Chapter 5—Environmental Consequences

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Snowy Plover

This chapter provides an analysis of how our management alternatives for Quivira Refuge might affect the environment. We assessed the environmental consequences of carrying out alternatives A, B, and C on the physical, biological, socioeconomic, and cultural resources of the refuge and the GPNC.

Our management actions in each alternative serve as the means for achieving our vision and goals for the refuge in response to issues raised by our managers and by the public and our partners. Because management would differ for each alternative, the environmental and social effects resulting from the implementation of each would also likely differ.

Table 4 in chapter 3, section 3.4, summarizes and compares the alternatives' actions and the associated consequences that are described below.

5.1 Analysis Methods

We evaluated effects on several levels, including whether the effects would be adverse or beneficial and whether the effects would be direct, indirect, or cumulative with other independent actions. In addition, we applied the duration of effects when estimating environmental consequences.

Direct effects are those where the effect on the resource would be immediate and the direct result of a specific action or activity. Examples of a direct effect include the effect of trail construction on vegetation along the trail or the effect of hunting on wildlife.

Indirect, or secondary, effects are those that are induced by implementation actions but that occur later in time or are farther removed from the place of action through a series of interconnected effects. Examples of indirect effects include those on down-

stream water quality from an upstream surface disturbance or the effect that recreational use along a trail may have on nearby plant communities.

A cumulative effect is defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and future action regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7).

Effects are often described in terms of their context, intensity, and duration. The duration of effects is either short term or long term. Short-term effects would persist for a period of 3–5 years and would consist primarily of temporary disturbance because of habitat restoration or facility construction and subsequent revegetation efforts. Long-term effects would last more than 5 years after project initiation and may outlast the 15-year lifespan of this CCP. Many long-term effects consist of long-term benefits to wildlife habitat resulting from our management actions.

5.2 Effects Common to All Alternatives

The following potential effects would be similar for each of the three alternatives:

- Carrying out our management direction, such as goals, objectives, and strategies, would follow the best management practices we established for the refuge.
- Our management activities and programs would avoid and reduce adverse effects on federally threatened and endangered species to the extent possible and practicable.
- Our refuge staff, contractors, researchers, and other consultants would acquire all applicable permits, such as those for future construction activities.

The sections below describe other effects that we expect to be similar for each alternative.

Regulatory Effects

As described in chapter 1 of this CCP, we must follow Federal laws, administrative orders, and policies in the development and implementation of the management actions and programs found in this document. Among these mandates are the Improvement Act, the Endangered Species Act, the Clean Water Act of 1977, and we must comply with Executive Order 11990–Protection of Wetlands and Executive Order 11988–Floodplain Management. The implementation of any of the alternatives described in this draft CCP and EA would not lead to a violation of these or other mandates. See appendix A for more information.

Environmental Justice

To comply with Executive Order 12898–Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations, none of our actions in this draft CCP and EA would disproportionately place any adverse environmental, economic, social, or health effects on minority or low-income populations. We are committed to ensuring that everyone has equal access to the Nation's fish and wildlife resources, as well as equal access to information that would enable the public to meaningfully take part in our activities and in the shaping of our policy.

Cultural Resources

All the alternatives would enhance cultural resources by protecting existing resources and extending protection to newly discovered resources. There have been limited cultural resource surveys performed on the refuge, so more surveys would be required before any new construction or excavation to fully satisfy the provisions of NEPA and other applicable acts and policies related to historic and archaeological resources. Before constructing trails or facilities, we would request a review by our Region 6 archaeologist and consultation with the Kansas State Historic Preservation Office to find any negative effects that might occur.

Geology and Soils

All alternatives would positively affect soil formation processes on the refuge. Some disturbance to surface soils and topography would occur at locations selected for: (1) administrative, maintenance, and visitor facilities; (2) the removal and eradication of invasive plant species; and (3) the restoration of native habitat.

5.3 Land Conservation Effects

This section discusses the effects of alternatives pertaining to land conservation.

Climate Change

The effects of climate change would extend beyond the boundaries of any single refuge and would therefore need large-scale, landscape-level solutions that extend beyond Quivira Refuge. Available information suggests that the restoration of soils, hydrology, and other ecosystem parts improves resilience. Our collective goal is to protect and improve resilience in ecological systems and communities so that, even as climate conditions change, the natural landscape would continue to support its full range of native biodiversity and ecological processes. Building resilience includes supporting intact, interconnected landscapes, restoring fragmented or degraded habitats, and preserving and restoring ecological processes. Climate change considerations similar for all alternatives are noted in the beginning of chapter 3.

Climate Change—Alternative A

Under our current management, there has only been a general focus on the restoration of native plant communities and aspects of species–habitat relationships relative to other proposed alternatives, thus the level of ecosystem resilience achieved under this alternative may be less than under the other alternatives.

Temperature and Precipitation Uncertainty

Translating global and continental climate change models to regional scales, such as for Kansas or the refuge, are difficult. There are still major uncertainties at the regional level, especially related to precipitation (Christensen et al. 2007), although models are getting increasingly reliable. Some robust predictions suggest that warming is likely to be most pronounced in the winter, and snow season length and snow depth have a greater than 90-percent probability of decreasing. Expected increases in temperature range from 4–9 °F in western North America during this century (Christensen et al. 2007).

Although temperature increases over the next several decades appear inevitable, the resulting effect on precipitation, moisture and wetland hydrology is highly uncertain. See the climate change section in chapter 4. Baseline checking of weather information at the refuge would continue to occur. Over the 15-year life of the plan, dramatic shifts are not expected, however, this baseline information may be useful for detecting trends across larger timeframes. The uncertainty about temperature and precipitation changes would continue to exist. We at the refuge would rely on outside entities such as USGS to help us downscale climate change models to increase the predictability of temperature and precipitation changes and to apply these predictions to our management.

Preservation of Water Rights

Monitoring water usage would help us preserve existing water rights. Regular usage of our individual water rights demonstrates beneficial use, and makes sure that the overall water amount will be available to us the future. The retention and use of these rights is important, especially if climate conditions cause a reduction of available runoff and there is greater demand for less water.

Baseline Inventory and Monitoring Programs for Natural Resources

Current management may detect and consider shifts in some plant and wildlife species distributions and conditions, but likely would not differentiate among the various factors influencing community changes. As a result, refuge-specific information used to improve our management strategies or to evaluate changes due specifically to climate factors over time is lacking.

Baseline monitoring programs for habitat conditions, weather stations, ground water levels, and river gauges would provide some ability to detect long-term trends related to climate change. These trends could include changes in vegetation composition, wetland water levels, some riverflows, and temperature. However, this information is likely to be limited in scope, site specific, and not easily related to regional or national climate change data and trends.

Working with Others

The effects of climate change are better seen, and the ability to address relative issues often seems more effective, at scales larger than the refuge. Thus we depend on our partners who work on a larger scale and who have resources allocated for climate change-related activities to help us. Our ability to proactively address climate change issues, given our

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Tiger Salamander

current engagement and our climate change-related partnerships with organizations like the GPLCC, is limited. Without greater participation by our staff, research, or conservation on the ground, is less likely to directly apply to refuge issues created by climate change.

Carbon Sequestration and Reducing the Carbon Footprint

Carbon sequestration rates vary depending on plant species, soil type, region, climate, topography and management practices that can affect plant productivity. On a local scale, carbon sequestration is largely influenced by light conditions, water availability, soil water-holding capacity and its nutrient content. Local conditions could change the frequency and severity of natural disturbances such as wildfires and strong winds, which would increase the probability of carbon dioxide emissions and, hence, carbon loss from these systems. In general, the protection and restoration of grassland and wetlands under alternative A would benefit carbon sequestration on the refuge. The largest gains in carbon sequestration could occur if cropland is restored to grassland or drained wetlands are restored (Bangsund et al 2005).

Some efforts toward reducing the footprint of facilities would occur. The reduction is likely to be modest and not well quantified.

Staff Time and Management Costs

Besides periodic reviews of information and measures already considered for refuge management, no more costs would be needed that are specifically associated with climate change monitoring programs and research. No major deviations would be made with our existing staff. By carrying out some green innovations, expenses for things like electricity; fuel, both gasoline and diesel; and propane may decrease.

Climate Change—Alternative B (Proposed Action)

Effects would be the same as under alternative A, except that it would be more likely that our refuge management would be improved to address shifts in species distributions or other community changes involving species–habitat relationships largely because of the refined focus on the habitat needs of focal species. Also, alternative B would offer more inventorying and monitoring activities that would allow greater detection of community changes as related to focal species and refuge goals and objectives. A major difference between alternative B and C is the control of water management on different areas of the refuge. Under alternative B, there may be more management options to support different species and habitat types over time.

Climate Change—Alternative C

Effects would be the same as under alternative A, except that a shift in management focus may result in more support for ecosystem resilience. However, there is some uncertainty in our ability to address shifts in species distribution and community changes partly because of unknowns about watershed management, how restoration activities might affect our management control and constraints, and what monitoring programs would be conducted to detect changes. This alternative, with relatively more constraints in water management, may be viewed as being more tolerant, or accepting, of a “new normal”

if climate change leads to substantial community shifts. Management may not be in a position to resist, or prolong, community changes on areas of the refuge over time relative to the other alternatives.

Land Protection—Alternative A

The following affect land protection activities under alternative A.

No Expansion of the Refuge Boundary

Our management would not have the added responsibilities that come with owning more land, so positive effects would be expected. Also, private landowners would not have unnecessary concerns about our expansion activities. Positive and negative effects would likely be associated with our acceptance of private landowner interests and the management of lands surrounding the refuge.

Promote Conservation on Private Lands

There are various private land conservation programs specifically paid for, organized, and focused to work with landowners to improve the conservation of natural resources while supporting different private landowner interests. Our refuge management has a common interest in conserving natural resources and acknowledges that success at a landscape level or on larger scales cannot be achieved without the support of private land managers, as shown in State of the Birds reports.

A potential negative effect is the risk that our refuge management would promote landscape programs when, in some cases, resulting land management on private lands may conflict with, or adversely affect, the achievement of refuge objectives. For example, private land initiatives that support the planting of tree rows for certain wildlife species conservation would contradict refuge goals and objectives for other species, especially if these activities were to occur next to large tracts of open habitat on the refuge.

Stay Current with Landscape-scale Activities

This would be beneficial for various reasons, such as having the necessary knowledge of landscape changes or developments to reevaluate the refuge's role in the landscape; to help interpret changes observed, or measured, on the refuge; to keep, or improve, interactions with the public and our neighbors; to keep, or improve, the relevancy of land management in educational programs; and to promote efficiency. We would continue to work with the GPLCC and keep up with their priorities.

Reduce Natural Resource Threats Related to Oil and Gas Activities

Oil and gas activities on refuge lands create added threats to natural resources by changing surface lands, development of infrastructure with risk of oil or poor-quality water leaks and spills, laying underground pipelines in our saline environment, introducing and spreading invasive species, and possibly incurring mismanagement or violations. All of these threats have occurred on refuge lands many times, yet, fortunately, none have had well-documented, long-term negative effects. We are increasingly concerned about the age and integrity of oil pipelines and equipment, especially those that exist in the most saline environments. Most of the active oil wells are located in and around the BSM area that is used by many waterbirds, including endangered whooping cranes and interior least terns. These species are largely responsible for the refuge's designation as an Important Bird Area and Ramsar wetland. In addition, we have concerns about how oil pumping noise interferes with the social behavior of birds and their ability to communicate, especially during the breeding season. For all of these reasons, we would seek to reclaim mineral rights, which would help resources.

Limiting and gradually eliminating oil wells and their associated activities would be a benefit to our visitors who generally do not expect, and frequently question, oil-related activities on the refuge. Most oil wells have reached the end of their useful lives, especially over the past 4 years, as 6 wells have been pulled and plugged in that time. There would be reduced economic activity on the refuge, which may affect the local economy.

Land Protection—Alternative B (Proposed Action)

Effects would be the same as under alternative A, but this alternative would embrace new opportunities that have emerged to increase protection, such as the creation of a new, Partners focus area surrounding the refuge and addressing the increasing threats of conservation on a landscape scale. Also, with the various interests related to conservation initiatives, there would be an increasing need to set priorities

for, and work collaboratively on, common concerns to improve the effectiveness of our management. As such, benefits could increase.

Land Protection—Alternative C

Effects would be the same as under alternative B, except that this alternative would emphasize restoring ecological processes, and would rank those areas that would most benefit. A secondary emphasis would be placed on providing resources for focal resources. These activities would be expected to increase benefits.

5.4 Native Ecological Community Conservation Effects

This section discusses the effects of alternatives pertaining to native ecological community conservation.

Big Salt Marsh—Alternative A

Fluctuations in water level and water quality, such as salinity, would occur, and the use of Rattlesnake Creek water would be limited. Some view this management philosophy as positive, as long as long-term variability is kept within a "natural" range where levels are not toxic to wildlife. Managing dynamic fluctuations in water conditions promotes nutrient cycling and wetland productivity. By allowing periodic drying of the marsh, carp are controlled, which improves water quality and sunlight penetration through the water column and reduces competition for invertebrate resources used by migratory birds. Restricting Rattlesnake Creek water from entering the BSM in most years would help restore the natural salinity to the marsh over time, which would also limit growth of emergent cattail and Phragmites that are less tolerant of high salinities. Also, promoting natural marsh cycles would provide opportunities to educate the public about inland salt-marsh systems.

Some may view this management philosophy as suboptimal at times in the marsh cycle when conditions are bad for viewing an abundance of birds and bird species in that area. In general, we would support many birds, but there are times when we would support less, such as when the marsh is mostly dry. With seasonal declines in water levels in the late spring and summer, there is increasing interspersion of shallow water–mudflat habitat that helps shorebirds during migration. But, water may not be available in some years for the waterfowl migration in September and October. However, in 2011, thousands of sandhill cranes used the dry marsh bed for roosting in October and November before the ground water flow started.

Whooping crane use of the BSM during the fall migration may be affected because of a reduced area of water during that time, although in one of the driest years in recent history, 2011, whooping cranes still used the BSM area in November. With generally lower water levels and declining levels during the summer, interior least terns and western snowy plovers are expected to use the salt flats on the edges of the BSM more for nesting, than when the marsh is kept full. Nesting on wide open salt flats generally increases nesting success partly because of the difficulty of predators finding nests. But, these same nests are subject to loss because of occasional flooding because of large rainfall events during the nesting season.

There would be no major changes to infrastructure in the BSM except to support levees and water control structures in the saline environment and to support or improve natural ground water flow. Public access would continue to be allowed via the Wildlife Drive.

The North Lake and Salt Flats areas, which are popular for hunting, were not flooded by the opening of the season in November 2010, 2011, and 2012 and these areas may not flood up until December in some years. With declining ground water levels, this may occur later and later over time, which would reduce hunting opportunities.

We would continue with prescribed fire and grazing on the margins of the BSM, in the meadows and uplands surrounding the marsh. Burning will prevent woody vegetation encroachment, recycle nutrients, prevent litter buildup and keep conditions in, or shift them to, an early successional stage. Prescriptions for burning and grazing would be to restore the native plant community.

Saltcedar will not be affected by increased salinities and may increase, with new seedling establishment annually, as water levels decline in the summer. Herbicides can control saltcedar if needed, and new establishments would need to be checked annually.

Big Salt Marsh—Alternative B (Proposed Action)

Under this alternative, we would have more opportunities to improve natural hydrology, with a higher probability of helping focal resources. Periodic drying of the marsh would allow wind to naturally scour basins, an important process for improved productivity. Hunting opportunities would change under alternative B, refer to the hunting section of this chapter.

Changes would include possibly altering the hunting boundary, eliminating hunting in portions of the BSM area, and opening other areas in created wetlands.

Big Salt Marsh—Alternative C

Under this alternative, we would have opportunities to improve natural hydrology, but there would, potentially, be fewer benefits to focal resources in some years. This alternative may improve system resiliency if more natural conditions were achieved, but much is unknown about future watershed management and the availability of water.

This alternative would likely provide less water and hunting for waterfowl early in the season, as natural hydrology would determine water levels.

Little Salt Marsh—Alternative A

Water management would continue and water control structures would be supported and replaced when needed. The LSM would continue to decline in storage capacity with sedimentation. There would be no waterfowl hunting. Public uses for wildlife observation and photography would continue.

The marsh is essential for holding water to flood all the created wetlands on the refuge, and, although it is losing capacity through sedimentation, it is still important and can be the last source of water for wildlife in a drought. Furthermore, the LSM is becoming fresher. Its salt is slowly being diluted because it is managed as a flow-through marsh and not as an overflow sump, as it was historically.

The marsh is attractive to many migratory birds, primarily for roosting and for some foraging if water levels are held low in the spring and fall. Endangered whooping cranes often use the mudflat–shallow water zones when they are available. Interior least terns nested successfully on the Rattlesnake Creek delta in 2011, and, with lower water levels and the control of invasive species, terns may continue to use the marsh for nesting.

The LSM is a popular wildlife viewing area with enhancements such as the observation tower, photo blind and adjacent hiking trail.

Carp infestation is a recurring problem because it is connected to the creek. High carp populations are associated with high water turbidity, low wetland productivity, sedimentation, and an increasing coverage of invasive Phragmites and cattail. Cattails would continue to dominate the shoreline of the marsh, as water levels are kept relatively stable during most of the year and salinities continue to decline. Phragmites and saltcedar will also continue to expand.

It is the most popular fishing location and has an accessible fishing pier. Fishing would continue but would be a low quality public use, as carp continue to dominate the fishery and Phragmites and cattail affect the accessibility to shorelines.

Little Salt Marsh—Alternative B (Proposed Action)

Effects would be similar to alternative A, except that the benefits to focal resources may increase slightly. We would attempt to restore saltgrass habitat on the shoreline and islands following the active management of emergent vegetation.

Deer, turkey and furbearer hunting would potentially occur in the uplands and meadows around the LSM, but would be subject to closure when whooping cranes use the marsh.

Little Salt Marsh—Alternative C

Effects would be similar to alternative B, except that this alternative would encourage natural conditions to the extent possible to promote long-term system resiliency at a time of uncertainty about climate change. At least in the short term, this alternative would make less water available for fall flooding, but it is possible that less would be needed as created wetlands would also be altered. The periods of highest flooding would occur after rainfall events in the spring, followed by drying in the summer and fall, which would still provide roosting habitat for whooping cranes in the early spring and fall. Nesting by interior least terns would not increase, but would be occasional if habitat conditions are favorable.

Riparian Corridor—Alternative A

The Riparian Corridor would continue to contain and transport nonnative, invasive species, such as Phragmites, saltcedar, Russian olive, and carp. We would continue to control these invasive species, including using chemical, mechanical, and prescribed fire treatments on saltcedar.

Benefits to wildlife here are ancillary. Salt Creek provides saline habitat for plains killifish, a major source of food for interior least terns. In years when water levels are low and shoreline and beach habitat is available along the Rattlesnake Creek, interior least terns have been observed using the riparian corridor for breeding activities. We would allow some plums and shrubs of various sizes and structure within the riparian corridor because certain birds and wildlife, such as Bell's vireo, prefer cover close to stream habitat.

Our management in the next 15 years would reduce woody vegetation within the riparian corridor overall largely because presettlement vegetation of prairie streams was predominantly grassy with relatively frequent fires and grazing, and grassy riparian streams function differently from those with predominantly woody vegetation (Lyons et al. 2000).

We would support processes of bank erosion that are within an acceptable range, but discourage excessive streambank damage resulting from long-term use by cattle. Cattle are not fenced out of riparian zones but are allowed to graze those areas along with the adjacent habitats. Removing invasive trees along the riparian corridor would discourage cattle from congregating in those areas and causing damage by resting under trees for shade.

Riparian Corridor—Alternative B (Proposed Action)

Effects would be the same as under alterative A, except that we would emphasize restoring native plant communities and the structure needed to support focal resources. Some more isolated areas, such as Dead Horse Slough, might be considered for the reintroduction of fish species of concern.

Riparian Corridor—Alternative C

Effects would be the same as under alterative B, except that we would evaluate current infrastructure related to the management of created wetlands and remove, or change, those features that are deemed to be nonessential or obstructions to natural hydrologic flow paths. We would also evaluate more diversion points as a strategy to better mimic natural hydrologic patterns in sloughs and in Rattlesnake Creek to restore natural hydrology and processes in certain areas to support the long-term sustainability of native communities. We presume that native wildlife would benefit from these actions.

Created Wetlands—Alternative A

There are many positive effects to managing the created wetlands as moist-soil producing, or seasonal, wetlands (Cross and Vohs 1988, Fredrickson and Taylor 1992, Laubhan and Fredrickson 1997, Laubhan and Roelle 2001, Laubhan et al. 2012). Among the primary advantages is the high productivity sustained with periodic drying and flooding of these systems (Mitsch and Gosselink 2003). Without actively managing these wetlands, it is likely that the extent and quality of seasonally flooded wetland resources would be substantially less in most years. Wildlife benefit from a high diversity of habitats here (for example, Skagen and Knopf 1993 and 1994, Hands 2008). Whooping cranes have been observed recently in some created wetlands where cattails have been removed and where newly flooded shallow habitat is created in the spring for example, official reports of whooping crane observations by refuge staff and the public submitted to Nebraska Ecological Services office). Western snowy plovers have recently begun to use some created wetlands after drawdowns in the spring for nesting and brood rearing (personal observation by refuge staff). It is evident that current refuge management has been and would continue to be successful in conserving biological communities at some level.

The refuge is still comprised of many habitat types that have different plant compositions of various heights and densities, have moisture conditions that collectively attract many species, and support threatened and endangered wildlife. But, we do not know how well we have done to support resources of highest concern. This is partly because there have been few feedback mechanisms built into the planning process for the purposeful consideration of how we could manage biological factors differently to achieve greater success. Relevant knowledge of some environmental factors and interactions on Quivira Refuge, such as soils, invertebrates, and the changes in certain water quality characteristics, are lacking, and information on the status and management of inland, nontidal, brackish-to-saline wetland systems in the United States is insufficient. A planning pro-

cess that more efficiently informs us could positively influence the predictability and long-term success of our implementation strategies.

The social and economic effects of managing created wetlands could be great because of the growing interest in refuge resources by nonconsumptive users (personal observation by refuge staff), such as birders who are attracted to the large amount of shorebirds migrating through here in the spring and by waterfowl hunters who want quality habitat that attracts and holds birds in the area. Many of the created wetlands are in the hunting areas, and hunters start using those areas in September for the early teal season and continue to hunt through the end of January, the end of the regular duck and goose hunting seasons. Closing all refuge hunting areas when whooping cranes are present has created substantial conflict in recent years.

See cultural resources effects under alternative C for more information.

Created Wetlands—Alternative B (Proposed Action)

Under this alternative: (1) we would more likely maximize support for focal resources; and (2) we would support and possibly improve the control of hydrology within refuge boundaries. This may increase the long-term probability of sustaining native communities that occurred presettlement, partly depending on watershed conditions. Because of management refinements and with more fully developed biological knowledge, we would more likely achieve greater success in conserving those resources of highest concern. For example, if we were to regularly integrate information on the detection of community thresholds, such as when salinities or nutrients exceed a normal range for an extended period of time, we may be more successful in managing for the long-term sustainability of focal resources and its associated cost. We would likely require more time collecting, synthesizing, and assessing information within a continual planning process. We may improve the conservation of many wetland-dependent resources of concern at State, regional, and national levels, such as whooping cranes, rails, northern pintails, and various shorebirds.

Rachel Laubhan/USFWS

Muskrat

Under alternative B, we would consider closing only hunting areas that are near those being used by whooping cranes. We also propose changing the locations of areas open to different hunting seasons in part to decrease conflicts. Birders and hunters both increasingly affect the economics of the area, as both out-of-state and local users spend money in the local economy because of Quivira Refuge's resources.

See cultural resources effects under alternative C for more information.

Created Wetlands—Alternative C

The greatest risk associated with this alternative is having less control over hydrology within refuge boundaries and relying increasingly on watershed conditions to achieve the refuge's purposes, goals, and objectives at a time when water quantity and quality are of increasing concern. Proposed restoration evaluation would consider larger, landscape changes and the constraints of our refuge management. The full restoration of wetland systems after human modification is never assured, and the limitations of chosen performance criteria has created uncertainty when assessing the success of past wetland restorations (Matthews and Endress 2008, Moreno-Mateos et al. 2012). Success criteria used before to measure wetland restorations include: species population response, sediment or nutrient load reduction or stabilization, the creation of a more natural-looking environment, and plant community characteristics. These could also be considered potential effects to future restoration.

With less water control, the availability and reliability of required resources for many species might be more dynamic within, and among, years. At the same time, a more careful evaluation of restoration possibilities may reveal a new biological potential for refuge lands—a shift in communities compared to what occurred presettlement or since. Still, environmental conditions may still be healthy, productive, and diverse. And these new conditions may, or may not, be more adaptable to the long-term trends associated with climate change (Erwin 2009). If less water were to be impounded and more temporally to seasonally flooded habitat replaces more permanently flooded habitat, then species associated with those habitat types would shift accordingly. For example, this change in conditions likely would favor many shorebird species and result in less use by some diving waterfowl species.

Social and economic effects would primarily affect hunting opportunities and the number of hunters because there may be fewer wetlands that attract waterfowl. There would be fewer areas to hunt, especially if our future management involves bison. It is likely that waterfowl using the refuge might be reduced in areas without water management capabilities, especially early in the fall, assuming that most wetlands would be dry until late November. Most early fall wetland habitat would be confined to the LSM, which would remain closed to hunting. If wetland resources are more limited and hold fewer waterbirds, then we would expect that wildlife observation-related activities would decrease as well. This would have a negative effect on both the social interactions and the economics of the local area.

Costs associated with the restoration and management of created wetlands under alternative C would be substantially increased in the short term, such as if infrastructure changes are required, and would likely decrease in the long term. But, much depends on the results of the evaluation of restoration potential. Time and costs associated with controlling invasive species, such as saltcedar, could possibly increase.

Effects to cultural and historic resources within created wetlands are greater under this alternative because wetland developments would be reevaluated and would likely be removed, or breached, and the wetlands would be returned to their natural communities as much as is practical. Wetland developments affecting cultural and historic resources span decades and were largely the result of the original refuge master plan. And many waterfowl hunting clubs used the refuge before its establishment. Now, we would seek to alter our infrastructure to achieve a more natural state of environmental conditions.

Freshwater Springs—Alternative A

There is limited knowledge of the functions and wildlife values of the freshwater springs area. The springs are most recognized for supporting a State-threatened Arkansas darter population, and they are a source of fresh water in an area of predominantly brackish to saline water. Fresh water can be important for wildlife not adapted to saline conditions. Also, the occurrence of environmental conditions ranging from fresh to saline may contribute to a greater diversity potential within that area of the refuge. However, recent questions exist about current conditions and management of springs. Exotic, invasive woody vegetation in the area has been increasing, and some relatively larger ponds in the area support green sunfish and possibly other predatory fish that may adversely affect Arkansas darter populations. There would be a reduction of woody

vegetation in the area of the springs and water cress and other nonnative aquatic plants would be controlled.

A beaver downed a tree in 2011, causing the enlargement of area surface water in the immediate vicinity of the spring. This may increase predator fish. There would be reduced coverage of exotic, invasive trees, such as Russian olive. This may improve the availability or quantity of water in the area of the springs. But, the existing pipe at the Boiling Springs would remain. Effects would be largely unknown, and, thus, the full habitat potential of the area may not be realized. Water quality would continue to be checked. We would evaluate the habitat to conserve fish communities, but our actions would be limited.

Tourism groups have been curious about the Boiling Springs area, but we presume that their interest has mostly been about the potential availability of hot springs for their use. But, the Boiling Springs are not hot springs, and increased visitor use would increase threats to its conservation. The area is not closed to public use, but, if use were to increase dramatically, we would consider closing it.

There are no known or anticipated economic or social effects attributed to the springs.

Freshwater Springs—Alternative B (Proposed Action)

Effects would be the same as under alternative A, except that our focus would shift to supporting native plant communities, largely through support of focal resources. Spring and Arkansas darter habitat conditions would be better protected and enhanced under this alternative. Management plans, implementation, and monitoring programs would be refined to more purposefully increase benefits to focal resources. If results of an evaluation suggest we remove the pipe or make a proper modification to the "enhanced ponds" in the area of the Boiling Springs, then we may improve the availability and sustainability of water and spring habitat conditions. Evaluations, however, may also encourage us to continue our current management.

Freshwater Springs—Alternative C

Effects would be the same as under alternative B, except that our focus would be on restoring natural ecological conditions. Results may, or may not, support focal resources besides spring and threatened and endangered species habitat, such as that of the Arkansas darter.

Meadow—Alternative A

While often considered part of upland or wetland habitats, meadow is a unique habitat type that occurs in a transitional zone between other upland and wetland communities. As such, changes in refuge surface and ground water hydrology likely have various effects on meadow, and many of these may not even be known. Obvious changes resulting from existing infrastructure, such as roads and dikes, and from the management of water mostly include shifts in vegetation composition or complete habitat conversions. For example, in areas where impoundments were built and managed to hold increased coverage and deeper water for longer periods, some meadow habitat has been replaced by cattail, Phragmites, or other tall, emergent vegetation that favors, or tolerates, those environmental conditions. At the same time, under these conditions, some upland prairie areas were converted to meadow or wetland communities. In certain areas, reduced levels in the ground water table and changes in surface runoff may have caused conversions from meadow to upland communities, such as tallgrass prairie. To more carefully consider habitat conversions that have occurred on the refuge, partly as a result of current management, past and present cover types were broadly compared on refuge lands (figures 11 and 12).

At the refuge scale, meadow provides a wide range of habitat conditions that support diverse and abundant wildlife communities. For example, saltgrass generally provides habitat that is short in height with density that ranges from sparse to dense that, collectively, are used by many waterbirds for foraging, nesting, and protective cover. Other meadow habitat, such as that occupied by sedges, rushes, and prairie cordgrass, provides relatively taller habitat used by wildlife that require, or prefer, those conditions, such as black rail or bobolink. With dynamic hydrologic conditions, meadow habitat is characteristically productive, and essential for supporting bird, invertebrate, amphibian, reptile, and small mammal communities. As such, we would have many variable effects if we were to alter conditions to favor certain species over others.

We have little control over many of the hydrologic conditions that drive changes in meadow, such as runoff from nearby private lands and reductions in ground water levels at the watershed scale. As a result, some future effects cannot be known.

We would prevent the extensive coverage of dense litter over long periods of time, but would allow rest periods for the subsequent use of habitat by wildlife following individual, or combined, flooding and drying, grazing, burning, and mechanical treatments. It is likely that measures would not be as specifically tied to species needs as would be under alternative B. The restoration of sheet flow or other past alterations would be minimal to none, thus the effects of alternative A would include existing infrastructure that limits the full biological potential of meadow in supporting native communities.

Meadow—Alternative B (Proposed Action)

Effects would be the same as under alternative A, except that the support of focal resources would be improved. Also, alternative B would likely form an improved awareness of the connectedness of different habitats and species relationships. This might be especially true with the meadow community because it is a highly transitional habitat type.

Meadow—Alternative C

A positive effect would be the restoration of natural processes and native vegetation characteristic of meadow in this region. For meadow, restoration of sheet flow and its effects on ground water levels might be especially influential to community changes. For example, if flooding depth, frequency, and duration are decreased among years in areas that are now open water or tall emergent, then these areas may be replaced by meadow. If flooding depth, frequency, and duration are increased among years, or ground water levels increase in areas that are now upland, especially in lower elevations, then these areas may be replaced by meadow. Of course, we would have little control over watershed management, which would greatly influence potential outcomes.

Effects on the meadow community would need to be considered for bison reintroduction or for patch burn grazing.

Woodland—Alternative A

Most shelterbelts, tree groves, and riparian woodland on the refuge are not dominated by native trees and are the result of tree plantings as land claims and other projects that occurred decades ago. At the time those decisions were made, differences existed in the conditions of prairie and riparian communities, grassland bird trends, and threats to conservation. Therefore, to be more consistent with presettlement conditions, we would allow only a few, select tree groves to remain on the refuge as part of woodland.

The abundance and, possibly, the richness of wildlife associated with woodland would be reduced from current levels. However, the abundance and, possibly, the richness of wildlife associated with open prairie habitat would increase over current levels. Allowing woodland to remain on the landscape would be based on an evaluation of variables and species–habitat trade-offs to sustain native sand prairie communities and to address other conservation concerns or threats. For example, we may allow the continued existence of woodland to support colonial nesting or species of conservation concern, especially if it occurs nears the refuge boundary where wooded areas occur on private land and if benefits to prairie species that prefer open habitat were found to be little to none if the trees were removed.

We do not plan to cut trees in the Migrants Mile in the near future, other than to thin and clean the stand. Reduced woodland in the riparian corridor would generally involve saltcedar control. With increased access during drought conditions, the cut-

Barry Jones/USFWS

Soapweed Yucca

ting of exotic, invasive species such as Russian olive and saltcedar in created wetlands and riparian corridor habitats would be a priority. Control of these species would also support improved soil and water conservation. Various types of woodland habitat are available and increasing at the regional and landscape scales outside refuge boundaries. See the sand prairie complex and wildlife sections in this chapter for more information about community effects.

We would expect mixed reactions on the cutting of trees. For example, birdwatchers that are interested in spotting the most bird species in the shortest amount of time would be disappointed in the effects, while those most interested in the conservation of declining endemic grassland birds would be pleased, and hunters likely would have mixed opinions. There would be no effect to waterfowl hunters. Most who visited to the refuge in recent years, however, came to see lots of waterfowl, shorebirds, and sandhill cranes or to view the endangered whooping crane. Woodland does not help these species or the observation of these species. We would likely need to increase awareness of the "wildlife first" mission of the Refuge System, and of the roles and responsibilities of the refuge to conserve species and reduce threats on various spatial scales.

Our costs would increase in the short term as woodland is reduced and proper habitat is restored. But, subsequent costs would decrease partly because of a reduction in resources spent to control woody encroachment and invasive species. Costs related to water use and availability would improve with substantial reductions in tree cover, especially saltcedar along the riparian corridor.

The reduction of trees and shrubs would create communities that are closer to what occurred in presettlement times. To accomplish this, several tree claims and shelterbelts planted around historical residence areas would likely be removed.

Woodland—Alternative B (Proposed Action)

Effects would be the same as under alternative A, except that we would emphasize developing prescriptions that would increase benefits for focal species.

Woodland—Alternative C

Effects would be the same as under alternative A, except that we would allow few isolated trees and no tree groves on the refuge except for those more naturally occurring native species that are associated with riparian areas or springs to reach conditions that are more like those during presettlement times.

Sand Prairie Complex—Alternative A

Tree and shrub encroachment affects the remaining tracts of sand prairie within the Great Bend Lowlands and on lands surrounding the refuge. Therefore, successfully reducing woody vegetation would promote unique and essential habitat conditions at various scales and would create communities closer to those of presettlement times.

Among the effects of woody vegetation spreading into prairie grassland, there are many important species–habitat relationships to consider, including those involving migratory birds. Declining trends of grassland bird populations are of serious conservation concern (Sauer et al. 2008), and it has been suggested that even large grassland tracts remaining in Kansas and Oklahoma that are largely part of an agricultural landscape may not support regional populations (With et al. 2008). While individual reports vary, research of woody vegetation in grassland generally finds negative effects on grassland birds (Bakker 2003; Coppedge et al. 2001, 2004; Chapman et al 2004; Grant et al. 2004, Coppedge et al. 2008). While there are several management and environmental conditions that influence woody plant dominance, such as plant adaptations and competition, fire and grazing regimes or prescriptions, and climate (Fuhlendorf 1999, Ratajczak et al. 2011), our refuge planning considers such factors in refining strategies to accomplish related objectives.

Many endemic or obligate grassland birds avoid areas with, or near, trees; incur lower densities or the probability of occurrence and nest success where trees are present; and suffer increased predation and parasitism in treed areas. Factors related to bird use of habitat in the landscape are complex and birds' responses to them are variable (Ribic et al. 2009). But, managing for larger tracts of open prairie seems a responsible action considering available information and the purpose of the refuge. In a recent literature review, it was shown that half of the 32 species of temperate, obligate grassland birds of North America have area sensitivity, "defined as a positive relationship between probability of occurrence of species or species density and [habitat or patch] area" (Ribic et al. 2009). Many birds included in this review occur on Quivira Refuge during the breeding season, such as northern harrier, upland sandpiper, grasshopper

sparrow, dickcissel, bobolink, and eastern and western meadowlarks. At the same time, it is important to remember the connectivity among habitats on the refuge and in the landscape. For example, Coppedge et al. (2008) showed that distance to ponds, creeks, and roads had both positive and negative effects on grassland bird abundance, which varied among species.

Other literature has shown the influence of trees in the landscape on waterbird annual life events and their use of habitat (Naugle et al. 1999). One study found substantial declines in duck nesting success when Russian olive trees were abundant at a landscape scale (Gazda et al. 2002).

Increasing coverage of shrubs in grasslands has similar effects as described above with trees, but some reports are noted that specifically discuss the effects of shrub cover on grassland birds. In the Flint Hills of Kansas, daily nest survival of grassland songbirds decreased with increasing shrub cover partly attributed to higher rates of predation, and occurrence of successful nests was associated with tallgrass and forbs but reduced shrub cover (Klug et al. 2010). In mixed grassland, probability of occurrence of 11 of 15 breeding grassland birds decreased with increases in coverage of trees, tall shrub, or brush (Grant et al. 2004). Studies in Oklahoma are some of the only reports describing bird–plum habitat relationships that may be used to evaluate tradeoffs of shrub management and guide decisions (Dunkin and Guthery 2009). While there are several management and environmental conditions that influence woody plant dominance, such as plant adaptations and competition, fire and grazing regimes or prescriptions, and climate (Fuhlendorf 1999, Ratajczak et al. 2011), refuge planning considers such factors in refining strategies to accomplish related objectives.

Besides the effects to migratory birds, other plants are affected by the increased woody vegetation. Cheatgrass thrives under scattered trees, tree rows and plum shrub habitat. Areas around, and under, almost all trees have a cheatgrass understory instead of native grasses, and cattle affect those areas by resting and congregating under trees for shade. Sand plum stands with a cheatgrass understory become largely impervious to fire because of the cool-season nature of cheatgrass. In the spring, hot prescribed fires burn around plum stands. Later, when the plum buds and leafs out, plum stands become even more resistant to fire. Native grasses appear to outcompete cheatgrass once the overstory and heavy cattle effects are taken away with the removal of trees or by mowing sand plum and other tall shrubs.

The successful, long-term management of the sand prairie complex under alternative A would result in sustaining open, native sand prairie communities dominated by short-to-medium, and medium-to-tall, warm-season grasses and reduced woody and invasive plant species coverage. Under alternative A, we would focus on supporting diverse, native communities in a more general sense relative to alternative B, and there would be various tradeoffs related to plant and wildlife community composition and structure. Because we would not consider certain focal resources at a finer scale, a wider range of habitat conditions and use by wildlife might be acceptable. This may support a higher diversity and abundance of wildlife overall at the refuge scale, but the needs of focal resources of management concern (table 3) may not be entirely satisfied. At the same time, other species not now considered of highest conservation concern, such as deer, likely would benefit more from alternative A, when compared to alternative B.

With a reduction of trees and shrubs, the abundance and, possibly, the richness of wildlife associated with those habitat types would be reduced, and the abundance and, possibly, the richness of wildlife associated with open prairie habitat would increase. We would expect mixed reactions on the cutting of trees. For example, birdwatchers who are interested in spotting the most bird species in the shortest amount of time would be disappointed in the effects, while those most interested in the conservation of declining endemic grassland birds would be pleased, and hunters likely would have mixed opinions.

Changes in the water table will likely have some effects on communities, such as shifts in species composition (Castelli et al. 2000, Henszey et al. 2004, Hammersmark et al. 2009), but both changes and consequences are unknown and likely would be largely influenced by watershed management.

Sand Prairie Complex—Alternative B (Proposed Action)

Effects would be the same as under alternative A, except that the habitat needs of focal resources would largely guide our management of plant community composition and structure on the refuge. Management prescriptions and priorities would be specific to accomplish the particular habitat needs of those species, such as providing stands of habitat of a certain size, shape, height, and density, within a specified distance to water or another habitat type. Species that are of conservation concern and have been a lesser priority of recent management would benefit, such as Bell's vireo or upland sandpiper.

Because focal resources collectively require a wide range and diversity of vegetation structure and composition, refuge habitat would support many, different wildlife with needs that are not specifically used in management decisionmaking. It is unknown if, and how, the costs of conducting management treatments would differ from alternative A, but these costs would be less than those associated with alternative C. On the other hand, more specific monitoring measures and subsequent feedback would be involved with alternatives B and C, when compared to A, to measure progress and to provide management recommendations.

The time required for monitoring programs and management planning would increase slightly.

Largely because of uncertainties related to future water availability and conditions, it is difficult to predict if alternatives B or C would create communities that are closer to what occurred in presettlement times.

Sand Prairie Complex—Alternative C

Effects would be the same as under alternatives A and B, except that, as a result of managing to restore natural functions and communities to the extent possible, community composition and structure would likely change more from alternative A than it would under alternative B.

When considering bison to replace cattle grazing as a management tool, substantial effects to communities would be expected. However, changes may be caused more by the removal of fences and the use of fire to influence the distribution and intensity of grazing rather than because of differences between these herbivores (Towne et al. 2005). After 10 years of grazing in Kansas tallgrass prairie, plant communities grazed by bison and cattle were 85 percent similar based on a comparison of parts measured (Towne et al. 2005). Mixed reactions would be expected from different interest groups if bison were reintroduced and areas were closed to the public for safety reasons.

In evaluating the use of bison, management would need to consider the following changes and associated costs: adding boundary fences that are proper for bison, removing most fencing within refuge boundaries, coordinating with the burning program, health screening and herd culling, constructing and keeping a handling facility, water tank needs, safety concerns, and the logistics related to moving bison. On the other hand, tourism may increase with opportunities to observe bison, which would help the economies of local communities.

Our costs would likely increase in the short term to reduce invasive species coverage and for possible changes in infrastructure. More monitoring programs would be required to evaluate infrastructure before and after changes.

We would focus on restoring natural functions and native communities to the extent possible to support certain cultural and historical aspects of natural communities that occurred in presettlement times. For instance, we would evaluate the application of grazing and fire in a way that more closely mimics what occurred then.

Cropland—Alternative A

The refuge would slowly reduce cropland acres and replant with proper native vegetation as cooperators voluntarily quit farming. 186 acres have been reseeded in the past 2 years. Slowly reducing the area of cropland and restoring native plant communities would continue at a rate of about 50 acres annually, depending on cooperator contracts and climate and resources available to buy native seeds. Once reseeded the areas would be aggressively managed with mowing, fire, grazing, “interseeding” and herbicides to improve stand establishment, pending climate conditions. After establishment, restored areas may be harvested for seed for other reseeding projects in the future. Food is not a limiting factor in the landscape, and reconstruction of annual cropland to native communities would not alter the ability to achieve regional and national waterfowl population goals. It is presumed that reconstruction would improve habitat conditions for native sand prairie communities.

Cropland areas create artificially high deer densities, as deer are drawn to the winter wheat crops and waste grain in other crop types. Use of cropped fields by deer and waterfowl may get more attention from visitors, as they concentrate wildlife and many are near roads and the auto tour route but these same animals use other parts of the refuge.

Farming as a management tool would remain an option for habitat restoration or to meet conservation goals (USFWS 2011), but farming solely to supply food crops for wildlife would be gradually reduced and eventually ended.

The use of genetically modified crops to prepare seedbeds for the reestablishment of native plants is allowed. An EA was completed for this use in 2011. That method has never been used on the refuge, but would remain a future option.

The slow rate of reseeding would be because of the high cost of native grass and forb seeds and associated restoration activities, such as seedbed preparation and invasive species control. The refuge uses a cooperator to harvest native grass seeds from the refuge for use in the reseeding program to reduce costs. We harvest seed in relatively normal to wet years with 75 percent going to the cooperator and 25 percent going to the refuge.

With farming, there is a risk of invasive species establishment and spread because of equipment and the disturbance of bare ground.

Cropland—Alternative B (Proposed Action)

Effects under alternative B would be the same, except that areas would also be reseeded instead of being left to naturally go back to a native community. This action would speed the recovery in those approximately 200 acres that were cropped before to a native community but would also cost much more in time and money than actions under alternative A. "Interseeding," burning, mowing, grazing and herbicide treatments would be used for restoration. These areas do not have the same types of wildlife use and public viewing opportunities that cropland has, so this addition would have fewer negative or positive effects (figure 14).

Cropland—Alternative C

Effects under alternative C would be the same as under alternative B, except that restoration activities would be accelerated and would consume more time and money than actions under either alternative A or alternative B, and the result would be a faster restoration of native communities. Ultimately, effects would be the same as under alternative B. Wildlife would benefit sooner under this alternative.

Migratory Birds—Alternative A

Our wetland management promotes high use by waterfowl, shorebirds, and other waterbirds; see the BSM, created wetlands, and LSM sections in this chapter for more detail. A wide diversity and abundance of migratory birds would continue to benefit from habitat management. Habitat use on the refuge would likely be reduced for heron rookeries, raptor perching, some neotropical migrant resting and foraging, and other tree- and shrub-associated species use, while habitat use likely would be increased for endemic grassland bird migration and nesting activities. It is possible that, with reduced woody coverage, the predation of eggs, young, and adult birds would decrease.

Certain generalist species that have benefited from human modifications to the landscape would have decreased benefits on refuge lands. However, it is expected that birds that see reduced benefits on refuge lands would be supported by current habitat conditions occurring in the landscape beyond refuge boundaries. Species recovery plans and various regional and national bird conservation plans would be supported.

Migratory Birds—Alternative B (Proposed Action)

Effects would be the same as under alternative A, except that a shift in management focus would increase the potential benefits to endemic and obligate grassland species and waterbirds adapted to environments with less coverage of trees and shrubs. Tree- and shrub-dependent species would have reduced benefits.

Migratory Birds—Alternative C

Because most woodlands would be removed, wading bird rookeries would likely exist off refuge and other tree-nesting species would decline on refuge lands. However, a diversity of woodland and shrubland habitat occurs on surrounding lands outside refuge boundaries. These are conditions that are commonly found, and are increasing, at both a regional and State level.

The overall abundance of migratory birds would likely decrease with potential changes in hydrology, refuge infrastructure, and management. For example, our current ability to hold and control water would be reduced, and, consequently, our ability to make desirable habitat conditions available to species at proper times would decrease. It is also expected that conditions for migratory birds would fluctuate in wet and dry periods; more "boom and bust" conditions would prevail. If water is properly managed at a watershed level, our management would support long-term ecosystem sustainability and productivity and, therefore, continue to provide long-term benefits

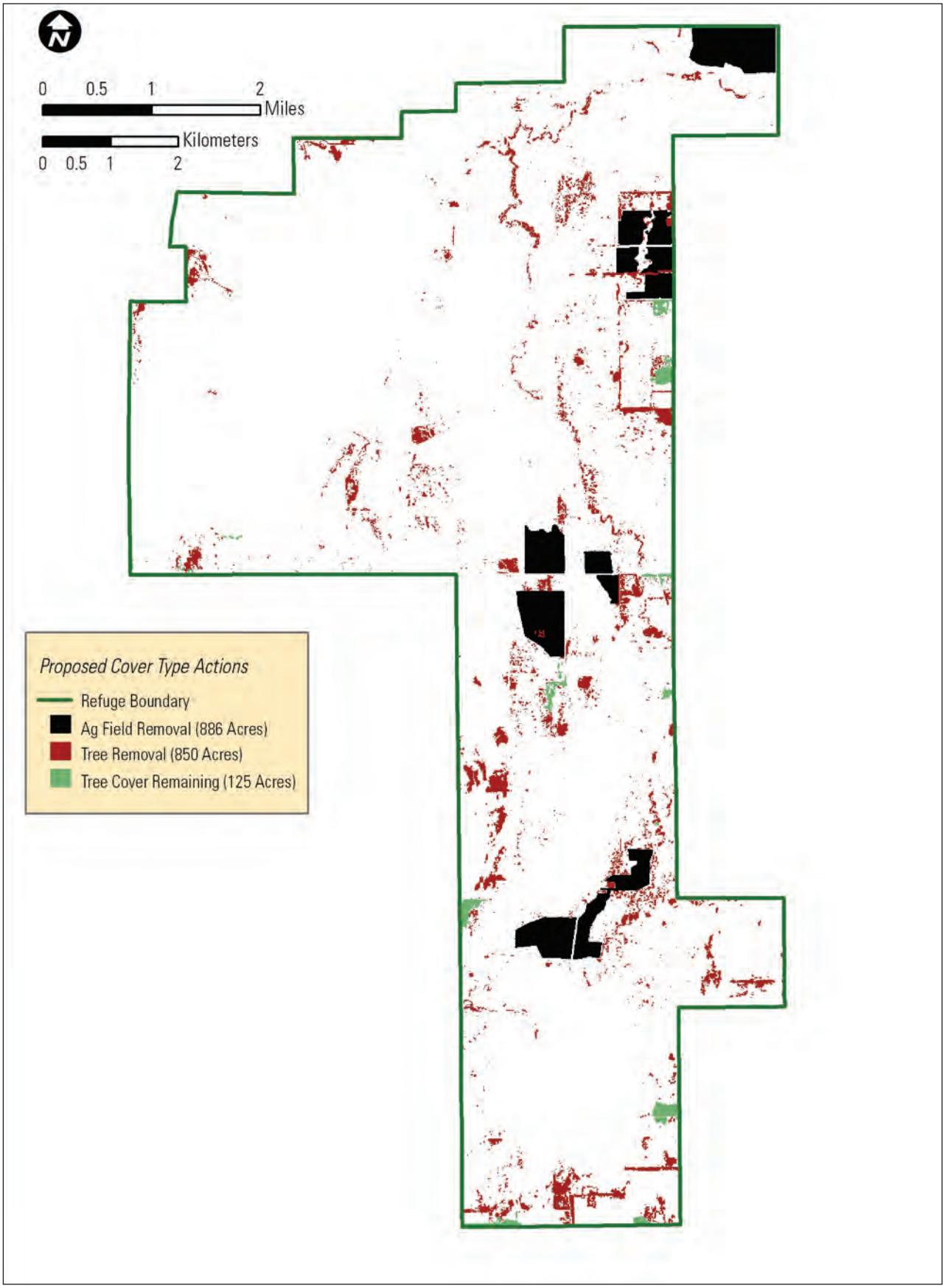

Figure 14. Cropland and tree coverage planning under alternative B (proposed action), Quivira National Wildlife Refuge, Kansas.

to migratory birds. But, we would no longer maximize wetland habitats every year.

Fish—Alternative A

Water quality would be improved as carp and other undesirable fish are reduced, mostly through the periodic drying of wetlands. These fish promote higher water turbidity, which lowers the productivity of plants that are beneficial to birds during migration and, in some cases, some native fish during the breeding season.

To reduce the likelihood of introducing foreign or unwanted diseases and pathogens to resident aquatic species, we would avoid stocking nonnative fish except at the Kids' Fishing Pond. Native fish populations would also benefit from our conserving desirable habitat. We would manage the BSM area to encourage a more natural range of high salinity and other water quality conditions, which we would expect to support plains killifish and other native fish populations that tolerate high salinity. We would continue to conserve the Boiling Springs freshwater habitat to support a healthy source population of State-threatened Arkansas darters.

Fishing opportunities on the refuge have traditionally been on the north and east sides of the LSM, and this would continue. Fishing at the Kid's Fishing Pond would remain unchanged. See the fishing section in this chapter for more detail.

The biological effects of crayfish are complex partly because of their interactions with, and the similar roles of, fish in ecological systems, including predating on each other's eggs or young, competing for food and shelter, and affecting community resources (Reynolds 2011). Both fish and crayfish would have significant effects on food web relationships that may negatively or positively influence migratory birds, depending on the balance of resources at a given point in time. The balance of resources would be constantly changing and, therefore, would be difficult to measure and track, especially when one considers that aquatic species would be frequently introduced to Quivira Refuge through Rattlesnake Creek and that many wetlands on the refuge would be managed to regularly flood and dry.

Fish—Alternative B (Proposed Action)

Effects would be the same as under alternative A, plus we would focus on species–habitat relationships to support a productive and healthy aquatic environment, including special focus on the Arkansas darter and plains killifish. As a result, we expect that native fish populations would improve.

Native fish populations may benefit even more from management that is more acutely focused on specific species–habitat needs; from the potential reintroduction of native fish; and from the results of evaluations to create and keep more suitable habitat in targeted areas both on and off the refuge, which we would conduct with help from the public and our partners. By not allowing the use of live fish bait, we expect to further reduce the likelihood of introducing diseases and pathogens to aquatic species. By allowing the frogging of bullfrogs only, changes in fish populations and other associated links in the ecosystem, such as invertebrates and birds, are possible, though we do not expect that the level of take would have major effects.

By periodically removing carp from the system, native fish populations would improve and fishing activities would likely increase.

Fishing opportunities on the refuge have traditionally been located on the north and east sides of the LSM, and this would continue.

Fish—Alternative C

Effects would be the same as under alternative B, except that, by restoring hydrology and communities to the extent possible, we would expect an improvement in water quality, but limitations on this improvement are possible because of uncertainties in future watershed management and conditions. Improvements in water quality and restored hydrology would be expected to benefit fish populations native to prairie streams. Sport and nonnative fish populations would likely decline in many areas of the refuge.

With removal of the Kid's Fishing Pond, fish populations would decrease in that basin because regular stocking would no longer occur and the pond would have shallow water or be dry, depending on spring flows. Conditions for fish on the refuge, overall, would vary in wet and dry years. The extent and duration of deep, permanent water on the refuge from Rattlesnake Creek would likely be reduced, which would adversely affect nonnative, or sport, fish. However, some of the natural sloughs and ponds, and riffle pool sequences that leave areas periodically isolated from the creek may function better to conserve native prairie fish populations. Also, overall and in certain years, there may be improved habitat for certain life cycle events of native fish, such as for nesting or brooding. Where water control is reduced, there may

be occasional issues related to carp or undesirable fish populations. In these cases, management might largely depend on dry periods to control populations and related effects, such as water turbidity, aquatic vegetation productivity and food chain viability.

Most fishing opportunities on the refuge have traditionally been on the north and east sides of the LSM, and this would not change. Fishing at the Kid's Fishing Pond, however, would no longer occur.

Maintenance and stocking costs would decrease.

Threatened and Endangered Species and Species of Concern—Alternative A

T and E species would remain a management priority, and we would continue to support recovery plans and the conservation of critical habitat. By reducing woody vegetation, we would expect to improve habitat conditions for all federally listed T and E species and all State-listed species except, possibly, for the eastern spotted skunk. However, there have been no known observations of this skunk species on the refuge in recent decades, and Stafford County is not reported as critical habitat for it. It is possible that, with reduced woody coverage, the predation of eggs, young, and adult T and E birds would decrease.

Our water management would continue to support habitat conditions that are favorable for migrating shorebirds and waterfowl, as well as for migrating and roosting T and E species. Areas in, and around, the BSM and the LSM have received the most use by whooping cranes on the refuge in recent years. The BSM area is traditionally used by both interior least terns and snowy plover. In 2011, a drought year, several pairs of interior least terns successfully used shoreline and beach habitat where the Rattlesnake Creek enters the LSM.

See the fish section in this chapter for more information on the Arkansas darter.

Threatened and Endangered Species and Species of Concern—Alternative B (Proposed Action)

Effects would be the same as under alternative A, plus, with a shift in management focus and more quantitative checking of management effects, potential benefits for T and E species may increase. We would measure and consider factors that properly describe vegetation conditions following treatments that influence species use to figure out our success in achieving our objectives. For example, we could evaluate our success in supporting the black rail, a State Species in Need of Conservation, by following water depth and coverage of certain plant species in the meadow habitat (Kane 2011).

Threatened and Endangered Species and Species of Concern—Alternative C

Effects would be the same as under alternative A, except that our shift in management focus from species-specific habitat needs to native communities and processes would likely result in decreased benefits to certain T and E species in some years and increased benefits in other years. We expect to have limited control over some areas of the refuge, and, therefore, habitat availability would be less dependable within, and among, years. At the same time, increased benefits may result if we find that habitats would support the reintroduction of species, such as lesser or greater prairie-chicken. Provided that water is properly managed at a watershed level, and pending climate change effects, our management would support long-term ecosystem sustainability and productivity and, therefore, continue to provide long-term benefits to T and E species.

Managing the BSM in a manner that more closely mimics what occurred during presettlement times would be expected to increase nesting habitat for western snowy plover and interior least tern. Less use of the BSM by whooping crane would be expected because there likely would be more years with little to no water at the time of migration. There would likely be less flooding of traditional least tern nesting areas because the basin would have more room to store rainfall, since water would not be kept artificially high in the spring, and artificial dikes and roads that impede waterflow would be removed.

Wildlife Native to the Region—Alternative A

Our management of habitat would support wildlife native to this region of the Great Plains. In doing so, other wildlife native to the larger Great Plains would also benefit, and species diversity would be

supported at regional, landscape, and national scales. Species associated with woody habitat would be expected to decrease within refuge boundaries, while native endemic species associated with open grassland would increase. However, a diversity of woody habitat conditions occurs on surrounding lands outside refuge boundaries. These conditions are commonly found, and are increasing, both regionally and across the State. Many of the species associated with woodlands on refuge lands have benefited from human modifications to the landscape such as the American robin and black-capped chickadee. It is likely that, with reduced woody coverage, the predation of wildlife prey eggs, young, and adults would decrease on the refuge.

For more information on species-specific examples and trade-offs, see chapters 3 and 4 and the appendixes.

Wildlife Native to the Region—Alternative B (Proposed Action)

Effects would be the same as under alternative A, except that, with our shift in management focus, potential benefits to endemic and obligate grassland species and wetland species that are adapted to environments with less coverage of trees and shrubs would increase.

Wildlife Native to the Region—Alternative C

Effects would be the same as under alternative B, except that the overall abundance of different wildlife would likely be mixed, depending on species and conditions. Wildlife populations would likely experience more dynamic fluctuations within, and among, years because of potential changes in hydrology, refuge infrastructure, and management. For example, our ability to hold and control water would be reduced, and, consequently, our ability to make desirable habitat conditions available to species at proper times would decrease. Provided water is properly managed at a watershed level, our management would support long-term ecosystem sustainability and productivity. Therefore, we would continue to provide long-term benefits to wildlife. If a patch burn strategy is carried out, we expect that there would be benefits to species diversity.

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Coyote

Wildlife Health—Alternative A

We would decrease adverse health conditions for wildlife. To the extent possible, and with the understanding that influences exist outside of our control, we would keep contaminant levels within a normal range for the ecosystem. Our surveillance of disease outbreaks would continue, and we would collect specimens and send them to a lab for testing when appropriate. With reductions in woody vegetation, we would expect positive changes in deer distribution and that contact rates would decline. Considering the current high population of deer, this may reduce the potential effects of chronic wasting disease; see chapter 4 for more details.

Wildlife Health—Alternative B (Proposed Action)

Effects would be the same as under alternative A, plus we would emphasize water sampling to improve the early detection of potentially adverse conditions for wildlife health and, possibly, prevent substantial wildlife die-offs. Regular water and, possibly, soil sampling in and near streams and tributaries, ditches, and oil wells on the refuge would track trends in contaminant levels. Changes in hunting regulations would be expected to improve wildlife health conditions, specifically for the high-density deer population.

Trapping could help control disease and nuisance animals, which would benefit wildlife. There would be a small economic benefit for trappers. And we would expect most trappers to live in the local area.

Wildlife Health—Alternative C

Effects would be the same as under alternative A, plus a broader suite of environmental conditions would be checked to further improve benefits to wildlife health. However, because there is the potential that we would have less control over water management, a decrease in our ability to manage disease and health concerns would be expected. At the same time, our management for ecosystem sustainability would be expected to increase resilience to adverse conditions, excluding human-caused disasters, such as an oil spill. Trapping effects would be the same as under alternative B.

Inventory, Monitoring, and Research—Alternative A

We conduct monitoring programs for surface waterflows, water levels, and water quality, but improved methods to collect this data are also being developed. We would evaluate the possibilities and constraints of observing ground water and soil factors. Effects include our receiving better information about these factors within the refuge boundaries and, perhaps, being able to favorably influence conditions.

There would be a relatively general focus on supporting diverse, native communities. For example, because we would not focus on specific focal resource needs, as under alternative B, a potentially wider range of habitat conditions and wildlife use would be acceptable. At a minimum, we would need to evaluate for native and nonnative trends, the diversity of refuge communities, and for T and E species conditions and activities. It would be expected that required monitoring programs would involve relatively broad-scale measures and perhaps less intensive sampling than under the other alternatives.

We would continue to inform a variety of interest groups on our findings. Limitations would exist relative to the types and extent of information that we would be able to collect or provide.

Our objectives and protocols and our historical methods and outcomes would be reviewed for relevancy and cost. Information learned from our activities would be properly used to gain more support for our refuge management and for resources of concern. We would continue to share information for varied interests, including local economies, educational institutions, and conservation programs and groups.

Inventory, Monitoring, and Research—Alternative B (Proposed Action)

Effects would be the same as under alternative A, except that monitoring measures related to species–habitat needs would be more specific. For example, our management focus and associated treatment prescriptions would need to evaluate species–habitat need factors such as providing stands of habitat of a certain size, shape, height, and density, within a specified distance to water and or to another habitat type. Species that are of conservation concern and have been a lesser priority of recent management, such as Bell's vireo or upland sandpiper, would likely benefit as a result of this finer level of monitoring. Because focal species, collectively, require a wide range and diversity of vegetation structure and composition, refuge habitat would continue to support many different wildlife species not considered focal species. It would be expected that more specific monitoring measures and subsequent feedback would be involved to measure our progress and to provide proper management recommendations.

Inventory, Monitoring, and Research—Alternative C

Activities related to soils and hydrology would be more extensive.

Activities related to biological factors would also be more extensive. For example, there would be more habitat and wildlife population monitoring programs used to decide if hunting and trapping would be allowed for a certain time. It would be expected that activities both before and after inventory, monitoring programs and research would be needed to evaluate the accomplishments of restoration activities.

Our management and monitoring programs would be more costly than they would be under the other alternatives. While the potential consequences to natural resources would be of primary concern, costs related to our management strategies and monitoring programs must be factored into decisionmaking, especially considering the uncertainties and constraints associated with Federal money and the varied interests of conservation groups.

5.5 Visitor Services Effects

This section discusses the effects of alternatives pertaining to visitor services.

Hunting—Alternative A

The following affect hunting activities under alternative A.

Effects Associated with an Unnaturally High and Increasing Population of Deer

White-tailed deer would likely increase until artificial controls, such as hunting, or natural controls, such as disease, change this trend. In the meantime, we presumed that there would be a growing risk of exceeding habitat carrying capacity and experiencing a decline in deer health and habitat conditions. The threat of chronic wasting disease would be of concern, as incidences occur closer to the refuge each year and because some local areas are managed to increase deer populations for the economic benefits of recreational hunting.

With an increasing deer population public viewing opportunities would be maintained or increased because deer that are not afraid of humans are easier to observe from vehicles. The refuge has many trophy bucks that one can view and photograph easily. But, the presence of many deer within, and near, the refuge could also create traffic safety issues. Having many trophy deer would also encourage poaching, which would be a law enforcement issue. Also, if disease did become an issue, public viewing of unhealthy deer would be expected to have mostly negative effects.

Because the refuge would continue to be closed to deer hunting, it would also remain closed to the retrieval of deer that are shot off the refuge. Some hunters have concerns that it is a waste of game to not be able to retrieve deer. Retrieving deer is not allowed, according to the CFR, primarily because much hunting occurs next to the refuge because it is closed and because there have been frequent and repeated requests in the past to retrieve big game animals that have crossed into the refuge after having been shot. Hunting blinds also exist extremely close to the refuge boundary in many areas.

While browse lines are evident, we have limited knowledge on the effects of deer on native vegetation and habitat conditions. Native forbs and, possibly, shrubs may be negatively affected by high deer populations.

Effects Associated with Whooping Crane Protection

Whooping cranes have spent more time on the refuge over the past few years in the fall, and, with climate change, they may spend even more time here in the future. This trend may improve the observation of this endangered species, but it may also limit the time that the refuge is open and available for hunting. All areas of the refuge are closed to hunting when whooping cranes are present, even in cases where only one bird is using a small area of the LSM for a month and never going near the upland hunting areas where hunters are only pursuing upland gamebirds.

Whooping cranes tend to be predictable in their daily movements once they arrive on the refuge, and they have traditional use areas on and off the refuge. Whooping cranes may actually be at higher risk when they fly off the refuge daily in the early morning and over hunters looking for sandhill cranes, than when they are on the refuge where sandhill crane hunting is not allowed. No whooping cranes have ever been known to have been shot by hunters on the refuge.

We suspect that many hunters would continue to be frustrated with our closures, particularly those related to whooping cranes.

Hunting—Alternative B (Proposed Action)

White-tailed deer hunting would be allowed on most of the refuge. The hunt plan would be fully developed after this CCP is completed, but would likely initially involve an archery-only or a youth-archery-muzzleloader-only season, with limited entry by draws for all hunt seasons. All possibilities for hunting deer would be explored, and safety for visitors would also be considered. Based on consultations with State experts, information used to justify a desired target population is limited partly because the potential range carrying capacity of the area is unknown and likely to be constantly changing because of factors such as land management at multiple scales. Initially, we would want to understand if selected harvest strategies would successfully result in a reduced deer population. Also, deer hunting on the refuge would create many more opportunities for

public hunting in a state of which less than 3 percent is publicly owned.

The viewing opportunities of trophy deer and deer with little-to-no fear of humans would likely decline, as deer would become more wary and difficult to observe and photograph closely.

There would be more potential interaction between hunters and nonhunters because more areas would be open for hunting, there would be longer hunting seasons, and there would be more chances for wildlife observers to see hunters in the field. Youth and muzzleloader hunting could increase the range of firearms used on the refuge and would increase the chances for safety issues with hunters and nonhunters. Youth and muzzleloader seasons would allow for more harvest, more opportunities for various hunters, and more opportunities to decrease deer densities to healthy levels. They would also allow us to meet goals for increased youth hunting.

It is unknown how refuge deer hunting would affect the number of hunting blinds immediately surrounding the refuge boundary, but it is possible that there would be increased requests from hunters to enter the refuge to retrieve deer, resulting in many calls after hours and on weekends when there may be no employees working. This may lead to frustration that the refuge doesn't provide 24-hour access to employees and to more costs for calling employees in to work whenever a hunter needs to retrieve a deer.

Turkey hunting would be allowed. Prairie-chicken hunting would be allowed if the refuge population increased and warranted hunting or harvesting for health purposes. Furbearer hunting would also be allowed, but weapons would be restricted to archery or firearms because of safety concerns. Many deer hunters also hunt furbearers. This offers more hunting opportunities for such popular furbearers as raccoons and bobcat when populations support it and according to State regulations.

We would only close areas of the refuge to waterfowl hunting when whooping cranes are in, or near, hunting units. Upland game hunting would not be closed when whooping cranes are present, unless we find that hunter presence would disturb whooping cranes. Under all hunting scenarios with any species and unit, the refuge would close specific units to hunting and other public uses if whooping cranes are using that area. Sandhill crane hunting would remain closed at all times on the refuge. We would need to spend more time on law enforcement, signage, and communicating specific closure areas. Reducing hunting threats to whooping cranes would be accomplished through increased public awareness of cranes via kiosks, brochures, signs, and public programs.

Waterfowl hunting areas would be realigned. The area of salt flats and North Lake would be closed to hunting because that is near one of the primary whooping crane use areas. In turn, we would open a similar-sized area of created wetlands in the middle of the refuge to waterfowl hunting that whooping cranes have not used in the past. This would result in closing one of the most popular waterfowl hunting areas, but it would also lessen the chances that an area would be closed because of the presence of whooping cranes and would provide more protection for them.

With changes in water management, those areas that we propose closing to waterfowl hunting would generally be dry in most years during the first month of waterfowl season because they would be allowed to fluctuate more naturally with hydrology of the BSM. The created wetlands would be a more reliable source of flooded habitat in most years, would remain open the entire season in most years, and, with active management, would provide higher-quality, moist-soil habitat that would attract more waterfowl. More parking areas and roads would need to be opened to provide access to these created wetlands.

There would be added costs for changing the hunt areas, signage, parking lots, brochures and more law enforcement. More costs would also occur if specific hunt areas have to be signed open and closed, but there would less likely be closures after the hunting area is redrawn.

Hunting—Alternative C

With respect to hunting, protection of resources would be the overriding principle. Hunting for migratory birds would remain the same as under alternative A, except that we would add sandhill crane hunting. The entire refuge would continue to be closed to migratory bird hunting when whooping cranes are present to give the greatest protection to the endangered species when they are using designated critical habitat at Quivira Refuge. Because sandhill crane hunting would be allowed, our refuge staff would increase awareness of cranes through kiosks, signage, and public programs. All other hunting, including upland game hunting, would continue and would only be closed in specific units if whooping cranes are present in those units, because of potential disturbance, not because of risk of shooting, as we presume that deer, turkey, quail and pheasant hunters would not shoot at waterfowl or cranes. This would allow more upland bird hunting with little-to-no risk to whooping cranes. Deer, turkey, prairie-chicken, and furbearer hunting would be opened and managed as under alternative B.

Added costs because of larger hunting areas, signage, law enforcement, more species and seasons, more permits and activities to administer, and wild-

life observation changes would be same as under alternative B.

Hunting would follow ecological restoration. Waterfowl and other migratory bird hunting would be expected to decrease, as we may not control water in some of the created wetlands and natural hydrology flows there would produce changing, less-consistent water conditions in the fall. Deer and turkey populations would be expected to decline because there would be fewer trees, less shrub habitat, and no cropland habitat on the refuge. Upland bird populations would be expected to decrease or remain the same as more prairie habitat is restored and fewer trees and shrubs exist and cropland is restored to native communities. Prairie-chickens would be expected to increase because more quality prairie would be available on the refuge.

Whooping crane use may increase with the increase in open meadow and prairie habitat without trees, croplands, and, possibly, with reduced artificial infrastructure to break up the landscape. Whooping crane use would likely vary because some wet years would produce widespread shallow sheet flow across meadows and the possible removal, or notching, of internal roads and canals might create water habitat that is less deep. The LSM, now a popular and consistent crane roosting area, would likely have less water during the fall in most years. Therefore, whooping cranes may use other areas, such as wide-open meadows, more often during migration.

If bison are restored to Quivira Refuge, hunting opportunities may have to be altered to prevent their interacting with hunters in the field. Refuge policy does not allow for the hunting of captive herds of ungulates on refuges. This includes bison.

Fishing—Alternative A

Fishing on all waters, according to State-established seasons and regulations, would continue to provide recreation opportunities that are compatible with our refuge management. Accessible fishing piers are already in place on the LSM and Kid's Fishing Pond, which are the two most popular fishing locations on the refuge. Fishing on most of the refuge would be of low quality because of carp infestations that reduce the productivity of invertebrates and creates high turbidity. Most who come to the refuge to fish are local, and they return often. There is little here to draw visitors from outside the local area here to fish, except during the annual Kid's Fishing Day, when from 70 to 100 people take part. Still, most come from within an hour's drive for this event. Many other locations hold a Kid's Fishing Day event on that same day because it is a State free-fishing day designed to encourage youth to fish.

Our refuge staff would continue to stock the Kid's Fishing Pond, either by purchasing local fish or by donations of fish from the State hatchery. The stocking of other waters has not occurred in the recent past but would be considered appropriate and possible under this alternative if the KDWPT is interested and has fish available. Many of the other waters on the refuge undergo periodic drying because we manage them for migratory birds. This would reduce, or end, the possibility of establishing other fishing areas that could be kept except, possibly, at Darrynane Lake.

Fishing for crayfish would not be allowed. This would be consistent with our decision to not allow the collection of minnow or bait. Enforcing the bait collecting restriction, however, would be difficult if crayfish fishing were allowed.

Prohibiting the use of live bait on the refuge would support the prevention of invasive species, pathogen, or disease introduction or spread.

Fishing—Alternative B (Proposed Action)

Effects would be the same as under alternative A, except that we would only allow fish stocking at the Kid's Fishing Pond.

No fish bait collecting would make more food fish available for wildlife. This is the preferred food source for nesting interior least terns that would be expected to continue nesting on the LSM.

Frogging for bullfrogs, only, would be allowed because it is considered fishing in Kansas and bullfrogs are plentiful on the refuge and a harvest could reasonably be sustained. Frogging regulations would be the same as fishing regulations for Kid's Fishing Pond.

Fishing—Alternative C

Effects would be the same as under alternative B, except that we would conduct more monitoring programs on fish, reptile and amphibian populations to make sure that these remain sustainable. Our staff would also conduct more aggressive control on nonnative fish, reptiles, amphibians, and aquatic nuisance organisms to restore and keep the ecological integrity of the system.

Drawdowns to control carp would be used as needed, as would the chemical control use of rote-

none. Costs to manage the fishery would increase with a biologist and technicians conducting biological surveys and creel surveys, with more management activities, and with the use of chemicals. Our staff would reintroduce native fish into the system after carp and other invasive species have been controlled.

Depending on the activity, permits may have to be issued for some fishing, such as for turtling, or frogging. The quality of fishing would improve because of carp control and subsequent restocking, but costs would be much higher. The Kid's Fishing pond would be removed.

Wildlife Observation and Photography—Alternative A

We would allow and encourage wildlife observation and photography throughout the entire refuge except in seasonally closed areas, which are used by nesting bald eagles, and tern nesting salt flats. Other areas may have to be closed because of changing conditions, such as when whooping crane roost areas are close to roads, the area around the photography blind on the LSM, and the Wildlife Drive.

Horseback riding could spread invasive species on access roads that are closed to public vehicles, but use would be low and not be expected to have an effect

Wildlife Observation and Photography—Alternative B (Proposed Action)

Effects would be the same as under alternative A.

Wildlife Observation and Photography—Alternative C

Effects would be the same as under alternative A, except that more closures would be carried out during the nesting season. Public entry would be restricted to a few selected roads. We would close the Wildlife Drive during nesting season every year to reduce potential disturbances to western snowy plovers, interior least terns, killdeer, and other birds. We would evaluate the potential environmental effects that the Wildlife Drive has on hydrology and

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The Kid's Fishing Pond is a popular spot during the annual Kid's Fishing Day.

consider removing it and human use of area during next 15 years.

If evaluation supports bison reintroduction, then this would have mixed effects. Areas would be closed to the public for safety reasons, but the presence of bison might become an attraction.

Environmental Education and Interpretation—Alternative A

Increased and improved environmental education programs at both Quivira Refuge and the GPNC would engage the public and help connect more visitors to nature thereby aiding in understanding and appreciating the natural resources found on the refuge, in Kansas, and across the Great Plains.

Updating displays in the Koch Habitat Hall (GPNC) would increase visitation to the facility because the citizens of Wichita and visitors around the State would be interested in seeing the new exhibits.

Through the GPNC, our partnership with the City of Wichita Department of Park and Recreation and the KDWPT would continue.

Environmental Education and Interpretation—Alternative B (Proposed Action)

Environmental education programs would be enhanced through improvements to facilities at both Quivira and the GPNC. There would also be an increase in appreciation of refuge resources for those who engage in virtual geocaching.

Moving the environmental education classroom building at the refuge to a site near the headquarters would improve our ability to provide environmental education programs and would further the development of a comprehensive program. See the facilities and infrastructure section in this chapter for more detail.

Increased and improved environmental education programs at both Quivira Refuge and the GPNC would engage the public and help connect more visitors to nature thereby aiding in understanding and appreciating the natural resources found on the refuge, in Kansas, and across the Great Plains.

Updating displays in the Koch Habitat Hall (GPNC) would increase visitation to the facility because the citizens of Wichita and visitors around the State would be interested in seeing the new exhibits.

Environmental Education and Interpretation—Alternative C

Effects would be the same as under alternative B, plus all aspects of public use, including facilities, roads, access, and permitted activities would be scrutinized. Because some roads and facilities may be targeted for elimination, the scope and logistics of both environmental education and interpretation programs may be limited. We would emphasize focal resources and how we manage for them in these programs.

Other Uses—Alternative A

There would be little effect from these activities because few people engage in them, and few people request prohibited activities.

Other Uses—Alternative B (proposed action)

Effects would be the same as under alternative A, except that commercial photography would expand opportunities for photographers and enhance the public's appreciation of wildlife.

Other Uses—Alternative C

Effects would be the same as under alternative B.

5.6 Public Outreach Effects

This section discusses the effects of alternatives pertaining to public outreach.

Alternative A

Major goals would be to foster an appreciation of wildlife and the outdoors, as well as to instill a sense of stewardship of lands like Quivira Refuge among the public. Continuing to work with Friends of Quivira would promote public awareness and outreach of the refuge.

Oversee the development, maintenance, and staff of our information booth at the annual Kansas State Fair to promote both Quivira Refuge and the GPNC.

Recruit, train, and use volunteers from local communities to help with management and public use goals at Quivira Refuge and the GPNC. The GPNC has an active volunteer program and large population to draw from in the Wichita area. About 2,800 hours of volunteer time is donated annually, with much of the time spent in outreach and education.

Alternative B (Proposed Action)

Effects would be the same as under alternative A, plus public understanding and awareness of refuge resources would be heightened through the installation of a tower camera at the bald eagle and BSM areas. One negative aspect of this change would be that viewers would not have to leave their homes to see the refuge, which conflicts with our various initiatives, such as Let's Go Outside, and Connecting People with Nature. But this method may also interest people in the refuge and encourage them to come out and see it in person.

The mounted, moveable camera would not be expected to negatively affect wildlife or the habitat around it, though there would be short-term effects during installation. There would be more costs for its installation and operation. Donations may be requested to offset costs.

Alternative C

Effects would be the same as under alternative B.

[redacted]

This section discusses the effects of alternatives pertaining to archeological and historic sites.

Alternative A

Properly obtaining permits and clearances before beginning work would reduce the effects from substantial dirt or surface alteration on the refuge.

Consultation with our regional archeologist during the planning phase of proposed projects to decide on the need for an archeological site clearance from the Kansas State Historic Preservation Office would help make sure that any cultural resources found would be adequately protected.

Alternative B (Proposed Action)

Effects would be the same as under alternative A, plus increased interpretation of cultural resources through exhibits in the visitor center, interpretive signage on tour roads and pullouts, and more, would increase the knowledge and awareness of Native American use of the site before the establishment of the refuge.

Alternative C

Effects would be the same as under alternative B.

[redacted]

This section discusses the effects of alternatives pertaining to visitor and employee safety and resource protection.

Visitor and Employee Safety—Alternative A

By making safety a high priority, refuge and GPNC employees, visitors, and contractors would enjoy a safe working and visiting environment. The refuge and GPNC would continue to make improvements to the safety program to meet the needs of a changing world, thus ensuring everyone's safety to the best of our ability.

Rachel Laubhan/USFWS

Egrets and Ibis

Visitor and Employee Safety—Alternative B (Proposed Action)

Effects would be the same as under alternative A.

Visitor and Employee Safety—Alternative C

Effects would be the same as under alternative A unless bison are reintroduced, at which time dangers would be heightened. We would train staff to work with, and around, bison. Job hazard analyses would need to be written to increase awareness and knowledge of bison. As a result, there would be more costs for employee training and safety needs.

Resource Protection—Alternative A

Because refuge law enforcement officers would enforce hunting, fishing, and all other regulations in accordance with CFRs, State laws, and refuge-specific regulations, the resources of the refuge would be protected as much as possible. The cultural resources of the refuge would also be protected as cultural clearance would be approved before restoration projects or other habitat disturbances would be conducted. Habitat and wildlife would be protected because refuge law enforcement officers would check and enforce unlawful oil and gas operations on and off the refuge. Endangered and threatened species would continue to be protected because managers and law enforcement officers would make management decisions that protect species or their critical nesting habitats.

Resource Protection—Alternative B (Proposed Action)

Effects would be the same as under alternative A, except that many more species would be permitted to be taken by trapping, fishing, and hunting on the refuge, including deer, turkey, prairie-chicken, bullfrogs, and furbearers. With each added species there would be many changes to the amount of regulations that require enforcement, and there would be a dramatic increase in visitor use, which, in turn, would require more law enforcement.

The hunting areas on the refuge would be modified, and species-specific hunting boundaries would be needed to allow big game, upland game, and waterfowl to be hunted at the same time as other uses. The refuge would only close areas where whooping cranes are present, which would require the added enforcement of temporary closures and signing. The increased workload because of multiple uses, the increased visitor use, and the new boundary distribution would require us to hire more law enforcement staff. One full-time refuge officer and two dual-function officers would be needed for adequate enforcement.

During the initial stages of carrying out alternative B, law enforcement officers would have to work many weekends and more overtime. Without more law enforcement, T and E species and resource protection could be harmed. With more law enforcement, refuge resources and infrastructure would be better protected and there could be an economic gain to the community with the new employment opportunities.

Resource Protection—Alternative C

Effects would be the same as under alternative B, except that the refuge would allow the hunting of sandhill crane when whooping cranes are not present. Because sandhill cranes look like whooping cranes, we would need to add staff time to more closely watch whooping crane locations to prevent an accidental shooting. There would be increased efforts to educate about whooping cranes through more signage, kiosk displays, and handout information. Waterfowl and sandhill crane hunting would not occur when whooping cranes are present, therefore staff time would also be required to close and enforce regulations on the closed areas.

The refuge may reintroduce a large bison herd that would increase the need for enforcement to prevent accidental or illegal take. Unlike cattle grazing, a bison herd would be present throughout the year, increasing the potential for hunter and bison interaction and injury. This safety concern would require staff and law enforcement to closely watch visitor use to prevent safety issues. Boundary fences would be required to be patrolled on regular basis to prevent bison from escaping the refuge and providing damage or injury to our adjacent landowners and to the public.

5.9 Administration Effects

This section discusses the effects of alternatives pertaining to administration activities.

Staff and Budget—Alternative A

Money would be adequate to keep our permanent staff and facilities. Current refuge programs such as habitat management, visitor services, fire, and maintenance would proceed with little change, increases or enhancement.

A list of permanent and temporary staff, as well as recommended staff increases, can be found in Section 4.9 Administration and in table 17.

Quivira Refuge would continue to provide office space for a regional refuge zone biologist and a Partners private lands biologist. The refuge would also continue to use the YCC program, and Youth in the Great Outdoors to hire youth for conducting natural resource projects. We would continue to raise money through grants and initiatives to supplement staff and to pay for projects.

Staff and Budget—Alternative B (Proposed Action)

Would allow us to fully carry out and achieve the stated goals and objectives for alternative B.

Staff and Budget—Alternative C

Effects would be the same as under alternative A, plus, to carry out more monitoring programs for populations and habitats, two permanent, full-time biological positions would be needed. And one added permanent, full-time employee would be needed to work specifically on controlling invasive species to accomplish full ecological restoration.

Facilities and Infrastructure—Alternative A

Under our current deferred maintenance list, the maintenance shop is scheduled for rehabilitation, which would include more space and would remove the in-ground hydraulic vehicle hoist. The shop bay is too short to allow some of the heavy equipment we use to be moved inside for maintenance and repair. The cost of the rehab is projected at $490,000.

Vehicle and equipment storage would be inadequate, as all vehicles must be kept inside and protected from packrats that can quickly move into vehicles parked outside to chew electrical wires and build nests. Biological controls, such as barn owl nest boxes, have been erected around all facilities to control these small mammals, but expensive repairs are still occasionally needed for vehicles and equipment that cannot be kept inside..

More employees that are not specific to Quivira Refuge have been stationed at the refuge, including a zone biologist and a private lands biologist. For them, we would need more vehicle and equipment storage. It is possible that other program employees would be stationed at Quivira Refuge because of its central location, so more storage area would be needed.

Adding onto the GPNC would allow staff of the partner agencies to conduct more meetings and present increased educational programs onsite. The addition would include increased office space for expanding staff needs. Adding another storage facility at the GPNC would extend the life of agency equipment (such as vehicles, boats and trailers) and keep it from being vandalized.

Facilities and Infrastructure—Alternative B (Proposed Action)

Effects would be the same as under alternative A, plus another cold storage building would allow vehicles and equipment to be better protected. Moving the environmental education classroom and bunkhouse from their current location to the headquarters administrative site would centralize buildings, improve visitor service, reduce staff travel, and improve water quality for these facilities.

Trapping could help control nuisance animals, which would benefit our refuge operations in preserving infrastructure. There would be a small economic benefit for trappers. And we would expect most trappers to live in the local area.

More space at the GPNC would accommodate an expanded and enhanced environmental education program. With additional space, we could serve more school programs, and allow our programming efforts to increase and improve. We would be able to entertain the idea of hosting traveling exhibits that would increase visitation to the facility.

Facilities and Infrastructure—Alternative C

Effects would be the same as under alternative B for buildings at Quivira Refuge and the GPNC, but much of the other infrastructure at the refuge would be reduced or removed to complete the ecological restoration and visitor services would be adversely affected.

We would evaluate, and likely reduce, trails, parking lots, roads, dikes, canals, water control structures, and fences at Quivira Refuge. Larger blocks of land would be fenced, if bison were to be reintroduced, to allow them to move on their own and graze as much as possible in a natural setting. Unnecessary roads would be removed and canals would only be used to spread waterflow over the refuge in sheet flow to mimic natural flooding and drying. More spillways would be constructed to spread sheet flow out of Rattlesnake Creek and across meadows and wetlands.

5.10 Socioeconomic Effects

What follows is an analysis of the economic effects associated with each alternative.

Effects from the Refuge Revenue Sharing Act

The Service makes revenue sharing payments to the counties for the land that is under administration. Under provisions of the refuge Revenue Sharing Act (RRS), local counties receive an annual payment for lands that have been bought by full fee-title acquisition by the Service. Payments are based on the greater of 75 cents per acre or 0.75 percent of the fair market value. The exact amount of the annual payment depends on Congressional appropriations, which in recent years have tended to be substantially less than the amount required to fully fund the authorized level of payments. In fiscal year 2011, RRS payments were appropriated at only 21.6 percent of the approved value. The three counties that contain the refuge each received a payment; Stafford County received $69,600, Rice County received $2,580, and Reno County received $2,115. Table 18 shows the effects of the $74,295 received by the local area in RRS payments. The RRS payments generate an estimated total effect of $22,200 in labor income and $30,200 in value added to the local 5-county area.

Table 18. Annual effects of Refuge Revenue Sharing Act payments under alternatives A, B and C on the area around Quivira National Wildlife Refuge, Kansas.

	Employment number of full and part time jobs	*Labor income in $thousand 2012*	*Value added in $thousand 2012*
Direct effects	0	$17.7	$22.5
Secondary effects	0	$4.4	$7.6
Total effect	0	$22.2	$30.2

Effects of Refuge Staff Salary Spending within the Local Economy

Quivira Refuge employees reside and spend their salaries on daily living expenses in the local area, thereby generating effects within the local economy. Household consumption expenditures consist of payments by individuals or households to industries for goods and services used for personal consumption. The IMPLAN modeling system contains household income consumption spending profiles that account for average household spending patterns by income level. These profiles also capture average annual savings and allow for leakage of household spending to outside the region. The IMPLAN household spending pattern for households earning $50–75 thousand dollars per year was used to reflect the average salary of full-time permanent employees at the refuge.

The current approved refuge staff consists of 17 employees: 12 permanent staff, 3 temporary staff, and the two regional staff; the salary associated with the vacant positions has not been included in the analysis (table 17). The two regional staff positions are not paid for by the refuge, but they are stationed at the refuge and, as such, their salary has been included in this analysis. Refuge staff is anticipated to remain the same under alternative B and to increase to 22 employees under alternative C with the addition of two wildlife biologists, a range technician in the invasive program, and two bison work staff.

Refuge staff estimate that current annual salaries total approximately $819,000 with an additional $81,050 to cover the staff funded at the regional level, for a total of $900,050, under alternative A. Staff needs would remain the same under alternative B and increase to $1.275 million under alternative C. The economic effects associated with spending of salaries in the local 5-county area by refuge employees are summarized in table 19. These effects only include the secondary effects of nonrefuge jobs created as refuge employees spend their salaries in the local five-county area. For alternative A, it is estimated that salary spending by Quivira Refuge staff would generate secondary effects of 5 jobs, $168,600 in labor income, and $301,700 in value added in the local economy. For alternative B, the effect of salary spending would remain the same as alternative A, as additional staff are not required. For alternative C, salary spending would generate secondary effects of 7 jobs, $238,900 in labor income, and $427,400 in value added.

Table 19. Annual effects of salary spending in the area around Quivira National Wildlife Refuge, Kansas.

	Employment number of full and part time jobs	*Labor income in $thousand 2012*	*Value added in $thousand 2012*
Alternatives A and B			
Direct effects	0	$0.0	$0.0
Secondary effects	5	$168.6	$301.7
Total effect	5	$168.6	$301.7
Alternative C			
Direct effects	0	$0.0	$0.0
Secondary effects	7	$238.9	$427.4
Total effect	7	$238.9	$427.4

Effects of Refuge Purchases of Goods and Services within the Local Economy

A wide variety of supplies and services are bought for refuge operations and maintenance activities. Refuge purchases made in the local five-county area contribute to the local economic effects associated with the Quivira Refuge. The refuge now spends an average of $270,000 per year on nonsalary expenditures. Major local expenditures include: sup-

plies related to habitat and grounds improvements, supplies related to the maintenance and repair of structures, and office supplies and utilities. Table 20 provides a breakdown of current nonsalary expenditures by expenditure category. To figure out the local economic effects of nonsalary expenditures, only expenditures made within the local five-county area are included in the analysis.

Table 20. Breakdown of Current Purchases of Goods and Services in the area around Quivira National Wildlife Refuge, Kansas.

Expense category	*Average annual percent of nonsalary expenditures*	*Percent spent in local five-county area*
Equipment maintenance and repair	10	85
Vehicle maintenance and repair	6	85
Habitat and grounds improvements and treatments (not including acquired lands restoration)	48	90
Travel	7	10
Construction of new structures	1	75
Maintenance and repair of structures	12	75
All other expenses (such as overhead, office supplies and utilities)	16	80

Average annual nonsalary expenditures are anticipated to be $272,972 for alternative A, the same for alternative B, and $397,973 for alternative C. Table 21 shows the economic effects associated with nonsalary related expenditures in local communities near the refuge. For alternative A, nonsalary related purchases would generate an estimated total economic effect of 5 jobs, $183,300 in labor income, and $199,900 in value added. The same effect would be generated under alternative B. For alternative C, nonsalary related purchases would generate an estimated total economic effect of 7 jobs, $267,200 in labor income, and $291,400 in value added.

Table 21. Annual effects of purchases of goods and services in the area around Quivira National Wildlife Refuge, Kansas.

	Employment number of full- and part-time jobs	*Labor income in $thousand 2012*	*Value added in $thousand 2012*
Alternatives A and B			
Direct effects	4	$150.9	$143.1
Secondary effects	1	$32.4	$56.8
Total effect	5	$183.3	$199.9
Alternative C			
Direct effects	6	$220.0	$208.6
Secondary effects	1	$47.2	$82.8
Total effect	7	$267.2	$291.4

Effects of Visitor Expenditures

Spending associated with recreational visits to national wildlife refuges generates significant economic activity. The Service report Banking on Nature: The Economic Benefits of National Wildlife Refuge Visitation to Local Communities, estimated the effect of national wildlife refuges on their local economies (Carver and Caudill, 2007). According to the report, more than 34.8 million visits were made to national wildlife refuges in fiscal year 2006 that generated $1.7 billion of sales in regional economies. Accounting for both the direct and secondary effects, spending by national wildlife visitors generated nearly 27,000 jobs and more than $542.8 million in employment income (Carver and Caudill, 2007). Approximately 82 percent of total expenditures were from nonconsumptive activities, 12 percent from fishing, and 6 percent from hunting (Carver and Caudill, 2007).

This section focuses on the local economic effects associated with Quivira National Wildlife Refuge visitation. Quivira Refuge offers a wide variety of recreation opportunities including wildlife observation and photography, interpretation, environmental

education, hunting, and fishing. Now, only waterfowl and upland bird hunting are allowed on the refuge, and opportunities would increase with deer, turkey, and furbearer hunting under alternatives B and C. With its key location in the middle of the central flyway, the refuge attracts hundreds of migratory birds each year and as a result, draws bird watchers and photographers from across the county. Wildlife observation is the primary visitor activity that occurs on the refuge.

Annual visitation estimates for the refuge are based on several refuge statistic sources including visitors entering the visitor center and office and the general observation of refuge staff. Annual visitation estimates are on a per-visit basis. Table 22 summarizes estimated visitation by type of visitor activity for alternatives A, B, and C. Under alternative B, the primary focus is the restoration of native communities that help focal resources, or focal species, and their respective habitats. This restoration is expected to enhance migratory bird and upland game hunting opportunities. Additionally, under alternative B, the public would have the opportunity to engage in big game, turkey, and furbearer hunting on the refuge. Conservation is also the primary focus of alternative C, with an emphasis on promoting the sustainability of native communities, including the introduction of bison onto the range, and lowering maintenance costs. Habitat would be allowed to fluctuate more under dry and wet cycles and water amounts and movement would be altered to mimic natural patterns. These conservation actions are expected to decrease migratory bird hunting and fishing opportunities and enhance upland game hunting opportunities. As with alternative B, a small amount of big game hunting would be allowed on the refuge.

Spending associated with recreational visits generates significant economic activity in the five-county area. A visitor usually buys a wide range of goods and services while visiting an area. Major expenditure categories include lodging, restaurants, supplies, groceries, and recreational equipment rental. To figure out the local economic effects of visitor spending, only spending by persons living outside of the local five-county area are included in the analysis. The rationale for excluding local visitor spending is twofold. First, money flowing into the local five-county area from visitors living outside the local area (hereafter referred to as nonlocal visitors) is considered new money injected into the local economy. Second, if residents of the local five-county area visit the refuge more or less because of the management changes, they will correspondingly change the spending of their money elsewhere in the local area, resulting in no net change to the local economy. These are standard assumptions made in most regional economic analyses at the local level. Refuge staff figured out the percentage of nonlocal refuge visitors. Table 22 shows the estimated percent of nonlocal refuge visits and visitor days under each alternative.

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The Great Plains Nature Center in Wichita, Kansas, looks out onto the wildlife habitats of Chisholm Creek Park.

Table 22. Estimated annual visitation activity at Quivira National Wildlife Refuge, Kansas, by alternative.

	Total number of visits	*Number of nonlocal visits*	*Average hours spent on refuge*	*Number of nonlocal visitor days**
Alternative A				
Fishing	1,000	100	4	50
Big game hunting	0	0	8	0
Waterfowl and migratory bird hunting	1,225	460	6	345
Upland game hunting	500	250	6	188
Nonconsumptive uses	12,000	10,200	4	5,100
Total Visitation	14,725	11,010		5,683
Alternative B				
Fishing	1,000	100	4	50
Big game hunting	5	4	8	4
Waterfowl and migratory bird hunting	1,286	483	6	362
Upland game hunting	525	263	6	197
Nonconsumptive uses	12,000	10,200	4	5,100
Total Visitation	14,816	11,050		5,713
Alternative C				
Fishing	1,050	105	4	53
Big game hunting	5	4	8	4
Waterfowl and migratory bird hunting	1,286	483	6	362
Upland game hunting	525	263	6	197
Nonconsumptive uses	12,000	10,200	4	5,100
Total Visitation	14,866	11,055		5,716

* One visitor day = 8 hours.

Besides the Quivira Refuge, refuge staff also manage and maintain the Great Plains Nature Center (GPNC), located outside of Wichita, Kansas. Visitors to the GPNC have the opportunity to tour the education center, observe wildlife in the park, fish in two ponds located at the center or attend one of the educational programs. In 2011, 145,700 visitors came through the center. Visitors were generally local residents and averaged approximately 30 minutes at the GPNC. These visits occurred in Sedgwick County, outside of the five-county project area, and thus the effect of these visits is not included in this report.

To estimate visitor expenditures, we use average daily visitor spending profiles from the Banking on Nature report (Carver and Caudill, 2007) that were derived from the 2006 National Survey of Fishing, Hunting, and Wildlife Associated Recreation (USFWS, 2008). The National Survey reports trip related spending of State residents and nonresidents for wildlife-associated recreational activities. For each recreation activity, spending is reported in the categories of lodging, food and drink, transportation, and other expenses. Carver and Caudill (2007) calculated the average per-person-per-visitor day expenditures by recreation activity for each region of the Service. We used the spending profiles for nonresidents for Region 6—which includes Kansas, and updated the 2006 spending profiles to 2012 dollars using the Consumer Price Index Inflation Calculator. Average daily spending profiles for nonresident visitors to Region 6 for fishing ($128.53 per day), waterfowl and other migratory bird hunting ($77.59 per day), upland game hunting ($179.99 per day), and big game hunting ($218.44 per day) were used to estimate nonlocal visitor spending for refuge fishing and hunting related activities. The average daily nonresident spending profile for nonconsumptive wildlife recreation (observing, feeding, or photographing fish and wildlife) was used for nonconsumptive wildlife viewing activities ($161.16 per day).

Visitor spending profiles are estimated on an average per day (8 hours) basis. Because some visitors only spend short amounts of time visiting a refuge, counting each refuge visit as a full visitor day would overestimate the economic effect of Quivira Refuge visitation. In order to properly account for

the amount of spending, the annual number of nonlocal refuge visits were converted to visitor days. Refuge staff estimate that nonlocal anglers spend approximately 4 hours (1/2 a visitor day) on the refuge, while waterfowl and upland game hunters spend approximately 6 hours (3/4 a visitor day). Nonlocal visitors that view wildlife on nature trails or take part in other wildlife observation activities typically spend 4 hours (1/2 a visitor day). Table 11 shows the number of nonlocal visitor days by recreation activity for each alternative. Total spending by nonlocal refuge visitors was determined by multiplying the average nonlocal visitor daily spending by the number of nonlocal visitor days at the refuge.

Table 23 summarizes the total economic effects, in thousands of dollars, associated with current nonlocal visitation by alternative. Under alternative A, nonlocal Quivira Refuge visitors would spend nearly $888,878 in the local economy annually. This spending would directly account for an estimated 8 jobs, $205,800 in labor income, and $339,200 in value added in the local economy. The secondary or multiplier effects would generate an additional 2 jobs, $87,600 in labor income, and $144,600 in value added. Accounting for both the direct and secondary effects, spending by nonlocal visitors for alternative A would generate total economic effects of 10 jobs, $293,400 in labor income, and $483,800 in value added.

Table 23. Annual effects of nonlocal visitor spending by alternative in the area around Quivira National Wildlife Refuge, Kansas.

	Employment number of full- and part-time jobs	*Labor income in $thousand 2012*	*Value added in $thousand 2012*
Alternative A			
Direct effects	8	$205.8	$339.2
Secondary effects	2	$87.6	$144.6
Total effect	10	$293.4	$483.8
Alternative B			
Direct effects	8	$206.7	$340.7
Secondary effects	2	$87.9	$145.2
Total effect	10	$294.6	$485.8
Alternative C			
Direct effects	8	$206.8	$340.8
Secondary effects	2	$87.9	$145.2
Total effect	10	$294.7	$486.0

As shown in table 22, Quivira Refuge nonlocal visitation for all activities is anticipated to increase by 31 visitor days under alternative B as compared to alternative A. Under alternative B, nonlocal Quivira Refuge visitors would spend $892,778 in the local area annually. Accounting for both the direct and secondary effects, spending by nonlocal visitors for alternative B would generate an estimated total economic effect of 10 jobs, $294,600 in labor income, and $485,800 in value added.

Quivira Refuge nonlocal visitation across all activities is anticipated to increase by 33 visitor days under alternative C as compared to alternative A (table 22). Under alternative C, nonlocal refuge visitors would spend $893,099 in the local area annually. Accounting for both the direct and secondary effects, spending by nonlocal visitors for alternative C would generate an estimated total economic effect of 10 jobs, $294,700 in labor income, and $486,000 in value added.

Summary of Economic Effects for Alternative A

Table 24 summarizes the direct and total economic effects in the five-county area of refuge management activities for alternative A. Under alternative A, Quivira Refuge management activities directly related to refuge operations generate an estimated 12 jobs, $374,400 in labor income, and $504,800 in value added in the local economy. Including direct, indirect, and induced effects, refuge activities generate a total economic effect of 20 jobs, $667,500 in labor income, and $1.015 million in value added. In 2009, total labor income in the five-county area was estimated at $2.572 billion and total employment was estimated at 66,660 jobs (IMPLAN 2009 data). Thus, total economic effects associated with Quivira Refuge operations under alternative A represent 0.026 percent of total income and 0.030 percent of total employment in the overall five-county

area economy. Total economic effects of refuge operations play a much larger role in the communities near the refuge where most of the refuge-related expenditures and public use-related economic activity occurs.

Table 24. Economic effects of alternative A.

	Employment number of full- and part-time jobs	*Labor income in $thousand 2012*	*Value added in $thousand 2012*
Refuge Administration*			
Direct effects	4	$168.7	$165.6
Total effects	10	$374.1	$531.7
Public use activities			
Direct effects	8	$205.8	$339.2
Total effects	10	$293.4	$483.8
Aggregate effects			
Direct effects	12	$374.4	$504.8
Total effects	20	$667.5	$1,015.5

* Refuge administration effects include effects associated with RRS payments made to counties, staff salary expenditures made in the local five-county area, and refuge nonsalary expenditures made in the local five-county area.

Summary of Economic Effects for Alternative B

Table 25 summarizes the direct and total economic effects in the 5-county area of refuge management activities for alternative B. Under alternative B, Quivira Refuge management activities directly related to refuge operations would generate an estimated 12 jobs, $375,400 in labor income, and $506,300 in value added in the local economy. Including direct, indirect, and induced effects, all refuge activities would generate a total economic effect of 20 jobs, $668,700 in labor income, and $1.018 million in value added.

Table 25. Economic effects of alternative B.

	Employment number of full- and part-time jobs	*Labor income in $thousand 2012*	*Value added in $thousand 2012*
Refuge Administration*			
Direct effects	4	$168.7	$165.6
Total effects	10	$374.1	$531.7
Public use activities			
Direct effects	8	$206.7	$340.7
Total effects	10	$294.6	$485.8

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Wheat harvesting in Kansas around 1900. Agriculture has long been important to the economy near Quivira Refuge.

Table 25. Economic effects of alternative B.

	Employment number of full- and part-time jobs	*Labor income in $thousand 2012*	*Value added in $thousand 2012*
Aggregate effects			
Direct effects	12	$375.4	$506.3
Total effects	20	$668.7	$1,017.5

* Refuge administration effects include effects associated with RRS payments made to counties, staff salary expenditures made in the local five-county area, and refuge nonsalary expenditures made in the local five-county area.

Table 26 summarizes the change in economic effects associated with Quivira Refuge operations under alternative B as compared to alternative A. Because of small expected increases in refuge visitation and administration, alternative B would generate $1,300 more in labor income, and $2,000 more in value added as compared to alternative A.

Table 26. Change in economic effect from alternative A to alternative B.

	Employment number of full- and part-time jobs	*Labor income in $thousand 2012*	*Value added in $thousand 2012*
Refuge Administration*			
Direct effects	no change	no change	no change
Total effects	no change	no change	no change
Public use activities			
Direct effects	no change	(+) $0.9	(+) $1.5
Total effects	no change	(+) $1.3	(+) $2.0
Aggregate effects			
Direct effects	no change	(+) $0.9	(+) $1.5
Total effects	no change	(+) $1.3	(+) $2.0

* Refuge administration effects include effects associated with RRS payments made to counties, staff salary expenditures made in the local five-county area, and refuge nonsalary expenditures made in the local five-county area.

Summary of Economic Effects for Alternative C

Table 27 summarizes the direct and total economic effects in the five-county area of refuge management activities for alternative C. Under alternative C, Quivira Refuge management activities directly related to refuge operations would generate an estimated 14 jobs, $444,600 in labor income, and $571,900 in value added in the local economy. Including direct, indirect, and induced effects, all refuge activities would generate a total economic effect of 24 jobs, $823,000 in labor income, and $1.235 million in value added.

Table 27. Economic effect of alternative C.

	Employment number of full- and part-time jobs	*Labor income in $thousand 2012*	*Value added in $thousand 2012*
Refuge Administration*			
Direct effects	6	$237.8	$231.2
Total effects	14	$528.3	$748.9
Public use activities			
Direct effects	8	$206.8	$340.8
Total effects	10	$294.7	$486.0
Aggregate effects			
Direct effects	14	$444.6	$571.9
Total effects	24	$823.0	$1,234.9

* Refuge administration effects include effects associated with RRS payments made to counties, staff salary expenditures made in the local five-county area, and refuge nonsalary expenditures made in the local five-county area.

Table 28 summarizes the change in economic effects associated with Quivira Refuge operations under alternative C as compared to alternative A. Because of increases in refuge visitation and administration, alternative C would generate 4 more jobs, $155,600 more in labor income, and $219,400 more in value added as compared to alternative A.

Table 28. Change in economic effect from alternative A to alternative C.

	Employment number of full and part time jobs	*Labor income in $thousand 2012*	*Value added in $thousand 2012*
Refuge Administration*			
Direct effects	(+) 2	(+) $69.1	(+) $65.5
Total effects	(+) 4	(+) $154.2	(+) $217.2
Public use activities			
Direct effects	no change	(+) $1.0	(+) $1.6
Total effects	no change	(+) $1.4	(+) $2.2
Aggregate effects			
Direct effects	(+) 2	(+) $70.1	(+) $67.1
Total effects	(+) 4	(+) $155.6	(+) $219.4

* Refuge administration effects include effects associated with RRS payments made to counties, staff salary expenditures made in the local five-county area, and refuge nonsalary expenditures made in the local five-county area.

5.11 Cumulative Impacts

Cumulative impacts include the incremental effects of the actions for an alternative when added to past, present, and future actions. Cumulative impacts can be the result of effects that appear minor when looked at individually, but that can become substantial when accumulated over time. The Council on Environmental Quality regulations that carry out NEPA require mitigation measures when the environmental analysis process detects possible significant effects on habitat, wildlife, or the human environment, including cumulative impacts.

None of the activities proposed for this CCP would be expected to produce substantial levels of cumulative environmental impacts that would require mitigation measures. Nevertheless, the final CCP would contain the following measures to preclude significant environmental effects from occurring:

- Federally listed species would be protected from intended or unintended effects by having the activities that cause those effects banned where these species occur.
- All proposed activities would be regulated to lessen their effects on wildlife, fish, and plant species, especially during sensitive reproductive cycles.
- Monitoring protocols would be established to decide on goal achievement levels and to find effects to resources that had been unforeseen as well as to help apply adaptive resource management to make sure that wildlife and habitat resources and the human environment are preserved.
- We could revise and amend this CCP after 5 years of implementation to apply adaptive resource management to correct unforeseen effects that occurred during the first years of the plan.