CONTENTS

CHAPTER 4. ENVIRONMENTAL CONSEQUENCES — 185

Introduction....187
- Level of Detail....187
- Level of Impacts....187
- Assumptions....187
- Short-Term versus Long-Term Effects....188
- Resource Impairment in National Park Units....188
- Baseline Conditions and the No-Action Alternative....188
- Cumulative Effects....189

Impacts on the Physical Environment....190
- Soils....190
- Water Resources....194
- Visual Resources....198
- Cumulative Effects....206

Impacts on Habitat....207
- Overview....207
- National Elk Refuge....207
- Grand Teton National Park....229
- Bridger-Teton National Forest....238
- Yellowstone National Park....242
- Other Federal and State Lands....242
- Private Lands....244
- Cumulative Effects....248

Maps

Irrigation Project Areas of the NER....226

Tables

Table 4-1: National Elk Refuge — Potential Changes in Habitat Acreage from the Short Term to the Long Term under Each Alternative....207

Table 4-2: Habitat Types and Classification of Willow, Aspen, and Cottonwood Communities....216

Table 4-3: National Elk Refuge — Estimated Farmed Acreages and Associated Forage Production Levels in Cultivated Fields....224

Table 4-4: Grand Teton National Park — Summary of Potential Changes in Acres of Habitats Relative to Baseline Acreages....230

[This page intentionally left blank.]

CHAPTER 4. ENVIRONMENTAL CONSEQUENCES

[This page intentionally left blank.]

INTRODUCTION

This chapter summarizes and compares the potential effects of each alternative on the physical environment, biological resources, social and cultural parameters and resources, and economic factors. The chapter also summarizes the ability of the U. S. Fish and Wildlife Service, the National Park Service, and other agencies to meet legal responsibilities under each alternative, as well as the consistency of each alternative with wildlife management principles. Existing conditions of the environment, biological resources, and socioeconomic factors are described in Chapter 3, and care was taken to ensure that the elements of each major issue identified in Chapter 1 were addressed in the analysis contained in this chapter. The analysis of potential effects on the environment, biological resources, and socioeconomic factors was used in assessing the effects of each alternative on the ability of the agencies to meet legal requirements.

LEVEL OF DETAIL

The potential effects of elk and bison management on some resources are described in detail for several reasons. First, the plan for managing elk and bison on the National Elk Refuge and in Grand Teton National Park is being completed before the preparation of the refuge's comprehensive conservation plan and the park's new general management plan. Elk and bison numbers and distributions and their management on the refuge and in the park have substantial and far reaching effects on some resources. An in-depth analysis was undertaken to ensure that decision-makers and the public would have an understanding of potential ramifications that elk and bison management would have on the range of management options to be evaluated in the future comprehensive and general plans for the two areas. For example, the refuge has specific responsibilities for providing habitat for breeding birds and to provide a refuge and grazing habitat for other ungulates (in addition to elk). Elk and bison management on the refuge has had considerable effects on the ability of the U.S. Fish and Wildlife Service to accomplish these purposes. Therefore, particular attention was paid to the potential effects on birds and large ungulates.

Furthermore, this planning document / environmental impact statement provides more than programmatic coverage for elk and bison management. The level of analysis in this chapter is sufficient to allow several management actions to be carried out without having to complete additional environmental analyses (e.g., environmental assessments) prior to implementation.

Another factor that has increased the complexity of the analysis is the number of geographic areas and jurisdiction in which impacts could potentially occur, including the refuge, the park, the national forest, Yellowstone National Park, BLM lands in Jackson Hole and in the Green River basin, and private lands in the Jackson Hole area and Green River basin.

LEVEL OF IMPACTS

The degree of impact can be quantified in some cases, such as when modeled estimates were used and when extensive monitoring or research results have provided pertinent numeric information. However, in most situations only qualitative descriptions of impacts are available. The following definitions are applied throughout the environmental impact statement, except where otherwise noted:

- *Negligible* — The impact would be at the lower levels of detection (<5% change).
- *Minor* — The impact would be detectable (a change of 5%–24%).
- *Moderate* — The impact would be readily apparent, and it would have the potential to become major (a change of 25%–50%).
- *Major* — The impact would be severe, or if beneficial, it would have exceptional beneficial effects (a change of >50%).

ASSUMPTIONS

Assessments were based on a variety of information, including meetings and other communications with natural resource and other professionals, published scientific information, agency re-

ports, and computer modeling, among other sources.

The following assumptions have been made in the analysis presented in this chapter:

- Funding and personnel would be sufficient to implement any alternative selected. This does not constitute a commitment for funding, and future budgets could change.
- Monitoring programs would be implemented and monitoring activities would be conducted a minimum of once every 5 years, and adjustments or revisions would be made to management as indicated by evaluations (but within the scope of the particular alternative).
- Standard operating procedures would be followed.
- The bison and elk management plan would be revisited at 15 years.

SHORT-TERM VERSUS LONG-TERM EFFECTS

Potential impacts are discussed in relation to short-term and long-term time frames. Short-term effects cover those that would be apparent within 15 years of implementing an alternative. Long-term effects are those that would either continue from the short term beyond the 15-year timeframe into the next 30 or more years or that would not be expected to occur until 15–30 years or more years.

RESOURCE IMPAIRMENT IN NATIONAL PARK UNITS

The purpose of the National Park System, as established by the NPS Organic Act and reaffirmed by the 1970 General Authorities Act, as amended, begins with a mandate to conserve park resources and values. NPS managers must seek ways to avoid, or to minimize to the greatest degree practicable, adverse impacts on park resources and values. However, the laws do give NPS managers discretion to allow adverse impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impacts do not constitute impairment of the affected resources and values. Congress has given the National Park Service management discretion to allow certain impacts within parks, limited by the statutory requirement that park resources and values must be left unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. An impact to any park resource or value may constitute impairment. An impact would be more likely to constitute impairment to the extent it affects a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

A determination on impairment is included in the impact analysis section for all impact topics relating to the resources and values of Grand Teton National Park and John D. Rockefeller, Jr., Memorial Parkway.

BASELINE CONDITIONS AND THE NO-ACTION ALTERNATIVE

The effects of alternatives are compared to baseline conditions and to the No-Action Alternative (Alternative 1). Baseline conditions, as described below, represent the conditions that have resulted from the current management program up through the signing of the record of decision.

- The Jackson elk herd is being maintained at approximately 13,350 animals, which is above the WGFD herd objective. The Wyoming Game and Fish Department is actively working to reduce elk numbers in the Jackson elk herd and the decision to adopt 11,029 as a herd objective and to actively manage toward this number is independent of the decision being made in this planning process.

Therefore, the potential impacts of reducing the herd from existing numbers (an estimated 13,356 in February 2004) to the herd objective are not addressed in the sections addressing potential effects of the alternatives. Rather, they are addressed in cumulative impacts sections.

- The number of elk wintering on the refuge has fluctuated between 5,000 and 7,500 animals over the past six years, which is consistent with the 1974 cooperative agreement between the U.S. Fish and Wildlife Service and the Wyoming Game and Fish Department that established a maximum of 7,500 elk for the refuge. Monitoring results indicate that elk numbers have not dropped below 5,000 on the refuge in many decades.
- In the fall of 2004 the Jackson bison herd numbered about 800 animals and could increase to 1,000 animals by the time the record of decision for this plan is signed.
- Wildlife populations, habitat, and socioeconomic factors fluctuate over time. Therefore, information from the past 5–20 years was used in the analysis where possible to better represent the average or range of baseline conditions.

Therefore, baseline conditions are slightly different than the affected environment described in Chapter 3.

Conditions that would occur under Alternative 1 involve a continuation of baseline conditions into the future. Although some conditions would remain the same over the long term under Alternative 1, other conditions (e.g., acreage of aspen on the refuge) might change from baseline conditions.

CUMULATIVE EFFECTS

At the end of each impact topic (the physical environment, habitats, wildlife, human health and safety, and social and economic resources) the anticipated cumulative effects of each alternative and reasonably foreseeable actions are disclosed. The anticipated direct effects of the reasonably foreseeable activities are discussed first, followed by a discussion of anticipated cumulative effects of each alternative and reasonably foreseeable actions. Reasonably foreseeable actions are described in Chapter 1. Existing conditions, ongoing management practices, and past events/activities are discussed in the Chapter 3, as well as this chapter.

The discussion focuses on four broad categories of reasonably foreseeable actions:

- transportation improvements
- federal land management activities
- Snake River restoration activities
- population growth and private land development

IMPACTS ON THE PHYSICAL ENVIRONMENT

SOILS

Potential effects on soils would primarily result from farming and irrigation practices on the National Elk Refuge, restoration of native vegetation in Grand Teton National Park, and possibly changes in numbers and distribution of elk and bison on the refuge and in the park. Potential effects of farming and irrigation practices were obtained from the *Irrigation System Rehabilitation Plan Environmental Assessment* (USFWS 1998). Assessments of the potential effects of elk and bison management on refuge and park soils were based on Stottlemeyer et al. (2003), with supplementary information from other sources.

IMPACTS OF THE ALTERNATIVES

Alternative 1

Analysis

Soils on up to 2,400 acres in cultivated fields on the refuge would continue to be disturbed to a depth of 6 inches by disk harrowing. Resulting soil erosion would be minimal because fields are nearly level. From 700 to 2,000 acres would be flood irrigated in any given year. Annual harrowing where feces have built up during winter feeding operations would continue to disturb the soil surface, but effects would be negligible.

Current flood irrigation practices would likely continue to cause soil nutrient depletion due to a relatively thin topsoil and cobbly or gravelly soils below. Fertilizers would be applied infrequently. As compared to a situation in which elk and bison were absent or at low densities, large numbers of elk and bison during fall and winter could contribute to inorganic nitrogen at levels that are negligibly to moderately higher, and to nitrogen mineralization rates that are negligibly to moderately higher (Stottlemeyer et al. 2003). Nitrogen mineralization produces highly usable nitrogen for plants. These effects would continue and would increase over the long term due to the growing bison population, and the effects would primarily occur in cultivated fields and some sagebrush shrublands, native grasslands, and wet meadows on the refuge and immediately to the east. Thus, urination and defecation by elk and bison in cultivated fields could offset, to some degree, the nutrient depletion caused by flood irrigation.

Heavy equipment used for feeding operations would compact soils to a negligible degree because most of the feeding occurs when the ground is frozen and feeding sites change daily. Large numbers of elk and bison could be compacting soils to a minor to moderate extent (Stottlemeyer et al. 2003), and this would continue.

In Grand Teton National Park relatively high concentrations of bison during the spring and summer could compact soils in localized areas, and they could be contributing to inorganic nitrogen levels and nitrogen mineralization rates that are negligibly to moderately higher. As the bison population continues to grow, localized impacts to soil could become problematic.

In Bridger-Teton National Forest localized areas of soil erosion could occur on winter elk range, but soil erosion does not appear to be a problem away from the state feedgrounds and major migration routes to these sites (USFS 2003b).

Conclusion

Up to 2,400 acres of cultivated fields on the National Elk Refuge would continue to be disturbed by disking, with negligible impacts. Continued flood irrigation would continue to deplete soil nutrients, which could be offset to some degree by waste products from bison and elk.

An unlimited number of bison in Grand Teton National Park over the long term could result in the most impacts to soils, even though effects would be negligible. Potential effects on soils in the park would not result in impairment to park resources.

Alternative 2

Analysis

Restoring native vegetation would require limited disking in cultivated fields, resulting in short-term, adverse impacts on these fields. Continuing

flood irrigation for several years until native vegetation became established would result in limited nutrient depletion, as described for Alternative 1. Once native vegetation was established, farming and flood irrigation would cease, and resulting impacts to soils would cease. The long-term accumulation of vegetative matter at the surface of the soil and the lack of disking and flood irrigation would eventually allow soils to build in a natural manner.

Moderate reductions in elk and bison numbers and densities and changes in their distribution and movements on the refuge, due to phasing out winter feeding and irrigation and eliminating hunting on the refuge, could reduce inorganic nitrogen levels and nitrogen mineralization rates. Effects would be nonexistent to negligible for several years, but would become more apparent after winter feeding and flood irrigation were eliminated. Even though fewer animals would be present, these and other nutrients would no longer be depleted by flood irrigation.

After the initial restoration efforts, no heavy equipment would be used in currently cultivated areas. This would have a negligible beneficial effect on soil compaction. Moderate reductions in elk and bison numbers and densities and increased movements throughout the refuge would reduce soil compaction, as compared to both baseline conditions and Alternative 1.

In Grand Teton National Park localized compaction of soils by bison would be lessened due to fewer bison inhabiting the park, as compared to baseline conditions and Alternative 1. This could negligibly reduce soil compaction, inorganic nitrogen levels, and nitrogen mineralization rates.

Restoring native vegetation on 4,500 acres of agricultural lands in the park would involve disking, which would temporarily disturb soils. However, these lands had been repeatedly plowed and disked in the past, and this additional work would have negligible adverse impacts. Resulting soil erosion would be negligible because most fields are nearly level or have very minimal slope.

Larger numbers of elk wintering in the Gros Ventre River drainage, Buffalo Valley, and other areas in Jackson Hole could increase soil erosion in localized areas. Potentially larger numbers of elk on state feedgrounds in the Gros Ventre River drainage, lower Hoback River, and south of Jackson could increase adverse impacts to soils adjacent to the feedgrounds. However, the overall effects on soils in the Jackson Hole area would be negligible and might be partially offset by treatments of aspen, Douglas-fir, sagebrush, and other habitats in the national forest to improve habitat conditions and increase the distribution of elk during winter. Habitat improvement would have negligible impacts on soils due to the temporary potential for soil erosion. It is not known whether soil erosion caused by bison grazing on south and southwest-facing slopes immediately east of the refuge would increase or decrease, although bison numbers would be lower compared to Alternative 1.

If large numbers of elk began migrating to the Green River basin and the Red Desert, soil erosion in localized areas could increase due to hoof action and higher levels of grazing and browsing pressure on vegetation that is already heavily grazed and browsed in some areas.

Conclusion

Restoring native vegetation would result in one-time, short-term impacts in cultivated fields on the refuge and agricultural lands in the park. Soils would benefit more than under any other alternative due to the restoration of native vegetation and the subsequent lack of disturbance. Potential effects on soils in the park would not result in impairment to park resources.

Alternative 3

Analysis

Continuing farming and flood irrigation under Option A of the habitat management program would have similar impacts to those described under Alternative 1. Soil erosion associated with disking would be minimal, and flood irrigation would likely continue to cause nutrient depletion in soils, as described under Alternative 1.

Under Option B the potential effects on soils in the cultivated portions of the refuge would be similar to those estimated for Alternative 2 due to similarities in the restoration of native vegetation and elimination of farming and flood irrigation.

Soil erosion would decline by a negligible degree, nutrients would no longer be depleted due to flood irrigation, and disking would not turn over the soil and would allow it to develop naturally.

Substantially reducing elk numbers and maintaining bison numbers near the existing level could reduce inorganic nitrogen levels and nitrogen mineralization rates, similar to Alternative 2. Effects would be nonexistent to negligible for several years, but would become more apparent after winter feeding was reduced to severe winters only. Under Option B reduced levels of inorganic nitrogen and the rate of nitrogen mineralization would be partially offset by the elimination of flood irrigation because flood irrigation would no longer deplete these and other nutrients.

With a lower number and density of elk and reduced use of heavy equipment for feeding elk and bison, soil compaction would be reduced compared to Alternative 1. Compaction would be further reduced under Option B with the elimination of farming practices, although tractors and other equipment would be used in the short term to restore native vegetation.

In Grand Teton National Park soil conditions in areas grazed by bison would remain similar to baseline conditions, but soil compaction, inorganic nitrogen levels, and nitrogen mineralization rates would be negligibly lower than under Alternative 1 (bison numbers would continue to grow under Alternative 1). In the short term activities to restore native vegetation to 4,500 acres of agricultural lands in the park would result in negligible adverse effects, similar to Alternative 2. In the long term soil conditions would be essentially unaffected.

Greater winter use by elk of Bridger-Teton National Forest and associated state feedgrounds could increase soil erosion in localized areas, as described in Alternative 2. Also, habitat treatments in the national forest could temporarily increase soil erosion, but enhanced habitat conditions would more than offset this effect. If large numbers of elk began migrating to the Green River basin and the Red Desert, localized areas of increased soil erosion could occur, as discussed in Alternative 2. Soil erosion caused by bison grazing on south and southwest-facing slopes immediately east of the refuge could increase compared to baseline conditions. Although bison numbers would not increase beyond baseline numbers, major reductions in winter feeding on the refuge could result in more bison using these slopes during winter.

Conclusion

Up to 2,400 acres of cultivated fields on the National Elk Refuge would continue to be disturbed by disking under Option A, with negligible impacts. Continued flood irrigation would continue to deplete soil nutrients, which could be offset to some degree by waste products from bison and elk. An estimated 800–1,000 bison in Grand Teton National Park over the long term could result in the most impacts to soils, even though effects would be negligible.

Stopping farming on the refuge under Option B and restoring native vegetation on the refuge and in the park would result in one-time, short-term impacts in affected areas, the same as Alternative 2. Soils would benefit more than under any other alternative due to the restoration of native vegetation and the subsequent lack of disturbance. Potential effects on soils in the park would not result in impairment to park resources.

Alternatives 4, 5, and 6

Analysis

Effects of farming practices on refuge soils would be similar to the effects described in Alternative 1. Soil erosion associated with disking would be minimal because cultivated fields are nearly level. Up to 2,400 acres would continue to be cultivated (similar to Alternative 1). The negligible effects of harrowing after the winter feeding season would continue as described under Alternative 1.

Approximately 61,106 feet of water pipeline would be installed. However, 40% of this distance (about 24,547 feet) would occur within cultivated fields, so no additional impacts to soils would occur. Laying the remaining 38,591 feet of pipeline within a 10-foot-wide right-of-way would result in soil disturbance to an estimated 9.4 acres. The pipeline would be buried several feet in places. A portion of the pipeline (2,030 feet) between the Flat Creek inlet and the Chambers project area would cross USFS land, resulting in the distur-

bance of approximately 0.5 acre in Bridger-Teton National Forest. The flood irrigation system for other fields would be improved. All disturbed soils along the pipeline right-of-way would be immediately replaced and reseeded to reduce the likelihood of soil erosion. Soil disturbance associated with pipeline construction and flood irrigation improvements would be minor and short term.

Converting from flood irrigation to sprinkler irrigation on about 1,100 acres on the refuge would reduce the leaching of nutrients because the amount and distribution of water application can be more easily and precisely controlled. Although this would allow nutrient levels to increase, the reduced period that elk and bison would spend on cultivated fields (due to lower numbers and reduced feeding) would offset gains to some extent because inorganic nitrogen levels and nitrogen mineralization rates due to animal waste would decline. Leaching would continue on up to 500 acres in flood-irrigated fields. Fertilizer use on cultivated fields would further increase nutrients in the soil. It is not clear whether inorganic nitrogen levels and nitrogen mineralization rates would increase or decrease in other habitats (e.g., some sagebrush shrublands, native grasslands, and wet meadows on the refuge and immediately to the east of the refuge). Although there would be fewer elk and bison under Alternatives 4, 5, and 6 than under baseline conditions, there could be greater use of these native habitats under Alternatives 4 and 6 due to reduced feeding, which would mean higher levels of nitrogen. However, if fewer animals used these habitats, then nitrogen levels would decline.

Soil compaction impacts in the short term would be similar to baseline conditions, but in the long term they would decline to a negligible degree due to fewer elk and bison, increased distribution and movements of elk and bison (Alternatives 4 and 6), and reduced use of heavy equipment for winter feeding operations (Alternatives 4 and 6).

In Grand Teton National Park soil conditions in areas grazed by bison would remain similar to baseline conditions in the short term, but with fewer bison, soil compaction, inorganic nitrogen levels, and nitrogen mineralization rates would decline by a negligible degree over the long term. In the short term, restoring native vegetation to 4,500 acres of agricultural lands in the park would result in negligible adverse effects, similar to Alternative 2. In the long term, natural soil conditions would be restored.

Increased winter use of Bridger-Teton National Forest and associated state feedgrounds by elk under Alternatives 4 and 6 could increase soil erosion in localized areas, as described in Alternative 2. Soil erosion would not increase to the extent it could under Alternatives 2 and 3. Soil erosion caused by bison grazing on south and southwest-facing slopes immediately east of the refuge would decline due to substantial reductions in bison numbers under Alternatives 4, 5, and 6.

If large numbers of elk began migrating to other areas under Alternative 6, soil erosion could increase in localized areas, including state feedgrounds. It is not known whether soil erosion caused by bison grazing on south and southwest-facing slopes immediately east of the refuge would increase or decrease; bison numbers would be substantially lower under Alternative 6, and no supplemental forage would be provided for bison in the long term under Alternative 6.

Conclusion

Alternatives 4, 5, and 6 would result in short-term soil disturbance of an estimated 9.4 acres along approximately 61,106 feet of water pipeline right-of-way on the refuge, with minor adverse effects. Additionally, soil in cultivated parts of the refuge would be periodically disturbed during disking and reseeding activities. Soil on agricultural lands in Grand Teton National Park would be temporarily disturbed by efforts to restore native vegetation (similar to Alternatives 2 and 3). Long-term impacts on soils would be beneficial. Potential effects on soils in the park would not cause impairment to park resources.

MITIGATION

Short-duration soil disturbances, such as the disturbance during the construction of irrigation pipelines would be mitigated by screening or using hay bales to reduce the potential of sediments reaching stream channels. Also, to the extent that nutrients were depleted, additional fertilizers would be used to lessen this impact.

WATER RESOURCES

WATER QUANTITY

Potential effects on water quantity on the refuge would primarily result from irrigation practices, including the methods of conveying water from source waters to irrigation systems. Effects on water quantity were evaluated in the 1998 *Irrigation System Rehabilitation Plan Environmental Assessment* (USFWS 1998), and the following assessment incorporates these findings, as well as supplementary assessments.

Impacts of the Alternatives

Alternatives 1 and 3 (Option A)

Analysis

An estimated 40% of diverted water used for irrigation currently is lost in transport, which would be expected to continue under Alternatives 1 and Option A of Alternative 3. Under Alternative 1 sprinkler irrigation would continue on only 60 acres, or about 5% of the amount of land that is being irrigated.

The actual amount of water that would continue to be diverted from Flat Creek, Nowlin Creek, and Cache Creek for flood irrigation of cultivated fields is unknown, but adjudicated water rights allow for the diversion of up to 105 cfs.

Water diversions for refuge irrigation purposes during peak run-off do not appear to be large enough to adversely impact streams and riparian vegetation. Water diversions from July through September, however, can involve substantial proportions of stream flow, when water levels are normally low and evaporation and transpiration rates are highest. In some cases this causes sections of streams below outtakes to go dry, putting stress on organisms dependent on water flow and wet or moist soils.

Conclusion

A substantial amount of water would be diverted for irrigation during peak run-off in May and June under Alternative 1 and Option A of Alternative 3, with negligible adverse effects because of the remaining large volume of water that would continue to flow in the creeks. However, from July through September diversions could continue to cause some sections of streams below outtakes to go dry, putting stress or organisms dependent on water flow and wet or moist soils.

Water quantity in the park would be unaffected by elk and bison management, and there would be no impairment of water resources.

Alternatives 2 and 3 (Option B)

Analysis

Water would no longer be diverted from Flat Creek, Nowlin Creek, and Cache Creek to meet National Elk Refuge irrigation demands under Alternative 2 and Option B of Alternative 3. Because the amount of water that has been diverted during peak flows in the recent past has not been a large portion of the stream flow, cessation of irrigation would likely increase water flow only to a minor degree. However, because the amount of water that currently is diverted from July through September (after the peak-flow period) comprises a large portion of the stream flow, stopping irrigation would result in a moderate to major increase in stream flows during this period.

No further irrigation on the National Elk Refuge would result in the forfeiture of refuge water rights, which would severely limit any water projects or irrigation projects in the future. Junior downstream users would have access to the abandoned water. This means that, although water flows on the National Elk Refuge, immediately below the refuge, and below the Cache Creek diversion would increase, increased water flows would not extend very far downstream.

Neither alternative would affect the quantity of water in park waters.

Conclusion

Stopping water diversions for irrigation purposes on the refuge would have minor benefits to stream flow in May and June, but major benefits to parts of streams during July and August, which is a critical period for streams and riparian zones. Water quantity in the park would be unaffected, and no park resources would be impaired.

Alternatives 4, 5, and 6

Analysis

Converting to a sprinkler irrigation system on up to 1,100 acres would increase water-use efficiency under these alternatives from about 5%–10% under Alternative 1 to an estimated 60%–70% (Kremer and Cornia, pers. comm., as cited in USFWS 1998). Less water would be diverted from Flat, Nowlin, and Cache creeks. This would result in only minor increases in stream flow below outtakes during peak flow periods. Flood irrigation would continue on up to 500 acres, but the delivery system would be improved to reduce loss. However, later in the summer when stream flow has declined still further, it is possible that nearly all or all water in the stream channel would be diverted for irrigation. The difference between these alternatives and Alternative 1 is that more acreage could be irrigated during this period. Except for the end of the irrigation season, when large amounts of water (and possibly all available water) would be diverted for sprinkler irrigation, water saved through more efficient conveyance, distribution, and use would remain in the watercourses.

These alternatives would not affect the quantity of park waters.

Conclusion

While more efficient use of water under Alternatives 4, 5, and 6 could increase stream flows, most or all of the available water during the most critical period (July–August) would continue to be diverted. Benefits to streams and riparian areas would be negligible to minor under these alternatives. None of these alternatives would cause impairment of park water resources.

Mitigation

Major reductions in water flow during July and August could be mitigated under Alternatives 3–6 by reducing the amount of water diverted during this time period. For example, it might be possible to supplement sprinkler irrigation with flood irrigation only during May and June.

Water Quality

Methodology Used to Analyze Impacts

Available information on water quality was reviewed for this analysis. Potential effects were evaluated based on numbers and distribution of elk and bison, the potential for large amounts of fecal material to be produced by concentrations of wintering elk and bison, the type and extent of irrigation and farming practices, and the efficiency of water use. The standard threshold definitions were used.

A beneficial effect would result in improved water quality as compared to baseline conditions, for example, from a decrease in herd size, greater dispersion of herds during winter, and any action that would tend to moderate water temperature either by increasing water use efficiency or increasing the height and canopy cover of streamside vegetation.

An adverse effect would result in the degradation of water quality as compared to baseline conditions, for example, from larger elk and bison herds, greater concentration of herds during winter feeding, and any action that would increase water temperature either by decreasing water use efficiency or reducing the height and canopy cover of streamside vegetation.

Impacts of the Alternatives

Alternative 1

Analysis

Water quality on the refuge is affected by concentrations of large numbers of elk and bison for several months each winter, diversion of water for flood irrigation, disking, and infrequent application of fertilizers.

In the short term this alternative would result in few if any changes in water quality as compared to baseline conditions on either the refuge or in the park. Large concentrations of elk and bison on the refuge in the winter would continue to introduce unnaturally high amounts of fecal material into watercourses, resulting in elevated fecal coliforms and nutrients. Existing farming practices would continue to result in short-term, negligible to minor, adverse effects to water quality due to

erosion when disking, with the potential to persist until ground cover was reestablished. Infrequent application of fertilizers can contribute to nutrient enrichment of watercourses, depending on a wide variety of factors such as weather, ambient soil conditions, and the type of fertilizer, which could result in minor to moderate adverse effects on water quality.

Over the long term a large increase in bison numbers could result in minor adverse effects on water quality on the National Elk Refuge as a result of more fecal material entering surface runoff. Also over the long term, the minor reduction in woody riparian vegetation in the southern part of the refuge could result in negligible to minor increases in water temperature in some streams. The areas affected are small, and most woody riparian vegetation has already disappeared.

Large animal concentrations and farming practices would contribute to negative long-term effects on downstream water quality due to conveyance of fecal material, sediments, nutrients, and fertilizers into surface waters.

Conclusion

Under Alternative 1 adverse impacts to water quality would continue primarily as a consequence of large concentrations of elk and bison on the refuge, continued diversion of water for flood irrigation, and continued disking in cultivated areas. Growing bison numbers would intensify adverse impacts over the long term. Water quality (specifically temperature and fecal coliforms) could be subject to long-term, minor, adverse effects. This alternative would result in the lowest water quality of any of the alternatives. Water quality in the park would be affected to a negligible to minor degree under this alternative. No park waters would be impaired.

Alternative 2

Analysis

In the short term this alternative would result in negligible changes in water quality. As elk and bison numbers declined, winter feeding and irrigation would be phased out, and approximately 2,400 acres of cultivated fields would be restored to natural conditions, and harrowing and fertilizing would be discontinued. As a result, this alternative would have long-term, major beneficial effects to water quality on the National Elk Refuge. Maximum elk numbers could decrease by an estimated 20% as compared to baseline conditions (from about 7,500 down to an estimated 6,000 elk), and the range in numbers would decline from approximately 5,000–7,500 to an estimated 1,200–6,000 elk. Bison numbers could decline by as much as an estimated 40%–70% compared to baseline conditions (from an estimated 800 down to 250–500 bison). Because winter feeding would be phased out and elk and bison numbers would be reduced, animals would no longer congregate in large numbers, which would reduce the amount of fecal coliforms and nutrients introduced into water courses. The limited amount of riparian woody vegetation that would recover under Alternative 2 would have no more than negligible effects on water temperature. Improvements in water quality would be higher under this alternative than Alternative 1, in part because of lower bison numbers.

Water quality in Grand Teton National Park would be subject to short-term, negligible to minor, adverse effects due to soil disturbance from restoring 4,500 acres of agricultural lands, which could increase sedimentation until native vegetation took hold. In the long term a healthier vegetation community on agricultural lands would possibly enhance water quality by a negligible degree. Reduced forage availability on the refuge during winter could cause a greater increase in elk utilization of riparian areas in the park. If browsing pressure increased to the extent that plant community structure was altered substantially, water quality could be lowered to a negligible degree in areas that are browsed.

Conclusion

Alternative 2 would result in lower levels of fecal coliforms, sediments, nutrients, and fertilizers into downstream waters, as compared to Alternative 1, resulting in the greatest long-term beneficial impacts to water quality on the refuge and in the park. Impacts would result from reductions in elk and bison numbers; increased distribution and movements of animals; eventual elimination of irrigation, farming, and fertilizer use; and conversion of agricultural lands to native vegetation. Short-term, negligible to minor, adverse impacts

to water quality in the park could result from restoring 4,500 acres of agricultural lands to native vegetation. This alternative would not result in the impairment of park waters.

Alternative 3

Analysis

On the National Elk Refuge short-term effects of this alternative on water quality would be negligible. Over the long term, however, this alternative could result in a moderate improvement in water quality on the refuge if farming was continued (Option A). The improvement under this alternative would result primarily from an estimated 70%–80% decrease in the numbers of wintering elk combined with a major reduction in years when supplemental food was provided. Bison numbers would not be permitted to grow as they would under Alternative 1. Lower concentrations of elk and bison would result in less fecal coliforms and nutrients being introduced into water sources. Also, riparian woody vegetation along some streamcourses would be able to increase, which would moderate water temperatures. Option B of Alternative 3 would result in additional beneficial effects to water quality due to less sedimentation and fertilizers as farming practices were phased out.

In Grand Teton National Park water quality would be subject to short-term, negligible to minor, adverse effects from potential sedimentation as a result of restoring 4,500 acres of agricultural lands, similar to Alternative 2. As compared to Alternative 2, far fewer elk in the Grand Teton National Park herd segment and fewer elk on the National Elk Refuge could reduce the potential for increased browsing of woody vegetation in park riparian areas. However, large numbers of elk from southern Yellowstone and the Teton Wilderness would continue to migrate through Grand Teton, and an increasing number could begin wintering in the park due to major reductions in winter feeding on the refuge. Because bison numbers would not decline as compared to baseline conditions, water quality concerns would continue in Grand Teton National Park in localized areas.

Alternative 3 would result in lower levels of fecal coliforms, sediments, nutrients, and fertilizers into downstream waters, as compared to Alternative 1, but reductions would not be as great as they would be under Alternative 2.

Conclusion

Both Options A and B of Alternative 3 would result in long-term, beneficial effects to water quality on the National Elk Refuge, although not to the same extent as under Alternative 2. Despite many similarities with Alternative 2, bison numbers would remain high (both options) and flood irrigation and farming would continue (Option A), which would limit improvements in water quality.

In Grand Teton National Park temporary, adverse effects from restoring native vegetation on most agricultural lands would be negligible to minor. Water quality might be improved somewhat compared to Alternative 1 because of fewer elk and bison and the restoration of most agricultural lands. This alternative would not result in the impairment of park waters.

Alternatives 4, 5, and 6

Analysis

Water quality on the refuge under Alternatives 4, 5, and 6 would be subject to short-term, minor, adverse effects from soil erosion (resulting in increased sedimentation) due to construction activities for irrigation pipeline installation. Over the long term, water quality on the refuge would improve by a moderate amount due to a decline in elk numbers (an estimated 20%–33% decline under Alternative 4, and 50%–75% under Alternative 6) and bison numbers (an estimated 45%–50% decline under Alternative 4, 45%–50% under Alternative 5, and 50%–60% under Alternative 6). Reducing supplemental feeding under Alternative 4 and phasing it out under Alternative 6 would result in wider winter distribution of animals and less potential for contamination of water sources from fecal coliforms and nutrients. Even though bison numbers would be lower under Alternative 5, elk numbers would remain high, and feeding would continue nearly every year, with large amounts of fecal material near feedgrounds potentially entering watercourses.

Under all alternatives replacing flood irrigation with sprinkler irrigation would result in more wa-

ter remaining within watercourses, contributing to improved water quality. Restoring willow and cottonwood habitats along lower Flat Creek would help these communities recover, increasing shading of the stream and possibly reducing water temperature. Reducing available grazing acreage in the southern part of the refuge by 600 acres under Alternative 4 would offset some of the benefits of lowering elk numbers in this alternative by further concentrating elk and impacting riparian vegetation.

Potential effects of restoring native vegetation on previously cultivated fields in Grand Teton National Park would have a short-term, negligible to minor, adverse effect and a long-term, negligible, beneficial effect on water quality, similar to Alternative 2.

Conclusion

Alternatives 4, 5, and 6 would result in lower levels of fecal coliforms, sediments, nutrients, and fertilizers into downstream waters, as compared to Alternative 1 because of fewer animal numbers and a sprinkler irrigation system. The reduction would be greatest under Alternative 6 (comparable to Alternative 2) because of the phaseout of supplemental feeding and least under Alternative 5 because of more elk and continued supplemental feeding.

Water quality in the park could potentially improve over the long term due to fewer elk and bison and the restoration of 4,500 acres of agricultural lands to native vegetation communities, although restoration activities would result in short-term, negligible to minor, adverse impacts. This alternative would not result in the impairment of park waters.

MONITORING

Water quality parameters would continue to be monitored at least every five years, regardless of alternative selected, for nitrogen and other nutrients, sediment, and fecal coliforms. Consideration would be given to monitoring water temperature and extent of shading by riparian vegetation.

MITIGATION

Management actions under each alternative would be conducted so as to avoid the degradation of water quality to the maximum extent practicable. Measures would be employed to prevent or control spills of fuels, lubricants, and other contaminants from entering watercourses and wetlands. Actions must be consistent with state water quality standards, to the extent possible, and with Clean Water Act section 401 certification requirements.

Erosion and siltation control measures would be undertaken during pipeline construction on the refuge for Alternatives 4, 5, and 6 and during activities associated with restoring native vegetation to agricultural lands in the park for Alternatives 2–6. All exposed soil would be stabilized at the earliest practicable date.

VISUAL RESOURCES

Visual resources could be affected by several actions being considered for the refuge, including conversion to sprinkler irrigation systems, use of large equipment (e.g., to distribute alfalfa pellets), maintenance of large structures (e.g., Quonset hut for storing alfalfa pellets), construction of fenced exclosures, and prescribed fire, as well as changes in vegetation and the numbers and distribution of elk, bison, and other wildlife.

Visual resources in Grand Teton National Park could be affected by the active restoration of previously cultivated areas and by the numbers and distribution of elk and bison.

The potential effects of changes in the sprinkler irrigation system on the refuge were analyzed in the *Irrigation Systems Rehabilitation Plan Environmental Assessment* (USFWS 1998). The analysis of potential effects resulting from changes in other management actions and from changes in elk and bison numbers was done qualitatively.

METHODOLOGY USED TO ANALYZE IMPACTS

The evaluation of potential effects of changes in irrigation practices on visual resources focused on the "visual absorption capabilities of Refuge lands

in relation to the most visually intrusive irrigation scenario being considered" (USFWS 1998). The scenario that was evaluated in detail was analyzed from five different angles and distances and is similar to the irrigation system included in Alternatives 4, 5, and 6, except that the center pivots in the Ben Goe project area were changed to side-roll sprinklers in Alternatives 4 and 5, and two center pivot sprinklers in the Peterson project area are included in Alternatives 4, 5, and 6. The following impact analysis addresses these changes.

Locations selected for detailed analysis represent areas of high visual sensitivity and differing landscape classes, a range of close and distant views of sprinkler irrigation equipment, and views of both single and multiple equipment scenarios likely to be seen by large numbers of visitors. The likelihood of seeing more than one irrigation system at one time was considered in an attempt to more comprehensively measure actual visual impacts of converting from flood irrigation to sprinkler irrigation. Viewpoint locations included the Headquarters, Nowlin, and Ben Goe project areas.

IMPACTS OF THE ALTERNATIVES

Alternative 1

Analysis

Management activities and facilities associated with elk and bison management on the National Elk Refuge and in Grand Teton National Park would continue to affect visual resources to the extent they have in the recent past.

National Elk Refuge — The flood irrigation structures and facilities that would be maintained under this alternative would continue to adversely affect the visual quality of the National Elk Refuge to a minor degree for some people visiting the refuge. For other people, this would not affect visual quality. Flood irrigation structures are low to the ground and are minimally intrusive.

More prominent, but more localized, are the side-roll sprinklers in the Headquarters area and the Quonset hut at the Nowlin area. The effects of these structures on visual quality are minor due to their localized nature and, more importantly, because they are in the vicinity of other human-made structures. Facilities are close to the road and are within 0.5 mile of town. The Nowlin Quonset hut is in proximity to storage sheds and several cabins in the Nowlin area.

Storage shed and Quonset hut used for alfalfa pellets.

During winter large diesel trucks with trailers would continue to be seen distributing alfalfa pellets each morning in the Headquarters, Nowlin, and Poverty Flats feeding areas (the McBride feeding area is not viewable). This would occur for an average of about 70 days each winter during about 9 out of 10 winters. Prescribed fire would continue on fewer than 5 days per year and effects would be temporary.

In the late fall and early winter, prior to winter feeding, visitors traveling along U.S. 26/89 would see large numbers of elk on many days from pull-outs along the highway and from some locations along the Elk Refuge Road, but only small numbers on other days. Once feeding operations begin, elk would continue to be tightly concentrated along feedlines or adjacent to feedlines for a few hours in the morning. Later in the day they would be more scattered, but still readily viewable. Bison viewing opportunities on the refuge during the winter season would continue to be low in the foreseeable future because they are fed primarily at the McBride feedground, which is not viewable from open roads or the highway. A few bison have been finding their way to the Poverty Flats feedground, which is also far from public viewing locations. As the bison population expanded, more bison might be seen nearer the highway and open refuge roads. Small, localized areas denuded of vegetation by bison wallowing or overgrazing might detract from the aesthetics of the refuge environment from some perspectives.

Vegetation along Flat Creek would remain dominated by wet meadow and marsh communities. Over the long term, the cottonwood stand along upper Flat Creek would be lost and aspen stands would continue to be lost in the Gros Ventre Hills. Eventually, all aspen stands could be lost in the Gros Ventre Hills, which can now be seen from the Kelly Road in Grand Teton National Park. The cottonwood stands on upper Flat Creek can be seen from Flat Creek Road on the National Elk Refuge during the months it is open to the public.

The introduction and spread of bovine tuberculosis, bovine paratuberculosis, chronic wasting disease, or other non-endemic, infectious disease could impact the scenery of the refuge to the extent that elk and/or bison populations were reduced. Elk and bison are important parts of the scenery of Jackson Hole at all seasons. If populations were substantially reduced, impacts to visual resources could be moderate to major under this alternative.

Grand Teton National Park — The large number of elk and bison in Grand Teton National Park during spring, summer, and fall would continue to add positively to the park's visual resources. Because bison are typically much more visible than elk in the park, they are an important component of the visitor experience. While a large bison herd over time would increase viewing opportunities, more bison could also result in localized damage to plant communities, which could detract slightly from the natural scenery of the area.

As described under the National Elk Refuge, an outbreak of a non-endemic infectious disease could have major impacts on visual resources and wildlife viewing opportunities.

Nonnative vegetation (smooth brome, musk thistle, and other invasive species) on approximately 4,500 acres of agricultural lands in Grand Teton National Park would continue to be unappealing to some people. Also, the sight of hunters dressed in blaze orange along U.S. 26/89 and other roadways in the park during the fall and early winter could continue to detract from the scenic quality for some visitors.

Other Federal Lands — Elk wintering on the National Elk Refuge and summering in Yellowstone National Park, the Teton Wilderness, and the Gros Ventre drainage would continue to contribute to visual resources in these areas.

Conclusion

The overall scenic quality of the refuge and park would remain much the same as it is today, except that bison would be much more abundant and viewable during the summer. The decline and eventual disappearance of aspen habitat on the National Elk Refuge would contribute to the loss of aspen habitat in Jackson Hole. The disappearance of remaining willow stands in the southern part of the National Elk Refuge and the cottonwood stands along upper Flat Creek would likely be noticed by few people. This alternative would not impair any visual resources in the park.

Alternative 2

Analysis

National Elk Refuge — As compared to Alternative 1, elk and bison management on the National Elk Refuge under Alternative 2 would gradually result in a more natural landscape.

Changes would include the restoration of native vegetation in cultivated fields and the removal of flood-irrigation structures and facilities, side-roll sprinklers, and the Quonset storage huts. It is possible that the elk and bison fence along the southern boundary of the National Elk Refuge and along U.S. 26/89 would also be removed. Diesel trucks would no longer be driven in four feeding areas each morning an average of 70 days each winter.

Reduced smoke from eliminating the prescribed fire program on the National Elk Refuge would have a negligible beneficial impact on visual resources.

As compared to Alternative 1, fewer elk and bison wintering on the National Elk Refuge would present more natural viewing opportunities. Instead of being artificially concentrated along feedlines, elk and bison would be more widely distributed as they search for forage, and visitors would see fewer animals than under Alternative 1.

If large numbers of elk and bison continued to overwinter on and near the National Elk Refuge,

there would be little, if any, improvement to willow, cottonwood, and aspen stands, and some stands could continue to decline and might ultimately disappear. This would result in visual resources being affected similarly to Alternative 1. If, however, elk began migrating to other wintering areas, and fewer elk remained on the refuge, willow, cottonwood, and aspen stands would begin recovering, which would contribute to a more natural looking landscape.

Adverse impacts to visual resources due to reductions in elk and bison numbers caused by a potential outbreak of an infectious disease would be lessened under this alternative, as compared to Alternative 1, because fewer animals would be present, and the prevalence rate would likely be lower than under any other alternative (except Alternative 3). Therefore, numbers would likely not decline as much as they would under the other alternatives (except Alternative 3).

Grand Teton National Park — Large numbers of bison would continue to be seen in Grand Teton National Park during summer and other seasons, although there would be fewer bison than under Alternative 1. Fewer elk, and more naturally fluctuating populations, could reduce wildlife viewing opportunities by a negligible or minor degree for some people. As described for the National Elk Refuge, visual resources could be affected by an outbreak of a non-endemic infectious disease, but adverse impacts under this alternative would be more similar to what would happen in a natural situation.

Restoring approximately 4,500 acres of agricultural lands in Grand Teton National Park would result in a more natural looking and more appealing landscape for some people, although many people would not notice the difference. The process of disking and reseeding former fields would temporarily adversely affect the natural appearance of these lands for a short period. Eliminating hunting in Grand Teton National Park would enhance the naturalness of the scenery during the fall and early winters because hunters dressed in blaze orange would no longer be seen in the park.

Other Federal and Private Lands — Potentially minor reductions in the number of elk in Yellowstone National Park, the Teton Wilderness, and the Gros Ventre drainage could result in negligible reductions in visual resources in these areas. If large numbers of elk began migrating to the Green River basin and the Red Desert, in addition to migrating pronghorn and mule deer, wildlife viewing opportunities would be enhanced for people along the migration route.

Conclusion

This alternative would contribute to a more natural looking landscape in the southern Jackson Hole area. If elk and bison did not begin using other winter ranges, overbrowsing of aspen and other woody plant communities could contribute to a further decline. Views of elk and bison on the refuge would be more natural because animals would not be artificially concentrated along feedlines, but fewer numbers of elk and bison than under Alternative 1 would diminish visual resources and the visual quality of the refuge and the park for some people. This alternative would not impair any visual resources in the park.

Alternative 3

Analysis

National Elk Refuge — As compared to Alternative 1, elk and bison management on the National Elk Refuge would result in a transition to a more natural landscape on the National Elk Refuge, but not to the extent of Alternative 2.

Under Option A of Alternative 3, the scenery associated with cultivated portions of the National Elk Refuge would remain the same as Alternative 1, except side-roll sprinklers in the Headquarters project area would be removed. This would be a negligible change because facilities would remain in the area.

Under Option B cultivated fields would be restored to native vegetation. Impacts would be similar to Alternative 2 as a result of removing flood-irrigation structures and facilities, as well as side-roll sprinklers. However, because winter feeding would continue under this alternative in the more severe winters, the Quonset huts would remain and diesel trucks would continue to be driven to the four feeding areas each morning, although not as frequently as under Alternative 1.

Prescribed fire would continue on only a few days each year, similar to Alternative 1, and effects on scenic quality would be temporary and negligible.

As compared to Alternative 1, views of elk and bison wintering on the National Elk Refuge would be somewhat more natural because fewer animals would be present, and they would be more widely distributed as they searched for forage. Under Alternative 3 bison would not be a regular part of the scenery, similar to Alternative 2.

If large numbers of elk migrated to the Green River basin and the Red Desert, aspen and willow habitat could recover on the refuge due to fewer elk browsing on woody vegetation. This would add to the naturalness of the scenery on the refuge.

A potential outbreak of a non-endemic infectious disease would have fewer effects on visual resources under this alternative than Alternative 1 because reducing winter feeding and eliminating irrigation (Option B) would reduce animal concentrations, similar to Alternative 2. Although animal numbers would decline if an infectious disease became established, the prevalence rate would likely be lower than under Alternative 1, and numbers would likely not decline to the same degree.

Grand Teton National Park — Large numbers of bison would continue to be seen in Grand Teton National Park during summer and other seasons, similar to baseline conditions, although there would be far fewer elk than under Alternative 1. As described for the refuge, impacts on wildlife viewing opportunities from a non-endemic infectious disease would be substantially lower than under Alternative 1 (and would be similar to Alternative 2) because the prevalence rate would likely be lower. Similar to Alternative 2, restoring approximately 4,500 acres of agricultural lands to native vegetation would result in a more natural looking and more appealing landscape to some people, although many people would not notice the difference. The process of disking and reseeding former fields would temporarily adversely affect the natural appearance of these lands. The likely recovery of aspen stands that otherwise would have been lost under Alternative 1 due to browsing by elk, in combination with fire suppression, would enhance the scenic quality of the park to a negligible degree.

The presence of elk hunters in Grand Teton National Park would detract from the naturalness of the scenery for some visitors during the fall and early winter.

Other Federal Lands — Potentially minor reductions in the number of elk in Yellowstone National Park, the Teton Wilderness, and the Gros Ventre River drainage and potential minor increases during some years would result in a greater variability of wildlife viewing opportunities in these areas. However, the effect on visual quality would be negligible in most years. If large numbers of elk began migrating to the Green River basin and the Red Desert, opportunities to view elk (in addition to pronghorn and mule deer) would be enhanced for some people.

Conclusion

This alternative would contribute to a slightly more natural looking landscape in the southern Jackson Hole area, including aspen stands and willow habitat. Views of elk and bison on the refuge would be more natural due to a major reduction in the artificial concentration of animals along feedlines. Relatively small numbers of elk compared to Alternative 1 would diminish visual quality on the refuge and in the park for some people, but maintaining large numbers of bison and increased visibility of bison on the refuge would offset these impacts to some extent. This alternative would not result in the impairment of visual resources in the park.

Alternatives 4 and 5

Analysis

National Elk Refuge — The center pivot systems that would be constructed under these alternatives would be either hidden from view (e.g., those in the McBride project area) or would be difficult to visually distinguish because of their distance from roads and highways and because they would blend into the background (those in the Nowlin and Peterson project areas). The three center pivots in the Nowlin project area would blend into the strong visual backdrop of Miller Butte when viewed from the highway turnout near the fish

The visual impact of side-roll sprinkler irrigation on the refuge would be negligible to minor.

hatchery. The two center pivots in the Peterson project area would be easier to see from most locations along the highway, but given the distance would not be noticeable to many viewers traveling at highway speeds (i.e., 40–60 mph) along this view corridor. Also, the metal-roofed Quonset huts and cabins in the middleground include a human agricultural element in the view plane and make the irrigation equipment compatible within this context. Irrigation equipment would be less conspicuous during late summer and fall when taller, honey-colored grasses are present than in the spring and early summer. The addition of center pivots in the Nowlin and Peterson project areas would be visually obtrusive to some visitors.

Constructing one small pumphouse (12 feet square) in the Nowlin area would have minor visual impacts. The pumphouse would be similar in size, shape, color, and construction materials to the town's pumphouses in the Headquarters area. It would also be located near several existing buildings found in the Nowlin area.

The visual impacts of side-roll and hand-line sprinklers in the Ben Goe and Headquarters areas would be negligible to minor. The sprinklers would cover more area but would be much lower and not as noticeable. Even though the irrigated fields in the Headquarters area extend all the way to the southern refuge boundary adjacent to Jackson, the sprinklers would be indistinguishable from more than 0.5 mile. Side-roll sprinklers adjacent to Elk Refuge Road would be within about 50 feet of the road edge and about 10 feet below the road grade. This view is seen by all road users leaving the interior of the National Elk Refuge, and the Headquarters area receives the heaviest year-round use of any other interior area. Views of side-roll line wheels would be more noticeable closer to the roadway. Well buildings and residences in the middleground introduce a human element into the view plane and make the irrigation equipment compatible within this context. These irrigation structures, at least the southern portions and systems to the west, would be almost indistinguishable to the naked eye.

Views of elk and bison wintering on the National Elk Refuge under Alternative 5 would be similar to Alternative 1. However, views over the long term under Alternative 4 would be similar to Alternative 1 in about half the winters because of continued feeding operations, but in non-feeding years views would be somewhat more natural due to fewer elk and wider distribution of animals as they search for forage. Numbers of elk viewable during most days in half of the winters would be much lower than under Alternative 1; bison are not readily visible from U.S. 26/89 or most points along Elk Refuge Road. Under Alternative 4 large numbers of elk and bison would be seen grazing on the southern part of the refuge on some days.

Willows along Flat Creek would recover inside a fenced exclosure that would be readily visible from the highway under both Alternatives 4 and 5. Because willow would recover only inside the exclosure, the scenic quality of the National Elk Refuge would not necessarily be enhanced. The edges of the willow stand would have squared corners and sharp edges, rather than blending into the natural environment. The aspen exclosure

would result in few visual impacts because the irregular fence-line and the fence would not be visible from the Kelly Road.

Adverse impacts to visual resources caused by a potential outbreak of an infectious disease would be somewhat less under Alternative 4, as compared to Alternative 1, but higher than under Alternatives 2, 3, and 6, because moderately reducing winter feeding would help reduce unnaturally high concentrations of these animals. Risks under Alternative 5 would be similar to Alternative 1, although substantial reductions in bison numbers would somewhat lower disease risks.

Grand Teton National Park — The number of bison under Alternatives 4 and 5 (350–500) would be similar to the numbers that existed from 1996 to 1999, but retaining relatively high numbers of elk would continue to contribute to wildlife viewing opportunities in Grand Teton National Park during spring, summer, and fall. As described for the National Elk Refuge, a non-endemic infectious disease could have a major, adverse impact on visual resources.

Restoring approximately 4,500 acres of agricultural lands in Grand Teton National Park to native vegetation under Alternatives 4 and 5 would reestablish a more natural looking and more appealing landscape for some people, although many people would not notice the difference. The process of disking and reseeding former fields would adversely affect the natural appearance of a small part of the park for a short period.

Continued elk herd reduction in parts of Grand Teton National Park would detract from the naturalness of the scenery for some visitors during the fall and early winter.

Other Federal Lands — The number of elk summering in Yellowstone National Park, the Teton Wilderness, and the Gros Ventre River drainage could increase by a negligible to minor amount under Alternatives 4 and 5. This could improve visual resources in these areas by a negligible degree.

Conclusion

Converting to sprinkler irrigation under Alternatives 4 and 5 would contribute to a slightly less natural looking landscape on the National Elk Refuge near the town of Jackson, as compared to Alternative 1. However, within the context of current agricultural activities and structures on the refuge and the highly variable landscape, sprinkler irrigation systems would result in negligible adverse impacts on the foreground character and background views. Restoring willow and aspen habitat on the refuge would enhance the natural look of the refuge. Moderate to large numbers of elk and bison on the refuge and in the park would continue to be important elements of the scenery of Jackson Hole. These alternatives would not result in the impairment of visual resources in the park.

Alternative 6

Analysis

National Elk Refuge — Approximately 1,100 acres of flood-irrigated fields would be converted to sprinkler irrigation, with impacts similar to those described for Alternatives 4 and 5. Impacts on scenic quality would be negligible to minor.

Actions under Alternative 6 that would enhance visual quality include the removal of the Quonset huts where alfalfa pellets are now stored and the elimination of diesel trucks used for feeding operations, which would be expected to occur in five years. Resulting impacts on scenic quality would be minor, beneficial, and long term.

As compared to Alternative 1, views of wintering elk and bison on the National Elk Refuge would be much more natural due to smaller numbers of elk and bison on most days and to wider distribution of animals as they search for forage. This would be similar to Alternative 2, except there would be fewer elk and bison in some years under Alternative 6. On some days, the National Elk Refuge's scenery would include large numbers of elk and bison grazing on the southern part of the refuge, but on other days, elk and bison could be absent, or only a few would be readily visible.

Maintaining elk at objective levels under this alternative would allow most of the willow habitat along Flat Creek on the refuge to recover, which would enhance the viewing experience for some people. This impact would be greater than under Alternatives 4 and 5, where willow habitat would

recover inside exclosures, which would be obvious to people passing by on the highway.

Sustaining aspen habitat in temporary and rotating exclosures under Alternative 6 would result in fewer visual impacts than under Alternatives 1, 2, and 3. Because of the irregular fence-line and the fence would not be visible from the Kelly Road, scenic quality would not be compromised.

Adverse impacts to visual resources due to reductions in elk and bison numbers caused by a potential outbreak of an infectious disease would be lessened substantially under this alternative, as compared to Alternative 1, because winter feeding would be eliminated and unnaturally high concentrations of animals would end. The prevalence rate would likely be lower than under any other alternative (except possibly Alternatives 2 and 3), and numbers would likely not decline to the point they would under Alternative 1.

Grand Teton National Park — Although reducing the bison herd to about 400 animals could affect viewing opportunities, it should not detract noticeably from the park's visual resources because bison numbers would be similar to what they were from 1996 through 1997. Fewer calves would be viewable, but most visitors would likely not notice the difference. Reducing the elk herd in the park to 1,200–1,600 animals could affect visual resources in the park by a minor to moderate degree for some people. However, elk and bison numbers under this alternative could very well be within the natural range of variability for the area, and bison and elk would continue to be part of the park's scenery. The continued presence of elk summering in Yellowstone National Park, the Teton Wilderness, and the Gros Ventre River drainage could offset changes in the Grand Teton segment because elk from these areas would still pass through Grand Teton National Park during spring and fall. Furthermore, closing the Blacktail Butte / Kelly hayfields area to hunting (if that option was chosen) would in the long term slow the movement of elk through the area and offset negative effects of lower elk numbers to some extent; elk viewing opportunities in these areas would likely increase. As described for the National Elk Refuge, a non-endemic infectious disease could have major impacts on wildlife resources in the park, but management actions under Alternative 6 would not exacerbate the situation.

Restoring approximately 4,500 acres of agricultural lands in the park to native vegetation would have the same impacts as Alternatives 2–5.

Continued elk herd reduction in the park would detract from the naturalness of the scenery for some visitors. However, it is possible that the herd reduction program could be discontinued if it was no longer necessary to help control elk numbers.

Other Federal Lands — If fewer elk summered in Yellowstone National Park, the Teton Wilderness, and the Gros Ventre River drainage, visual resources could increase by a negligible to minor degree, similar to Alternatives 4 and 5. If elk began migrating out of the Jackson Hole area, people might be able to view large numbers of elk during the migration, enhancing visual resources for them.

Conclusion

Alternative 6, similar to Alternatives 4 and 5, would contribute to a slightly less natural looking landscape near the town of Jackson due to sprinkler irrigation of cultivated fields. However, impacts on the foreground character and background views would be negligible. Restoring willow and aspen habitat on the refuge would enhance natural conditions. Views of elk and bison on the refuge would be more natural because animals would not be artificially concentrated along feedlines, but numbers of elk and bison would be lower than under Alternative 1, diminishing the visual quality of the refuge and park for some people. This alternative would not impair any visual resources in the park.

MITIGATION

Setting sprinkler systems back at least 50 feet from road edges would maximize the distance between equipment and viewers and minimize visual intrusion without a major loss of irrigated acreage. Using side-roll systems with small wheel diameters in highly visible areas could reduce their visual impacts. Center pivot sprinklers in some places could be replaced with lower stature sprinkler systems (e.g., side-roll sprinklers). When not

being used, irrigation equipment could be aligned parallel to the primary view angle and farthest from the primary viewer location at each site. Dulling the surface or color-coating irrigation equipment would help minimize reflective metal surfaces so the structures would better blend with their surroundings. Any equipment storage facilities would be as far as possible from roads or adjacent to existing facilities. Storage facilities and pump houses would be constructed with materials and would be painted to help them blend with their surroundings.

Constructing exclosures (Alternatives 4, 5, and 6) in an irregular shape and with rounded corners would mitigate, to some extent, the unnatural appearance of the willow, aspen, and cottonwood stands that recover inside of the exclosures.

CUMULATIVE EFFECTS

Cumulative effects on soils, water quantity, and water quality are not anticipated to occur as a result of impacts of the alternatives in combination with impacts of reasonably foreseeable actions. Negative negligible cumulative effects on visual resources could result under Alternatives 4, 5, and 6 as water irrigation systems on the refuge, combined with more development on private lands and prescribed fire areas in the park and the national forest, resulted in a slightly less natural and scenic landscape.

IMPACTS ON HABITAT

OVERVIEW

The discussion in this section parallels the "Habitat" section in Chapter 3 in that it is subdivided by jurisdictions and landownership: National Elk Refuge, Grand Teton National Park / John D. Rockefeller, Jr., Memorial Parkway, Bridger-Teton National Forest, Yellowstone National Park, other federal and state lands, and private lands. Under each area the plant community types are organized in the same order as in Chapter 3, and each alternative is discussed under each plant community type. Table 4-1 shows the potential changes in the amount of each plant community type across all alternatives.

The analysis of the impacts on refuge habitats assumes that most elk and bison would continue to migrate between the refuge, the national park, and the national forest, only foraging on the refuge from approximately November to April.

NATIONAL ELK REFUGE

MARSHLANDS

Impacts of Alternatives 1–6

Analysis

Residual vegetation could be reduced in marshland areas if growing numbers of bison learned to forage in this habitat; currently, bison do not use marshland communities (Cole, pers. comm. 2002).

Marshland communities on the National Elk Refuge are expected to experience a negligible change in area or condition in the short and long terms under Alternatives 1, 2, and 3 compared to baseline conditions and Alternative 1 (see Table 4-1).

Under Alternative 2 and Option B of Alternative 3, there is a potential exception to the negligible change in acreage in marshland habitats. An estimated 50 acres (8%) of marshland habitat could be converted to wet meadow habitat in the Headquarters area because Cache Creek would no longer be diverted to irrigate cultivated fields (Cole, pers. comm. 2002). Due to a lack of prescribed fire under Alternative 2, there would also be a reduction in forage production, but the overall condition of marshland habitat would remain good.

Under Alternatives 4–6, marshland habitat condition and acreage would remain similar to baseline conditions in the long term. In the short term there could be localized, short-duration adverse impacts to marshland habitat due to the installation of water pipes for the sprinkler irrigation system.

Conclusion

The total number of acres of marshland communities on the refuge, and the condition of marshland habitat, would remain similar to baseline conditions in all alternatives with the possible exception of Alternative 2 and Option B of Alternative 3. Under Alternatives 4, 5, and 6, marshland habitat condition and acreage would remain similar to baseline conditions and Alternative 1 in the long

TABLE 4-1: NATIONAL ELK REFUGE — POTENTIAL CHANGES IN HABITAT ACREAGE FROM THE SHORT TERM TO THE LONG TERM UNDER EACH ALTERNATIVE

	Baseline	Alt. 1	Alt. 2 and 3 (B)	Alt. 3 (A)	Alt. 4 and 5	Alt. 6
Marshlands	630	630	630	630	630	630
Wet Meadows	1,720	1,770	1,620	990→270	1,500→1,250	990→270
Native Grasslands	8,090	8,400→9,000	10,600→3,250	8,090→3,090	8,160	8,090→3,090
Sagebrush Shrublands	8,010	8,010→9,170	8,210→17,430	8,100→14,860	8,180→8,940	8,160→13,160
Aspen Habitat	1,850	1,760→0	1,760→0	1,760→0	1,760→1,000	1,850
Willow Habitat (Classes I/II/III)	300	250	400	1,030→1,750	520→770	1,030→1,750
Cottonwood Habitat	1,090	870	870→760	1,090	940	940
Conifer Forest	160	160+	160+	160+	160	160+

NOTE: All acreage totals have been rounded to the nearest 10 acres; therefore, numbers of acres may be slightly different than numbers cited in Chapter 3.

An arrow (→) denotes a change in acreage at the end of the short term to the long term. No arrow indicates there would be no change in acreage from the short term to the long term.

term. In the short term, there could be localized, short-duration adverse impacts to marshland habitat due to the installation of water pipes for the sprinkler irrigation system.

Mitigation

In pipeline construction under Alternatives 4, 5, and 6, it is anticipated that heavy equipment would not need to be used in wetlands, and their use in wetlands would be avoided if at all possible. Prior to construction activities, a survey would be conducted to determine the presence of any wetlands. Any unavoidable impacts to wetlands or "waters of the U. S." would be authorized and permitted by the U.S. Army Corps of Engineers prior to implementation of sprinkler irrigation projects. If construction in wetlands was unavoidable, the following measures would be taken. To minimize soil and plant root disturbance and to preserve pre-construction elevations, heavy equipment used in wetlands would be placed on mats. Whenever possible, excavated material would be placed on an upland site; when this was not feasible, temporary stockpiling of excavated material in wetlands would be placed on filter cloth, mats, or other semi-permeable surface, or comparable measures would be taken to ensure that underlying wetland habitat was protected. In such cases, the material would be stabilized with straw bales, filter cloth, or other appropriate means to prevent reentry into the waterway or wetland. Temporary stockpiles in wetlands would be removed as soon as practicable. Wetland areas temporarily disturbed by stockpiling or other activities during construction would be returned to their pre-existing elevations, and soil, hydrology, and native vegetation communities would be restored as soon as practicable.

WET MEADOWS

Alternative 1

Analysis

Management actions are not expected to change the water regime under Alternative 1, but an estimated 50 acres of willow habitat would convert to wet meadow habitat in the short term due to continued browsing on willow plants by elk (Cole, pers. comm. 2002). This would bring the wet meadow habitat acreage total to an estimated 1,770 acres in the next 15 years (Table 4-1).

There would be a minor decline in the condition of some wet meadow areas due to bison hoof damage (Cole, pers. comm. 2002). If bison numbers continued to grow in the next 20 years at the existing rate of increase (depending on hunting success in Bridger-Teton National Forest), wet meadow communities would experience moderate negative impacts, declining to a fair to poor condition; this would result in a minor to moderate decrease in forage production. Increased bare areas and erosion would limit the total forage produced and could make areas more susceptible to nonnative plant species such as perennial pepperweed and Canada thistle.

Conclusion

Compared to baseline conditions, wet meadow communities under Alternative 1 would increase by an estimated 50 acres in the short and long terms. Large areas of wet meadow habitat would continue to be heavily grazed each fall and winter, which would sustain a lower amount and height of residual vegetation than under baseline conditions. As bison numbers continued to increase, the amount of heavily grazed wet meadow habitat would increase, and the condition of some wet meadow habitats would decline to fair or poor condition.

Alternatives 2 and 3 (Option B)

Analysis

Under Alternative 2 and Option B of Alternative 3 an estimated 100 acres of wet meadow habitat would likely convert to willow habitat within 15 years due to decreased numbers of elk and bison browsing on remnant willow plants in some wet meadow communities (see Table 4-1). This would be true if the U.S. Forest Service proceeded with habitat improvements in Bridger-Teton National Forest because improved habitat would shortstop elk and bison in the national forest (Cole, pers. comm. 2002). In addition, cessation of winter feeding would not draw elk and bison to the refuge. An estimated 50 acres of marshland habitat could also convert to wet meadow communities due to cessation of irrigation, bringing the total

number of acres of wet meadow habitat to an estimated 1,620 acres.

If no habitat improvements occurred in the national forest, elk and bison would continue to browse in wet meadow areas, preventing suppressed willow plants from growing into mature willow stands. There also would be no hunting on the refuge in Alternative 2, but hunting in the national forest would continue, and many elk and bison might stay on the refuge to avoid the hunt, especially if there was no improved winter habitat to keep them in the national forest. In the long term, if many elk and bison continued to use the refuge to escape hunting pressure, the numbers and duration of elk and bison occupation on the refuge would still be too high to result in wet meadow habitat converting to willow habitat (Cole, pers. comm. 2002).

Although there would be fewer elk and bison grazing on wet meadow habitats in the long term, the elimination of winter feeding would sustain a lower amount of residual vegetation, which would be similar to baseline conditions or Alternative 1.

Stopping irrigation diversion from Flat Creek would not likely produce large changes in wet meadow acreage or condition in the short or long terms, but there could be a negligible decline in acreage. The overall condition of wet meadow communities would be expected to remain good. Good condition wet meadow communities would be dominated by near 100% cover of native sedge species and water-tolerant grasses. There would be considerable residual material from previous year's growth under the bases of growing plants, except in areas that had been previously burned, and few areas would be invaded by nonnative weed species (Cole, pers. comm. 2002).

Conclusion

It is estimated that wet meadow communities would be fewer by an estimated 150 acres in the long term compared to Alternative 1 (for an estimated average of about 1,620 acres). Although elk and bison numbers would be less than under Alternative 1, large areas of wet meadow habitat would continue to be heavily grazed each fall and winter due to the elimination of winter feeding. Many elk and bison could stay on the refuge rather than in the national forest where hunting would be allowed; because of this continued use, most wet meadow habitat on the refuge would not convert to willow habitat.

Alternative 3 (Option A)

Analysis

Management actions are not expected to change the water regime under Option A of Alternative 3.

An estimated 730 acres of wet meadow habitat would likely convert to willow habitat in 15 years, and an additional 720 acres in the long term due to low elk numbers (Singer and Zeigenfuss 2003). This would decrease the wet meadow acreage from the current estimated 1,720 acres to an estimated 270 acres (see Table 4-1).

In the long term, there would be minor physical damage and a decrease in forage production in wet meadows from bison grazing and hoof damage, resulting in increased soil hummocking and erosion (Cole, pers. comm. 2002). The overall condition of wet meadow communities would remain good to fair.

Conclusion

Wet meadow habitat would have an estimated 1,500 fewer acres in the long term compared to Alternative 1, due primarily to the conversion of wet meadow habitat to willow habitat, with a long-term estimated average of about 270 acres being sustained. Although elk and bison numbers would be less than under Alternative 1, large areas of wet meadow habitat would continue to be heavily grazed each fall and winter due to significant reductions in winter feeding and the reduced amount of available wet meadow habitat.

Alternatives 4 and 5

Analysis

Under Alternatives 4 and 5 a 500-acre exclosure would be erected around wet meadow communities with suppressed willow plants to allow the suppressed willows to grow into mature stands by excluding browsing ungulates. After 15 years an estimated 250 acres of wet meadow habitat would convert to willow habitat inside the 500-acre exclosure (Table 4-1). In the long term the entire 500

acres in the exclosure would convert to willow habitat. Residual vegetation within the fence would be taller and denser in the short term than under baseline conditions and Alternative 1. In the long term, as willow communities dominated the exclosure, residual herbaceous vegetation would be reduced and would eventually disappear (Cole, pers. comm. 2002). Wet meadow communities outside the exclosure (1,220 acres) would remain in good condition, as described under Alternative 2

Wet meadow habitats that contain suppressed willows (950 acres) outside the exclosure would remain wet meadow communities because of continued heavy browsing by elk in the short and long terms. Residual vegetation would remain low in many areas.

Few wetlands exist in irrigation project areas. Flat Creek is considered a "water of the United States" by the U. S. Army Corps of Engineers and as such receives protection under the Clean Water Act of 1977. Similarly, a small linear wetland feature along Flat Creek between the Chambers and the southeastern portion of the McBride project areas would be impacted as a result of the proposed pipeline crossing of Flat Creek (Cole, pers. comm. 2002). In addition, several small areas of emergent wetland could occur within proposed locations of sprinkler irrigation systems in the Ben Goe and Nowlin project areas. These wetland areas could be impacted by the change from flood irrigation to sprinkler irrigation. Less surface water would be available with sprinkler irrigation, potentially causing these wetland areas to shrink. The presence of these wetlands, however, has not be verified by certified wetland experts. Whenever possible, construction in wetlands would not take place, but any unavoidable impacts to wetlands or waters of the United States would have to be authorized and permitted by the U.S. Army Corps of Engineers prior to implementation of sprinkler irrigation projects.

There would be a minor decline in wet meadow acreage if sprinklers replaced flood irrigation in the Headquarters area. While Cache Creek flows would continue to be diverted, there would be much less wastewater with sprinkler irrigation, and therefore less water to supplement wet meadow habitat.

Conclusion

Wet meadow communities under Alternatives 4 and 5 would be fewer by an estimated 550 acres in the long term compared to Alternative 1 due mainly to the recovery of willows in the 500-acre exclosure. Large areas of wet meadow habitat outside the exclosure would continue to be heavily grazed each fall and winter.

Localized, short-duration, adverse impacts could result from the installation of the water pipeline for the sprinkler irrigation system, but no long-term effects would result.

Alternative 6

Analysis

The effects of Alternative 6 on wetland communities on the refuge would be similar to the effects of Alternative 3 (Table 4-1), but there would be less hoof damage and soil hummocking (Cole, pers. comm. 2002). Residual vegetation would remain low in many areas due to the reduced amount of available wet meadow habitat and the elimination of supplemental feeding. However, the overall condition of wet meadow communities would remain good.

Conclusion

The acreage of wet meadow communities would be similar to Alternative 3, and the overall condition would be good, with less hoof damage and soil hummocking compared to Alternative 1.

Mitigation

The mitigation measures to reduce adverse impacts associated with pipeline construction in wet meadow communities would be the same as described above under "Marshlands."

NATIVE GRASSLANDS

Alternative 1

Analysis

Native grassland communities would likely increase in the short term by an estimated 300 acres and by about 900 acres in the long term (refer to Table 4-1) as the cottonwood community along

upper Flat Creek and the sagebrush shrubland community in Long Hollow and other areas convert to native grassland habitat due to continued heavy browsing by elk and bison (Cole, pers. comm. 2002).

The future condition of native grassland habitats would depend primarily on control of cheatgrass, crested wheatgrass, and other invasive species, which would continue to increase under current management practices. As a result, the quality of winter forage would decline on native grassland communities (Cole, pers. comm. 2002).

Native grassland habitat would likely remain in good condition at the baseline numbers of elk and bison on the refuge (an estimated 5,000–7,500 elk [average of about 5,600] and 800–1,000 bison). Zeigenfuss et al. (2003a) found few instances of reductions in vegetation productivity due to grazing by elk and bison and few negative influences of grazing on plant species diversity. Grazing by elk and bison primarily occurs during the dormant season, which does not have the level of impacts that can occur during the growing season (Holechek 1995). Nonetheless, heavy grazing in some areas has resulted in a higher percentage of bare ground and slightly higher cover of exotic plant species (Zeigenfuss et al. 2003a).

Trampling, trailing, and dense manure accumulation would continue near the feedgrounds and could spread to more locations, but relative to the entirety of native grassland acreage on the refuge, these effects would be minor (Cole, pers. comm. 2002). As bison numbers increased, negative effects would grow, depending on the number of bison and the length of time they spent on the refuge.

Under Alternative 1 most native grassland communities on the alluvial fan would not convert to sagebrush shrubland habitat in the long term because large numbers of browsing elk and bison would prevent sagebrush from reestablishing.

Conclusion

It is estimated that native grassland habitats on the refuge would increase by about 300 acres in the short term and by about 900 acres in the long term as cottonwood habitat and sagebrush shrubland converted to native grassland habitat due to excessive elk and bison browsing. Most native grassland communities would probably remain in good condition in most areas of the refuge in the short term, but unlimited numbers of bison could have detrimental effects over the long term.

Alternatives 2 and 3 (Option B)

Analysis

In the short term, restoration of cultivated fields (and conversion of an estimated 110 acres of cottonwood habitat) to native grassland communities native would increase grassland habitat from the current estimated 8,090 acres to approximately 10,500 acres (see Table 4-1). Given current seed sources, the restored plants would be species native to the area but would not be the same genotypes as local native plants. It would be unlikely that all native species would be represented (Cole, pers. comm. 2002). There would be a major decline in forage quantity produced (compared to the forage production of the cultivated fields), but there would be a minor increase in forage quality.

Some small areas of native grassland communities on the alluvial fan in the central and east central portions of the National Elk Refuge are in the process of converting to sagebrush shrubland habitat. Reduced numbers of elk and bison under Alternative 2 and Option B of Alternative 3 would allow that process to continue; however, 15 years would not be enough time for large-scale conversion to take place (Cole, pers. comm. 2002). In the long term it is estimated that 5,000 acres of native grassland habitat would likely convert to sagebrush shrubland habitat, plus approximately 50 acres of cottonwood habitat in the north end of the refuge, would convert to native grassland communities, resulting in an estimated 5,750 fewer acres as compared to Alternative 1.

Areas of native grassland communities that are too dry or on south-facing slopes would likely never convert to sagebrush shrubland habitat. In addition, wildfires under this alternative would be allowed to burn if they did not threaten structures and human safety; these fires could cause sagebrush shrubland habitat to convert to native grassland habitat.

If cheatgrass and crested wheatgrass were controlled, most native grassland habitats would remain in good condition (Cole, pers. comm. 2002).

Conclusion

In the short term there would be an estimated 2,200 more acres of native grassland habitat due mainly to the restoration of cultivated fields to native vegetation, compared to Alternative 1. In the long term, there could be an estimated 5,750 fewer acres of native grassland habitats due to conversion of native grasslands on the alluvial fan to sagebrush shrubland communities. Lower numbers of elk and bison browsing on sagebrush plants would result in substantial acreage of native grassland habitat converting to sagebrush shrubland habitat.

Alternatives 3 (Option A) and 6

Analysis

Reduced numbers of elk under this alternative, compared to Alternative 1, would allow some small areas of native grassland habitats on the alluvial fan to continue converting to sagebrush shrubland habitats (Cole, pers. comm. 2002). In the short term native grassland acreage would be similar to baseline conditions. Compared to Alternative 1, in the long term an estimated 6,000 acres would likely convert to sagebrush shrubland, resulting in an overall reduction in native grassland communities under Option A of Alternative 3 and Alternative 6 (see Table 4-1).

If cheatgrass and crested wheatgrass were controlled, native grassland habitats in most areas of the refuge would remain in good condition, and native grassland habitats in the vicinity of feedgrounds that are now in fair condition would increase moderately to good condition (Cole, pers. comm. 2002).

Conclusion

Option A of Alternative 3 and Alternative 6 would result in an estimated 6,000 fewer acres of native grassland habitat in the long term than would occur under Alternative 1.

Alternatives 4 and 5

Analysis

Under Alternatives 4 and 5 native grassland habitat would increase by an estimated 70 acres due to the decline of cottonwood communities along Flat Creek that would be browsed heavily by elk and bison compared to baseline conditions (Table 4-1). However, as compared to Alternative 1, these alternatives would result in 840 fewer acres of native grassland habitat in the long term.

If cheatgrass and crested wheatgrass were controlled, most native grassland habitats would remain in good condition (Cole, pers. comm. 2002).

Under Alternative 4 there would be minor improvement in the fair condition of native grassland communities in the vicinity of feedgrounds due to lower bison density and reduced supplemental feeding frequency (Cole, pers. comm. 2002).

Under Alternative 5 there would be localized negative effects in the immediate vicinity of the feedgrounds, caused by trampling, trailing, and dense manure accumulation, but relative to the entirety of native grassland habitat on the National Elk Refuge, these effects would be minor (Cole, pers. comm. 2002).

Conclusion

The estimated amount of native grassland habitat on the refuge in the long term would be less by a minor amount (an estimated 840 acres) as compared to Alternative 1. Reduced numbers of elk and bison under Alternative 4 would result in a minor improvement of native grassland communities in the vicinity of feedgrounds. Reduced numbers of bison under Alternative 5 would lessen the detrimental effects of hoof damage to native grassland habitat.

Mitigation

Prescribed fire and allowing naturally ignited fires to burn (when under prescription) in native grassland and sagebrush shrubland habitats would help sustain these habitats in healthy condition and grassland habitat as a component of the landscape.

Eliminating prescribed fire on the refuge under Alternative 2 would result in the loss of grassland habitat over the long term due to uninterrupted vegetation succession. Potential ways to mitigate this adverse impact would require other actions (such as mechanical treatment and use of herbicides) that would conflict with the management philosophy of this alternative.

SAGEBRUSH SHRUBLANDS

Alternative 1

Analysis

The condition of sagebrush shrubland communities would experience minor declines (from good to fair) in some areas of the refuge due to browsing by elk and bison (Cole, pers. comm. 2002). However, the Long Hollow sagebrush community near the McBride feedground would experience a major decline in condition. High bison numbers associated with this alternative would result in an estimated 100–200 acres of sagebrush shrubland habitat converting to native grassland habitat within 15 years (see Table 4-1).

Beyond 15 years, conversion of an estimated 600 additional acres of sagebrush shrubland communities to native grassland communities would occur east of the Flat Creek Road near Bridger-Teton National Forest boundary and at the base of the Gros Ventre Hills (Cole, pers. comm. 2002).

An estimated 90 acres of aspen and 110 acres of cottonwood would convert to sagebrush shrubland habitat within 15 years due to continued browsing by elk and bison. In the long term, nearly all aspen habitat would convert to sagebrush shrubland habitats (Cole, pers. comm. 2002).

Most areas of native grasslands in the alluvial fan would not convert to sagebrush shrubland because browsing by current numbers of elk and growing numbers of bison under this alternative would prevent sagebrush shrubland species from establishing themselves.

Conclusion

In the long term sagebrush shrubland habitat would increase by an estimated 1,160 acres under Alternative 1 due primarily to the conversion of other plant communities to sagebrush shrubland habitat. The condition of sagebrush shrubland communities would generally remain in good condition (i.e., plant species diversity and vegetative structure being representative of native sagebrush communities), with some localized areas declining to fair condition due to heavy browsing and trampling.

Alternatives 2 and 3 (Option B)

Analysis

Sagebrush shrubland habitat would experience a negligible change in condition on most of the refuge compared to baseline conditions. In the short term, it is estimated that 110 acres of cottonwood habitat and about 90 acres of aspen habitat would convert to sagebrush shrubland communities due to continued browsing by elk and bison (Cole, pers. comm. 2002). In the long term nearly all the remaining acres of aspen habitat (1,760 acres) would convert to sagebrush shrubland communities, with some aspen stands converting to conifer forest habitats and an additional 55 acres of cottonwood habitat converting to sagebrush shrubland. An estimated 2,400 acres of restored native grassland communities (formerly cultivated fields) would also convert to sagebrush shrubland in the long term (see Table 4-1).

Some small areas of native grassland communities on the alluvial fan in the central and east-central portions of the refuge are in the process of converting to sagebrush shrubland habitat. In the short term there would be a minor increase in sagebrush shrubland habitat near Poverty Flats due to this natural conversion. In the long term an estimated 5,000 acres of this area would likely convert to sagebrush shrubland habitat due to fewer elk and bison under these alternatives (Cole, pers. comm. 2002).

Conclusion

Compared to Alternative 1, Alternative 2 and Option B of Alternative 3 would result in an estimated 8,260 more acres of sagebrush shrubland habitat on the refuge due to the conversion of a variety of plant communities to sagebrush shrubland habitats (with a long-term average of an estimated 17,430 acres being sustained). Most of the acreage would remain in good condition.

Alternative 3 (Option A)

Analysis

Under Option A of Alternative 3 there would be 5,690 more acres of sagebrush shrublands on the refuge in the long term compared to Alternative 1. Most of the acreage would remain in good condition (Cole, pers. comm. 2002). In the short term an estimated 90 acres of aspen habitat would convert to sagebrush shrubland habitat due to continued elk browsing on woody vegetation. In the long term nearly all aspen stands (1,850 acres) would convert to sagebrush shrubland communities (see Table 4-1).

Similar to Alternative 2, 5,000 acres of native grassland habitat on the alluvial fan would convert to sagebrush shrubland communities in the long term.

Conclusion

Under Option A of Alternative 3 there would be 5,690 more acres of sagebrush shrubland habitat on the refuge in the long term compared to Alternative 1. Most of the acreage would remain in good condition.

Alternatives 4 and 5

Analysis

Under Alternatives 4 and 5 the condition of sagebrush shrubland habitat would remain in good condition (Cole, pers. comm. 2002).

In the short term an estimated 90 acres of aspen habitat would convert to sagebrush shrubland communities due to continued elk browsing on woody vegetation. In the long term nearly all of the estimated 760 acres of aspen stands outside the 1,000-acre aspen exclosure would be replaced by sagebrush shrubland habitat (see Table 4-1). Some aspen stands would convert to conifer forest habitats.

An estimated 80 acres of cottonwood habitat would also convert to sagebrush shrubland habitat due to continued elk and bison browsing along upper Flat Creek, bringing the total sagebrush shrubland communities under Alternatives 4 and 5 to an estimated 8,180 acres in the short term (see Table 4-1) and an estimated 8,940 acres in the long term (Cole, pers. comm. 2002).

Conclusion

Under Alternatives 4 and 5 sagebrush shrubland communities on the refuge would have less acreage compared to Alternative 1 by an estimated 230 acres in the long term (resulting in a long-term estimated average of about 8,940 acres). Most of the acreage would remain in good condition, and some areas would improve due to fewer bison.

Alternative 6

Analysis

Compared to Alternative 1, there would be an estimated 3,990 more acres of sagebrush shrubland communities in the long term (see Table 4-1). Approximately 150 acres of cottonwood habitat outside the cottonwood exclosure would convert to sagebrush shrubland in the long term. The effects of Alternative 6 would be similar to Alternatives 2 and 3 in that 5,000 acres of native grasslands on the alluvial fan would convert to sagebrush shrubland in the long term. If hunting was eliminated on the northern fifth of the refuge in the long term, a minor decline in condition from good to fair would likely occur.

Conclusion

It is estimated that approximately 5,000 acres of native grassland habitat would convert to sagebrush shrubland in the long term; however, sagebrush shrubland on the northern part of the refuge could decline from good to fair condition due to increased grazing and browsing pressure.

Mitigation

Mitigation measures for potential adverse impacts to sagebrush shrubland habitats would be similar to those identified above under "Native Grasslands."

RIPARIAN AND ASPEN WOODLANDS

Four habitat classes have been defined for willow, aspen, and cottonwood communities, as shown in Table 4-2. In the following analysis, references are

made to a particular area being in good (Class I), fair (Class II), or poor condition (Classes III and IV). Generally, the classes describe the extent of browsing, the condition of the vegetation type, and the extent of bird life as an indicator of community health.

In addition to elk and bison, numerous other herbivore species feed on woody vegetation communities, including mule deer, moose, beavers, porcupines, small mammals, birds, and insects. The individual impacts of each species have not been measured, but these impacts on woody plant communities would continue under all alternatives in addition to the impacts of elk and bison.

Alternative 1

Analysis

Woody vegetation would continue to decline under Alternative 1 both in terms of condition and acreage due to high levels of ungulate browsing (Dobkin, Singer, and Platts 2002; Diene et al. 2000). Riparian and aspen woodland stands closest to the feedgrounds would continue to be impacted the most (Cole 2002a; Dobkin, Singer, and Platts 2002). USFS and WGFD habitat improvements on Bridger-Teton National Forest lands adjacent to the National Elk Refuge would have little effect on habitat condition on the refuge because current levels of supplemental feeding would continue to concentrate elk and bison near the feedgrounds. Table 4-1 presents the anticipated acreage changes in riparian and aspen woodland communities on the refuge.

Aspen Communities — Aspen has the greatest potential for permanent loss of all woody plant community types. Most aspen communities on the National Elk Refuge are already in Class III/IV condition (Dobkin, Singer, and Platts 2002; Cole, pers. comm. 2002; Smith, Cole, and Dobkin 2004a). Under Alternative 1 aspen stands would continue to shrink as conifer forest habitat and sagebrush shrubland habitat encroach due to fire suppression, combined with heavy browsing of aspen suckers by elk. Cole (2002a) estimates that an additional 5%–10% of aspen habitat (90–185 acres) would be lost in the next 15 years. For the sake of simplicity, and to avoid overestimating the loss of aspen trees, the most conservative estimate of 5% loss of aspen habitat has been used in all alternatives.

In the long term, the pace of this loss would likely accelerate because many mature aspen stems are about 120 years old, and their maximum life span is about 150 years (Cole, pers. comm. 2002).

Willow Communities — Willow habitats are already in poor condition (Classes III and IV) in the southern part of the refuge (Dobkin, Singer, and Platts 2002; Smith, Cole, and Dobkin 2004a), and under Alternative 1 the condition of willow stands in this area would continue to decline in the short and long terms due to heavy browsing by elk. Approximately 50 acres of willow habitat in the southern part of the refuge, currently in Class III condition, would convert to suppressed willow plants in wet meadow habitat (Class IV) within 15 years and would eventually disappear (Cole, pers. comm. 2002). In the long term the National Elk Refuge would lose existing rootstock of approximately 1,450 acres of suppressed willow plants in the southern end of the refuge that now exist in wet meadow habitat, making any future reestablishment difficult without major soil disturbance.

There would be no acreage change for the 250 acres of willow habitat in the northern end of the refuge in the short term, but an estimated minor decline in the condition of willow stands would be expected (Cole, pers. comm. 2002).

Cottonwood Communities — An estimated 110 acres of cottonwood habitat would convert to native grassland communities, and an additional 110 acres would convert to sagebrush shrubland habitat. In the short term, an estimated major decline in the condition of cottonwood stands along Flat Creek would continue beyond already poor conditions, and loss of acreage of cottonwood communities could be possible close to the McBride feedground as some large mature trees succumb to girdling from bison rubbing. Other deciduous shrub species such as willow, serviceberry, chokecherry, rose and gooseberry would continue to decline in height and density. Approximately 220 acres of cottonwood communities occurring along upper Flat Creek would eventually be lost (Cole, pers. comm. 2002).

Approximately 870 acres of cottonwood stands along the Gros Ventre River would experience an

TABLE 4-2: HABITAT TYPES AND CLASSIFICATION OF WILLOW, ASPEN, AND COTTONWOOD COMMUNITIES

Class	Definition	Condition
Willows		
Class I	Very lightly browsed (0%–10% consumption). Habitat maximizes height of willows (averaging 6.9 feet), with large crown sizes; canopy cover averages 78%. Willows grow to the edges of streams and benefit the stream aquatic ecosystem by shading streamsides and producing large amounts of leaf and shoot litter-fall. Habitat has high abundance and diversity of birds, dominated by a number of bird species that are habitat specialists.	Good
Class II	Moderately browsed (11%–20% consumption). Habitat is still healthy and abundant, but the average height of willows is 4.9 feet, and canopy cover is reduced to an average of 65%. Willows generally do not grow over streamsides, provide much less shade to streams, and do not provide as much cover or litter inputs into the stream. Class II habitat provides less habitat and nutrient inputs to aquatic invertebrates and fish. Fewer bird species that are habitat specialists are present.	Fair
Class III	Heavily browsed (21%–35% consumption). Willow size and production is dramatically reduced. Willows average 3.7 feet tall (only 54% of Class I willow habitat); canopy cover averages 31% of class I. Bird species are more likely to be habitat generalists.	Poor
Class IV	Severely over-browsed (more than 35% consumption). Willow plants are short (averaging 3 feet). Some willows, severely hedged and scattered in small patches, are no taller than surrounding grass. Canopy cover averages 26%. Willow communities have lost most of their ecological function, and bird habitat is vastly different than in class I. Class IV willow habitat on the National Elk Refuge is classified as wet meadow habitat. Habitat contains a simple bird community, dominated by habitat generalists or bird species more typical of wet meadow or native grassland habitats. On the National Elk Refuge 1,450 acres of class III and class IV willow habitat occurs in what are now wet meadow communities.	Poor
Aspens		
Class I	Lightly browsed. Robust aspen trees and shrubs of varied sizes and age classes, standing dead trees are present but not numerous, and there is a dense herbaceous layer of forbs, sedges, and grasses. Tree overstories are relatively dense. Recruitment of young trees and shrubs is evident. Young aspen trees occur at the periphery of stands and in areas where trees have died due to disturbances, such as lightning strikes or blowdown. Habitat contains a diverse bird community. Another example of a class I stand would be a young, vigorous aspen stand that develops after a stand-replacing fire. Although most aspen stems would be of the same age class, this would still be a good condition stand.	Good.
Class II	Moderately browsed. Fewer age classes of aspen trees. The overstory is sparser than class I, but more than 50%. The understory is getting sparse, with fewer species of shrubs, forbs, sedges, and grasses. There is reduced recruitment of young trees and shrubs. Fewer bird species that are habitat specialists are present.	Fair
Class III	Heavily browsed. Sparse, decadent overstory of aspen trees, scattered clumps of decadent, pedestaled shrubs, and the complete absence of recruitment by woody species. Snags do not remain standing for long and are relatively common. Most of the birds are woodpeckers and generalist species that occur in many different habitats as well as in human-disturbed landscapes. Some class III aspen on the National Elk Refuge has more than 50% overstory but no understory and no successful regeneration of aspen trees.	Poor
Class IV	Severely overbrowsed. Few live trees, few snags, and deadwood present on the ground. The overstory is comprised of sagebrush and snowberry/rose shrubs or dry native bunch grasses. The bird community is dominated by species typical of sagebrush shrubland or native grassland habitats. Some class IV aspen habitat is converting to conifer forest. Conifer species, which are shade tolerant, encroach on aspen habitat and shade out the aspen suckers, which need direct sunlight to grow. The combination of long periods without disturbances to provide open areas for aspen sucker growth and heavy browsing by ungulates allows conifer species to encroach.	Poor
Cottonwoods		
Class I	Lightly browsed. Robust cottonwood trees and shrubs of varied sizes and age classes, standing dead trees are present but not numerous, and there is a dense herbaceous layer of forbs, sedges, and grasses. Tree overstories are relatively dense, and midstories are dense and continuous. Recruitment of young trees and shrubs is evident. Habitat contains a diverse bird community.	Good
Class II	Moderately browsed. Fewer age classes of cottonwood trees. Sparser overstory than class I, but more than 50%. The understory is getting sparse, with fewer species of shrubs, forbs, sedges, and grasses. There is reduced recruitment of young trees and shrubs. Fewer bird species that are habitat specialists are present.	Fair
Class III	Heavily browsed. A sparse, decadent overstory of cottonwood trees; scattered clumps of decadent, pedestaled shrubs; and the complete absence of recruitment by woody species. Snags do not remain standing for long and are relatively common. Most of the birds are woodpeckers and generalist species that occur in many different habitats as well as in human-disturbed landscapes.	Poor
Class IV	Severely overbrowsed. Few live trees, few snags, and deadwood present on the ground. The overstory is comprised of sagebrush and snowberry/rose shrubs or dry native bunch grasses. The bird community is dominated by species typically occurring in sagebrush shrubland or native grassland habitats.	Poor

SOURCE: Willow class definitions from Singer and Zeigenfuss (2003). Aspen and cottonwood class definitions formulated from Dobkin 1994; Dobkin, Singer, and Platts 2002; and field observations by E. Cole, National Elk Refuge biologist.

estimated minor decline in condition due to elk and bison browsing, but no acreage change is expected in the next 15 years (Cole, pers. comm. 2002). In the long term, some limited acreage loss of cottonwood habitat would be likely in the Gros Ventre River corridor.

Conclusion

In the short term an additional 50 acres of willow habitat would convert to suppressed willow plants in wet meadows habitat on the refuge. In the long term the remnant willows on about 1,500 acres of wet meadow habitat (classified as Class IV willow habitat) would die, leaving little chance for healthy willow habitat to recover on its own. The condition of aspen communities would continue to decline, and it is estimated that most and possibly all stands would eventually die out. Cottonwood communities would decline in condition, and an estimated 220 acres of cottonwood habitat would be lost along upper Flat Creek. Remaining stands would be in Class I and II condition.

Alternative 2

Analysis

The northern end of the refuge would most likely see an estimated moderate increase in elk and bison use during fall and early winter compared to Alternative 1 due to the elimination of hunting and the eventual elimination of supplemental feeding on the refuge (Cole, pers. comm. 2002). Even though habitat improvement in Bridger-Teton National Forest would draw elk and bison from the refuge (concurrent with winter feeding being phased out), this would likely not hinder the increased use and densities of elk and bison at the northern end of the refuge. Eliminating hunting on the refuge would allow elk and bison to make additional use of this area.

There are two possible scenarios for Alternative 2 after cessation of supplemental feeding. Under both scenarios, elk and bison populations would fluctuate from year to year depending on predation, disease, and the number of animals harvested on surrounding lands (Cole, pers. comm. 2002).

Scenario 1 — Without supplemental feeding elk and bison would stay on the refuge only until standing forage was exhausted or inaccessible, which would happen when elk and bison numbers were high and/or winters were harsh (Cole, pers. comm. 2002). In response, the Wyoming Game and Fish Department could increase its supplemental feeding program on the Gros Ventre feedgrounds or open a new feedground in Buffalo Valley. The state could also cull bison and have depredation hunts for elk to mitigate private property damage. These factors could result in fewer elk and bison on the refuge, but numbers and duration of stays on the refuge in some years might still be too high to allow full recovery of woody plant communities.

Scenario 2 — The cessation of supplemental feeding could result in elk and bison roaming farther for food and eventually establishing migration routes into the Green River basin and the Red Desert. Therefore, elk and bison would spend less time on the refuge, allowing an overall improvement in the condition of woody plant communities. Scenario 2 is not portrayed in Table 4-1 because it would not occur without the cessation of supplemental feeding in the Gros Ventre drainage and South Park and possibly on other state feedgrounds. The migration scenario would also not occur without the cooperation of public and private organizations and individuals.

Aspen Communities — In scenario 1 there would be an estimated moderate decline in the condition of aspen habitat beyond the already poor condition of aspen stands. A moderate decline in aspen condition in the short term would result from the continued failure of aspen suckers to escape browsing and grow to full height. In 30 or more years most mature aspen stems would disappear, and under Alternative 2 nothing would grow out of the browse zone to replace them. Eventually, most of the current estimated 1,850 acres of aspen habitat would convert to sagebrush shrubland communities, and some aspen stands would convert to conifer-dominated communities.

If scenario 2 occurred, there would be minor improvement in the condition of aspen habitat (Cole, pers. comm. 2002). Depending on how many elk would migrate to other wintering areas, some aspen stands could survive in the long term.

Willow Communities — For approximately 1,190 acres of willow habitat in the southern end of the

refuge (currently in Class III/IV condition, including 1,140 acres of suppressed willows that are classified as wet meadow habitat) to achieve full recovery, elk numbers must be reduced to between 2,400–2,700 for 6 to 10 years; recovery would take an estimated 25 to 30 years (Singer and Zeigenfuss 2003). However, if elk numbers were low for a period of 3 years, it would be enough time for some willow stems to grow out of the browse zone (Cole, pers. comm. 2002). As elk numbers fluctuated above and below the 2,400–2,700 range over a period of years, height release of willows would be sporadic, and it would likely take a number of decades to reach full recovery to Class II or Class I condition.

Under scenario 1 if a major disturbance or intervention (such as fencing, flooding, return of beavers) did not occur in the short or long term, most wet meadow areas where willow plants are suppressed could remain suppressed as elk continued to browse in these areas. However, with fewer elk on the National Elk Refuge in most winters, willow habitat could increase by an estimated 100 acres in the south end of the refuge within 15 years (see Table 4-1). Approximately 250 acres of willow stands on the northern end of the refuge would likely remain in fair to good condition (Class I/II). Although elk numbers would be lower under Alternative 2, improvement of Class II stands to Class I condition would not be likely due to the cessation of hunting on the refuge and due to the north end being a safe zone from hunting in Bridger-Teton National Forest. Therefore, these north end willow stands would continue to be browsed by elk seeking safety from hunting.

Under scenario 2 if migration occurred in the long term, and very few elk remained on the refuge in the winter, Alternative 2 would result in willow stands becoming dominant in the southern end of the refuge on what is now wet meadow habitat with suppressed willow plants. Approximately 250 acres of willow stands in the northern end of the refuge would improve by a moderate amount, and possibly all willow communities would achieve Class I condition.

Cottonwood Communities — Despite the change in management and numbers of elk and bison under scenario 1, the effects on the cottonwood community on upper Flat Creek would be similar to Alternative 1.

Under scenario 2 there would be moderate to major improvement in the condition of cottonwood communities along the upper portion of Flat Creek in the long and short terms, and a possible minor acreage increase in the long term since many elk and bison would migrate to other wintering areas. This would allow a minor improvement in the condition of cottonwood habitat along the Gros Ventre River. Cottonwood establishment and persistence would also benefit from increased water flows in Flat Creek due to cessation of irrigation diversion for the cultivated fields (Cole, pers. comm. 2003). Cottonwood habitat along upper Flat Creek would achieve Class I/II condition compared to the current Class III/IV condition.

Conclusion

Compared to Alternative 1, if the majority of elk in the Jackson elk herd unit continued to winter within the herd unit boundaries, Alternative 2 would result in an estimated 150 more acres of Classes I and II willow habitat on the refuge and an estimated 400 acres of willow habitat being sustained over the long term. However, similar to the effects of Alternative 1, most of the 1,850 acres of aspen habitat would be lost in the long term, and cottonwood habitat would decline by an estimated 220–330 acres on the refuge. The condition of remaining cottonwood stands would be Classes I and II.

If a large portion of the elk that otherwise would have wintered on the refuge migrated to other wintering areas, elk numbers on the refuge could be reduced sufficiently to allow an increase in Class I and II willow habitat by nearly 1,500 acres. Other willow stands would improve in condition (for a total of about 1,750 acres), and cottonwood and aspen communities would retain their current acreage (1,090 and 1,850 acres, respectively) and would improve in condition.

Alternative 3

Analysis

Lower numbers of elk with decreased supplemental feeding would result in overall moderate improvement in riparian and aspen woodlands in the short and long terms (Cole, pers. comm. 2002). Eliminating hunting in the northern fifth of the

refuge would minimize the benefits of reduced elk numbers on the refuge because the elk would learn which part of the refuge was a safe zone and would spend more time there during the fall and early winter. In the long term elk and bison numbers on the refuge would be low enough to allow elk and bison to winter on the refuge without supplemental feeding in all but the most severe winters. Under these conditions elk and bison would likely not wander far beyond refuge boundaries, although more elk could make greater use of national forest land immediately east of the refuge (e.g., within about 5 miles).

Aspen Communities — Elk numbers on the refuge under this alternative would be reduced, but they would likely spend more time at the north end of the refuge (during fall and winter, in particular) due to the reduced frequency of supplemental feeding and hunting closures in the northern fifth of the refuge; this would reduce the benefits of lower numbers of elk (Cole, pers. comm. 2002) compared to Alternative 1.

Over the next 15 years, despite lower elk and bison numbers under Alternative 3, there would be an estimated moderate decline in the condition of aspen communities over their already poor condition (Cole, pers. comm. 2002). Aspen acreage would decrease by an estimated 5% (90 acres) during the next 15 years due to continued browsing by elk (see Table 4-1). In 30 or more years from mature aspen stems would disappear, and very few if any saplings would grow out of the browse zone to replace them. Most of these stands would convert to sagebrush shrubland habitats, and some would convert to conifer-dominated communities.

If many elk were to migrate out of the Jackson Hole area in the winters, the effects on aspen communities would be similar to the effects of scenario 2 under Alternative 2.

Willow Communities — Willow habitat could increase by an estimated 730 acres in the south end of the National Elk Refuge in the short term compared to baseline conditions as remnant willow plants converted to Class I/II willow communities. There would be an increase in willow habitat (Table 4-1) because elk numbers would be sustained below 2,000 and bison numbers below 800–1,000. Compared to Alternative 1, Alternative 3 would have an estimated 1,500 more acres of willow habitat in Class I and II condition (and some in Class III condition) on the southern part of the refuge in the long term. Willow acreage would not increase on the northern end of the refuge because all sites suitable for willows are currently occupied by willow stands.

Cottonwood Communities — In the short term, there would be a moderate improvement in the condition of the cottonwood communities along the upper portion of Flat Creek because the frequency of feeding on the National Elk Refuge would be reduced (Cole, pers. comm. 2002). No acreage change is expected from baseline conditions. Portions of the riparian zone would potentially become dense thickets of cottonwood, willow, serviceberry, and chokecherry, potentially shading out and causing a decrease in the herbaceous vegetation in the thickest patches of woody vegetation. However, this would depend on the frequency of emergency feeding operations. At least four consecutive years without feeding would be necessary for cottonwood to successfully escape browsing pressure (Cole, pers. comm. 2002). In the long term, there might be a slight acreage increase in the Flat Creek cottonwood zone and moderate improvement in condition.

The Gros Ventre River cottonwood community would experience negligible change in condition or acreage in the short and long terms because, although elk numbers would be lower, elk would be using the area more because it would be a safety zone during hunting season.

Conclusion

Aspen communities would decrease by as much as 1,850 acres in the long term, which is similar to Alternative 1. Class I and II willow habitat on the refuge would be more by an estimated 1,500 acres in the long term (for a total of about 1,750 acres) as compared to Alternative 1. The amount of cottonwood habitat would remain similar to baseline conditions (about 1,090 acres), which is 240 acres more than cottonwood communities under Alternative 1.

Alternatives 4 and 5

Analysis

Maintenance of current elk hunting areas, the addition of exclosures (under Alternatives 4 and 5), and slightly lower elk densities (under Alternative 4) could promote an estimated major improvement of deciduous woody plant communities in the northern end of the refuge (Cole, pers. comm. 2002). The improvement would be more pronounced if winter range improvement projects were undertaken immediately east of the refuge (e.g., within 5 miles) and other locations in the national forest.

Aspen Communities — Inside the 1,000-acre exclosure on the north end of the refuge there would be a major improvement in aspen condition from Classes III/IV to Classes I/II, and an estimated 5% acreage increase could be anticipated (Cole, pers. comm. 2002). Fire or other large-scale disturbance of mature aspen stems could facilitate replacement of mature stems by causing large-scale growth of aspen suckers, although dense growth of aspen suckers could shade out and eliminate most herbaceous vegetation.

Outside the exclosure, there would be a minor decrease in the already poor condition of aspen and about a 5% acreage (90 acres) decrease over 15 years due to continued browsing by elk (see Table 4-1). In the long term approximately 850 acres of aspen habitat would convert to sagebrush shrubland and conifer habitats.

Without a 1,000-acre aspen exclosure on the north end of the refuge, upland aspen stands would continue to shrink as mature aspen trees continued to die without being replaced by aspen suckering, and as stands subsequently were replaced by conifer forest habitat and sagebrush shrubland habitat. There would be an estimated minor decline in the already poor condition that currently exists (Cole, pers. comm. 2002). An estimated 5% of aspen communities (90 acres) would be lost in the next 15 years. In the long term most aspen stands would be lost and replaced with sagebrush shrubland and conifer forest habitat.

Willow Communities — In the short term a 500-acre exclosure on the southern end of the refuge would lead to an estimated major improvement in the condition of 250 acres of willow communities from Classes III/IV to Classes I/II. Fire within the exclosure would increase willow densities and speed up the development of willow within gaps. Over the long term (assuming that additional restoration activities were implemented), willow habitat in Class I condition would increase to an estimated 500 acres within the exclosure.

Willow communities outside the exclosure in the southern part of the refuge would continue to decline in condition because elk would still browse, and elk densities would not be low enough to allow these willows to regenerate. In the long term, willow plants outside the exclosure would die out as existing root systems continued to deteriorate (Cole, pers. comm. 2002). An estimated 270 acres of willow habitat in Class II and III conditions would continue outside exclosures, mostly on the northern end of the refuge.

If Alternatives 4 and 5 did not include a 500-acre willow exclosure in the southern part of the refuge, willow habitat would continue to decline in condition by a minor amount in the short term due to continued browsing by elk. The remaining acreage of willow habitat on the south end (approximately 50 acres) would convert to wet meadow habitat in the long term (Cole, pers. comm. 2002).

With a 1,000-acre aspen exclosure, there would likely be increased pressure on willow and other woody vegetation communities outside the exclosure because elk would browse more heavily on whatever woody vegetation was accessible. There would be a minor decline in the condition of willow habitat in the Gros Ventre River corridor due to the aspen exclosure (Cole, pers. comm. 2002).

Under Alternative 4, without a 1,000-acre aspen exclosure, there would be a negligible decline in the condition of willow habitat on the northern end of the refuge compared to baseline conditions. Under Alternative 5, without a 1,000-acre aspen exclosure, willow habitat on the northern end of the refuge would experience a minor decline in condition with some conversion of willow communities to wet meadow habitat on wetter sites, and to spotted knapweed or upland grass on drier sites (Cole, pers. comm. 2002).

Cottonwood Communities — A 100-acre cottonwood exclosure would extend farther out into the

floodplain than cottonwood communities currently occur, which could increase the width of the riparian corridor, depending on flood events. There would be major improvement in the condition of cottonwood communities inside the 100-acre Flat Creek exclosure and a minor acreage increase in the short and long terms (Cole, pers. comm. 2002).

Along the upper portion of Flat Creek, outside the exclosure, there would be a major decline in the condition of cottonwood habitat over the already poor condition (Classes III/IV) because elk and bison would continue to browse the accessible cottonwood habitat, and lower elk and bison numbers and reduced supplemental feeding frequency would not mitigate for the increased pressure. In the long term, loss of an estimated 150 acres of cottonwood habitat along Flat Creek would be likely (Table 4-1).

In the short and long terms, if Alternatives 4 and 5 did not include a 100-acre cottonwood exclosure, an estimated major decline in the condition of these cottonwood stands along upper Flat Creek would continue beyond already poor conditions, and an estimated 220 acres of cottonwood communities close to the McBride feedground could be lost (Cole, pers. comm. 2002).

A 1,000-acre aspen exclosure in the northern end of the refuge would likely increase browsing pressure on cottonwood and other woody vegetation outside the exclosure because elk would browse more heavily on whatever woody vegetation remained accessible. Under Alternative 4 increased browsing pressure on cottonwood communities along the Gros Ventre River would nullify the benefits of reduced elk numbers, and there would be negligible change in the condition of cottonwood habitat (Cole, pers. comm. 2002). Under Alternative 5, with a 1,000-acre aspen exclosure, many cottonwood communities along the Gros Ventre River would decline from good or fair condition (Classes I/II) to poor condition (Classes III/IV). Cottonwood habitat along the Gros Ventre River would persist in the long term, but minor acreage reduction could occur.

If Alternative 4 did not include a 1,000-acre aspen exclosure, cottonwood stands along the Gros Ventre River would experience an estimated minor increase in condition due to fewer browsing elk and bison, but no acreage change is expected in the next 15 years (Cole, pers. comm. 2002). In the long term cottonwood habitat would likely persist in the Gros Ventre River corridor at about the same acreage as baseline conditions and with minor improvement in condition. The areas within the Gros Ventre riparian zone where cottonwood suckers and seedlings are capable of growing out of the browse zone would likely increase slightly.

If Alternative 5 did not include a 1,000-acre aspen exclosure, cottonwood stands along the Gros Ventre River would experience an estimated minor decline in condition, but the decline would be less than with an aspen exclosure. Some cottonwood stands could decline from Classes I/II to Classes III/IV. However, no acreage change would be expected in the next 15 years (Cole, pers. comm. 2002).

Conclusion

It is estimated that the amount of willow habitat in Classes I and II would be more by an estimated 520 acres in the long term compared to Alternative 1 (for a total of about 770 acres). The amount of aspen habitat on the refuge would decrease by an estimated 850 acres in the long term, leaving an estimated 1,000 acres compared to almost no aspen habitat under Alternative 1. The amount of cottonwood habitat would decrease from the current 1,090 acres by about 150 acres, leaving an estimated 940 acres. Most of the remaining willow and aspen habitat would be in large blocks formed by the exclosures and would be in Class I condition. Remaining cottonwood habitat would be in Class II or III condition.

Alternative 6

Analysis

Several factors would promote a major improvement in riparian and aspen woodland communities on the refuge; those factors are continued elk hunting in the near short term, the addition of rotating temporary exclosures that would allow nearly all to all of the existing aspen habitat to recover, a permanent exclosure that would protect 100 acres of cottonwood communities, and lower elk densities (Cole, pers. comm. 2004). The improvement would be more pronounced if winter range improvement projects were undertaken

immediately east of the refuge (e.g., within 5 miles) and other locations in the national forest.

Aspen Communities — Under Alternative 6 an estimated 600 acres of aspen would be enclosed in several exclosures of varying sizes. Aspens in these exclosures would be burned or cut to stimulate regeneration, and after approximately 10 years, the fencing would be removed and another 600 acres of aspen would be enclosed. These temporary exclosures would be rotated until all aspen habitats on the refuge were treated and protected from browsing for approximately 10 years. The objective on the refuge would be no net loss of aspen. If it appeared that some unenclosed aspen stands would be lost before 10 years had passed, additional acreage would be enclosed beyond the initial 600 acres. In the long term (an estimated 30 years), after all aspen stands on the refuge have recovered, the exclosures would be removed. Monitoring of aspen habitat condition would continue, and if it appeared that ungulates were having negative impacts on aspen communities, exclosures would continue to be temporarily erected and rotated at appropriate intervals to insure the continued existence of Classes I/II aspen habitat on the refuge.

Inside the aspen exclosures there would be a major improvement in aspen condition from Classes III/IV to Classes I/II, and an estimated 5% acreage increase could be anticipated.

If Alternative 6 did not include 600 acres of rotating temporary aspen exclosures, upland aspen stands would continue to shrink as mature aspen trees continued to die without being replaced by aspen suckering, and as stands subsequently were replaced by conifer forest and sagebrush shrubland. There would be an estimated minor decline in the condition of aspen stands over the already poor condition (Classes III/IV) that currently exists (Cole, pers. comm. 2002), and an estimated 5% of aspen communities (90 acres) would be lost in the next 15 years.

Without aspen exclosures, the loss of aspen habitat loss would likely accelerate in the long term, with aspen communities eventually disappearing.

Willow Communities — Willow habitat on the southern part of the refuge would not be protected by an exclosure; instead, elk numbers would be lowered to 2,400–2,700 animals. Singer and Zeigenfuss (2003) predicted that lowering elk numbers to this level would reduce browsing pressure enough to allow willows to recover to Class I or II condition without fencing, but they indicated that suppressed willow plants in wet meadow habitats (Class IV condition) might need active disturbance in the form of flooding, fencing, burning, or the return of beavers to fully recover. If monitoring indicated that willow habitat was not going to recover in a reasonable amount of time with reduced elk numbers, elk numbers would be further reduced until sufficient recovery occurred (but would not be reduced below 1,000–2,000 elk). As a last resort, one or more exclosures would be erected in areas where willow habitat was not recovering.

The effects of Alternative 6 on willow communities would be similar to Alternative 3. After elk numbers were reduced, the condition of willow communities would be expected to improve from Classes III/IV to Classes I/II. Willow canopy cover in most areas occupied by willows would likely increase to about half of the objective level of 60%–85% in the short term, and canopy cover would reach objective levels in the long term.

Cottonwood Communities — The effects of a 100-acre cottonwood exclosure under Alternative 6 would be similar to Alternative 4.

If Alternative 6 did not include a 100-acre cottonwood exclosure, in the short and long terms impacts would be as described in Alternative 4.

Without a 600-acre aspen exclosure, there would not be increased browsing pressure on cottonwood stands due to elk concentrating on whatever woody vegetation was accessible; therefore, cottonwood stands along the Gros Ventre River would experience an estimated minor increase in condition due to fewer browsing elk under Alternative 6. No acreage change would be expected over the next 15 years (Cole, pers. comm. 2002). In the long term cottonwood habitat would likely persist in the Gros Ventre River corridor at about the same acreage as baseline conditions and with minor improvement in condition.

Conclusion

The amount of aspen habitat on the refuge would remain similar to baseline conditions (1,850 acres), but most aspen stands would improve in condition to Classes I and II as compared to almost no aspen habitat under Alternative 1. It is estimated that the amount of willow habitat in Classes I and II would increase by an estimated 1,500 acres in the long term compared to Alternative 1 (for a total of about 1,750 acres). The amount of cottonwood habitat would decrease from the current 1,090 acres by about 150 acres, leaving an estimated 940 acres in Classes I and II, an estimated 70 acres more than under Alternative 1.

Mitigation

The alternatives include measures to mitigate the adverse impacts of excessive elk browsing on woody vegetation. With respect to elk, habitat treatments would be coordinated with the phase-out of supplemental feeding on the refuge (Alternatives 2, 3, 4, and 6), and agencies could avoid treating willow and cottonwood communities in areas where regrowth would be heavily browsed.

Conifer Forests

All Alternatives

Analysis

Conifer forest habitat covers approximately 160 acres on the National Elk Refuge.

No significant acreage change of conifer forest communities would be expected under any alternative (see Table 4-1). There would likely be a minor increase in conifer cover in most aspen stands due to natural succession in the absence of fire combined with differential browsing pressure on palatable deciduous species.

Conclusion

No significant acreage change in conifer forest would be expected under any alternative.

Mitigation

No mitigation would be necessary.

Cultivated Fields

Irrigated and non-irrigated acreage, total and herbaceous forage production, and pounds of forage produced per acre would be similar for baseline conditions and Alternative 1.

Alternative 1

Analysis

Forage production on about 2,400 acres of cultivated fields on the refuge would remain similar to past levels (an average of about 3,300 tons/year of herbaceous forage) if sufficient personnel could be found to perform flood irrigation work.

Forage production could increase in the future if

- the U.S. Fish and Wildlife Service discovered more desirable plant species with greater production potential
- sprinkler irrigation was increased (up to a maximum of 260 acres under existing authorization), which would increase forage production; at a minimum of 5,000 pounds per acre, forage could increase by 650 tons/year or more (see Table 4-3)

Forage production could decrease in the future because of

- the difficulty of efficiently managing water on the refuge using flood irrigation due to the porous refuge soils, poor condition of ditches and headgate structures, and limited number of irrigators
- the nonnative plant species invading approximately 230 acres of cultivated fields near the town of Jackson could reduce forage production by about 80%–90% in that area in the long term

Current levels of elk wintering on the refuge would not impact cultivated fields in the future. If bison numbers continued to grow, they could reach a point where they could not be prevented from entering the southern part of the refuge and could not be hazed off the refuge in the spring. It is possible that bison would feed on the forage during the growing season, and this could cause major declines in forage available for the following winter season; but even if the increased numbers of bison only fed on the cultivated fields during

TABLE 4-3: NATIONAL ELK REFUGE — ESTIMATED FARMED ACREAGES AND ASSOCIATED FORAGE PRODUCTION LEVELS IN CULTIVATED FIELDS

	Baseline	Alternative 1	Alternatives 2 and 3 (Option B)	Alternative 3 (Option A)	Alternatives 4, 5, and 6
Acres/Year (1992–2001)					
Flood Irrigated	930 acres[1]	930 acres	NA	990 acres	500 acres
Sprinkler	60 acres	60 acres	NA	0	400 acres
Sprinkler[2]	NA	NA	NA	NA	700 acres
Non-Irrigated	1,410 acres	1,410 acres	(2,400 acres)[3]	1,410 acres	800 acres
Total Acres	2,400 acres	2,400 acres	(2,400 acres)[3]	2,400 acres	2,400 acres
Acres/Year (Driest Year[4]					
Flood Irrigated	830 acres	830 acres	NA	830 acres	500 acres
Sprinkler	60 acres	60 acres	NA	0	400 acres
Sprinkler[2]	NA	NA	NA	NA	700 acres
Non-Irrigated	1,510 acres	1,510 acres	(2,400 acres)[3]	1,570 acres	800 acres
Acres/Year (Wettest Year)[5]					
Flood Irrigated	2,000 acres	2,000 acres	NA	2,000 acres	500 acres
Sprinkler	60 acres[1]	60 acres	NA	0	400 acres
Sprinkler[2]	NA	NA	NA	NA	700 acres
Non-Irrigated	340 acres	340 acres	(2,400 acres)[3]	400 acres	800 acres
Tons of Forage/Year					
Flood Irrigated					
Average Year	1,900 tons	1,900 tons	NA	2,000 tons	1,000 tons
Driest Year	1,100 tons	1,100 tons	NA	1,100 tons	600 tons
Wettest Year	5,900 tons	5,900 tons	NA	5,900 tons	1,500 tons
Sprinkler Irrigated					
5,000 lbs/ac objective	180 tons	180 tons	NA	180 tons	1,000 tons
2,500 lbs/ac objective	NA	NA	NA	NA	900 tons
Non-Irrigated					
Average Year	1,200 tons	1,200 tons	(1,300 tons)[3]	1,200 tons	700 tons
Driest Year	500 tons	500 tons	NA	500 tons	200 tons
Wettest Year	500 tons	500 tons	NA	600 tons	1,300 tons
Total Tons for All Fields					
Average Year	3,300 tons	3,300 tons	(1,300 tons)[3]	3,200 tons	3,600 tons
Driest Year	1,800 tons	1,800 tons	NA	1,600 tons	2,700 tons
Wettest Year	6,600 tons	6,600 tons	NA	6,500 tons	4,700 tons
Total Lbs./Acre All Fields					
Average Year	2,800 lbs./ac.	2,800 lbs./ac.	(1,100 lbs./ac.)	2,700 lbs./ac.	3,000 lbs./ac.
Driest Year	1,500 lbs./ac.	1,500 lbs./ac.	0	1,300 lbs./ac.	2,300 lbs./ac.
Wettest Year	5,500 lbs./ac.	5,500 lbs./ac.	0	5,400 lbs./ac.	3,900 lbs./ac.

1. There was no sprinkler irrigation system on the National Elk Refuge in 1993.
2. Objectives for the amount of forage produced with sprinkler irrigation would be 5,000 lbs/ac on 400 acres and 2,500 lbs/ac on 700 acres under Alternatives 4, 5, and 6. The forage would be better quality with a 2,500 lbs/ac objective.
3. Forage production for these fields in Alternative 2 are accounted for in native grassland habitats.
4. Driest years' estimates for the current situation are based on figures from 2001.
5. Wettest year estimates for the current situation are based on figures from 1993, except for sprinkler irrigated acreage, which was 0 in 1993.

the winter, this would still mean less standing forage available for elk.

Conclusion

Forage production on about 2,400 acres of cultivated fields on the refuge would remain similar to past levels (an average of about 3,300 tons/year of herbaceous forage) if sufficient personnel could be found to perform flood irrigation work. If sprinkler irrigation was extended to a maximum of 260 acres, forage production could increase by an estimated minimum of 650 tons/year (an increase of about 18% over the average 3,300 tons/year). Plant species diversity would remain low compared to native species composition and plant communities would continue to be dominated by nonnative species.

Alternatives 2 and 3 (Option B)

Analysis

Prior to Euro-American settlement, the areas on the refuge that are now cultivated fields were most likely sagebrush shrubland. If these fields were restored to native habitat, as called for in Alternative 2, refuge management would endeavor to reestablish sagebrush shrubland plant species. This is a very slow-growing plant community, and initially, native grasses would dominate replanted sites. After about 25 years (or longer) sagebrush would begin to dominate.

Over the course of 15 years, as irrigation was phased out and approximately 2,400 acres of cultivated fields were restored to native vegetation, forage production would become similar to what currently exists on native grasslands. After 25 years or longer, many of these rehabilitated native grasslands would convert to a sagebrush shrubland habitat (Cole, pers. comm. 2002). Based on forage production on other refuge grasslands, it is estimated that in the short term these restored grasslands would produce about 1,300 pounds/acre or 1,600 tons/year (Table 4-3). Herbaceous forage production on native grasslands (i.e., forage that is most palatable to ungulates) would be an estimated 1,100 pounds/acre or about 1,400 tons/year, which is an estimated 60% reduction compared to Alternative 1.

Reduced forage production on what are now cultivated fields could have large effects on the refuge's ability to overwinter elk and bison because these fields occur in the southern part of the refuge, which receives the least amount of snow and is therefore more accessible to grazing elk and bison. Forage in the northern portion of the refuge is often unavailable to elk and bison because of greater snow depth.

After the cultivated fields were totally restored to native grasslands and sagebrush shrublands, forage production would depend totally on plant species characteristics, the timing and amount of precipitation in a given year, insect infestation, invasion of nonnative plant species, and other environmental factors. The loss of agricultural land on the refuge is not subject to the Farmland Protection Policy Act.

Conclusion

Cultivated plant species on all 2,400 acres of existing cultivated fields would be converted to native grassland habitat. Alternative 2 and Option B of Alternative 3 would result in an estimated 60% less herbaceous forage production on the approximately 2,400 acres that are now cultivated compared to Alternative 1.

Alternative 3 (Option A)

Analysis

Under Option A an average of approximately 990 acres would be flood irrigated per year, and about 1,410 acres per year would not be irrigated. Total forage production for the entire 2,400 acres of cultivated land would be an estimated 3,200 tons/year on a 10-year average or approximately 2,700 pounds per acre (Table 4-3). This would be similar to Alternative 1.

Although forage production under Option A would be similar to Alternative 1, with emergency only supplemental feeding and bison and elk hunting or other public access on the southern end of the refuge, lower numbers of elk and bison would be grazing on these fields.

Conclusion

The effects of Option A would be similar to Alternative 1.

Alternatives 4, 5, and 6

Analysis

Under Alternatives 4, 5, and 6 forage production on cultivated fields would increase from approximately 3,300 tons/year under Alternative 1 to an estimated average 3,600 tons/year (Table 4-3).

Although the amount of forage produced with more sprinkler irrigation would not be dramatic, the resulting forage would be more palatable and of higher quality. Sprinkler irrigation would allow refuge managers more flexibility in determining the amount and timing of water application, which affects the growth and nutritional value of forage. Sprinklers also increase the efficiency of irrigation by requiring less water from creeks, and fewer staff are needed to implement the program.

map

Irrigation Project Areas of the NER

The modifications to the flood irrigation system would result in only a minor increase in forage production on the approximately 500 acres that would continue to be flood irrigated each year because efficiency is as related to soil characteristics and available labor as it is to structural improvements.

A similar amount of forage would be produced on cultivated fields under Alternatives 4, 5, and 6; however, different numbers of animals would be consuming this forage under each alternative.

Conclusion

Alternatives 4, 5, and 6 would result in more palatable and higher quality forage produced on cultivated fields compared to Alternative 1.

Mitigation

The loss of the refuge's cultivated fields under Alternative 2 and Option B of Alternative 3 would reduce forage production on the refuge, but this would be offset by fewer elk and bison, increased distribution of animals, and possibly migration top other wintering areas. No additional mitigation would be necessary to address the reduction in forage production on the refuge, and no other negative impacts are anticipated.

To mitigate the effects of grasshoppers on forage production, integrated pest management that includes the use of insecticides and baits could be considered.

Total and Herbaceous Forage Production on the National Elk Refuge outside Exclosures

Impacts of the Alternatives

Acreage totals have been rounded to the nearest 10 acres and tons, and pounds per acre have been rounded to the nearest 100 tons or 100 pounds per acre. Therefore, forage production numbers may be slightly different than figures cited in Chapter 3.

Alternative 1

Analysis

The 10-year average for total forage production for all habitats on the National Elk Refuge (24,250 acres) is estimated at 22,900 tons of total forage and 19,000 tons of herbaceous forage. Projected forage production under Alternative 1 would be 23,000 tons of total forage production in the short term and 22,600 tons in the long term. Projected herbaceous forage production would be 18,800 tons in the short term and 18,500 tons in the long term. These figures represent a 100–500 ton decline (a decrease of 0.5%–3%) in total and herbaceous forage production. Forage production declines would be due primarily to the decrease of woody vegetation as large numbers of elk and bison browsed in riparian and aspen woodland habitats.

Conclusion

Under Alternative 1 refuge-wide total forage production would be negligibly less in the short and long terms compared to baseline conditions. Herbaceous forage production would also decline by a negligible amount (0.5%–3%) in the short and long terms.

Alternative 2

Analysis

The estimated average total forage production for all habitats on the National Elk Refuge (24,250 acres) would be 21,300 tons in the short term, a decline of 1,600 tons (7%), and 22,100 tons in the long term, a decline of 800 tons (4%) as compared to baseline conditions. Estimated short-term herbaceous forage production would decline to approximately 16,800 tons (a decrease of 2,200 tons or 12%) and long-term production to 16,600 tons (a decrease of 2,400 tons or 13%) compared to baseline conditions. These declines would be due to the restoration of cultivated fields to less productive native vegetation.

As compared to Alternative 1, Alternative 2 would have 1,700 fewer tons (7%) of total forage production in the short term and 500 fewer tons (2%) in the long term. Herbaceous forage production under Alternative 2 would be 2,000 fewer

tons (11%) in the short term and 1,900 fewer tons (10%) in the long term.

Conclusion

As compared to Alternative 1, total forage production on all habitat types under Alternative 2 would be less by a minor amount in the short term and by a negligible amount in the long term. Herbaceous forage production would be less by a minor amount in the short and long terms.

Alternative 3 (Option A)

Analysis

Under Option A of Alternative 3 the estimated average total forage production for all habitats on the National Elk Refuge (24,250 acres) in the short term would be 23,000 tons (a 100-ton increase or 0.5%) and in the long term 23,500 tons (a 600-ton increase or 3%) as compared to baseline conditions. The increase in total forage production would be due primarily to the natural conversion of native grasslands to sagebrush shrublands and the increase in woody vegetation due to fewer numbers of browsing elk. Estimated short-term herbaceous forage production would decrease to 18,700 tons (a 300-ton decrease or 2%) and long-term production to 18,400 tons (a 600-ton decrease or 3%).

As compared to Alternative 1, Alternative 3 would have a similar amount of total forage production in the short term and an estimated 500 more tons (2%) in the long term. Herbaceous forage production under Alternative 3 would have 100 fewer tons (0.5%) in the short and long terms as compared to Alternative 1.

Conclusion

As compared to Alternative 1, total forage production under Alternative 3 would be more by a negligible amount in the short and long terms. Herbaceous forage production would be less by a negligible amount.

Alternative 3 (Option B)

Analysis

Under Option B of Alternative 3 the average total forage production for all habitats on the National Elk Refuge (24,250 acres) would be estimated at 21,500 tons in the short term (a 1,400-ton decrease or 6%) and 22,400 tons in the long term (a 500-ton decrease or 2%) compared to baseline conditions. Estimated herbaceous forage production would decrease to 16,900 tons in the short term (a 2,100-ton decrease or 11%) and 16,700 tons in the long term (a 2,300-ton decrease or 12%). These declines would be due to restoring cultivated fields to less productive native vegetation.

Compared to Alternative 1, total forage production under Option B would decrease by 1,500 tons (7%) in the short term and 200 tons (1%) in the long term. Herbaceous forage production would decrease by 1,900 tons (10%) in the short term and 1,800 tons (9%) in the long term.

Conclusion

As compared to Alternative 1, total forage production under Option B of Alternative 3 would be less by a minor amount in the short term and a negligible amount in the long term. Herbaceous forage production would be less by a minor amount in the short and long terms.

Alternatives 4 and 5

Analysis

Under Alternatives 4 and 5 a 500-acre willow exclosure, a 100-acre cottonwood exclosure, and a 1,000-acre aspen exclosure would be erected to allow woody vegetation to recover from ungulate browsing. The forage in these exclosures would not be available for elk and bison, but would provide habitat for Neotropical migratory birds. Under Alternative 5 average total forage production for all vegetation types on 22,650 acres outside exclosures would be an estimated 21,100 tons in the short and long terms. This is an estimated 1,800 tons (8%) less than under baseline conditions. Herbaceous forage production would decrease by an estimated 1,600 tons (8%) in the short term and by 1,800 tons (9%) in the long term as compared to baseline conditions.

Sprinkler irrigation on 1,100 acres would increase forage production on cultivated fields. However, fencing off willow, cottonwood, and aspen habitat would withdraw 1,600 acres from the refuge's forage production base. The result would be a minor

decrease in overall total and herbaceous forage available for elk and bison.

As compared to Alternative 1, total forage production under Alternatives 4 and 5 would be less by 1,900 tons (8%) in the short term and 1,500 tons (7%) in the long term. Herbaceous forage production would be less by 1,400 tons (7%) in the short term and 1,300 tons (7%) in the long term.

Conclusion

As compared to Alternative 1, total forage production and herbaceous forage production under Alternatives 4 and 5 would be less by a minor amount in the short and long terms.

Alternative 6

Analysis

Under Alternative 6 a total of 600 acres of aspen stands would be enclosed within several temporary rotating exclosures, and a 100-acre cottonwood permanent exclosure would be erected to allow woody vegetation to recover from overbrowsing by ungulates. These exclosures would be unavailable for elk and bison, but they would provide habitat for Neotropical migratory birds. However, 600 acres of forage within these exclosures would become available for ungulates after approximately 30 years, unless it was evident that temporary, rotating exclosures must continue indefinitely to preserve aspen habitat on the refuge.

Under this alternative the estimated short-term total forage production for all habitats on the refuge outside the exclosures would be 22,600 tons (on 23,550 acres), a 300-ton (or 1%) decrease from baseline conditions. Estimated long-term production would be 24,200 tons (on 24,150 acres), a 1,300-ton (6%) decrease. Herbaceous forage production would be 400 tons (2%) less in the short term and 100 tons (0.5%) more in the long term than under baseline conditions.

Sprinkler irrigation on 1,100 acres would increase forage production on cultivated fields, and fewer elk would allow willow habitat to recover. The result would be a negligible to minor increase in overall total and herbaceous forage in the short term and a minor increase in the long term.

As compared to Alternative 1, total forage production under Alternative 6 would be less by 400 tons (2%) in the short term and more by 1,600 tons (7%) in the long term. Herbaceous forage production would be less by 200 tons (1%) in the short term and more by 600 tons (3%) in the long term.

Conclusion

Total forage production under Alternative 6 would be less by a negligible amount in the short term and more by a minor amount in the long term compared to Alternative 1. Herbaceous forage production would be less by a negligible amount in the short term and more by a negligible amount in the long term.

GRAND TETON NATIONAL PARK

Sixty-three plant community types identified in Grand Teton National Park and John D. Rockefeller, Jr., Memorial Parkway were divided into nine general categories (excluding open water and human development), as described in Chapter 3.

MARSHLANDS

Impacts of All Alternatives

Analysis

The marshland communities in Grand Teton National Park are expected to experience negligible changes in acreage or condition in the short and long terms under all alternatives compared to baseline conditions (see Table 4-4).

Conclusion

The acreage of marshland habitat in the national park would not be expected to change more than a negligible amount under any alternative. None of the alternatives would result in impairment of marshland habitat.

Mitigation

Mitigation for park marshlands would not be necessary.

TABLE 4-4: GRAND TETON NATIONAL PARK — SUMMARY OF POTENTIAL CHANGES IN ACRES OF HABITATS RELATIVE TO BASELINE ACREAGES

Vegetation Category	Baseline	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6
Marshlands	16,968	NC	NC	NC	NC	NC	NC
Wet Meadows	13,390	NC	NC	NC	NC	NC	NC
Native Grasslands	8,093	NC	+	+	+	+	+
Sagebrush Shrublands	56,843	+	+	+	+	+	+
Riparian and Aspen Woodlands	22,324	–	+	+	NC+	NC+	+
Conifer Forest	123,093	+	NC	NC	NC	NC	NC
Agricultural Lands	5,610	NC	–	–	–	–	–
Bare Rock and Krummholz	58,640	NC	NC	NC	NC	NC	NC
Tundra	5,635	NC	NC	NC	NC	NC	NC

NC = no change from baseline numbers of acres.
+ = an increase in acres of this plant community type.
– = a decrease in acres of this plant community type.

WET MEADOWS

Alternative 1

Analysis

A study by McCloskey and Weidner (2002) in three wet meadow sites may indicate that heavy ungulate use is negatively affecting plant reproductive capacity, flowering height, canopy cover, and percentage of bare ground in some wet meadow habitats. Kentucky bluegrass (a nonnative grass species) and oxeye daisy (a nonnative invasive weed) occur in wet meadow habitats and are preferred forage for elk and other ungulates. They have low growing points and can spread by sending out stems that creep along the surface or under the surface of the soil and do not need to make seed to reproduce. Kentucky bluegrass and oxeye daisy can be grazed to the ground and thrive and expand. Heavy grazing pressure on the edges of these meadows appears to be allowing both of these nonnatives to outcompete native grasses and expand their range. Approximately 80% of these meadows are currently in nonnative plant species (Haynes, pers. comm. 2004). The spread of nonnative species can occur fairly rapidly, and continued heavy grazing and ground disturbance would likely result in an increase in exotic species in wet meadow communities (Hobbs and Huenneke 1992; Singer 1995).

Wet meadow acreage under Alternative 1 would not change due to any management actions that are being considered in this planning process. However, wet meadow plant communities might shift from native species to nonnative species in some areas as large numbers of elk and growing numbers of bison continued to heavily graze in these areas. This effect might be more pronounced on the west side of the Snake River due to the fact that it serves as a safe zone from hunting.

Conclusion

There would be no change in the amount of wet meadow acreage in the national park, but there could be a shift from native species to nonnative species in some areas due to grazing pressure by elk and bison. Alternative 1 would not result in impairment of wet meadow habitat in the park.

Alternative 2

Analysis

Fewer elk and bison summering in the national park in most years would result in fewer areas of bare ground in wet meadow habitats and less invasion by nonnative plant species. In the short and long terms, wet meadow acreage would not change due to any management actions under this alternative compared to baseline conditions and Alternative 1. Conversely, in years when elk numbers ranged from 2,000 to 3,000 in the park, nonnative plant species could expand their range in the wet meadow communities due to heavy elk grazing (Haynes, pers. comm. 2003).

Conclusion

In the short and long terms, wet meadow acreage would not change due to any management actions under this alternative compared to baseline conditions and Alternative 1. Alternative 2 would not result in impairment of wet meadow habitat.

Alternatives 3, 4, and 6

Analysis

Fewer numbers of ungulates summering in the national park could result in fewer areas of bare ground in wet meadow habitats and fewer invasions by nonnative plant species. Large numbers of bison under Alternative 3 could negate some benefits to wet meadow communities in areas where bison graze. Wet meadow acreage would not change under these alternatives, and wet meadow plant communities would likely remain dominated by native plant species due to fewer numbers of elk grazing in the park, especially under Alternative 6.

Conclusion

Fewer ungulates summering in the national park could result in less bare ground in wet meadow habitats and fewer invasions by exotic species. Large numbers of bison under Alternative 3 could negate some benefits to wet meadow communities in areas where bison graze. Most wet meadow acreage would not change under these alternatives. Alternatives 3, 4, and 6 would not result in impairment of wet meadow habitat in the park.

Alternative 5

Analysis

Fewer bison summering in the national park could result in fewer areas of bare ground in wet meadow habitats and fewer invasions by nonnative plant species; however, positive effects would be less than under Alternatives 2, 3, and 4 because the number of elk under Alternative 5 would be similar to those under Alternative 1. Wet meadow acreage would not change, but wet meadow plant communities in some areas of the park would likely shift from native species to nonnative species due to more than 2,000 elk grazing in the park (Haynes, pers. comm. 2003). This effect might be more pronounced on the west side of the Snake River because it serves as a safe zone from the elk herd reduction program .

Conclusion

The positive effects would be less than under Alternatives 2, 3, and 4 because the number of elk under Alternative 5 would be similar to those under Alternative 1. Wet meadow acreage would not change, but wet meadow plant communities in many areas of the park would likely shift from native species to nonnative species because there would be more than 2,000 elk grazing in the park. Alternative 5 would not result in impairment of wet meadow habitat.

Mitigation

No mitigation beyond measures to reduce numbers of elk and bison, as considered in the alternatives, would be necessary.

Native Grasslands

Alternative 1

Analysis

Baseline numbers of elk and bison under Alternative 1 are not expected to affect acreage or condition of native grassland communities in the short or long terms compared to baseline conditions. However, if bison numbers continued to increase under Alternative 1 (potentially up to 2,000–3,000), heavily grazed areas would increase, resulting in more bare ground and shorter, less dense vegetation in many areas. As the condition of native grassland habitats declined with increasing grazing pressure, nonnative plant species could invade and possibly dominate many areas (Haynes, pers. comm. 2004). A future reduction in bison numbers could correct the problem.

Conclusion

In the short term current numbers of elk and bison are not expected to affect the condition of native grassland communities in the national park to any measurable degree. In the long term increasing numbers of bison could cause the condition of native grassland habitat to decline in some areas. However, the limited extent of impacts would not result in the impairment of native grassland habitat in the park.

Alternatives 2–6

Analysis

Approximately 4,500 acres of agricultural lands would be restored to native plant communities. At present it is not possible to quantify gains in na-

tive grasslands and sagebrush shrublands as a result of this restoration. Actual acreage increases would depend on soils, grazing pressure, slope, aspect, availability of prescribed fire, proximity to native vegetation communities, and available surface and subsurface moisture. For the sake of this analysis it is assumed that native grassland and sagebrush shrubland habitats would gain in the long term, with 2,250 acres of each habitat type.

Restoring agricultural lands would initially increase native grassland communities by about 4,500 acres. In the long term (longer than 25 years), approximately 2,250 acres of native grassland habitat would convert to sagebrush shrubland communities. This would bring the long-term total for native grassland habitats to an estimated 10,340 acres.

Lower numbers of elk and bison under this alternative would contribute to a minor increase in species diversity and probably result in less open ground as observed by Zeigenfuss et al. (2003) in favored areas currently receiving intense grazing.

Conclusion

Native grassland habitat in the park would increase by an estimated 4,500 acres under Alternative 2 in the short term, which is similar to Alternatives 3–6. In the long term it is estimated that sagebrush would dominate about half of this acreage, leaving approximately 2,250 acres more native grassland habitat compared to Alternative 1. The condition of native grassland habitat could improve negligibly in some areas due to fewer bison. Native grassland habitat would not be impaired in the park under this alternative.

Mitigation

The reestablishment of native vegetation on formerly cultivated areas in the park without a follow-up program to periodically burn sagebrush shrubland habitat would result in a high amount of sagebrush habitat and low production of herbaceous vegetation in sagebrush communities. Periodic prescribed fire over the long term in restored vegetation communities would mitigate this adverse effect.

SAGEBRUSH SHRUBLANDS

Alternative 1

Analysis

Sagebrush shrubland habitat in the national park covers approximately 56,840 acres, and a high amount is in an advanced stage of succession. Under Alternative 1 sagebrush shrubland communities could increase in acreage as mature aspen stands converted to sagebrush shrubland habitats due to heavy elk browsing, climate change, and fire suppression. Localized areas could also decline in condition due to the large numbers of bison allowed in this alternative.

Conclusion

Under Alternative 1 sagebrush shrubland communities in the national park might increase in acreage in the short term compared to baseline conditions. In the long term sagebrush shrubland habitat could increase due to conversion of aspen stands. Localized areas could also decline in condition due to the growing bison population, but the limited extent of impacts would not result in the impairment of sagebrush shrubland habitat in the park.

Alternatives 2–6

Analysis

Under Alternatives 2–6 sagebrush shrubland communities would not be expected to change in condition or acreage in the short term from baseline conditions. Compared to Alternative 1, sagebrush shrubland condition and acreage in these alternatives would be similar in the short term, and acreage would be greater by 2,250 acres in the long term.

Fewer elk and bison grazing in the national park would contribute to a minor potential increase in species diversity and would likely result in less open ground as observed by Zeigenfuss et al. (2003a) in favored areas that are currently intensely grazed.

Conclusion

In the long term, it is estimated that the amount of sagebrush shrubland habitat in the park would

increase by approximately 2,250 acres, as some restored native grassland habitat succeeded to sagebrush shrubland communities. The condition of sagebrush shrubland habitat could improve negligibly in some areas due to fewer bison. Sagebrush shrubland habitat would not be impaired under these alternatives because there would be a net increase in the amount of sagebrush habitat (in what are now agricultural fields), and elk and bison numbers would not be higher than the habitat can support.

Mitigation

Mitigation measures for potential adverse impacts to sagebrush shrubland habitats in the Jackson Hole area would be similar to those discussed under "Native Grasslands" above.

Riparian and Aspen Woodlands

Alternative 1

Analysis

Riparian and aspen woodland communities presently occur on approximately 22,320 acres in Grand Teton National Park and are composed of willow, aspen, and cottonwood habitats.

Aspen Communities — Currently, 51% of surveyed stands in the park are considered to be healthy, functioning normally, and regenerating in the absence of disturbance (McCloskey and Sexton 2002). Recently disturbed stands (9% of surveyed stands) are also healthy and regenerating but have experienced sharp declines in the number of suckers three years after a fire and could be negatively affected by ungulate browsing. More monitoring is necessary to determine the success of suckers under current site conditions.

An estimated 40% of aspen communities (mature and encroached stands) are in the process of converting to other habitat types (McCloskey and Sexton 2002). Mature aspen stands (22% of the surveyed stands) are being negatively affected by a combination of climate change, suppressed fire, and ungulate browsing. Intense browsing by an estimated 2,500–3,200 elk under Alternative 1 would most likely continue to adversely affect these mature stands.

Conifer-encroached aspen stands (particularly those that are heavily browsed) are in the process of converting to conifer forests. Unlike solid stands of aspen, conifer encroached aspen stands carry fire well. In nature, conifer encroachment is a necessary prerequisite for an aspen stand-replacing fire.

Given the numbers of elk under Alternative 1 and the effects described above, aspen acreage would likely begin to decrease compared to baseline conditions due to the relatively high level of browsing pressure in the park and the encroachment of conifer trees. Over the long term (greater than 50 years) aspen could potentially diminish by as much as 50% across the landscape under existing trends (McCloskey and Sexton 2002).

Willow Communities — Most willow stands are in good to excellent condition (Singer and Zeigenfuss 2003). Of the willow stands found to be heavily browsed in the park, the majority were in areas having high or very high moose densities (Singer and Zeigenfuss 2003). Currently, elk only minimally contribute to heavy browsing of willow in the park, impacting localized areas only. In areas where willow has been burned, ungulate browsing has kept regrowth within the browse zone.

Cottonwood Communities — In general, cottonwood stands in the park are in poor condition, with some stands in a low-fair condition (Haynes, pers. comm. 2003). Lack of flooding, current numbers of elk, and growing numbers of bison could be expected to continue to degrade cottonwood habitat in the short and long terms until it disappears from the landscape in the national park.

Many cottonwood stands are mature, and if current conditions continued under Alternative 1, these stands could disappear over the next 50–100 years (Haynes, pers. comm., 2003).

Ungulate browsing, rubbing, and trampling, although not as severe as on the refuge, contribute to the decline in condition of some cottonwood stands in the park.

Conclusion

Elk numbers in Grand Teton National Park under Alternative 1 would likely continue to contribute to declining conditions and acreage of aspen habi-

tat due to the relatively high levels of browsing. Although elk could be adversely affecting willow stands in areas, the effects appear to be localized and relatively small. Cottonwood stands are being affected by ungulate browsing, rubbing, and trampling. Browsing by elk in this alternative would not impair woody vegetation habitat because it is only one of several factors that are having negative impacts on riparian and aspen woodland communities.

Alternative 2

Analysis

Alternative 2 has no objective for elk numbers, but an estimated 600–3,000 elk could summer in Grand Teton National Park under this alternative. In years when elk numbers were at the lower end of the estimate, this would represent a decrease of approximately 75% compared to current low years. In years when elk numbers were at the upper end, this would be similar to recent high numbers.

Aspen Communities — Under Alternative 2 the intensity of browsing in aspen stands would decline somewhat as a result of reduced numbers of elk in the Grand Teton segment, which would permit more aspen recruitment. Successive waves of good recruitment years would be essential to maintaining healthy and self-perpetuating stands over the long term.

Although the number of elk in the Grand Teton segment would decline under this alternative, use of aspen stands in the park by elk from the Yellowstone and Teton Wilderness segment would continue and could potentially increase with the eventual elimination of winter supplemental feeding on the refuge and the elimination of the elk herd reduction program in the park. The number of wintering elk in the park could be higher than baseline conditions and Alternative 1. Aspen communities currently in the mature category and those threatened with encroachment (40% of total) would benefit most from reductions in the Grand Teton herd segment (McCloskey and Sexton 2002). However, other aspen communities, especially those in which aspen is no longer a dominant species, would also benefit, especially if some type of disturbance, such as fire, was reintroduced.

Compared to baseline conditions and Alternative 1, Alternative 2 would likely result in a minor amount of additional aspen habitat in the long term, especially in stands that currently are classified as mature (Haynes, pers. comm. 2003).

Willow Communities — The condition of a small proportion of the willow communities in the national park that are currently heavily browsed could improve in localized areas, resulting in taller willow stems and possibly increased density of willow plants in these areas. If the amount of willow habitat increased under Alternative 2, it would only increase by a minor amount, and this additional willow habitat would likely occur in small spring and seep areas (Haynes, pers. comm. 2003).

Cottonwood Communities — Large fluctuations in summering elk numbers down to an estimated 600 (almost 25% of existing numbers) would provide low-browsing pressure years, with a probable surge in cottonwood recruitment, assuming conducive environmental conditions. Cottonwood recruitment along the Snake River would likely occur only if the flood regime was restored (Haynes, pers. comm. 2003).

Compared to baseline conditions and Alternative 1, Alternative 2 would likely result in more cottonwood habitat in the short and long terms. This would occur on tributary streams to the Snake River where normal flooding still takes place.

Conclusion

Overall browsing pressure by elk in the park would decline substantially, and there would likely be consecutive years of low elk numbers, which would allow recovery of some heavily browsed stands (possibly as low as 600 elk compared to a baseline low of an estimated 2,500). Compared to Alternative 1, willow, cottonwood, and aspen acreage would likely be higher by a negligible to minor amount, with a minor increase in plant species diversity occurring within aspen, willow, and cottonwood communities. Alternative 2 would not impair these habitats because elk are currently not impairing woody vegetation in the park, and lower elk numbers would benefit these communities.

Alternative 3

Analysis

An estimated 500–1,000 elk would summer in Grand Teton National Park under Alternative 3, a reduction of an estimated 70%–80% compared to baseline conditions.

Aspen Communities — The effects of Alternative 3 would be similar to those of Alternative 2. Additionally, compared to baseline conditions and Alternative 1, the effects of Alternative 3 would result in improved conditions and a minor amount of additional aspen habitat in the short and long terms.

Willow Communities — A small proportion of the willow communities in Grand Teton National Park that are currently heavily browsed could receive less browsing pressure in localized areas (moose currently exert more browsing pressure on willows in the park than do elk). Compared to baseline conditions and Alternative 1, Alternative 3 could result in improved condition of willow stands and possibly a minor increase in the amount of willow habitat in the long term. This additional willow habitat would likely occur in spring and seep areas (Haynes, pers. comm. 2003).

Cottonwood Communities — A reduction in elk numbers would allow more cottonwood trees to regenerate in those areas where flooding occurs and cottonwood saplings to grow out of the browse zone. Other deciduous woody understory vegetation would also be allowed to recover in some areas (Haynes, pers. comm. 2003). Under this alternative bison could still occasionally rub or girdle large trees, but the effect would not be great enough to reduce the recovery of most cottonwood stands. In areas where flooding rarely occurs, cottonwood habitat would continue to decline. Compared to baseline conditions and Alternative 1, the effects of Alternative 3 would result in an improved condition of many cottonwood stands.

Conclusion

Browsing pressure by elk would decline substantially under Alternative 3 due to an estimated 70%–80% reduction in elk numbers in the park. This reduction in browsing pressure could result in a minor improvement in the condition and acreage of willow, cottonwood, and aspen communities in the long term compared to Alternative 1. The beneficial effects would only be minor because willow communities would continue to be affected by moose browsing, cottonwood habitat would continue to be affected by reduced flooding along the Snake River, and aspen habitat would continue to be affected by lack of disturbance and conifer encroachment. These habitats would not be impaired under Alternative 3 because elk are currently not impairing woody vegetation in the park and substantially lower elk numbers would benefit woody vegetation communities.

Alternative 4

Analysis

An estimated 1,300–1,600 elk would summer in Grand Teton National Park under Alternative 4; this would be an estimated 50% decline from baseline conditions, which would result in a moderate to major reduction in browsing pressure.

Aspen Communities — A moderate to major reduction in the number of elk in the Grand Teton herd unit would contribute to lower levels of browsing in aspen stands at some times of the year, which would allow larger numbers of aspen suckers to grow taller than 10 feet. These benefits would be offset somewhat by a potential increase in the use of aspen stands by migrating and wintering elk from the Yellowstone and Teton Wilderness segments due to cutbacks in winter supplemental feeding on the refuge and no declines (and possible increases) in elk numbers in these other segments. Compared to baseline conditions and Alternative 1, the effects of Alternative 4 would result in aspen communities that are in better condition and could result in a minor addition of aspen acreage in the long term (Haynes, pers. comm. 2003).

Willow Communities — A small proportion of willow communities in the national park that are currently heavily browsed might receive less browsing pressure in localized areas, resulting in taller willow stems and possibly increased density of willow plants in these areas (Haynes, pers. comm. 2003). Compared to baseline conditions and Alternative 1, Alternative 4 could improve conditions of willow stands and increase the amount of willow habitat, but no more than a negligible

amount in the long term. The numbers of elk would be large enough in this alternative that some elk would still likely gravitate to the spring and seep areas where any additional willow cover would be likely to occur.

Cottonwood Communities — Browsing intensity in cottonwood stands would also decline by a moderate to major extent compared to baseline conditions and Alternative 1. This decreased browsing intensity would allow more cottonwood saplings to grow beyond the browse zone than would occur under Alternative 1 and to eventually achieve tree size. The flood regime would continue to be the limiting factor in cottonwood stand regeneration. Compared to baseline conditions and Alternative 1, the effects of Alternative 4 would result in a minor improvement in the condition of cottonwood communities in the long term (Haynes, pers. comm. 2004).

Conclusion

Browsing pressure by elk would decline somewhat under Alternative 4 due to an estimated 50% reduction in elk numbers in the park, which could result in a minor improvement in the condition and acreage of aspen communities in the long term compared to Alternative 1. Fewer elk would also benefit willow and cottonwood communities but not to the same extent as aspen stands because elk are having less of an effect on willow and cottonwood communities. Alternative 4 would not impair these habitats because elk are currently not impairing woody vegetation in the park, and lower elk numbers would benefit woody vegetation communities.

Alternative 5

Analysis

The number of elk summering in the national park under Alternative 5 would remain below 2,500 animals after initial reductions. Browsing intensity could decrease by a negligible amount compared to baseline conditions. There might be negligible benefits to aspen, willow, and cottonwood habitats in the short and long terms compared to baseline conditions and Alternative 1 by reduced browsing pressure. Aspen habitat would continue to be affected by a lack of disturbance and conifer encroachment. Cottonwood habitat would continue to be affected by the reduced amount of flooding along the Snake River.

Conclusion

Elk browsing pressure in the park could decline by a negligible amount under Alternative 5 due to a negligible to minor reduction in elk numbers. This reduction in browsing pressure could result in a negligible improvement in condition and acreage of aspen communities in the long term compared to Alternative 1. Lower elk numbers could also benefit willow and cottonwood communities, but not to the same extent as aspen stands because elk are having less of an effect on willows and cottonwoods. This alternative would not impair these habitats because elk are currently not impairing woody vegetation in the park, and slightly lower elk numbers would not increase adverse impacts to woody vegetation communities.

Alternative 6

Analysis

The effects of Alternative 6 on aspen, willow, and cottonwood communities in the national park would be similar to the effects of Alternative 4, except that (1) the lack of winter supplemental feeding on the refuge could result in more elk wintering in the park, and (2) the periodic major reductions in elk numbers in the park under Alternative 6 (following above-average and severe winters) would provide periods of enhanced recovery. An estimated 1,200–1,600 elk would summer in Grand Teton National Park under Alternative 6, which is an estimated 50% decline from baseline conditions. This reduction in elk numbers could greatly reduce browsing pressure compared to baseline conditions and Alternative 1, recognizing that use of the national park by elk from the Yellowstone and Teton Wilderness herd segments might increase slightly in some years.

Conclusion

Browsing pressure by elk would decline under Alternative 6 due to an estimated 50% reduction in elk numbers in the park. This reduction would result in effects that are similar to those described in Alternative 4. Alternative 6 would not result in

impairment of riparian and aspen woodland habitats.

Mitigation

Mitigation in the park would include the use of prescribed fire to reintroduce natural processes to aspen stands that are in poor condition. Aspen stands that would benefit the most from treatment include mature stands, stands threatened by encroachment by conifers, and stands that have already lost their dominance to conifers.

Conifer Forests

All Alternatives

Analysis

Currently, conifer-encroached aspen stands are converting to conifer forest due to heavy browsing of aspen by elk combined with fire suppression, and this would not change under Alternative 1. In the long term conifer forest habitats could become the dominant plant communities in many areas that are currently aspen woodland habitats. Conifer forest habitats are also encroaching on cottonwood communities along the Snake River due to the elimination of flooding after completion of Jackson Dam. In the long term conifer forest communities could increase in acreage as they became the dominant plant community along the Snake River.

Alternatives 2–6 would not affect conifer forests, conifer-encroached aspen stands, or conifer-encroached cottonwood forests more than a negligible amount in the park.

Conclusion

Conifer forest communities in the park might experience a negligible increase in acreage under Alternative 1 due to minor increases in conifer cover in aspen stands. Alternatives 2–6 would not affect conifer forests, conifer-encroached aspen stands, or conifer-encroached cottonwood forests more than a negligible amount. Conifer forests in the park would not be impaired under any of the alternatives.

Mitigation

No mitigation would be necessary.

Agricultural Lands

Alternative 1

Analysis

Agricultural lands include approximately 5,610 acres of historically cultivated lands in the Elk Ranch area in the northern part of Grand Teton National Park and the Kelly hayfields, Mormon Row, and Hunter-Talbot areas in the southern part of the park. It is anticipated that the acreage of agricultural lands would not change under Alternative 1.

Under Alternative 1 irrigation on Elk Ranch and the weed control program would continue, with some experimental restoration of agricultural lands to native habitats in limited areas. Irrigation on an estimated 1,100 acres at Elk Ranch could continue only as long as those pastures are needed for livestock grazing. Following cessation of livestock grazing, irrigation would be continued while restoration was planned and implemented to reduce the threat of invasions by nonnative plant species, which has happened in areas such as the Kelly hayfields and Hunter Ranch. Otherwise, agricultural lands are expected to remain similar to baseline conditions because continued irrigation on Elk Ranch and only experimental agricultural restoration would not significantly alter agricultural plant communities over the short and long terms.

Should populations of bison continue to grow unchecked under Alternative 1, competition for preferred grazing sites, mostly in agricultural areas and native grassland sites, would increase, with some localized damage becoming evident. Hobbs et al. (2003) noted that some areas regardless of population size would always be excessively used. This excessive use would most likely continue to affect agricultural lands and increase with increasing numbers of bison, but the overall effect across the park would not be significant.

More bison would mean more disturbance from wallowing. Staff at the national park have noticed some evidence of wallows serving as a point of establishment for nonnative invasive plant spe-

cies, but managers have not documented this effect (Haynes, pers. comm. 2003).

Conclusion

Acreage and forage production on agricultural lands in Grand Teton National Park would remain similar to baseline conditions in the short and long terms. Allowing nonnative invasive plant species to remain on agricultural lands would not impair park resources.

Alternatives 2–6

Analysis

Approximately 4,500 acres of nonnative plant communities on agricultural lands in the Kelly hayfields, Mormon Row, and Hunter-Talbot areas would be restored to native vegetation communities. Agricultural lands would gradually decrease from approximately 5,600 to approximately 1,100 acres over an estimated 20–30 years or more. About 1,100 acres of agricultural lands in the Elk Ranch area would not be restored to native vegetation and would continue to be irrigated as long as livestock are grazed in this area. Agricultural lands are primarily at the lower elevations of the park; therefore, most treated lands would likely be restored to native grasslands and sagebrush shrubland communities. Depending on moisture availability, some negligible amounts of acreage could revert to riparian and aspen woodland habitats and possibly marshland communities (Schiller, pers. comm. 2002). For the purposes of this analysis, native grassland communities and sagebrush shrubland habitats are each assumed to gain 50% of the 4,500 acres that would be restored. Plant species diversity would be expected to increase substantially on these restored agricultural lands.

Native grasses would likely far surpass nonnative plant species in palatability, and these restored agricultural lands could provide relief to ranges on the refuge in both spring and fall.

Competition for preferred grazing sites, mostly in agricultural and native grassland sites, would continue to cause some localized damage.

Conclusion

In the park there would be 4,500 fewer acres of agricultural land in the long term. Plant species diversity would increase substantially on these lands. Park resources would not be impaired because native vegetation would be restored and the potential effects of restoration activities would be minor and of short duration.

Mitigation

No mitigation would be necessary.

BRIDGER-TETON NATIONAL FOREST

MARSHLANDS

Marshland habitats in the national forest would not be affected in the short and long terms by Alternatives 2 through 6 any differently than they are being affected under Alternative 1.

WET MEADOWS

Alternatives 1 and 5

The condition of wet meadow habitat varies widely in the Teton Division, from good condition to fair or poor condition (USFS 2003b). Most wet meadow habitats likely do not receive heavy use by elk, but heavy use does occur in some areas especially near state feedgrounds. Small wet meadows that exist as openings in conifer forests are typically in good ecological condition (USFS 2003b). In general, the acreage of wet meadow habitat is decreasing due to succession and fire suppression (i.e., encroachment by sagebrush and conifer trees).

Wet meadow habitats in the national forest would not be affected because elk and bison would be fed on the refuge in most or all years. Wet meadows would continue to be heavily grazed in localized areas, and light grazing would occur in most areas.

Alternatives 2, 3, 4, and 6

In the short term few if any changes in the condition of wet meadow habitat in the national forest would be observed because elk would continue to be fed alfalfa pellets in above-average winters. In

the long term, as supplemental feeding was phased out, more elk would remain in the national forest. This could lead to a higher level of grazing pressure in some riparian wet meadow communities in the long term compared to baseline conditions and Alternative 1.

If large numbers of elk migrated to the Green River basin and the Red Desert under Alternatives 2, 3, and 6, some wet meadow communities in the Pinedale and Big Piney ranger districts could receive higher levels of grazing by elk. Residual vegetation could be reduced in areas; however, to the extent this happened, it would occur during transition periods when elk were on the move.

Native Grasslands

Alternatives 1 and 5

Native winter range in the Gros Ventre, Spread Creek, and Buffalo Valley drainages would not be affected any more under these alternatives in the short and long terms than under baseline conditions. Supplementally feeding elk every winter on the National Elk Refuge, in combination with winter feeding on the three state feedgrounds in the Gros Ventre River drainage, would continue to draw elk away from native winter ranges, thereby reducing any widespread adverse impacts caused by large numbers of wintering elk. However, adverse impacts to grassland habitat would continue within and adjacent to state feedgrounds and along major elk migration routes to these sites, with the severity of impacts varying from site to site (Kilpatrick, pers. comm. 2004). Ecological conditions in areas designated as southern slope mosaic, which includes grassland and sagebrush habitat, would continue to be within potential functioning condition. Forage production would continue to be limited in sagebrush communities due to excessive shrub cover, and grass production would continue to decline in some areas due to continued increase in the cover of conifer trees. In other words, the carrying capacity of elk winter range in the Buffalo Valley area, Gros Ventre River drainage, and slopes to the east of the refuge and park would continue to be below natural potential.

Elk and bison that migrate to the refuge would continue to make heavy use of the west and south slopes immediately east of the refuge (e.g., within about 5 miles), which could adversely impact vegetation. This area currently receives use by bison during the late summer and fall, despite bison hunting that occurs on these lands. Larger numbers of bison under Alternative 1 could increase the level of adverse impacts on adjacent national forest lands, although hunting pressure could somewhat reduce impacts.

Alternatives 2, 3, 4, and 6

In the short term, few if any changes in the condition of winter range in the national forest would be observed because elk would still be fed alfalfa pellets in above-average winters. In the long term larger numbers of elk would make greater use of native winter ranges in the national forest such as in the Buffalo Valley area, Gros Ventre River drainage, and possibly the south and southwest slopes south of the Snow King Resort (and east of U.S. 191) and the lower Hoback River drainage. However, numbers would not be expected to reach levels that would result in adverse impacts to grassland habitats. During supplemental feeding years in Alternatives 3 and 4, elk would not use native winter range extensively, because feeding would draw them down to the refuge.

Habitat improvement projects over the next 15 years in certain areas now dominated by Douglas-fir, mixed conifers, lodgepole pine, and sagebrush would result in an increase in the amount of bunchgrass-dominated habitat in areas occupied by elk during winter. These disruptions to vegetation succession would likely more than offset any adverse impacts resulting from an increase in elk use of native winter range by helping disperse elk over larger areas. The increased acreage of native grassland habitat would continue into the long term because treatments would occur on a rotational basis. Heavy use of localized areas by elk during winter and spring under some alternatives could adversely impact vegetation on these sites, but adverse impacts would be lessened by treating relatively large areas. Overall effects on native grassland habitat would be improved to some degree by elk being drawn and hazed onto state feedgrounds, which could result in an increase in adverse impacts to native grassland habitats in the vicinity of the feedgrounds and along major migration routes to these sites (Kilpatrick, pers. comm. 2004).

In the long term bunchgrass-dominated habitat on national forest lands immediately east of the refuge (e.g., within about 5 miles of the refuge) would receive more use by elk and bison. Forage on the west and south slopes immediately to the east of the refuge would remain available longer than forage on much of the southern end of the refuge due to southerly exposures and the fact that slopes enhance the ability of elk and bison to feed on standing forage.

If large numbers of elk began migrating south out of Jackson Hole under Alternatives 2, 3, and 6, and if they were not shortstopped by state feedgrounds, grazing pressure in native grassland habitats in the Pinedale and Big Piney ranger districts could increase. Most of the grazing would occur during migration periods and would therefore not substantially increase grazing pressure. In early spring, elk graze on early green-up as it is available, but spring grazing during the critical growth stage of plants is light because dispersal occurs fairly quickly, and because elk tend to move in small groups rather than large concentrations (BLM 1981). Nonetheless, it is acknowledged that some adverse impacts to grassland habitat could occur in localized areas. Some elk would likely winter in suitable winter range, which could increase the amount of residual grass cover that is removed in some areas. Some localized adverse impacts to vegetation and soils could occur.

SAGEBRUSH SHRUBLANDS

Alternatives 1 and 5

Native winter range in the Gros Ventre, Spread Creek, and Buffalo Valley drainages would not be affected any more under this alternative in the short and long terms than has been occurring under baseline conditions. Supplementally feeding elk every winter on the refuge, in combination with winter feeding on the three state feedgrounds in the Gros Ventre River drainage, would continue to draw elk away from native winter ranges, thereby maintaining a relatively low level of adverse impacts caused by large numbers of wintering elk, except adjacent to state feedgrounds. Impacts associated with feedgrounds are greatest within a few hundred yards, but can extend up to a mile depending on topography and other factors. General conditions of the dry forest openings and southern slope mosaic of the Teton Division of the forest, which includes sagebrush habitat, are within potential functioning condition (USFS 2003b). However, carrying capacity of winter range continues to be depressed by (1) more sagebrush habitat than natural (relative to the amount of grassland), (2) lowered forage production in sagebrush communities due to excessive shrub cover, and (3) continued encroachment of coniferous trees into sagebrush habitats. All of these factors are primarily a result of fire suppression.

Although elk typically do not overbrowse sagebrush, they do overutilize green rabbitbrush, antelope bitterbrush, and a variety of herbaceous plant species associated with sagebrush shrubland habitats (Kilpatrick, pers. comm. 2004). One result has been a shift in species composition and reduced plant species diversity and an increase in the density and canopy cover of sagebrush, except on and immediately adjacent to feedgrounds where heavy trampling has greatly reduced sagebrush cover.

Elk and bison that migrate to the refuge would continue to make heavy use of the west and south slopes immediately east of the refuge (e.g., within about 5 miles), which could be adversely impacting sagebrush shrubland habitat. This area currently receives use by bison during the late summer and fall, despite bison hunting on these lands. It is possible that growing numbers of bison in the Jackson herd could increase the level of adverse impacts by bison on adjacent national forest lands, although hunting pressure on these lands could help reduce impacts somewhat.

Under Alternative 5 in the long term, use of sagebrush shrubland habitat on the west and south slopes would decline compared to baseline conditions and would be even lower compared to Alternative 1.

Alternatives 2, 3, 4, and 6

In the short term few if any changes in the condition of winter range in the national forest would be observed because elk would be fed alfalfa pellets in above-average winters. However, in the long term, when supplemental forage was no longer supplied on the refuge, larger numbers of elk would make greater use of native winter

ranges in the national forest. This would likely lead to adverse impacts to vegetation only in localized areas.

Treatment of sagebrush and other habitats in the Buffalo Valley area and the Gros Ventre River drainage, and slopes immediately to the east of the refuge, would result in an initial reduction of several thousand acres of sagebrush habitat in the Teton Division of the national forest. After the period of initial treatments, sagebrush / grasslands would be rotationally treated about every 25–50 years, which could result in a lower acreage of sagebrush shrubland habitat being maintained than what has occurred in recent years, and sagebrush canopy cover would be lower (Kilpatrick, pers. comm. 2004). If large numbers of elk eventually began migrating to other wintering areas, fewer elk might winter on native winter range in the Gros Ventre River basin than under baseline conditions and Alternative 1, which could alleviate potential adverse impacts.

In the long term bunchgrass-dominated habitat on national forest lands immediately east of the refuge (e.g., within about 5 miles) would receive more use by elk and bison. There would be a moderate to major reduction in elk numbers on the refuge and a major reduction in bison numbers under Alternative 2, but with a major reduction in supplemental feeding within 15 years, there would be an increased use of areas supporting standing forage. Forage on the west and south slopes immediately to the east of the refuge would remain available longer than forage on much of the southern end of the refuge due to southerly exposures and the fact that slopes enhance the ability of elk and bison to feed on standing forage.

If large numbers of elk began migrating south out of Jackson Hole, assuming they were not short-stopped by state feedgrounds, they would likely not have detrimental effects on sagebrush communities in areas used as transitional range. Some areas in the Pinedale and Big Piney ranger districts could be used as winter range by some of these elk.

Bison numbers would be larger under Alternative 3, and this could increase adverse effects on sagebrush shrubland communities.

Somewhat lower numbers of elk using native winter range under Alternative 4 would result in fewer adverse impacts than under Alternatives 2 and 3.

Riparian and Aspen Woodlands

Alternatives 1 and 5

Available information suggests that the current level of browsing in the Gros Ventre River drainage (especially near state feedgrounds) would greatly reduce the amount of aspen habitat in Class I and II condition (see Table 4-2) in the drainage (Krebill 1972a; Bartos, Brown, and Booth 1994). This also assumes continued very low levels of fire in aspen habitat, which is another key factor. There would also be an increase in the low, shrubby growth form of aspen habitat (Kilpatrick, pers. comm. 2004). Some aspen in the Gros Ventre River drainage are in areas not used by elk during critical periods and would remain relatively unaffected.

Alternatives 2, 3, 4, and 6

In the short term, browsing rates by elk would not change appreciably in the national forest because elk would continue to be fed during most winters. As the number of days and annual frequency of winter supplemental feeding declined, more elk would begin using native winter range in the national forest, and this would continue over the long term. Without habitat treatments, larger numbers of elk using winter range in the national forest would increase the already heavy browsing pressure on willow, aspen, and cottonwoods, which could lead to more rapid declines in habitat condition and acreage in some areas.

Despite larger numbers of elk using native winter range under Alternative 2, the treatment of large acreages of conifer-encroached aspen habitat in the Buffalo Valley area and in the upper and lower Gros Ventre River drainage would result in a net improvement in the condition of aspen stands, including more acreage of aspen habitat in Class I and II condition, but only if treatments were conducted in ways that allowed a sufficient number of aspen suckers to grow beyond 10 feet tall.

If prescribed fire was used to treat conifer-encroached aspen stands, sagebrush, and other habitats, small acreages of willow and cottonwood habitat could be burned. These small-scale treatments, however, might not offset the adverse impacts of larger numbers of elk wintering in the national forest, and might actually add to the adverse impacts to willow and cottonwood habitat. Large-scale treatments could increase the quantity and quality of resprouting shrubs and offset the impacts to some willow and cottonwood communities (Kilpatrick, pers. comm. 2004).

CONIFER FORESTS

All Alternatives

Conifer forests in Bridger-Teton National Forest are not expected to be impacted or would be impacted to a negligible degree by actions being considered in this environmental impact statement.

YELLOWSTONE NATIONAL PARK

Approximately 25% of the Jackson elk herd summers in southern Yellowstone National Park south of Yellowstone and Heart lakes, west of the Yellowstone River, and east of the hydrographic divide between two branches of the Snake River. Biologists in Yellowstone National Park concluded that changes in numbers and distribution of elk that would occur as a result of actions taken in this planning process would not measurably affect the habitats in southern Yellowstone. Therefore, effects on habitats are not discussed in this analysis.

OTHER FEDERAL AND STATE LANDS

MARSHLANDS

Marshland habitats on other federal and state lands would not be affected in the short and long terms by Alternatives 2–6 any differently than they are being affected under baseline conditions and Alternative 1.

WET MEADOWS

Alternatives 1 and 5

Wet meadow habitat comprises a small proportion of the lands administered by the Bureau of Land Management in Jackson Hole, and elk would likely have little, if any effect, on these habitats compared to the effects of the Snake River, maintenance of levees, and livestock grazing. On federal and state lands in the Green River basin, minimal use of wet meadow communities by elk would continue.

Alternatives 2, 3, and 6

Elk grazing in wet meadow areas along the Snake River could increase by a minor to moderate amount compared to baseline conditions and Alternative 1 due to phasing out supplemental feeding on the refuge.

If large numbers of elk began migrating to the Green River basin and the Red Desert, grazing in riparian wet meadows on lands administered by the Bureau of Land Management could increase, resulting in less residual vegetation. In most areas increased grazing by elk would likely not be high enough to adversely impact these habitats. However, in some localized areas, wet meadow habitat could be grazed heavily enough each year to result in reduced ecological condition due to the already heavy use that some of these areas received from livestock grazing.

Alternative 4

Elk grazing could increase by a negligible to minor amount in wet meadow habitats along the Snake River in some years, compared to baseline conditions, due to reductions in supplemental feeding on the refuge.

NATIVE GRASSLANDS AND SAGEBRUSH SHRUBLANDS

Alternatives 1, 4, and 5

Alternatives 1, 4, and 5 would not result in any changes in utilization of forage by elk in native grassland and sagebrush shrubland habitats of federal and state lands in the Green River basin and the Red Desert.

Alternatives 2, 3, and 6

There would be no additional effects on native grassland and sagebrush shrubland habitats compared to baseline conditions and Alternative 1 if more elk did not migrate into the Green River basin or the Red Desert to winter or if migrating elk ended up on state feedgrounds.

If substantial numbers of elk from the Jackson elk herd unit began migrating to these areas, and if migrations were not shortstopped by state feedgrounds or cattle feedlines, grazing pressure on native grasslands and sagebrush shrublands would increase in the Green River basin and the Red Desert. Although federal and state lands in the Green River basin could accommodate more elk in some areas (Stroud, pers. comm. 2004), habitats on federal and state lands in their current condition and use levels would not be able to accommodate the numbers of elk that now winter on state feedgrounds in the Green River basin plus some of the elk now wintering on the National Elk Refuge and on state feedgrounds in the Gros Ventre River basin.

Most available forage resources on native grasslands and sagebrush shrublands on federal lands in the Green River basin and the Red Desert are already being consumed by livestock, feral horses, and native ungulates (BLM 1996b; Weymand, pers. comm. 2004). BLM range conservationists attempt to keep total utilization rates by all domestic, feral, and native herbivores lower than approximately half the annual production, although actual standards for specific areas might be somewhat different than 50%.

In addition, a major increase in the number of elk wintering on federal and state lands in the Green River basin and the Red Desert would increase the level of competition with livestock that are in grazing allotments during the winter and early spring. Given the vast acreages involved and unknown numbers and distributions of elk that might migrate to these areas, potential effects cannot be determined beyond this broad assessment at this time.

Desert Shrublands

Desert shrubland habitat only occurs in the Green River basin and the Red Desert.

Alternatives 1 and 5

These alternatives would not result in any changes in utilization of forage by elk in desert shrubland habitats on federal and state lands in the Green River basin and the Red Desert.

Alternatives 2, 3, and 6

If more elk did not migrate to the Green River basin to winter, or if migrating elk ended up on state feedgrounds, there would not be any additional effects on desert shrubland habitat compared to baseline conditions and Alternative 1.

If, on the other hand, substantial numbers of elk from the Jackson elk herd unit began migrating to these areas, and if state feedgrounds in the Green River basins were also phased out as part of a large multi-agency effort, grazing pressure in desert shrublands would likely increase in the Green River basin and the Red Desert. Many of the effects would be similar to those described above for sagebrush shrublands under "Other Federal and State Lands."

Riparian and Aspen Woodlands

Alternatives 1, 4, and 5

Alternatives 1, 4, and 5 would not result in any changes in the condition of riparian and aspen woodland habitats on federal and state lands in the Green River basin and the Red Desert compared to baseline conditions.

Alternatives 2, 3, and 6

Alternatives 2, 3, and 6 would cause few changes in the short term. In the long term, as the number of days and annual frequency of winter supplemental feeding declined on the refuge, browsing pressure could increase in cottonwood habitat along parts of the Snake River, including parcels administered by the Bureau of Land Management. This could further reduce the condition of cottonwood habitats in localized areas.

If large numbers of elk began migrating to the Green River basin and the Red Desert, browsing pressure in willow and aspen habitats on federal and state lands would likely increase. A major increase in elk numbers would further hinder the

recovery of willow habitats and continue the degradation of aspen stands that are already being affected by elk. Furthermore, it is likely that elk would begin contributing to the degradation of willow and aspen habitats in some areas not currently used by elk. In most areas, however, browsing pressure by elk would likely not be high enough to adversely impact these habitats.

Alternative 4

Alternative 4 would cause few changes in the short term. In the long term, as the number of days and annual frequency of winter supplemental feeding declined on the refuge, browsing pressure in cottonwood habitat could increase on BLM lands along the Snake River. Conversely, the major reduction in the Grand Teton National Park segment of the elk herd could limit increased browsing pressure in non-feeding years. It is possible that changes under Alternative 4 could contribute negligibly to reductions in the condition of cottonwood habitats on these lands. Alternative 4 would not change the effects that elk are having on cottonwood habitats on BLM areas in the Green River basin and the Red Desert.

CONIFER FORESTS

Alternatives 1, 4, and 5

Lands administered by the Bureau of Land Management in Jackson Hole do not contain conifer habitat, other than the encroachment of Engelmann spruce and other conifer trees into cottonwood habitat. Over the long term conifer habitat could replace cottonwood habitat in some areas. Conifer habitat on BLM lands in the Green River basin and the Red Desert would not be affected by any of the alternatives.

Alternatives 2, 3, and 6

It is not anticipated that the potential increase in elk use of cottonwood habitat on BLM lands in Jackson Hole would measurably increase the rate at which cottonwood habitat was lost over the long term (e.g., the conversion from cottonwood forests to Engelmann spruce forests). If large numbers of elk began migrating to the Green River basin and the Red Desert, greater browsing pressure could increase the rate at which some aspen forests converted into conifer forests.

PRIVATE LANDS

MARSHLANDS

Marshland habitats on private lands would not be affected in the short or long term by Alternatives 2 through 6 any differently than they are being affected under Alternative 1.

WET MEADOWS

Alternatives 1 and 5

Because wet meadow habitat on private land is associated with pastureland in many instances, moderate to heavy grazing by livestock is not uncommon; thus, vegetation height in wet meadows is reduced on many private lands. Elk contribute to the grazing pressure on wet meadows during specific times of the year, especially late fall, early winter, and spring. The level of grazing does not compare to that of livestock, but it can measurably affect vegetation height in localized areas. Elk use of wet meadows on private lands in the Green River basin would continue to be minimal.

Alternatives 2, 3, and 6

In the short term in the Jackson Hole area, few changes would be evident because most elk and bison that would winter on the refuge under Alternative 1 would continue wintering on the refuge under Alternatives 2, 3, and 6. However, after winter supplemental feeding was phased out in the long term, elk and bison could increase their use of wet meadow habitat on private lands in Buffalo Valley, the Gros Ventre River basin, in parts of Jackson Hole, and possibly the Hoback River basin compared to baseline conditions and Alternative 1.

If large numbers of elk started migrating out of Jackson Hole, grazing in riparian wet meadows on private lands could increase, with a reduction in residual vegetation. In most areas increased grazing by elk would likely not be high enough to adversely impact these habitats.

Alternative 4

Grazing of wet meadow habitats on private lands in the Jackson Hole area could increase compared to baseline conditions due to reductions in winter

supplemental feeding on the refuge. Impacts would be reduced if elk and bison were hazed off private lands, except on lands having conservation easements that specifically allow or encourage use by wintering elk or bison.

Native Grasslands and Sagebrush Shrublands

Alternatives 1 and 5

This alternative would not result in any changes in forage use by elk and bison in grassland and sagebrush shrubland habitats on private lands in Jackson Hole, the Buffalo Valley, the Gros Ventre River basin, the Hoback River basin, Green River basin, and the Red Desert. Elk and bison would continue to have negligible effects on grassland and sagebrush shrubland habitats on private lands.

Alternatives 2, 3, and 6

In the short term in Jackson Hole few changes would be evident because most elk and bison that would winter on the refuge under Alternative 1 would continue wintering on the refuge under Alternatives 2, 3, and 6. In the long term, to the extent that elk and bison found wintering areas outside the refuge after supplemental feeding was reduced, they could increase their use of native grassland and sagebrush shrubland habitats on private lands in Jackson Hole, Buffalo Valley, the Gros Ventre River basin, and possibly the Hoback River basin compared to baseline conditions and Alternative 1. This would reduce forage available to livestock, and forage utilization could be heavy in some areas. However, to the extent that future conservation easements would allow or encourage winter use by elk and/or bison, the extent of the problem could be reduced.

Similarly, if a substantial number of elk began migrating to the Green River basin and the Red Desert, native grassland and sagebrush shrubland habitats on some private lands in these areas could be affected over the long term by increased grazing pressure during fall migration and during winter and early spring, compared to baseline conditions and Alternative 1.

Alternative 4

In the short term effects would be similar to Alternative 2. In the long term, when a lower proportion of elk were migrating to the refuge for the winter season, elk and bison use of grasslands and sagebrush shrublands could increase on private lands in the Buffalo Valley, parts of Jackson Hole, and the Gros Ventre River basin. This could result in less residual grass cover and sagebrush in localized areas on private lands in Jackson Hole, although no adverse impacts to vegetation conditions or the ability to produce forage would be anticipated.

This alternative would not result in any additional impacts to native grassland habitat on private lands in the Green River basin and the Red Desert.

Desert Shrublands

Alternatives 1, 4, and 5

These alternatives would not result in any changes in utilization of forage by elk and bison in sagebrush shrubland habitats on private lands in the Green River basin and the Red Desert.

Alternative 2, 3, and 6

The potential effects of a large influx of elk into the Green River basin and the Red Desert would be similar to the potential effects on desert shrubland habitats on federal and state lands in the Green River basin and the Red Desert.

Riparian and Aspen Woodlands

Alternatives 1 and 5

Currently, the condition of willow, aspen, and cottonwood habitat in the Jackson Hole area continues to decline, and acreage of these habitats continues to decline as well. Browsing of woody riparian vegetation on private lands in the Green River basin is not occurring to any large extent under baseline conditions.

Alternatives 1 and 5 would not change the effects that elk are now having on willow, aspen, and cottonwood habitat on private lands in Buffalo Valley, the Gros Ventre River basin, Jackson Hole,

the Hoback River basin, the Green River basin, and the Red Desert. Elk might be less likely to use private lands under Alternative 5 compared to Alternative 1 due to enhanced forage production on the refuge and less competition with bison, but this at most would have negligible effects.

Alternatives 2, 3, and 6

In the short term in the Jackson Hole area, few changes would be evident in riparian and aspen woodlands because most elk and bison that would winter on the refuge under Alternative 1 would continue wintering on the refuge under Alternative 2. However, to the extent that elk and bison began wintering in areas off the refuge, they could increase their use of private lands. Increased browsing pressure in some areas could be high enough to contribute to further degradation and loss of acreage in willow, aspen, and cottonwood stands.

If large numbers of elk began migrating to the Green River basin and the Red Desert, browsing pressure in some willow, aspen, and cottonwood habitats on private lands could increase, potentially resulting in moderate to major adverse impacts in localized areas.

Alternative 4

In the short term in the Jackson Hole area, few changes would be evident because most elk and bison that would winter on the refuge under Alternative 1 would continue wintering on the refuge under Alternative 4. However, in non-feeding winters, to the extent that elk and to a more limited extent bison began wandering out from the refuge onto private lands, use of willow, aspen, and cottonwood habitat could increase on private lands compared to baseline conditions and Alternative 1. Furthermore, as fewer elk migrated to the refuge each fall and winter, use of private lands in Buffalo Valley and the Gros Ventre River basin could increase. Increased damage to woody vegetation could occur in localized areas. Alternative 4 would not change the effects that elk are having on willow, aspen, and cottonwood habitat on private lands in the Green River basin and the Red Desert.

CONIFER FORESTS

Alternatives 1 and 5

Existing conifer forests on private lands would not be affected under Alternatives 1 and 5.

Alternatives 2, 3, 4, and 6

If elk use of aspen habitat increased by a moderate to major amount on particular private lands in the Jackson Hole area and the Green River basin, the rate of loss of aspen habitat and the conversion from aspen habitat to conifer forest could increase. It is not anticipated, however, that greater elk use of cottonwood habitat on private lands in Jackson Hole would increase the rate of loss of cottonwood habitat and the conversion from cottonwood forests to Engelmann spruce forests. Any increases in elk browsing of cottonwood habitat on private lands in the Green River would likely not facilitate a conversion to coniferous forest.

AGRICULTURAL LANDS

Alternatives 1 and 5

Elk and bison would continue to have negligible or no effects on private agricultural lands in Jackson Hole, Buffalo Valley, the Gros Ventre River and Hoback River drainages, the Green River basin, and the Red Desert. Supplemental feeding operations on the National Elk Refuge and WGFD elk feedgrounds and hazing activities would continue to keep most elk on feedgrounds and would limit the number of elk venturing onto private lands. In the Green River basin the resident Steamboat elk herd east of Farson primarily inhabits federal lands, and impacts to private agricultural lands are minimal.

Alternatives 2, 3, and 6

In the short term effects of elk and bison on private agricultural lands in Jackson Hole, Buffalo Valley, the Gros Ventre River and Hoback River basins, and the Green River basin and the Red Desert would be similar to baseline conditions and Alternative 1.

In the long term, when supplemental forage was no longer provided under Alternatives 2 and 6

even in above-average and severe winters, some elk and bison would begin wandering off the refuge in search of forage, and a portion of the elk and bison populations that normally would have wintered on the refuge would instead begin wintering in other parts of Jackson Hole, the Buffalo Valley area, the Gros Ventre River basin, and possibly the Hoback River basin, the Snake River Canyon, the Wind River basin, and areas in Idaho such as Teton Valley north to areas east of Afton. Under Alternative 3 there could be fewer adverse impacts because a relatively small number of elk and potentially a large number of bison would be fed on the refuge during severe winters. Although most elk and bison would remain on federal lands during the fall, winter, and early spring, some could find their way onto private agricultural lands, resulting in adverse impacts.

The biggest concerns from the standpoint of ranchers would be competition for forage on private pastures and rangelands (both standing forage and along feedlines), increased potential for disease transmission to livestock, damage to fences, and safety (Williams, pers. comm. 2003). However, elk would likely be hazed to existing state feedgrounds or federal lands, and bison would either be hazed back toward the refuge or the park, or the Wyoming Game and Fish Department would have the prerogative to carry out special hunts or cull animals from the herd. No feedgrounds exist in Buffalo Valley, so hazing elk to feedgrounds would not be an option. To the extent that elk found their way to the Green River basin, they either would graze at one of the state feedgrounds along the perimeter of the basin or could be hazed to one of the feedgrounds.

If, however, large numbers of elk began migrating to the Green River basin and the Red Desert and were not shortstopped by state feedgrounds, competition with livestock for forage and depredation of hay and other crops on agricultural lands in the Gros Ventre River drainage, the Hoback River drainage, and the Green River basin would likely increase. Impacts could be moderate to major in localized areas, but overall effects on agricultural production throughout these drainages and basins would likely be negligible to minor.

In terms of potential effects on standing vegetation in private agricultural fields, competition with livestock for forage during the fall and early spring could be the largest effect if all feedgrounds were phased out and large numbers of elk annually migrated to the Green River basin. Increased distribution of elk would not be expected to reduce hay production or the production of any other agricultural crop, except possibly during the early spring when elk migrate back to summer ranges. In early spring, elk graze on early green-up as it is available, and this could cause damage in localized areas on private lands, especially in alfalfa fields (Bennett, pers. comm. 2004); however, elk generally move fairly quickly from wintering areas to transitional and summer range (Anderson 1958; BLM 1981; Irwin 2002), and therefore, the effects of spring grazing during the critical growth stage of plants could be light. Nonetheless, it is assumed that some adverse impacts to growing crops would likely occur in localized areas.

Over time, elk hunting would likely be adjusted, which would result in more pressure on elk on private lands during the fall and early winter. Despite adjustments to hunting regulations, it is possible that adverse impacts to agricultural lands would continue in localized areas under these alternatives over the long term. No damage to soil or the ability of private lands to produce agricultural crops would be anticipated.

Alternative 4

In the short term, effects of elk and bison on private agricultural lands in Jackson Hole, Buffalo Valley, Gros Ventre River basin, Hoback River basin, and Green River basin and the Red Desert would be similar to baseline conditions and Alternative 1.

In the long term some elk and bison could venture onto private agricultural lands in Jackson Hole and the Buffalo Valley area, the Gros Ventre River basin, and the Hoback River basin during below-average to average winters. During these winters sufficient standing forage would be available to provide for the needs of the numbers of elk and bison that would be wintering on the refuge. If, in a given winter, standing forage on the refuge was insufficient to keep mortality from rising above 5%, the Fish and Wildlife Service would provide supplemental feed.

Elk that showed up in the Gros Ventre and Hoback River basins due to declines in supplemental feeding on the refuge would likely be hazed onto state feedgrounds before they began causing damage to private lands. Bison could be either hazed or culled. Nonetheless, it is possible that adverse impacts could occur to private agricultural lands in localized areas. In the Buffalo Valley area, impacts to agricultural areas could increase even though elk would likely be hazed and harvest strategies would be adjusted to reduce specific components of the elk herd.

CUMULATIVE EFFECTS

TRANSPORTATION IMPROVEMENTS

The reconstruction of U.S. 26/287 west of Togwotee Pass would result in short-term ground disturbance of 275 acres total during construction. Habitat types that could be disturbed include willow riparian and irrigated hayfields (33.0 acres), sagebrush park and meadow (5.5 acres), cottonwood riparian, (19.2 acres), mixed forest (52.3 acres), willow riparian, sagebrush park and spruce / fir / pine mix (44.0 acres), spruce / fir (71.5 acres), aspen / lodgepole pine mix, aspen and sagebrush park (30.3 acres), and lodgepole pine / sagebrush park / willow riparian (19.2 acres). All disturbed areas not occupied by highway facilities would be promptly reclaimed, further reducing long-term impacts. Given the hundreds of thousands of acres of native habitat in the Jackson Hole area, the disturbance of 275 acres, in conjunction with the impacts of the proposed bison and elk management alternatives, would have a negligible effect on vegetation communities in the analysis area. The proposed alternatives would not contribute to the effects of the planned transportation improvements on habitat.

FEDERAL LAND MANAGEMENT ACTIVITIES

Grand Teton National Park Fire Management

Planned fire management actions could result in a reduction in some habitat types and reduced habitat quality in the short term. Prescribed fire can be used to maintain and restore more diverse vegetative communities in landscapes where natural fire regimes have been disrupted. Prescribed fires may, in the short and long terms, alter plant communities, but in the long term more vegetative diversity is created, and replicating natural fire regimes promotes plant succession. Habitat types affected by the park's fire management actions would benefit in the long term due to the restoration of natural processes.

Alternative 1, in combination with the effects of planned fire management actions, would not result in cumulative effects. Restoring 4,500 acres of agricultural lands to native vegetation under Alternatives 2–6, together with fire management activities, would result in beneficial, cumulative, long-term effects.

Grand Teton National Park Recreation Infrastructure Improvements

Potential construction of a multi-use trail extending from Moose to the north Jenny Lake junction would result in the loss of an undetermined amount of habitat along planned trail routes. The range and specific details of the improvements are unknown at this time. In addition, improvements to the Gros Ventre campground would result in site-specific, temporary habitat impacts during construction. Effects would likely be negligible because the areas already have been altered, and developed area footprints would not be significantly increased.

Alternative 1, in combination with the effects of park infrastructure improvements, would not result in cumulative effects. Converting formerly cultivated areas to native vegetation under Alternatives 2–6, combined with the impacts of infrastructure improvements, could result in negligible, short-term, adverse, cumulative impacts. In the long term restoring native vegetation on 4,500 acres of formerly cultivated lands would likely offset negative impacts of infrastructure improvements.

Bridger-Teton National Forest Fuels Management Projects

Bridger-Teton National Forest has identified 15 fuels reduction projects in the primary analysis area, and several others in the secondary analysis area in the upper Green River watershed. These projects would alter over 5,400 acres of national forest land and would reduce certain habitat types following various fuel reduction treatments. Some

habitat types, such as native grasslands, would benefit in the long term at the expense of other habitat types, such as conifer forest.

Because supplemental feeding would be reduced or eliminated under the bison and elk management alternatives considered in this environmental impact statement (Alternatives 2, 3, 6, and to a lesser extent Alternative 4), more elk could winter on native range and potentially move into these forest project areas. Treated habitats would result in more plant diversity but would also experience increased grazing and browsing. Habitat treatments in the national forest could offset to some extent the deterioration of woody vegetation on the refuge. These forest projects would not result in cumulative impacts under Alternatives 1 and 5 because elk would continue to be supplementally fed in most years on the refuge, preventing increased use of native transitional and winter range.

BLM Upper Green River Special Recreation Management Area

Actions planned in the Upper Green River Special Recreation Management Area would improve sensitive riparian vegetation zones that are now adversely affected. However, sagebrush areas would experience negative impacts as campsites, roads, and parking areas were reduced and some areas of this habitat type degraded. Cumulative impacts under all alternatives are expected to be negligible because of the small amount of acreage (16.5 acres) that would be directly impacted. None of the bison and elk management alternatives considered in this environmental impact statement would contribute measurably to these effects and would not result in cumulative effects on habitat in this area.

Pinedale Anticline Oil and Gas Exploration and Development Project

Oil and gas development activities in the Pinedale anticline project area would disturb vegetation communities due to the location of well pads, roads, pipelines, and other facilities. Standard management practices and mitigation would be implemented to protect vegetation and ensure that disturbed areas were properly restored. None of the bison and elk management alternatives considered in this environmental impact statement would contribute measurably to these effects and would not result in cumulative effects on habitat in the Pinedale anticline study area.

Jonah Infill Drilling Project

Under all action alternatives for the Jonah infill drilling project, additional well development is anticipated to result in significant impacts to vegetation due to loss of habitat, forage, and soil protection, as well as increased potential for invasive, nonnative species. Under all action alternatives specific management requirements and mitigation measures would be implemented; therefore, impacts to vegetation would depend on the effectiveness of these measures. None of the alternatives considered in this environmental impact statement for bison and elk management would contribute measurably to these effects and would not result in cumulative effects on habitat in the Jonah infill project area.

Snake River Restoration Activities

The restoration project by the U.S. Army Corps of Engineers along the Snake River would prevent further degradation of habitat and facilitate habitat recovery. Work would be confined to gravel bars or gravel channels within the river corridor, and no loss of riparian habitat is anticipated. In the long term woody riparian habitats and wetlands would benefit as natural processes were restored and these habitat types increased.

Of the alternatives considered in the bison and elk management plan, Alternatives 1 and 5 would continue supplemental feeding on the refuge in most years, alleviating any need for increased foraging by elk in Snake River riparian areas. Conversely, Alternatives 2, 3, 4, and 6 would increase elk distribution in some or all years, and the effects of increased elk grazing and browsing along the Snake River could offset to some extent the beneficial effects of improving and increasing the riparian habitat along the river.