19 million in personal income and 132 jobs, an annual increase of \$52,300 in personal income and 3 jobs, as compared to Alternative 1. Of the estimated average 132 jobs, 78 jobs (an increase of 1 job) would primarily be for outfitters and hunting guides. With a large decline in the elk population, 85 jobs would be generated, 50 of which would be for outfitters and guides, a decrease of 27 jobs from baseline conditions.

Estimated spending in Wyoming by out-of-state hunters would annually generate \$2.11 million in personal income and 139 jobs in the state, an annual increase of \$50,300 in personal income and 3 jobs in the overall Wyoming economy.

Conclusion

Elk hunting in Jackson Hole would contribute a negligible amount to the local economy. The average number of nonlocal Wyoming resident and nonresident elk hunters in the Jackson elk herd unit under Alternative 6 would generate an esti-

mated annual average of \$2.60 million in personal income and 150 jobs in the Jackson area economy. This represents an annual decrease of over \$793,100 in personal income (or less than a 0.1% decline in personal income) and 36 jobs in the Jackson area economy, compared to Alternative 1.

Mitigation

No mitigation measures would be necessary.

BISON HUNTING

Methodology for Analyzing Impacts

Bison hunting was allowed on the National Elk Refuge during the 1989–90 season and for a short time in the fall of 1990. A total of 39 bison were taken during these two seasons. Bison hunting was then stopped by a lawsuit, as discussed in Chapter 1. According to the 2001 Jackson elk hunter survey, bison hunting on the refuge is still very desirable, with 76% of local Wyoming residents, 80% of nonlocal Wyoming residents, and 61% of out-of-state hunters stating they would apply for a bison tag (Koontz and Loomis 2005).

From 1997 through December 2002, hunters harvested 122 bison in Bridger-Teton National Forest east of the refuge. Similar to elk hunting, bison hunting would have an economic impact on the local economy through expenditures made by hunters during their stay in the area. In addition to local hunter spending, license fee revenue would be generated for the Wyoming Game and Fish Department to partially offset the cost of administering the hunt.

Because no specific expenditure information was collected for bison hunting, estimates developed by the Wyoming Cooperative Extension Service for the 1996 *Jackson Bison Herd Long-term Management Plan and Environmental Assessment* (NPS and USFWS 1996) were used to determine economic impacts, and they should be considered low. These estimates were based on WGFD elk hunter expenditure data, plus personal communication with WGFD personnel. The anticipated number of bison hunters that would hunt under each alternative would be negligible compared to the number of elk hunters, ranging from a low of 45 bison hunters to a high of 150 (see Table 4-16). Besides the estimates of spending by

local bison hunter provided by the Wyoming Cooperative Extension Service, bison hunters would also spend money purchasing WGFD hunting licenses. Fees for a 2004 hunting license were \$330 for a resident bison tag and \$2,100 for a nonresident bison tag. According to WGFD personnel, 90% of bison hunters are residents and 10% are nonresidents. This percentage split between resident and nonresidents was used to estimate hunting license revenue across the management alternatives.

If non-endemic diseases such as bovine tuberculosis or paratuberculosis infected the Jackson bison herd, and the herd was reduced, hunter opportunities would also be lower to the same degree.

No bison hunting opportunities would be provided in Grand Teton National Park under any alternative.

Impacts of the Alternatives

Alternative 1

Analysis

Opportunities for bison hunting would not be provided on the refuge under this alternative, which is the same as baseline conditions.

Bison hunting opportunities in Bridger-Teton National Forest immediately east of the refuge would continue. The refuge's winter feeding program would continue to result in low winter mortality, allowing the bison population to grow and provide opportunities for hunting. There was an average of about 50 hunters east of the refuge each year during the 2001–3 hunting seasons. Although the number of bison would continue to grow, hunting opportunities would not correspondingly increase because most bison would remain on the refuge and in the park during hunting season as a result of the supplemental feeding program. It is estimated that the average number of bison harvested each year could potentially increase to 50 animals per year, which would result in approximately 60 hunters being able to hunt bison each year in the national forest (Brimeyer, pers. comm. 2004). Based on estimates provided the 1996 bison management plan by the Wyoming Cooperative Extension Service, 60 bison hunters would spend an estimated total of \$40,530 per year in the local area, which would generate

TABLE 4-16: BISON HUNTER SPENDING IMPACTS

	Alternative 1	Alternative 2	Alternative 3	Alternatives 4 and 6	Alternative 5
Estimated Average Number of Hunters	60	50	150	90	75
Total Economic Effects (Direct and Secondary)					
Personal Income (dollars/year)	\$9,726	\$8,105	\$24,315	\$14,589	\$12,158
Jobs	0.76	0.64	1.90	1.20	1.00

\$9,726 in personal income and 0.76 job (see Table 4-16). In addition to the amount hunters spent in the local area, an average of \$30,420 would go to the Wyoming Game and Fish Department for license fees.

Conclusion

The economic impacts of bison hunting would be negligible. Assuming an average of about 60 bison hunters per year in the national forest in the long term, these hunters would spend an estimated average of \$40,530 per year in the local area, which would generate \$9,726 in personal income and 0.76 job annually in the local economy.

Alternative 2

Analysis

Bison hunting would not be permitted on the refuge, the same as Alternative 1.

Even though bison numbers would drop considerably under this alternative (to 250–500), continued bison hunting immediately to the east of the refuge in Bridger-Teton National Forest might not result in a long-term decline in bison numbers. No supplemental winter feeding on the refuge would force bison to wander farther during the fall and winter and onto national forest lands during hunting season. Bison could also wander onto private lands, where they could be harvested or culled. It is estimated that an average of less than 50 bison would be harvested each year, compared to 60 under Alternative 1. Based on estimates provided for the 1996 Jackson bison plan by the Wyoming Cooperative Extension Service, 50 bison hunters would spend on average \$33,775 in the local area, which would generate \$8,105 in personal income and 0.64 job annually in the local economy (see Table 4-16). This represents an annual decrease of \$1,621 in personal income and 0.12 of a job compared to Alternative 1. In addition,

an average of \$25,350 would go to the Wyoming Game and Fish Department for license fees.

Conclusion

The economic impacts of bison hunting would be negligible. An average of 50 bison hunters hunting in the national forest each year in the long term would spend on average \$33,775 in the local area, generating an average of about \$8,105 in personal income and less than 1 job annually in the local economy.

Alternative 3

Analysis

In the long term the number of bison harvested each year would increase to an estimated average of about 120 bison. As many as 50 bison would continue to be harvested in the national forest and about 70 on the refuge. An average of about 150 hunters annually could hunt bison under this alternative. Spending would amount to an average of \$101,325 in the local area, which would annually generate \$24,315 in personal income and 1.9 jobs (see Table 4-16). This would be an annual increase of \$14,589 in personal income and 1.14 jobs in the Jackson area economy, as compared to Alternative 1. In addition, hunters would spend an average of \$76,050 for state license fees.

Conclusion

This alternative would generate the largest amount of personal income and jobs in the Jackson area in the long term, but the economic impacts would still be negligible. An estimated average of 150 bison hunters would spend an average of \$101,325 in the local area, which would annually generate \$24,315 in personal income and 1.9 jobs. This would represent an annual increase of \$14,589 in personal income and 1.14 jobs in the Jackson area economy compared to Alternative 1.

Alternatives 4 and 6Analysis

The number of bison harvested each year in the long term would decline to about 70 animals under Alternatives 4 and 6. The number of bison harvested on the refuge and in the national forest could be equally split, or as many as 50 bison could continue to be harvested in the forest. An average of about 90 hunters would spend on average \$60,795 in the local area, annually generating \$14,589 in personal income and 1.2 jobs (see Table 4-16). This would be an annual increase of \$4,863 in personal income and 0.44 job in the Jackson area economy, as compared to Alternative 1. In addition, an average of \$45,630 would go to the state for license fees.

Conclusion

The economic impacts of bison hunting under Alternatives 4 and 6 would be negligible. In the long term an estimated average of about 90 bison hunters would spend on average \$60,795 in the local area, which would generate \$14,589 in personal income and 1.2 jobs annually in the local economy. This would be an annual increase of \$4,863 in personal income and 0.44 job in the Jackson area economy, as compared to Alternative 1.

Alternative 5Analysis

In the long term the number of bison harvested each year would decline to an estimated average of about 60 bison. The number of bison harvested on the refuge and in the national forest could be equally split, or up to 50 bison could continue to be harvested in the forest. An average of about 75 hunters would spend on average \$50,663 in the local area, annually generating \$12,158 in personal income and one job (see Table 4-16). This would represent an annual increase of \$2,432 in personal income and 0.24 job, as compared to Alternative 1. In addition, an average of \$38,025 would go to the state for license fees.

Conclusion

The economic impacts of bison hunting would be negligible. An estimated 75 bison hunters would spend on average \$50,663 in the local area in the

long term, which would generate \$12,158 in personal income and one job annually. This would represent an annual increase of \$2,432 in personal income and 0.24 job in the Jackson area economy, as compared to Alternative 1.

Mitigation

No mitigation measures would be necessary.

CUMULATIVE EFFECTS

No cumulative effects on the economic impacts of recreational opportunities would be expected.

OTHER ECONOMIC IMPACTS**ANTLER SALES****Methodology for Analyzing Impacts**

The annual auctioning of elk antlers, which have been collected every spring on the National Elk Refuge by the Boy Scouts, has benefited the refuge as well as the Boy Scouts. The refuge receives 80% of the money and the Boy Scout troop retains 20%. Over the past 10 years the auction has raised as much as \$108,000 in a year, with an average of \$89,800 per year. Changes in elk and bison management on the refuge could potentially affect the number of antlers collected and, therefore, the amount of money that both the refuge and the Boy Scouts would gain from this activity.

The following analysis assumes for all alternatives that bull elk foraging on the National Elk Refuge would drop their antlers on the refuge, making them available for collection. However, many factors affect whether elk remain on the refuge throughout the antler-dropping season, even when supplemental feeding occurs. When weather is mild and snow levels are low, elk often leave the refuge and forage in the surrounding forest. Disturbance by antler poachers or other people illegally accessing refuge lands could cause elk to leave the refuge. In addition, wolves stalking the herd could cause some elk to seek shelter in the forest or move onto park lands (weather permitting). Often these animals return to the refuge, but the more time elk spend outside the refuge boundaries, the greater the chance that they will drop their antlers on national forest, park, or private lands. Although this might represent a finan-

cial loss to the National Elk Refuge and the Boy Scouts, private individuals who collect antlers in the national forest and on private lands could benefit from greater distribution of elk antlers throughout the area.

Impacts of the Alternatives

Because the analyses are concise, they also function as conclusion statements.

Alternatives 1 and 5

Proceeds from Boy Scout antler sales under Alternatives 1 and 5 would be lower than current conditions because elk numbers on the refuge would range from 5,000 to 7,500 and the Jackson elk herd would total 11,000 animals. In the past 10 years elk numbers on the refuge have often exceeded 7,500 animals due to the Jackson herd being over objective; therefore, antler sales have been more profitable than they would be once the herd was reduced to an estimated 11,000 animals. Proceeds from antler sales would range from an estimated \$59,700 to \$89,600, and average \$66,600, a 26% decrease compared to current conditions. The National Elk Refuge's share of the antler sales would average an estimated \$53,300 under Alternatives 1 and 5, and the Boy Scouts' share an estimated \$13,300.

Alternative 2

Elk numbers on the refuge would range between 1,200 and 6,000 animals under Alternative 2. Proceeds from the Boy Scout antler auction would range from an estimated \$14,300 to \$71,700, and average \$43,000, a 26% loss in revenue as compared to baseline conditions and Alternative 1. The National Elk Refuge's share of the antler sales would average \$34,400, and the Boy Scouts' share \$8,600.

Alternative 3

Under Alternative 3 the elk herd on the refuge would number between 1,000 and 2,000 animals; consequently, there would be fewer antlers to collect. Proceeds from the Boy Scout antler auction would range from an estimated \$11,900 to \$23,900, and average \$17,900, a 54% loss in revenue as compared to baseline conditions and Alternative 1. The National Elk Refuge's share of the antler

sales would average \$14,300, and the Boy Scouts' share \$3,600.

Alternative 4

Under Alternative 4 the elk herd on the refuge would be approximately 5,000 animals after the initial implementation phase. Proceeds from the Boy Scout antler auction would range from an estimated \$47,800 to \$59,700 and average \$53,700, a 14% loss in revenue as compared to baseline conditions and Alternative 1. The National Elk Refuge's share of the antler sales would average \$43,000, and the Boy Scouts' share \$10,700.

Alternative 6

Under Alternative 6 the elk herd on the refuge would range between 1,200 and 3,200 animals. Proceeds from the antler auction would range from an estimated \$28,700 to \$38,200, and average \$33,400, a 37% loss in revenue as compared to baseline conditions and Alternative 1. The National Elk Refuge's share of the antler sales would average \$26,800, and the Boy Scouts' share \$6,700.

Mitigation

No mitigation measures would be undertaken.

IMPACTS ON LANDSCAPING

Large numbers of elk and bison browsing and grazing in urban, suburban, and rural neighborhoods could negatively impact landscaping in the Jackson Hole area and the Green River basin in those alternatives that would reduce or eliminate supplemental feeding on the National Elk Refuge and under Alternative 1, which would allow bison numbers to grow unchecked.

Impacts of the Alternatives

Alternatives 1 and 5

Analysis

Currently, the Wyoming Game and Fish Department receives about a dozen calls a year regarding elk damaging landscaping in the Spring Gulch area. In those years when supplemental feeding of elk on the refuge is delayed, the problem is likely to be worse than in years when feeding begins

early (B. Long, pers. comm. 2004). Under Alternative 1 supplemental feeding would continue in almost all years, and therefore, most elk would remain on the refuge through the winters. Landscaping on private property in the Jackson Hole area and the Green River basin would not be impacted by elk browsing and grazing any more than has occurred in the recent past.

As bison numbers continued to grow under Alternative 1, some bison could leave the refuge, and private property could experience more damage than has occurred in the past. However, bison would likely be hazed away from populated areas.

Under Alternative 5 landscaping damage caused by bison would be less than under Alternative 1 because bison numbers would be around 400 animals, and feeding would occur nearly every year.

Conclusion

Landscaping in the Jackson Hole area and the Green River basin would not be impacted by elk browsing and grazing any more than has occurred in the recent past. As bison numbers continued to grow under Alternative 1, some areas could experience more bison damage to private property than has occurred in the past. Fewer bison under Alternative 5 would reduce the level of potential impacts.

Alternatives 2 and 6

Analysis

Supplemental feeding would be phased out under Alternatives 2 and 6, resulting in many elk dispersing to other areas to forage. In addition to elk inhabiting native winter range, some elk would likely forage in suburban, urban, and rural neighborhoods in the Jackson Hole area and in the Green River basin, which would result in damage to trees and shrubs in yards, golf courses, and city parks. Damage to landscaping on private property would be heaviest during severe winters. As compared to baseline conditions and Alternative 1, negative economic impacts to some home and business owners could be substantial. During mild winters, large numbers of elk could continue to be supported on the National Elk Refuge even without supplemental feeding, and landscaping damage on private property would be reduced but it

might be more than under baseline conditions and Alternative 1. Elk that became habituated to feeding in suburban and urban areas during severe winters could return to these areas even in mild winters rather than stay on the refuge. Damage would likely be greatest during severe winters.

After phasing out supplemental feeding, bison numbers would grow or decline in response to natural conditions. In years when bison numbers were high, damage to landscaping in the Jackson Hole area could be substantial compared to Alternative 1. However, herd numbers would likely be less than under Alternative 1, so damage to landscaping in the Jackson Hole area would likely be less than what might occur under Alternative 1.

Conclusion

Compared to Alternative 1, damage to landscaping on private property in the Jackson Hole area and the Green River basin would likely be heaviest during severe winters under Alternatives 2 and 6. During mild winters large numbers of elk could continue to be supported on the National Elk Refuge even without supplemental feeding, and landscaping damage in suburban, urban, and rural neighborhoods would be much less, although it would likely be more than under Alternative 1. Landscaping damage by bison could be reduced because bison numbers would probably number from 250 to 500.

Alternative 3

Analysis

Supplemental feeding would occur only during severe winters under Alternative 3. In non-feeding years many elk would likely disperse to other areas to forage, and during above-average winters more elk would forage on private property in suburban, urban, and rural neighborhoods. Landscaping on private property in the Jackson Hole area and the Green River basin would be damaged, resulting in negative economic impacts to home and business owners as compared to baseline conditions and Alternative 1. However, landscaping damage would not be as great as under Alternative 2 because the refuge would supplementally feed in severe winters.

With a relatively large bison herd (an estimated 1,000 animals), some bison could leave the refuge and forage in suburban areas and golf courses in the Jackson Hole area. Although potential landscaping damage would not be as great as under Alternative 1, negative economic impacts to some home and business owners could be substantial.

Conclusion

Landscaping on private property in suburban, urban, and rural neighborhoods in the Jackson Hole area and the Green River basin would be damaged, resulting in negative economic impacts to home and business owners as compared to Alternative 1. Although potential landscaping damage due to bison would not be as great as under Alternative 1, negative economic impacts to some home and business owners could be substantial.

Alternative 4

Analysis

A framework would be developed to adaptively and progressively transition from intensive supplemental feeding to greater reliance on free-standing forage under Alternative 4. In non-feeding periods or years some elk would disperse to other areas to forage, and landscaping on private property in suburban, urban, and rural neighborhoods in the Jackson Hole area could be damaged, resulting in negative economic impacts to some home and business owners.

A smaller bison herd under Alternative 4, along with reduced feeding, could result in some bison leaving the refuge and foraging on private property in suburban areas and golf courses in the Jackson Hole area. Although potential landscaping damage would not be as great as under Alternative 1, negative economic impacts to some home and business owners could be substantial.

Conclusion

Landscaping on private property in the Jackson Hole area could be damaged in localized areas, resulting in negative economic impacts to some home and business owners as compared to Alternative 1. Although potential landscaping damage due to bison would not be as great as under Al-

ternative 1, negative economic impacts to some home and business owners could occur.

Mitigation

Several mitigation measures would be implemented to minimize the extent of depredation of landscaping and other property damage. For example, home and business owners could better protect trees and gardens through the use of enclosures. Hazing, depredation hunts, and agency culling might be needed to keep elk and bison away from trees, gardens, and other areas where they could potentially damage private property (e.g., fences). The U.S. Fish and Wildlife Service and the National Park Service would work with the Wyoming Game and Fish Department to assist in preventing and managing conflicts.

In areas where the chances of landscaping and property damage would be especially high (under Alternatives 2, 3, 4, and 6), habitat improvement projects could be specifically located and designed to help draw elk and bison away from these areas. The enhancement of forage production under Alternative 4 and possibly Alternative 6 would also help attract elk and bison away from private lands as winter feeding was scaled back or eliminated. By enhancing habitat near areas of potential conflict, there would be a destination for hazing animals, and it would be more likely that targeted animals could be kept away from private lands. Conservation easements in some areas might be used to provide forage for large ungulates.

IMPACTS ON LIVESTOCK OPERATIONS

Livestock operations could be affected by one or more of the following factors: numbers of elk and bison, animal density, frequency and intensity of supplemental feeding, animal distribution, elk and bison migrations, habitat improvements, and potential for contact between elk/bison and livestock. All of these factors, individually or in combination, have the potential to impact cattle operations, the predominant form of livestock enterprise in the Jackson Hole area.

METHODOLOGY FOR ANALYZING IMPACTS

Areas that were examined for possible direct impact included risk of disease transmission, testing

and vaccinations, modification of public land grazing allotments, private land acquisitions and easements, damage to agricultural crops, and depredation of stored hay. Indirect effects might include the perception by out-of-state buyers that Wyoming cattle could be compromised by disease-exposed elk and bison emigrating from the National Elk Refuge.

Where data were available, estimates of impacts are presented in dollar ranges. Where dollar estimates were not available, qualitative or relative assessments are made.

The analysis of disease-related impacts was based on a synthesis of information from two primary sources: (1) a disease experts meeting held November 12–14, 2002, and including representatives from the U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, Animal and Plant Health Inspection Service, Wyoming Game and Fish Department, and the Wyoming Livestock Board; and (2) published scientific literature.

OVERVIEW OF POTENTIAL DISEASE EFFECTS ON LIVESTOCK

Brucellosis

Brucellosis is by far the principal disease of concern to cattle producers, given its prevalence in the Jackson elk and bison herds. The potential transmission of brucellosis from elk and bison to cattle is the most significant issue being addressed in terms of potential effects on agricultural production in the Jackson Hole area and the Green River basin.

Risk of Transmission

One cattle herd in eastern Idaho recently contracted brucellosis from infected elk (Hillman 2002). In Wyoming elk presumably infected a cattle herd in Sublette County in 2003 and at least one of two Teton County herds infected in 2004. Transmission from elk or bison to cattle would likely only occur when (1) infected pregnant elk or bison shared the same feedground with cattle in winter (Thorne 2001) and (2) cattle contacted an aborted fetus and/or fluids, or contacted vegetation or soil that was contaminated by infected birthing material (from February to June for elk,

or from mid-December to mid-June for bison). Transmission of brucellosis from elk to cattle is very unlikely to occur during normal live births because elk are meticulous about cleaning their birth sites (Thorne 2001). Also, elk tend to isolate themselves when giving birth under normal conditions, reducing the chance that cattle would contact any contaminated material.

The Greater Yellowstone Interagency Brucellosis Committee (GYIBC 1997) has identified several factors that affect the risk of brucellosis transmission from elk and bison to livestock, as listed on page 131. Factors reducing risk include spatial and temporal separation and vaccination. Factors increasing risk include high density of animals, and association of susceptible animals with infected animal. The risk of transmission is affected by environmental factors because the *Brucella* organism has limited viability outside its host. The risk of transmission from elk or bison to cattle is almost certainly confined to contamination by a birth/abortion event by adult females. Susceptibility varies with species, and some individual animals may be naturally resistant to infection.

Elk and bison in Jackson Hole are free-ranging and could come into contact with livestock during migration in the fall and spring, and on summer ranges. During above-average or severe winters bison could leave the refuge in search of forage (the case under Alternatives 2 and 3, and possibly 6).

Limited cattle grazing occurs in Grand Teton National Park in the Kelly hayfields, Antelope Flats, and Hunter-Talbot areas during summer, and elk and bison could come into contact with cattle during late spring and early summer in these areas. Cattle grazing in the park occurs from about May 30 to October 31, when permitted. A cattle driveway from Blacktail Butte to the Elk Ranch area is used from June 25 to July 1. Because elk abortions may occur through June (Thorne et al. 1982), and because there is some overlap of elk calving grounds and cattle grazing allotments, cattle could be exposed to brucellosis for a short period on the West Elk Ranch, East Elk Ranch, and adjacent private lands.

Bison calving grounds overlap more fully with livestock grazing allotments in the park, and there are several allotments where cattle could come

into contact with aborted fetuses, infected birthing material, or contaminated vegetation or soil. The peak of the bison calving period is from May 1 through mid-June. While 95% of all births occur by the third week of July, births can occur well outside the normal birthing period (Cain et al. 2001). Mid-December through mid-June would be the most likely time period that brucellosis would cause bison to abort their calves (Meyer and Meagher 1995b). Therefore, this period would have the greatest risk of transmission to livestock. As long as brucellosis is present in the free-ranging Jackson bison herd, there is some level of risk that livestock could contract the disease from bison under any of the alternatives.

Elk and cattle could also come into contact with each other on private lands adjacent to the National Elk Refuge and Grand Teton National Park, and for a short period at the end of the elk calving season in active livestock grazing allotments in the national forest that overlap with elk calving areas (see the “Elk Calving Areas” map). Most cattle are turned out onto the allotments in mid-June. Clause et al. (2002) found there was limited interaction between elk and cattle in 11 of 12 risk areas on public grazing allotments from late May to mid-June. Behavioral differences keep elk and cattle separate under normal conditions in calving areas and summer ranges. The chance for transmission of brucellosis from elk to cattle on national forest grazing allotments during late spring and early summer is low. Nonetheless, there have been recommendations that livestock grazing in elk calving areas be delayed until late June or July to avoid any risk of disease transmission to cattle (Smith and Robbins 1994).

Testing and Vaccinating for Brucellosis

Regardless of the alternative selected, livestock producers in western Wyoming would continue to test and vaccinate cattle in accordance with state law and regulations. It is expected that testing will be required for at least some Wyoming cattle after the state reattained its brucellosis-free status in September 2006. Although the details of the required testing (e.g., number of cattle to be tested) have not yet been determined, Jackson Hole producers could be required to perform the tests.

Whether or not producers in the Jackson Hole area voluntarily altered their current vaccination and testing practices or would be forced to by more stringent state requirements would likely depend on the perception of the risk of transmission, regardless of the actual risk. Since brucellosis would not be eradicated from the elk and bison herds in Jackson Hole under any of the alternatives being considered, there would be a perceived risk to producers under all alternatives.

Potential Economic Effects of Brucellosis Outbreak on Cattle Producers

The presence of brucellosis in cattle would have following consequences for ranchers:

- *Abortions* — A cow that aborts or has a calf that does not survive because of the debilitating effects of brucellosis has, in effect, been maintained for a year without financial return.
- *Decreased weight gain by calves* — Calves from infected cows may have less than normal weight gains, since milk production from infected cows may be inadequate. Affected calves at the time of sale may weigh 100 pounds less than calves from healthy cows.
- *Delays in calf production* — Brucellosis would result in some infected cows being difficult to breed, resulting in fewer market cattle each year.
- *Increased rates of culling and replacement* — Brucellosis-affected cows are usually culled at a faster than normal rate because of reproductive deficiencies.

The recent brucellosis outbreaks in Wyoming demonstrate the non-production related consequences that could happen in the future if elk or bison transmitted brucellosis to cattle (after Wyoming regained brucellosis-free status). These consequences include the disruption of current incomes of cattle producers because of quarantines, and the loss of future incomes due to animal depopulations. Depopulation costs could be somewhat mitigated by the sale of affected cattle and indemnity payments.

After re-attaining class-free status, the state will still need to continue an acceptable level of sur-

veillance testing to maintain that status and to satisfy its trading partners.

Other Documented Diseases

None of the following diseases in the Jackson elk and bison herds would pose threats to the livestock industry.

- Livestock appear to be resistant to strains of *Pasteurella multocida* (M. W. Miller 2001; Disease Expert Meeting 2002).
- Livestock would not be impacted by the presence of necrotic stomatitis, psoroptic mites, or elk lungworms in the Jackson elk herd under any of the alternatives.
- Viral microparasites (e.g., bovine viral diarrhea, parainfluenza virus-3, and bovine respiratory syncytial virus) are relatively common in domestic livestock populations and can be serious in cattle. These viral microparasites are not likely to result in detectable impacts to livestock (Disease Expert Meeting 2002).

Undocumented Diseases

Some diseases do not now occur in the Jackson elk and bison herds, but they could have major adverse impacts to the livestock industry if they became established. The risk of transmission to livestock would likely correspond closely with elk and bison population levels in Jackson Hole. (Alternatives 1 and 5 would generally have a higher risk, while Alternatives 2, 3, and 6 would have a lower risk, and Alternative 4 an intermediate risk.)

Bovine tuberculosis and paratuberculosis are both of concern to the livestock industry (Thorne et al. 1982). Currently, bovine tuberculosis is nearly eradicated from domestic cattle (Demarais et al. 2002), and no captive cervid herds in the United States are known to carry it. However, because of the perceived risk to eradication programs for bovine tuberculosis in cattle, wildlife populations that sustain tuberculosis are of concern (Clifton-Hadley et al. 2001). Mortality rates in domestic cattle herds due to paratuberculosis can range up to 25% annually (Thorne et al. 1982).

The most likely way bovine tuberculosis and paratuberculosis could come to Jackson Hole

would be through domestic livestock (Disease Expert Meeting 2002) or wild cervids contacting infected captive cervids (Thorne et al. 1992). The probability of either disease reaching Jackson Hole is unknown, but is expected to be low, and the alternatives considered in this document do not pose a substantial risk of introducing the diseases into the Jackson Hole area. The potential risk involves the prevalence these diseases would reach under different management scenarios, which could in turn result in increased risk for livestock.

The chance of tuberculosis and paratuberculosis becoming established could be reduced through monitoring, early detection, and control of the disease in domestic livestock and captive cervids. In general, reduction of winter feeding, which would reduce animal concentrations, would do more to reduce the risk of these diseases becoming established than would reducing the number of animals on the refuge. A secondary factor would be the number of animals wintering on the refuge.

Based on current information, elk, mule deer, moose, and white-tailed deer are susceptible to chronic wasting disease (Williams, Miller et al. 2002). In 2005 a Colorado moose was found to be infected, but this species' social behavior makes it likely that moose infection would be rare (Colorado Division of Wildlife 2005). It appears highly unlikely that chronic wasting disease would have a direct effect on cattle.

Anthrax has not been observed in the Jackson elk and bison herds, but it has been observed in cattle and moose in the Green River basin. The probability of anthrax appearing in the Jackson elk and bison herds is unknown. Anthrax is not transmitted from animal to animal, so the management alternatives would do little to alter the chance of its introduction. Bison are very susceptible to anthrax (Disease Expert Meeting 2002). If anthrax was suspected in the Jackson elk or bison herd, all appropriate regulatory agencies would become involved in order to protect human and domestic animal health. Initially, livestock would be just as likely to contract anthrax as wildlife (Disease Expert Meeting 2002).

Malignant catarrhal fever is associated with sheep and the closest location to Jackson Hole where

domestic sheep grazing occurs is the west slope of the Teton Range.

Impacts of the Alternatives

Impacts Common to All Alternatives

Livestock Grazing Practices and Competition for Forage

None of the alternatives would impact the status of cattle grazing allotments in Grand Teton National Park or in other federal areas, including the Bridger-Teton National Forest and BLM lands in the Green River basin and the Red Desert.

Under all alternatives current permittees would be requested to modify their grazing practices so as to minimize the potential for contact between elk/bison and cattle, thereby minimizing the potential for disease transmission. Permittees would be requested to delay turnout dates and/or truck cattle between pastures where conflicts could occur. Although permittees would not be required to adopt the recommended modifications, some might do so voluntarily. A delay in turning out cattle onto allotments would mean that permittees would incur additional costs for feed.

Land Acquisition within the National Elk Refuge

Under all alternatives, efforts to acquire additional private inholdings within the refuge would continue as opportunities arose and as funds allowed.

Alternatives 1 and 5

Analysis

Risk of Brucellosis Transmission from Elk to Livestock — Near total separation between elk and livestock during winter has been maintained in the Jackson Hole area and would continue into the future under these alternatives. In the long term the number of elk on the National Elk Refuge would remain similar to baseline levels, but some elk could begin leaving the refuge, increasing the chances of elk transmitting brucellosis to cattle. If elk and livestock co-mingled during the period when abortions in elk usually occur, the risk of brucellosis transmission to livestock could increase. However, the refuge's winter feeding program, along with nearby state feedgrounds, has generally kept elk off private lands in the

Jackson Hole area. To the extent that elk stayed on the refuge, there would continue to be minimal risk of transmission from elk to livestock until April when elk leave the refuge.

In spring elk begin migrating up through Grand Teton National Park and into Bridger-Teton National Forest. From April until the end of June it is possible for elk that had wintered on the refuge to overlap in distribution with cattle on active livestock grazing allotments in the park and the national forest, as discussed earlier. Under normal circumstances elk tend to isolate themselves, and the risk on summer ranges would be lower than risk during the winter or spring.

Risk of Brucellosis Transmission from Bison to Livestock — Currently, the potential for transmission of brucellosis from bison to livestock is low in the Jackson Hole area (National Academy of Sciences 1998; Disease Expert Meeting 2002). Current efforts to spatially segregate bison and livestock would continue. Cattle are not allowed onto the park until June 1 (except the Gros Ventre allotment, May 15; and Teton Valley Ranch, May 1). All cattle permitted in the park must be vaccinated for brucellosis, but brucellosis vaccines used in cattle are not 100% effective.

In the short term Alternatives 1 and 5 would not result in any increase in the risk of brucellosis transmission from bison to livestock. In the long term a growing bison population under Alternative 1 (a 10%–14% annual rate increase) could increase the transmission risk, depending on the success of the refuge's winter feeding program in keeping bison on the refuge in winter. However, if bison began dispersing onto agricultural lands during the calving period when bison abortions occur, the risk of livestock being infected could increase (e.g., in the Spring Gulch area, west of the National Elk Refuge and north of Jackson). However, the Wyoming Game and Fish Department would presumably continue to take action to reduce or avoid co-mingling of livestock and bison (e.g., hazing, culling) during the bison calving period, which would lower or eliminate the actual threat of any increased risk.

Under Alternative 5 if bison did leave the refuge, the risk of transmission would be reduced by a moderate amount because of reduced prevalence of brucellosis in bison due to fewer bison and

RB51 vaccination and less chance of contact with livestock.

During the summer the risk of transmission in Grand Teton National Park could be reduced a minor to moderate degree due to fewer bison and RB51 vaccinations. The contribution of RB51 would depend on how efficacious the vaccine was in a field setting and the extent to which continued winter feeding would offset any benefits.

Grazing allotments in Grand Teton National Park would continue to be the area with greatest risk of transmission during the spring and early summer because cattle are brought onto grazing allotments starting May 1. The extent to which bison calving occurs in livestock grazing allotments is unknown.

Bison inhabiting private lands adjacent to the refuge and park during the calving period also pose a risk to livestock, and this would continue under Alternative 1.

Perception of Risk of Disease Transmission — Alternative 1 would probably have little or no impact on the perception of risk in the short term. Over the long term, however, Alternative 1 could increase the perception of risk simply because of more bison.

The perceived risk of transmission would likely be somewhat lower under Alternative 5 than under Alternative 1 due to fewer bison and vaccination programs for both bison (with RB51) and elk (with Strain 19). Nearly annual winter supplemental feeding (9 out of 10 years) would encourage elk and bison to remain on the refuge and away from livestock during winter.

Brucellosis Testing and Vaccination — Testing and vaccinating female calves in the Jackson Hole area would continue, and related costs would be a small portion of total production costs in the long term. Because the perception of risk would increase over the long term as bison numbers continued to grow, a small number of producers could modify their current testing and vaccination practices. Because bison inhabiting the refuge and park only overlap in distribution with a handful of livestock operators, the potential effects would be negligible.

Competition for Forage — The diets of elk, bison, and cattle overlap substantially (Shaw 1996; Wisdom and Thomas 1996). In one study cited by Miller et al. (2002), dietary overlap between elk and cattle was 31% and in another study, it ranged from 37% to 88%, depending on forest type and timing.

Hobbs et al. (1996, as cited by Miller 2002) demonstrated that heavy elk grazing in the winter and early spring (in one location in Colorado) can create a less suitable situation for cattle, possibly affecting cattle growth rates. While the effects on livestock of early-spring elk grazing could apply to the Jackson Hole area, the effects of winter grazing are probably of little consequence under Alternative 1 due to winter feeding of elk on the refuge and on state feedgrounds, which would continue to effectively draw most elk away from native winter range.

Under Alternative 1 elk could continue to compete to a limited extent with livestock for forage during summer in Grand Teton National Park and Bridger-Teton National Forest, but the effect is expected to be minimal (Miller 2002; Haynes, pers. comm. 2004). The use of livestock grazing allotments by elk in the park could be reduced to some extent during cattle grazing (Zeigenfuss et al. 2003b) because researchers have documented an aversion by wild ungulates to the presence of livestock (Wisdom and Thomas 1996, which cited four supporting studies). No studies are known that show an aversion by livestock to the presence of wild ungulates (Wisdom and Thomas 1996). Crucial elk winter range in Bridger-Teton National Forest does not overlap substantially with areas grazed by cattle in the summer (Hobbs et al. 2003). Later turnout dates for cattle would further reduce any potential competition (by June, cattle are able to forage on green-up vegetation, not residual vegetation).

Under Alternative 1 an estimated 1,000 bison under baseline conditions would result in considerable competition between bison and livestock in some areas of Grand Teton National Park due to the overlap in habitat use and diet during spring and summer, and competition would increase with a growing bison herd. However, as noted for elk, bison might avoid the use of livestock grazing allotments in the park when cattle are present. This would reduce direct competition to some extent

during much of the growing season. However, as bison numbers rose, bison might be less affected by the presence of cattle; possible effects on livestock production have not been quantified. Under Alternative 5, 350–400 bison would likely reduce competition for forage in the park by a moderate amount.

Under baseline conditions there is minimal competition between elk and cattle for forage in the Green River basin and the Red Desert because elk are stopped by state feedgrounds, and elk straying from these feedgrounds are hazed back to the feeding sites. An exception is the Steamboat elk herd east of Farson, where some competition between elk and cattle could occur. The amount of forage removed by elk in the Pinedale and Green River resource management areas is a small fraction of what is removed by livestock. Alternative 1 would not alter this situation.

Elk grazing has resulted in minimal competition with livestock on private lands in Jackson Hole, Buffalo Valley, the Gros Ventre River and Hoback River drainages, and the Green River basin.

Conservation Easements — Under Alternatives 1 and 5 there would be a long-term commitment to winter feeding on the refuge, so there would be little need for the Fish and Wildlife Service and the Park Service to acquire conservation easements outside the refuge and park with respect to elk and bison winter range.

Property Damage / Depredation of Stored Hay — The Wyoming Game and Fish Department reimburses landowners for certain damages caused by elk depredate agricultural lands. According to the agency, almost all damage to private property in the Jackson Hole area is caused by elk, and mostly to stored hay that has either been eaten or trampled by elk. Between 1999 and 2002 the state reimbursed property owners a total of \$15,197 for damages caused by elk in the Jackson Hole area (B. L. Smith, pers. comm. 2003). If it were not for the winter feeding program on the refuge and state feedgrounds, losses to ranchers and annual reimbursements to ranchers would be considerably higher.

Under Alternatives 1 and 5 property damage caused by elk would be expected to continue and presumably at the same levels experienced in the

past. Property damage caused by bison, now minimal, could increase with a larger bison herd that dispersed onto private agricultural lands in search of forage. Impacts overall would be relatively minor, but individual ranchers could experience moderate to major adverse impacts. Under Alternative 5 a smaller bison herd would likely result in minimal damage.

Depredation of stored hay in the Green River basin has been minimized through the use of state feedgrounds for elk and the fact that most of the hay produced in the Farson area is trucked to other locations (Lewis, pers. comm. 2004).

Potential Economic Effects — For Jackson Hole area cattle producers, any additional impact of Alternative 1 beyond baseline-level impacts would likely stem from increasing numbers of bison over time. Property damage and depredation of stored hay could increase due to continued growth in the herd, but effects would likely be minimal since WGFD personnel would presumably continue to respond quickly to incidences or potential incidences of depredation and damage. However, some producers could be affected to a moderate or major degree, especially since the state has not reimbursed property owners for damages caused by bison. The economic impact of increased competition for forage in the park is unknown, but would likely be negligible. Under Alternative 5 a smaller bison herd would result in less potential for depredation of stored hay, property damage, competition with cattle for forage, and risk of brucellosis transmission to cattle. However, differences would probably not be measurable.

Escalating bison numbers under Alternative 1 would increase the risk of brucellosis transmission from bison to cattle, although the risk of transmission would remain low.

Conclusion

The risk of elk and bison transmitting brucellosis to livestock would remain low under Alternative 1 due primarily to near annual winter feeding that maintains separation between elk/bison and livestock, even though winter feeding is responsible for maintaining brucellosis in elk and elevated brucellosis levels in bison. Under Alternative 5 the risk of transmission from bison to livestock would be lower, similar to Alternatives 3 and 4,

and higher than Alternatives 2 and 6. For cattle producers, an additional adverse impact beyond baseline impacts under both alternatives would likely stem from increasing numbers of bison. Eventually more bison and elk could leave the refuge during winter, increasing the risk of disease transmission to livestock. Of all of the alternatives considered, Alternative 1 would result in the highest level of long-term risk, although it would result in less risk than Alternatives 2, 3, 4, and 6 in the short term due to continued winter feeding.

Property damage and depredation of stored hay caused by elk would be negligible in the short term because of continued winter feeding. However, in the long term the growing bison population could result in bison and elk moving off the refuge during winter, which could increase property damage and depredation of stored hay in Jackson Hole, but impacts are expected to be negligible. Competition between bison and livestock under Alternative 1 would continue to increase in the park as the bison population grew; effects on livestock production are unknown. Continuing supplemental feeding on the refuge nearly every winter would minimize the potential for animals to wander off the refuge and cause property damage and depredation of stored hay. Competition between bison and livestock under Alternative 5 would be lower by a major amount in the park compared to Alternative 1 (similar to Alternatives 2, 4, and 6).

Alternative 2

Analysis

Risk of Brucellosis Transmission from Elk to Livestock — While the winter feeding program on the refuge was being phased back under Alternative 2, the risk of brucellosis transmission to livestock could increase as elk began seeking new winter range or decrease because elk would be more dispersed and less likely to overlap with livestock use. Although most of these elk would find winter range in the national forest, some animals might find their way to private lands where livestock are being fed on feedlines. This could become more problematic as winter feeding was phased out and above-average and severe winters occurred. Normally, elk avoid feeding with cattle if these areas are fenced and food is

available on the refuge or state feedgrounds. However, if more elk began wintering outside the refuge, their use of cattle feedlines could increase. Even a small number of infected elk on a cattle feedline could substantially increase the probability of brucellosis transmission in the short term.

If large numbers of elk began migrating to the Green River basin and the Red Desert and were not stopped by state feedgrounds, the potential for transmission to livestock in these areas would initially increase. Currently, state feedgrounds around the perimeter of the Green River basin keep elk from going onto private lands where they could come into contact with cattle being fed on feedlines. WGFD personnel would presumably help keep elk off cattle feedlines, but they would not be able to completely prevent co-mingling.

In the long term brucellosis seroprevalence would decline without supplemental feeding on the refuge, and the probability of transmission to cattle would also decrease. However, the decline in risk might only be minor over the 15-year life of the management plan because there would be a greater chance for contact between elk and cattle under Alternative 2 as winter feeding was gradually eliminated.

Risk of Brucellosis Transmission from Bison to Livestock — In the short and long terms the present low risk of transmission of brucellosis from bison to livestock would be further reduced due to a lower prevalence and fewer bison. However, seroprevalence of brucellosis in bison would remain relatively high, possibly similar to what is evident in Yellowstone National Park bison (e.g., 30%–33%; Meyer and Meagher 1997). Furthermore, the propensity of some bison to spend a portion of the winter outside the refuge (Cain et al. 2001) would likely increase as winter feeding on the refuge was gradually eliminated. However, fewer bison would reduce the likelihood that large numbers of bison would leave the refuge and park in search of forage. Also, WGFD personnel would presumably continue to haze bison, cull select animals, and work with landowners to discourage bison from using their property. Nevertheless, if only one domestic animal became infected, the impact on the livestock industry could be substantial. Areas of highest risk during the winter could include private lands west of the refuge in the Spring Gulch area.

Perception of Risk of Disease Transmission —

The perception of brucellosis transmission risk would likely remain similar to baseline conditions during the first few years as winter feeding was being gradually eliminated. However, over the years more elk and bison would likely begin venturing onto private lands (while the prevalence of brucellosis in the herds was still relatively high), which in turn could increase the perception of risk in the Jackson Hole area. However, after the seroprevalence rate dropped to low single digits for elk, the perceived risk of transmission could decline substantially.

The perception of risk of transmission from bison to livestock could increase in the long term because the prevalence of brucellosis in bison would decline by a moderate amount in the long term, but it would remain relatively high (comparable to the prevalence in Yellowstone National Park bison). In terms of perceived risk, the reduction in seroprevalence might very well be outweighed by the fact that bison would no longer be drawn to the refuge through artificial feeding and by the actual or perceived increase in winter distribution.

Brucellosis Testing and Vaccination — Testing and vaccinating of livestock could increase in the short term as a consequence of a greater perceived risk associated with the potential for brucellosis transmission from elk. However, once prevalence in elk had declined to a negligible level, testing and vaccination would likely return to baseline levels. Nevertheless, it is also possible that livestock testing and vaccination could re-

main higher than now because of the perceived risk of transmission from bison. Because only a small number of ranchers could potentially be affected, the long-term effects would be negligible to minor.

If cattle producers modified their current testing and vaccination practices in response to increased elk and bison distribution, the economic impact on producers over the long run would be relatively minor. Table 4-17 shows cow-calf production costs in 2003 and 2004 for the U.S. region that includes western Wyoming. In years of very low cattle prices, however, a producer's profit margin might be less than the costs of vaccination and testing.

Competition for Forage — As winter feeding was gradually eliminated and as elk increased their use of native winter range in the national forest, some winter ranges could receive substantially higher use by elk. Impacts on livestock production would be negligible. Many elk would find their way to state feedgrounds. For elk that did not end up on a state feedground, some could winter in areas not typically grazed by livestock. Delaying turnout dates for cattle would further reduce potential effects of increased numbers of elk on native winter range because by June cattle are able to forage on green-up vegetation, not residual vegetation. Therefore, even if numbers of elk using native winter range in the Buffalo Valley area, the Gros Ventre River drainage, areas south of Jackson, and the lower Hoback River drainage increased, use would likely not have any measurable effects on livestock production.

TABLE 4-17: COW-CALF PRODUCTION COSTS — BASIN AND RANGE FARM RESOURCE REGION (INCLUDING WESTERN WYOMING), 2003–2004

	Dollars per Bred Cow	
	2003	2004
Operating Costs		
Purchased Cattle	\$ 99.94	\$ 117.79
Feed	264.62	290.07
Veterinary and Medicine	18.33	18.45
Other Operating Costs	<u>86.71</u>	<u>90.61</u>
Total Operating Costs	469.60	516.92
Overhead Costs		
Opportunity Cost of Unpaid Labor	410.83	413.86
Capital Recovery Costs of Machinery and Equipment	70.31	73.42
Other Allocated Overhead	<u>93.43</u>	<u>95.28</u>
Total Allocated Overhead	574.57	582.56
Total Costs	\$ 1,044.17	\$ 1,099.48

SOURCE: USDA, Economic Research Service.

Spring grazing by elk on federal and private lands in the Jackson Hole area, including Buffalo Valley and the Gros Ventre River drainage, might not be affected any more than under Alternative 1 because elk currently leave winter feedgrounds as soon as green-up allows. However, the distribution of elk during early spring might change with the shift to reliance on native winter range. Also, the continued growth of grass through early summer could offset any impact that elk had on vegetation in early spring (W. Miller 2002).

Minimal current competition between elk and livestock for summer forage in Bridger-Teton National Forest and Grand Teton National Park would likely not change under Alternative 2 (Wisdom and Thomas 1996; Miller 2002), and elk numbers would not decline to the point where it would affect forage availability for livestock. However, if bison numbers declined to 250 animals, more forage could be available to livestock in some park areas during summer. Restoring native vegetation on previously cultivated fields in the park, but not on grazing allotments, would not affect the amount of forage available to livestock (Haynes, pers. comm. 2004).

If large numbers of elk began migrating to the Green River basin and the Red Desert under this alternative, livestock production could be affected by the added grazing pressure from elk during winter and early spring on national forest and BLM lands, as well as private lands. On rangelands that have relatively low productivity and that are already fully grazed by cattle, competition could be high (Wisdom and Thomas 1996). Although elk grazing during the dormant season would not likely adversely impact understory vegetation and might not affect the amount of forage available to livestock during summer (BLM 1981), winter grazing by elk could reduce forage available to cattle during spring and early summer (Wisdom and Thomas 1996). Given the vast acreages involved and unknown numbers and distributions of elk, potential effects cannot be determined beyond this broad assessment at this time.

Conservation Easements — To the extent that the U.S. Fish and Wildlife Service and National Park Service worked with partners to acquire conservation easements on key elk winter and transitional ranges under this alternative, live-

stock production could be sustained in some areas where land use would otherwise change from agriculture to housing developments if the purpose of the easement was to conserve agricultural practices. However, helping sustain livestock grazing on private lands in the Jackson Hole area and other areas could perpetuate the risk of disease transmission, depending on the timing of livestock grazing.

Property Damage / Depredation of Stored Hay — Relative to Alternative 1, property damage under this alternative would likely increase as winter feeding was phased out and elk potentially migrated to wintering areas outside Jackson Hole. In the Jackson Hole area elk and bison could depredate haystacks, damage property (e.g., fences, facilities), and eat forage on cattle feedlines. However, damage and depredation by bison might not increase to the extent of Alternative 1 because of fewer bison. Damage to agricultural crops is not anticipated in the Jackson Hole area. To the extent that property damage and depredation of hay increased under Alternative 2, costs to ranchers would increase, negating one of the purposes of the winter feeding program.

Aside from the possible transmission of brucellosis to livestock, the depredation of stored hay by elk might be the largest effect of increased winter distribution outside Jackson Hole. Costs to the Wyoming Game and Fish Department would likely increase assuming continued reimbursements to property owners; however, some landowners might not be fully reimbursed for lost hay.

Grazing by elk on early green-up vegetation could increase on private lands, potentially causing damage in localized areas, especially in alfalfa fields (Bennett, pers. comm. 2004). However, elk generally move fairly quickly from wintering areas to transitional and summer range (C. Anderson 1958; BLM 1981; Irwin 2002); so the effects of spring grazing would likely be negligible. During winter vegetation in irrigated fields would probably already have been harvested, baled, and stored or trucked to another location by fall, so there would be nothing to attract elk (Bennett and Lewis, pers. comm. 2004).

In the Green River basin it is likely that the use of cattle feedlines by elk would increase if large numbers migrated to this area. As previously dis-

cussed, various techniques would be used to minimize this occurrence, but these efforts would probably not be completely successful. Therefore, the consumption of cattle feed by elk could increase costs to ranchers to a negligible or minor degree.

Potential Economic Effects — Gradually eliminating winter feeding on the refuge would lead to increased competition for forage on federal lands, increased use of private lands by elk and bison, and greater depredation of stored hay and crops, with adverse impacts to ranchers and agricultural communities in the Jackson Hole area. Overall effects to agricultural production would be negligible, but some ranchers could be impacted by a moderate or major amount. Some losses and damages would likely be compensated, but some individual ranchers could incur some costs.

In the short term the risk of brucellosis transmission to cattle would increase under Alternative 2 compared to Alternative 1 due to more elk and bison using private lands before the prevalence of the disease had declined in elk. Once disease prevalence had declined, the risk would also decline. Producer costs for brucellosis testing and vaccination in the Jackson Hole area and the Green River basin would likely be negligible, similar to Alternative 1.

Conclusion

Overall, Alternative 2 would reduce the already low risk of brucellosis being transmitted from elk/bison to livestock more than the other alternatives (except for Alternative 6). However, until disease prevalence in elk was reduced, there could be an increased risk of transmission, compared to Alternative 1, due to more elk and bison using private lands. This would especially be true in the Green River basin if large numbers of elk began to migrate there and were not stopped by state feedgrounds.

Alternative 2 would have the greatest possibility of elk and bison causing damage to private property (including crops) and depredation of stored hay. This would increase costs to ranchers and the Wyoming Game and Fish Department, which would generally reimburse ranchers for damage caused by elk. Competition between bison and livestock would be lower by a major amount in the

park compared to Alternative 1 (similar to Alternatives 4, 5, and 6).

Direct impacts on cattle producers would generally be minor, similar to the other alternatives. Costs for testing and vaccinating female calves in the Jackson Hole area would be a small portion of total production costs.

Alternative 3

Analysis

Risk of Brucellosis Transmission from Elk to Livestock — There would be a minor to moderate reduction in the risk of brucellosis transmission in the short and long terms because (1) prevalence in the elk herd would be lowered, resulting in fewer abortions; (2) elk would be fed during the most severe winters, encouraging them to stay on the refuge; and (3) winter range improvements adjacent to the refuge and in the Gros Ventre River drainage and Buffalo Valley would encourage elk to use these areas rather than private lands. Nevertheless, some animals could wander onto private lands where livestock were being fed on feedlines, increasing transmission risks in localized areas. If a vaccination program was implemented, the risk of transmission during the winter would be reduced substantially.

As described for Alternative 2, if large numbers of elk began migrating to the Green River basin and the Red Desert and were not stopped by state feedgrounds, the potential for brucellosis transmission to livestock in these areas would initially increase. Although WGFD personnel would help keep elk off of cattle feedlines, they could not completely prevent co-mingling. If a vaccine was located in the short term that would be effective at reducing the level of brucellosis in elk before they began finding other wintering areas, the risk to livestock could be avoided or greatly minimized.

The risk of brucellosis transmission from elk to cattle on spring and summer ranges would only be slightly lower if vaccination occurred under Alternative 3 because only a small proportion of the Jackson elk herd (up to an estimated 18%) would be available to be vaccinated on the refuge during an estimated 2 out of every 10 winters.

Risk of Brucellosis Transmission from Bison to Livestock — In the absence of any vaccination, brucellosis prevalence in the bison herd would be reduced by a minor to moderate amount in the long term compared to Alternative 1 because of reduced winter feeding and bison densities (approximately 1,000 animals compared to 2,000 under Alternative 1). A vaccination program would decrease the risk by a moderate degree because reduced disease prevalence.

Under Alternative 3 the chances of bison leaving the National Elk Refuge during winter would not be as high as under Alternative 2 because supplemental feeding would be provided in severe winters. Some bison could leave during less severe winters, although enhanced forage on refuge and adjacent national forest lands could encourage bison to remain on federal lands during mild and average winters. Bison that had not been vaccinated could increase the risk of brucellosis transmission to livestock compared to Alternative 1 (assuming that bison would not leave the refuge during winter under that alternative).

Maintaining the bison herd at approximately 1,000 animals, as compared to unrestricted growth under Alternative 1, would result in a minor to moderate reduction (with an effective vaccine) in transmission risk during summer.

Perception of Risk of Disease Transmission — The perception of brucellosis risk would likely be similar to baseline conditions while winter feeding was being reduced. However, with less winter feeding on the refuge, the increased potential for elk and bison to wander onto private lands could increase the perception of risk in the Jackson Hole area, pending the development of an effective vaccine.

With respect to elk, the perception of risk would likely be higher for the next 15–20 years, while prevalence declined naturally and assuming no vaccination. Once the seroprevalence rate in elk dropped to low single digits, the perceived risk of transmission from elk to livestock could decline substantially.

The perception of transmission risk from bison to livestock could increase in the long term because prevalence in bison would remain relatively high (similar to the rate in the Yellowstone herd) and

because bison could be more inclined to wander onto private land.

Brucellosis Testing and Vaccination — Similar to Alternative 2, if cattle producers modified their current testing and vaccination practices in response to increased elk and bison distribution in Jackson Hole and increased elk distribution in the Green River basin, the resulting increases in the cost of testing and vaccinating would have a relatively minor economic impact over the long run (see Table 4-17).

Competition for Forage — Competition between elk/bison and livestock would be similar to that described under Alternative 2, with the following exceptions. Competition between elk and livestock in Grand Teton National Park would decline at most by a negligible amount due to lower elk numbers under Alternative 3, and competition between bison and livestock would decline under Alternative 3, but not to same extent as under Alternative 2.

Conservation Easements — Potential effects of conservation easements on agricultural production would be similar to Alternative 2 (as well as Alternatives 4 and 6).

Property Damage / Depredation of Stored Hay — Property damage and depredation of stored hay under this alternative would likely be similar to Alternative 1 in the short term. However, as the numbers of elk on the refuge and park were reduced under Alternative 3 over a 10–15 year period, impacts could increase, similar to Alternative 2. However, feeding elk and bison in severe winters would tend to reduce potential conflicts. Compared to Alternative 1, the potential for bison to damage property and eat stored hay could be much lower under Alternative 3 in the long term.

Potential Economic Effects — Similar to Alternative 2, ranchers and agricultural communities in the Jackson Hole area and in the Green River basin could be adversely economically impacted under Alternative 3 due to increased competition for forage on federal lands, greater use of private lands by elk and bison, and more depredation of stored hay and crops. Overall effects to agricultural production in the Jackson Hole area and the Green River basin would be negligible, but some ranchers could be impacted to a moderate or ma-

ior degree. The state would reimburse ranches for some losses and damages caused by elk, but some ranchers would incur costs.

The low risk of brucellosis transmission from elk or bison to cattle would result in negligible local economic impacts (similar to all alternatives). Producer costs for brucellosis testing and vaccination in the Jackson Hole area and the Green River basin would not be substantially affected under Alternative 3, as discussed previously.

Conclusion

The risk of brucellosis transmission from elk to livestock would be lower than under Alternatives 1 and 5, but the risk of transmission from bison to livestock would be higher than all other alternatives, except Alternative 1 (all seasons) and Alternatives 4 and 5 (in late spring and early summer). Eventually the prevalence of brucellosis in elk would decline, but until then the risk of transmission would be higher in winter and early spring than under Alternative 1. This would especially be true in the Green River basin if large numbers of elk began to migrate there and were not stopped by state feedgrounds.

The possibility of damage to private property (including crops) and depredation of stored hay would be similar to Alternative 2 because of greater elk and bison use of private lands in the Jackson Hole area and the Green River basin. Costs to ranchers and the Wyoming Game and Fish Department would increase. Competition between bison and livestock would be similar to baseline conditions, but would not increase to the same extent as under Alternative 1.

Alternative 4

Analysis

Risk of Brucellosis Transmission from Elk to Livestock — In the short term seroprevalence of brucellosis would not be expected to change appreciably under Alternative 4 compared to Alternative 1. In the long term reducing the frequency of winter feeding and vaccinating a minimum of 80% of elk calves with Strain 19 vaccine would moderately reduce disease prevalence in elk. Nevertheless, the long-term risk of brucellosis transmission from elk to livestock during winter

and early spring could increase by a negligible to minor degree compared to Alternative 1 because fewer elk would winter on the refuge and more elk could wander onto private land in search of forage (e.g., west and south of the refuge). To prevent co-mingling with livestock, the Wyoming Game and Fish Department would likely take immediate action to haze elk to other areas. Also, habitat improvements in the national forest would encourage elk to use winter forage on native ranges, thereby reducing direct contact with livestock. To the extent that elk remained on federal lands and private lands that were not wintering livestock, the risk would remain very low, similar to baseline conditions and Alternative 1.

The risk of brucellosis transmission from elk to livestock during the late spring and early summer would be reduced by a minor to moderate amount because of a minor reduction in disease prevalence in the herd compared to Alternative 1. Using Strain 19 to vaccinate elk would likely have a minimal impact because the efficacy of the vaccine is low (an estimated 25%–30%), it could only be administered during winter feeding operations, and continued high concentrations of elk during winter feeding would offset benefits.

If a more efficacious vaccine for elk was developed and could be delivered effectively without having elk concentrated on feedlines, then prevalence in elk could be further reduced, along with the risk of transmission to livestock.

Risk of Brucellosis Transmission from Bison to Livestock — Reduced winter feeding, lower bison densities, and fewer animal numbers would contribute to a lower prevalence of brucellosis. Compared to Alternative 1, the long-term risk of brucellosis transmission to livestock during winter would be moderately lower because of fewer bison. The risk would be slightly lower than under Alternative 3 without vaccination because feeding fewer bison would decrease the chance of bison leaving the refuge once feeding was reduced.

As long as it was logistically feasible, RB51 vaccine could be used on bison. The risk for transmission to livestock during winter would be moderately reduced. The chances of bison using food in areas where cattle are fed in the winter would probably be lower than under Alternative 3 because of more supplemental feeding.

Even though the chances of bison leaving the refuge during winter are not considered as high under this alternative as under Alternatives 2 and 3, some animals could leave during some winters. Forage enhancements on the refuge could encourage bison to remain. Furthermore, WGFD personnel would likely react quickly to any reports of bison getting near livestock feeding operations, and they would presumably haze, cull, or take other actions to prevent co-mingling.

During summer the risk of transmission would be lower to some degree because of reduced prevalence in bison and fewer animals. A successful vaccination program would further decrease prevalence and moderately reduce the risk to livestock.

Perception of Risk of Disease Transmission — Pending the development of more effective vaccines for elk and bison, the perception of risk to livestock during winter under Alternative 4 could be higher than under Alternative 1. This perception would be related to elk and bison being more apt to come into contact with livestock feeding operations as a result of reduced winter feeding, despite actions that would minimize co-mingling. The perception of risk during late spring and early summer could somewhat decline due to a moderate, long-term reduction in brucellosis prevalence in elk, lower numbers of elk in the Grand Teton segment, and much lower numbers of bison.

Brucellosis Testing and Vaccination — In the absence of a positive find in a herd, current brucellosis vaccination and testing practices would likely continue under this alternative. The perception of an increased risk of brucellosis transmission could prompt more ranchers to test and vaccinate their livestock. If cattle producers modified their current testing and vaccination practices in the long term in response to this alternative, the increased cost of testing and vaccinating would have a negligible effect on producers over the long term (see Table 4-17).

Competition for Forage — As winter feeding was gradually reduced and as elk increased their use of native winter range in the national forest, some winter ranges could receive substantially higher use compared to baseline conditions, but not as high as under Alternatives 2, 3, and 6. As ex-

plained in Alternative 2, increased use of native winter range by elk in Jackson Hole, Buffalo Valley, and the Gros Ventre River drainage would likely have only a negligible effect on livestock production.

Similar to Alternatives 2 and 3, spring grazing by elk on federal and private lands in the Jackson Hole area might not be affected to any large degree because elk currently leave winter feedgrounds as soon as spring growth allows.

Also similar to Alternatives 2 and 3, competition between elk and livestock for summer forage in Bridger-Teton National Forest and Grand Teton National Park under Alternative 4 would be minimal (Miller 2002) and elk numbers would not decline enough to affect forage availability for livestock. A major reduction in bison numbers in the Jackson herd could result in more forage being available to livestock in some areas during summer.

Conservation Easements — Potential effects of conservation easements on agricultural production would be similar to those discussed under Alternative 2, as well as Alternatives 3 and 6.

Property Damage / Depredation of Stored Hay — In the short term the risk of property damage and the depredation of stored hay would remain similar to baseline conditions because elk and bison would continue to be fed in most winters and their numbers would be declining. In the long term, after the reduction in winter feeding on the refuge, occurrences of property damage and depredation of stored hay could increase by a negligible to minor amount, but not to the extent that could occur under Alternatives 2, 3, and 6. Under Alternative 4 measures to minimize the need for elk and bison to roam off the refuge in search of food would include reducing elk numbers by a minor amount and bison numbers by a major amount, making sufficient forage available to sustain elk and bison inhabiting the refuge, providing supplemental feeding in some winters, enhancing winter transitional range in the national forest, and working with landowners to reduce conflicts on private lands. For the purposes of this analysis, it is assumed that Alternative 4 would potentially result in a higher level of property damage and depredation of stored hay than under Alternatives 1 and 5, but less damage than under Alter-

natives 2, 3, and 6. No increased property damage or hay depredation in the Green River basin would be expected.

The agencies would work closely with the Wyoming Game and Fish Department and landowners, including the local livestock community, to coordinate actions that would prevent conflicts due to elk and/or bison dispersal and to defray costs of managing potential conflicts. Preventing access to food/hay on private lands would be vital for effective management.

Potential Economic Effects — Ranchers and agricultural communities in Jackson Hole and adjacent areas could be adversely impacted under Alternative 4 due to possible increases in competition for forage on federal lands, increased use of private lands by elk and bison, and increased depredation of stored hay and crops. Overall effects to agricultural production in the Jackson Hole area would be negligible at most, but individual ranchers could be impacted to a moderate or major degree (although it is unlikely that moderate to major impacts would occur). Economic effects, if any, would be less than under Alternatives 2, 3, and 6. Some losses and damages by elk would likely be compensated by the state, although some ranchers could incur some costs.

A low risk of brucellosis transmission from elk or bison to cattle would have minimal economic impacts (similar to all alternatives). Costs for brucellosis testing and vaccination in the Jackson Hole area would likely not be substantially affected under Alternative 4.

Conclusion

The risk of brucellosis transmission from elk to livestock during winter would be among the lowest of the alternatives in the long term, with an intermediate risk during late spring and early summer (lower than Alternatives 1 and 5). The risk of transmission from bison to livestock would also be intermediate. The short-term risk of transmission could increase during winter and early spring to a small degree, compared to Alternative 1, because a small number of elk and bison could make use of private lands before the prevalence of brucellosis had declined.

With reduced winter feeding, elk and bison could increase their use of private lands in the Jackson Hole area, resulting in damage to private property and depredation of stored hay, but not to the extent that could happen under Alternatives 2, 3, and 6. Alternative 4 would likely not result in increased damage to crops in the Jackson Hole area, and competition between bison and livestock would be lower by a major amount in the park compared to Alternative 1 (and similar to Alternatives 2, 5, and 6).

Alternative 6

Analysis

Risk of Brucellosis Transmission from Elk to Livestock — In the short term, as the winter feeding program on the refuge was being phased back under Alternative 6, the risk of brucellosis transmission from elk to livestock would increase because some elk would begin seeking new winter range. While most of these elk would find winter range in the national forest, some animals could wander onto private lands where livestock were being fed on feedlines (e.g., the Gros Ventre River drainage, Buffalo Valley, Jackson Hole, and possibly the lower Hoback River drainage). Potential contact with livestock could become increasingly problematic during above-average and severe winters.

The risk of brucellosis transmission would increase somewhat during late winter and early spring, but several factors would help reduce the likelihood of this actually occurring. For example, elk numbers on the refuge would be reduced relatively quickly under this alternative, so the herd size would be commensurate with the amount of forage being provided on the refuge, which in turn would reduce the likelihood of elk searching elsewhere for forage. Also, improving winter range in the Buffalo Valley area, the Gros Ventre River drainage, and areas immediately to the east of the refuge would provide additional forage away from cattle ranches. Furthermore, immediate action (e.g., hazing, culling) would likely be taken whenever it appeared that elk were beginning to commingle with livestock or were about to move onto private land where livestock were being fed. In many cases elk could be hazed to the nearest state feedground, but if elk began wintering on private

lands in the Buffalo Valley area or in Idaho, there might not be an established state feedground.

In the long term brucellosis prevalence would decline in elk, decreasing the probability of disease transmission to livestock. Within 15–20 years the risk of transmission would likely decline more than it would under Alternatives 2 and 3 because of enhanced forage on and near the National Elk Refuge, which would make it less necessary for elk to search for winter range in other areas, and a major reduction in seroprevalence in bison, which would reduce the possibility of elk being reinfected by bison. Therefore, Alternative 6 would result in the largest reduction of seroprevalence in elk (and, therefore, the largest reduction in risk to livestock) of any alternative being considered. If a moderately or highly efficacious vaccine was developed for elk that could be used without having to supplementally feed elk, the seroprevalence of brucellosis in elk could be further reduced over the long term.

Risk of Brucellosis Transmission from Bison to Livestock — In the short and long terms a major reduction in prevalence and fewer bison in the herd would substantially reduce an already low risk of transmission of brucellosis from bison to livestock.

In the short term the risk of disease transmission to livestock could temporarily increase during late winter and early spring if bison left the refuge in search of food. WGFD personnel would presumably continue to haze bison, cull select animals, and work with landowners to discourage bison use of their property. The area of highest risk during the winter might include private lands west of the refuge in the area of Spring Gulch.

In the long term the risk of disease transmission to livestock during late winter and early spring would be lower under Alternative 6 than Alternative 1. Alternative 6 would have the most aggressive control programs for brucellosis of any of the alternatives, resulting in the lowest level of risk to livestock of any of the alternatives being considered.

Perception of Risk of Disease Transmission — In the short term the perception of risk to livestock during winter could be higher than under Alternative 1 if ranchers believed elk and bison would

be more apt to come into contact with livestock feeding operations, despite factors that would minimize co-mingling. Once the prevalence of brucellosis in elk and bison had substantially declined, the perception of risk would be lower than under Alternative 1.

The perception of risk during late spring and early summer could decline somewhat in the short term due to fewer bison and declining prevalence of brucellosis in elk and bison. In the long term a major reduction in bison numbers and seroprevalence in elk and bison would substantially reduce the perception of risk.

Brucellosis Testing and Vaccination — An increased perception of brucellosis risk could prompt more ranchers to test and vaccinate their livestock. The amount of testing and vaccinating of livestock herds could return to baseline levels in the long term after brucellosis prevalence in elk and bison had declined to a negligible level. Only a small number of ranchers could potentially be affected, and long-term effects would be negligible.

Competition for Forage — Competition between elk/bison and livestock under Alternative 6 would be similar to Alternatives 2 and 3. However, Alternative 6 would not affect livestock production in the Green River basin to the same degree as Alternatives 2 and 3 because elk that wandered toward the Green River basin would likely be stopped by one of several state feedgrounds for elk.

Conservation Easements — To the extent that the U.S. Fish and Wildlife Service and the National Park Service worked with partners to acquire conservation easements on key elk winter and transitional ranges under this alternative (and Alternatives 2, 3, and 4), future livestock production could be sustained, as described for Alternative 2.

Property Damage / Depredation of Stored Hay — Increased winter distribution of elk and bison in the Jackson Hole area could increase property damage and depredation of stored hay in the short term because supplemental feeding on the refuge would be phased out within 5–10 years under Alternative 6, as opposed to 10–15 years under Alternative 2.

In the long term potential property damage and depredation of hay in the Jackson Hole area would likely be higher than under Alternatives 1 and 5, but lower than under Alternatives 2 and 3 for several reasons. Elk and bison numbers would be controlled under Alternative 6, in contrast to Alternative 2 where they would not be. Therefore, it would be unlikely for large numbers of elk and bison to leave the refuge in search of forage. The Jackson bison herd would be much smaller under Alternative 6 than under Alternative 3.

Potential Economic Effects — Similar to Alternatives 2 and 3, ranchers and agricultural communities in the Jackson Hole area and in some adjacent areas could be adversely impacted by Alternative 6 due to major reductions in winter feeding on the refuge and subsequent increases in competition for forage on federal lands, increased use of private lands by elk and bison, and increased depredation of stored hay and crops. Overall effects to agricultural production would be negligible, but some ranchers could be impacted to a moderate to major degree. Some losses and damages by elk would likely be compensated by the state, but some individual ranchers could incur some costs.

A low risk of brucellosis transmission from elk or bison to cattle would have minimal economic impacts (similar to all alternatives). However, the risk of brucellosis being transmitted from elk or bison to cattle could increase in the short term under this alternative compared to Alternative 1 due to more elk and bison possibly wandering onto private lands before disease prevalence had declined in elk. In the long term, the risk of transmission would decline due to the reduction in prevalence in elk. Producer costs for brucellosis testing and vaccination in the Jackson Hole area and surrounding areas would likely not be substantially affected under Alternative 6, for the reasons discussed previously.

Conclusion

Overall, Alternative 6 would reduce the already low risk of brucellosis being transmitted from elk/bison to livestock more than the other alternatives, similar to Alternative 2. However, in the short term the risk of transmission would increase, compared to Alternative 1, if more elk and bison used private lands before the prevalence of brucellosis had declined.

Eliminating winter feeding on the refuge could cause elk and bison to increase their use of private lands in the Jackson Hole area, increasing the possibility of damage to private property and depredation of stored hay. This effect would be greater under this alternative and Alternatives 2 and 3. Costs to ranchers and the Wyoming Game and Fish Department could increase as a result. Competition between bison and livestock would be lower by a major amount in the park compared to Alternative 1 (similar to Alternatives 2 and 4).

Mitigation

Risk of Brucellosis Transmission

Measures to mitigate the risk of brucellosis being transmitted from elk and bison to livestock that are included in the alternatives include spatial separation and reduced seroprevalence in elk and bison. For the purposes of this analysis, it is assumed that brucellosis will not be eradicated from elk and bison in the Jackson Hole area in the foreseeable future under any of the management alternatives.

Risk of Transmission of Other Diseases

For some diseases (e.g., bovine tuberculosis), livestock could be vaccinated, but this might not be possible for all diseases. Measures could be taken to separate elk/bison and livestock, but livestock would need to be separated year-round. This option could involve not allowing livestock to graze on federal grazing allotments. Other mitigation measures could include immediately stopping winter feeding and undertaking major population reductions or depopulation of the elk and bison herds if a non-endemic infectious disease appeared.

No mitigation measures would be necessary if chronic wasting disease became established in the Jackson elk herd because livestock do not appear to be susceptible.

Property Damage / Depredation of Stored Hay

Ranchers could better protect stored hay through the use of exclosures and stack yards. Hazing, depredation hunts, and WGF'D culling might also be needed to keep elk and bison away from areas where they could damage private property.

As discussed under some alternatives, habitat improvement projects could be specifically located and designed to help draw elk and bison away from certain areas. It might also be possible to set up a program to pay landowners to provide forage for large ungulates and to reduce livestock grazing on their properties. Conservation easements could be used for this purpose in some areas.

CUMULATIVE EFFECTS

No cumulative effects on livestock operations are anticipated as a result of the impacts of the alternatives in combination with impacts of reasonably foreseeable actions.

IRREVERSIBLE AND IRRETRIEVABLE RESOURCE COMMITMENTS

Irreversible commitments are those that cannot be reversed, except perhaps in the extreme long term. For example, the extinction of a species would be an irreversible loss of a resource.

In contrast, irretrievable commitments are those that are lost for a period of time, perhaps a long period of time. For example, a highway built through a forest represents an irretrievable loss of forest habitat for the time that the highway remains.

HABITAT RESOURCES

Irreversible losses could occur in willow habitat on the National Elk Refuge under Alternatives 1, 2, 5, and 4 (in that order) due to the loss of root stock as continued heavy browsing by elk in the winters prevented suppressed willow plants in wet meadow habitat from recovering to Class I or II condition. The refuge could lose the following amount of potential willow habitat: Alternative 1, an estimated 1,500 acres; Alternative 2, an estimated 1,400 acres; and Alternatives 4 and 5, an estimated 1,010 acres. Although it is possible for willow plants to sprout from seeds, this type of regeneration rarely occurs. Alternatives 3 and 6 are not projected to result in the loss of any willow habitat because the low numbers of ungulates under these alternatives would not prevent suppressed willow plants in wet meadow communities from regenerating and growing into mature willow stands. In addition, irretrievable losses could occur in aspen habitat on the refuge that was not protected by fencing under all alternatives except 6 due to continued browsing by elk. The refuge could lose the following amount of aspen habitat in the long term: Alternatives 1–3, an estimated 1,850 acres; and Alternatives 4 and 5, an estimated 760 acres. Alternative 6 would preserve all aspen habitat occurring on the refuge.

In Bridger-Teton National Forest there could be irretrievable losses of aspen habitat in localized areas in the long term under Alternatives 1 and 5 due to heavy browsing by elk in combination

with conifer encroachment as a result of fire suppression.

ELK

The potential exists for irretrievable commitments of elk resources if chronic wasting disease became established in the Jackson Hole area and substantially reduced the elk population. While this event is beyond the control of wildlife managers, the potential effect would be greatest under those alternatives where large numbers of animals were concentrated on feedgrounds. The loss would be irretrievable because in addition to always being fatal to infected animals, chronic wasting disease contaminates the environment for long periods of time. Soil on the refuge feedgrounds could become a reservoir of chronic wasting disease that would continue to infect animals many years into the future. This situation is considered an irretrievable loss (loss for a period of time) rather than an irreversible loss (cannot ever be reversed) because it is not known how long contamination of the environment would persist. Decontamination methods used on game farms and research facilities have been unsuccessful to date, and animals introduced to these facilities years after a chronic wasting disease outbreak and depopulation have subsequently become infected.

Alternatives 1 and 5 would pose the greatest risk for irretrievable loss of elk resources due to large concentrations of elk on the feedgrounds occurring in every year or almost every year. Alternatives 4 and 3 would pose the next highest risk because feeding, although reduced, would still occur in some years; if chronic wasting disease arrived during a feeding year, the potential would exist for rapid spread of the disease and extensive contamination of the environment. Alternatives 6 and 2 would present the least amount of risk because supplemental feeding would be phased out completely, although under Alternative 2 feeding would not be phased out for up to 10 years.

OTHER UNGULATE SPECIES

Mule deer and moose on the refuge could undergo irretrievable losses under Alternatives 1, 2, 4, and 5 due to the loss of willow habitat as a result of browsing by large numbers of elk. In addition, aspen habitat on the refuge would be lost under Alternatives 1 through 5, and fenced aspen habitat under Alternatives 4 and 5 would no longer be available to mule deer and moose. In the long term aspen habitat would be reduced on the refuge for mule deer and moose under Alternatives 1 through 5. (See “Habitat Resources” above for amount of willow and aspen habitat lost under each alternative.)

Elk could infect mule deer with chronic wasting disease, either directly or through habitat contamination, which could potentially result in a high prevalence of this disease among mule deer and an irretrievable commitment of mule deer resources. The risk would be highest under Alternatives 1 and 5, followed by Alternatives 4 and 3, due to concentrations of animals on the refuge feedgrounds. (See “Impacts on Other Ungulates.”)

PREDATORS AND SCAVENGERS

The potential exists for irretrievable commitments of predator and scavenger resources to occur if chronic wasting disease became established in the Jackson Hole area and substantially reduced the elk population. Although predators and scavengers would benefit in the short term from larger numbers of sick and dead animals, if elk numbers were reduced to low levels and remained suppressed for a long time, predator and scavenger populations could also be reduced. The greatest risk for predators and scavengers undergoing irretrievable losses would occur under Alternatives 1 and 5, followed by Alternatives 4 and 3. Alternatives 6 and 2 present the least amount of risk. Some predators, such as wolves, cougars, grizzly bears, and black bears could resort to other ungulate species for alternate prey. However, some of these species, such as moose, mule deer, and bighorn sheep have experienced population declines in recent years and might not be numerous enough to sustain the predator and scavenger population in the Jackson Hole area.

RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

Long-term productivity for the National Elk Refuge and Grand Teton National Park / John D. Rockefeller, Jr., Memorial Parkway refers to the capability of the land to provide resources into the future. The short term use of maintaining high numbers of elk on the refuge in the winter (e.g., Alternatives 1 and 5, and to some degree Alternative 4) for the purpose of providing the public with opportunities to view and harvest large numbers of animals, could potentially compromise the refuge's ability to provide habitat and elk resources in the future. Woody vegetation, which provides habitat for other ungulates and Neotropical migratory birds, cannot be sustained outside exclosures under alternatives that maintain large numbers of elk on the refuge. However, exclosures could deny access to other ungulates, rendering most woody vegetation on the refuge unavailable to moose and mule deer.

Concentrating large numbers of elk on feedgrounds could reduce the ability of the environment to produce elk in the future if a disease, such as chronic wasting disease, became estab-

lished in the Jackson Hole area. In addition, this disease poses risks not associated with other diseases because of its ability to contaminate the environment for long periods of time. Although animals infected with chronic wasting disease may be shedding the infectious agents of the disease anywhere they travel or anywhere they die, concentrating large numbers of elk in a specific area, such as a feedground, would concentrate the infectious agents in an area where many elk would potentially come in contact with them. The feedgrounds are located in the southern part of the refuge, which receives the least amount of snow, and therefore, has the most available forage in the winters. Even under those alternatives where supplemental feeding would be phased out (e.g., Alternatives 2 and 6), substantial numbers of elk would continue to forage in the feedground areas, albeit not at the densities that occur during winter feeding. Once these areas became contaminated with infectious agents of chronic wasting disease, elk would potentially become infected years into the future. Even depopulation and reintroduction of elk would not solve the problem because introduced elk would contract the disease from the soil on the feedgrounds.

UNAVOIDABLE ADVERSE EFFECTS

Implementing the alternatives could result in adverse environmental effects that could not be avoided even with mitigation measures. These adverse effects are related to chronic wasting disease. Although the alternatives considered in this planning process would have no effect on whether or not chronic wasting disease arrived in the Jackson Hole area, concentrating large numbers of elk on the feedgrounds could affect

the speed at which the disease spread and the prevalence that it reached in the elk population. Phasing out supplemental feeding could mitigate these effects. However, if chronic wasting disease were to arrive prior to phasing out feeding, it might be too late to reduce the speed of infection and prevalence rate. Environmental contamination concentrated on the feedgrounds could continue to infect elk for many years into the future.

POSSIBLE CONFLICTS WITH AGENCY, TRIBAL, COUNTY OR STATE PLANS OR POLICIES

Actions considered in this environmental impact statement do not appear to conflict with tribal and national forest goals, objectives, policies, or plans, and they do not conflict with the 1994 *Jackson / Teton County Comprehensive Plan*. The county plan emphasizes the importance of wildlife and other natural and scenic resources to community character and the economic well-being of the community. Protection of wildlife habitat, particularly crucial winter range and migration corridors used by ungulates, is the first objective mentioned in the plan. Alternatives 3–6 support the objectives in the plan by preserving and restoring riparian and aspen woodland habitats on the refuge and, to some extent, in the park either by erecting exclosures or reducing elk numbers. In addition, Alternatives 2, 3, 4, and 6 support the preservation of ungulate migration corridors by reducing or phasing out supplemental feeding and encouraging a wider distribution of elk on native winter range. Presumed habitat improvements in Bridger-Teton National Forest under Alternatives 2–6 would preserve and restore habitat on crucial winter range in the Gros Ventre River drainage and the Buffalo Valley area. Furthermore, formerly cultivated agricultural lands in the park would be restored to native vegetation under Alternatives 2–6, thereby providing native habitat for Neotropical migratory birds, small mammal populations, and other species.

The *Jackson / Teton County Comprehensive Plan* identifies elk as a premier species that has significant biological, ecological, economic, educational, and aesthetic values to Teton County. It states that elk and their habitat must be protected to ensure their continued survival in the county. Alternatives that would phase out (Alternatives 2 and 6) or reduce (Alternatives 3 and 4) supplemental feeding would support the long-term survival of elk by reducing the risk of serious impacts to the elk population due to a non-endemic disease. Alternatives that would maintain high levels of elk in the Jackson Hole area through supplemental feeding every year or nearly every year (Alternatives 1 and 5) would support the objective of providing large numbers of elk for consumptive

and non-consumptive uses. The introduction of a non-endemic disease, such as chronic wasting disease, would negate the advantages of supplemental feeding and could result in substantial declines in the elk population.

Alternatives 1 and 3–6 would contribute to Teton County's economic well-being by providing for an elk and bison hunt on the refuge. Although hunting is not directly addressed in the county plan, maintaining outdoor recreation and adventure opportunities is included in the county's vision statement.

Restoring elk migrations to possible historical wintering areas in the Green River basin and the Red Desert would conflict with current land uses and policies of the Wyoming Game and Fish Department. Some of the main reasons that the Wyoming Game and Fish Department does not foresee pursuing this effort include the following: (1) lingering questions about whether elk from Jackson Hole historically migrated to the Green River basin and the Red Desert; (2) doubts about whether a portion of the elk population could be "trained" to migrate to the basin; (3) the attraction of elk onto state feedgrounds, making feed-ground management more difficult and costly; (4) no plans to phase out feeding on state feedgrounds; (5) large elk movements from the Jackson elk herd to other herd units, which would complicate herd management; (6) the reality that elk would be drawn into cattle feedlines on private lands in key parts of the potential migration corridor; (7) the potential for elk with high levels of brucellosis to intermingle with cattle on feedlines and other situations; (8) the need for the Bureau of Land Management to reallocate forage; and (9) the likelihood of increased wildlife-vehicle collisions on highways in the Green River basin.

Implementation of the strategy would also require the support of the U.S. Forest Service and the Bureau of Land Management, since elk migrations and winter grazing would predominantly occur on lands under their jurisdiction.