

Comprehensive Conservation Plan

Quivira National Wildlife Refuge

Kansas

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Approved by

 **10-23-13**

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Kansas

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Summary



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Kansas Sunflower

We, the U.S. Fish and Wildlife Service, manage the Quivira National Wildlife Refuge, which consists of 22,135 acres in Stafford, Rice, and Reno Counties in south-central Kansas. Our staff at the Quivira National Wildlife Refuge also manages the Great Plains Nature Center in Wichita, Kansas, in partnership with the Kansas Department of Wildlife, Parks and Tourism and the City of Wichita Department of Park and Recreation.

Quivira National Wildlife Refuge is located in the Great Plains. Its purposes are to provide migration, nesting, resting, and feeding habitat for migratory birds and to develop, advance, manage, conserve, and protect fish and wildlife resources.

The refuge also provides opportunities for the public to enjoy compatible wildlife-dependent public use activities including hunting, fishing, wildlife observation, photography, environmental education, and interpretation.

This document contains the comprehensive conservation plan for Quivira National Wildlife Refuge.

The Refuge

We developed a vision for Quivira National Wildlife Refuge that describes the focus of refuge management, including what will be supported and improved in the future. This is the essence of what we want to accomplish at the refuge by the end of the life of this CCP in 15 years.

We also developed a set of goals for Quivira National Wildlife Refuge to direct our work in achieving the vision and purposes of the refuge and to outline approaches for managing the refuge's resources.

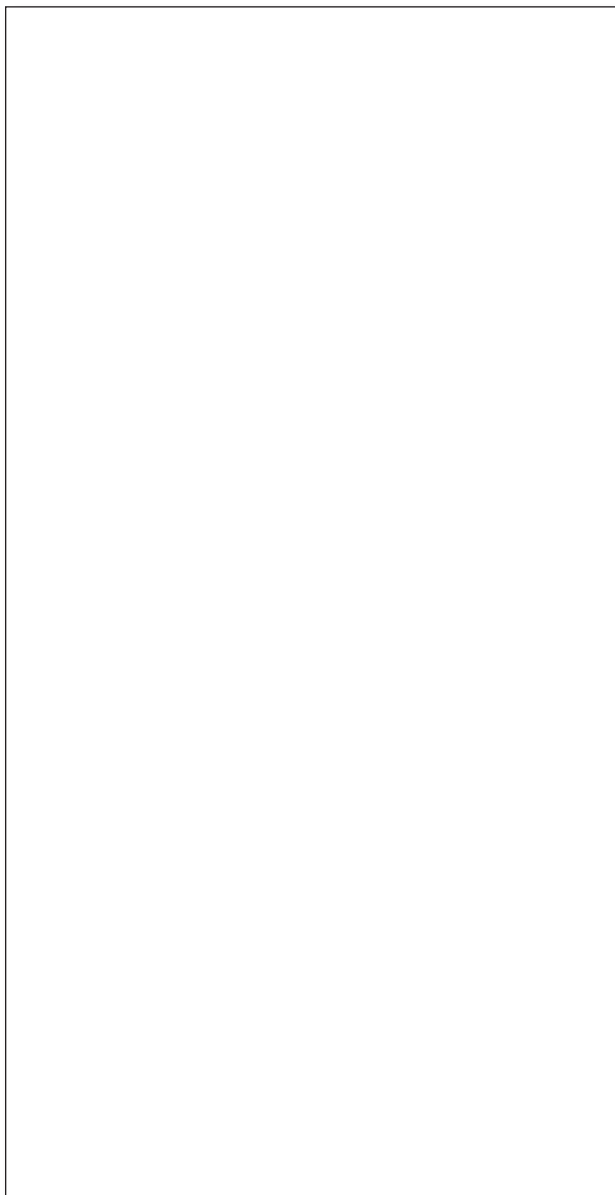


Barry Jones/FWS

This dickcissel nest was found in the Hornbaker Unit of Quivira Refuge.

Vision Statement

The vision for Quivira National Wildlife Refuge is as follows:



Goals

Our goals for Quivira National Wildlife Refuge are based on the National Wildlife Refuge System Improvement Act of 1997, the refuge's purposes, and the information we gathered during planning.

Landscape Conservation Goal

Actively protect, preserve, manage, and restore the functionality of the diverse ecosystems of the Rattlesnake Creek watershed.

Native Ecological Community Conservation Goal

Actively conserve and improve environmental conditions within refuge boundaries to promote sustainable, native ecological communities and support species of concern associated with this region of the Great Plains.

Visitor Services Goal

See that visitors enjoy quality, wildlife-dependent recreational opportunities.

Public Outreach Goal

Help visitors of all abilities understand, appreciate, and support our mission, the refuge's unique habitats, and the refuge's importance to migratory birds and other wildlife and plant species.

Cultural Resources Goal

Identify, value, and preserve the cultural resources and cultural history of the refuge and connect staff, visitors, and the community to the area's past.

Visitor and Employee Safety and Resource Protection Goal

Provide for the safety, security, and protection of visitors, employees, natural and cultural resources, and facilities of the refuge and the Great Plains Nature Center.

Administration Goal

Provide and support facilities, strategically fill approved positions and allocate staff, increase volunteer opportunities and partnerships, and effectively raise and use money to maintain the long-term integrity of infrastructure, habitats, and wildlife resources at the refuge and at the Great Plains Nature Center.

Management Direction

The comprehensive conservation plan directs the management of the Quivira National Wildlife Refuge

to meet the purposes of the refuge and to address issues.

The plan is intended to be a broad umbrella of general concepts and specific objectives for the refuge over the next 15 years. As the plan is implemented, we will develop stepdown plans with details for carrying out actions needed to achieve objectives.

Concepts and Objectives for the Refuge

We will focus on restoring native communities and promoting the potential natural range of conditions on Quivira National Wildlife Refuge that help focal resources or focal species and their respective habitats and on increasing public use opportunities for hunting. We will increase our attention and understanding of the connectedness of habitats and the effectiveness of our management. To achieve this, we will make relatively minor changes to our current operations; inventory, monitoring programs, and research; staff; and infrastructure.



Rachel Laubhan/FWS

White Pelicans

Abbreviations

Administration Act	National Wildlife Refuge System Administration Act of 1966
AFY	acre-feet per year
BSM	Big Salt Marsh
CCP	comprehensive conservation plan
CFR	Code of Federal Regulations
cfs	cubic feet per second
DOI	U.S. Department of the Interior
EA	environmental assessment
EPA	Environmental Protection Agency
°F	degrees Fahrenheit
FWS	U.S. Fish and Wildlife Service
GIS	geographic information system
GPLCC	Great Plains Landscape Conservation Cooperative
GPNC	Great Plains Nature Center
Improvement Act	National Wildlife Refuge System Improvement Act of 1997
KDWPT	Kansas Department of Wildlife, Parks and Tourism
LSM	Little Salt Marsh
NEPA	National Environmental Policy Act of 1969
NWR	national wildlife refuge
NVCS	National Vegetation Classification System
NRCS	Natural Resources Conservation Service of the U.S. Department of Agriculture
Partners	Partners for Fish and Wildlife
PLJV	Playa Lakes Joint Venture
the refuge	Quivira National Wildlife Refuge
Refuge System	National Wildlife Refuge System

Region 6	Mountain-Prairie Region 6 of the U.S. Fish and Wildlife Service
Service	U.S. Fish and Wildlife Service
U.S.	United States
U.S.C.	United States Code
USGS	U.S. Geological Survey

A glossary of these and other terms follows chapter 4.

Chapter 1—Introduction



© Bob Gress

Black-necked Stilt

We, the U.S. Fish and Wildlife Service (Service or FWS) manage the Quivira National Wildlife Refuge (Quivira Refuge or refuge), which consists of 22,135 acres in Stafford, Rice and Reno Counties in south-central Kansas. Our staff at the Quivira Refuge manages the Great Plains Nature Center (GPNC) in partnership with the Kansas Department of Wildlife, Parks and Tourism (KDWPT), and the City of Wichita Department of Park and Recreation. To address the long-term management of the refuge and the GPNC, we have developed this comprehensive conservation plan (CCP).

This chapter introduces our process for development of the Quivira Refuge CCP. It describes our involvement as well as that of the public, our partners, the State of Kansas, and other interested parties and also describes conservation issues and plans that affect the refuge.

The chapters that follow contain information we used and the results of our analysis. These form the foundation of the plan:

Chapter 2 describes the refuge and planning issues.

Chapter 3 describes the physical, biological, and social environment of the refuge.

Chapter 4 describes objectives and strategies for all aspects of managing the refuge.

The refuge is part of the National Wildlife Refuge System (Refuge System), and is located in south-central Kansas (figure 1). The GPNC is a Service administrative site and an educational facility, but it is not a unit of the Refuge System.

We have developed this CCP to provide a foundation for the management and use of Quivira Refuge. The CCP specifies the necessary actions to achieve the vision and purposes of the refuge. Wildlife is the first priority in refuge management, and public use, including wildlife-dependent recreation, is allowed and encouraged as long as it is compatible with the purposes of the refuge. The CCP will serve as a working guide for management programs and activi-

ties throughout the refuge over the next 15 years. Although this document contains management direction for the refuge, greater detail will be provided in stepdown management plans as part of carrying out the final CCP.

1.1 Purpose and Need for the Plan

The purpose of this CCP is to define the role that Quivira Refuge will play in support of the mission of

the National Wildlife Refuge System and to provide long-term guidance for managing programs and activities. The CCP will help us:

- communicate with the public and our partners in carrying out the mission of the Refuge System;
- establish a clear statement of direction for managing the refuge;
- provide refuge neighbors, refuge visitors, and government officials an understanding of our management actions on, and around, the refuge;

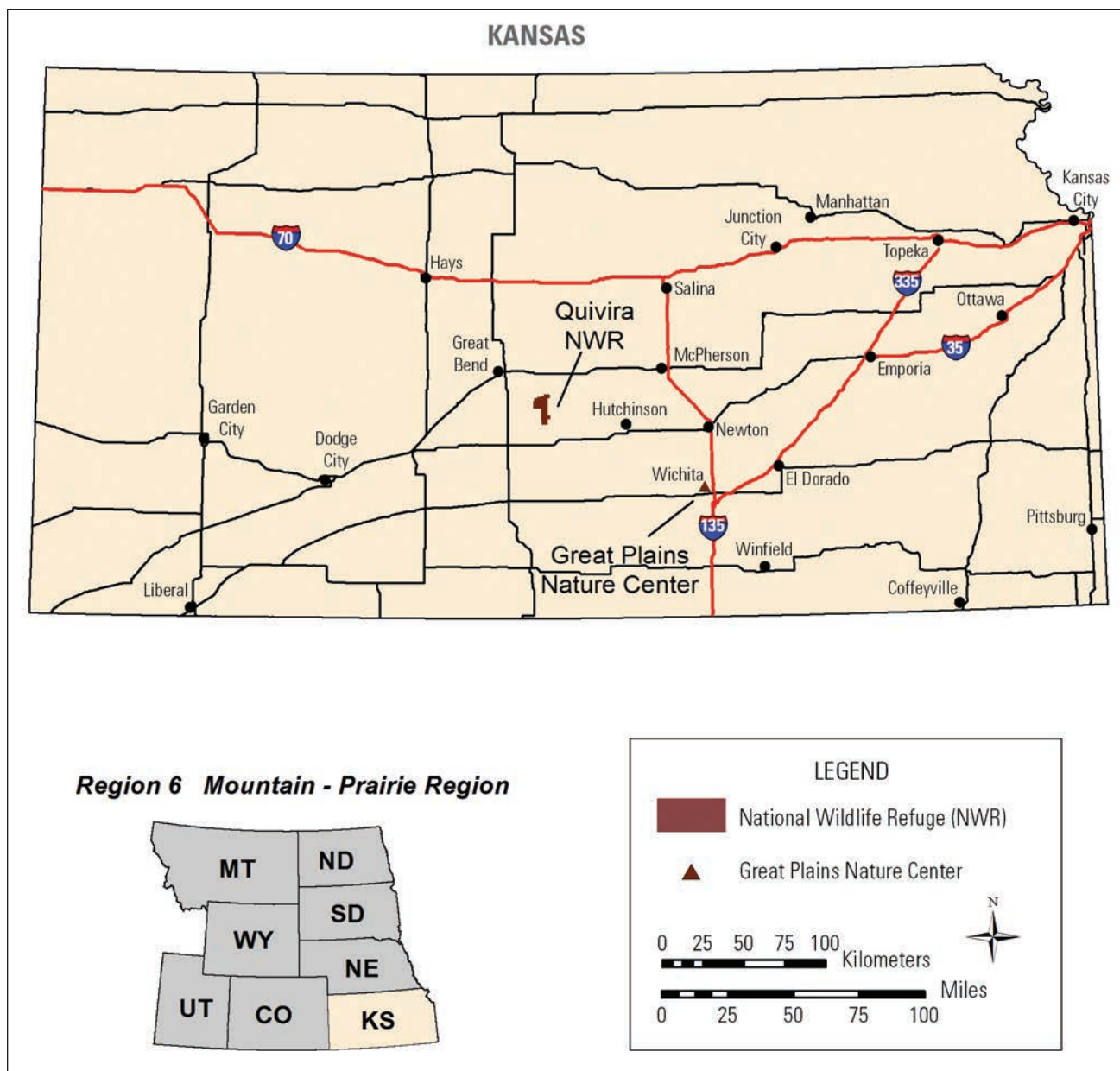


Figure 1. Quivira National Wildlife Refuge and Great Plains Nature Center, Kansas.

- make sure that our management actions are consistent with the mandates of the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act) (Public Law 105–57);
- make sure that our management of the refuge is consistent with Federal, State, and county plans;
- establish a basis for developing budget requests for refuge operation, maintenance, and capital improvement needs.

1.2 The U.S. Fish and Wildlife Service and the Refuge System



We are the principal Federal agency responsible for fish, wildlife, and plant conservation. The Refuge System is one of our major programs.

U.S. Fish and Wildlife Service



In the late 19th and early 20th centuries, America's fish and wildlife resources declined at an alarming rate, largely because of unrestricted market hunting. Concerned citizens, scientists, and hunting and angling groups joined together and generated political will for the first significant conservation measures taken by the Federal Government. These actions included the establishment of the Bureau of Fisheries in the 1870s and, in 1904, passage of the first Federal wildlife law, the Lacey Act, which prohibited interstate transportation of wildlife taken in violation of State laws. Beginning in 1903, President

Theodore Roosevelt created more than 50 national wildlife refuges across the Nation.

Over the next three decades, the United States ratified the Migratory Bird Treaty with Great Britain, and Congress passed laws to protect migratory birds, establish new refuges, and to create a source of money for refuge land acquisition. In 1940, we, the FWS, were created within the U.S. Department of the Interior (DOI), and several existing Federal wildlife functions, including law enforcement, fish management, animal damage control, and wildlife refuge management, were placed in our charge, under one organization, for the first time.

Today, we enforce Federal wildlife laws, manage migratory bird populations, restore nationally significant fisheries, conserve and restore vital wildlife habitat, protect and recover endangered species, and help other governments with conservation efforts. In addition, we administer a Federal aid program that distributes hundreds of millions of dollars to the States for fish and wildlife restoration, boating access, hunter education, and related programs across the United States.

National Wildlife Refuge System

The mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

In 1903, President Theodore Roosevelt designated the 5.5-acre Pelican Island in Florida as the Nation's first wildlife refuge for the protection of native nesting birds. This was the first time the Federal Government set aside land for wildlife. This small, but significant, designation was the beginning of the National Wildlife Refuge System.

One hundred years later, the Refuge System has become the largest collection of lands in the world specifically managed for wildlife, encompassing more than 150 million acres within more than 550 refuges and more than 3,000 small areas for waterfowl breeding and nesting. Today, there is at least one refuge in

every State including Puerto Rico and the U.S. Virgin Islands.

The Improvement Act established a clear mission for the Refuge System. It states that we must manage each national wildlife refuge to:

- fulfill the mission of the Refuge System;
- fulfill the individual purposes of each refuge;
- consider the needs of fish and wildlife first;
- include the development of a CCP for each unit of the Refuge System and to fully involve the public in the preparation of these plans;
- support the biological integrity, diversity, and environmental health of the Refuge System;
- recognize that wildlife-dependent recreation activities, including hunting, fishing, wildlife observation, photography, environmental education, and interpretation, are legitimate and priority public uses;
- allow our refuge managers to identify compatible public uses;

Besides the mission for the Refuge System, the wildlife and habitat vision for each unit of the Refuge System supports the following principles:

- Wildlife comes first.
- Ecosystems, biodiversity, and wilderness are vital concepts in refuge and district management.
- Habitats must be healthy.
- Growth of refuges and districts must be strategic.
- The Refuge System serves as a model for habitat management with broad participation from others.

Following passage of the Improvement Act, we began to carry out the direction of this new legislation including preparing CCPs for all national wildlife refuges. The Improvement Act says we will create CCPs with involvement from the public, and each refuge must have a completed CCP by 2012.

People and the Refuge System

The Nation's fish and wildlife heritage adds to the quality of American lives and is an integral part of the country's greatness. Wildlife and wild places have always given Americans special opportunities to have fun, relax, and appreciate the natural world.

Through birdwatching, fishing, hunting, photography, and more, wildlife recreation contributes millions of dollars to local economies. In particular, money generated from the taxing of sporting arms and ammunition and of fishing equipment, as authorized by the Pittman–Robertson and Dingell–Johnson Acts, respectively, has generated tens of millions of dollars. We distribute this money to the States to increase wildlife and fish populations, expand habitat, and to train hunters across the Nation. Our efforts to support national wildlife refuges also generate substantial economic help for communities that surround these refuges and wetland management districts.

Economists report that visitors to national wildlife refuges contribute more than \$1.7 billion annually to local economies. They also enjoy the nature trails, auto tours, interpretive programs, and hunting and fishing opportunities found on refuges.

1.3 National and Regional Mandates

We manage national wildlife refuges to achieve the mission and goals of the Refuge System along with the designated purpose of each individual refuge as described in establishing legislation, Executive orders, or other establishing documents. The key concepts and guidance for the Refuge System are in the National Wildlife Refuge System Administration Act of 1966 (Administration Act), Title 50 of the Code of Federal Regulations (CFR), The “Fish and Wildlife Service Manual,” and the Improvement Act.

The Improvement Act amends the Administration Act by providing (1) a unifying mission for the Refuge System; (2) a new process for determining compatible public uses on refuges; and (3) a need for each refuge to be managed under a CCP. The Improvement Act states that wildlife conservation is the priority of Refuge System lands and that the Secretary of the Department of the Interior will make sure that the biological integrity, diversity, and environmental health of refuge lands are kept. Each refuge must be managed to fulfill the Refuge System's mission and the specific purposes for which the refuge was established. The Improvement Act requires us to check

the status and trends of fish, wildlife, and plants in each national wildlife refuge.

Detailed descriptions of these and other laws and Executive orders that may affect a CCP or our carrying out of a CCP are in Appendix E—Key Legislation and Policy. Our policies for planning and the day-to-day management of refuges are in the Refuge System Manual and the “Fish and Wildlife Service Manual.”

1.4 Refuge Contributions to National and Regional Plans

Quivira National Wildlife Refuge contributes to the conservation efforts outlined in the various State and national plans described here.

Conserving the Future

A 2011 report, “Conserving the Future, Wildlife Refuges & the Next Generation” (FWS 2011), is the culmination of a yearlong process by teams of our employees to evaluate the Refuge System nationwide. The report contains 42 recommendations packaged with three vision statements for wildlife and habitat, people, and leadership. This CCP incorporates all three vision statements. Our planning team examined the recommendations in this document for guidance during CCP planning.

Partners in Flight

The Partners in Flight Program began in 1990 to address the declining population levels of many migratory bird species. Its challenge is to support functional natural ecosystems in the face of human population growth. Partners in Flight worked to identify priorities for landbird species and habitat types. Their activity has resulted in 52 bird conservation plans covering the continental United States.

North American Waterbird Conservation Plan

The North American Waterbird Conservation Plan provides a contiguous framework for conserving

and managing colonial-nesting waterbirds, including 209 species of seabirds, coastal waterbirds (gulls, terns, and pelicans), wading birds (herons and ibises), and marshbirds (certain grebes and bitterns). Geographically, the plan covers 28 countries, from Canada to Panama, as well as islands and near-shore areas of the Atlantic and Pacific oceans, the Gulf of Mexico, and the Caribbean Sea. As with Partners in Flight and other migratory bird plans, the North American Waterbird Conservation Plan has a goal to establish conservation action and to exchange information and expertise with other bird conservation initiatives. The plan also calls for establishment of “practical units for planning” for terrestrial habitats. Quivira Refuge is located within the Central Mixed-grass Prairie Bird Conservation Region in the Central Prairies Waterbird Conservation Planning Region.

North American Waterfowl Management Plan

Written in 1986, the North American Waterfowl Management Plan envisioned a 15-year effort to achieve landscape conditions that could sustain waterfowl populations. Specific plan objectives are to increase and restore duck populations to the average levels of the 1970s—62 million breeding ducks and a fall flight of 100 million birds (FWS and Canadian Wildlife Service 1986). Recognizing the importance of waterfowl and wetlands to North Americans and the need for international cooperation to help in the recovery of this shared resource, the United States and Canadian Governments developed a strategy to restore waterfowl populations through habitat protection, restoration, and enhancement. The innovative plan is international in scope and regional in its implementation. Its success depends on the strength of partnerships, called joint ventures, which involve Federal, State, Provincial, tribal, and local governments; businesses; conservation organizations; and individual citizens.

Joint ventures are regional, self-directed partnerships that carry out science-based conservation through a wide array of community participation. Joint ventures develop implementation plans that focus on areas of concern identified in the plan. Quivira Refuge lies within the Playa Lakes Joint Venture. We have considered The North American Waterfowl Management plan and the supporting efforts of the Playa Lakes Joint Venture throughout the planning process, and these will be supported and promoted within the CCP.

U.S. Shorebird Conservation Plan

In 2000, the U.S. Shorebird Conservation Plan began through a partnership between Federal, State, and nongovernmental conservation agencies and researchers mainly to sustain the quantity and quality shorebird habitat at local-to-hemispheric scales (Brown et al. 2001). The plan is meant to complement other conservation plans already developed for waterfowl, colonial waterbirds, and landbirds. The plan involves eleven regional groups, and Quivira Refuge is part of the Central Plains–Playa Lakes Region. Nearly all the 37 shorebird species listed for the region use Quivira Refuge during migration. At least six of those species have been reported nesting on the refuge, mostly common in occurrence.

Recovery Plans for Federally Listed Threatened or Endangered Species

We are responsible for administering the Endangered Species Act that requires development and implementation of federally endangered species recovery plans. Quivira Refuge contributes to the

whooping crane and interior least tern recovery plans. Management actions identified in the plans are intended to recover and conserve species and their ecosystems to levels where protection under the Endangered Species Act is no longer necessary.

Kansas State Wildlife Action Plan

The Kansas Comprehensive Wildlife Conservation Plan (Wasson et al. 2005) is a strategic, habitat-based plan that considers 315 species of greatest conservation need living within the State. Regions are identified and key habitats are ranked within the plan according to the degree of threat to their well-being. The plan lists species of concern for each key habitat along with issues of concern and strategies to address them. Issues of concern include existing data gaps, extensive changes in habitat structure over the past century, ongoing fragmentation and conversion of habitat, the spread of invasive species, and effects of natural resource management on habitat conditions. In addition, information is lacking for many species in need. Criteria used to rank the relative importance of species conservation strategies were derived from species status and considered whether or not species were regionally endemic or were subject to commercial harvest but were not eligible for



Barry Jones/FWS

Windmill located in the Reno Unit of Quivira Refuge.

money from programs such as Federal aid. Quivira Refuge is part of the Central Mixed-grass Prairie Conservation Region where mixed and sand prairie are listed first and second in importance, respectively. We support the habitats and many associated species listed in The Kansas Comprehensive Wildlife Conservation Plan.

Responding to Accelerating Climate Change

The Service expects accelerating climate change to affect the Nation's fish, wildlife, and plant resources in profound ways (Staudinger et al. 2012). While many species will continue to thrive, some may decline and some may go extinct. Others will survive in the wild only through direct and continuous human intervention. In 2010, we completed a strategic plan to address climate change for the next 50 years. This strategic plan uses three key strategies: adaptation, mitigation, and engagement. In addition, the plan acknowledges that no single organization or agency can address climate change. Partnerships are necessary across the Nation and around the world. This plan is an integral part of the DOI's strategy for addressing climate change as expressed in Secretarial Order 3289 (September 14, 2009).

The Service will use the following guiding principles from the strategic plan to respond to climate change:

- **priority setting**—continually evaluate priorities and approaches, make difficult choices, take calculated risks, and adapt to climate change
- **partnership**—commit to a new spirit of coordination, collaboration, and interdependence with others
- **best science**—reflect scientific excellence, professionalism, and integrity in all of our work
- **landscape conservation**—emphasize the conservation of habitats within sustainable landscapes, applying our strategic habitat conservation framework
- **technical capacity**—assemble and use state-of-the-art systems to meet the climate change challenge

- **global approach**—lead national and international efforts to meet the climate change challenge

1.5 Landscape-Scale Conservation

In the face of escalating challenges such as land use conversion, invasive species, water scarcity, and refuge issues that have been amplified by accelerating climate change, we have broadened our vision from applying an ecosystem approach to conservation to looking at the interrelation of ecosystems across landscapes.

Strategic Habitat Conservation

The National Ecological Assessment Team, a cooperative effort between us and the U.S. Geological Survey (USGS), wrote a report outlining a unifying adaptive resource management approach for conservation (USGS 2006). It can be applied on a landscape scale and across the entire range of a focal species or across a suite, or guild, of species. This is strategic habitat conservation, a new way of thinking and doing business that uses biological goals for focal species populations, makes strategic decisions about needed work, and constantly reassesses (figure 2).

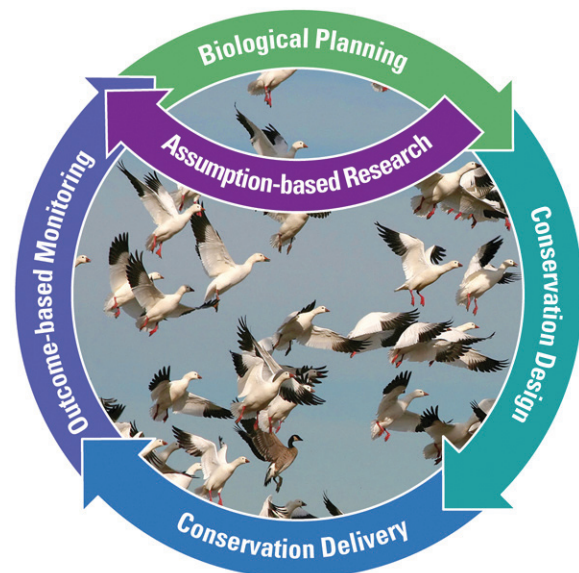


Figure 2. Basic strategic habitat conservation process.



Figure 3. Great Plains Landscape Conservation Cooperative with Quivira National Wildlife Refuge, Kansas.

Landscape Conservation Cooperatives

Strategic habitat conservation helps us to apply adaptive management across large landscapes. We used the framework of strategic habitat conservation to identify the first generation of landscape conservation cooperatives. These cooperatives are partnerships between us and Federal agencies, States, tribes, nongovernmental organizations, and universities. Designed to help planning and science, the cooperatives will help us conduct biological planning, conservation design and delivery, and monitoring programs and research.

Quivira Refuge lies within the Great Plains Landscape Conservation Cooperative (GPLCC) (figure 3). The GPLCC has grasslands, playas, saline lakes, prairie rivers, streams and riparian corridors, savannas, shrublands and sand dune habitats in parts of Kansas, Nebraska, western Oklahoma and Texas, eastern Colorado and New Mexico, and southeast Wyoming.

The GPLCC has identified priority species, which include the burrowing owl, black-tailed prairie dog, American bison, American burying beetle, mountain

plover, long-billed curlew, lesser prairie-chicken, grasshopper sparrow, Cassin's sparrow, lark bunting, Harris' sparrow, prairie falcon, northern pintail, sandhill crane, least sandpiper, western sandpiper, long-billed dowitcher, whooping crane, snowy plover, Wilson's phalarope, interior least tern, piping plover, Bell's vireo, Arkansas River shiner, Arkansas darter, Topeka shiner, Pallid and shovelnose sturgeon, paddlefish, blowout penstemon, and sand dune lizard. Many of these species have been reported on the refuge, such as burrowing owl, grasshopper sparrow, Cassin's sparrow, lark bunting, Harris's sparrow, prairie falcon, Bell's vireo, Arkansas darter, and all the listed waterfowl, shorebirds, and cranes.

The GPLCC will serve as a convening body to bring all interested parties together to address existing and future issues related to climate change and landscape-scale conservation.

1.6 Planning Process

The Improvement Act requires that we develop a CCP for Quivira Refuge. This is the final plan, and it

will guide our refuge management for the next 15 years.

We prepared this plan in compliance with the Improvement Act and part 602 (National Wildlife Refuge System Planning) of the “Fish and Wildlife Service Manual.” The actions described herein meet the needs of the Council on Environmental Quality regulations that implement the National Environmental Policy Act of 1969 (NEPA). Other requirements and guidance are contained in the Refuge System’s planning policy, issued in 2000. This policy established needs and guidance for refuge and district plans, including CCPs and stepdown management plans, to make sure that planning efforts follow the Improvement Act. The planning policy identifies several steps for CCP and environmental analysis development (figure 4).

We began in September 2009 by creating a planning team comprised primarily of our staff from the Quivira Refuge and our Mountain-Prairie Region 6 of the U.S. Fish and Wildlife Service (Region 6) Division of Refuge Planning. Added teammates included staff from some of our other divisions; staff from the KDWPT; and members of the Osage Nation. See Appendix F—List of Preparers, Consultation, and Coordination for a complete teammate list. During preplanning, we, the team, developed a mail-

ing list and identified internal issues and qualities unique to the refuge. We then identified and reviewed the purposes of the refuge and current programs, compiled and analyzed relevant data.

Scoping for the public and our partners started with a notice of intent to prepare a draft CCP and environmental assessment (EA) that was published in the Federal Register on Wednesday, February 24, 2010. We informed about the plan’s progress through news releases, the first planning update, and three public scoping meetings held between March 8 and 10, 2010, in Stafford, Great Bend, and Wichita, Kansas, between 4 and 7 p.m. Throughout the planning process we encouraged comment on, and added input to, the draft CCP and EA to comply with the public involvement needs of NEPA. Table 1 lists the specific planning steps taken to date for the preparation of this final CCP.

Coordination with the Public

The mailing list we use contains more than 270 names and has private citizens; local, regional, and State government representatives and legislators; other Federal agencies; and interested organizations.

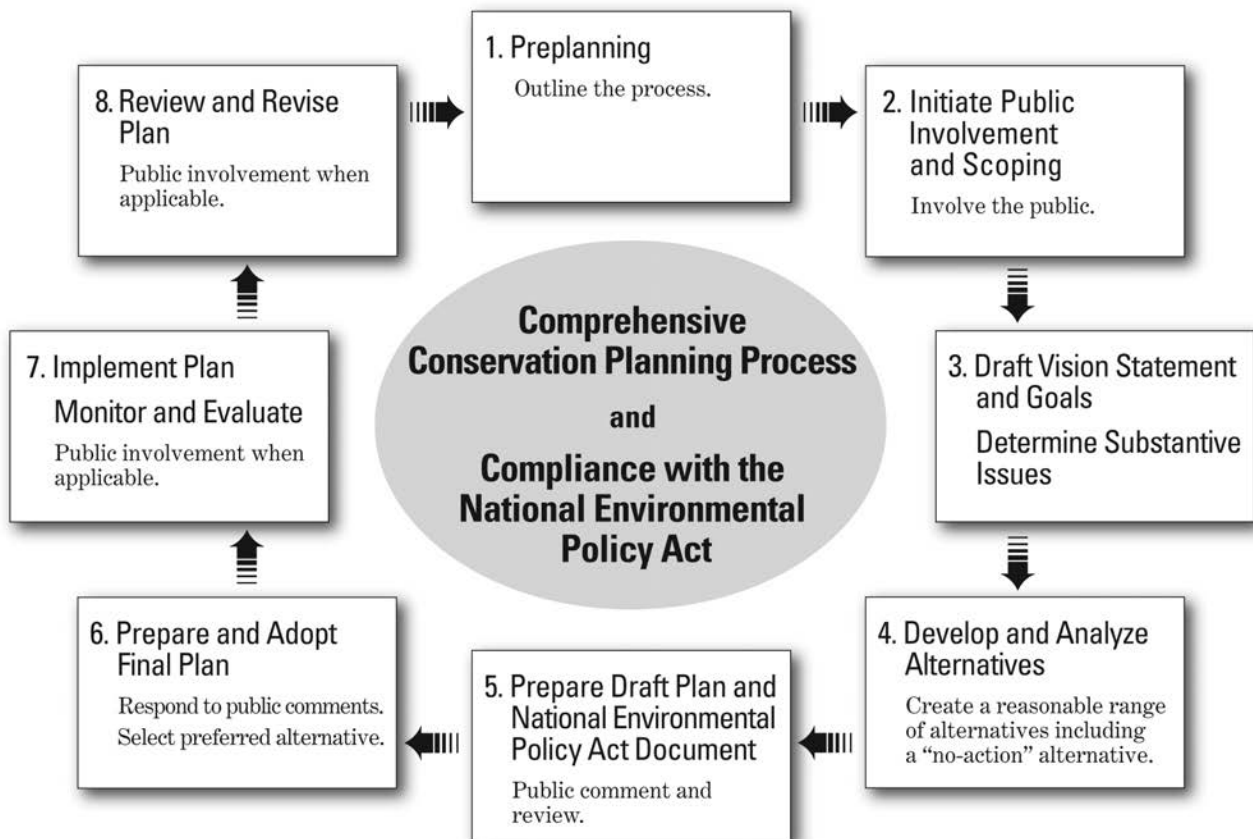


Figure 4. Process steps for comprehensive conservation planning and associated environmental analysis.

Table 1. Summary of the Comprehensive Conservation Plan process for Quivira National Wildlife Refuge, Kansas.

<i>Date</i>	<i>Event</i>	<i>Outcome or purpose</i>
September 22–23, 2009	Preplanning meeting	Toured the refuge, formed into an initial planning team, started the mailing list, and discussed the planning schedule and data needs.
October 5, 2009	Work plan	Completed the work plan.
October 30, 2009	Planning team invitation letters mailed	Service Regional Director invited tribal nations and the KDWP to be on the planning team.
February 2010	Planning update	Mailed the first planning update to those on our mailing list. The update described the planning process and announced upcoming public scoping meetings.
February 24, 2010	Notice of intent	Published the notice of intent to prepare a CCP in the Federal Register (volume 75, number 36, pages 8394–8395).
March 8–10, 2010	Public scoping meetings	Held public meetings in Stafford, Great Bend, and Wichita, Kansas. The public had an opportunity to learn about the CCP process and provide comments.
March 9–10, 2010	CCP kickoff and vision and goals meeting	Reviewed the refuge purposes, identified refuge qualities and issues, and developed a draft vision statement and goals for the refuge.
March 22–23, 2011	Hydrogeomorphic method analysis project update	Reviewed the progress and findings of the hydrogeomorphic analysis project.
November 2–3, 2011	Alternatives development planning meeting	Discussed management alternatives.
March 13–14, 2012	Environmental consequences and choosing proposed action workshop	Reviewed the environmental consequences for the alternatives, and to select a proposed action alternative.
May 1–2, 2012	Objectives and strategies work session	Developed objectives and strategies for the proposed action alternative.
May–June 2012	Draft plan preparation	Prepared the draft CCP and EA.
November 2012	Draft plan internal review	Team and other Service staff reviewed the draft CCP and EA and provided comments to help clarify the analyses and provide consistency.
January–March 2013	Draft plan preparation	Completed the draft plan for public review.
April 2013	Draft plan public review	The planning team completed the draft plan for distribution to the public for review.
April 2013	Planning update	Mailed the second planning update to those on our mailing list. The update announced upcoming public scoping meetings.
April–May 2013	Public scoping meetings	Public meetings were held in Great Bend, Stafford, and Wichita, Kansas.
June–September 2013	Public comments review	The planning team reviewed the public comments and determined needed changes for the final CCP.
October 2013	Decision on preferred alternative	The Regional Director selected the preferred alternatives and signed the finding of no significant impact.
November 2013–April 2014	Final Plan preparation	The planning team finished revising and editing the final CCP for printing and distribution.

See Appendix D—Public Involvement for more detail.

We mailed the first planning update using our mailing list, and we made updates available at the public scoping meetings. The update included information on the history of the refuge and on the CCP process. It included an invitation to attend the public scoping meetings and contained information on how to be placed on the CCP mailing list as well as on how

to submit comments to us. Our planning team leader accepted emails at address: toni_griffin@fws.gov.

We held three public scoping meetings from March 8 to March 10, 2010. We used an open house format and set up stations tended by our staff to provide information and answer questions. Attendees were encouraged to ask questions and offer comments. We recorded verbal comments, and each person was given a comment form that could be used to submit added thoughts or questions in writing.

Written comments were due March 31, 2010. We received more than 80 comments orally and in writing during the scoping process. We received letters from 3 organizations (National Wild Turkey Federation, Defenders of Wildlife, Great Bend Convention and Visitors Bureau) and from 12 individuals. Each member of our team reviewed the comments, and we considered them throughout the planning process.

State Coordination

Our Regional Director for Region 6 of the Service sent a letter to KDWPT, inviting them to take part in our planning process. As a result, three of their representatives joined our planning team.

We mailed the first planning update to the offices of U.S. Representatives Lynn Jenkins, Jerry Moran, and Todd Tiahrt and U.S. Senators Sam Brownback and Pat Roberts for Kansas telling them of the planning process, inviting them to attend our public scoping meetings, and asking them to provide comments on issues to be addressed during the planning process. We also mailed planning updates to Kansas Governor M. Parkinson, to Kansas State senator Ruth Teichman, and to State representatives Mitch

Holmes and Dennis Moore. We also invited these elected officials to attend our scoping meetings by phone.

Tribal Coordination

Our Regional Director for Region 6 sent a letter to tribes that have been identified as possibly having a cultural and historic connection to the Quivira Refuge area. The Citizen Potawatomi Nation, Kickapoo Tribe in Kansas, Kickapoo Tribe of Oklahoma, Kiowa, Osage Nation of Oklahoma, Prairie Band of Potawatomi of Kansas, Seneca-Cayuga Tribe of Oklahoma, Shawnee, and Wyandotte Nation of Oklahoma tribal councils all received this letter.

The Osage Nation tribal council responded to our letter, and they appointed Dr. Andrea Hunter, tribal historic preservation officer; James Munkres, archaeologist I; Rebecca Brave, Native American Graves Protection and Repatriation Act assistant; and Bradley P. Stumph, natural resource specialist, to represent them on our planning team. These tribal representatives attended two planning meetings, our vision and goals workshop and our hydrogeomorphic method analysis project update session. The Osage



Rachel Laubhan/FWS

Silky Prairie Clover

Nation reviewed the draft CCP and EA during internal review, and they provided comments.

Other tribal councils did not respond to the letter from our Regional Director, but we continued to invite their comments.

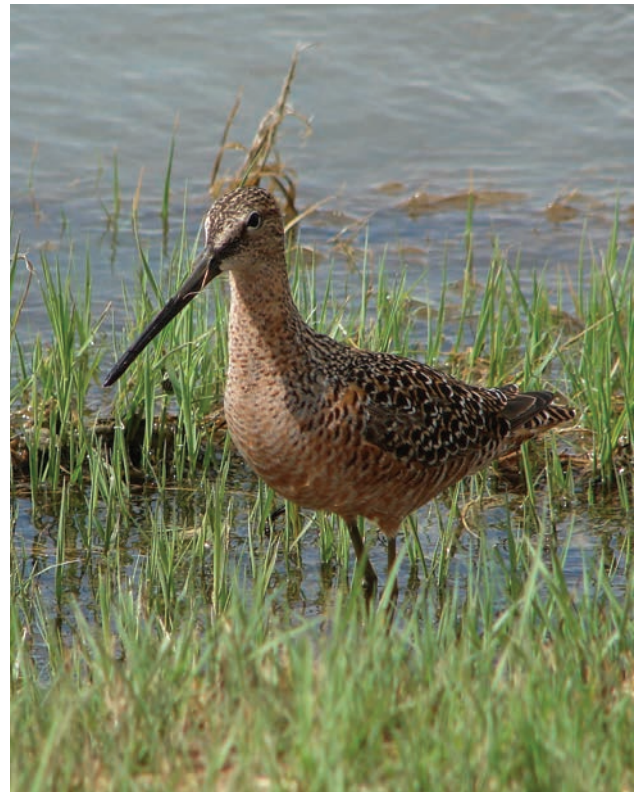
Results of Scoping

We used the comments, collected from scoping meetings and correspondence, in the development of a final list of issues that were addressed in the draft CCP and EA. We decided which alternatives could best address these issues. The planning process ensures that we resolve or give priority to issues with the greatest effect on the refuge resources and programs over the life of the final CCP. Chapter 2 contains the issues we identified, along with a discussion of effects on resources. In addition, we considered suggested changes to current refuge management presented by the public and other groups.

The Draft Plan

Availability of the draft CCP and EA for Quivira Refuge was announced in the Federal Register on April 22, 2013, and comments on this document were collected through May 31, 2013. Three public meetings to discuss this plan were announced in a planning update released in April 2013. These meetings were held from April 29 to May 1, 2013 in the local communities of Great Bend, Stafford, and Wichita, Kansas. Meeting attendees were given the opportunity to submit comments. Comments were also collected online, by email, and by mail.

The public commented on the draft CCP and EA during a review period. We recorded all comments, oral and written. The planning team then reviewed them. Some modifications were made to this final CCP based on the public review. Appendix D has



Rachel Laubhan/FWS

Long-billed Dowitcher

more detail about our involvement with the public, including responses to substantive public comments on the draft CCP and EA.

The Final Plan

Approved by the Regional Director, this final CCP directs the management of the Quivira National Wildlife Refuge to meet the purposes of the refuge and to address issues.

The plan is intended to be a broad umbrella of general concepts and specific objectives for the refuge over the next 15 years. As the plan is implemented, we will develop stepdown plans with details for carrying out actions needed to achieve objectives.

Chapter 2—The Refuge



Dan Severson/FWS

Whooping Crane

This chapter explains the establishment, management history, purpose and special values of Quivira National Wildlife Refuge. Planning issues and a discussion of their effects on resources are also summarized here. Our planning process sought to resolve issues that have the greatest effect on refuge resources and programs, and it ranked these issues for further consideration over the life of the plan.

2.1 Establishment, Acquisition, and Management History

The following section describes the establishment, acquisition, and management history of Quivira Refuge.

Establishment

In May 1955, the Migratory Bird Conservation Commission approved the establishment of, and the processing of purchase agreements for, the “Great Salt Marsh National Wildlife Refuge” to recognize two unique, historic saltmarsh and salt flat areas, the Big Salt Marsh (BSM) and the Little Salt Marsh (LSM).

In 1958, the name of the refuge was changed to Quivira National Wildlife Refuge after the Spanish term for the area. Quivira Refuge has a mixed-grass sand prairie ecosystem that contains a diversity of grassland and wetland vegetation associations (Faber-Langendoen 2001) with a range of salinities, stream corridors, salt flats, sand dunes and hills, and agricultural lands.



Barry Jones/FWS

Boiling Springs

Acquisition History

After establishment, acquisitions were made to bring the refuge area to 21,820 acres by 1969. In August 1991, two Hornbaker tracts totaling 116 acres southwest of the refuge were acquired from the Farmers Home Administration. Approximately 200 more acres were bought from Richardson in 1998 in the BSM area. These acquisitions enlarged the refuge to 22,135 acres (table 2)

Management History

Water management has played a major role at the refuge. In 1957 we filed for a “senior” right to divert 22,200 acre-feet of water from Rattlesnake Creek to refuge wetlands (Estep 2000, Striffler 2011). In 1982, we filed a Notice of Proof of completion of work for water right permit #7571. In 1996, the Kansas Division of Water Resources certified a permit for only 14,632 acre-feet of water diversion from Rattlesnake Creek because we could not show that we had diverted 22,200 acre-feet during the period of proof.

The current Kansas Water Right for the refuge is 14,632 acre-feet per year not to exceed 300 cubic feet per second from Rattlesnake Creek. The actual quantity of water normally diverted from Rattlesnake Creek for refuge management is less than this water right, often because sufficient quantities are not available at the time water is desired to achieve refuge habitat goals and objectives. In years with below-average precipitation and heavy demands for agricultural irrigation, the refuge receives insufficient quantities to exercise all habitat management

options. Water is not metered when it leaves the refuge mostly because water rights are absent downstream where it enters the Arkansas River.

Water control structures may be found in figure 5.

2.2 Purposes

Every unit of the Refuge System has one or more purposes for which it was established. They are the foundation on which to build all management programs, from biology and public use, to maintenance and facilities. No action that anyone takes may conflict with them. The purposes are found in the legislative acts or administrative orders under which lands are either transferred or acquired, or conservation easements are established, for a refuge unit. An individual unit may contain lands that have been acquired under a variety of transfer and acquisition authorities, which then gives the unit more than one purpose.

On May 3, 1955, Quivira Refuge was established under these authorities and for these purposes:

- Migratory Bird Conservation Act (16 United States Code [U.S.C.] § 715d)
 - for use as an inviolate sanctuary, or for any other management purpose, for migratory birds
- Fish and Wildlife Act of 1956 (16 U.S.C. § 742f(a)4)
 - or the development, advancement, management, conservation, and protection of fish and wildlife resources
- Fish and Wildlife Act of 1956 (16 U.S.C. § 742f(b)1)
 - for the benefit of the United States Fish and Wildlife Service, in performing its activities and services

The goals, objectives, and strategies identified in this CCP support these purposes

Table 2. Land acquisition history of the Quivira National Wildlife Refuge, Kansas.

Acres reserved from public domain	Acres acquired by other Federal agency	Acres donated	Acres bought	Acres in agreement easement or lease	Total acres in refuge	Total cost of land acquisition
0	116	199.2	21,820.1	0	22,135.3	\$2,059,238

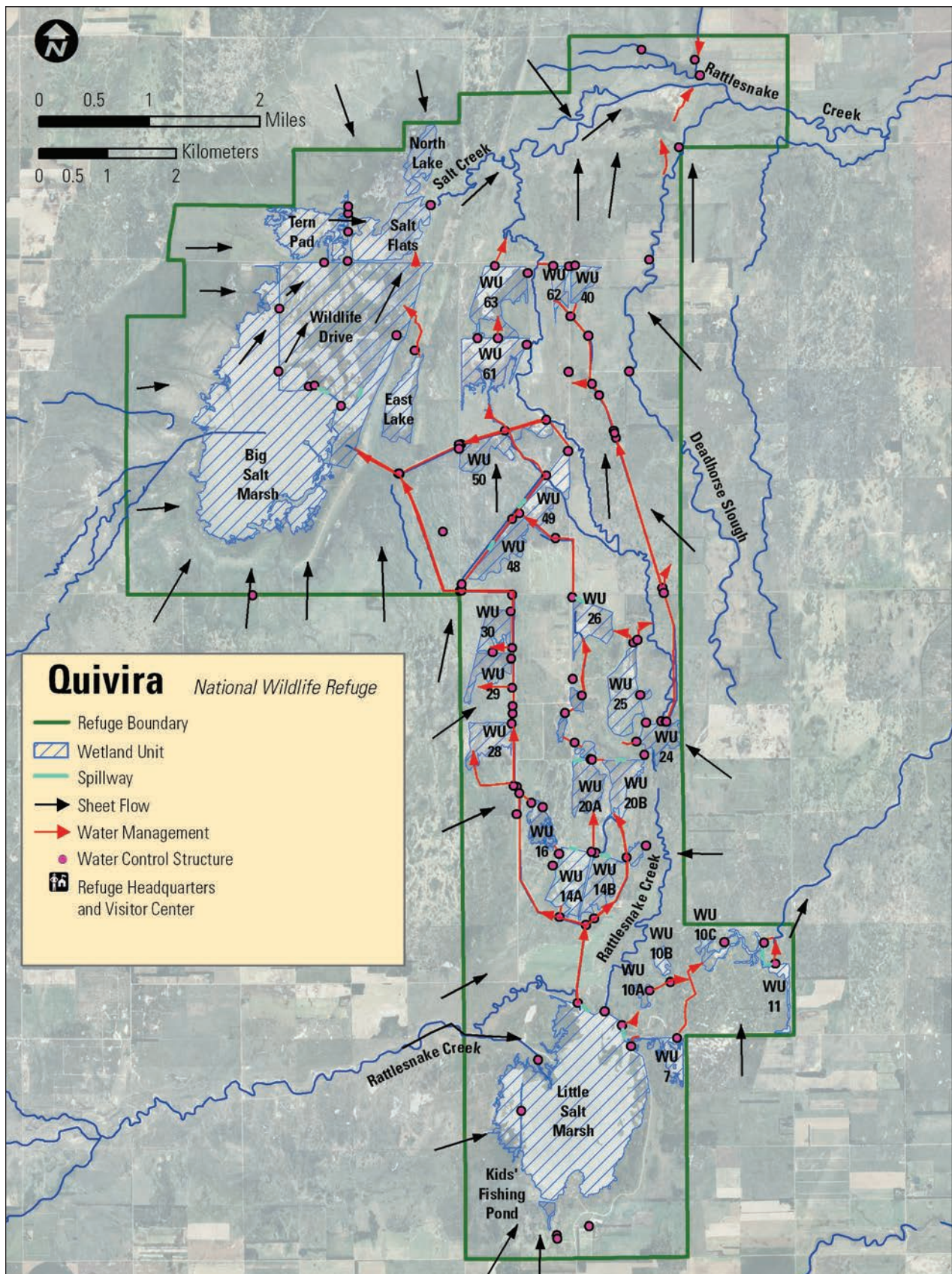


Figure 5. Water control structures, Quivira National Wildlife Refuge, Kansas.

2.3 Vision

We developed a vision for Quivira Refuge that describes the focus of refuge management, including what will be different in the future. This is the essence of what we want to accomplish at the refuge by the end of the life of this CCP in 15 years. The vision for Quivira Refuge is as follows:

Near the confluence of the Rattlesnake Creek and Arkansas River in central Kansas, water remains the great driver of a diverse complex of saltmarsh and unique native sand prairie community that is Quivira National Wildlife Refuge. The combination of these productive habitats as well as the refuge's midcontinent location continue to attract millions of birds needing to replenish essential reserves and to find protection in the mosaic of largely open grasses, sedges, rushes, and water. Through environmental education and outreach, we promote understanding and appreciation of the refuge's dynamic landscapes. For visitors, each moment is unique—the smell of moist earth and salty air, the primitive call of a crane, the whispering bluestem, the cacophony of geese, the early steps of a snowy plover chick, or the discovery of a subtle pattern or design in nature. In a land of recurring extremes, ongoing collaboration between refuge professionals, partners, and the public sustains a healthy system. Through land stewards transcending refuge boundaries, the integrity of these ecosystems are conserved with awe, respect, and appreciation of the gifts it offers for all to receive.

2.4 Goals

We also developed a set of goals for Quivira Refuge based on the Improvement Act, the refuge's purposes, and the information we gathered, with help from the public, during planning. These goals will direct our work in achieving the vision and purposes of the refuge, and they outline approaches for managing the refuge's resources.

Landscape Conservation Goal

Actively protect, preserve, manage, and restore the functionality of the diverse ecosystems of the Rattlesnake Creek watershed.

Native Ecological Community Conservation Goal

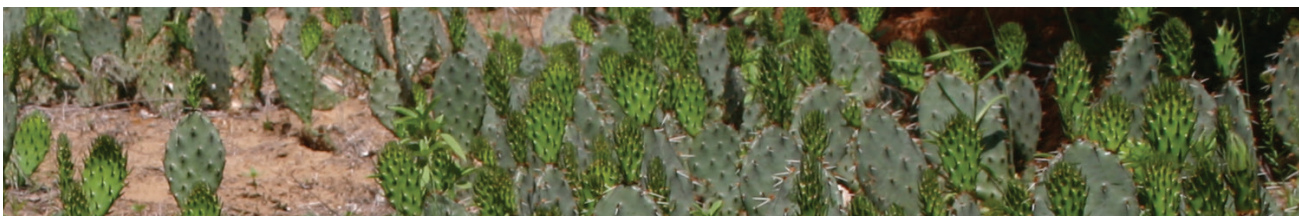
Actively conserve and improve environmental conditions within refuge boundaries to promote sustainable, native ecological communities and support species of concern associated with this region of the Great Plains.

Visitor Services Goal

See that visitors enjoy quality, wildlife-dependent recreational opportunities.

Public Outreach Goal

Help visitors of all abilities understand, appreciate, and support our mission, the refuge's unique habitats, and the refuge's importance to migratory birds and other wildlife and plant species.



Prickly Pear

Cultural Resources Goal

Name, value, and preserve the cultural resources and cultural history of the refuge and connect staff, visitors, and the community to the area's past.

Visitor and Employee Safety and Resource Protection Goal

Provide for the safety, security, and protection of visitors, employees, natural and cultural resources, and facilities of the refuge and the GPNC.

Administration Goal

Provide and maintain facilities, strategically acquire and allocate staff, increase volunteer opportunities and partnerships, and effectively raise and use money to support the long-term integrity of infrastructure, habitats, and wildlife resources at the refuge and at the GPNC.

2.5 Special Values

The public helped us to name the special values of Quivira Refuge, which are the characteristics and features that make it special, valuable for wildlife, and worthy of national wildlife refuge status. Special values can range from unique biological features to something as simple as “a quiet place to see a variety of birds and enjoy nature.”

Naming the special values for Quivira Refuge, listed below, helps us to recognize its worth and to make sure that these values are preserved, protected, and enhanced through planning.

Rare, Diverse, and Quality Habitat

Quivira Refuge contains unique systems, including inland saltmarsh and native sand prairie. The saltmarsh and alkali flats support a diverse range of wildlife species that use the refuge for migration and nesting. The refuge contains quality grassland habitat that is complimented by a grassland buffer that surrounds the refuge and creates large blocks of contiguous habitat for grassland-dependent species,

including prairie-chicken. The refuge has large areas of wetland habitat that supports many wildlife species and has the potential for moist soil management.

Wildlife Species

Quivira Refuge is located in a transition zone providing habitat for both eastern and western migratory bird species. Large numbers and concentrations of these birds occur on the refuge, and a variety of rail species are also present. The refuge also supports a diverse population of reptiles and amphibians, as well as a prairie dog town.

Species of Concern

The refuge provides critical habitat for the federally listed whooping crane and State-listed western snowy plover. Bald eagles winter and nest on the refuge, and federally listed interior least terns also nest here.

Water Resources

Quivira Refuge has senior water rights, approximately 14,000 acre-feet per year, and water management capability on the refuge is good because of a strong network of infrastructure that has water control structures and dikes.

Communities and People

Local, regional, and international communities support Quivira Refuge. It has a Friends group and boosts the economies of surrounding, rural communities. Less than 3 percent of Kansas' lands are owned by the public, and the refuge makes up a large part of that. In addition, the refuge feels little urban encroachment.

Education and Visitor Services

Quivira Refuge offers many opportunities for wildlife-dependent recreation, including hunting, fishing, wildlife observation, photography, environmental education, and interpretation. Forty percent

of the refuge, or approximately 9,000 acres, is open to hunting. All of the refuge is open to fishing and to foot traffic for wildlife observation and photography year round, except when temporary closures are necessary for events like eagle or tern nesting. Quivira Refuge also comanages the GPNC in Wichita, which complements and supports its purposes.

Cultural Resources

The area is rich in Native American history, as generations of people came here for both food and water. As such, the potential exists for cultural resources to be found on Quivira Refuge.

Facilities and Infrastructure

There is good access to, and within, Quivira Refuge. Directions to the refuge are well signed, and many sites within the refuge are accessible to persons with disabilities.

Special Designations

Quivira Refuge has many special designations including: Ramsar Site, as identified by Wetlands of

International Importance; Western Hemisphere Shorebird Reserve Network contributor; one of the Eight Wonders of Kansas; and Important Bird Area, as identified by the National Audubon Society. We have also designated the Santana Research Natural Area on the refuge.

2.6 Planning Issues

Based on an analysis of comments collected from the public, input from our staff, and a review of the needs of the Improvement Act and NEPA, we identified several key issues for Quivira Refuge. These were used to create alternatives for future management and are summarized below.

Water Quantity and Quality

Agriculture dominates the area, oil production is common, and water rights have been overappropriated within the water management district. These water resource and land use trends relate to additional concerns of current and future characteristics of water quality. Future water availability and quality may not be assured, yet adequate water quantity and chemistry are critical factors of refuge saltmarsh and wetland communities. Substantial declines in the



White-tailed Deer

water table would also likely affect grassland and meadow habitats.

Tree Management

There are differences of opinion about tree management on Quivira Refuge. Prairie restoration, with a reduction in current tree coverage, is generally understood and supported. Yet, some would prefer that we keep tree coverage at a higher level for a variety of reasons.

Whooping Crane Closures

When whooping cranes, which are federally listed as endangered, are present, Quivira Refuge closes to hunting to avoid disturbing them and to prevent accidentally shooting them. Whooping crane arrivals and departures are unpredictable, which makes it difficult for hunters to plan ahead. Public lands for hunting in Kansas are also limited, which exacerbates their frustration. And yet, while disappointing hunters, whooping cranes do attract birders.

We at the refuge have received many requests to reconsider our refuge-wide closures. At the nearby Cheyenne Bottoms Wildlife Area, KDWPT has successfully protected whooping cranes by using partial area closures. This may prove to be effective for us as well.

Prohibiting the Collection of Shed Antlers

Deer population density on Quivira Refuge is relatively high, and those who have an interest in shed antler collection do not support our decision to prohibit this activity on all refuges in Kansas. However, collecting or taking of any plant, wildlife or parts thereof from a national wildlife refuge without a permit is specifically prohibited under Title 50 CFR Part 27.61.

Deer and Turkey Hunting

Deer and turkey hunting have never been approved as a public use activity or management strategy on Quivira National Wildlife Refuge, but there is interest in allowing these hunting activities



Eastern Racer

Rachel Laubhan/FWS

in the future. Populations of these species continue to increase, and research suggests that effective population management may require a control of some sort both on and off refuge lands.

Increasing Public Use and Wildlife Compatibility

We are aware of potential benefits and harm to natural resource conservation brought on by an increasing interest in birding and ecotourism. Whooping cranes and rare birds quickly attract many birders and photographers when they appear on the refuge. According to the National Wildlife Refuge System Compatibility Policy, these wildlife-dependent recreational use activities are welcome as long as they are found not to interfere with, or detract from, the fulfillment of the Refuge System mission or the purposes of the refuge.

Chapter 3—Refuge Resources and Description



© Bob Gress

Pectoral Sandpiper

This chapter describes the environment found at Quivira Refuge that will be affected by the actions we choose to enact as a result of the planning process contained in this CCP. The environment has physical and biological parts and elements that have been created by humans, such as cultural resources, special management areas, visitor services, operations and socioeconomics.

3.1 Physical Environment

The following sections describe aspects of the physical environment of the refuge. Physical characteristics include climate, climate change, air quality, geography and physiography, water resources, and soils. Many regional descriptions of the physical environment have been completed and may be reviewed

for more detail, such as a report on the Rattlesnake Creek Subbasin available through the Kansas Department of Agriculture (2006).

Climate

The refuge climate is dry sub humid, lying along the transition boundary between the rain shadow of the Rocky Mountains and the warm, moist air currents of the Gulf of Mexico. Regional weather patterns depend on the interaction of these two air masses (Sophocleous and Perkins 1992).

Refuge habitat conditions are influenced greatly by climate and management strategies, and prescriptions are adjusted based on seasonal and annual fluctuations in precipitation, temperature, and evaporation. Weather data have been recorded from a station in Hudson, Kansas, about 8 miles west of

the refuge, since at least 1941. Based on this historical data, the coldest month is January, with average low and high temperatures of 20 and 41 °F, respectively, and the warmest month is July, with average low and high temperatures of 68 and 95 °F, respectively. Annual precipitation varies between 13 and 41 inches, with a long-term average of 24–25 inches. It rains an average of 74 days per year in Stafford County and 71 percent of the precipitation falls during the growing season, which averages 185 days between April and September. Mean snowfall is 20 inches per year, yet substantial accumulations seldom occur. The average annual free-surface evaporation is about 64 inches (Sophocleous et al. 1997), with rates being highest during the summer months (Latta, 1950).

Because of its location at a climatic boundary prone to multiple air masses, Kansas is also vulnerable to strong thunderstorms, especially in the spring months. Many of these storms become super cell thunderstorms. According to statistics from the National Climatic Data Center, Kansas has reported more tornadoes (for the period January 1, 1950 through October 31, 2006) than any state except Texas, and it averages more than 50 tornadoes annually (NOAA, 2006). Prevailing winds are from the southeast during the summer months, May through September. Northeast winds are common throughout the winter months, October through April. Average wind velocities are moderately strong in all seasons and reach their greatest velocities during the spring. The mean, 0.02-mile (30-meter) wind speeds for Quivira Refuge range from 13.4 to 14.5 miles per hour (Kansas Corporation Commission 2008).

Climate Change

Climate change is the preeminent issue for conservation in the future. Over the next two decades, a warming of about 0.36 °F per decade is projected for the planet as a whole. Warming is expected to continue for centuries, even if greenhouse gas emissions are stabilized, because of the substantial time lags of climatic processes (Christensen et al. 2007).

Along with this projected warming, atmospheric moisture transport and convergence is projected to increase, resulting in a widespread increase in annual precipitation over most of the continent, except the south and southwestern part of the United States (Christensen et al. 2007). This increased precipitation is more likely to occur in winter and spring months, rather than in the summer (Christensen et al. 2007). It is also considered likely that extreme weather, such as heat waves and flooding, will become more frequent. Increases in annual precipitation may be partially offset by increases in evaporation. Moisture availability, rather than just

precipitation, is an essential resource for plants and animals.

Such changes will influence many environmental factors that will affect our management of Quivira Refuge, such as the balance of water inflows and outflows, water runoff patterns, the rate and extent of erosion, aquifer recharge rates, water quality parameters, and species abundance and distributions. However, climate change predictions are generally applied at large spatial scales, and much uncertainty remains about the use of this information at local scales (Weins and Bachelet 2010). Thus, it is difficult to plan for specific management changes on the refuge based on our current understanding.

While finding specific management actions to address climate change are not possible at this time, a report on the potential effects of human-caused climate change was prepared for the Playa Lakes Joint Venture (PLJV) region with a focus on habitats (Matthews 2008) (figure 8). This report synthesized much of the relevant information available at the time, including works of the Intergovernmental Panel on Climate Change and many peer-reviewed publications. The author notes that while global and regional shifts in climate are natural, adapting to recent changes is different because of landscape modifications like habitat fragmentation, invasive species, and water quality degradation. Species most vulnerable to climate change have restricted ranges, specialized habitat needs, and are largely migrants. Predicted potential climate change effects on habitat within the PLJV region cited in this report are summarized in the list below. It is important to note differences in climate change predictions at various scales of the PLJV region, such as overall, southwest, and northeast, though all scales are important considerations in the management of natural resources that occur on the refuge. The author also qualifies predictions with the understanding that local variations in weather patterns, like the amount and intensity of precipitation, are a continuing characteristic of the region.

Predicted Potential Effects of Climate Change at the Scale of the Playa Lakes Joint Venture Region

- decreasing annual precipitation in contrast to the larger Great Plains region
- increasing winter temperatures causing less snow, or frozen, precipitation and less ice cover and more rain, with precipitation falling later and melting earlier
- decreasing water volume in wetlands in fall and winter leading to more shallow habitat

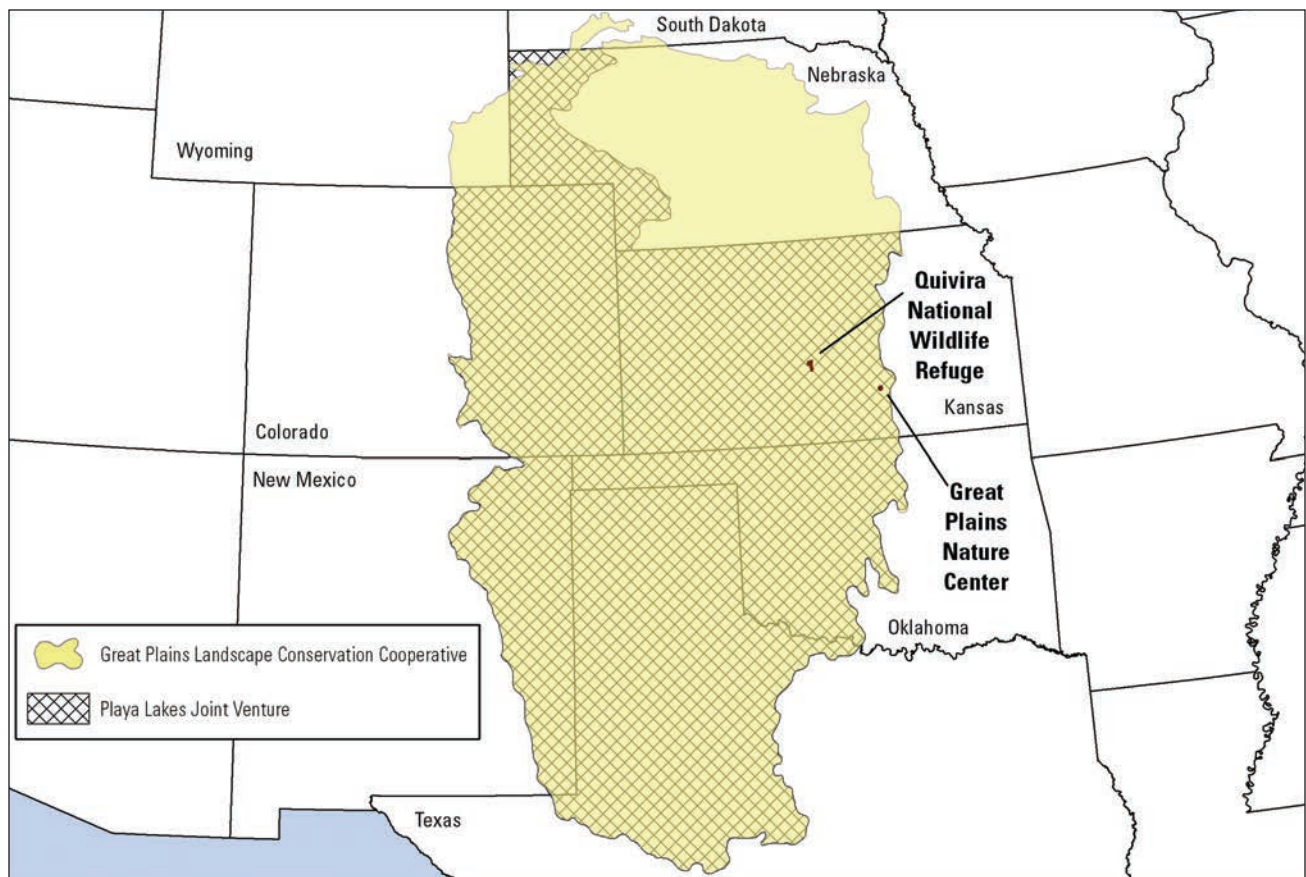


Figure 6. Playa Lakes Joint Venture region, Quivira National Wildlife Refuge, Kansas.

- decreasing presence of flooded, or functioning, wetlands, especially more ephemeral and shallow types—which compose most of the wetlands in the PLJV region—or those that respond quickly to changes in precipitation and evaporation, like playas, warm-water sloughs, floodplain marshes, and wet meadows, resulting in decreased cooler, deeper water during warm periods, particularly in the summer and early fall
- increasing rate of increase in summer temperatures
- changing plant species productivity, abundance, and ranges across all habitat types and partly related to the differences in their tolerance levels or adaptation strategies to events like drought, flooding and fire
- changing distribution of wetlands across the landscape
- decreasing connectivity among wetlands by ground water or by periods of high precipitation and flooding
- increasing likelihood of disease transmission because of higher concentrations of waterfowl in limited habitat areas, higher winter temperatures, and more
- changing species composition, or abundance, of fish
- changing water column turnover cycles for larger, deeper wetlands that leads to the reduced overall productivity of open-water habitat
- decreasing sensitivity and increasing resiliency of sandhill wetlands, or those influenced by ground water—not playas, or wetlands dependent on precipitation and with no, or limited, connectivity to ground water—to temperature and precipitation extremes during the next one to two decades or longer with changes in erosion rates possibly causing sandhills to move
- sustaining local populations of specialized arthropod species in saline wetlands may be affected by persistent dry conditions and

sustaining bird species with great dependence on saline wetlands could be negatively affected by more extreme flooding and drying events

- increasing drought frequency
- increasing abundance of fully flooded playas, or temporary, seasonal wetlands, in the spring
- increasing abundance of fast runoff events
- increasing sedimentation rates
- decreasing food availability for birds with shifts in the quality and state of wetlands, such as moving from a water condition that is dominated by plants large enough to be seen by the human eye, which results in oxygen-rich water, to one that support a dense growth of algae that depletes oxygen
- likely increasing generalist invasive exotic species
- decreasing overall water quality
- eastern shifting of the central United States and Canada migratory flyway
- decreasing sensitivity to climate changes by larger catchments and watersheds with more permanent flowing water relative to smaller catchments and watersheds with less permanent flowing water
- altering flow regimes for rivers and streams in the PLJV region, with lower flows occurring in later summer and early fall and higher flows occurring in the winter and spring and with low-order streams being more directly affected by winter and spring flooding events than the middle, and lower, reaches of rivers
- emerging economic and political trends and resultant changes in land use patterns, such as agricultural strategies and practices, urbanization, and fire suppression, will decide natural resource effects
- shifting distribution—moving north and east into the PLJV region—of nematodes, insects and other arthropod species that are native to North America but exotic to region
- increasing grassland productivity with the increased rates of spring precipitation, while increasing levels of atmospheric carbon dioxide and other complex feedback mechanisms may affect the duration of this trend
- accentuating thermal effects on grassland habitats by insects, notably plant pollinators and herbivores will affect associated predator–prey relationships and influence species abundance and phenologies, like the timing of breeding, migration, and other life events
- increasing fire on the landscape to help most grassland habitats, while creating uncertainty about what grassland types and conditions will follow burns over the long term
- affecting prairie dog communities, but how is not known, with one study suggesting that prairie dog herbivory might support their resilience to climate change

Predicted Potential Effects of Climate Change on Areas within the PLJV Region:

- An increasingly extreme annual precipitation gradient between the southwestern and northeastern parts of the PLJV region will develop—uncertainty makes drawing clear boundaries extremely difficult. It is likely that, by midcentury, areas farther north, perhaps to Nebraska, will be similar to the current thermal regime of the southern high plains.
- For northern and eastern parts of the PLJV region, including the refuge area, there may be an increase in annual precipitation of less than 10 percent by 2100 and uncertainty about specific changes in hydrologic patterns, like timing. This precipitation trend is in contrast to that at a PLJV scale and more consistent with trends at a Great Plains scale.
- For northern and eastern parts of the PLJV region, current trends suggest that ephemeral wetlands could shift to more permanent types. However, some models suggest that summers could become warmer in these areas and increase evaporation rates.
- For the southwest area of the PLJV region, increasing drought frequency and severity could turn semiarid regions into deserts.

Collectively, the potential effects of climate change described above inform us on how environmental conditions may change in the future, as well as how the roles, and relative importance, of natural resources that occur on the refuge might change within the context of the PLJV region. Many strategies used in traditional refuge management may also be used to address challenges related to climate change, like the control of invasive species, the support of native communities, the control or reduction of habitat fragmentation, the manipulation of water levels, and the periodic assessment of conservation goals and objectives, but new strategies may also have to be developed.

Land Features

Quivira Refuge is located in the Great Bend Lowland, or Prairie, which is part of the Arkansas River Lowlands section of the larger Central Lowland physiographic province (Schoewe 1949). Following the large, northward bend of the Arkansas River in central Kansas, the Great Bend Lowland is an alluvial plain, with sediment originally deposited by flowing water that has local, gently rolling hills. Refuge lands range in elevation from about 1,700 to 1,800 feet above sea level (Schoewe 1949) and are only slightly higher in elevation than the Arkansas River (Hathaway et al. 1978). Arbogast and Johnson (1998) refer to the Great Bend (Sand) Prairie as a “mosaic of sand sheets and dune fields,” with dune orientations that are mostly northwesterly and southwesterly. Surface materials are mostly easily erodible sands and gravels of Quaternary Dunes (Schoewe 1949, Zeller 1968) that are generally of Rocky Mountain origin deposited from laterally shifting channels of the ancestral Arkansas River (Fent 1950). The Rattlesnake Creek is a mostly perennial tributary that meanders northeasterly through the Great Bend Lowland and flows through Quivira Refuge about 15 miles from its confluence with the Arkansas River.

Thin, unconsolidated, or undifferentiated, alluvium that is less than 20 feet thick and more-recent Eolian sand deposits are common in the area of the refuge (Arbogast 1995, Arbogast and Johnson 1998, Sophocleous 2003). The alluvial materials are poorly sorted sand, silt, and clay broadly described as silty sand, sandy loam, or loess, whereas, sands are well sorted. Poorly sorted materials are less porous, have poor drainage when compared to well-sorted materials, and are commonly associated with local depressions like wetlands. In contrast, well-sorted deposits are characteristic of higher sand dune sites and often occur in areas of ground water recharge or springs. Particle size of deposits also influence soil and water

properties, which partly determine plant and wildlife communities. Dune sands generally are very fine-to-fine-sized particles, and those of the beach ridge occurring along the east and southeast side of the BSM, which were derived from a Wisconsin-age lake, are fine-to-medium sized (Arbogast and Johnson 1998, Heitmeyer et al. 2012). More detailed soil descriptions and their relationships with different communities on the refuge are provided in the soils section of this chapter.

A broad description of the geologic stratigraphy of the Quaternary alluvium in the area of the Quivira Refuge, in order from surface to bedrock, is as follows: (1) sand dunes; (2) relatively continuous near-surface silt-clay bed from a loess deposit; (3) alternating sequences of sandy silt-clay, sand, and gravel lenses; (4) basal sand and gravel beds of fluvial origin; and (5) bedrock (Latta 1950, Macfarlane et al. 1993, Fader and Stullken, 1978, Kansas Department of Agriculture 2006). The type, relative age, and position of parent material greatly influence soil formation, hydrology, and resulting plant communities. The Permian bedrock, many feet below the relatively more permeable surface materials, is up to 350 feet thick in the area of the refuge (Macfarlane et al. 1993, West et al. 2010). Fader and Stullken (1978) state that the Permian bedrock underlying the refuge is primarily associated with the Salt Plain Formation, although an area along the east boundary of the refuge is associated with the Harper Sandstone Formation. In other reports, these two Permian bedrock formations are collectively called the Harper Salt Plain Formation or “red beds.” Materials in these formations consist of reddish-brown sandstone, siltstone, shale, salt, gypsum, anhydrite, and limestone, which are a source of saline water that is characteristic of the refuge (Rubin et al. 2001, Kansas Geological Survey and Kansas State University 1997). At various depths between the surface and bedrock zones are clay lenses or layers that create separation between saltwater of the bedrock aquifer and fresh water of the higher alluvium aquifer of Cretaceous bedrock (Latta 1950, Sophocleous and Ma 1998, Sophocleous 2000, Rubin et al. 2001). More detailed descriptions of geology and hydrology of the area may be found in the Water Resources Inventory and Analysis Report (Striffler 2011) and hydrogeomorphic method analysis report (Heitmeyer et al. 2012) prepared for the refuge.

Soils

Soils are diverse (figure 7) and they differ with respect to texture, moisture and nutrient retention capacities and salinities. Such differences influence

plant and wildlife community distribution and composition. Refuge lands are comprised of the following soil subgroups: 37 percent Subirrigated; 22 percent Saline Subirrigated; 17 percent Sands, choppy and subirrigated; 14 percent Aquolls; 10 percent Sandy; and less than 1 percent each of Loamy Clay and Clay Upland (Soil Survey Staff 2010). Ecological site characteristics and State transition models are described by the National Vegetation Classification System (NRCS) for each soil subgroup (Soil Survey Staff 2010), Heitmeyer et al. 2012).

Water Resources

Hydrology is one of the most important factors influencing ecosystem structure and function. Consequently, hydrology also is of primary importance in planning our refuge management activities. However, hydrology involves complex relationships that exist at multiple spatial scales that are difficult to characterize in a CCP and EA. Therefore, a review of the Water Resources Inventory and Analysis Report (Striffler 2011) and the hydrogeomorphic method analysis report prepared for the refuge, as well as models and reports that provide detailed descriptions of water resources in the Rattlesnake Creek basin, is recommended. For purposes of this CCP and EA, a more general description of water resources is provided below.

Regional Context

Refuge lands occur within the Rattlesnake Creek watershed, which is approximately 95 miles long and 18 miles wide and encompasses parts of 10 counties (Basin Management Team 2010). Within the watershed, Quivira Refuge is located at lower elevations in the eastern part of the watershed and Big Bend Ground-Water Management District No. 5 (USGS 2012b, Sophocleous and McAllister 1987, Rattlesnake Creek/Quivira Partnership 2000). Refuge resources and management are dependent on surface water from the Rattlesnake Creek, but surface and ground water interactions are common, most noticeably in the form of seeps, springs, and underflow.

Surface Water

The drainage area of the watershed is 1,047 square miles, but the upstream area that actually contributes runoff to the area of the refuge is only 519 square miles, as identified by the contributing drainage area for USGS Zenith gaging station #07142575 (USGS 2012d). Rattlesnake Creek flows

are checked continuously at the Zenith station, a distance of about 2 aerial miles before entering the southwest boundary of the refuge.

Traditionally, total annual flows in the creek are positively correlated with annual precipitation amounts. However, data from the Zenith gauge show a declining trend in average annual streamflow during recent years that is related to an increased use of ground water for irrigation coupled with reduced precipitation (Striffler 2011). But of equal or greater importance are the observed changes in the timing of within-year flows. In part because of land use activities upstream from the refuge, water often has been unavailable when needed during the growing season to manage plant communities or to provide habitat for wildlife.

Ground Water

The Rattlesnake Creek watershed overlies the Great Bend Aquifer, which is part of the High Plains Aquifer. In general, ground water flow at a regional scale is eastward (Hathaway et al. 1978), but local variation occurs (figure 5). Near the refuge, the depth to ground water is generally 1–4 feet (Sophocleous 2003, Hathaway et al. 1978). Ground water pumping is a primary water source for irrigated crops, including small grains such as wheat and some corn. In general, most farmland presently lies west of the rangeland and woodland tracts that are next to the refuge boundary.

Water Quality

Major factors affecting water quality in the Rattlesnake Creek Subbasin include complex interactions between aquifers and soil stratigraphy (Sophocleous and Ma 1998, Rubin et al. 2001), irrigation practices (Hathaway et al. 1978, Rubin et al. 2001), and oil and gas activities (Rubin et al. 2001). While mineral composition varies within the watershed, northeastern Stafford County—of which the refuge area is a part—is referred to as a mineral intrusion area. Here, water in the aquifer has contact with salt-bearing Lower Permian bedrock, causing chemical reactions of dissolved solids and the natural occurrence of sodium chloride-type salts (Hathaway et al. 1978). As a result, saline and sodic soils and waters are produced, depending on soil drainage capacities and evaporation patterns (Hathaway et al. 1978, Rattlesnake Creek/Quivira Partnership 2000). High rates of ground water pumping in the Rattlesnake Creek corridor may disrupt the natural discharges of saltwater because of decreased surface flows and increased saltwater entry into the freshwater aquifer (Rubin et al. 2001). Differences in the conductance of water occurs throughout the water-

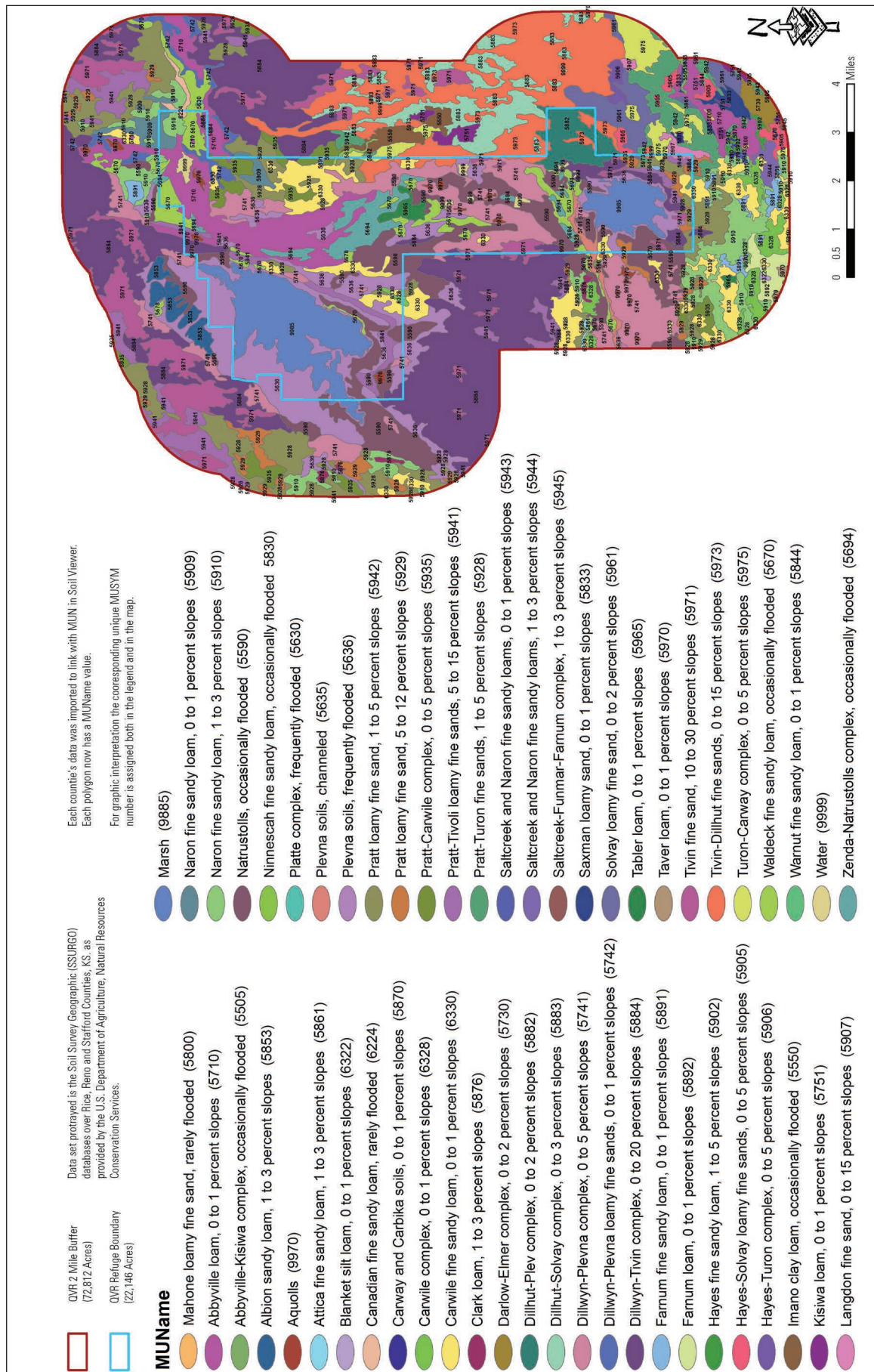


Figure 7. Refuge soil map, Quivira National Wildlife Refuge, Kansas. Source: Soil Survey Staff 2010.

shed, with wide ranges possible in the area of the refuge (less than 750, 750–2,250, and up to greater than 2,250 micromhos) (Hathaway et al. 1978). More well test results of chemical quality data sampled at certain points in time in the Great Bend Prairie may be found in a report by Hathaway et al. (1978).

Abnormally high nutrient levels in different states, such as nitrates found in oxygenated conditions, may have adverse ecosystem effects (Christensen 2001). Nitrate concentrations in the Great Bend Prairie aquifer are commonly affected by irrigation well density, subsurface clay lenses, and land use practices. Land managers who use grazing or who manage herbivores in areas of high nitrate concentrations, especially when using more intensive grazing in drought conditions, are often concerned about differential effects to forage plants. For example, cornstalks may hold more nitrates than some bluestem grasses, and the lower 6 inches of a plant may have the highest nitrate concentrations. Land managers adjust strategies to decrease, or prevent, potential adverse effects, such as toxicity and poisoning that can lead to cattle asphyxiation. Nitrate levels reported before in the Great Bend Prairie aquifer are relatively high, often greater than 0.000083454 pound per gallon (10 milligrams per liter), compared

to many other samples of uncontaminated ground water collected throughout the United States, which average less than or equal to 0.000025036 pound per gallon (3 milligrams per liter) (Townsend and Young 1995). Based on 42 samples of ground water collected in Stafford County, Townsend and Young (1995) reported that nitrate nonpoint-source contamination was more evident in shallow wells typically used for domestic and stock, with a mean (range) depth of well equal to 60.04 (28.87–93.83) feet (18.3 [8.8–28.6] meters), compared to deep wells typically used for irrigation, with a mean (range) depth of well equal to 83.99 (41.99–135.17) feet (25.6 [12.8–41.2] meters). Nitrate–N values had a mean (range) of 0.00005508 (0.000010849–0.000095972) pound per gallon (6.6 [1.3–11.5] milligrams per liter) for shallow wells and 0.000032547 (0.000011684–0.000079281) pound per gallon (3.9 [1.4–9.5] milligrams per liter) for deep wells. There were no substantial differences in nitrate–N concentrations between sandy and loamy soils or flood versus center-pivot irrigation methods. A thicker clay layer above well screens was positively associated with lower nitrate concentrations in the study. Results of this research may be used in evaluating the potential effects of existing wells in a given area, or considered, when planning the addition or removal of wells on refuge lands.



Rachel Laubhan/FWS

Rattlesnake Creek flows into Little Salt Marsh on Quivira Refuge.

Recent Trends in Water Quantity

Recent regional trends in water quantity that are important in refuge planning include: (1) the encroachment of woody vegetation into open prairie, which likely has resulted in higher water use when compared to the natural plant communities that occurred before human settlement (Striffler 2011, Heitmeyer et al. 2012); and (2) declines in the ground water table and streamflows that are inadequate to meet refuge management needs (Sophocleous 1997, Rattlesnake Creek/Quivira Partnership 2000).

Water Rights and Management

Refuge hydrology is complex, largely because of dynamic precipitation and flow patterns, surface–ground water interaction, and a highly altered landscape that uses extensive ground water pumping within the watershed. Overall, the main sources of surface water entering the refuge are precipitation, ground water discharge, and Rattlesnake Creek surface inflows. Primary surface outflows are evaporation, plant transpiration, ground water recharge, and surface drainage outflows. As discussed above, short- and long-term shifts in the water balance occur in response to precipitation patterns and land use activities within the watershed.

The refuge senior water right [Permit #7571] allows quantities of 14,632 acre-feet per year (AFY) and flows of 300 cubic feet per second (cfs). This water right seems adequate for current refuge management except that often the refuge does not receive water sufficient to meet our water right and water is not always available at a time when it is most critical for refuge management. The refuge waterflow system, or infrastructure, allows various levels of control in flooding, dewatering, and moving water among more than 30 water units (figure 5, Striffler 2011).

In high flow years, excess water may be transferred downstream or used to support desirable water depths in water units, such as impoundments or wetland areas. Sediment and water chemistry may be altered through the periodic flushing and draining of water through the refuge water conveyance system. Occasional dewatering of wetlands is desired to promote the nutrient cycling required for supporting the long-term productivity of wetland systems and for the management of plants with different germination and growth needs (Mitsch and Gosselink 2003). Water depths are often regulated to increase the availability of food resources or structural conditions for waterbirds that have different nutritional needs and adaptations used in acquiring resources.

Air Quality

The Clean Air Act requires the Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (EPA 2011a). In accordance with this need, the EPA has set standards for the following six pollutants to protect the health of humans and the environment: carbon monoxide, lead, nitrogen dioxide, ozone, particle pollution, and sulfur dioxide. Other primary functions of EPA are to provide regulatory authority and technical help to State and local control agencies, as well as to conduct programs that research many different aspects of air science and technology (EPA 2011b). Of particular interest to natural resource managers is current EPA research linking air quality to ecosystem exposure (EPA 2011c), which may provide new insights about the relative importance of sustaining natural resources to improving air quality and interactions between air quality and ecosystem health.

The Kansas Department of Health and Environment's Bureau of Air is the agency that checks, regulates, and reports air quality in Kansas and sends data to the EPA's Air Quality System. Cold winters, warm dry summers, and high winds cause ozone and particulate matter to be criteria pollutants of particular concern in Kansas, especially during events of blowing soil and surface inversions (Kansas Department of Health and Environment 2010). Because of the remoteness of Quivira Refuge, it is presumed that farming and burning activities that affect air quality are of most concern for the refuge. However, the refuge is mostly in Stafford County, where the population density is in the 6,000–9,000 category, and is not included in any Kansas Department of Health and Environment monitoring area or in any designated statistical area. Hutchinson, Great Bend, and Salina are cities close to the refuge that are listed as Micropolitan Statistical Areas, but the Kansas Department of Health and Environment only operates monitors in the Salina Micropolitan Statistical Area, which covers Ottawa and Saline Counties. Salina is downwind of Wichita and is a proposed ozone monitoring site for the next 5 years.

Thus, based on available information, air quality is not a current issue near the refuge, but it may be a consideration in the near future, depending on activities at a larger landscape scale.

3.2 Biological Resources

Evaluating refuge lands in the appropriate ecological context is needed for developing management

goals and objectives that will best meet the purposes of the refuge and optimize contributions to the conservation of biological resources at larger spatial scales. Among the factors that contribute to the diversity and abundance of refuge flora and fauna is the refuge's central location within the mixed-grass transition zone where characteristically short western and tall eastern grasses meet, northern cool-season grasses and southern warm-season grasses converge, and many species range distributions overlap. Thus, depending on shifting short- and long-term environmental conditions, biological resources of the refuge are dynamic within, and among, years. In addition, wetland habitats that tend to be fewer and less reliable in this geographic region attract some species that rely on both wetland and grassland resources for life events. For example, dry shoreline and salt flat habitat provides nesting sites for waterbird species, such as interior least tern, western snowy plover, black-necked stilt, and American avocet. Also, the complex of upland and wetland habitats produces a high abundance and diversity of plants, invertebrates, and vertebrates and, therefore, is an attractive source of food for species associated with both communities. Collectively, these factors contribute to a diverse flora and fauna, because the distributions of many western and eastern wildlife and plant species overlap, such as with the presence of both the eastern and western meadowlark and kingbird.

Quivira Refuge supports a diversity of wetland types that each provide resources like invertebrates, plant foods, and cover in unique combinations that are important for meeting the life requisites of focal species. In addition, each wetland provides multiple plant communities simultaneously, such as tall emergent and wet meadow, and plant communities tend to change temporally in response to abiotic factors like bare mudflats in spring that can be colonized by annual emergent vegetation later in the same year.

Within created wetlands, the partial drawdown or flooding of a unit and brief periods of inundation during the spring has resulted in sparse vegetation interspersed with expanses of mudflats that provide suitable foraging habitat for spring and fall migrating shorebirds. If partial drawdown or flooding is prolonged through the summer, bare mudflats next to shallowly flooded habitats have provided shorebird nesting habitat. Conversely, if water is maintained on units for longer periods, perennial emergent vegetation tends to colonize sites. Local interspersed of emergent herbaceous wetland cover and open water is reported to benefit a high diversity of marshbirds, provided long-term wetland cycling is sustained (Weller and Spatcher 1965, Bolenbaugh et al. 2011), and wetland size is a reported influential factor of habitat use for some waterbirds (Brown and Dinsmore 1986). Depending on the type of perennial veg-

etation, suitable nesting and foraging habitat has been provided for grebes and bitterns (cattail or bulrush) or rails and phalaropes (sedge or rush). In addition, semipermanent units that support emergent vegetation interspersed with open water have offered suitable breeding habitat for amphibians and thermal cover for waterfowl during early winter.

In grasslands, differences in species niche selection allow cohabitation within the same community. Bird habitat selection differs largely based on behavioral interactions and needs of various life activities, such as for foraging, mating, nesting, brooding, or protection from weather or predators (Wiens 1973, Cody 1985a, Cody 1985b). In general, sand prairie grassland for this region has been described as being dominated by grasses with lesser amounts of forbs and woody vegetation (Küchler 1974, Natural Resource Conservation Service 2010). Ecological site descriptions report potential woody coverage of less than 5–15 percent on some soil associations and up to about 30–40 percent on others, with amounts changing largely dependent on management history. Some shrub cover exists as a natural part of the grassland community to provide valuable wildlife food and different types of cover for nesting, resting, escape, and thermal protection. During winter, a combination of grassland and shrub habitat contributes to bird use diversity and abundance, including focal species (Davis 2001). However, some woody vegetation has been managed to conserve native grassland communities because, for example, extensive tall, dense shrub cover is avoided by some breeding grassland birds (Cooper 2009) and has been associated with higher rates of predation (Klug et al. 2009, 2010).

All biological resources of the refuge are dynamic within, and among, years, depending on short- and long-term environmental conditions. Therefore, evaluating the potential contribution of refuge lands to wildlife is complex and requires consideration of short- and long-term community dynamics relative to the status and importance of species and communities at various spatial scales.

Populations of many species native to the area have declined because of habitat loss and degradation caused by factors such as land use changes, the spread of invasive species, habitat fragmentation, urbanization, and management actions that affect the quantity and quality of water resources. The importance of each of these factors depends on the scale considered. In this planning process, we examined several plans and documents at scales ranging from local to national that were relevant to the purposes and goals of Quivira Refuge. These included our lists of species of management and conservation concern (FWS 2008a) that consider various national and international bird conservation plans and other locally important status reports, or designations.

The descriptions of plant and wildlife communities that follow are not comprehensive.

Plant Communities

This section includes details on the various plant communities found on Quivira Refuge.

Landscape Context: Status and Trends of Plant Communities

Saltmarsh and sand prairie are two distinct ecological communities of Quivira Refuge and the western Great Plains that are of importance at both the global and State scale (Kansas Natural Heritage Program, Kansas Biological Survey 2008). Based on the Natural Plant Communities of Kansas status list dated October 9, 2003, saltmarsh is globally ranked as an imperiled community because of its rarity or its vulnerability to extinction, but is now not able to be ranked at a State level because of the lack of, or conflicting, information. Sand prairie, on the other hand, is a secure community at a global level, but is State listed as imperiled because of its rarity and vulnerability to extirpation in Kansas.

More than 97 percent of lands in Kansas are in private ownership, and most are highly altered from conditions that occurred before European settlement. For example, an evaluation of land cover maps and remotely sensed data shows that current plant community alliances differed substantially from before settlement times—or before about 150 years ago, and more recent times of about 5 years ago (Peterson et al. 2004). Changes in land use from the historical period include 48 percent of lands cultivated in Kansas, and a dramatic reduction in the area of native short, and tall, grass communities. Recent changes in land use affected less than 20 percent of Kansas lands and included conversion of grassland to cropland—greater than 2,471,053 acres (1,000,000 hect-



Rachel Laubhan/FWS

Insects thrive in Quivira Refuge plant communities.

ares)—and woodland, as well as the conversion of cropland to grassland. The latter can be attributed to enrollments in the Conservation Reserve Program, rather than to the reconstruction, or restoration, of native grassland conditions that occurred historically (Heisler et al. 2003, Briggs et al. 2005).

Presettlement Conditions

Küchler (1974) characterized potential natural vegetation for Kansas at a landscape scale. Based on that report, Quivira Refuge's potential natural vegetation includes: saltmarsh (saltgrass–seepweed), floodplain vegetation (cottonwood–willow) and prairie cordgrass, and sand prairie (bluestem–sandreed). While historical surveys vary with respect to the presence of little, or no, woody vegetation, there seems to be agreement that woody vegetation was not a dominant feature, and trees were generally cottonwood and willow (Wilcox 1870, Gates 1937, Thompson 1871, unpublished refuge reports on file at Quivira Refuge headquarters, Stafford County, Kansas).

Küchler's vegetation descriptions, relevant to refuge lands, are provided in table 3. More detail on ecological site potentials are provided by the soil survey staff (2010), which were used to describe potential presettlement conditions of refuge lands in figure 8 and table 4 (Heitmeyer et al. 2012).

Table 3. Vegetation descriptions for Quivira National Wildlife Refuge, Kansas.

<i>Küchler's classification</i>	<i>General description</i>	<i>Major plants</i>	<i>Other characteristic parts</i>	<i>Location (Kansas and landscape)</i>
Saltmarsh	Dense to open stands of short-to-medium-tall grasses, few forbs	<i>Dominants:</i> saltgrass, seepweed	Wood bluegrass, western ragweed, prairie dogbane, white heath aster, woolly-fruit sedge, Canada wildrye, foxtail barley, inland rush, plains bluegrass, tall or yellow knotweed, drooping bulrush, sea purslane	Alkaline, periodically flooded depressions in central and north-central Kansas
		<i>Local Codominants:</i> spikerush, three-square, prairie bulrush, prairie cordgrass, alkali santon		

Table 3. Vegetation descriptions for Quivira National Wildlife Refuge, Kansas.

<i>Küchler's classification</i>	<i>General description</i>	<i>Major plants</i>	<i>Other characteristic parts</i>	<i>Location (Kansas and landscape)</i>
Floodplain vegetation (western and central Kansas)	<i>Savanna</i> : tall, medium-tall, and low broadleaf deciduous scattered trees and shrubs with “impoverished” bluestem prairie understory	<i>Dominants</i> : cottonwood, peachleaf willow, and, in eastern Kansas, black willow and American elm	Nearly 30 species and combined species found in eastern and western Kansas ***	Floodplains and streambanks with permanent and intermittent flooding (note differences in eastern and western Kansas) ***
	<i>Freshwater marsh</i> : dense stands of tall-grasses with forbs common but not prominent	<i>Codominant in western Kansas</i> : sandbar willow <i>Dominants</i> : prairie cordgrass	Wood bluegrass, big bluestem, rice cutgrass, whitegrass, Michigan lily, Virginia bunchflower, switchgrass, cup plant or squarestem rosinweed, hardstem and softstem bulrush, Indiangrass, eastern gamagrass, broadleaf or common cattail	Shallow depressions of floodplains, periodically flooded or with high water table; common in eastern Kansas and in bluestem prairie
Sand prairie	Medium dense stands of grasses that are medium-tall to tall, forbs common	<i>Dominants</i> : big bluestem, little bluestem, sandreed, switchgrass	Sand bluestem, field sage-wort, sand milkweed, sideoats grama, sandbur, sand lovegrass, umbrella plant, field snakecotton, flaxflowered gilia, prairie sunflower, golden aster, roundhead lespedeza, fourpoint evening primrose, sand paspalum, chickasaw plum, hardstem and softstem bulrush in wet spots, sand dropseed, and broadleaf or common cattail in wet spots	Sandy sites in south-central Kansas

Source: Küchler 1974.

Table 4. Hydrogeomorphic relationship of historical distribution of vegetation communities or habitat types to geomorphic surface, soils, and hydrological regime in the area of Quivira National Wildlife Refuge, Kansas.

<i>Habitat type</i>	<i>Geomorphic surface</i>	<i>Major soil types</i>	<i>Flood frequency*</i>
Sandhills	Dune sands	Tivin	OP
Sandy grassland (Beach ridge)	Beach ridge	Pratt–Tivoli	OP
Saltmarsh	Alluvial or lacustrine depressions	Soil survey geographic database marsh	SGD, ROB
Saltgrass	Depression fringes	Plevna	SGD, ROB
Seasonal herbaceous	Alluvium depressions	Aquoll, Waldeck	Seasonal surface
Riparian creek corridors	Rattlesnake Creek corridor	Varied, sand	Continual creek flow
Subirrigated saline grassland	Alluvium	Abbyville, Natrisols	SGD, OP
Subirrigated nonsaline grassland	Alluvium	Dillhut–Plevna, Hayes–Solweg, Dillwyn, Zenda	GD, OP
Upland sandy grassland	Dune sands	Canadian, Carwille, Naron, Pratt, Tivin–Dillhut	OP
Upland clay or loam Grassland	Dune loess, loam	Farnum, Tabler	OP

* OP—mostly onsite precipitation; SGD—saline ground water discharge; GD—ground water discharge with low salinity; ROB—Rattlesnake Creek overbank and backwater surface flows; Seasonal surface—mostly seasonal surface water runoff and minor creek overbank flooding, relatively fresh or slightly brackish water; Continual creek flow—sustained flows in Rattlesnake Creek.

Sources: relationships were found on land cover maps prepared for the Government Land Office survey notes taken in the late 1800s, historical maps and photographs, current and historical U.S. Department of Agriculture soil maps (Dodge et al. 1978, NRCS 2010), geomorphology maps, region-specific hydrology data (Fader and Stullken 1978, Sophocleous 1997, Jian 1998, Estep 2000, Striffler 2011), and various botanical accounts and literature (NRCS 2010, Ungar 1961).

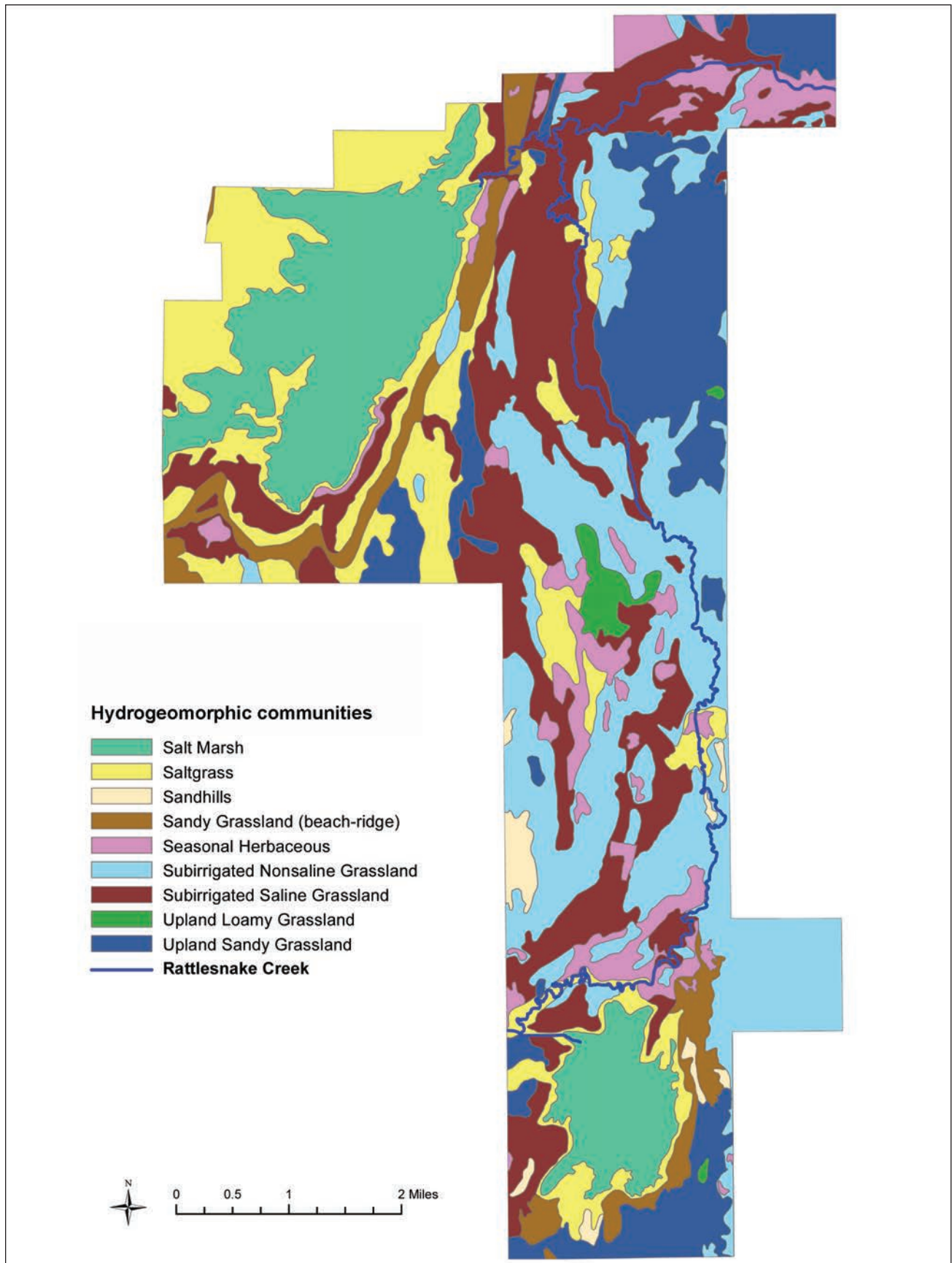


Figure 8. Potential presettlement conditions, Quivira National Wildlife Refuge, Kansas. *Source: Heitmeyer et al. 2012.*

Historical biological information on the salt-marshes of Quivira Refuge is extremely limited. There are a few aerial photos, drawn maps, and miscellaneous notes in published and gray literature. However, hydrologic inputs to the LSM historically occurred only from periodic overbank flooding of Rattlesnake Creek and from precipitation. It was not until the late 1920s–early 1930s that a ditch was constructed to divert Rattlesnake Creek flows directly into the LSM. Likely, this essential hydrologic change generated various short- and long-term transformations of the marsh ecosystem, such as water quantity and quality changes and the introduction or increased presence of carp. For example, at the time of refuge establishment, notes in Quivira Refuge’s master plan suggest that the estimated size of the LSM was about 640 acres and its greatest depth was 4 feet. However, a comparison of aerial photographs ranging from the 1920s to today shows that the historical size of the marsh was much smaller (Heitmeyer et al. 2012).

During the 1958–1960 growing seasons, an intensive ecological study of vegetation in, and around, the BSM was conducted by Ungar with emphasis on salt tolerance and its resulting effects on plant distribution (1961, 1964, and 1965). At the time, the marsh covered parts of 12 sections, and water depths rarely reached 2–3 feet, partly because of constructed ditches that had been dug to control drainage before the refuge’s establishment.

Seasonal fluctuations in water depth and quality in the BSM were because of characteristic sporadic rains and drying in July and August. The main source of salts in the BSM was found to be sodium chloride. Water and soil samples collected in 1959 and 1960 found similar monthly changes in chloride ion concentration and total salinity, and variability occurred among sampling sites. The lowest salinities occurred in the adjacent prairie and the highest salinities occurred in the barren salt flats, with a general increase in salinity values as the marsh dried in July. In the water, the chloride ion concentration range was equal to 0.008–1.65 percent, and the total salinity range was equal to 0.02–2.96 percent. In the soil surface from 0–3.94 inches (0–10 centimeters), the chloride ion concentration range was equal to 0.001–2.34 percent, and the total salinity range was equal to 0.003–2.96 percent. Salts were greater at the surface, from 0–3.94 inches (0–10 centimeters), than in the soil subsurface, from 23.62–27.56 inches (60–70 centimeters). Soil salinity had more of an effect on the distribution of rooted plants than water salinity, and extremes in salinities—where survival was equal to, or greater than, 1-percent salinity—were most limiting to plant distribution, when compared to averages. Ungar’s research and other biological studies conducted since (Reinke 1981, Har-

ris 1999) have identified many unique features of Quivira Refuge’s inland saltmarsh systems.

Fine-scale descriptions of lands where created wetlands now occur are limited, however, the following observations were noted from Quivira Refuge’s original master plan (FWS 1962):

- In general, refuge infrastructure development was intended to increase the availability of water, such as coverage, depth, and duration, by converting temporally and seasonally flooded areas to more permanently flooded wetland types to help resources of concern at the time, which were primarily migratory waterfowl during migration.



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Prairie cordgrass is an important component of meadows on Quivira Refuge providing relatively taller conditions for wildlife.

- Unit 7 was a low sump area of about 15 acres fed from the LSM.
- Drainage from unit 11 went northeast through a natural channel.
- Units 14a and 14b occurred along an old creek channel, and dominant plants were alkali sacaton and saltgrass.
- Unit 16 was a natural sump dominated by alkali sacaton and saltgrass flats.
- Unit 21 was a natural low area in an old creek channel.
- Units 22 and 23 were natural ponds and depended on surface runoff for water, and both had a good history of waterfowl use, including dabbling and diving ducks.
- Unit 24, or Darrynane Lake, was an existing 16-acre impoundment on Rattlesnake Creek, part of an old hunting club property that had a washed concrete spillway.
- Unit 25 was a natural, low saltgrass–sacaton area between sand knolls.
- Unit 26 contained about 90 acres of good farmland.
- Unit 28 was surrounded by tallgrass to the south and east.
- Unit 34 was in a low area in a tallgrass pasture.
- The plan for Unit 44 was to have it drain into scattered sump areas on the flats to the north.
- Units 47 and 55 were saltgrass flats that characteristically flooded in spring and were used by 50,000 ducks in 3–4 inches of water.
- Units 48 had 75 surface acres and unit 49 had 100 surface acres.
- Unit 50 was an old hunting club property.
- Unit 57 was a natural lake called McCandless or East Lake.
- Unit 60 had a history of heavy duck use in late winter, indicating that it had some deep

water and remained ice free longer than other wetland habitats.

- Unit 62 was covered by a dense stand of prairie cord grass.
- Dead Horse Slough was an existing slough at the time.
- The BSM was unit 72, and it was planned to be the storage unit for habitat area in the northwestern part of the refuge that was attractive to diving ducks like scaup, red-head, and canvasback.

Current Conditions

Since presettlement times and refuge establishment in 1955, more environmental changes have occurred on refuge lands (Heitmeyer et al. 2012). In 1954, a reconnaissance map of the area was completed that described cover types, associated dominant plants, and miscellaneous notes of vegetation conditions for the purpose of assessing property values before acquisition of lands by the Federal Government. Our refuge staff recently recreated the hand-drawn map of 1954 in a geographic information system (GIS) (figure 9) and recoded cover types to use as a general baseline cover map to facilitate its comparison with a recent vegetation map of refuge lands made in 2011 (figure 10). While important shifts in plant communities mapped in 1954 and 2008 are evident (table 5), results should be viewed with caution partly because of differences in the purposes for which the two maps were developed; methodologies, such as observer bias, minimum mapping unit, equipment, and technology; and environmental conditions occurring at specific points in time, such as certain days, months, years during relatively wet and dry periods.

Some of the more notable differences include: (1) an increase in the occurrence of nonnative and invasive species in both grassland and wetland communities; (2) an increase in the coverage of shrubs and trees, especially in uplands and riparian zones; (3) the establishment and spread of *Phragmites* and cattail in wetlands; (4) the extensive development of artificial infrastructure; (5) an increase in the area of surface water; and (6) indications of a decline in shortgrass species. However, the 1954 appraisal and other refuge reports described much of the refuge land area as being overgrazed at the time of establishment, and this grazing regime likely favored shortgrass over tallgrass species, as reported by Aldous (1935) in central Kansas.

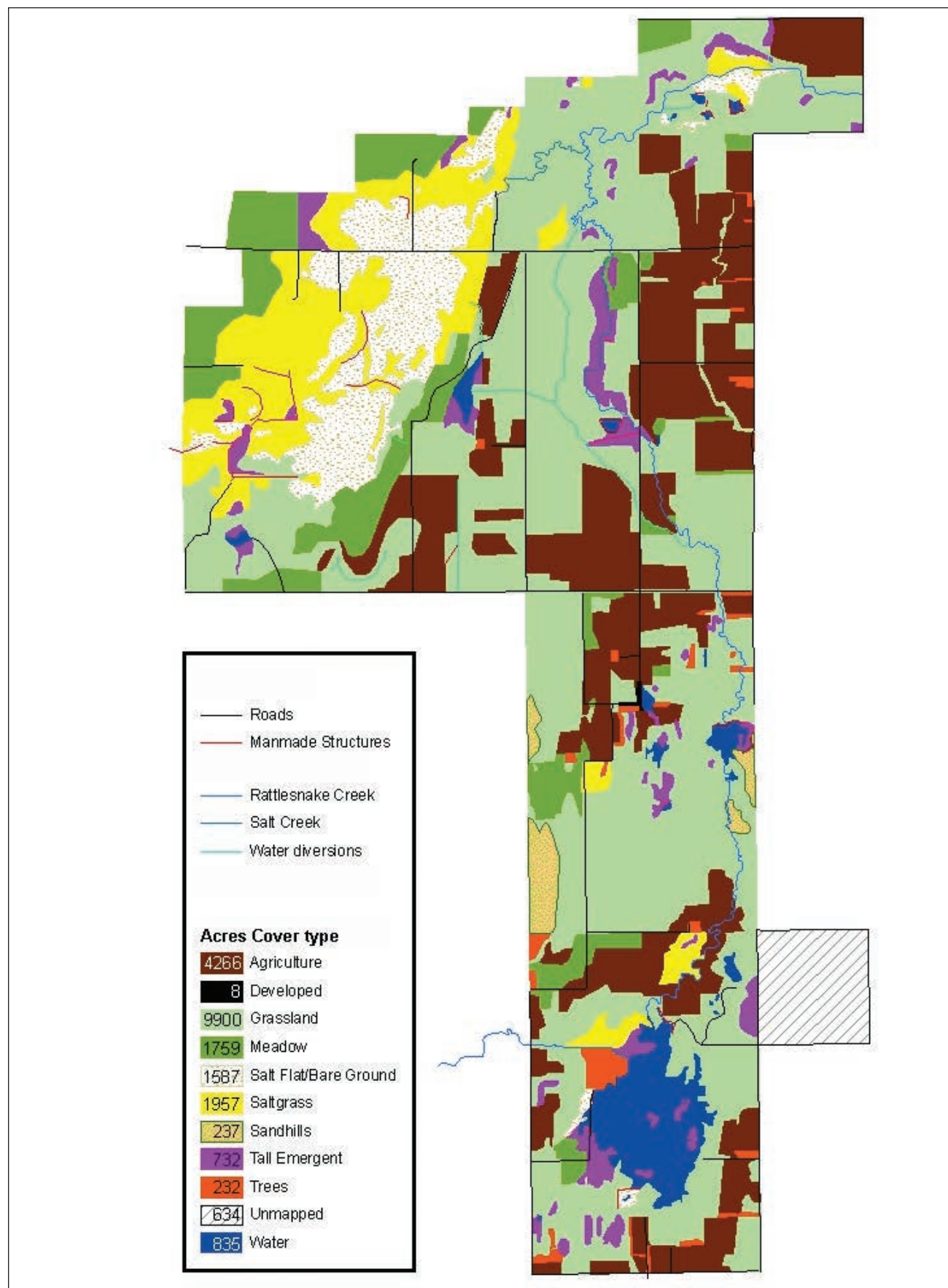


Figure 9. Vegetation cover types in 1954, Quivira National Wildlife Refuge, Kansas.

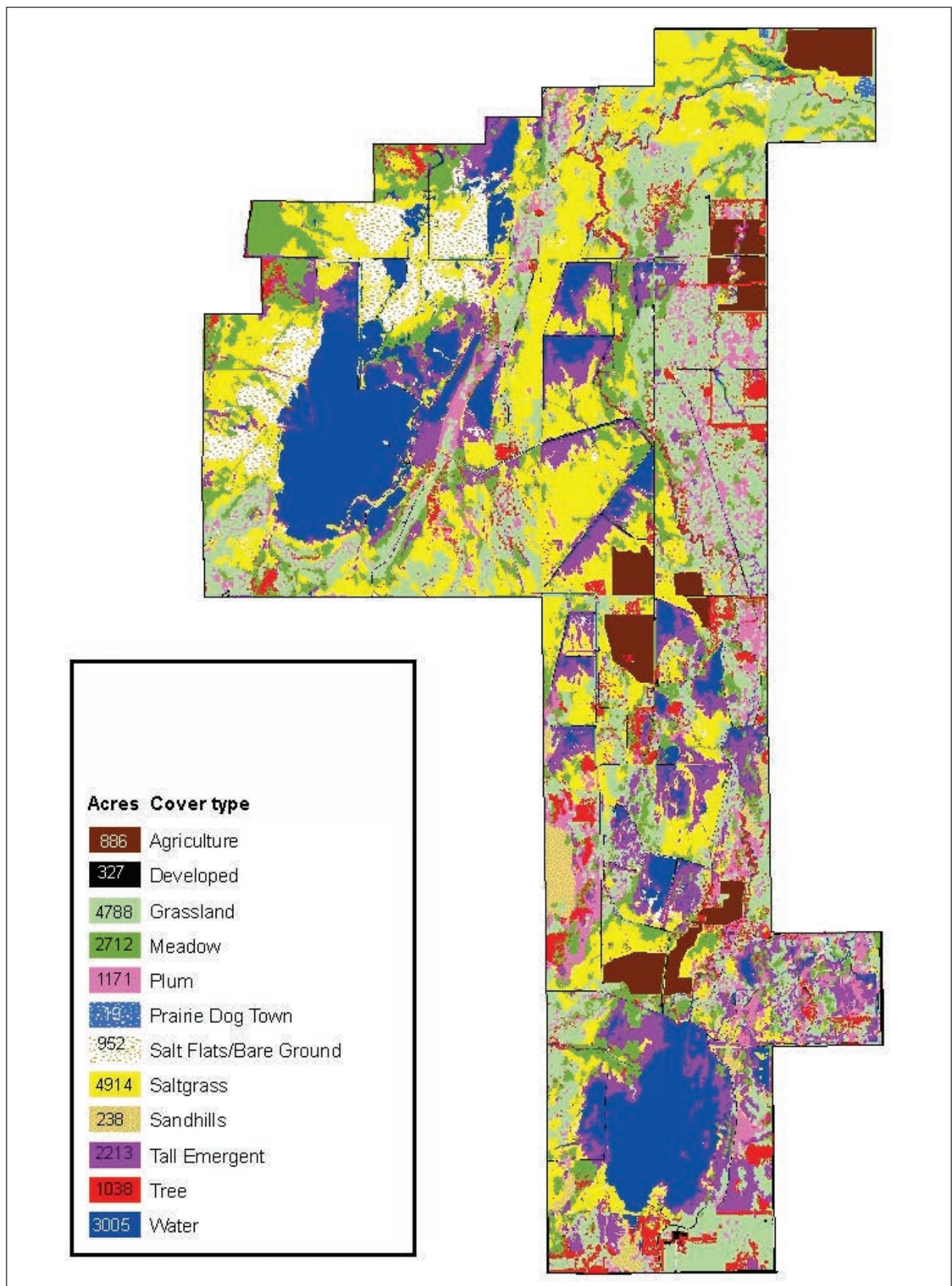


Figure 10. Vegetation cover types in 2008 (NVCS), Quivira National Wildlife Refuge, Kansas.

Table 5. Comparison of vegetation cover types between 1954 and 2011 on Quivira National Wildlife Refuge, Kansas.

<i>Cover type</i>	<i>Map*</i>	<i>Descriptions (dominant plant species)</i>
Grassland	1954	big and little bluestem, switchgrass, Indiangrass, sand lovegrass, buffalograss, blue grama, sideoats grama, three-awn, sand dropseed, wild barley, wild rye, bluestem wheatgrass, panic grass, saltgrass (G1 and G2 symbols on original map)
	2011	big and little bluestem, switchgrass, Indiangrass, and less of other prairie grasses and forbs (sometimes lesser amounts of meadow species present)
Sandhills	1954	Sandhills with carrying capacity of >5 acres of cow and calf for 6 months because of low vegetation density. Based on our soil survey geographic database soil map, this is most of the Tivin fine sand with 10–30% slope sites on Quivira Refuge. (G3 symbol on original map is comprised of the Sandhills and Saltgrass cover types)
	2011	unmapped areas, polygons with >50% Tivin fine sand with 10–30% slopes (figure 7)
Saltgrass	1954	Saltgrass (G3 symbol on original map includes Sandhills and Saltgrass cover types)
	2011	Saltgrass
Salt flat, bare ground	1954	bare soil, mostly with alkaline salts (white) on surface (Af symbol on original map)
	2011	bare ground areas, some with alkali and sparse cover of saltgrass
Meadow	1954	little bluestem, Indiangrass, three-square, sedges, rushes (H symbol on original map, “wild hay”)
	2011	Medium-short emergent plants, primarily prairie cordgrass, three-square, sedges, rushes (not tall bulrushes, sometimes lowland prairie grasses mixed in this cover type)
Tall emergent	1954	three square bulrush, hardstem bulrush, nutgrass [<i>Scirpus paludosus</i>], sedges, rushes (M symbol on original map; for Marsh, fresh; in swales and depressions and next to wetland areas)
	2011	cattail, Phragmites, tall bulrushes (mostly softstem bulrush)
Water	1954	surface water (W symbol on original map)
	2011	surface water
Trees	1954	mostly shelterbelt strips or groves near buildings and cultivated fields. One site with saltcedar on the delta where Rattlesnake Creek enters the LSM. Several groves of open, mixed oaks scattered in the “grazing type” (B, T symbols on original map)
	2011	black locust, tamarisk, cottonwood, Russian olive, Siberian elm, and some tall shrubs that were not plum
Plum	1954	not included in map description
	2011	sand plum with little coverage (<5%) of American plum and other shrubs
Agriculture	1954	farmed areas and few small sites that were primarily forbs (weeds)
	2011	farmed areas
Prairie dog towns	1954	not included in map description
	2011	active prairie dog towns

*The 1954 map was adapted to improve visual clarity. The current map used 2008 aerial photos that were ground truthed in 2010 and 2011 and was completed in 2011. Of note, descriptions of certain cover types are similar but not exactly the same for the 1954 and current maps. For instance, current “tall emergent” plant types are taller than what occurred in the past.

A recent inventory of refuge vegetation was completed in 2011, and approximately 22,262 acres of refuge lands were mapped to plant association classes. The inventory excluded a small tract of refuge land that occurs a few miles west of the main refuge boundary, but includes at least parts of boundary road areas, which accounts for the seeming discrepancy in refuge acreage. Protocol largely followed National Vegetation Classification System (NVCS) standards (Federal Geographic Data Committee

2008) and other guidance. The minimum mapping unit of the aerial photos was 0.5 acre, but ground truthing only included plum stands 0.2 acre or greater. Ground truthing used 2008 aerial photographs and was conducted in 2010, which was relatively wet, and 2011, which was relatively dry. Thus, it is presumed that certain plant species were more conspicuous under wetter conditions and other species were more conspicuous under dry conditions. A plant key was used to classify different combinations

of 20 herbaceous, 5 shrub, and 15 tree-dominant plant species into suitable categories, which resulted in the identification of 43 vegetation associations (table 6) (Farr and Laubhan 2011).

Based on this inventory and on estimates from summed GIS acreage data, Quivira Refuge is comprised of the following association types: 48.6 percent (10,819 acres) herbaceous wetland zones, 13.5 percent (3,005 acres) open water, 22.0 percent (4,898 acres) grassland, 6.6 percent (1,469 acres) shrubland, and 3.9 percent (868 acres) riparian area and upland woodland categories combined. It is important to understand that this coverage estimation is scale dependent. For instance, shrub associations were only classified as such if stands were equal to, or

greater than, 0.2 acre and shrub coverage was equal to, or greater than, 50 percent. This minimum mapping unit was chosen because it was reasonable for both mapping and for our management planning and implementation. Therefore, smaller shrub stands may exist that are mapped as grassland. Similarly, existing ephemeral or seasonal wetlands measuring less than 0.2 acre were classified as different herbaceous and woodland associations of which they were a part. The most abundant plants for each association type were: saltgrass, cattail, and three-square in wetlands; little bluestem, switchgrass, and Indiangrass in grasslands; plum and saltcedar—also considered a small tree—in shrubland; and locust, Russian olive, and cottonwood in forest or woodland.

Table 6. National Vegetation Classification System (NVCS) associations, Quivira National Wildlife Refuge, Kansas.

<i>Vegetation associations</i>	<i>Acres</i>	<i>Hectares</i>
Boxelder woodland	0.3	0.1
Agriculture vegetation	885.9	358.5
Tree-of-heaven forest	7.8	3.1
Big bluestem–helianthus herbaceous vegetation	551.2	223.1
Big bluestem–western Great Plains herbaceous vegetation	426.4	172.6
Sand bluestem herbaceous vegetation	62.5	25.3
Bare ground	18.9	7.6
Black-tailed prairie dog town grassland complex	18.9	7.6
Cheatgrass seminatural herbaceous vegetation	82.1	33.2
Northern catalpa forest	11.9	4.8
Hackberry woodland	0.6	0.3
Roughleaf dogwood shrubland	22.7	9.2
Inland saltgrass herbaceous vegetation	4926.1	1993.5
Russian olive woodland	29.2	11.8
Spikerush fascicularis herbaceous vegetation	329.3	133.3
Green ash forest	3.1	1.3
Kentucky coffeetree forest	16.2	6.6
Eastern redcedar seminatural forest	85.4	34.5
Osage orange woodland	5.6	2.3
Mullberry woodland	8	3.3
Switchgrass vegetation	431.8	174.8
Switchgrass–Indiangrass vegetation	1245	503.8
Common reed western North American temperate seminatural herbaceous vegetation	72.5	29.3
Plains cottonwood–black willow forest	389.5	157.6
Plum shrubland	1231.1	498.2
Fragrant sumac shrubland	28.1	11.4
Riverine sand flats–bar sparse vegetation	936.3	378.9
Black locust or honeylocust forest	253.8	102.7
Sandbar willow or mesic graminoids shrubland	57.1	23.1
Soapberry woodland	1.6	0.6

Table 6. National Vegetation Classification System (NVCS) associations, Quivira National Wildlife Refuge, Kansas.

<i>Vegetation associations</i>	<i>Acres</i>	<i>Hectares</i>
Little bluestem–sideoats grama western Great Plains herbaceous vegetation	2058.8	833.2
Common threesquare herbaceous vegetation	1107.6	448.2
Softstem bulrush semipermanently flooded herbaceous vegetation	167.9	68
Softstem bulrush–cattail herbaceous vegetation	366.9	148.5
Prairie cordgrass–spikerush and sedge herbaceous vegetation	1293.6	523.5
Saltcedar seminatural temporarily flooded shrubland	126.4	51.2
Cattail Great Plains herbaceous vegetation	1615	653.6
American elm woodland	1.9	0.8
Siberian elm woodland	50.6	20.5
Para grass herbaceous vegetation	2.8	1.1

The Boiling Springs has an artesian well and an associated freshwater habitat of small streams and pools that form a few acres. In the area of the artesian well, water cress is abundant as well as a source population of State-threatened Arkansas darters. All of our alternatives in this CCP and EA suggest the need to further evaluate potential future management to support the Arkansas darters. Besides mapped vegetation associations, other important factors to consider include the current existence of a pipe where water from the spring flows to the surface and increasing woody vegetation. The pump remains from an oil well that has been removed, and it is unknown if the removal of the pipe would result in more springs or if habitat suitability would increase for the Arkansas darter. Increasing woody vegetation in the area may also create changes in water quality or habitat use. A beaver downed one large tree in 2011, creating a dam in the area where Arkansas darters live. Casual observations suggest that larger pools in the area would encourage use by predator fish, such as the green sunfish, and that would likely adversely affect Arkansas darter populations.

Wildlife Communities

This sections includes details on the various wildlife communities found on Quivira Refuge

Status and Trends of Wildlife Communities

While national wildlife refuges are managed for wildlife first, a particular refuge cannot be managed for all associated wildlife every year. Habitat condi-

tions constantly change over time generally favoring a broad diversity of wildlife species. Thus, planning that evaluates trade-offs in management effects on wildlife at various spatial and temporal scales may better sustain native communities.

As part of this process, various regional and national conservation plans and species of concern lists are considered collectively within the context of the refuge bird list and other relevant local conservation factors such as: (1) the refuge purposes and relevant policies and mandates; (2) a species native or nonnative status; (3) species population trends; (4) species range distribution in relation to refuge location; (5) species current and potential occurrence on refuge lands; (6) species tolerance of grassland fragmentation, urbanization, and agricultural activities; and (7) the availability and condition of habitat outside refuge boundaries. A detailed analysis of species tolerance of grassland fragmentation is presented in appendix H. Collectively, these considerations helped us to develop a list of priority management species we call focal species (table 3).

Presettlement Conditions

Consideration of changes in wildlife since presettlement is important for understanding the full range of native habitat conditions and for evaluating current management potential. For instance, knowledge of native species life needs and behavior may be used to describe what the environment used to look like and how it functioned. Many native herbivores and predators that were an inherent part of the historical natural system no longer occur on refuge lands or in the region, and, consequently, their absence likely has altered fundamental ecosystem processes. For example, grazing or browsing by bison, pronghorn, elk, and prairie dogs in central Kansas used to variably influence many indigenous prairie plants and wildlife

that have unique adaptations, and now their roles or functions are only partially replaced by domestic cattle, sheep, or goats.

Similarly, the use of prescribed fire and artificial manipulation of hydrology do not completely mimic the historical frequency, intensity and magnitude of historical fires and water movement on the landscape. Thus, complete restoration of historical processes and associated native plant and wildlife community will not be possible regardless of the alternative we select in this CCP and EA, however, the extent to which restoration will occur differs among the alternatives. In managing for wildlife, strategies may be used for various purposes, including compensating for one, or more, of the many long-term, or permanent, imbalances that have been created in the landscape.

Conditions of wildlife communities since refuge establishment have not been summarized, but have been recorded in the refuge master plan, annual narratives, and other files and documents. Of particular relevance to our alternatives, the deer count on the refuge at the time of establishment was less than 20, and turkey were not present. Also, the master plan showed our intention to manage habitat to encourage use by greater prairie-chickens, noting their former occurrence on refuge lands and their absence in the early 1950s. Because birds are a primary focus of the Refuge System and changes in communities have been many and complex, it is worth referring those interested in more details to a discussion by Johnson (2009) of the changes in bird communities and range distributions over the past three decades.

Current Conditions

The refuge is recognized nationally and internationally for its importance in wildlife conservation. Quivira Refuge is a Ramsar Wetland of International Importance, a Western Hemisphere Shorebird Reserve Network site, and a Globally Important Bird Area. The most current inventory of Quivira Refuge wildlife is provided in appendix G, but some highlights are described below.

Birds

More than 300 species of birds are thought to use Quivira Refuge. Some main attractions for visitors to the refuge are spring and fall bird migrations that include hundreds of thousands of geese and ducks, more than 30 species of shorebirds, many sandhill cranes, and the occurrence of rare species, such as the whooping crane, interior least tern, and snowy plover. Quivira Refuge wetlands provide migration and wintering habitat used by large populations of Canada geese, greater white-fronted geese, and, increasingly in recent years, snow geese. From 2009

to 2010, more than 11,000 ducks, 300,000 Canada geese, 402,500 white-fronted geese, and 425,000 snow geese were estimated to visit the refuge on independent, bimonthly survey dates. More than half of the fall surveys in 2009–2010 and 2008–2009 showed use by more than 20,000 geese, and three of the fourteen 2009–2010 surveys each reported more than 30,000 sandhill cranes. From 2002 to 2006, an annual average of more than 30,000 shorebirds were counted on Quivira Refuge during biweekly migration surveys (Hands 2008). In 2010, biweekly data counted 55,491 shorebirds on the refuge during the migration periods surveyed. With Cheyenne Bottoms Wildlife Management Area only about 30 miles away from the refuge and with high local variation in weather patterns, many birds rely on both areas to acquire necessary life resources. It has been suggested that these areas, combined, often hold more than 90 percent of the world's population of such species as stilt sandpipers and white-rumped sandpipers.

While many rare birds may be observed at Quivira Refuge, some receive much more attention than others. Whooping cranes are usually observed in small family groups during migration on Quivira Refuge. In recent years, the highest recorded season total for whooping cranes observed using areas on and near the refuge is 91 in the spring and 112 in the fall. Thus, the relative importance of the refuge to whooping cranes during migration is substantial, considering that the population in recent years has ranged from approximately 250 to possibly 300 during the winter of 2011–2012. Whooping cranes may stay on the refuge for up to 5 to 6 weeks in the fall, but spring migration stays are typically shorter and last from several days to weeks. Bald eagles are also a common wintering attraction, with a high of 204 eagles reported on the Quivira Refuge during the Christmas Bird Count in 2010. Only recently has one bald eagle pair been reported nesting on the refuge,



Harris' sparrow, reported on Quivira Refuge, has been identified as a priority species by the Great Plains Landscape Conservation Cooperative.

and they successfully fledged two young annually during 2010 and 2011. Quivira Refuge is one of the few sites in Kansas with nesting black-necked stilt, interior least tern, snowy plover, and various rail species. Production of interior least tern on Quivira Refuge fluctuates, but colonies of equal to, or greater than, 10 nesting pairs are common, and young raised to flight stage has been as high as 36 to 40 individuals. More information on threatened and endangered species and other species of concern may be found in the appendixes.

Quivira Refuge is primarily a migration refuge, but, as shown above, many birds use habitat for nesting as well. Of the birds reported nesting on Quivira Refuge, 23 species are considered Birds of Management Concern (FWS 2008a). Of these, 13 species are Birds of Conservation Concern in Region 6, and 11 species are Birds of Conservation Concern in Bird Conservation Region 19, Central Mixed-grass Prairie (FWS, Mountain–Prairie Region 2008a). For a comparison, the total number of birds listed as Birds of Conservation Concern for Region 6 and Bird Conservation Region 19 include 43 and 16 breeding species, respectively. Based on available published information on how climate affects bird breeding in the region, most nesting activities begin in April and

extend to August. But, bird use and timing of different breeding events vary within, and among, community types. Because management of wooded habitat is a current topic of interest in considering alternatives, it is important to note that many nesting bird species associated with wooded habitat on the refuge are generalists that have not exhibited population declines and may occur in more than one habitat type or have benefited from the expansion of urban and residential areas or constructed habitats like bridges, nest boxes, and farmland.

The presence of upland grassland passerines on Quivira Refuge is often overshadowed by the more easily identifiable and popular wetland-associated birds. However, many of these species are adversely affected by increasing woody vegetation, and refuge management has traditionally struggled with successfully reducing trees and shrubs to levels more characteristic of natural prairie. Some of the more common native passerines that characteristically breed on the refuge include: upland sandpiper, both eastern and western meadowlark, bobolink, dickcissel, grasshopper sparrow, field sparrow, lark sparrow, and brown-headed cowbird.

Many of the species associated with woodlands on refuge lands have benefited from human modifications to the landscape (table 7).

Table 7. Observed woodland bird use at Quivira National Wildlife Refuge, Kansas.

<i>Bird species</i>	<i>Woodland units</i>												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
wood duck		X											1
wild turkey		X							X				2
great blue heron					X								1
green heron		X											1
yellow-crowned night-heron									X				1
Mississippi kite									X				1
bald eagle											X		1
Cooper's hawk									X				1
red-tailed hawk											X	X	2
American kestrel					X								1
mourning dove												X	1
yellow-billed cuckoo	X	X		X					X			X	5
eastern screech owl	X	X					X		X				4
great horned owl		X		X	X		X						4
barred owl	X				X				X				3
chuck-will's widow									X				1
chimney swift					X								1
red-headed woodpecker												X	1
red-bellied woodpecker	X	X			X			X	X				5
downy woodpecker	X	X		X	X		X	X	X				7



Rachel Laubhan/USFWS

*Egrets and Ibis***Table 7. Observed woodland bird use at Quivira National Wildlife Refuge, Kansas.**

<i>Bird species</i>	<i>Woodland units</i>												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
hairy woodpecker	X	X			X			X	X				5
northern flicker		X					X	X	X				4
eastern wood-pewee	X							X	X			X	4
great crested flycatcher	X	X	X	X	X	X	X	X	X	X			10
western kingbird												X	1
eastern kingbird												X	1
Bell's vireo											X		1
warbling vireo	X	X			X	X		X		X	X	X	8
red-eyed vireo	X	X							X				3
blue jay		X							X			X	3
American crow									X				1
black-capped chickadee	X	X							X				3
white-breasted nuthatch	X	X			X				X				4
Carolina wren	X				X				X				3
house wren	X	X	X			X	X	X	X	X		X	9
blue-gray gnatcatcher	X	X			X	X	X	X	X				7
eastern bluebird	X	X		X		X		X	X				6
American robin		X	X						X	X		X	5
gray catbird	X												1
northern mockingbird						X							1
brown thrasher	X		X						X	X		X	5
yellow warbler	X	X		X				X			X	X	6
field sparrow				X					X				2
Northern cardinal	X	X		X	X		X	X	X	X	X	X	10
indigo bunting	X	X		X	X				X				5
common grackle												X	1
orchard oriole				X				X				X	3
Baltimore oriole		X		X				X	X	X	X	X	7
American goldfinch						X		X				X	3
Total species	21	24	4	11	15	7	8	15	29	7	7	18	49

Mammals

There are many information gaps about mammal populations and habitat use on the refuge. However, casual observations, limited refuge studies, and available literature were used to develop a refuge species list—which may be found in appendix G—and to gain knowledge of refuge habitat–mammalian community relationships. For example, while small mammals are widely known as an important prey base for many birds characteristic of the prairie, certain species have unique associations with open, sandy environments, such as the plains pocket gopher, eastern mole, plains pocket mouse, and Ord’s kangaroo rat.

Prairie dogs are well-known associates of Great Plains grasslands, especially in shortgrass and mixed-grass prairie, and there are two prairie dog towns on Quivira Refuge (figure 11). The expansion of prairie dog towns on the refuge is limited by the high ground water table. Roads, canals, and other artificial infrastructure factors likely influence ground water conditions in certain areas of the refuge, thereby restricting the prairie dog colonies to an area that is likely smaller than what occurred historically.

There are various species associated with habitat in and around wetlands, such as beaver and muskrat. The least and short-tailed shrew are often found in mesic, or lowland, prairie here. With increasing coverage of woody vegetation, it is likely that the mammal community has shifted from what historically occurred in this area. The nine-banded armadillo is one obvious addition since refuge establishment, though the population seems to be low. The various potential effects to the sand prairie system resulting from mammalian community shifts are largely unknown, but it is presumed that supporting species characteristic of this unique environment would also promote important functions, such as soil disturbance, plant dispersal, burrow production as habitat for various wildlife, and food web interactions.

In the early to mid-1800s, deer in Kansas generally occurred along wooded parts of streams and in large, timbered areas in the eastern part of the State (Sexson et al. 1985a). Deer were considered extirpated in Kansas in 1904, and were still largely absent in 1933. By refuge establishment in the mid-1950s, it was estimated that there were easily less than 20 deer in the area of the refuge. In other words, it was an extremely rare event, and exciting, to see a deer on refuge lands in the mid-1950s. Since refuge establishment, legal harvest of deer has not been permitted on the refuge. In 1960, it was noted that, “An occasional white-tailed deer was seen on the refuge area, deer observations were becoming more frequent, and that the manager saw three deer between January and April.” (from refuge narrative on file at

the refuge). By 1971, deer sightings were described as common, and about 100 deer were estimated to be using the refuge area during the summer months, with a buck-to-doe ratio of 1:3. By 1980, deer were described as being “frequently seen throughout the refuge” (from refuge narratives on file at the refuge). Results of a statewide, 1984–1985, landowner deer survey showed deer populations were increasing throughout Kansas (Sexson et al. 1985b). Results of spotlight surveys conducted on Quivira Refuge between 1989 and 2005 found continued, substantial increases in the deer population (Althoff et al. 2006). While hunting was occurring on private lands next to the refuge, the numbers of deer counted during the prerifle season were not greater when compared to numbers counted during rifle season and after. No data were collected that could be used to definitively explain the results. Researchers noted evident browse lines in wooded areas and concurrent declines in the percentage of does with twins, which is commonly linked to poor herd health. Recent and ongoing distance sampling documents extremely high deer densities in areas of the refuge—19 groups per square kilometer, or 41 individual deer per 0.39 square mile (1 square kilometer), (Blecha et al. 2011). However, preliminary results of a September 2011 assessment found sampled deer—5 bucks and 5 does from ages 1.5 to 7.5 years—were healthy.

Although deer numbers on the refuge at the time of establishment were less than 20, relatively intense studies of white-tailed deer have occurred on the refuge in recent years because of their increasing population. Among many findings, some, in particular, are worth noting for planning purposes: (1) surveys show high, localized densities of both groups—19 groups per square kilometer—and individuals—41 deer per 0.39 square mile (1 square kilometer), (2) doe survival rates are relatively high compared to bucks because of poaching and hunting; (3) deer prefer existing woodland canopy and canopy edge; (4) use of private land is substantially higher during fall and winter; (5) male deer use private land more than females during winter and summer; and (6) during winter, male deer are in closer proximity with other males, in comparison to female-to-male or female-to-female associations, (Blecha et al. 2011).

Observations and preliminary data from a deer health assessment conducted on Quivira Refuge in 2011 suggest the population is now healthy. However, woodland canopy edge and food plots and fields where deer congregate could be key habitats for potential future chronic wasting disease transmission (Blecha et al. 2011). Method of spread is unknown. Frequent contact between younger males suggests that management actions targeting that age class might cause reductions in contact rates and lessen the chance of disease transmission. Because



Tiger Salamander

deer within the Quivira Refuge population extensively use private lands, researchers believe that management of deer would be most successful if conducted on both private and refuge lands.

Reptiles and Amphibians

Reptiles and amphibians, or herptile species, recently documented as occurring on Quivira Refuge include three toads, four frogs, one salamander, six turtles, two lizards, and 13 snakes; see appendix G. Other herptile species have reported distributions in the area, but have not been documented on Quivira Refuge. Of significance to us, many herptile species may spend their entire lives on refuge lands. Thus, our refuge management actions could substantially alter metapopulation dynamics—or the spatially separate populations—of these species.

Furthermore, changes in herptile communities may effectively show how our management affects them, depending on the objectives. For instance, amphibians are often used in research and monitoring programs as sensitive indicators of water quality. At the same time, observing herptiles is not always easy, because many species spend considerable time underground, or have active periods that vary seasonally or that occur at night.

Like many birds and mammals, several herptiles have associations with open prairie, loose sandy soils, and wet environments that are characteristic of Quivira Refuge, such as Great Plains and Woodhouse's toads, yellow mud and spiny softshell turtles, lesser earless and prairie lizards, Graham's crayfish snake, western plains garter, and eastern and western hog-nose snakes. The six-lined racerunner and ornate box turtle are particularly abundant in sand or open prairie, and the latter is commonly observed on the refuge. The western massasauga is only abundant in a few locations in Kansas, one of which, is the refuge.

Fish

Management of fish communities on the refuge is largely constrained by the species that enter it via Rattlesnake Creek. Those who frequently fish the LSM report that carp and channel catfish are common. A published survey of Rattlesnake Creek fish that included areas on, and near, the refuge found that the upper parts of the stream with low chloride concentrations supported communities dominated by red shiners or common carp; and lower, more saline, parts of the stream supported communities dominated by plains killifish (Eberle et al. 1996). Fathead minnows and sand shiners were other common species found in samples.

Arkansas darters were documented in the area of the Boiling Springs. The presence of a healthy source population of Arkansas darters at the Boiling Springs area was confirmed through observations of many fish of different ages by local experts in 2011. Casual sampling of Quivira Refuge creek and spring habitat by local experts in 2011 also found river carp-sucker, mosquito fish, black bullhead, green sunfish, bluegill, and one goldfish.

Other

There are 10 species of crayfish reported to occur in Kansas (Ghedotti 1998). The northern crayfish is distributed throughout Kansas and is the most commonly observed species in streams (Ghedotti 1998). A baseline survey of crayfish species is unknown for Quivira Refuge, but crayfish and their burrows are a common occurrence. Various birds, fish, reptiles, amphibians, and mammals, eat crayfish, and many of them also compete with crayfish for food. Crayfish have been reported as a potential food item of whooping cranes (Armbruster 1990) and various waterbirds (Huner 2000). Reptiles and amphibians use crayfish burrows as shelter (Collins et al. 2010).

Other wildlife, such as butterflies, are listed in appendix G. Past refuge inventories of other wildlife are incomplete or nonexistent, and efforts to expand inventories have occurred in recent years. However, much remains to be learned of these species and associations on Quivira Refuge.

Federally and State-Listed Species

Quivira Refuge habitats support Federal and State threatened and endangered species, Federal candidate species, and State Species in Need of Conservation, including those species with designated critical habitat on the refuge and those that most commonly depend on refuge resources (table 8).

Table 8. Threatened and endangered species and species of concern, Stafford County, Kansas.

<i>Species</i>	<i>Federal status</i>	<i>State status</i>
Whooping crane*	endangered (CH)	endangered (CH)
Interior least tern*	endangered	endangered (CH)
Eskimo curlew	endangered	endangered
Piping plover	threatened	threatened (CH)
Arkansas darter *	Federal candidate species	threatened (CH)
Lesser prairie-chicken	Federal candidate species	
Sprague's pipit	Federal candidate species	
Western snowy plover *		threatened (CH)
Eastern spotted skunk		threatened
Plains minnow		threatened

* Those species that most commonly depend on refuge resources

CH indicates species with designated critical habitat on Quivira Refuge lands.

State Species in Need of Conservation that occur in Stafford County include: black rail, black tern, bobolink, Chihuahuan raven, eastern and western hognose snake, ferruginous hawk, glossy snake, golden eagle, long-billed curlew, mountain plover, short-eared owl, southern bog lemming, and whip-poorwill. In general, habitat conditions on Quivira Refuge should be suitable for most of these species, though several are not known to regularly use the area.

The KDWPT (2011) periodically updates descriptions and State distributions of species that are State listed or are of management concern. Information on status and occurrence of these species on the refuge are available in appendix G. Additional information is available on listed species and associated information for Stafford County (FWS 2012c, KDWPT 2011).

3.3 Management Tools

We use prescribed treatments to manage habitat primarily to promote the long-term sustainability of native wildlife and their associated ecosystems.

Native prairie vegetation and wildlife of the Great Plains evolved with periodic ecological disturbances from herbivory in the form of grazing, fire, flooding, drought, wind, ice, and other natural forces. In other

words, long-term ecosystem sustainability is dependent on periodic disturbance. Landscapes, increasingly, have not incurred their characteristic, historical disturbances largely because land uses have been altered and concerns of human safety have arisen as human populations have grown. For example, wildfires generally do not grow large and burn across millions of acres of prairie, huge herds of bison do not migrate across the plains, and streamflow peaks and lows are relatively less dynamic.

A primary purpose of management uses on refuges is to conduct strategies that produce effects similar to historical disturbances to support, or restore, ecosystems. Quivira Refuge uses various management strategies to accomplish goals and objectives that promote a diverse plant community dominated by native vegetation that supports many different migratory and resident wildlife species. Management uses carried out in recent years include combinations of rest; water management; prescribed grazing and fire; mechanical treatments such as mowing, haying, farming, or tree cutting; and chemical use for control of exotic or invasive species (FWS 1994).

But, human-caused landscape changes and our management affect how uses are carried out. For example, some disturbance types are used more frequently than what occurred historically to control invasive plants or nonnative plants that have different tolerance thresholds than native species. Flooding is highly controlled on the refuge to regularly provide required resources for waterbirds and other wildlife, and wetlands have been created and altered. Brief overviews of primary refuge management uses are provided below.

Rest

For planning purposes, rest is a product of management decisions related to disturbance frequencies. In this case, we use this term to refer to the time when we choose not to graze, flood, drain, burn, or otherwise directly affect an area using an active form of management. It is important to recognize rest as a management use because community responses to prairie stressors, such as grazing, burning, and climate, are inherently variable in space and over time (Helzer 2010). Thus, management actions may produce changes in communities that last years, even during “rest,” while natural forces also continue to occur. As referenced throughout the document, allowing many years of rest from disturbance in Great Plains grasslands runs contrary to natural ecosystem processes and may lead to adverse habitat conditions, such as the invasion by woody species and

an excessive accumulation of standing dead plant material that inhibits new plant growth.

Water Management

Water management on Quivira Refuge has been used to provide food and different types of habitat for waterbirds and other wetland-dependent wildlife throughout the year. Even before the refuge's establishment, water was impounded by various duck clubs to promote the area's use by waterfowl. Development of refuge infrastructure has occurred over decades, generally following the original refuge master plan.

Water management involves an extensive system of impoundments and dikes, canals, and associated control structures (figure 5). Maintaining water control infrastructure is essential for us to manage the refuge efficiently, and system operations, such as manipulating water levels, can be time-consuming and planning intensive.

Prescribed Fire

Historical prairie fires of the central Great Plains have been described as occurring about once every 3–4 years in tallgrass areas and once every 5–8 years in mixed-grass prairie, and they ranged in size from less than 0.25 acre to millions of acres (Helzer 2010). Fire characteristics and its resulting effects are dependent on fuel, weather, and topographic conditions at the time and place of ignition, and, historically, there were few natural fuel breaks in the open prairie and no suppressions by humans. Fire influences environmental conditions, such as light, moisture, and nutrients, that affect plant competition and wildlife use and promotes biodiversity and health, such as through increased nutrient cycling, the reduction in the amount of residual and woody vegetation, and by decreasing the potential effects of certain insects and of certain diseases caused by moisture and nutrient stress.

Over the past century, aggressive wildland fire suppression and the lack of prescribed fire implementation in the prairie have resulted in unnaturally altered habitats. Fire exclusion and the substantial increase of agricultural land uses are two major factors that are undoubtedly responsible for the declining abundance of some wildlife species.

Prescribed fire is now used in all major habitat types on the refuge to achieve fire program objectives involving both hazardous fuel reduction and habitat management. Prescriptions require specific

procedures that set priorities for human safety, and, therefore, particular environmental and fire-behavior parameters regulate when burning may, or may not, occur to accomplish habitat objectives. In recent years, prescribed fire has been conducted on about a third of the refuge each year. There are 15 pre-defined fire treatment units, several, of which, may be further subdivided into 2–4 smaller units, using natural and constructed features to decide boundaries, such as water units and roads. For individual prescribed burns, boundaries may also be adjusted based on changing conditions, such as moisture, vegetation, and adjacent treated areas, to meet our refuge management objectives and to maximize safety and efficiency considerations associated with the prescription.

Because most of the available fuel within the refuge is grass, fires consume the fuel and go out quickly. Overall, fuel load varies by soil type and disturbance history, often ranging from 2,500 to at least 8,000 pounds per acre. Grass and forb responses vary because of the time of year, intensity, and duration of the fire, but they most often reestablish in place of woody vegetation. Other fuel types are present on the refuge, but they are seldom contiguous enough to be the primary carrier of fire. Between mid-October and mid-May, fuel in the form of dead grass and marsh vegetation is present in amounts that are greater than 2 tons per acre, or 4,000 pounds per acre. While fire generally results in little wildlife mortality, a large wildfire during drought conditions or occurring late in the growing season could reduce cover and forage availability for wildlife to the point that would increase mortality, especially if cover and forage are limited in the larger landscape, a situation that seldom occurs. All wildfires occurring on the refuge are now suppressed.

Grazing

Prescribed grazing on Quivira Refuge, usually involving cattle, consists of the clipping and removal of plant parts and soil disturbance caused by associated hoof action. As with other treatments, the main parts of grazing are timing and intensity. Its effects vary by timing in relation to climate influences on plants, the frequency and duration that plants are exposed to grazing, the number and type of livestock involved, environmental conditions, management history of the site, and infrastructure such as fence configuration and the distribution of water sources.

Specific plans are developed for each grazed area of the refuge, but they may change annually, or more frequently, depending on conditions. Traditionally, grazing occurs on the refuge between April and Sep-

tember or October, but it may occur earlier to control cattail growth or cheatgrass. Maintenance grazing periods typically last 5–7 consecutive days. More intensive, restoration grazing may occur onsite, such as when controlling large, dense stands of cattail.

Mechanical Treatments

A variety of mechanical treatments are used on Quivira Refuge.

Haying, Mowing, Tree cutting

These management uses are used to remove the buildup of residual vegetation in grasslands and wetlands or to manage the coverage of invasive woody vegetation. As with other mechanical activities, guidance and policy is appropriately followed to help avoid disturbing breeding birds. Timing and other considerations are made to encourage our desired plant species and habitat conditions and to discourage undesirable plant species.

Farming, such as Plowing, Disking, Planting, and Harvesting, and Restoration Activities

Many acres on the refuge were farmed before its establishment. Afterward, farming on poorer soils was retired, and those acres were replanted with native seed. In the 1960s, during the time of refuge development, there were about 2,500 acres under cultivation on the refuge to primarily provide supplemental grains and browse foods for migrating waterfowl. For decades, cropland management consisted of cooperative farmers conducting a winter wheat–milo–fallow crop rotation using strips 50–1,000 feet wide. Traditionally, a quarter-to-one-third of the total crop shares have been either sold or left in the field as the refuge crop shares. Even in the 1980s, it was estimated that refuge grain fields provided less than 10 percent of foods needed to support waterfowl use and that surrounding lands were a much greater source of grain and browse foods for wildlife.

There are 885.24 acres of refuge lands dryland farmed through cooperative agreements with local farmers. Acreage of farmed land on the refuge has been gradually decreasing, partly because of the low productivity of crops. Also, since establishment, there has been a shift in the understanding and need of refuge crops to supplement wildlife food resources. As refuge lands are retired from farming, management starts activities, such as the treatment of noxious weeds and the seeding of desired plants, to

encourage the restoration of native vegetation. Genetically modified crops have never been used on the refuge, but current policy allows for the future use of such crops to reestablish native plants.

Disking of Wetlands

Disking is sometimes used in dry wetlands to stimulate the germination and growth of desired plants during subsequent flooding, or to manage undesirable conditions, such as cattail growth.

Chemical Treatments

The application of chemicals is used to effectively manage undesirable plants, such as exotic, noxious weeds. Use of chemicals on the refuge follows required guidance and policy with an approved integrated pest management plan and with annual pesticide use proposals that provide specific guidance on the use of herbicides.

3.4 Human History and Cultural Resources

This section describes what is known about the human history and cultural resources of the refuge.

Prehistoric Resources

Available archaeological studies used certain methods to date artifacts that suggest native people first occupied the south-central Kansas region 10,000 to 12,000 years before the present (Buller 1976). These people had a highly mobile lifestyle that depended largely on big game hunting. About 9,000 years before the present, regional patterns of human use began to change in response to regional climate fluctuations and increasing populations of people. Archaeological evidence suggests that these changes included more localized, less mobile, population centers and a greater diversity of tools.

Prehistoric Occupation

Certain dating methods suggest that by about 3,000 years before the present, larger campsites that

received repeated use occurred along floodplains of the Arkansas River and, presumably, Rattlesnake Creek. Inhabitants of the area collected wild plants, hunted large and small animals, and created chipped and ground tools. Human populations in south-central Kansas continued to increase and, by about 2,000 years before the present, small villages were established, and there is evidence that early agriculture was present along some waterways.

Protohistoric and Historic Native Americans

When the Spanish explorer Don Francisco Vasquez de Coronado reached the region in 1541, several Native American groups were present in central Kansas, including the Pawnee, Wichita, Plains Apache, Kansa, Kiowa, and Osage (Grajeda 1976, Wedel 1942). Throughout recorded early history, native people were attracted to the Quivira Refuge

region because of the presence of salt, camp sites on higher elevation sandhills and uplands, and abundant wildlife. Although many tribes moved in and out of the region, the influx of European settlers was prevalent by the mid-1800s and, by the late 1870s, most tribes had been relocated to Oklahoma.

Historic Euro-Americans

The Spanish word “Quivira” is a form of the Native American name “Kirikuru,” which is what local people called themselves when Coronado visited the region in search of the fabled Seven Cities of Cibola. After following the course of what is now the Arkansas River into the central Great Plains, the Coronado expedition spent several months encamped with the native peoples in a semipermanent village. The precise location of this village is not known, but it is believed to be northeast of the present-day Quivira Refuge. Thereafter, only a few trappers and

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A member of the Wichita Tribe posing for famed photographer Edward S. Curtis sometime around 1927.

explorers visited the area until the mid-1800s (Dolin 2010).

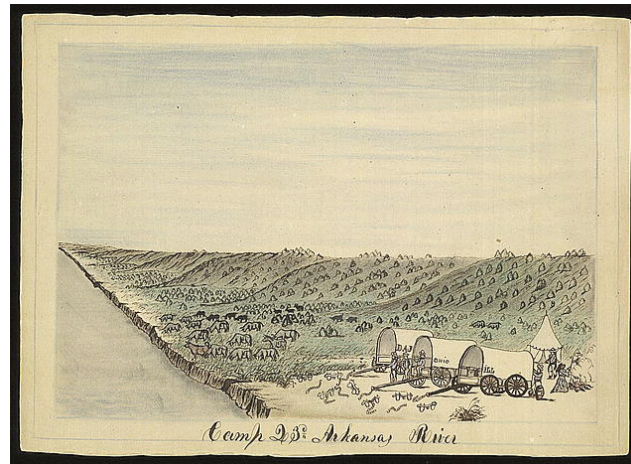
The first European definitively known to visit the Great Bend region of Kansas after Coronado was the French explorer Etienne de Bourgmont in 1724. Western explorers and fur trapping expeditions traveled through the Great Bend region in the mid- and late 1800s, and the Santa Fe Trail was established within 12 miles of the current refuge boundary (Cutler 1883, Blackmar 2002).

From May through July 1843, Captain Nathan Boone led an expedition of Army dragoons from Fort Gibson, Oklahoma. The route looped through south-central Kansas, and mentioned several prominent landmarks, including Salt Creek, a large salt lake, and the Arkansas River. Boone's journal provides a decent glimpse of the landscape from that period, including descriptions of the area both near, and within, present-day Quivira Refuge, including the following excerpts:

- June 10th: “after travelling 5 miles S.W. came to the Arkansas river at a point where for miles up and down, not a tree was growing.” The crossing is believed to be near present-day Alden.
- June 11th: “Their first 4 miles were through Sand hills or drifting sand and in one place, a lake near a mile long of salt water.” This is thought to be the BSM.
- June 11th: “Near 200 elk seen within 10 miles of camp and plenty of buffalo S.W. within 5 miles beyond a range of sand hills.” The location of this camp is estimated to be directly north of present-day Quivira Refuge along the Arkansas River.
- June 22nd: “Started at 7 A.M. and marched 15 miles S. 30 W. and en-camped on open prairie on the head of the Creek, supposed to be the creek [a branch of present-day Rattlesnake Creek] on which we encamped on the 4th of June. No timber in sight since we left the river. Saw some buffalo, and passed some of the largest buffalo roads bearing to the E.S.E. probably to the salt in that region.”

History

The General Land Survey was conducted in this region in 1871. The following year, surveyors for the



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A drawing by Daniel A. Jenks depicts his party's encampment on the Arkansas River in 1859 near present-day Great Bend, Kansas.

Santa Fe Railroad explored and documented a wide swath across Kansas, describing every other section of land along their route. Detail can often be found in the journals, field notes, and maps from both surveys. Below are excerpts from the Railroad Survey:

- April, 1872; section 33, T21S, R11W [For all but the S.E. 1/4, this is the BSM.] “embraces an area of some five Sec and has the appearance of a shallow lakebed—the top soil all being gone makes it about a foot lower than the adjacent land—Its surface to the subsoil is a light or whitish color and seems to be impregnated with alkali.”
- Section 17, T22S, R11W [Entire section, 2 miles west of what is now the Migrants Mile area] “All pure sand without any vegetation. All hills and hollows. Constantly drifting. Worthless.” It is important to note that, for the survey, land was being evaluated for farming, grazing, or other uses.
- E 1/2, section 13, T22S, R11W [Just south-east of present-day Migrants Mile]. “Dog village over most of both quarters.”
- E 1/2, section 1, T23, R11W [East half of the section on which the present-day headquarters is located] “Surface mostly covered with drifting sand. In some small basins, good grass is found.”

The first European settlement in Stafford County occurred in the 1860s, and, by 1876, a few people located near the BSM on Quivira Refuge (Cutler 1883, Ogle and Company 1904, Steele 1953). A company was organized for the purpose of manufactur-

ing salt, which was soon found to be unprofitable, and the homesteaders began using the marshes and adjacent grasslands for pasture, hayland, and cattle production (Sheridan 1956). The artesian wells, seeps, and springs near the BSM were relished by people in the area and believed to have health benefits. Early settler accounts from the region commonly speak of the abundance and desirability of wild haylands next to the BSM basin (Hay 1890). By the early 1900s, some upland areas at Quivira Refuge had been converted to small grain agriculture and some native prairies were modified with the introduction of non-native species.

Besides agriculture expansion in the Quivira Refuge area, the saltmarshes were used for commercial and recreational waterfowl hunting after the turn of the 20th century. Private hunting clubs, including the Hutchinson Gun and Hunting Club, Stafford Gun Club, Ellinwood Club, Park Smith Club and the McGuire Club either owned or leased much of the marsh lands, and, in the late 1920s or early 1930s, they dug a permanent ditch to connect, and divert, water from Rattlesnake Creek to the LSM. Other

wetland areas along Rattlesnake Creek were also partly impounded by hunting clubs with small dikes and ditches, such as the 16-acre Darrynane Lake (Unit 24) impoundment.

By the 1930s, many upland areas on, and next to, Quivira Refuge had been converted to cropland and pasture. By 1954, about 4,266 acres of what is now Quivira Refuge were in agricultural production (figure 9).



George Spangerberger's Privy

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This barn is on George Spangerberger's farmstead located in South Hutchinson, Kansas.

3.5 Special Management Areas

We established the Santana Research Natural Area on Quivira Refuge in 1967 to preserve 347 acres of native bluestem prairie—classified as K-74, Bluestem Prairie—which includes 15 acres of a century-old cottonwood timber claim. Research natural areas are intended to represent the full array of North American ecosystems with their biological communities, habitats, natural phenomena, and geological and hydrological formations. As with designated Wilderness Areas, natural processes are allowed to predominate without human intervention.

Under certain circumstances, deliberate manipulation may be used to support the unique features for which a research natural area was established. This is the case with Santana Research Natural Area, as the 1984 management plan for the area described a current and future need to control woody vegetation, specifically listing cottonwood, black willow, Russian olive, sand plum, dogwood, and skunkbush as potential invading species. Our activities to support the habitat and biological communities here include prescribed fire, grazing, mowing, and cutting woody plants to prevent their spread.

Activities such as hiking, birdwatching, hunting, fishing, wildlife observation, and photography are permissible, but not mandated, in research natural areas. These special areas also may be closed to all public use if such use is found to be incompatible with primary refuge purposes. The Santana Research Natural Area on Quivira Refuge is open to the public but is not within the hunting area, and no fishing opportunities are available. Because our intent is to not alter or disrupt the characteristic bluestem grasslands found here, no trails or facilities have been, or will be, established in the area.

3.6 Visitor Services

Visitors can enjoy a variety of wildlife-dependent activities, such as hunting, fishing, wildlife observation, photography, environmental education, and interpretation. Most who come use the 14-mile auto tour route. Brochures containing area maps, public use regulations, bird species, and general information are available. Our refuge office is open Monday–Friday, 7:30 a.m.–4:00 p.m. The auto tour route and the rest of the refuge are open from 1 and one-half hours before dawn to 1 and one-half hours after dusk, except during hunting season when hunters are allowed a reasonable amount of time to access hunting areas before dawn and to leave after dusk.

No fees or registration are required for visiting the refuge. There are many access roads, and several county and township roads pass through the refuge. Therefore, attempts to estimate visitation present a challenge for our refuge staff. Visitors are asked to sign the guest register at the headquarters visitor center, but registration is not mandatory. Nonhunting use is estimated each year based on the guest register, head counts of education and interpretation groups, and estimates of visitors on the tour route during various seasons. Current annual visitation is estimated to be 65,000.

Visitors also make use of educational and interpretive activities in the classrooms and auditorium at the GPNC's large visitor center building as well as on the adjacent grounds.

Traditional tribal uses are also allowed on the refuge with a special use permit.

Hunting

Currently, about 8,062 of the refuge's 22,135 acres are within the hunting area. Hunting is permitted for ducks, geese, quail, pheasant, squirrel, rabbit, snipe, and rail. Hunting is not allowed for deer, turkey, or cranes. Hunting season runs from September 1 to February 28, with specific seasons within this period coinciding with State seasons. An accessible hunting blind is available by reservation in Unit 30.

Hunting rules, such as licensing needs and daily possession limits, follow applicable Federal and State regulations. Refuge-specific regulations include:

- Persons possessing, transporting, or carrying firearms on national wildlife refuge lands must comply with all provisions of State and local law. Persons may only use, or discharge, firearms in accordance with refuge regulations—50 CFR 27.42 and specific refuge regulations in 50 CFR Part 32. Discharge of a firearm is prohibited for any reason other than for the taking of game animals in legal hunting areas.
- Hunting is not permitted outside of the public hunting areas or from across roads, trails, or parking areas.
- Vehicle travel and parking is restricted to roads, pullouts, and parking areas.
- Steel shot, bismuth, or other nontoxic shot is required in all gauges when hunting any game on the refuge. The possession of lead shot in the field is prohibited.

- Trapping and baiting are prohibited.
- Retrieving game from areas closed to hunting is prohibited.
- The use of dogs for hunting and retrieving is encouraged. Dogs and other pets must be under their owners' control. From March 1 through August 31, all dogs and other pets must be leashed.
- Portable devices or temporary blinds of natural vegetation are permitted, though we encourage preventing the spread of nonnative invasive vegetation. Permanent blinds or pits may not be constructed. All equipment and blinds must be removed daily.

Many lands next to, or near, the refuge boundary are leased for private hunting. Thus, hunting activities are quite prevalent in the area.

Hunting on the refuge will expand and change as a result of this CCP, see chapter 4 for details.

Fishing

Fishing is allowed on all refuge waters in accordance with State fishing regulations, however, access is generally restricted to the LSM, the Kids' Fishing Pond, and a few points on Rattlesnake Creek. Accessible fishing piers are located at the north end of the LSM and at the Kids' Fishing Pond. The Kids' Fishing Pond is open for kids up to 14 years, although adults may fish there if they are accompanying a youth. Only one fish may be taken per person per day.

Fish species listed in the State fishing regulations may be taken. All other wildlife species, including turtles, frogs, and snakes are protected and may not be disturbed or removed from the refuge. Fishing with trotlines and setlines is prohibited. The use of seines for taking bait is not permitted. Fishing from water control structures and bridges, and the use of live bait is prohibited.

Fishing is also allowed at Chisholm Creek Park near the GPNC, managed and maintained by the City of Wichita.

Wildlife Observation and Photography

Quivira Refuge is a premiere birdwatching site in Kansas, and one of the top sites in North America.

Birders travel to the refuge from across Kansas, as well as the United States, and many return to Quivira Refuge on a regular basis. Peak birder visitation usually coincides with the peak shorebird and waterfowl migration seasons in the spring and fall.

Besides birders, Quivira Refuge is popular with more general wildlife observers who visit to view deer, beaver, bald eagles, and the considerable amount of geese, ducks, and cranes that regularly visit during the same period.

The 40-plus miles of public roads within, or alongside, refuge boundaries include a 14-mile tour road that features a 4-mile Wildlife Drive through the BSM. There is an accessible observation tower, equipped with a spotting scope and seating, at the LSM, and a similar scope and seating are located at a viewpoint along the Wildlife Drive. Photo blinds, available on a first-come, first-served basis, are located at the LSM and on the Migrants Mile Trail. Horseback riding and bicycling on established roads, not hiking trails, are also allowed along with dogs that are under their owner's control and that are leashed during the nesting season of April 1 to August 15.

A large percentage of visiting birders and general wildlife enthusiasts are also photographers. Many professional and experienced photographers use the refuge on a regular basis.

Environmental Education

Whereas general school field trips formed most school visits in the past, educational programs have been increasingly focused on topics that help schools and other educational organizations by matching State curriculum-based standards. Several curricula have been developed and used for topics such as bird migration, prairie studies, animal communication, and shorebirds. New curricula are continually under development to offer a variety of subjects to a wider spectrum of grade levels.

Programs are presented either at the refuge or at schools. For onsite visits, Quivira opened a remodeled and modernized environmental education classroom in 2010 to better accommodate and focus on children's education. The facility, designed to hold a class of up to 45 persons, has built-in audiovisual equipment and a large variety of classroom supplies. It serves as the refuge's primary indoor class space, but also as a center for outdoor education activities associated with the nearby Migrants Mile Trail. As an alternate, or added, educational space, the headquarters' conference room, is occasionally used. Virtual geocaching is also allowed to enhance environmental education on the refuge.



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The Butterfly Blossoms Pathway native prairie wildflower interpretive trail at Quivira Refuge was made possible through a partnership with The Friends of Quivira.

The emphasis at the GPNC is on providing an opportunity for people of all ages to learn about the natural resources of the Great Plains, to develop an appreciation of the beauty and value of this region, and to become stewards of the natural resources. Environmental education, a learning process that increases knowledge and awareness about the environment and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action, is one tool used with school groups to achieve our stated goals. On average, the GPNC's staff conducts nearly 1,800 presentations and programs to school groups; community organizations, such as civic, church, and Scouting groups; organized recreation groups from places like city recreation centers and day camps for latchkey children; and casual visitors. Staff provides educational programs both on, and off, site; and programs are conducted year round. With a variety of wildlife available for their use under permit, staff is able to use live animals to help make connections with their audiences.

Interpretation

We lack a current refuge visitor services plan and a primary interpretive theme to provide guidance for our refuge management and staff. However, interpretation has been a vital part of Quivira Refuge's operations for many years. Primary themes have

included birds and bird migration, refuge management, fire management, and endangered species. The primary method to present interpretive information to the public is via displays and signs, programs and workshops, brochures, and by Web and other social media. Interpretive displays are available at the headquarters. Topics in permanent displays include bird migration, saltmarshes, Quivira Refuge area history, endangered species, and refuge habitats. Other displays, either temporary or permanent, are added to augment knowledge about our refuge management, flora, and fauna. Displays are also present along the refuge tour road. Nine information kiosks are situated along the route, with maps and information about refuge habitats and hunting. The tour road also features eight different wayside exhibits featuring refuge wildlife and management activities. In addition, the Migrants Mile Trail, Quivira Refuge's premier hiking trail, has many interpretive signs along its length featuring wildlife and wildlife habitat.

Our refuge staff presents interpretive programs and workshops whenever possible, either by request or by scheduling through area schools or community organizations; see the outreach section in this chapter for more details. These are topic-oriented talks, slide shows, or guided walks and auto tours.

Both our refuge-general brochure and our bird checklist were revised and reprinted in 2011. Brochures about other topics, such as whooping cranes, common wildlife, and grasses have also been devel-

oped and printed. Our headquarters also has a rack featuring brochures of other nearby sites of interest, as well as other Service topics.

Quivira Refuge's Web site, in the content management system as of 2012, has long been popular as a source of information. Quivira Refuge was one of the first sites in the content management system. The current Web site has become diverse and detailed, offering interpretive information about subjects such as birds, mammals, reptiles and amphibians, and refuge habitats. Special features include separate pages dedicated to providing a variety of information about the endangered whooping crane, climate influences on refuge plants, and changes in the refuge environment throughout the year. Especially popular are the listings of recent bird observations and road conditions. During the most recently recorded period, March 2010 through February 2011, Quivira Refuge's Web site had 38,185 total visitors and 983,667 total visitor hits. Also during this period, there was an average of 107 visitors to the Web site per day.

In 2011, Quivira Refuge also began using Facebook and Flickr to showcase refuge wildlife, wildlife management, and current happenings; see the outreach section in this chapter for more detail.

Other Uses

Quivira has more than 2 miles of supported hiking trails, including the mile-long Migrants Mile Trail, which is a popular destination. Other activities that have been found to be compatible with the priorities of the refuge include bicycling and horseback riding only on established roads and, depending on the time of the year, bringing dogs on leashes. A national and well-publicized bicycling route passes through the center of the refuge on NE. 140th Street.

Activities that are prohibited on the refuge because of conflicts with wildlife include camping, boating, picnicking, canoeing, fires, the use of all-terrain vehicles, and the collecting of plant, animal, mineral, or any other natural materials.

See appendix B for more details.

Special Events

Annual events, such as Kids' Fishing Day in June, Monarch Mania in September, and Refuge Week Celebration in October, are held by refuge staff with the support of The Friends of Quivira. The Friends of Quivira and Friends of the Great Plains Nature Cen-

ter are reciprocal partners and, as such, support each other's special events as needed and as time permits.

Public Outreach

Our mission—that of the Refuge System and Quivira Refuge—is an important focus topic for the refuge's environmental and interpretive programs and is also a priority for all outreach activities. It is a goal for all programs to include at least basic information on these missions. Programs that focus on refuge management are regularly given to area communities through civic organizations, churches, public libraries, and schools. Other than these programs, the primary outlets for outreach include the Kansas State Fair, refuge special events, and the Web and other social, or online, media.

Quivira Refuge is the lead partner in the operation of our booth at the annual Kansas State Fair in nearby Hutchinson, Kansas. The primary purpose of the booth is to teach others about our mission, to showcase Kansas refuges, and to educate about various wildlife-oriented topics and programs, our Ecological Services Division, Partners for Fish and Wildlife (Partners), and other operations. Our staff from Quivira Refuge and other offices in the State are on hand to help and educate fair visitors during the 10-day event.

Several special events are held annually, all in partnership with the Friends of Quivira. Some, such as Kids' Fishing Day in June and Monarch Mania in September, each have their own recurring annual themes, such as fish for the fishing day and butterflies for the monarch day, and often involve a combination of activities, education, and, in some cases, refreshments for the participants. Others, such as the Great Migration Rally in May and the Refuge Week Celebration in October, feature topics and activities that vary each year.

Quivira Refuge's Web site, updated several times a week, is also an important outlet for public information about the refuge's mission and objectives. Regular features include new happenings around the refuge, such as improvements, construction, and management; road conditions; schedules for special events; and bird observations. The Web site also has hunting and fishing regulations and bird count tallies. Refuge staff also regularly reports similar information on its official Facebook site, which is updated several times a week. Unusual bird observations, whooping crane sightings, and road conditions are also posted on the Kansas Listserv, used by many birders statewide.

3.7 Partnerships

Quivira Refuge and the GPNC collaborate with educational, regulatory, and research institutions that support refuge goals and objectives. Our refuge has formal and informal partnerships with Fort Hays State University, Sterling College, Kansas State University, Emporia State University, Friends University, Wichita State University, and others to work on research and educational projects. These working relationships involve, among other things, offering summer classes for educators to obtain continuing education credits, offering board memberships for the GPNC, and offering students working opportunities through AmeriCorps or internships.

The refuge is part of the Rattlesnake Creek Partnership, which seeks to resolve water rights issues in Groundwater Management District 5. The refuge partners with the KDWPT on a variety of wildlife-related projects, including avian influenza surveillance, chronic wasting disease and deer health programs, fish stocking, breeding shorebird surveys, and educational and interpretive programs. Quivira Refuge is a member of the Wetlands and Wildlife National Scenic Byway's planning committee, and Quivira staff regularly attends planning meetings about the Byway and the local Byway communities.

Partnerships with Ducks Unlimited over the years have resulted in many habitat improvement projects on the refuge, and these will continue.

Quivira Refuge staff partners with the Friends of Quivira to plan and present educational programs and annual events. The Friends of Quivira operate a nonprofit bookstore in the refuge visitor center.

The GPNC operates under a memorandum of agreement with the City of Wichita and the KDWPT. Together, they have partnerships with many corporate sponsors like The Coleman Company, Koch, and Spirit AeroSystems and with educational institutions like Wichita State University and Friends University. This partnership also often works informally with other universities and colleges to provide work experience for interns when available.

The GPNC is supported by the Friends of the Great Plains Nature Center, who operate a bookstore in the nature center, support educational programming at the nature center, and provide pay for six employees, including a full-time naturalist who presents environmental education programs in schools and locations throughout the Wichita metropolitan area. The Friends of the Great Plains Nature Center naturalist helps in educational programming for both the GPNC and Quivira Refuge.

The refuge and the GPNC are always open to establishing new partnerships where possible that help wildlife and habitat conservation. The refuge is looking to establish a partnership to control invasive species in the Rattlesnake Creek watershed, such as saltcedar, and a partnership with neighbors to prevent the continued encroachment of invasive woody species, such as eastern red cedar and Russian olive.

With the addition of a Partners biologist to the staff at Quivira Refuge and a new focus area that is comprised of Quivira Refuge and Cheyenne Bottoms, new partnerships should continue to be developed.

3.8 Socioeconomic Environment

Quivira Refuge is open for the compatible, wildlife-dependent uses of hunting, fishing, wildlife observation, and photography. These recreational opportunities attract visitors and bring dollars to the community. Associated visitor activity, such as spending on food, gasoline, and overnight lodging in the area, provides local businesses with extra income and increases the local tax base. Our refuge management decisions about public uses, the expansion of services, and habitat improvement may either increase or decrease visitation to the refuge and affect visitor spending in the local economy.

As part of the development of this CCP, we hired a contractor to prepare a socioeconomic study for the Quivira Refuge (USGS 2012c). This study provides the basis for the sections that follow, including population and employment, public use of the refuge, and baseline economic activity.



Barry Jones/FWS

School kids from the local community learn about issues affecting the wildlife in their area at the Stafford County, Kansas, Conservation Day.

For the purposes of an economic impact analysis, a region (and its economy) is typically defined as all counties within a 30–60 mile radius of the impact area. Only spending that takes place within this regional area is included as stimulating changes in economic activity. The size of the region influences both the amount of spending captured and the multiplier effects. Quivira Refuge is located in south-central Kansas. Most of the economic activity related to the refuge is located within the five-county area of Stafford, Rice, Reno, Barton and Pratt Counties, therefore, these counties compose the local economic region for this analysis. The Refuge is also a partner in the establishment and daily operations of the GPNC located 90 miles from the refuge. While the GPNC lies outside the local economic region, connections with refuge activities will be discussed.

Collectively, the 5-county area has a population of approximately 116,000 people and covers a total area of 4,431 square miles (U.S. Census Bureau 2010). Within the five-county area, the cities of Ellinwood, Great Bend, Hutchinson, Larned, Lyons, Pratt, Stafford, Sterling and St. John are economically significant to the refuge and, as such, are additional areas of focus for the regional economic setting.

Population, Ethnicity, and Education

Table 9 lists population estimates and trends for the 5-county area and table 10 lists population estimates for the nine communities near the refuge. In 2010, the counties accounted for approximately 4 percent of the State's population (U.S. Census Bureau 2010). While Kansas has experienced an increase in the number of residents since 2000, 4 of the counties have experienced a decline in residents, with only Pratt showing a slight, 0.1-percent increase (U. S. Census Bureau 2010a). Ellinwood, Larned, Sterling and St. John have experienced declining populations, with St. John showing the greatest decline, losing more than 20 percent of its population since 2000.

Though Kansas is expected to grow in population, population decline is expected to continue in all five of the counties surrounding the refuge (The University of Kansas Institute for Policy and Social Research 2012). Barton and Stafford are expected to show the greatest decline, losing more than 20 percent of their populations by 2040, while Pratt is expected to show the least decline, with an expected loss of 9 percent. The overall decline in population may be due to an aging population as well as to migration to more urban areas. This trend can be

observed across many of the rural counties in Kansas (Wichita State University 2011).

Table 9. State and county population estimates in the area around Quivira National Wildlife Refuge, Kansas.

	<i>Residents (2010)¹</i>	<i>Persons per square mile (2010)¹</i>	<i>Percent population change (2000– 2010)²</i>
Kansas	2,853,118	34.9	6.8
Barton	27,674	30.9	–1.9
Pratt	9,656	13.1	0.1
Reno	64,511	51.4	–0.4
Rice	10,083	13.9	–6.3
Stafford	4,437	5.6	–7.4

Source: ¹U. S. Census Bureau 2012b. ²U. S. Census Bureau 2010a.

Table 10. Community population estimates in the area around Quivira National Wildlife Refuge, Kansas.

	<i>Residents (2010)¹</i>	<i>Persons per square mile (2010)¹</i>	<i>Percent population change (2000–2010)²</i>
Ellinwood	2,131	1,966	–1.5
Great Bend	15,995	1,505	4.2
Hutchinson	42,080	1,994	3.2
Larned	4,054	1,745	–4.3
Lyons	3,739	1,736	0.2
Pratt	6,835	922	4.0
Stafford	1,159	1,233	7.8
Sterling	2,328	1,640	–11.9
St. John	1,036	575	–20.7

Source: ¹U. S. Census Bureau 2012b. ²U. S. Census Bureau 2010a.

While the percentage of the State population with at least a bachelor's degree is higher than the national average (29.3 percent compared to 27.9 percent), each county within the 5-county area has lower than both the State and national averages (ranging from a low of 18.8 percent in Reno to a high of 22.7 percent in Pratt). Each of the nine communities surrounding the refuge also fall below State and national averages, with Stafford and Lyons having the lowest (13.2 percent) (U. S. Census Bureau 2010a).

In 2010, more than 87 percent of the population of Kansas self-identified as white, not of Hispanic or Latino origin (U. S. Census Bureau 2010a). This percent is lower than reported for each of the counties within the 5-county area (ranging from a low of 90.6 percent in Barton County to a high of 96 percent in Pratt County). Relative to the other counties in the 5-county area, Barton County had the largest percentage of the population who identified as Hispanic or Latino (13.3 percent) (U. S. Census Bureau 2012b) while Reno County had the highest percentage of the population who identified as African-American (4.1 percent) (U. S. Census Bureau 2012b).

Regional Economic Setting

Table 11 shows the median household income, poverty, and unemployment rates for the 5-county area, while table 12 lists the same for communities near the refuge. The five counties and nine communities

have median household incomes below both State and national levels. Of the counties, Barton had the highest median household income at \$43,763 per year, while Stafford had the lowest at \$39,375. Of the communities, Great Bend had the highest median household income at \$42,293 per year, while Stafford had the lowest at \$33,182 (U. S. Census Bureau 2010a).

In 2010, 12.4 percent of the Kansas population was living below the poverty line, compared to 13.8 percent nationally. Poverty rates within the 5-county area are similar to State and national averages, with Pratt having the lowest rate (10 percent) and Stafford having the highest (14 percent). The communities near the refuge show substantial variability, from 6.7 percent in Larned to nearly 20 percent in St. John (U. S. Census Bureau 2010a).

Table 13 shows the percent employment by sector within the 5-county area. The combined 5-county area had a total employment of more than 73,000 individuals in 2011 (Bureau of Economic Analysis 2012). Farm employment accounted for nearly 6 percent of the workforce. The highest percentage of total

Table 11. State income, unemployment, and poverty statistics and county statistics in the area around Quivira National Wildlife Refuge, Kansas.

	<i>Median household income (2010)</i>	<i>Percentage of individuals below poverty (2010)</i>	<i>Percentage unemployed (2010)</i>	<i>Change in percent unemployed (2000–2010)</i>
Kansas	\$49,424	12.4	4.1	1.3
Barton	\$43,763	12.2	3.6	0.1
Pratt	\$43,583	10.0	2.2	–0.8
Reno	\$41,431	13.1	3.0	0.1
Rice	\$43,164	13.7	4.2	0.6
Stafford	\$39,375	14.0	2.7	0.6

Source: U. S. Census Bureau 2010a.

Table 12. Community income, unemployment and poverty statistics in the area around Quivira National Wildlife Refuge, Kansas.

	<i>Median household income (2010)</i>	<i>Percentage of individuals below poverty (2010)</i>	<i>Percentage unemployed (2010)</i>	<i>Change in percent unemployed (2000–2010)</i>
Ellinwood	\$39,444	7.7	3.0	0.9
Great Bend	\$42,293	13.7	3.9	1.3
Hutchinson	\$38,880	15.7	3.2	–0.3
Larned	\$37,235	6.7	2.8	0.8
Lyons	\$41,552	15.7	3.7	1.5
Pratt	\$39,142	11.1	2.0	0.1
Stafford	\$33,182	15.2	2.5	0.5
Sterling	\$36,192	14.4	6.3	–2.1
St. John	\$37,589	19.0	3.4	2.2

Source: U. S. Census Bureau 2010a.

Table 13. Employment by sector in the area around Quivira National Wildlife Refuge, Kansas.

<i>Industry</i>	<i>2011</i>	<i>Percent of total</i>
Farm proprietors employment	3,365	4.6
Nonfarm proprietors employment	15,388	21.0
Forestry, fishing, and related activities	637	0.9
Mining	5,907	8.1
Utilities	124	0.2
Construction	3,362	4.6
Manufacturing	4,934	6.7
Wholesale trade	2,300	3.1
Retail trade	7,351	10.1
Transportation and warehousing	561	0.8
Information	828	1.1
Finance and insurance	3,354	4.6
Real estate and rental and leasing	1,628	2.2
Professional, scientific, and technical services	2,146	2.9
Management of companies and enterprises	671	0.9
Administrative and waste management services	2,731	3.7
Educational services	412	0.6
Health care and social assistance	8,406	11.5
Arts, entertainment, and recreation	867	1.2
Accommodation and food services	4,317	5.9
Other services, except public administration	3,483	4.8
Federal, civilian	397	0.5
Military	502	0.7
State and local	10,599	14.5

Source: Bureau of Economic Analysis 2012.

employment was found in the government and government enterprise sector (15.7 percent of nonfarm employment). This sector includes both local and nonlocal government agencies. The second and third highest percentages of total employment were in health care and social assistance (11.5 percent) and retail trade (10.1 percent). Forestry, fishing, and related activities accounted for less than 1 percent of the total employment by sector.

Agricultural Sector

Kansas is a highly productive region in the United States for both crops and livestock. In 2011, Kansas had an agricultural output of more than \$17 billion, with crop output contributing more than \$6 billion, animal output contributing nearly \$9 billion, and services and forestry contributing more than \$2 billion. The top five commodities produced in the State were cattle and calves, corn, wheat, soybeans, and sorghum grain (Economic Research Service 2012).

As of the 2007 Census of Agriculture, the 5-county area was home to more than 4,000 farms, with more than 2.7 million acres in agricultural production. This accounted for more than 6.26 percent of the total land in production in the State (U. S. Department of Agriculture 2007). In 2007 within the 5-county area, Reno had the greatest number of farms and acreage in production (1,749 farms, and 780,893 acres). Pratt had the fewest number of farms (538) and Rice had the smallest acreage in production (428,422) (U.S. Department of Agriculture 2007).

Recreation and Tourism

Angling, hunting, and wildlife viewing are popular recreational activities across Kansas and within the five-county area. According to the recent 2011 National Survey of Fishing, Hunting and Wildlife-Associated Recreation, approximately 1.2 million residents and nonresidents took part in wildlife-associated activities in Kansas (FWS 2012a). Of all participants, 46 percent identified as sportsmen and women, engaging in either hunting or fishing, and 69 percent reported engaging in wildlife-watching activities. For the purpose of the National Survey, wildlife watching is broken down into away-from-home activities taking place at least 1 mile from home and around-the-home activities taking place within 1 mile from home. All visitors to the refuge that engage in wildlife watching are considered away-from-home participants. The number of hunting days by both residents and nonresidents totaled 5.2 million, with Kansas residents accounting for 78 percent of hunting days. The number of fishing days by residents and nonresidents totaled 4.1 million, with Kansas residents accounting for 98 percent of fishing days. In 2011, residents and nonresidents spent a

total of 1 million days watching wildlife away from home, with residents accounting for 77 percent of wildlife watching days. The in-state spending associated with these activities totaled \$820 thousand in 2011, with \$293 thousand spent on trip-related expenditures, \$197 thousand spent on equipment, and \$330 thousand spent for other items (FWS 2012a).

The Wetlands & Wildlife National Scenic Byway connects Cheyenne Bottoms Wildlife Area in Barton County to Quivira Refuge. Along this 77-mile stretch of road, visitors have the opportunity to view more than 300 bird species and visit the remains of the Santa Fe Trail, historic sites, museums, and natural sites. The byway also connects several cities. Claflin, Ellinwood, Great Bend, Hoisington, Hudson, St. John, and Stafford are all considered Byway Communities (Kansas Scenic Byways Program).

From 2009–2010, a visitor survey was conducted by Fort Hays State University's Kansas Wetlands Education Center. The survey found that day trips were the most popular trip length for visitors to the Wetlands & Wildlife National Scenic Byway, with trips 1–3 days in length being the second most popular. In general, day visitors spent under \$100 within the local area, while visitors staying 1–3 days generally spent \$100–\$200. Most visitors to the area were Kansas residents. According to Barton County Counselor and Administrator, Richard Boeckman (personal interview, date unknown), several byway communities are collaborating to improve marketing and increase tourism in the area. He says the byway, refuge, and Cheyenne Bottoms are all considered important assets to the local economy.

Public Use of the Refuge

The USGS headed a National Wildlife Refuge Visitor Survey (USGS 2012a) at Quivira Refuge and several other refuges to tell us more about visitor use. Data in this report, outlined in the following sections, came from survey forms completed by visitors to Quivira Refuge during the selected sampling periods of fall 2010 and spring 2011.

According to the USGS (2012a), about half of visitors, or 47 percent, had only been to Quivira Refuge once in the 12-month survey period, while the other half, or 53 percent, had been there multiple times. These repeat visitors went to the refuge an average of 7 times during the 12-month period. Fifty nine percent of visitors used the refuge during only one season, 28 percent used it during multiple seasons, and 13 percent used it year round.

Most visitors, 64 percent, first learned about the refuge from friends or relatives, 21 percent from printed information, and 18 percent from highway

signs. Key information sources used by visitors to find their way to the refuge included highway signs, by 54 percent; earlier knowledge, by 46 percent; and a road atlas or highway map, by 44 percent.

Twenty-five percent of visitors live in the local area, which is within 50 miles of the refuge, whereas 75 percent are nonlocal visitors (USGS 2012a). For 79 percent of local visitors and for 59 percent of nonlocal visitors, Quivira Refuge was the primary purpose, or sole destination, of their trip. Local visitors reported that they traveled an average of 32 miles to get to the refuge, while nonlocal visitors traveled an average of 319 miles. About 60 percent of visitors travelling to Quivira Refuge were from Kansas.

Nearly all, or 99 percent of, visitors to Quivira Refuge said that they were citizens or permanent residents of the United States (USGS 2012a). Visitors were 62 percent male, with an average age of 57 years, and 38 percent female, with an average age of 59 years. On average, visitors reported they had 16 years of formal education, college or technical school. The median level of income was \$50,000–\$74,999.

Visitors reported that they spent an average of 5 hours at Quivira Refuge during 1 day there (USGS 2012a). However, the most frequently reported length of visit during 1 day was 8 hours, as reported by 31 percent of respondents. The key modes of transportation used by visitors to travel around the refuge were private vehicle, by 93 percent of respondents, and walking or hiking, by 11 percent. More than half of visitors, or 69 percent, said that they were part of a group on their visit to the refuge, often travelling with family and friends.

According to the USGS, visitors took part in a variety of refuge activities during the survey period (USGS 2012a). The top activities reported were birdwatching, by 77 percent of respondents; wildlife observation, by 70 percent; auto tour route or driving, by 53 percent; and photography, by 51 percent. The primary reasons mentioned for their most recent visit included birdwatching, by 52 percent of respondents; hunting, by 18 percent; photography, by 10 percent; and wildlife observation, by 9 percent. The visitor center was used by 70 percent of visitors, mostly to ask information of staff or volunteers, by 91 percent of this group; or to view the exhibits, by 82 percent; or to use the facilities, by 75 percent.

Visitor Levels

Of those who visited Quivira Refuge and took part in the USGS's National Wildlife Refuge Visitor Survey, overall satisfaction with the services, facilities, and recreational opportunities we provided were rated as follows (Sexton et al. 2012):



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Painted turtles are easily viewed at Quivira Refuge.

- Ninety-two percent were satisfied with the recreational activities and opportunities.
- Ninety-one percent were satisfied with the information and education provided about the refuge and its resources.
- Ninety-three percent were satisfied with the services provided by employees or volunteers.
- Ninety-three percent were satisfied with the refuge's job of conserving fish, wildlife and their habitats.

Satisfaction levels were divided into quadrants. All Quivira Refuge services and facilities fell into the Keep Up the Good Work quadrant (Sexton et al. 2012). Refuge recreational opportunities fell into Keep Up the Good Work except for volunteer, kayak and canoe, bicycling, fishing, and hunting, which fell into the Look Closer quadrant. The average importance of fishing, hunting, bicycling, and volunteer opportunities in Look Closer may be higher among visitors who engaged in these activities during the past 12 months. However, there were either not enough people in the sample to evaluate such responses or it is unknown how many in the sample took part in an activity. Boating is not allowed on the refuge, which may explain the low importance rating for kayaking and canoeing. All transportation-related features fell into Keep Up the Good Work.

Economic Contributions of the Refuge

Quivira Refuge affects the local economy through the visitor spending it generates and the employment

it supports. Combining the effects of our employment and visitor spending, the total economic activity generated in the 5-county study area is approximately \$1.015 million in added value.

U.S. Fish and Wildlife Service Employment

Refuge management activities directly related to refuge operations generate an estimated 20 jobs and \$667,500 in labor income. It is estimated that salary spending by Quivira Refuge staff generates secondary effects of 5 jobs, \$168,600 in labor income, and \$301,700 in value added to the local economy.

Visitor Spending

A region, and its economy, is typically defined as all counties within 50 miles of a travel destination (Stynes 1998). Visitors that live within the local, 50-mile area of a refuge typically have different spending patterns than those who travel from longer distances. Approximately 25 percent of visitors to Quivira Refuge said that they live within the local area. Nonlocal visitors, or 75 percent, stayed in the local area, on average, for 2 days. Table 14 shows local and nonlocal visitor expenditures reported on a per-person-per-day basis. Nonlocal visitors spent an average of \$55 per person per day, and local visitors spent an average of \$45.

3.9 Operations

This section describes funding, staff and facilities at Quivira Refuge.

Table 14. Total visitor expenditures, expressed in dollars per person per day, for Quivira National Wildlife Refuge, Kansas.

<i>Visitors</i>	<i>Sample size</i>	<i>Median</i>	<i>Mean</i>	<i>Standard deviation</i>	<i>Minimum</i>	<i>Maximum</i>
Nonlocal	100	\$42	\$55	\$57	\$0	\$313
Local	30	\$29	\$45	\$55	\$0	\$250

Funding and Staff

Refuge staff is comprised of 11 permanent full-time employees, 1 permanent part-time employee, 3 temporary employees, and 2 regional employees that are not paid through the refuge (table 15). The current staff level remains well below the minimum prescribed in the June 2008 Final Report—Staffing Model for Field Stations (FWS 2008b), which recommends that eight more staff, including three maintenance workers, one biologist, two biological technicians, one refuge law enforcement officer, and one GPNC visitor services specialist be added.

Table 15. Base staff budgeted in fiscal year 2012 and other staff stationed at Quivira National Wildlife Refuge, Kansas.

<i>Staff group</i>	<i>Position</i>
Current staff	
management	General Schedule–13 refuge manager
	General Schedule–12 deputy refuge manager and collateral duty law enforcement officer (vacant)
	General Schedule–9 wildlife refuge specialist and collateral duty law enforcement officer
	General Schedule–11 zone fire management officer
	General Schedule–7 supervisory range technician (vacant)
biology	General Schedule–11 wildlife biologist
public use	General Schedule–12 park ranger—visitor services manager at the GPNC
	General Schedule–9 park ranger for visitor services
administration	General Schedule–9 administrative officer
	General Schedule–5 office assistant, 0.5 full-time equivalent
maintenance	Two Wage Grade Schedule–8 maintenance workers
maintenance, temporary or term	Two Wage Grade Schedule–6 tractor operators, career seasonal, 6 months
	General Schedule–5 range technician for invasive species control, term position
Current staff stationed at, but not paid by, Quivira Refuge	
biology	Zone biologist
	Partners biologist

Facilities

Facilities are used to support habitat and wildlife management programs and wildlife-dependent public uses for 65,000 annual visitors. The refuge has two full-time maintenance workers and two part-time tractor operators to support buildings, water conveyance structures, fences, and roads.

Facilities have been regularly updated over the years. The refuge headquarters was built in 1964 and a visitor center with a conference room was added in 1992. In 2011, these facilities were remodeled, and space was developed for seven more offices. The shop was built in 1979 and has been kept in good condition. Two residences were built in 1964 to provide housing for refuge employees at the headquarters and shop area and have been kept in good condition.

Half of the original block building office built in 1958 houses an environmental education classroom. The other half of the building is a bunkhouse that can house six seasonal employees or volunteers. The building is in poor condition and would be difficult to remodel or improve because of its construction.

We received a three-bedroom trailer as unused excess from the Federal Emergency Management Agency in 2009 and placed it at the environmental education classroom site. It is in good condition. There are two cold storage buildings, one eight-bay building was built in 1991 and a four-bay equipment storage building was built in 2005. Two full-hookup trailer pads are also available at the environmental education classroom site for use by volunteers. A new, concrete, accessible, aboveground tornado shelter was placed there in 2010.

We own 7 acres of land at the GPNC and a 23,000-square foot visitor center and office building that was built in 1995 and is in good condition. We will also own a garage and storage building on the site pending official transfer. Remaining land there is owned by the city of Wichita, including parking lots, Chisholm Creek Park, and associated trails.

Quivira Refuge's public use facilities are shown in figure 11. More than 45 miles of public roads exist either within, or next to, the refuge's boundaries. Of these, 16.8 miles are refuge owned. The refuge maintains 55 public parking lots, ranging from being graveled to grass surfaced.

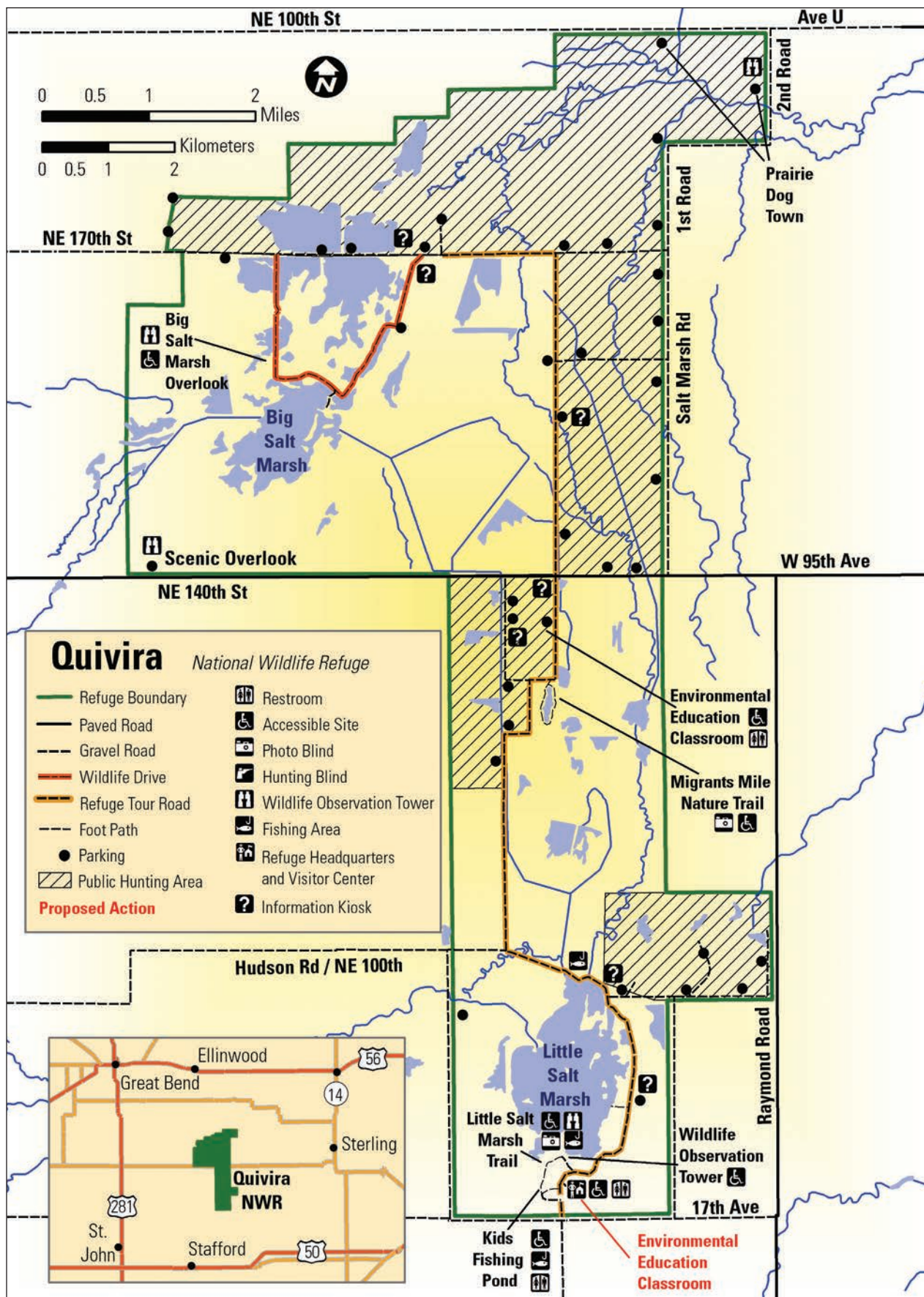


Figure 11. Public use facilities at Quivira National Wildlife Refuge, Kansas.

Refuge facilities include:

- headquarters office and visitor center building, 6,720 square feet
- maintenance shop, fire cache, and vehicle storage building, 9,200 square feet
- two 176-square foot grain bins
- eight-bay cold storage building, 6,750 square feet
- four-bay equipment storage building, 3,600 square feet
- environmental education classroom and bunkhouse, 1,900 square feet
- two 2002-square foot, three-bedroom houses for staff, with one stall, attached garage and one 400-square foot stall, detached garage for each
- oil storage building with 3 associated 1000-gallon, aboveground fuel tanks, 180 square feet
- pesticide storage building, 140 square feet
- fencing storage shed, 576 square feet
- two metal, 192-square foot pump houses for the domestic water supply
- pole shed building, 2,160 square feet
- storage building, 192 square feet
- asphalt hiking trail, 0.65 mile; earthen hiking trail, 0.57 mile; and photo blind at Migrants Mile
- earthen hiking trail at the LSM, 0.63 mile
- accessible wooden observation tower on the LSM, 6,536 square feet
- BSM overlook
- two vault toilet restrooms
- one photo blind at the LSM
- one accessible hunting blind
- nine information kiosks
- self-guided gravel auto tour route, 14 miles
- eight wayside interpretive exhibits
- two fishing piers
- fifty-five parking lots
- refuge roads, 16.8 miles
- canals, 25 miles
- one hundred and three water control structures
- nine entrance signs



FWS

The Kid's Fishing Pond has one of two fishing piers on the refuge.

Chapter 4—Management Direction



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Wilson's Phalaropes

This chapter describes how we intend to carry out the proposed action through the formulation of objectives and strategies that are designed to help us achieve our goals for Quivira Refuge.

4.1 Management Focus

As stated in the Improvement Act, the primary mission of our Refuge System is wildlife conservation. Multiple policies and guidance documents have been developed to accomplish this mission, including the policy on Biological Integrity, Diversity, and Environmental Health and the 2011 Conserving the Future document developed in collaboration with our stakeholders and the public. The Biological Integrity, Diversity, and Environmental Health policy provides

directives for supporting and restoring the biological integrity, diversity and health of the Refuge System, whereas Conserving the Future articulates the desired roles for refuges and provides recommendations for the next decade and beyond (FWS 2011) and states, “At the root of these challenges [that the Refuge System must address] is the increasing consumption of natural resources, which has caused loss, degradation and fragmentation of habitat around the world. Habitat loss is largely responsible for the current extinction event, in which the Earth may lose half of its species in the next 100 years.”

Our focus and planning approach for Quivira Refuge is consistent with the visions and principles promoted in the Improvement Act; the policy on Biological Integrity, Diversity, and Environmental Health; and the Conserving the Future document, including conserving native communities and species of concern and developing “quantifiable conservation

objectives” that “integrate the conservation needs of the larger landscape (including the communities they support).”

4.2 Overview of Goals and Objectives

The vision, proposed alternative, and goals for Quivira Refuge collectively focus objectives and associated management strategies on achieving sustainable, diverse, native communities that will conserve native species of concern at landscape and local scales. Achieving this vision represents the greatest contribution we at the refuge can make in addressing current and future threats to natural resources in the central Great Plains. Threats include increasing habitat fragmentation and decreasing landscape connectivity, adverse effects on water quantity and quality, and cumulative risks associated with changing climate and energy production. To alleviate these and to meet the purposes of the refuge requires us to consider multiple perspectives, including Refuge System policies and guidance, the current understanding of native community ecology, increasing human demands on natural resources, continued landscape change, and our need to collaborate with the public and our partners, on projects that span beyond refuge boundaries.

4.3 Landscape Conservation Goal

Actively protect, preserve, manage, and restore the functionality of the diverse ecosystems of the Rattlesnake Creek watershed.

Quivira Refuge’s contribution toward conserving natural resources in the central Great Plains must be considered within the context of the greater, surrounding landscape. Substantial loss and degradation of native environments have occurred there, which limits the amount, distribution, and quality of habitat available for native wildlife. Identifying primary needs of wildlife that are of conservation concern is essential for making decisions about the desired future condition of refuge lands, because we may have the potential to fulfill those needs. In addition, incorporating information on ecosystem function at the watershed scale is necessary because past and

ongoing modifications near the refuge significantly affect our current, and future, capability to sustain the functions required to provide quality wildlife habitat. The watershed is the most appropriate scale at which to consider these factors because all flow of energy and materials in its environment are contained within its boundaries. This means that land use practices, such as conservation actions, at one site within a watershed can influence other sites within that same watershed.

In the case of Quivira Refuge, the Rattlesnake Creek watershed (subbasin) forms our most appropriate scale at which to consider landscape conservation planning. Refuge lands are at the lowest elevation of the subbasin, and the end of its primary surface water source, Rattlesnake Creek, is northeast of the BSM where it joins with Salt Creek on the refuge (figure 12). The subbasin mostly overlies the Great Bend Prairie Aquifer, which is a subregion of the High Plains Aquifer (Basin Management Team 2011). Although the area of the subbasin is 1,232 square miles, the area that actually contributes runoff to the refuge is only about 519 square miles and contributes drainage for USGS Zenith gaging station #07142575, which is located within a few miles of the creek’s entrance into the refuge (USGS 2012d). The long-term average annual precipitation since 1948 is 24.33 inches, but it varies from about 15 to more than 27 inches. The average annual free-surface evaporation is about 64 inches (Sophocleous et al. 1997), with rates being highest during the summer months (Latta, 1950).

The dominant land use in this watershed is agriculture, and crop irrigation occurs largely by pumping ground water from the aquifer, which can affect ground water levels on, and near, the refuge. In addition, there is a direct connection between ground water levels and Rattlesnake Creek flows. The quantity of ground water pumped is inversely related to the amount and timing of precipitation, but most pumping occurs from May through October when surface water from Rattlesnake Creek is needed for managing refuge habitats to support annual wildlife needs.

Water rights in Groundwater Management District Number 5, which encompasses the subbasin, are overappropriated, with 1,377 water rights authorizing the use of 266,726 AFY. Ground water use often exceeds recharge (Basin Management Team 2011). The 10-year rolling average of ground water use for the stream–corridor part of the subbasin has been around 30,000 AFY for the years 2009–2011, and basin-wide estimates that include the refuge and the larger mineral intrusion area exceeded 55,000 AFY (Basin Management Team 2012). Since 1974, streamflow at USGS Zenith gaging station #07142575 has averaged 44.36 cfs, and average streamflow for the

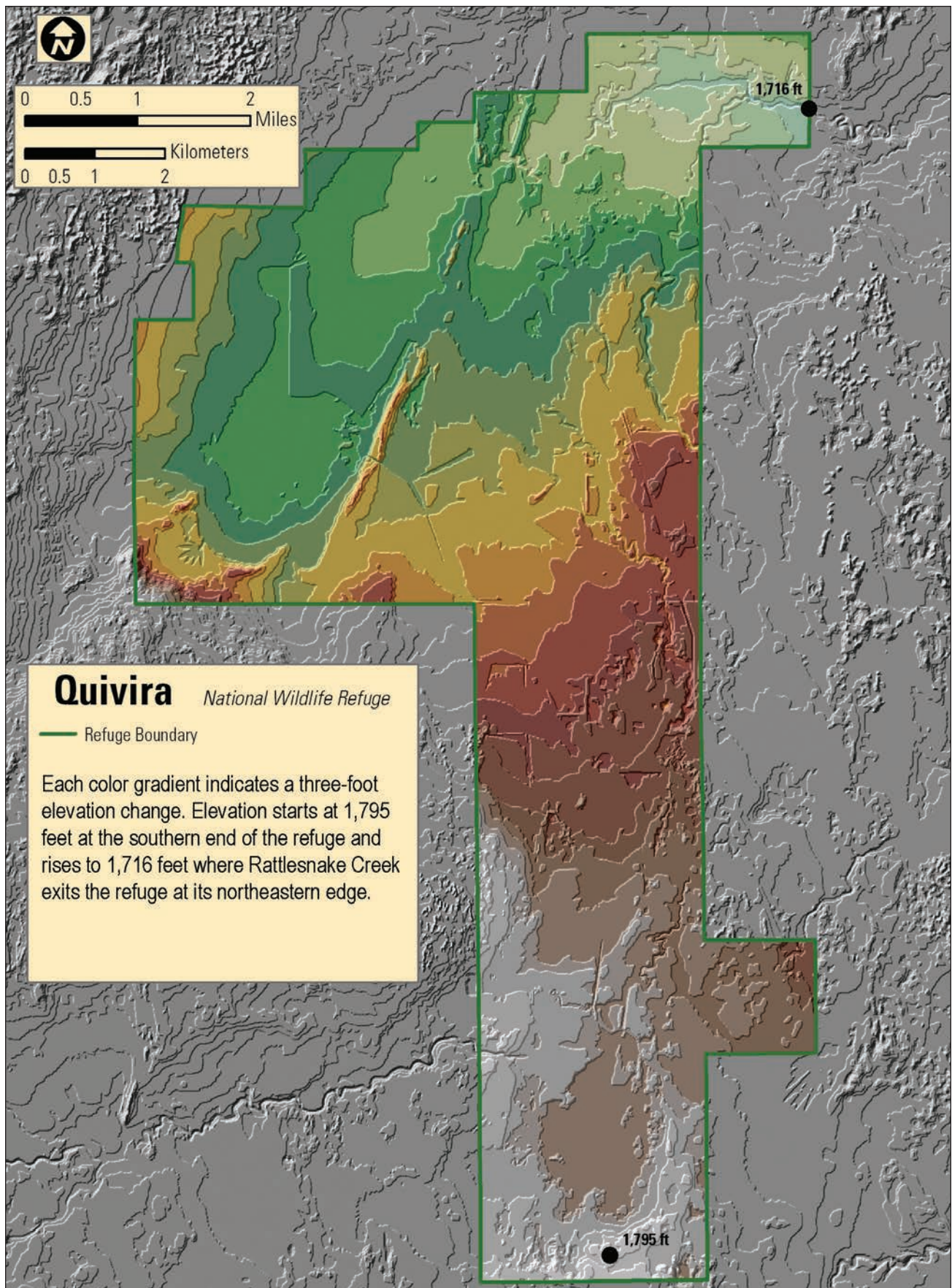


Figure 12. Elevation at Quivira National Wildlife Refuge, Kansas.

years 2000–2009 was 37.36 cfs (Basin Management Team 2011). These flows are below historical reports. A streamflow of 100 cfs was estimated in the area of the refuge at the time of establishment in the 1950s, and that was during a dry period (Heitmeyer et al. 2012). Declines in the ground water table lead to reduced streamflows that are often insufficient to meet surface water demands. Water levels have continued to decline throughout most of the subbasin between 2001 and 2012 (Basin Management Team 2012). Total water use for the subbasin reported for years 1989 through 2009 averaged 175,656 AFY, ranging from 119,204 AFY in 1997 to 216,347 AFY in 2002 (Basin Management Team 2011).

The refuge has a senior water right [Permit # 7571] allowing use of Rattlesnake Creek water quantities of 14,632 AFY and flows of 300 cfs. Since 1984, the minimum desirable streamflow criteria for USGS Zenith gaging station #07142575 have been: 15 cfs for the months of December through June, 5 cfs in July, 3 cfs from August through October, and 10 cfs in November. There are periods of record where the minimum desirable streamflow was not met, but water use was not administered because it was difficult to figure out individual diversion effects on streamflow (Basin Management Team 2012).

Information on current environmental conditions at the subbasin scale was evaluated to identify factors that could limit the value of the refuge and adjacent lands for wildlife. In addition, land use practices occurring in the watershed were considered that have altered, or could alter, important processes, like hydrology, and that constrain our, and the public's, ability to provide quality habitat in the entire subbasin. We used this evaluation to develop landscape objectives that address priority needs in the subbasin and to make decisions on which habitat types to provide on refuge lands. Relative to the rest of the subbasin, land use activities closer to the refuge have created an area that has more grassland and wetland habitat (figure 13). This offers potential benefits to native communities and species of concern.

Landscape Conservation

Objective 1: Land Ownership and Collaboration

Throughout the life of the plan, collaborate with other programs and with natural resource agencies to promote land protection, restoration, and management in the Rattlesnake Creek watershed, emphasizing lands within 10 miles of the refuge boundary.

Strategies

- Continue to include Partners staff in our regular refuge staff meetings.
- Collaborate with Partners, NRCS, KDWPT, and other agencies to develop private lands programs that promote the sustainability of water resources, the control of invasive species, and the restoration of native plant communities in the Rattlesnake Creek watershed.
- Collaborate with educational institutions, as well as with other agencies and organizations, to craft pertinent research and monitoring programs to identify best management practices that can be incorporated into private lands programs.
- Collaborate with agencies responsible for regulating water use in the Rattlesnake Creek watershed to help identify and improve water use efficiencies.

Rationale

We considered expanding the refuge boundary and acquiring more fee-title lands to enhance landscape conservation. However, it would be difficult for us to obtain large tracts of land adjoining the refuge in fee title, and any acquired lands would require extensive restoration and maintenance. Agriculture and energy developments within the watershed have significantly altered surface and ground water dynamics, which has not only resulted in the loss and fragmentation of wetland and grassland habitats near the refuge, but has altered hydrologic functions that influence refuge wetlands and grasslands (Heitmeyer et al. 2012). Therefore, we decided that it would be better to collaborate with our partners to develop and conduct programs that address natural resource issues on private lands near the refuge.

Many agencies and organizations have programs that are available to landowners in the subbasin, including Partners, KDWPT, PLJV, NRCS, and the Rattlesnake Creek Partnership, among others. Such programs may provide better conservation in the Rattlesnake Creek watershed because current, and emerging, environmental threats, such as water deficiencies and invasive species, are pervasive and difficult, if not impossible, to address by only acquiring and restoring small tracts of land. Furthermore, new techniques, such as decision support systems and models, are being developed by several entities, like the landscape conservation cooperative, the Western

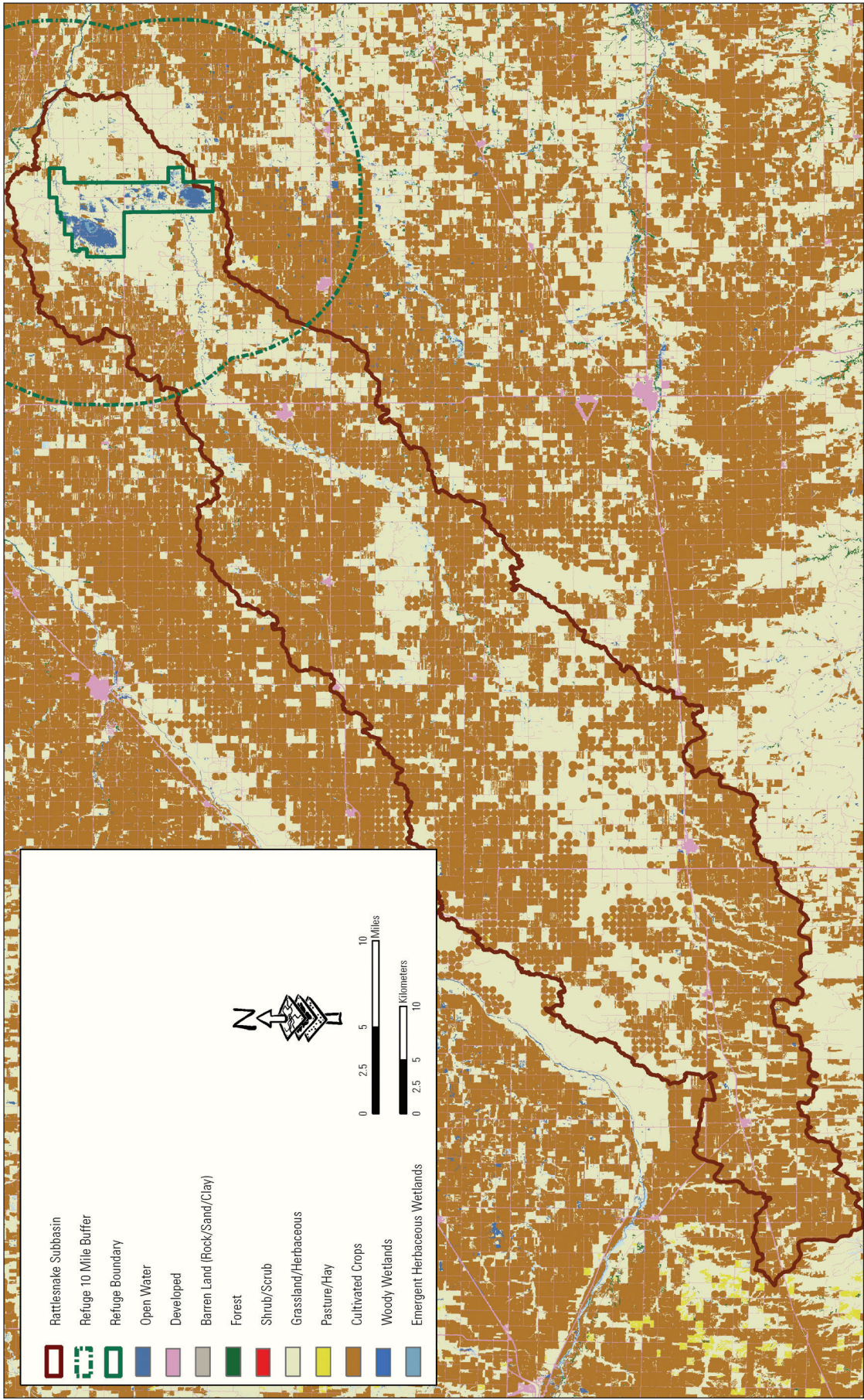


Figure 13. Land use and habitat outside the boundaries of Quivira National Wildlife Refuge, Kansas.

Governors Association, and KDWPT, which help target lands where implementation of program practices would generate the greatest benefits. Private lands programs are also cost effective because they are flexible and can be strategically deployed to address specific issues. They not only improve habitat for wildlife on lands around the refuge, but they help us to reduce the sources of invasive species, to protect senior water rights, and to do more on refuge lands.

This objective should complement, rather than override, the objectives of the Rattlesnake Creek Subbasin management plan, which identifies multiple, ranked areas for water conservation throughout the watershed. Many activities that occur more than 10 miles from the refuge influence our water resources. We support water conservation-related activities throughout the subbasin that contribute to the improvement and sustainability of water resources.

Landscape Conservation

Objective 2: Habitat Fragmentation

- Reduce fragmentation of refuge grassland habitats within the next 15 years by strategically removing, at most, 850 acres of trees or tall shrubs, as shown in appendix H, to benefit grassland-dependent wildlife, particularly species that exhibit area sensitivity during essential life cycle events.
- Initiate the restoration of about 866 acres of remaining refuge agricultural lands (figure 6) during the next 15 years to suitable, native plant communities, based on ecological site descriptions, to help native grassland species, including those that are area sensitive during certain life cycle events.

Strategies

- Remove specific tree species as follows (other strategies may be used if they are likely to increase success in achieving objectives):
 - Eastern red cedar—cut, pile, and burn; prescribed fire to prevent invasion; mowing.
 - Black locust, honey locust, elm, Russian olive, cottonwood, or trees that resprout—cut and spray herbicides, or spray herbicides and cut, particularly black locust.
 - Cottonwood and eastern red cedar—cut and pile cedar under cottonwood, follow with burning.
 - Saltcedar—burn and apply herbicide to regrowth because cutting is difficult.
 - Plum and sumac—conduct a combination of three treatments within two growing seasons to include burning or mowing as low as possible.
 - Large cottonwood—chainsaw and follow up with herbicide.
- Restore agricultural lands, including areas that are removed from production but not seeded to natives, and treed areas.
 - Prepare a largely weed-free, smooth seedbed. Options include using herbicides or planting Glyphosate-ready crops or other agricultural crops, with the last year being a grain crop. As stated earlier, policy allows for the use of genetically modified crops, and that remains an option. However, the refuge has never permitted this use to date and does not plan to do so in the near future. It is a more commonly used strategy in the northern plains largely because of differences in agricultural trends.
 - Use high-diversity seeding, at least 15–20 species of forbs and grasses, that is suitable for the soil type and for other environmental conditions.
 - Collect seed from the refuge or buy local ecotypes.
 - Seed during normal-to-wet periods and avoid seeding during drought periods.
 - Broadcast seed over snow, if possible.
 - Buy a native grass harvester, such as a stripper, and harvest local seed.

Rationale

We studied refuge lands and the current surrounding landscape to identify the desired future vegetation types needed to sustain native habitats

and associated focal species. A review of existing spatial data showed that land use beyond the refuge boundary is dominated by crop and livestock production. Our planning team found that the remaining grassland tracts near the refuge are often isolated from each other and surrounded by croplands and by woody vegetation in areas that are not conducive to farming, like sandhills, and in shelterbelts that are used between fields and in areas that are managed for game, especially white-tailed deer. In addition, managing for livestock often creates areas with short-stature grasses and few forbs that do not provide adequate structure for native wildlife at certain times during the year. For example, fields of hay and other crops may be used by species for breeding or other activities early in the growing season, but harvesting, or plowing between plantings, often occurs before primary nesting activities are complete. Given these considerations, our planning team found that native prairie habitats were underrepresented in the landscape surrounding the refuge to sustain habitat for wildlife on the refuge.

Woody encroachment into habitat that was open before, resulting in the eventual replacement of grassland, has been reported as one of the greatest threats to this ecosystem (Knapp et al. 2008). Woody encroachment into grasslands around the world not only threatens ecosystem integrity but, more specifically, threatens the presence, abundance, nesting success, and local composition of grassland-obligate birds (Bakker 2003, Chapman et al. 2004). Based on our observation, this trend appears to hold true for the remaining tracts of sand prairie in, at least, the northern section of the Rattlesnake Creek watershed and on lands surrounding the refuge. Therefore, reducing woody vegetation would help refuge lands to provide unique and essential grassland habitat conditions.

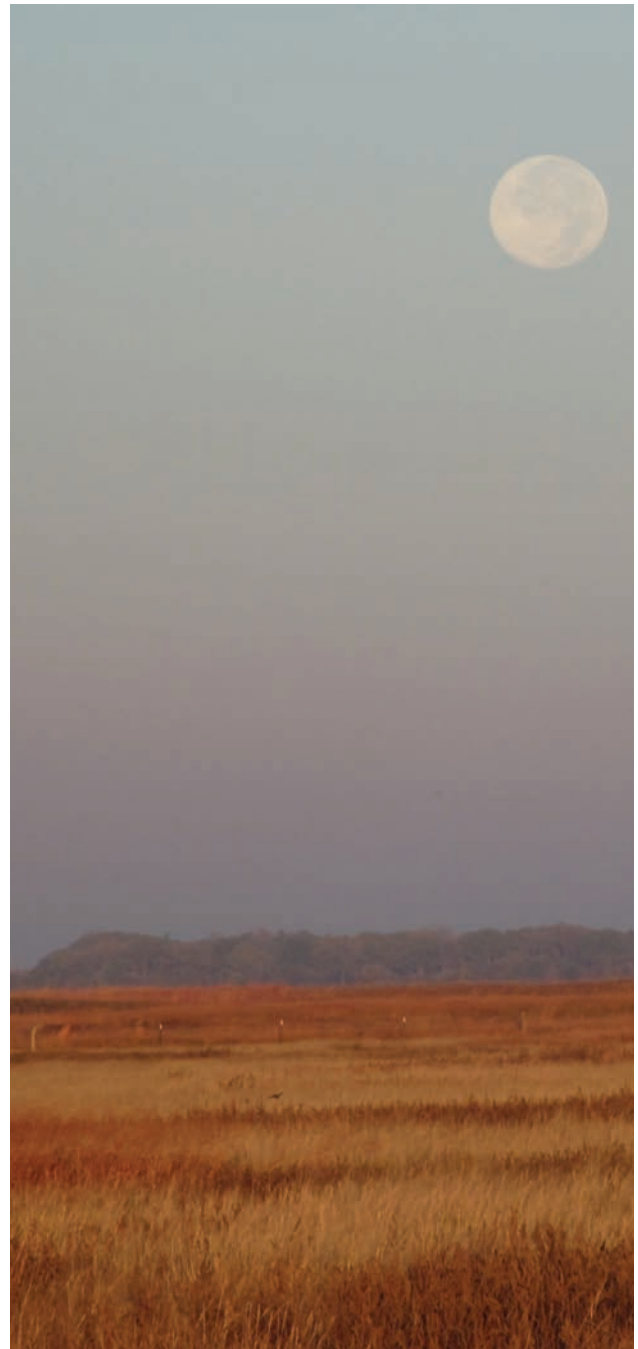
Landscape Conservation

Objective 3: Environmental Health and Climate Change

- Promote ecological resilience by restoring and maintaining native communities based on the following principles:
 - Continue to collect climate information and to conduct baseline inventories of refuge water use and wetland water chemistry during the next 15 years to document changes in abiotic factors to assess

changes in environmental conditions that will help us develop our approach.

- Conduct inventories of refuge habitats, including composition and structure of vegetation, at periodic intervals not to exceed 5 years, to document vegetation conditions that can be used to assess changes because of our actions and because of natural variation.



A twilight view from Old Township Road on Quivira Refuge.

Barry Jones/FWS

- Conduct informal surveillance of select wildlife species, such as waterfowl, shorebirds, and deer, during the next 15 years to detect disease outbreaks and monitor wildlife health.

Strategies

- Continue collecting climate information from established weather stations on refuge lands.
- Collaborate with our Region 6 Water Resources Division staff and with our partners to design and carry out:
 - monitoring programs on Rattlesnake Creek flow parameters at designated points of diversion on the refuge;
 - inventories of water chemistry on refuge lands.
- Develop educational programs to help the public understand the threat of environmental contaminants.
- Collaborate with our partners to collect relevant abiotic data and to periodically assess changes in environmental conditions that will help us adjust our activities.
- Reclaim mineral rights on refuge lands, as legally allowed, when existing oil wells are not used or abandoned.
- Continue to collaborate with our partners like KDWPT and academic organizations to conduct surveillance that increases the detection, prevention, and knowledge of disease outbreaks, including avian influenza and chronic wasting disease, and adjust refuge hunting programs if necessary.

Rationale

Land use practices in the Rattlesnake Creek watershed have not only resulted in the loss and fragmentation of native habitats, but they have also modified how remaining native habitats function. Agricultural and energy practices, as well as our past refuge management activities, have resulted in the introduction of nonnative plants and animals; an increased presence of chemicals, like fertilizers and pesticides; and altered disturbance regimes, such as the frequency, timing, and magnitude of fire, herbiv-

ory, and hydrology, that influence processes like nutrient cycling and sedimentation. The effects of these would likely be exacerbated by climate change, which is predicted to include higher temperatures and less frequent, but more intense, precipitation events at the refuge. Collectively, these factors can have significant effects on our ability to restore and support native plant communities and associated wildlife species.

Addressing these challenges will require us to develop flexible strategies that promote native species diversity, which has been reported to increase the resiliency of systems to climate change (Peterson et al. 1998). To accomplish this objective, we must use information about the current status of key abiotic factors that influence plant community composition and, ultimately, wildlife community composition in our management plans. We chose climate, water quality, and water quantity measures as primary abiotic factors to monitor because they influence the vegetation composition and structure of refuge habitats and are among the first to change in response to altered environmental conditions, regardless of what caused the change. For example, refuge lands are located at the lowest elevation in this agriculture-dominated watershed, thus, the amount, timing, and quality of water entering the refuge is not only influenced by climate patterns but also by agricultural practices, like irrigation and pesticide use, and by energy practices, like drilling and the storing of resources onsite.

4.4 Native Ecological Community Conservation Goal

Actively conserve and, as appropriate, improve environmental conditions within refuge boundaries to promote sustainable native ecological communities and support species of concern associated with this region of the Great Plains.

We are required to provide the plant communities necessary for wildlife to complete their annual life cycle needs, like breeding and migration. Thus, we chose habitat-based objectives that provide the resources necessary to support a native wildlife community over objectives based on individual wildlife species because (1) the long-term, sustainable productivity of habitats is essential for wildlife regardless of the landscape scale we consider; (2) most of the management activities conducted by our refuge staff indirectly influences wildlife composition and popula-

tion by altering vegetation composition and structure; (3) decisions about our management activities must be made within the context of current habitat conditions relative to the life requisites of multiple species; and (4) assessing habitat composition and structure to gauge our progress in achieving the vision and goals of Quivira Refuge is more reliable and informative than assessing wildlife populations because their migrations can include great fluctuations in things like turnover rates and lengths of stay that would affect our study of them.

We need to integrate multiple factors, including landscape form and function, regional and local environmental stressors, and the public's various perspectives, to make decisions about habitat types and management strategies. We used information from peer-reviewed outlets and refuge reports as the foundation on which to develop objectives that are supported by the best available science, that contain sufficient specificity to guide future management, and that could be studied to assess our progress and help us make decisions using an adaptive management framework (Adameik et al. 2004). Before we held planning meetings, our refuge staff compiled and synthesized pertinent data—with the relevant literature referenced and cited throughout this document—to help guide our discussions and to make sure that our decisions were consistent with the facts. We also developed charts and tables to help us interpret data, and many of these are in this CCP.

Sometimes objectives can be misinterpreted when taken out of context. For example, seeing habitat-based objectives as static targets to achieve annually on the same tract of land is inconsistent with the more flexible reality of plant community ecology, and attempts to manage for static targets tend to alter important processes, like hydrology, that eventually lead to lower productivity. To resolve this potential problem, our refuge staff will apply the following to the set of biological objectives created to support this goal:

- We will consider these objectives collectively as representing a continuum of spatial and structural conditions that are characteristic of that habitat type in the central Great Plains.
- We will use these objectives as a reference to provide the full range of conditions necessary to support the wildlife community that is native to the refuge and the surrounding area.
- We will optimize the area and distribution (structure) of various habitat conditions characterized by the objectives to help focal

species within the constraints imposed by using management that ensures sustained productivity (processes, function) of the habitat.

The following describes the initial steps we took to collect and organize information in a manner that would be useful for developing habitat-based objectives, including assumptions and rationales used to make decisions during our planning meetings.

Delineation of Current Habitat Types

Our staff at Quivira Refuge completed a spatially explicit plant community inventory in 2011. Based on 2008 aerial photography, communities were mapped to the alliance, or dominants, and finer associations, or subdominants, as defined by the NVCS using e-cognition software. The minimum mapping unit was 0.5 acre, but was adjusted to 0.2 acre during ground truthing of woody vegetation. More than 95 percent of the e-cognition polygons were ground truthed for accuracy and modified if necessary (figure 10 and table 7). A total of 43 associations, ranging in area from 0.3 to 4,926 acres, were mapped.

In addition, Quivira Refuge took part in a pilot project to map invasive species during 2011 (Edvarchuk and Ransom 2012). Approximately 10,160 acres, or 46 percent, of refuge lands were inventoried for 17 priority invasive species using standardized protocols that provided 90 percent confidence in detecting infestations greater than 100 square feet. A total of 3,573 individual infestations totaling 133 acres were mapped. These detailed maps were used to produce more map products using a GIS, as needed, to inform our planning activities. For example, plant associations provide valuable information for developing our strategies for specific areas, whereas broader community categories are more suitable when evaluating area needs of grassland-nesting birds.

Defining a Focal Wildlife Community

The refuge staff, with input from the core planning team, developed a list of focal species that we will use to help guide our development of habitat-based objectives. By providing the habitat types and conditions necessary to support focal species, we will also provide life requisites for other species and plants on the refuge and surrounding landscape. The concept of using select wildlife species to subdivide community resources along a continuum has been used to guide planning and management of both wetlands (Short 1989) and grasslands (VerCauteren and Gillihan 2004), as well as to describe habitat use patterns (Skinner 1975).

We chose migratory birds and threatened and endangered species known to use the refuge to serve as a starting point for developing the larger focal wildlife community because these species are a primary responsibility of the Refuge System and are central to the purpose of Quivira Refuge. The current refuge bird list contains more than 340 species and represents sightings recorded since refuge establishment. The list not only has native or endemic species characteristic of the region, but also species whose occurrences are considered rare or accidental and those that were introduced to the area following substantial habitat changes (Johnsgard 1978). The current list of threatened and endangered bird species known to occur on the refuge has species that are listed by both Federal and State governments. While refuge bird lists are not based on standardized surveys, this list is the best available information we have for some species occurrences on the refuge.

We further refined the refuge bird list to create a suite of focal species to help us quantify the range of structural and successional habitat conditions that we will need to provide for them. This approach helps us to prevent underestimating the wildlife values of the site, and it has been advocated by others. For example, breeding bird species documented in the Great Plains is approximately 320 (Johnsgard 2009), but developing suitable grassland restoration objectives for a local area may focus on as few as 32 bird species (Samson and Knopf 1994).

The following criteria were used to identify the focal community:

- Include species that conform to the purpose of the refuge, including those listed as endangered, threatened, or of concern by various laws or conservation plans. We consulted various plans, including our species of conservation and management concern for the Mountain–Prairie Region, the U.S. Shorebird Conservation Plan, the North American Waterfowl Management Plan, and the Central Mixed-grass Prairie Bird Conservation Region, which is part of the North American Bird Conservation Initiative.
- Include species that rely on unique or important refuge wetland habitats. Habitat uniqueness and importance on the refuge has been noted through its designation as a wetland of international importance by the Ramsar Convention and as a site of regional importance for shorebirds by the Western Hemisphere Shorebird Reserve Network.
- Include species that have comparatively greater dependence on, or association with, unique characteristics of refuge habitats, such as native sand prairie. The incorporation of species that use these habitats provides a more representative description of native upland communities and promotes diversity at spatial scales beyond refuge boundaries.
- Include species with core distributions that include refuge lands and have habitat needs that are not typically provided for on private lands in the vicinity. For example, species that require larger blocks of key habitat were given priority consideration relative to species that are considered habitat generalists or that have adapted to human modifications like urban encroachment and agriculture.
- Include species that are indicators of ecosystem health, such as having an abundance of prey species, or changing salinity conditions.

We identified 127 focal bird species that have recently occurred on the refuge and are representative of native habitat types and species of concern (table 16). We chose many focal species, in part, because of the importance of refuge habitats to a diversity of wetland-dependent species during migration. We do not expect to benefit all focal species every year because many factors outside the boundaries and control of the refuge influence species occurrences and densities. For example, climate conditions are a primary driver of waterfowl, shorebird, and whooping crane migration chronology and residence times. Furthermore, we will not be able to conduct monitoring programs for all focal species. Instead, life cycle needs of these species will be used to guide our development of habitat-based objectives, which subsequently will be used to develop annual management planning and implementation activities and monitoring programs.

Species other than birds, such as the Arkansas darter and regal fritillary, are important parts of native communities, and they may be added to the focal species list in the future because resources and landscape conditions will continue to change and more information of species–habitat relationships will become available.

Life Requisites of Focal Species

For each focal species, the life cycle events occurring on Quivira Refuge, such as breeding or migration, were noted and a literature search was conducted to locate quantitative information that

Table 16. Focal species by life event and habitat at Quivira National Wildlife Refuge, Kansas.

Species common name		Recent seasonal abundance ¹				Management priority by habitat association and life event ²		
		March to May	June to August	September to November	December to February	Migration	Breeding	Wintering
Ducks, geese, and swans								
1	Greater white-fronted goose	c	r	c	c	WWW		WWW
2	Snow goose	c	r	c	c	WWW		WWW
3	Ross's goose	u		u	u	WW		WW
4	Cackling goose	c	r	c	c	WWW		WWW
5	Canada goose*	c	c	c	c	WWW	WWW GGG	WWW
6	Trumpeter swan	o		o	o	W		W
7	Tundra swan	o		o	o	W		W
8	Wood duck*	c	c	c	o	WWW		
9	Gadwall*	c	u	c	o	WWW	WW GG	
10	American wigeon*	c	u	c	o	WWW		
11	Mallard*	c	c	c	c	WWW	WWW GGG	WWW
12	Blue-winged teal*	c	c	c		WWW	WWW GGG	
13	Cinnamon teal	u	r	o	r	W		
14	Northern shoveler*	c	u	c	u	WWW	WW GG	WW
15	Northern pintail*	c	u	c	c	WWW	WW GG	WWW
16	Green-winged teal*	c	o	c	u	WWW		
17	Canvasback*	c	o	c	u	WWW		WW
18	Redhead*	c	o	c	u	WWW		WW
19	Ring-necked duck	c	o	c	u	WWW		WW
20	Greater scaup	o		o	o	W		W
21	Lesser scaup*	c	o	c	u	WWW		WW
22	Bufflehead	u		c	c	WWW		WWW
23	Common goldeneye	c		c	c	WWW		WWW
24	Hooded merganser*	u	r	u	u	WW		WW
25	Common merganser	u		r	c	WW		WWW
26	Red-breasted merganser	r		o	r	W		W
27	Ruddy duck*	c	u	c	u	WWW		WW
Grouse and quail								
28	Greater prairie-chicken*	r	r	r	r	G		
29	Lesser prairie-chicken	Refuge was part of historical range, but is not now. May use in future, especially considering climate change adaptation.						
30	Northern bobwhite*	u	u	u	u	GG SS		
Loons and grebes								
31	Pied-billed grebe*	c	c	c	o	WWW	WWW	
32	Horned grebe	u		u	o	WW		
33	Eared grebe*	c	o	c	r	WWW		
Pelicans and miscellaneous								
34	American white pelican	c	c	c	o	WWW		

Table 16. Focal species by life event and habitat at Quivira National Wildlife Refuge, Kansas.

<i>Species common name</i>		<i>Recent seasonal abundance¹</i>				<i>Management priority by habitat association and life event²</i>		
		March to May	June to August	September to November	December to February	Migration	Breeding	Wintering
<i>Hérons, egrets, and ibis</i>								
35	American bittern*	u	u	u	o	WW	WW	
36	Least bittern*	o	u	o		W	WW	
37	Great blue heron*	c	c	c	u	WWW		
38	Great egret*	c	c	c		WWW	WWW (foraging)	
39	Snowy egret*	c	c	c		WWW	WWW (foraging)	
40	Little blue heron*	u	u	o		WW		
41	Green heron*	u	u	o		WW		
42	Black-crowned night-heron*	c	c	c	r	WWW	WWW	
43	Yellow-crowned night-heron*	u	u	o		W		
44	White-faced ibis*	c	c	c	r	WWW	WWW (foraging)	
<i>Birds of prey</i>								
45	Mississippi kite*	u	u	o		TT	TT	
46	Bald eagle*	u	u	u	c	WW TT	TT	WWW TTT
47	Northern harrier*	c	o	c	c	WWW GGG	W G	WWW GGG
48	Swainson's hawk*	c	c	o		GGG TTT	SSS TTT	
49	Ferruginous hawk	o		r	o	G		G
50	Rough-legged hawk	u		r	u	WW GG		WW GGG
51	Prairie falcon	r	r	o	o			W
<i>Rails and cranes</i>								
52	Black rail*	u	u	r		WW	WW	
53	King rail*	u	u	r	r	WW	WW	
54	Virginia rail*	c	c	u	o	WWW	WWW	
55	Sora*	c	u	c		WWW	WW	
56	Sandhill crane	c		c	o	WWW		W
57	Whooping crane	o		o	r	W		
<i>Shorebirds</i>								
58	Black-bellied plover	u	u	u	r	WW		
59	American golden-plover	u	o	u		WW		
60	Western snowy plover*	c	c	c		WWW	WWW	
61	Semipalmated plover	c	u	c		WWW		
62	Piping plover	u	o	o		W		
63	Killdeer*	c	c	c	o	WWW	WWW	
64	Black-necked stilt*	c	c	u		WWW	WWW	
65	American avocet*	c	c	c		WWW	WWW	
66	Spotted sandpiper*	c	u	c		WWW		

Table 16. Focal species by life event and habitat at Quivira National Wildlife Refuge, Kansas.

	<i>Species common name</i>	<i>Recent seasonal abundance¹</i>				<i>Management priority by habitat association and life event²</i>		
		March to May	June to August	September to November	December to February	Migration	Breeding	Wintering
67	Solitary sandpiper	u	u	o		WW		
68	Greater yellowlegs	c	c	c	o	WWW		
69	Willet	u	u	u		WW		
70	Lesser yellowlegs	c	c	c	r	WWW		
71	Upland sandpiper*	c	o	o		WWW	WW	GG
72	Whimbrel	o	o	o		W		
73	Long-billed curlew	o	o	o		W		
74	Hudsonian godwit	u	r	u		WW		
75	Marbled godwit	u	u	u		WW		
76	Ruddy turnstone	o	o	o		W		
77	Sanderling	o	o	o		W		
78	Semipalmated sandpiper	c	c	c		WWW		
79	Western sandpiper	c	c	c		WWW		
80	Least sandpiper	c	c	c		WWW		
81	White-rumped sandpiper	c	c	u		WWW		
82	Baird's sandpiper	c	c	c		WWW		
83	Pectoral sandpiper	u	u	u		WW		
84	Dunlin	u	o	u	r	WW		
85	Stilt sandpiper	c	c	c		WWW		
86	Buff-breasted sandpiper	o	r	u		WW		
87	Short-billed dowitcher	u	u	o		WW		
88	Long-billed dowitcher	c	c	c		WWW		
89	Wilson's snipe	u	r	u	o	WW		
90	Wilson's phalarope*	c	c	c		WWW	WWW	GGG
91	Red-necked phalarope	o	r	o		W		
<i>Gulls and terns</i>								
92	Franklin's gull	c	u	c	r	WWW		
93	Interior least tern*	u	u	o		WW		
94	Black tern*	c	c	u		WWW		
95	Forster's tern*	c	c	o		WWW		
<i>Pigeons and doves</i>								
96	Yellow-billed cuckoo*	o	u	r			SS	
<i>Owls</i>								
97	Short-eared owl*	r		r	o			G
<i>Woodpeckers</i>								
98	Red-headed woodpecker*	c	c	c			TTT	
<i>Flycatchers</i>								
99	Western kingbird*	c	c	u			SSS	TTT
100	Eastern kingbird*	c	c	u			TTT	
101	Scissor-tailed flycatcher*	o	o	o			S	

Table 16. Focal species by life event and habitat at Quivira National Wildlife Refuge, Kansas.

Species common name		Recent seasonal abundance ¹				Management priority by habitat association and life event ²		
		March to May	June to August	September to November	December to February	Migration	Breeding	Wintering
Shrikes and vireos								
102	Loggerhead shrike*	u	u	u	u	SS TT		
103	Bell's vireo*	u	u	o		SS		
Larks								
104	Horned lark*	o	o	o	o	G	G	
Thrushes, pipits, waxwings, and miscellaneous								
105	Sprague's pipit	r		r		G		
Longspurs								
106	Lapland longspur	r		o	u			GG
107	Chestnut-collared longspur	r			r	G		
Wood warblers								
108	Yellow warbler*	u	u	o		SS (riparian area)	SS TT	
109	Common yellowthroat*	c	c	u	o	GGG	WWW GGG	
Sparrows and towhees								
110	Cassin's sparrow	r					G S	
111	Field sparrow*	c	u	c	u	GGG	GG	GG
112	Vesper sparrow	c	r	c		GGG		
113	Lark sparrow*	c	u	o		GGG	GG	
114	Savannah sparrow	c		c	o	GGG		
115	Grasshopper sparrow*	u	u	u		GG	GG	
116	Le Conte's sparrow	o		o	r	W G		
117	Harris's sparrow	c	r	c	c	GGG		SSS
Grosbeaks and buntings								
118	Blue grosbeak*	u	u	r			SS	
119	Dickeissel*	c	c	r			GGG	
Blackbirds and allies								
120	Bobolink*	u	u				GG	
121	Red-winged blackbird*	c	c	c	c	WWW	WWW	
122	Eastern meadowlark*	c	c	c	c		GGG	GGG
123	Western meadowlark*	u	o	u	c		G	GGG
124	Yellow-headed blackbird*	c	c	u	r	WWW	WWW	
125	Orchard oriole*	c	c	o			TTT	
126	Baltimore oriole*	c	c	o			TTT	
Finches								
127	American goldfinch*	c	c	c	c	GGG	GGG	GGG

* Reported nesting on the refuge.

¹ Abundance is indicated as follows: c = common (certain to be seen in suitable habitat), u = uncommon (present, but not certain to be seen), o = occasional (seen a few times during season), r = rare (seen every 2–5 years).² Habitat association is indicated as follows: G= grass or meadow, W= wetland–riparian area–flooded, S= shrubs, T= isolated trees–small groves. Within a cell, the number of times a letter is repeated is proportional to abundance. For example, WWW= common and W= occasional or rare in wetland habitat during the indicated life event.

characterized suitable habitat conditions for as many focal species as possible. Sources of information largely included dissertations, scientific periodicals, published books and refuge files held onsite. The specific information we sought included:

- chronology of use, including dates of spring migration, breeding, fall migration, and wintering activities on the refuge
- spatial needs for breeding, including minimum area, perimeter-to-area ratios, area of 50-percent occupancy, and distance from other required, or hostile, habitat types or conditions, such as nesting within a minimum distance to water or from a woodland edge
- vegetation composition at breeding sites, including the percent of grass, forb, and shrub
- vegetation structure at nest sites of breeding species, including litter depth, visual obstruction, and plant height
- characteristics of waterbird foraging habitats, including preferred foraging depths, diet, and vegetation cover

Information on each of these factors was not available for all species. This is not a problem, however, because information on individual species was grouped into functional guilds, such as species that forage in water less than 2 inches, to identify important parameters that influence habitat suitability. We further organized this information into categories that were based on our capability. For example, foraging depths of waterbirds were grouped in minimal increments of greater or equal to 2 inches because our staff experience suggests that the existing water infrastructure, such as structure type and canals, would facilitate management at this level of specificity. We do not denote distinct community types for individual species, but we provide a broader perspective of multiple species benefits provided by a habitat type in different successional conditions (figure 14).

While our approach maximizes the use of existing information, there are limitations. First, most quantitative information on the habitat needs of many species is based on certain points during the breeding season and reflects conditions near nest sites or breeding territories during the growing season. By comparison, there is relatively little quantitative information on the habitat needs during the non-breeding period, except for dietary information and

waterbird foraging depths. Therefore, the quantitative information compiled to develop objectives is limited because, as focal species table 16 shows, Quivira Refuge is an important migration stopover for wetland-dependent migratory birds, and it also provides some wintering habitat. In cases where we lacked detailed information, our planning team used less common descriptive measures and anecdotal information provided by experts to categorize the habitat needs of some focal species.

Second, most information on habitat needs of species was obtained from research not conducted on the refuge. As such, the results of this research may not apply directly to the refuge because of differences in landscape context, like the land use practices surrounding the refuge; abiotic qualities, like soils and climate; and other factors. Our planning team reduced this concern by considering only information from sand prairie or sandhill ecosystems. However, information on many species were still absent, thus, information from other ecotypes was also included. In these cases, the habitat measures, like visual obstruction and plant height, were included only if they could be met in refuge habitats. We made this determination by comparing the metrics reported in the literature to the ecological site potential of the appropriate habitat on the refuge.

Given these limitations, we decided that using habitat-based objectives for a given native plant community to represent a continuum of conditions along a successional gradient for long-term sustainability is an appropriate interpretation of the data. From our perspective, this more aptly represents the dynamic nature of systems and ends any attempt to maintain static habitat conditions within, and among, years or to manage exclusively for a few, select species or species groups. At the same time, it provides sufficient guidance to make sure that different seral stages required by wildlife are provided on refuge lands, with the understanding that refuge-specific information is limited and that the applicability of data collected on other sites may not apply directly to the refuge. It also embraces the value of using quantitative information, which:

- decreases the confusion associated with qualitative terms such as “tall” and “dense” and provides a unifying perspective of what management is attempting to achieve;
- enables our staff to establish thresholds that clarify when a decision must be made about treatment and the type of treatment to apply;
- provides a baseline on which to develop a monitoring plan that will provide refuge-

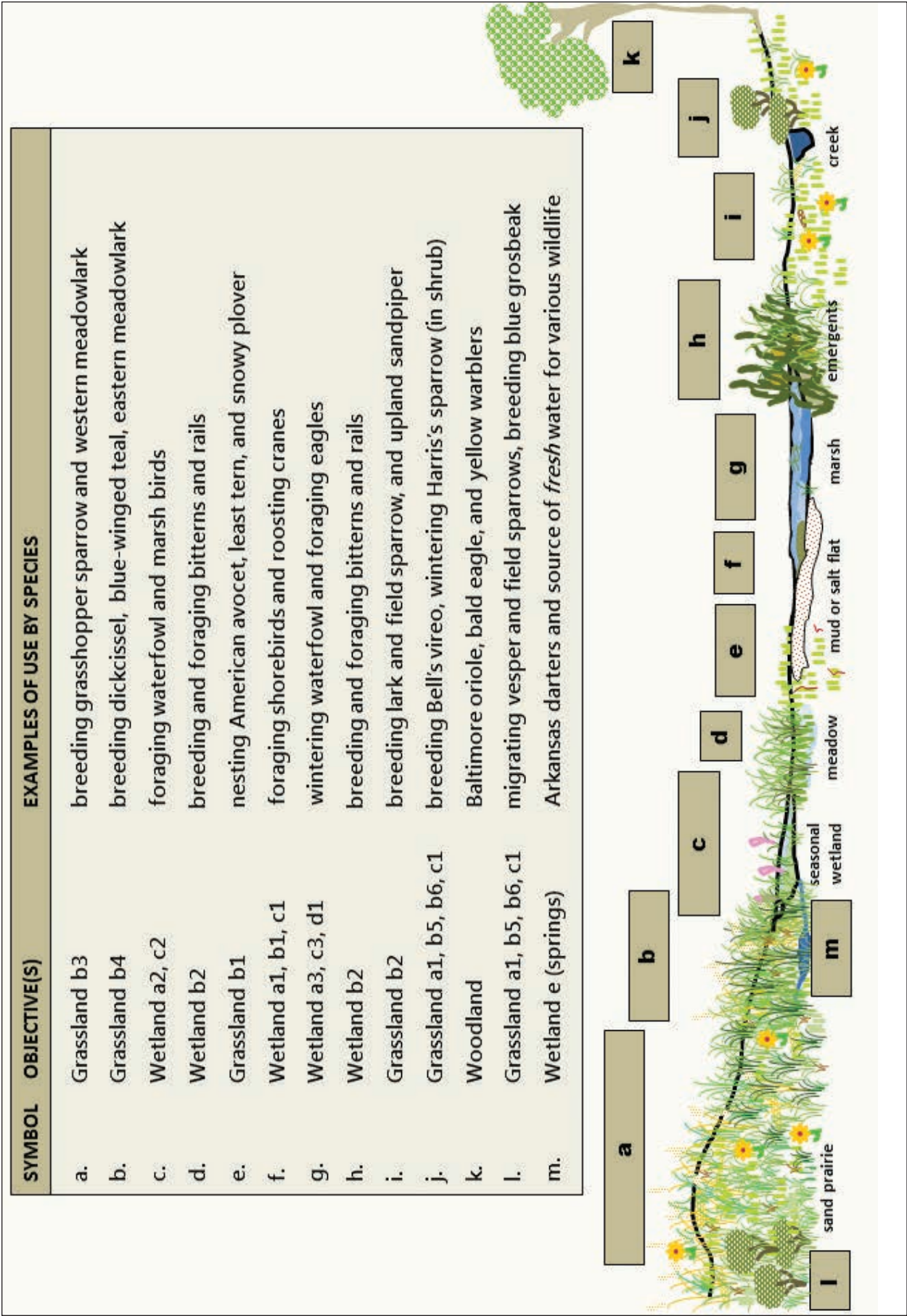


Figure 14. Native ecological community conservation objectives for Quivira National Wildlife Refuge, Kansas, illustrated in a community profile schematic.

specific information useful for understanding treatment effects and species–habitat relationships, which ultimately can be used to refine management treatments.

Native Ecological Community

Conservation Objective 1: Wetlands

Maintaining the integrity and persistence of all wetland types is important. Of principal importance is restoring and maintaining the suitable hydrological cycles characteristic of each wetland type to the extent possible, as described in the objective below, because hydrology is the single greatest driver of wetland functions, including nutrient cycling and sediment dynamics, as well as plant community dynamics (Mitsch and Gosselink 2003, Euliss et al. 2004, Laubhan et al. 2012).

Criteria

A. Apply from mid-February through May—spring migration:

1. Reliably provide at least 70 percent of the 2,931 estimated potential acres of early successional habitat—defined as bare mudflat or salt flat with less than 25 percent cover vegetation—flooded to depths less than 6 inches to provide foraging habitat for shorebirds and waterfowl, as well as roosting

habitat for cranes (table 17); tolerate 5 percent or less in exotic or invasive plant species.

2. Reliably provide at least 70 percent of the 1,581 estimated potential acres of early mid-successional habitat—defined as greater than 75 percent cover of annuals—moist soil—or wet meadow—sedges and rushes—flooded to depths less than 15 inches for foraging waterfowl (table 17); tolerate 1 percent or less in exotic or invasive plant species and 25 percent or less in perennial robust emergent vegetation, such as cattail.

3. Reliably provide at least 70 percent of the 2,160 estimated potential acres of mid- to late-successional habitat, defined as less than 25 percent cover of emergent vegetation and greater than 20 percent aquatic vegetation, flooded to depths of 6–30 inches to provide foraging and roosting habitat for American white pelican and waterfowl (table 17); tolerate 5 percent or less in exotic or invasive plant species.

B. Apply from May through July—breeding season:

1. Reliably provide at least 70 percent of the 1,740 estimated potential acres of early successional habitat, defined as bare mudflat and salt flats with less than 25 percent cover of all vegetation, next to moist or shallowly—equal to, or less than, 1 inch—flooded areas to provide breeding habitat for western snowy plovers, interior least



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An example of a wetland with interspersed tall, dense cover on Quivira Refuge.

terns, and resident focal species (table 17); tolerate 5 percent or less in exotic or invasive plant species.

2. about 400–500 acres, with a minimum block size of 50 acres, of mid- to late-successional habitat, defined as 30–60 percent interspersed, flooded emergent cover with a visual obstruction of 4–20 inches and a height greater than 20 inches to provide breeding and foraging habitat for pied-billed grebe, sora, Wilson’s phalarope, black-crowned night-heron, and American bittern in most years (table 17); tolerate 5 percent or less in exotic or invasive species.

C. Apply from late July to November—fall migration:

1. Reliably provide at least 70 percent of the 576 estimated potential acres of early successional habitat, defined as bare mudflat or salt flat with less than 25 percent cover vegetation, flooded to depths less than 6 inches to provide foraging habitat for shorebirds and waterfowl, as well as roosting habitat for cranes (table 17); tolerate 1 percent or less in exotic or invasive species.
2. Reliably provide at least 70 percent of the 1,073 estimated potential acres of early mid-successional habitat, defined as greater than 75 percent cover of annuals—moist soil—or wet meadow—sedges or rushes—flooded to depths less than 15 inches for foraging waterfowl (table 17); tolerate 1 percent or less in exotic or invasive plant species and 25 percent or less in perennial robust emergent vegetation, such as cattail.
3. Reliably provide at least 70 percent of the 903 estimated potential acres of mid- to late-successional habitat, defined as less than 25 percent cover of emergent vegetation and greater than 20 percent aquatic vegetation, flooded to depths of 6–30 inches to provide foraging and roosting habitat for American white pelican and waterfowl (table 17); tolerate 5 percent or less in exotic or invasive plant species.

D. From November through February—winter—reliably provide at least 70 percent of the 5,086 estimated potential acres, with a minimum block size of 50 acres, of mid- to late-successional habitat, defined as less than 25 percent vegetation cover and greater than 20 percent aquatic vegetation, flooded to depths



Rachel Laubhan/FWS

Damselflies on a wetland with submerged aquatic vegetation.

of 6–30 inches to provide foraging and roosting habitat for geese, diving ducks, swans, American white pelican, whooping and sandhill cranes, and bald eagles—foraging only (table 17); tolerate 5 percent or less in exotic or invasive plant species.

E. Support the current integrity of freshwater springs on the refuge, including quantity, as possible, and waterflow direction; native vegetation composition; and Arkansas darter protection.

For each part of this objective, the greatest potential area is based on current water control structure elevations; available information, like spatial analysis using a GIS, aerial imagery, light detection and ranging and vegetation data, and our staff experience and knowledge of management potential; and on management philosophy described herein. Even if environmental and management conditions are ideal, the greatest potential is not intended to be met in any given year because of the need to vary prescriptions to mimic natural wetland processes to sustain long-term wetland structure and function. This means that, for a given created wetland, we will not maintain static hydroperiods within, and among, years.

Wetlands Strategies

- Store Rattlesnake Creek water in the LSM, in accordance with existing water rights, to:
 - provide a source of water that can be used to manage vegetation and to provide flooded habitat in created wetlands;
 - inundate mudflats and annual vegetation that will provide foraging habitat for waterbirds.

Table 17. Estimated greatest potential distribution of wetland habitat conditions (acres by unit and objective) for the proposed alternative for Quivira National Wildlife Refuge, Kansas.

Wetland	Acres	<i>Mid-February through May spring migration</i>			<i>May through July summer breeding</i>		<i>August–November fall migration</i>			<i>November– February winter</i>
		A1	A2	A3	B1	B2	C1	C2	C3	D
		Acres bare flats <25% vege- tation, flood <6 inches	Acres >75% annu- al or mead- ow, flood <15 inches	Acres <25% emerging >20% sub- merged aquatic veg- etation, flood 6–30 inches	Acres of bare flats <25% cover	Acres of 30– 60% tall emerg- ing, flood <10 inches	Acres of bare flats <25% vege- tation, flood <6 inches,	Acres >75% annu- al or mead- ow, flood <15 inches	Acres <25% emerg- ing >20% submerged aquatic vegetation, flood 6–30 inches,	Acres <25% emerging, flood 6–30 inches
Little Salt Marsh	931	181.2	0	662.9	3.8	87.3	181.1	0	662.9	931
Unit 7 (created)	62	15.8	40.5	5.6	15.8	0	15.8	40.5	5.6	62
Unit 10a (created)	19	12.9	12.9	6.3	0	6.3	0	12.9	0	19
Unit 10b (created)	14	0	0	10.3	0	0	3.9	0	10.3	14
Unit 10c (created)	7	6	6.1	0.8	6.1	0	0	6.1	0.8	7
Unit 11 (created)	30	11.9	12	16.3	0	0	0	12	6.3	30
Unit 12b (created)	12	8.8	8.8	2.9	0	11.5	0	8.8	2.9	12
Unit 14a (created)	100	15.5	73.9	0	27.3	0	15.6	73.9	0	100
Unit 14b (created)	45	43.1	43.1	1.7	0	1.7	0	43.1	1.7	45
Unit 16 (created)	14	0	5.8	8.5	0	14.2	0	5.8	8.5	14
Unit 20a (created)	69	60.3	60.4	8.5	0	8.5	0	60.4	8.5	69
Unit 20b (created)	66	0	62.2	3.7	0	3.7	0	62.2	3.7	0
Unit 21 (created)	11	3.9	0	5.9	3.8	1.5	3.8	0	5.9	11
Unit 22 (created)	12	0	0	12.1	0	12.1	0	0	12.1	12
Unit 23 (created)	14	0	0	14.1	0	14.1	0	0	14.1	14
Unit 24 (created)	54	0	0	54.1	0	54.1	0	0	54.1	54
Unit 25 (created)	54	0.6	53.4	0	0	0	0	53.4	0	54
Unit 26 (created)	69	69.1	69.1	0	0	0	0	69.1	0	69
Unit 28 (created)	61	60.8	60.9	0	0	0	0	60.9	0	61

Table 17. Estimated greatest potential distribution of wetland habitat conditions (acres by unit and objective) for the proposed alternative for Quivira National Wildlife Refuge, Kansas.

		<i>Mid-February through May spring migration</i>			<i>May through July summer breeding</i>		<i>August–November fall migration</i>			<i>November– February winter</i>
		A1	A2	A3	B1	B2	C1	C2	C3	D
<i>Wetland</i>	<i>Acres</i>	Acres bare flats <25% vege- tation, flood <6 inches	Acres >75% annu- al or mead- ow, flood <15 inches	Acres <25% emerging >20% sub- merged aquatic veg- etation, flood 6–30 inches	Acres of bare flats <25% cover	Acres of 30– 60% tall emerg- ing, flood <10 inches	Acres of bare flats <25% vege- tation, flood <6 inches,	Acres >75% annu- al or mead- ow, flood <15 inches	Acres <25% emerg- ing >20% submerged aquatic vegetation, flood 6–30 inches,	Acres <25% emerging, flood 6–30 inches
Unit 29 (created)	27	23.7	23.7	3.6	0	0	0	23.7	3.6	27
Unit 30 (created)	42	41.6	41.6	0	0	0	0	41.6	0	42
Unit 37 (created)	50	0	0	49.8	0	49.8	0	0	49.8	50
Unit 40 (created)	36	36.7	36.4	0	0	0	0	36.4	0	36
Unit 48 (created)	55	54.4	54.4	0.8	0	0	0	54.4	0.8	55
Unit 49 (created)	85	83.9	83.9	1.3	83.9	0	83.9	83.9	1.3	85
Unit 50 (created)	91	90.5	90.6	0	0	0	0	90.6	0	91
Unit 57 (created)	89	0	43.4	34.0	11.5	43.4	11.5	0	34	89
Unit 58 (created)	116	67.5	0	48.9	0	48.9	0	0	0	116
Unit 61 (created)	121	121.2	104.2	0	121.2	0	17.2	104.2	0	121
Unit 62 (created)	38	35.7	35.8	1.7	0	0	1.7	35.8	1.7	38
Unit 63 (created)	103	93	93	0	10	0	10.0	93	0	103
Unit 80 N. Lake	393	393.2	0	72.1	393.2	0	0	0	0	393
Marsh Road Meadow	494	267.6	226.2	226.2	267.6	0	0	0	0	0
Wildlife Drive (BSM)	801	723.2	0	107.3	697.1	0	25.1	0	0	801
Big Salt Marsh	1209	408.8	0	800.6	98.3	0	206.4	0	0	1209
Salt Springs	252	0	238.3	0	0	14.7	0	0	14.6	252
Total	5646	2930.9	1580.6	2160	1739.6	371.8	576	1072.7	903.2	5086

NOTE: Table does not include wetlands managed as part of the grassland habitat type.



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Northern shoveler in a wetland with midheight, sparse vegetation.

- Transport water from the LSM to:
 - create mudflats and shallow water habitats, <16 inches, for foraging and roosting waterbirds;
 - expose bare mudflat and salt flat habitat for nesting shorebirds;
 - promote the germination and growth of vegetation in created wetlands.
- Support infrastructure and replace water control structures as necessary. Develop structures for A2 and A3.
- Use a combination of treatments, such as prescribed fire, chemical, grazing, and mechanical, to reduce and control invasive species and hazardous fuel.
- Refine the measures used in objectives as new information becomes available, such as through monitoring programs or research.
- When appropriate, use wildfires to help achieve land and resource management objectives.
- Refine strategies as new or better information become available to improve success in accomplishing objectives.
- Disk wetland soil surface when necessary and appropriate to benefit or encourage germination and growth of desirable vegetation.

Wetlands Rationale

Located within the migration corridor of the central flyway, Quivira Refuge is an important stopover for a diversity of waterbirds. Thus, we consider providing migratory habitat to be most important; and a primary role of refuge wetlands is to provide plant foods rich in carbohydrates, like seeds, tubers, and browse, and animal foods high in protein, like invertebrates. During spring, these foods provide the energy necessary for birds to reach their breeding grounds and, for some species, accumulate reserves necessary for egg production. In the fall, these foods provide energy for birds traveling to wintering grounds and protein for feather molt. Diets vary among species, with shorebirds consuming predominantly invertebrates, waterfowl consuming a combination of plant foods and invertebrates, cranes consuming predominantly plant foods, and American white pelican consuming fish.

While providing migration habitat is our primary concern, refuge wetlands also support limited breeding habitat for several bird species and, in some years, provide early winter habitat, primarily for large-bodied waterbirds that forage in wetlands. Therefore, we want to provide suitable habitat for completing these life cycle events even though the area of habitat needed is much less than for migration habitat. Primary nesting species include the federally listed interior least tern, the State-threatened western snowy plover, pied-billed grebe, sora, Wilson's phalarope, American bittern, and black-crowned night-heron.

Early winter habitat offers abundant, energy-rich foods and, for some waterfowl species, thermal cover in stands of tall emergent vegetation such as cattail and bulrush. As with the breeding season, the foods and cover required by these species are typically produced when we manage refuge wetlands for migration habitat. Therefore, the primary consideration for winter habitat is to make suitable sites available by flooding at suitable times and depths. In addition, wildlife values of a given wetland change within, and among, years, and attempts to manage for static conditions often leads to lower primary productivity that reduces wildlife benefits. Given these considerations, objectives were developed by considering refuge wetlands collectively rather than by developing objectives for each wetland unit.

The refuge also has a unique habitat in the freshwater springs, which supports a population of the State-threatened Arkansas darter. We want to maintain the integrity of these springs for them. Because little is known of the historical condition of this area, necessitating further study, the life history needs of the Arkansas darter will be used to guide our management efforts while we conduct more research.

Little Salt Marsh

Historically, hydrology of the marsh was determined by a combination of ground water levels and overbank flooding of Rattlesnake Creek. Water levels in the marsh fluctuated greatly and in some years no surface water was present. Similarly, water chemistry ranged from brackish to fresh depending on the amount of surface water inputs. However, before refuge establishment, Rattlesnake Creek was diverted directly into the marsh. Consequently, complete drying of marsh substrates is rare as some water enters the marsh annually and water chemistry likely has changed.

The ability to restore the hydrology of the LSM and reactivate the historic Rattlesnake Creek channel is not considered feasible because refuge water rights may be forfeited. In addition, extensive ground water depletion in the watershed, coupled with reduced flows in Rattlesnake Creek, has severely reduced the quantity and timing of water reaching the refuge that affects management capability. For example, in years of below average precipitation and extensive agricultural demands, insufficient water quantities are delivered to the refuge to exercise all habitat management options (Heitmeyer et al. 2012). Consequently, continuing to use the LSM as a storage reservoir is the best way for providing quality wildlife habitat on the refuge.

Although the hydrology of the LSM has been altered, management can still manipulate water lev-

els within the marsh to promote important processes (for example, nutrient cycling) and simultaneously optimize habitat for a diversity of waterbirds. Partial drawdowns can be conducted to oxidize soils and facilitate plant decomposition on the marsh perimeter, which provide nutrients for invertebrates and create suitable conditions for plant germination and growth on islands and along the marsh perimeter (Fredrickson and Taylor 1982, Laubhan et al. 2012). In addition, partial drawdowns also create bare flats suitable for nesting shorebirds and concentrate prey for shorebirds (invertebrates), as well as bald eagles and American white pelicans (fish). Conversely, addition of water during storage phases of the cycle results in flooding of newly established vegetation and creates a range of water depths suitable for roosting and foraging by many waterbirds throughout the year, including shorebirds and cranes.

Big Salt Marsh

The historical hydrology of the BSM has been altered by activities both on, and off, the refuge. Development of the water transport infrastructure on the refuge has included canals that facilitate the movement of water from Rattlesnake Creek to the BSM, whereas ground water depletion in the watershed has likely reduced the quantity and timing of ground water discharge to the BSM. In combination, we presume that increased use of Rattlesnake Creek water and smaller amounts of ground water dis-



Rachel Laubhan/FWS

Big Salt Marsh

charge has resulted in lower salinities, which is supported by the increased occurrence of cattail and other species that germinate under low saline conditions. In addition, the increased input of Rattlesnake Creek water has altered the timing of flooding and reduced the frequency and extent of drying. Collectively, these changes have stimulated a change in vegetation community composition, including an increase in cattail and an accompanying decline in salt-tolerant emergent species such as alkali bulrush and alkali sacaton. We also presume that these changes have altered the composition of the invertebrate community.

Although vegetation communities with different salinity tolerances provide food and cover to focal wildlife species, emergent vegetation better adapted to less saline conditions can be managed in other areas of the refuge to provide food resources and robust structural cover, as in created wetlands and wet meadows. By contrast, the ability to provide an interspersed of barren salt flats with large expanses of saltgrass and scattered areas of salt-tolerant emergent plant species is unique to the BSM area because saline conditions limit the amount of vegetation cover on mud and alkali flats, which provides open areas near water that are suitable for nesting interior least terns and snowy plover, foraging and roosting habitat for cranes, and foraging habitat for migratory shorebirds. In addition, the deeper parts of the marsh provide flooded open water that provides foraging and roosting habitat for American white pelicans and diving ducks throughout the year.

Given these considerations, mimicking historical conditions to the extent possible and relying on ground water discharge as the primary hydrologic input represents our best way for managing the BSM. Dynamic fluctuations in water quantity and quality will occur within, and among, years. In most years, surface water will be allowed to evaporate in late summer and ground water discharge will slowly begin to provide surface water in late October, with the marsh becoming full by January. Areas that are typically shallow when the marsh is fully flooded will have water during the spring, and then slowly begin drying in late spring through the summer. Use of Rattlesnake Creek water will be diverted to keep water chemistry, as in salinity, within the range of conditions necessary to sustain native plant communities or to avoid infrastructure damage during substantial flooding events.

Big Salt Marsh Strategies

- Support or improve appropriate salinity gradients through water management,

including limiting relatively fresher water from Rattlesnake Creek.

- Support or improve water control structures and associated infrastructure.
- Use a combination of treatments, such as prescribed fire, chemical, grazing, and mechanical, to promote native plant communities and reduce invasive species and hazardous fuel.
- Evaluate, then change or install water control structures to improve surface waterflows.
- Evaluate, then change or remove roads, such as ditches and roads on the west side, Y road, Road to Mandalay, and Tern Pad Road, that significantly alter surface waterflows.
- Evaluate the south end and, when oil wells become inactive, remove oil well roads and restore those areas.
- Replace the Unit 80 structure with a larger structure to better export water from the BSM to Salt Creek and to improve water management capability to better prevent flooding of least tern and snowy plover nests.
- When appropriate, use wildfires to help achieve land and resource management objectives.

Created Wetlands

The primary purpose of managing created wetland units is to produce plant and animal foods for migratory birds during spring and fall migration that supplement foods provided in other wetland types, see objectives A2 and C2 above. Plant food production in these units usually exceeds the production in other wetland types on the refuge because the time and rate of drawdowns can be manipulated to stimulate the germination and growth of desirable annual vegetation, like barnyard grass and sprangletop, that produces abundant seed and structure for invertebrate production after reflooding in the fall and winter. Similarly, making these foods available to a greater diversity of birds is possible because we can control the time and depth of flooding (Fredrickson and Taylor 1982, Laubhan and Fredrickson 1997, Laubhan et al. 2012, Laubhan and Roelle 2001). Created wetland units that we manage to mimic seasonally flooded wetlands to produce foods also provide

many other benefits. For example, drawdowns to stimulate plant germination often can be timed to create mudflats, oxidize soils, and increase invertebrate availability during spring shorebird and crane migration. Following plant germination, units can be shallowly flooded to improve plant growth and seed production, and provide summer foraging habitat for breeding species.

Some created wetlands on Quivira Refuge can also be managed as temporary or semipermanent wetlands to supplement migration or breeding habitat and thermal cover for certain species.

Created Wetlands Strategies

- Manage hydroperiods for desired conditions. Gather and apply information on the germination and growth needs of plants and on the utilization criteria, such as chronology, foraging depths, and nesting needs, of the species that use these wetlands.
- Keep water transfer infrastructure and associated water control structures 95-percent free of emergent vegetation.
- Evaluate water control structure conditions and replace or change them as necessary. One such structure is on Dead Horse Slough.
- Use a combination of treatments, such as prescribed fire, chemical, grazing, and mechanical, to reduce and control invasive species and hazardous fuel.
- Inventory these units to refine the measures used in objectives. Correlate water level gauge readings with unit elevation gradients to help predict habitat potentials.
- When appropriate, use wildfires to help achieve land and resource management objectives.

Freshwater Springs

The freshwater springs are a source of permanent water that is unique to the refuge. The site has been modified by the installation of a pipe and the creation of more small pools to trap spring flows and by the installation of a pipe that created an artesian well. These pools support aquatic vegetation, and surrounding lands support a mixture of native and non-native vegetation and scattered trees. Monitoring programs of wildlife use here have not been conducted, but the value of this habitat for waterbirds is



Created Wetland

likely limited because of the small size and depth of these pools and the presence of trees. However, the area does support an isolated population of Arkansas darter.

Freshwater Springs Strategies

- Within 5 years, begin collaboration with experts and review current information to evaluate potential habitat improvements that support Arkansas darters, including the possible removal of existing infrastructure north of the springs.
- Within the life of the CCP, develop a more detailed management plan specific to the freshwater springs area that incorporates the current knowledge of experts and current information.

Temporary and Seasonal Prairie Wetlands

There are many temporary and seasonal wetland basins interspersed throughout the upland communities on the refuge. The exact locations of all basins are not known, but most are less than 0.5 acre. Local precipitation and ground water fluctuations determine their hydrology, and no water management capabilities exist for them. Consequently, plant communities there are dynamic and range from perennial sedges and rushes and annual emergent vegetation to obligate upland species. When flooded, we presume that these basins provide temporary foraging habitat for waterbirds, like waterfowl and ibis, and supplement foods in other wetland types. Other uses for these wetlands may also occur.

We manage these basins as part of their surrounding upland communities and typically use prescribed fire and grazing to alter vegetation



Rachel Laubhan/FWS

Seasonal Prairie Wetland

community composition and structure. However, we will not intentionally drain or ditch these wetlands, and we will control their nonnative vegetation.

Temporary and Seasonal Prairie Wetlands Strategies

- Determine and map the location of these basins.
- Protect the integrity of basin morphology, such as their shape, structure and pattern.
- Avoid mechanical disturbances that will drain these basins.
- Time prescribed fires and grazing to avoid their peak periods of use by wildlife.
- Control nonnative vegetation and hazardous fuel.
- When appropriate, use wildfires to help achieve land and resource management objectives.

Native Ecological Community Conservation Objective 2: Grasslands

The grasslands objective was written based on the considerations of different species–habitat relationships of focal species, known characteristics of the soil–plant associations on the refuge, the need for periodic management treatments, and limitations of management. Individually, objectives capture perceived differences in bird habitat types within the grassland community that also seem realistic for management implementation. It represents the potential range of natural environmental conditions of the grassland community needed to promote the long-term sustainability of the system. Quantifiable measures of vegetation composition, height, density, litter depth, and other factors are commonly reported attributes of breeding grassland bird habitat descriptions and were used to develop the objective (appendix H).

Available quantitative information of grassland bird cover and structural needs during the nonbreeding season is comparably less than that during breeding. Knowledge of birds outside of the breeding

season traditionally relates to diet, energetics, foraging behavior, and, more recently, large-scale movements between breeding and wintering grounds. Descriptions that quantify structure and composition of habitat preferred by nonbreeding grassland passerines are lacking. Yet, management of grassland determines the extent, distribution, and within stand attributes of different habitat conditions within the community. Limited information of nonbreeding bird habitat was used to determine shrub attributes in grassland and is discussed in more detail below. Otherwise, until more information becomes available, management presumes that accomplishment of the grasslands objective relevant to the breeding season will concurrently satisfy habitat needs during the nonbreeding season. For example, by managing for a range of successional stages during the breeding and growing season as defined in the objective below, then a similar range of conditions will be provided during the nonbreeding season. As well, the distribution of the different successional stages would be expected to shift, dependent on methods of dispersal and growth in relation to current plant composition (Ratajezak et al. 2011), the ecological site potential, environmental conditions under relatively wet and dry conditions, and disturbance history.

Some woody vegetation is acceptable within native grasslands, thus the planning team had to evaluate relevant available information to identify optimal habitat conditions and suitable management actions such as mowing or burning. Again, species-habitat relationship information, such as percent shrub cover and proximity to other habitat types, facilitated this process.

Criteria

A. From January through March—nonbreeding—provide a range from 5–30 percent of tall, about 3–10 feet, native shrub interspersed within larger grassland blocks to support both focal grassland and shrub-grassland specialists.

B. Apply from April through August—breeding:

1. Provide at least 500 acres of estimated habitat that is predominantly native—short, bare to sparse—to help associated focal species, such as breeding killdeer, American avocet, interior least tern, western snowy plover, upland sandpiper, and ground-foraging passerines; composition less than 5 percent grass or fine-stemmed emergent, less than 5 percent forb, and no shrub; mean greatest height less than 6 inches; visual obstruction, or height density, less than 4 inches; no litter depth; no overlap with similar habitat made available under wetland objective B1 above.
2. Provide at least 70 percent of the estimated 4,163 acres of predominantly native—short-mid, sparse-medium—grassland habitat, including at least 1 area on, or near, a prairie dog town on, or next to, refuge lands to support associated focal species, such as breeding burrowing owl, field sparrow, lark sparrow, grasshopper sparrow, upland sandpiper, and western meadowlark; composition 40–50 percent grass or fine-stemmed emergent, 10–20 percent forb, and 10–20 percent shrub; mean greatest height of 6–20 inches; visual obstruction, or height density, less than 4 inches; litter depth of 0.2–1.2 inches.
3. Provide at least 70 percent of the estimated 2,053 acres of predominantly native—mid-tall, medium—grassland habitat to support associated focal species, such as breeding western meadowlark, grasshopper sparrow, bobolink, dickcissel, northern harrier, and blue-winged teal; composition 40–50 percent grass or fine-stemmed emergent, 10–20 percent forb, and less than 15 percent shrub; mean greatest height greater than 6 inches; visual obstruction, or height density, of 4–12 inches; litter depth greater than 0.8 inch.
4. Provide at least 70 percent of the estimated 2,756 acres of predominantly native—tall, medium-dense—grassland habitat to support associated focal species, such as breeding western meadowlark, grasshopper sparrow, bobolink, dickcissel, northern harrier, and blue-winged teal; composition 40–50 percent grass or fine-stemmed emergent, 10–20 percent forb, and less than 15 percent shrub; mean greatest height greater than 20 inches; visual obstruction, or height density, of 4–12 inches and greater than 12 inches; litter depth greater than 0.2 inch; acres outside of those with at least 50 percent plum or shrub coverage—1,278.58 acres—which mostly occur in subirrigated soil types where tallgrasses characteristically dominate.
5. Provide more than 10 sparse stands of shrub—mostly plum—interspersed within larger grassland blocks and riparian corridors to support associated focal species, such as lark and field sparrows; shrub height about 3–10 feet; stand size about

0.40–0.90 acre each; and within-stand shrub coverage of 7–11 percent.

6. Provide more than 10 dense stands of shrub—mostly plum—habitat interspersed within larger grassland blocks and riparian corridors to support shrub-dependent focal species, such as Bell's vireo; shrub height about 3–10 feet; stand size about 0.75–1.5 acre each; and within-stand shrub coverage of 25–35 percent.

C. From September through December—nonbreeding—provide the same as criterion A.

There are about 9,512 acres of native, grass-dominated vegetation associations outside of what is defined as wetland, based on GIS calculations of recent coverage (table 18). The acreage estimates used in the grassland criteria B.1–4 do not include other association types in the larger grassland landscape: about 82 acres of nonnative, invasive cheatgrass; 1,279 acres of plum or shrub-dominated (equal to, or greater than, 50 percent) habitat; about 870 acres of recently or currently farmed lands; 1,008 acres of trees; and 3,483 acres of herbaceous or emergent wetland association types, such as prairie cordgrass–three square (2,054), cattail–rush (1,096), water (176), spikerush (135), and *Phragmites* (23). Still, these other association types interspersed throughout the larger grassland blocks are managed as part of grassland.

While the restoration of farmed lands, nonnative habitats, and many woody-dominated habitats to native grassland association types will be started over the next 15 years, the duration of this restoration phase is unknown and may take many years, depending on various factors such as climate. Because of this uncertainty, these other association types are not included in the acreages used in the grassland criteria B.1–4.

Strategies

- Use a wide range of disturbance types, levels, and frequencies to support or improve habitat, including prescribed grazing or fire, flooding and drying, and chemical and mechanical methods.
- Use a combination of treatments such as prescribed fire, chemicals, grazing, and mechanical methods to reduce and control invasive species and hazardous fuel.



Kildeer in short, sparse upland habitat.



Little bluestem in intermediate grassland.



Switchgrass in tall, dense grassland.

- Promote the restoration and conservation of native understories and the reduction or elimination of cheatgrass-dominated understories when applying treatments for shrub-related objectives.

Table 18. Dominant nonwetland habitat types at Quivira National Wildlife Refuge, Kansas.

<i>Habitat type</i>	<i>Dominant vegetation</i>	<i>Estimated acres</i>
Native tallgrass	Switchgrass	1,720
	Big bluestem	974
	Sand bluestem	62
Native midgrass	Little bluestem	2,053
Native shortgrass	Saltgrass	4,362
	Prairie dog town	19
	Buffalograss	1
Natural bare-sparse	Sand flats	322
Shrub	Plum, sumac, dogwood	1,279
Nonnative upland grass	Cheatgrass	82
Agricultural (farmed)	Agricultural (farmed)	885
	Cottonwood	355
	Locust	253
	Saltcedar	125
	Other	105
	Red cedar	85
	Willow	57
	Russian olive	28
Wetland	Prairie cord-grass-three square	2,054
	Cattail-rush	1,096
	Water	176
	Spikerush	135
	Phragmites	23
Other	Roads	316
	Bare ground (like oil pads)	12
	Buildings, structures	6

- Evaluate the feasibility of managing sites when planning annual prescriptions. For example, some semipermanent shrub sites have long-term coverage of some shrub hab-

itat where management can be difficult to impossible and other sites occur between drainages that can impede equipment access.

- Conduct a monitoring program early on to meet our objectives for shrubs because we have limited knowledge and information on plum habitat.
- When appropriate, use wildfires to help achieve land and resource management objectives.

Rationale

Quivira Refuge is recognized for wetland and waterbird resources, but the refuge is also comprised of thousands of acres of upland, native sand prairie habitat that commonly support grassland obligates and species of concern, such as grasshopper sparrow and dickcissel. The decline of grassland bird populations are of serious conservation concern (Sauer et al. 2008). In general, these declines are attributed to habitat loss and degradation caused by many factors, including land use changes, the spread of invasive species, habitat fragmentation, urbanization, and the management of water quantity and quality. The relative importance of each of these factors depends on the resources and scales considered. Quivira Refuge lands have the potential to contribute to grassland bird conservation, especially when considering that public lands compose less than 3 percent of Kansas and Quivira Refuge comprises a smaller percentage of those lands that are specifically managed for natural resource conservation.

Some woody vegetation is acceptable within native grasslands. Nonbreeding (fall, winter, spring) specialists of grassland and shrub-grassland in Texas, many of which also occur on Quivira Refuge, had their highest combined densities reported in shrub-grassland habitat with less than 30 percent interspersed woody vegetation generally less than 3.28 yards tall by 24.71 acres (3 meters tall by 10 hectares) compared to habitat with less than 10 percent woody interspersed or less than 50 percent woody interspersed (Igl and Ballard 1999). When evaluated separately, grassland specialists had their highest densities in the same habitat as when combined, but shrub-grassland specialists had their highest densities in woodland dominated by trees more than 3.28 yards tall and secondarily in brushland dominated by woody plants less than 3.28 yards tall and comprising more than 30 percent woody canopy coverage. If Quivira trends are similar to what was reported, then management will be supporting less optimal habitat for grassland-shrub



Barry Jones/FWS

View from sandhills.

specialists to support both grassland and shrub-grassland specialists during the nonbreeding season. The same intent influenced the decision to provide at least 10 dense and sparse stands each—or between 5–30 percent interspersed total shrub coverage—during the breeding season. Also considered was the knowledge that much additional shrub coverage occurs in the landscape that is not defined as shrub habitat for refuge mapping and planning purposes because stands are less than 0.2 acre in size or have more than 50 percent shrub coverage (not a dominant plant type within stand).

There are about 9,512 acres of native grass-dominated vegetation associations outside of what is defined as “wetland” based on GIS calculations of recent coverage. Grassland communities are dynamic and cannot be held in static conditions, as illustrated in State transition diagrams of soil-vegetation associations and ecological site descriptions (Natural Resource Conservation Service 2010). For example, factors contributing to grassland dynamics include variation in climate effects, such as from changes in precipitation, temperature, and wind; landscape features, such as differences in soil, aspect, and slope position; plant-wildlife interactions, such as plant adaptations to herbivory and soil disturbance; and the timing of environmental changes or disturbances in relation to plant and wildlife life stages (Anderson 2006, Helzer 2010). Thus, it is unrealistic to set an objective that attempts to maintain static conditions over time. Development of this objective considered these factors, the recent spatial location of various vegetation associations, and the understanding that areas of the refuge will be “rested” (no planned burning or grazing) each year. This explains the desirability to attain a minimum of 70 percent of the estimated potential acres of the associated grassland conditions described in the grassland criteria B. 1–4.

While this proportion is somewhat arbitrary, it promotes the sustainability of ecosystem processes and the need for periodic disturbance as well as management’s ability to mimic natural stressors, such as when using fire and herbivory.

Native Ecological Community Conservation Objective 3: Woodlands

At least 125 acres of woodlands largely located on the refuge perimeter and within 55 yards of the refuge’s main roads will remain (figure 15) during the next 15 years, see appendix H.

Strategies

- Based on current conditions, maintain woodlands in areas identified in appendix H.
- Keep select trees or small groves that are located in areas along roads or next to other nondesirable habitat on and off the refuge where removal would not provide substantial benefits to native wildlife, such as obligate grassland birds, and where their presence may benefit species of concern, such as Loggerhead shrike or bald eagle. Ultimately, this will be the refuge manager’s decision based on available information.
- Conduct no substantial active management, such as regular stand thinning and fire suppression in most cases, specifically to benefit

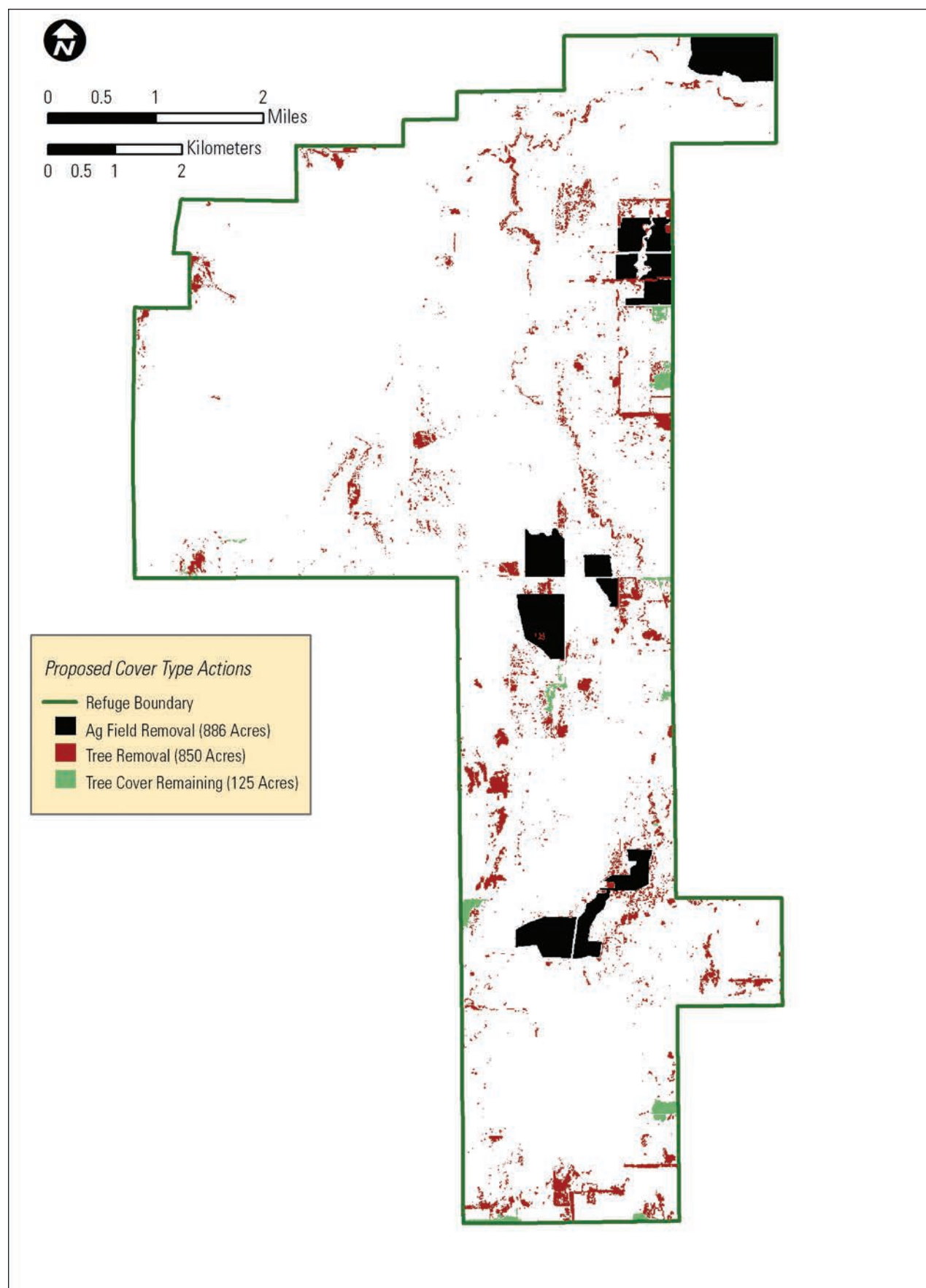


Figure 15. Cropland and tree coverage planning at Quivira National Wildlife Refuge, Kansas.

species largely associated with nonnative woodlands. Prioritize time and money resources for other species–habitat communities over woodland, especially shelterbelts and nonnative types.

- Manage woodlands to reduce seed or propagation sources or to maintain fence lines and other infrastructure, such as removing red cedar growth under canopy trees or Russian olive in the Artesian Grove.
- Do not allow encroachment of woodland into surrounding habitat.
- Allow limited native trees to remain onsite where they might have occurred naturally, such as up to a few willow or cottonwood trees near a spring.

Rationale

Historically, nonwetland habitats comprising the refuge were dominated by native prairie interspersed with inclusions of shrubs (Heitmeyer et al. 2012). However, changes in land use practices in the watershed, coupled with our past management direction, led to the encroachment of shrubs and native and nonnative trees. By 2008, thousands of acres of woody vegetation existed on refuge lands (figure 16). Years ago, our refuge staff decided that restoring native prairie communities represented the best use of refuge lands, given the extensive loss and fragmentation of this habitat in the watershed and the accompanying population declines of some species, particularly of grassland obligates that rely on it.

However, removing all trees during the next 15 years may not be warranted given the location of

woodlands surrounding the refuge and other hostile habitat on and off refuge lands. And it may not be feasible given our limited staff and budgets.

Migratory birds that require woodlands to complete essential life history events, like nesting, historically were not common on the refuge. Thus, they generally were not selected as focal species during the planning process. However, isolated trees and small groves would benefit focal species, such as loggerhead shrike and Swainson's hawk. Because woodland areas are attractive to wildlife enthusiasts, primarily bird watchers and photographers, a list of birds recorded using the woodlands not now planned for removal in the next 15 years was compiled from refuge files and recent observations to assess potential loss in birdwatching opportunities on the refuge (table 11). This list—which is presumed to be incomplete given that formal surveys have not been conducted—includes 49 species, indicating that birdwatchers will still have opportunities to view woodland-associated birds on refuge lands in easily accessible areas. It seems that bird species richness will be maintained.

4.5 Visitor Services Goal

Visitors enjoy quality wildlife-dependent recreation opportunities.

As part of the Service's guiding principles, legitimate and appropriate wildlife-dependent uses of refuges include compatible activities involving hunting, fishing, wildlife observation, photography, interpretation and education.



FWS

Shrubland



FWS

Woodland

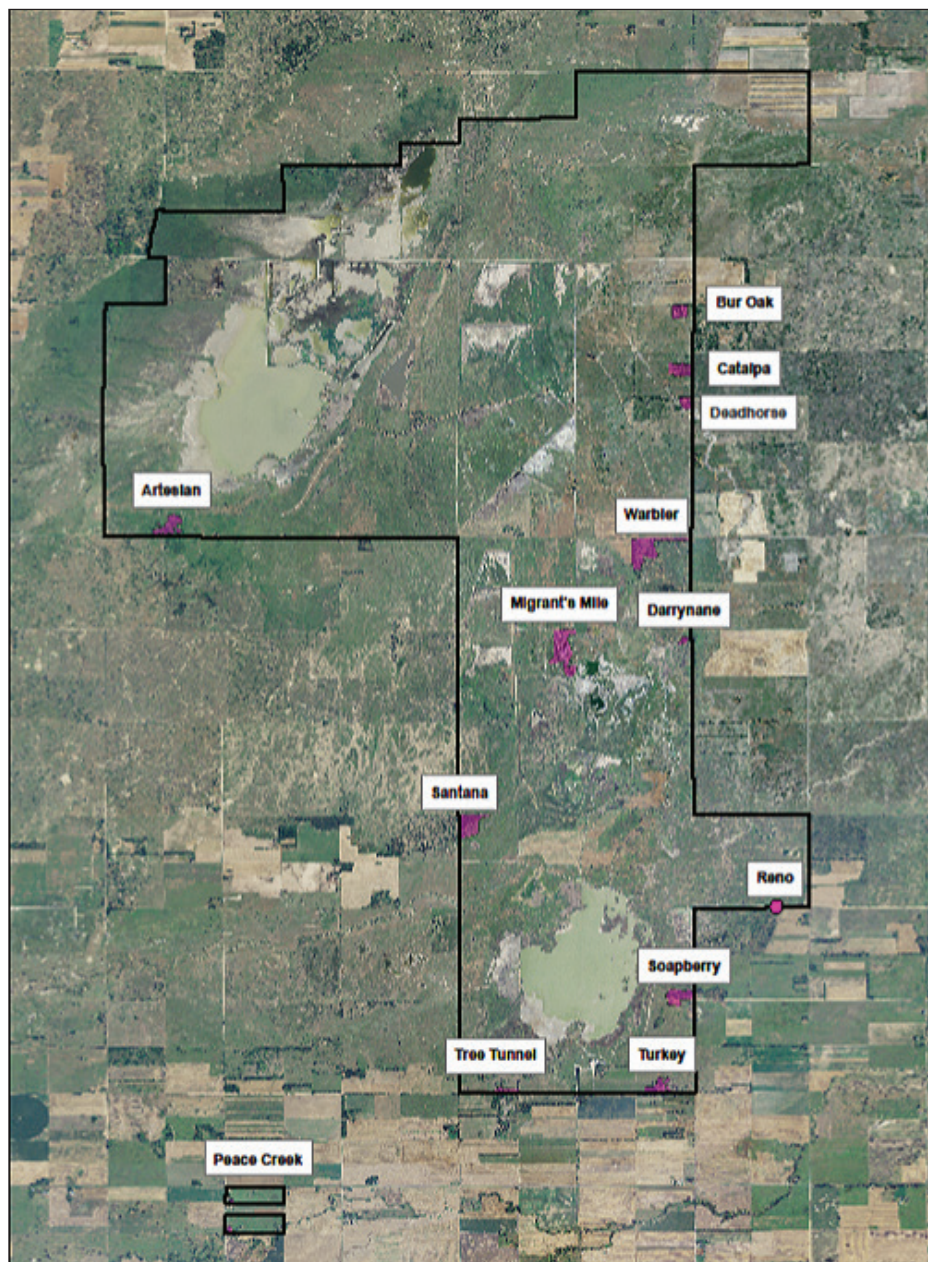


Figure 16. Location of woodland groves at Quivira National Wildlife Refuge, Kansas, in 2012.

Hunting Objective 1

Throughout the life of the plan, continue to allow compatible waterfowl, upland bird, and small game hunting opportunities within traditional boundaries (figures 11) that adequately protect whooping cranes and promote employee and public safety.

Strategies

- Write a detailed hunt plan during the life of the CCP. Refuge-specific regulations may apply to any hunt program on the refuge.
 - Consider an extended light goose season during the spring conservation order.
 - Update the CFR to be consistent with the approved hunt plan.
- Close the refuge to waterfowl and upland bird hunting as necessary to protect whooping cranes. The refuge manager has the authority to decide when to open and close the refuge to hunting.
- Continue to provide and improve access to hunting information through kiosks, signs, interpretive displays, handout literature, and by other means, such as through social media and the refuge's Web site.
- Do not allow the hunting of certain species that are not common or are closely associated with potential impacts to species of concern, such as rail, woodcock, snipe, sandhill crane, and prairie-chicken. Because the occurrence of many of these species is limited, hunting opportunities will not be significantly reduced and educational opportunities related to the conservation of these species and associated communities could be promoted.
- Continue to allow hunting of Northern bobwhite, pheasant, and dove within traditional hunt boundaries (on less than 40 percent of the refuge). Of note, bobwhite occurrence on the refuge regularly includes areas both inside and outside of hunt boundaries. Allow the hunting of small game according to refuge-specific regulations.
- Close the refuge to the public between dusk and dawn, except for special events or activ-

ities that require a refuge permit or for unique circumstances permitted by the refuge manager.

- Allow only nontoxic shot on the refuge.
- Provide adequate law enforcement that supports staff and public safety and the protection of natural resources.

Rationale

The perspectives and opinions on public use-related issues vary widely. Therefore, an objective approach was applied to discuss and evaluate public-use activities within the context of Service laws, policies, and guidance. Many of the concerns related to hunting activities involved decisions beyond the scope of this CCP. Therefore, a more detailed stepdown management plan is needed that considers: (1) reducing risks to threatened, endangered and protected species; (2) the safety of refuge staff and the public; (3) the logistics or the ability to implement actions that ensure compliance with laws and regulations; (4) potential conflicts among use activities; and (5) the requirement of refuge-specific regulations and permits, such as limits to hunting intensity, season, method, and area within approved boundaries and opportunities for youth or the military.

Among the major factors that are considered in decisionmaking, besides the balancing of multiple use activities and compatibility with wildlife, are observations of whooping crane behavior and habitat use that is unique or specific to the area of the refuge. Both consumptive and nonconsumptive users share concern for the protection of whooping cranes. Also, many hunters indicated a preference for the opportunity to hunt the North Lake area for a limited number of days, which is often due to refuge closures because whooping cranes are present, over hunting in alternative areas over more hunt days when there has traditionally been no to little observed use of the refuge by whooping cranes. As part of planning, we will continue to consider tradeoffs like these and other management decisions.

Hunting Objective 2

Throughout the life of the plan, broaden and increase safe and compatible hunting opportunities on the refuge, such as for deer, turkey, and furbearers, that will require refuge-specific permits (figure 17).

Strategies

- Use refuge-specific regulations to restrict aspects of trapping activities, such as the number, location, and types of traps used, and require the approval of a special use permit by the refuge manager.
- Consult with the State of Kansas and experts, when writing a more-detailed hunt plan, on factors important in decisionmaking, such as limits based on deer health and population targets or thresholds.
- Understand that the hunting of deer, turkey, and furbearers will not necessarily need to occur throughout the entire approved area, nor during every season or year.

Rationale

Before and during the planning of this CCP, the public requested consideration of opportunities for deer and turkey hunting. Deer population trends have increased substantially since refuge establishment, from less than 20 in the entire local population to a density of 41 individual deer per 0.39 square mile (1 square kilometer) based on recent distance sampling reported by Blecha et al. (2011). There are concerns about the combination of high-density populations and the rate of spread of Chronic Wasting Disease, which was reported in Stafford County in 2013.

Some think hunting could help address deer-related issues, while others feel that deer hunting would negatively impact deer viewing opportunities. While opinions on deer hunting on the refuge vary, there seems to be general agreement that unique hunt opportunities, such as for youth, are acceptable. All hunting possibilities—including exceptions to hunting closures when whooping cranes are present such as for the limited use of archery in hunting deer—will be explored in the development of a more-detailed hunt plan. Safety, compatibility with wildlife, logistics, and the potential tradeoffs of multiple use activities will be considered in the development of policy and guidance.

The wild turkey population varies annually on the refuge, but has generally increased since the establishment of the refuge. While turkey hunting will be allowed, refuge-specific regulations will limit opportunities. Compatibility with wildlife and potential conflicts with nonconsumptive uses, especially in the spring, will be considered.

Furbearer hunting will require refuge-specific regulations. Approval of a special use permit will be

required to control aspects of hunting or trapping, and the desired reduction of furbearer impacts to refuge infrastructure and management implementation will be considered.

Fishing Objective 1

Throughout the life of the plan, allow fishing in refuge waters with minimal disturbance to other wildlife and the natural aquatic ecosystem.

Strategies

- Allow fishing, in accordance with State and Federal regulations, year round on all waters on the refuge.
- Provide and maintain accessible fishing docks for visitors with disabilities.
- Do not allow boats on any waters.
- Do not stock Refuge waters (except Kids' Fishing Pond, see objective 2), but instead manage wetlands and lakes for migratory birds, allow these to fluctuate through natural hydrologic cycles.
- Do not allow bait collecting and live fish bait, except night crawlers, on any waters.
- Provide educational materials and interpretive exhibits about native fish, the threat of introducing or spreading nonnative plants or wildlife and other things that could hurt the environment, like diseases harmful to humans or wildlife populations.
- Plan and conduct unique fishing events for kids to encourage and support a new generation of anglers.
- Do not allow frogging.

Rationale

Fishing is a tool to help the public connect with nature and to promote existing and future programs. Fishing and its promotion provides a type of compatible public use that is encouraged by initiatives such as the Department of the Interior's "Youth and the Great Outdoors" and the U.S. Fish and Wildlife Service's "Let's Go Outside." Boats and bait collecting

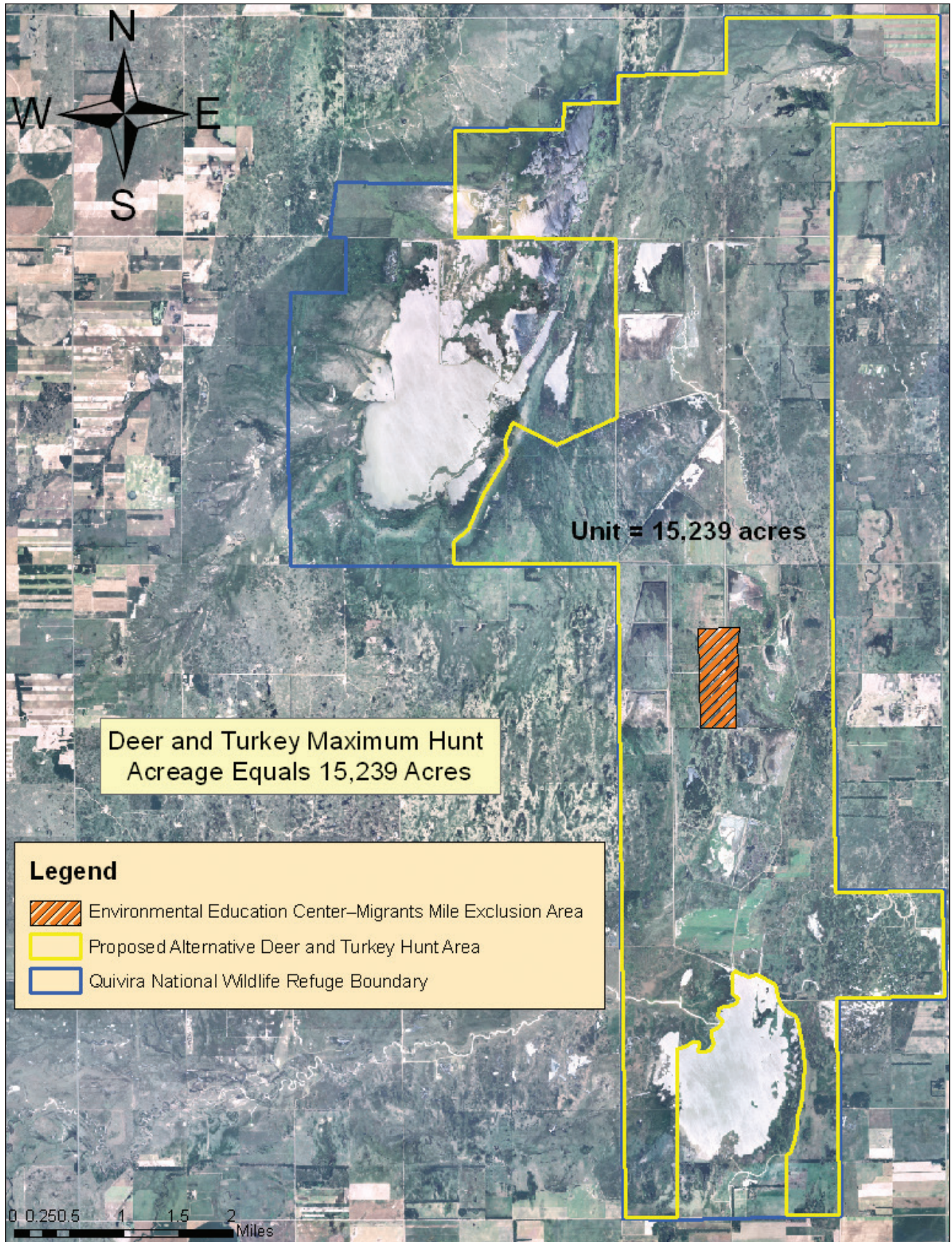


Figure 17. Proposed deer and turkey hunt area, Quivira National Wildlife Refuge, Kansas.

are not allowed because they increase the risk of exotic and invasive species introduction and spread.

Frogging will be prohibited on the refuge because, at various life phases (eggs, tadpoles, adult), frogs are an important diet item for many wildlife species. Also, frogging commonly occurs at night when the refuge is closed to the public. Therefore, frogging opportunities would be very limited. Because bait collecting is not allowed on the refuge, we would need regulations to control the frog species and sizes collected, among other considerations, and these would be difficult to enforce, especially when law enforcement on the refuge is limited.

Fishing Objective 2

Enhance fishing and fishing education opportunities for youth by maintaining the Kids' Fishing Pond and annually stocking it with sport fish species.

Strategies

- Allow fishing, in accordance with State and Federal regulations, for kids 14 and under (and adults accompanying such children). Adults will not be permitted to fish without children.
- Maintain the existing accessible fishing dock.
- Produce and install an interpretive panel about aquatic ecology with children-supplied artwork and text.
- Produce and support an interpretive media that is coproduced, written, and continually revised by, and for, children to enhance their knowledge of fishing and fish resources.

Rationale

Similar to Objective 1, but in addition, maintaining a population of sport fish at the Kids' Fishing Pond by stocking provides a location where fish populations are continually stable. It also provides a type of compatible public use that follows initiatives described in objective 1.

Wildlife Observation and Photography Objective 1

Throughout the life of the plan, increase awareness and access to wildlife observation and photography opportunities on the refuge and the Great Plains Nature Center.

Strategies

- Maintain and improve the 14-mile wildlife auto tour route, trails, other public roads, observation towers, spotting scopes, and photography blinds.
- Keep and improve diverse and dynamic interpretive displays, social media, and handout literature that continually enhance and increase visitors' awareness of and interest in exploring the refuge.
- Loan equipment, like binoculars, scopes, and backpacks, through the Birding Initiative and through Connecting People With Nature.
- Continue to provide opportunities at the GPNC for wildlife observation and photography during operating hours and from sunrise to sunset every day via City of Wichita Chisholm Creek Park.
- Keep refuge open daily during daylight hours.
- Allow and encourage use throughout the entire refuge except in seasonally closed areas.
- Promote awareness of opportunities through the Wetlands and Wildlife National Scenic Byway.
- Collaborate with Friends groups and others to install a tower camera at the bald eagle and BSM areas to provide more observation opportunities of remote wildlife.
- Allow horseback riding and bicycling on established roads, not on hiking trails.
- Allow the walking of pets according to refuge regulations. Pets must be leashed and under their owners' control at all times,

unless for purposes approved by the refuge manager.

Wildlife Observation and Photography Objective 2

Over the next 10 years, promote and expand public use of woodland groves by birdwatchers, and photographers.

Strategies

- Develop information in brochures, panels and social media that promote wildlife observation and photography in designated woodland areas around the refuge.
- Enhance access to at least some woodland groves while considering management constraints and other priorities.
- Promote awareness of opportunity through the Wetlands and Wildlife National Scenic Byway.
- Encourage minimal use of the Artesian Grove through interpretive panels explaining the special nature of the site.
- See that activities comply with refuge regulations and Service policy.

Rationale for Wildlife Observation and Photography Objectives 1 and 2

Use information provided to promote connections that nurture the appreciation and stewardship of natural resources. Promoting conservation partnerships with support groups (such as Friends groups and scenic byway) would increase awareness of observation and photography opportunities, and general respect for wildlife resources. Better access to refuge areas would make it easier for people to observe and photograph wildlife.

Environmental Education and Interpretation Objective 1

Within 10 years, refuge staff will design and conduct 5–10 programs to enhance the advocacy and

improve awareness of our mission and management; fish and wildlife resources; our refuge management activities; and the refuge's natural, cultural, and historic resources.

Strategies

- Develop an environmental education and interpretation plan.
- Refuge staff will continue to coordinate with Friends of Quivira to create special events and educational programs.
- Provide environmental education programs at the refuge that teach curriculum-based programs for all school grade levels to help meet State educational standards.
- Encourage the use of the refuge by educational organizations as an “outdoor classroom.”
- Continue to promote national initiatives, such as Connecting People with Nature, America's Great Outdoors, and Let's Go Outside!
- Continue to engage visitors to the refuge through loan programs for binoculars and other educational products.
- Continue to provide interpretive programs at the refuge on a variety of refuge management and wildlife-oriented subjects, both by request and as scheduled activities, and increase programs as staff and time allow.
- Interpret the cultural history of the refuge area, including tribal uses and early settlement.
- Continue relevant and effective annual school events, such as those about the conservation of whooping cranes.
- Continue networking and communicating with area educators as to availability of environmental education programs and opportunities both on and off the refuge.
- Allow virtual geocaching.



Visitors participate in the Monarch Mania event held at Quivira Refuge.

Environmental Education and Interpretation Objective 2

Within 5 years, refuge staff will increase interpretive media by 25 percent, thus reaching more public both onsite and offsite.

Strategies

- Educate and inform individuals, schools, and other organizations through accessible programs, exhibits, signs, pamphlets, the Internet, and social media.
- Continually evaluate interpretive media like brochures, signs, and displays for relevancy, effectiveness, and timeliness.
- Use social media to increase contact and exposure to the refuge.

Environmental Education and Interpretation Objective 3

Interagency staff at the GPNC will conduct an average of 1,700 onsite and offsite programs every year focusing on “at risk” youth and other underserved audiences.

Strategies

- Evaluate needs and increase Service staff, as applicable, to support programming efforts.

- Increase communication and networking efforts with Unified School District 259 (Wichita) and area school administrators to advertise and market GPNC programs (such as school field trips and in-classroom presentations)
- Coordinate educational programs with area educators to make sure that State Core standards are being met through programming efforts.
- Increase the distribution of educational kits and discovery boxes to educators.
- Continue to promote national initiatives, such as Connecting People with Nature, America’s Great Outdoors, and Let’s Go Outside!
- Educate and inform individuals, schools, and other organizations through accessible programs, exhibits, signs, pamphlets, the Internet, and social media.
- Continue to support the GPNC through its partnership with the City of Wichita Department of Park and Recreation and the KDWPT.
- Use funding opportunities from the Urban Presence Initiative to support educational programming at the GPNC.

Environmental Education and Interpretation Objective 4

Within 5 years Refuge and GPNC staff will create a definition of environmental education and increase the level of professionalism of environmental education programs presented.

Strategies

Partner agency staff will attend capacity building training and environmental education workshops.

Environmental Education and Interpretation Objective 5

Increase outreach and marketing efforts to increase participation by teachers and students in the Junior Federal Duck Stamp program by 10 percent within 5 years.

Strategies:

- Hire a consultant to evaluate our program and suggest improvements to increase participation.
- Display artwork throughout the year at various locations, at least 10 venues per year, including the Kansas State Fair, to further promote interest in wildlife and art.
- Create educational and marketing products, such as calendars and guides, that will engage potential participants, including parents, teachers and students.
- Educate and inform individuals, schools, and other organizations through accessible programs, exhibits, signs, pamphlets, the Internet, and social media.

Environmental Education and Interpretation Objective 6

Throughout the life of the plan maintain 2 miles of foot trails and increase interpretative signs on trails by 50 percent within 10 years.

Strategies

- Evaluate Birdhouse Boulevard trail and interpretive components for potential improvements and updates.
- Evaluate the Headquarters and Little Salt Marsh trails for interpretive signage needs and install signage as outlined.
- Evaluate signage needs on the Migrants Mile Trail and replace and install as outlined.

- Evaluate trail surfaces, boardwalks, directional signs, and bridges and improve as needed.
- Develop and provide printed media such as trail maps and guides.
- Consider incorporating a fitness program on refuge and GPNC trails through HealthyKansas.org

Rationale for Environmental Education and Interpretation Objectives 1–6

It is important for all ages of the public to have an understanding of the refuge and GPNC missions, goals, and responsibilities. Both facilities are in the “backyard” of several local communities, providing a sense of pride can be nurtured and perpetuated by increased understanding through education and interpretation. In addition, all the local communities benefit economically from their proximity to the facilities and their popularity as destinations. As community members come to know more about the refuge and the GPNC, they will be better able to educate both other residents and visitors.

Other Uses Objective

Throughout the life of the plan, provide appropriate and compatible opportunities for wildlife-dependent and non-wildlife-dependent recreation that support the six priority public uses or contribute to the appreciation of the refuge. These opportunities will not be allowed to disturb wildlife and will not be allowed when areas are closed for safety reasons.

Strategies

- Allow dog training by individuals, not commercial vendors, as described in appendix B.
- Allow commercial photography with a special use permit.
- Allow commercial tours for birding only with a special use permit.
- Allow firewood cutting in limited designated areas with a special use permit.

- Do not allow the collection of berries, fruit, roots, and mushrooms.
- Do not allow the collection of shed antlers and wildflowers.
- Do not allow commercial guiding for hunting.
- Do not allow boating or camping.
- Do not allow unauthorized vehicle use on roads and trails.
- Do not allow off-road vehicle use.
- Do not allow the collection of reptiles and amphibians or crayfish.
- Review requests for other non-wildlife-dependent for compatibility and appropriateness on a case-by-case basis.

Rationale

The Improvement Act states that other uses can occur within the Refuge System, but they must support, or not conflict with, a priority public use. Furthermore, a use may not keep a national wildlife refuge from accomplishing its purposes or the mission of the Refuge System.

The refuge supports various forms of nature-based outdoor recreation that, while not strictly wildlife dependent, may support or facilitate wildlife-dependent recreation. These include activities such as equestrian use, bicycling, or hiking, which are compatible with the purposes of the refuge and contribute to the appreciation and enjoyment of it. These opportunities have been found to be appropriate at certain times of the year, and compatible with the goals and objectives set by the refuge. The opportunities will not be allowed to disturb wildlife during certain times of the year, and will not be allowed when areas are closed for safety reasons.

4.6 Public Outreach Goal

Visitors of all abilities understand, appreciate, and support the Service mission, as well as the refuge's unique habitats and importance to migratory birds and other wildlife and plant species.

Following are objectives for a variety of public outreach activities.

Public Outreach Objective 1

Within 5 years, refuge and GPNC staff will design and conduct outreach programs to present to 10–20 civic and environmental organizations annually in local communities within a 50-mile radius of each respective site.

Strategies

- Develop speaker-led multimedia programs that emphasize refuge or GPNC features, facilities, management goals, and natural, cultural, and historic resources. Actively seek new civic organizations, clubs, educational groups, and other entities to which we can present programs.
- Work with Friends of Quivira and Friends of the Great Plains Nature Center to promote public awareness of the refuge and its mission and provide opportunities for the public to learn more about the resources of the Great Plains.
- Emphasize the importance of Quivira and the GPNC to area communities because of the strong draw the sites have to visitors from outside the area. Present information about what makes each site special, such as unique features to the sites, great bird-watching opportunities, and rare species occurrences.
- Work with the Friends of the Great Plains Nature Center to develop information about how Quivira Refuge and the GPNC function as “green” operations in the environment. Provide educational material about geothermal, solar, and other features at these sites through media such as displays, literature, and the Web.
- Install a tower camera at the bald eagle and BSM areas to provide more observation opportunities of remote wildlife to heighten understanding and awareness of refuge resources, encourage refuge visitation, and increase positive personal experiences with natural resources.



FWS

The blue goose, representing the Refuge System, rides in the Octoberfest Parade held in Stafford, Kansas.

Public Outreach Objective 2

By working in partnership with respective Friends groups, foster appreciation and increase knowledge of the refuge and GPNC by holding at least 10 special events annually and through the Friends' newsletters and Web sites.

- Present theme-oriented special events throughout the year that emphasize either subjects, such as butterflies or birds, or activities, such as fishing.
- Make sure that all special events are used to emphasize the purpose, mission, and wildlife of the refuge and the GPNC.
- Contribute regular articles to Friends newsletters and Web sites about refuge and GPNC news, management actions, and other pertinent subjects.

- Recruit, train, and use volunteers from local communities to help us meet our management and public use goals at Quivira Refuge and the GPNC. Strive to help GPNC volunteers contribute at least 2,800 hours of service to the nature center. The Friends of the GPNC volunteer coordinator will work to increase and enhance the GPNC volunteer corps.

Public Outreach Objective 3

Within 5 years, contribute to knowledge and appreciation of the refuge, GPNC, and the Service through a minimum of 65,000 public visits to the respective sites; 8,000 visits to offsite stations such as the Kansas State Fair, and 40,000 visits to online media.

- Increase and continually freshen Quivira Refuge Web content by offering fresh, informative, and pertinent content about refuge operations, bird and wildlife sightings, hunting, events, and more. The GPNC staff and webmaster continue to update existing pages and add more pages as needed for new events, projects, and programs.
- Oversee the development, maintenance, and staff of our information booth at the annual Kansas State Fair for both Quivira Refuge and the GPNC and continue to update and change its theme. Make sure that information about our various operations, missions, and activities is regularly available, but also offer fun and educational, hands-on exhibits for the entire family.
- Develop static, portable displays about refuge and GPNC wildlife, facilities, and management that can be used at fairs, conventions, and other events that last a day or more.
- Install traffic counters at strategic locations to count visitor use.
- Work with partners to survey visitor use.

Rationale for Public Outreach Objectives 1–3

Following the 2011 “Conserving the Future” visioning workshop, implementation teams were cre-

ated to address a variety of issues, such as urban wildlife refuges, community partnerships, communication, interpretive and environmental education, volunteers, hunting, fishing, and outdoor recreation. These implementation teams were tasked with developing plans that outline goals, objectives, and strategies to meet issues identified at the visioning workshop. Once these plans are complete, Quivira Refuge staff will review and incorporate their recommendations to enhance public outreach as they apply to refuge and GPNC operations and visitor services opportunities. The plans will also form the basis for various stepdown plans, such as for Visitor Services, that will be created following the completion of this document.

Public outreach furthers the mission of the refuge and the Refuge System for the protection of public trust resources by garnering support for wildlife and their wild places. Using the principle that appreciation begins and is nurtured through understanding, outreach builds and enhances a sense of stewardship in the public, which in turn allows the public to feel better connected to the natural world through the refuge and the GPNC.

4.7 Cultural Resources Goal

The cultural resources and cultural history of the refuge are identified, valued, and preserved and connect staff, visitors, and the community to the area's past.

Following is the objective for cultural resources on Quivira Refuge.

Cultural Resources Objective

Protect and preserve cultural resources on the refuge through coordination with the Region 6 cultural resources branch, which helps our refuge staff in meeting the requirements of Section 106 of the National Historic Preservation Act and other cultural resources-related legislation.

Strategies

- Inform the Region 6 cultural resources staff of refuge projects early in project planning by using the Cultural Resources Review Form.

- Develop exhibits and signs to enhance educational opportunities.
- Encourage collaboration with interested tribes in developing relevant materials and correct interpretation.

Rationale

The refuge was once an important Native American gathering site for hunting and salt gathering. Different cultural values are acknowledged, respected, and celebrated by the Refuge System (FWS 2011). Cultural services are one of many ecosystem services, or benefits, that one can get from nature (FWS 2011).

4.8 Visitor and Employee Safety and Resource Protection Goal

Provide for the safety, security and protection of visitors, employees, natural and cultural resources and facilities of the refuge and Great Plains Nature Center.

Following are objectives for a variety of visitor and employee safety and resource protection activities.

Visitor and Employee Safety Objective

Ensure visitor safety and the safety of our employees at Quivira Refuge and the GPNC. Strive to keep the refuge 100-percent visitor accident free and keep employee accidents and injuries, as reportable to the Office of Workers Compensation Program, below the regional average of 6.2 hours of lost time a year over the life of the plan.

Strategies

- Educate and inform visitors of their responsibilities when visiting national wildlife refuges and the ways they might mitigate potential dangers and hazards.

- Use directional and informative signs, visitor information kiosks, updated Web pages, and posted warnings to help reduce preventable accidents and mishaps.
- Close roads deemed unsafe for travel because of weather conditions or poor visibility, and post closings on our Web page promptly to alert visitors about our conditions before travelling, if possible.
- Maintain up-to-date station safety plans that provide emergency contacts, procedures, and training for all employees.
- Conduct an annual safety inspection of all facilities.
- Provide emergency shelters, accessible facilities, and suitable trails and roads.
- Review and follow infectious disease plans and policies and update as necessary every year.
- Law enforcement officers help with protecting visitors and report serious incidents to the proper authorities, per our guidance found in regulation 054 FW 1.
- Keep a collateral duty safety officer at Quivira Refuge.
- Provide employees with suitable personal protective equipment.
- Make sure that all required safety and operator training is completed before engaging in risky tasks or work situations. Make sure that other training, such as cardiopulmonary resuscitation, or CPR, and first aid, is available to employees as needed or requested.
- Make sure that employees review job hazard analyses before engaging in at-risk tasks.
- Practice sound risk management, “the state in which risks are acceptable.”

Rationale

Visiting a national wildlife refuge can be inherently dangerous. Snake bites, stinging and biting insects and their associated diseases, extreme hot and cold temperatures, wind, lightning, tornados,

standing or turbulent water, uneven terrain, and steep edges can potentially turn a pleasant day out into a life-altering experience. Our role is to help identify these dangers, inform about them, and mitigate these dangers to the greatest extent possible.

Reducing the potential for accidents and injuries is cost efficient, provides better job satisfaction for employees, and is the right way to conduct business. We require written job hazard analyses before undertaking all at-risk tasks, such as operating an all-terrain vehicle or pounding fence posts. A library of job hazard analyses is available on the Region 6 safety office Web site and at refuge headquarters.

Resource Protection Objective

Protect wildlife and other natural and cultural resources from damage, theft, or illegal taking to preserve resources for visitors to the refuge and to prevent their unnatural decline.

Strategies

- Enforce hunting, fishing, and all other regulations in accordance with the CFR, State laws, and refuge regulations to protect designated critical habitat and wildlife.
- Close areas to protect wildlife from human disturbance when necessary.
- Enforce regulations and apply refuge closure strategies, as determined by the refuge manager, to protect whooping cranes and other resources of concern.
- Use law enforcement and education to protect cultural resources in accordance with Federal, State, and tribal laws, policies and guidelines.
- Keep at least two dual-function law enforcement officers or one dual-function and one full-time permanent law enforcement officer.
- Provide ample and easy access to refuge regulations through various media such as printed leaflets, Web site and social media, and six information kiosks located throughout the refuge.

Rationale

To adequately staff refuges with sufficient officers to protect wildlife and habitat and to make refuges safe places for staff and visitors is a top priority for the Refuge System. Conserving the Future (FWS 2011), Recommendation 16, charges us to: Conduct a new, independent analysis of refuge law enforcement to measure progress and to identify needed improvements.

4.9 Administration Goal

Provide and support facilities, strategically acquire and allocate staff, increase volunteer opportunities and partnerships, and effectively develop and use money to support the long-term integrity of infrastructure, habitats, and wildlife resources at the refuge and the Great Plains Nature Center.

Following are objectives for a variety of administration activities.

Strategies

- Continue to correctly document budget and staff needs through memos and reports.
- Continue to hire one to five seasonal biological aids and technicians and continue to hire range technicians, as money allows, each year.
- Provide office space at Quivira Refuge for a regional refuge zone biologist, a Partners private lands biologist, and for other program staff as needed.
- Use the Youth Conservation Corps program to help accomplish refuge goals and objectives.
- Raise money through grants and initiatives, such as AmeriCorps and Youth in the Great Outdoors, to supplement our staff and projects.
- Keep permanent fire staff to include a fire management office, and refill a supervisory range technician.

Funding and Staff Objective 1

Strive to keep funding level for 11 permanent full-time and 1 permanent part-time staff positions; provide regional or zone office space as needed; and continue to seek money for vacant, seasonal, temporary, and youth positions.

Funding and Staff Objective 2

Plan to recruit and fill new positions that are identified in this CCP as being needed for accomplishing the goals and objectives to protect habitat, infrastructure, and wildlife resources at Quivira Refuge and the GPNC throughout the life of the plan.



The Great Plains Nature Center

Strategies

- Identify needed positions and projects in the Refuge Operations Needs System database and update as requested. The top refuge priority identified in the database is one full-time maintenance worker.
- Coordinate with our regional law enforcement coordinator.
- Continue to correctly document budget and staff needs through memos and reports.
- Evaluate and add a new position at the GPNC to meet needs
- Refine and increase participation in our refuge volunteer program.

Rationale

Conserving the Future (FWS 2011) states, “We must engage and prepare a diverse group of qualified and enthusiastic professionals that want to make the Service and the Refuge System their life’s work. We must be adaptive and flexible to recruit a workforce that reflects society...to ensure a workforce of the best and brightest minds...we must look for ways to transfer knowledge from senior staff. As part of this succession, we will value diversity of people and skills to create a culture of inclusivity.”

Conserving the Future (FWS 2011), Recommendation 22, charges us to: within the next 10 years, make our workforce match the diversity in the civilian labor workforce and recruit and keep a workforce that reflects the ethnic, age, socioeconomic and cultural backgrounds, and language diversity of contemporary America.

- Maintain the roads and parking lots required to support public use opportunities consistent with our goals and objectives.
- Maintain the fencing, wells, and other infrastructure necessary to operate a grazing program that helps us achieve our goals and objectives for the refuge.
- Maintain existing buildings, including an office, visitor center, maintenance shop, three storage buildings, one pole barn, two residences, and two comfort stations.
- Review displays, interactive, portable, and static, about area flora, fauna, ecology, and history at our visitor centers and update as resources allow.
- Maintain and enhance the existing 2 miles of trails and accompanying structures, like bridges, boardwalks, interpretive signs, and kiosks, to provide quality visitor use experiences.
- Explore creating more trails on the refuge to provide more opportunities for compatible wildlife-dependent recreation.
- Maintain infrastructure at the GPNC, including Koch Habitat Hall, Coleman Auditorium, offices, classrooms, and a storage garage, to support our multiagency partnership with the City of Wichita Park and Recreation Department and KDWP.

Rationale

Visitor services infrastructure for both the refuge and GPNC need routine annual and long-term maintenance to keep them in good-to-excellent condition. Because of our salty environment at the refuge, our water control facilities and equipment deteriorate faster than those at refuges that protect freshwater marshes. Much of the refuge is also comprised of the sandy, Sand Prairie ecotype soils, which necessitates more constant maintenance to keep water control structures from washing out. Some old water control structures need to be replaced. Boundary fences and signs are in constant need of replacement because of severe weather events, environmental degradation and occasional vandalism.

The maintenance shop requires an addition and updating. The bunkhouse and environmental education classroom were created out of the old, original 1957 block office building, which was abandoned because of poor domestic water quality. So, there is a

Facilities Objective 1

Within 5 years at the refuge and GPNC, review and update our refuge deferred maintenance projects list and document deficiencies, and submit a ranked project list for potential money every year.

Strategies

- Support and enhance the water delivery infrastructure necessary to achieve our wetland goals and objectives for the refuge.

need to again abandon this building and move operations to the current headquarters site to consolidate facilities and operations at one location with good quality water. An improved environmental education program could ensue near the headquarters with access to accessible trails, the observation tower, the visitor center, the Kid's Fishing Pond and to quality wetlands and grasslands for interpretation.

Energy conservation modifications have recently been made at several facilities, but more improvements are needed.

Facilities Objective 2

At the GPNC, within 5 years, identify changes and additions to the facility that will improve our cooperative partnership and agency's performances while enhancing the visitors' experience.

Strategies

- Work with partner staffs and develop a plan to expand the building, thus adding office space, classrooms, and a large public meeting space that has the possibility to accommodate traveling exhibits.
- Encourage Friends of the GPNC to investigate strategies to pay for building a new addition to the facility and for improved and enhanced programming efforts.
- Continue to work with corporate sponsors to provide up-to-date and state-of-the-art exhibits in the Koch Habitat Hall.

Rationale

Current exhibits are reaching the end of their expected lifespan and should be replaced and updated. The building will be insufficient for anticipated future needs.

Facilities Objective 3

Within 15 years, design and develop a new environmental education site near the headquarters area.

Strategies

- Include a capital improvement project in the Service asset and maintenance management system.
- Develop a conceptual site plan and engineering design.
- Demolish and rehabilitate old environmental education site.
- Construct new environmental education site.

Rationale

Same as objective 2 and rationale for environmental education and interpretation objective 1. Centralized buildings improve visitor service, reduce staff travel, and improve water quality.

Facilities Objective 4

Within 15 years design and construct another cold storage building and fire cache on the refuge.

Strategies

- Include a capital improvement project in the Service asset and maintenance management system.
- Develop a conceptual site plan and engineering design.
- Potentially demolish and rehabilitate old site.
- Construct new cold storage building and fire cache.

Rationale

Additional storage space is needed to better protect vehicles and to support other refuge objectives.



FWS

Migrants Mile Trail

4.10 Stepdown Management Plans

This CCP is a broad umbrella plan that provides general concepts and specific wildlife, habitat, visitor services, and partnership objectives over the next 15 years. The purpose of stepdown management plans is to provide detail for our managers and employees so they may more effectively carry out the specific actions and strategies authorized by this CCP. Table

19 lists the stepdown plans needed, their status, and their next revision dates.

4.11 Monitoring and Evaluation

We believe that the uncertainty surrounding habitat management can be dealt with most efficiently within the paradigm of adaptive resource manage-

Table 19. Stepdown management plans for Quivira National Wildlife Refuge, Kansas.

<i>Plan</i>	<i>Completed plan, year approved</i>	<i>New or revised plan, completion year</i>
Habitat management plan (annual)	2012	2013 revise annually
Habitat management plan	—	2017
Inventory and monitoring plan	—	2014
Integrated pest management plan	2012	2017
Fire management plan	2009	2014 validate annually
Visitor services plan	1986	2017
Law enforcement plan	2012	2017
Station safety plan	2012	2017
Water management plan (annual)	2012	2013 revise annually
Hunting plan	—	2016
Trapping plan	—	2016
GPNC operations plan	2012	2013 revise annually
Santana Research Natural Area plan	1984	revise as appropriate

ment (see figure 18) (Holling 1978, Kendall 2001, Lancia et al. 1996, Walters and Holling 1990). This approach provides a framework within which we can make objective decisions and reduce the uncertainty surrounding those decisions. The key components of an adaptive resource management plan follow:

- clearly defined management goals and objectives
- a set of management actions with associated uncertainty as to their outcome
- predictions of various alternative responses to management strategies
- monitoring or assessing select natural resource conditions of interest, largely directed by objectives
- communicating and using new information to direct future decisionmaking

The adaptive management framework facilitates an iterative process, whereby our understanding of

the effectiveness of strategies and the response and conditions of natural resources on the refuge is improved over time. Reducing the uncertainty of habitat management via adaptive resource management helps in the continual development of long-term habitat management plans.

4.12 Plan Amendment and Revision

This CCP will be reviewed annually to decide if it needs revision. A revision will occur when significant information becomes available, such as a change in ecological conditions. The final CCP will be augmented by detailed stepdown management plans to address the completion of specific strategies in support of the CCP goals and objectives. Revisions to the CCP and the stepdown management plans will be subject to public review and NEPA compliance. At a minimum, this plan will be evaluated every 5 years and revised after 15 years.

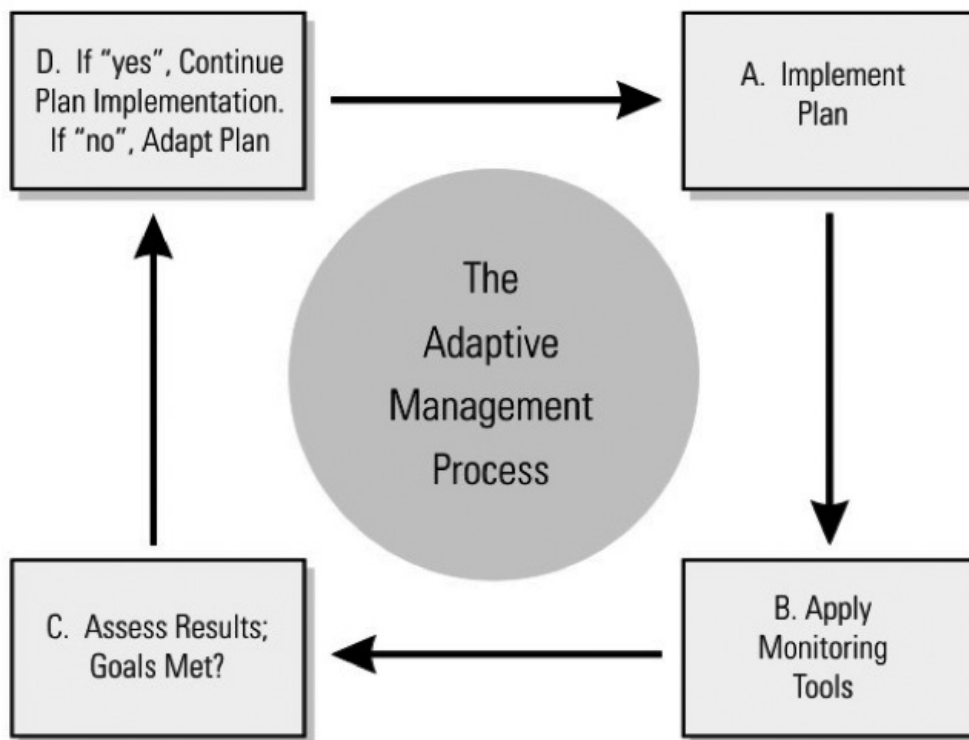


Figure 18. The adaptive resource management process.

Glossary

abiotic—Pertaining to nonliving things.

accessible—Pertaining to physical access to areas and activities for people of different abilities, especially those with physical impairments.

adaptive resource management—The rigorous application of management, research, and monitoring programs to gain information and experience necessary to assess and change management activities; a process that uses feedback from research, monitoring programs, and evaluation of management actions to support or change objectives and strategies at all planning levels; a process in which policy decisions are carried out within a framework of scientifically driven experiments to test predictions and assumptions inherent in management plan. Analysis of results helps managers decide whether current management should continue as is or whether it should be modified to achieve desired conditions.

Administration Act—National Wildlife Refuge System Administration Act of 1966.

alternative—A reasonable way to solve an identified problem or satisfy the stated need (40 CFR 1500.2); one of several different means of accomplishing refuge purposes and goals and contributing to the Refuge System mission (Draft Service Manual 602 FW 1.5).

amphibian—A class of cold-blooded vertebrates including frogs, toads or salamanders.

annual—A plant that flowers and dies within 1 year of germination.

baseline—A set of essential observations, data, or information used for comparison or a control.

biological control—The use of organisms or viruses to control invasive plants or other pests.

biological diversity, also biodiversity—The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur (Service Manual 052 FW 1.12B). The National Wildlife Refuge System's focus is on indigenous species, biotic communities, and ecological processes.

biotic—Pertaining to life or living organisms; caused, produced by, or comprising living organisms.

canopy—A layer of foliage, generally the uppermost layer, in a vegetative stand; mid-level or under-

story vegetation in multilayered stands. Canopy closure (also canopy cover) is an estimate of the amount of overhead vegetative cover.

CCC—See Civilian Conservation Corps.

CCP—See comprehensive conservation plan.

CFR—See Code of Federal Regulations.

cfs—Cubic feet per second.

Civilian Conservation Corps (CCC)—Peacetime civilian “army” established by President Franklin D. Roosevelt to perform conservation activities from 1933–42. Activities included erosion control; fire-fighting; tree planting; habitat protection; stream improvement; and building of fire towers, roads, recreation facilities, and drainage systems.

Code of Federal Regulations (CFR)—The codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal Government. Each volume of the CFR is updated once each calendar year.

compatibility determination—See compatible use.

compatible use—A wildlife-dependent recreational use or any other use of a refuge that, in the sound professional judgment of the Director of the U.S. Fish and Wildlife Service, will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge (Draft Service Manual 603 FW 3.6). A compatibility determination supports the choice of compatible uses and identified stipulations or limits necessary to make sure that there is compatibility.

comprehensive conservation plan (CCP)—A document that describes the desired future conditions of the refuge and provides long-range guidance and management direction for the refuge manager to accomplish the purposes of the refuge, contribute to the mission of the Refuge System, and to meet other relevant mandates (Draft Service Manual 602 FW 1.5).

concern—See issue.

conspecific—An individual belonging to the same species as another.

cool-season grasses—Grasses that begin growth earlier in the season and often become dormant in the summer. These grasses will germinate at lower temperatures. Examples of cool-season

grasses at the refuge are western wheatgrass, needle and thread, and green needlegrass.

coteau—A hilly upland including the divide between two valleys; a divide; the side of a valley.

cover, also cover type, canopy cover—Present vegetation of an area.

cultural resources—The remains of sites, structures, or objects used by people in the past.

depredation—Destruction or consumption of eggs, broods, or individual wildlife because of a predatory animal; damage inflicted on agricultural crops or ornamental plants by wildlife.

drawdown—The act of manipulating water levels in an impoundment to allow for the natural, cyclical drying out of a wetland.

EA—See environmental assessment.

ecosystem—A dynamic and interrelating complex of plant and animal communities and their associated nonliving environment; a biological community, with its environment, functioning as a unit. For administrative purposes, the Service has designated 53 ecosystems covering the United States and its possessions. These ecosystems generally correspond with watershed boundaries and their sizes and ecological complexity vary.

EIS—Environmental impact statement.

emergent—A plant rooted in shallow water and having most of the vegetative growth above water such as cattail and hardstem bulrush.

endangered species, Federal—A plant or animal species listed under the Endangered Species Act of 1973, as amended, that is in danger of extinction throughout all or a substantial part of its range.

endangered species, State—A plant or animal species in danger of becoming extinct or extirpated in a particular state within the near future if factors contributing to its decline continue. Populations of these species are at critically low levels or their habitats have been degraded or depleted to a substantial degree.

endemic species—Plants or animals that occur naturally in a certain region and whose distribution is relatively limited to a particular locality.

environmental assessment (EA)—A concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action and alternatives to such action, and provides sufficient evidence and analysis of effects to decide whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9).

EPA—Environmental Protection Agency.

extinction—The complete disappearance of a species from the earth; no longer existing.

extirpation—The extinction of a population; complete eradication of a species within a specified area.

fauna—All the vertebrate and invertebrate animals of an area.

Federal trust resource—A trust is something managed by one entity for another who holds the ownership. The Service holds in trust many natural resources for the people of the United States of America as a result of Federal acts and treaties. Examples are species listed under the Endangered Species Act, migratory birds protected by international treaties, and native plant or wildlife species found on a national wildlife refuge.

Federal trust species—All species where the Federal Government has primary jurisdiction including federally endangered or threatened species, migratory birds, anadromous fish, and certain marine mammals.

flora—All the plant species of an area.

FMP—fire management plan.

forb—A broad-leaved, herbaceous plant; a seed-producing annual, biennial, or perennial plant that does not develop persistent woody tissue but dies down at the end of the growing season.

fragmentation—The alteration of a large block of habitat that creates isolated patches of the original habitat that are interspersed with a variety of other habitat types; the process of reducing the size and connectivity of habitat patches, making movement of individuals or genetic information between parcels difficult or impossible.

Friends group—Any formal organization whose mission is to support the goals and purposes of its associated refuge and the National Wildlife Refuge Association overall; Friends organizations and cooperative and interpretive associations.

General Schedule—Pay rate schedule for certain Federal positions. Sometimes “GS.”

geographic information system (GIS)—A computer system capable of storing and manipulating spatial data; a set of computer hardware and software for analyzing and displaying spatially referenced features (such as points, lines and polygons) with nongeographic attributes such as species and age.

GIS—See geographic information system.

goal—Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units (Draft Service Manual 620 FW 1.5).

grassland tract—A contiguous area of grassland without fragmentation.

habitat—Suite of existing environmental conditions required by an organism for survival and reproduction; the place where an organism typically lives and grows.

habitat disturbance—Substantial alteration of habitat structure or composition; may be natural (for

- example, wildland fire) or human-caused events (for example, timber harvest and disking).
- habitat type, also vegetation type, cover type**—A land classification system based on the concept of distinct plant associations.
- herbivory**—The state or condition of feeding on plants or plant parts.
- herptile**—A reptile or an amphibian.
- HMP**—Habitat management plan.
- HUA**—Hydrologic unit area.
- hydroperiod**—The seasonal pattern of the water level of a wetland that is often used to characterize wetland types. Examples of seasonal patterns include flood frequency, duration, and depth.
- impoundment**—A body of water created by collection and confinement within a series of levees or dikes, creating separate management units although not always independent of one another.
- Improvement Act**—National Wildlife Refuge System Improvement Act of 1997.
- indigenous**—Originating or occurring naturally in a particular place.
- integrated pest management (IPM)**—Methods of managing undesirable species such as invasive plants; education, prevention, physical or mechanical methods of control, biological control, responsible chemical use, and cultural methods.
- introduced species**—A species present in an area because of intentional or unintentional escape, release, dissemination, or placement into an ecosystem as a result of human activity.
- invasive plant, also noxious weed**—A species that is nonnative to the ecosystem under consideration and whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health.
- involute sanctuary**—A place of refuge or protection where animals and birds may not be hunted.
- IPM**—See integrated pest management.
- issue**—Any unsettled matter that requires a management decision; for example, a Service initiative, opportunity, resource management problem, a threat to the resources of the unit, conflict in uses, public concern, or the presence of an undesirable resource condition (Draft Service Manual 602 FW 1.5).
- Kansas Department of Wildlife, Parks and Tourism (KDWPT)**—A State agency responsible for overseeing the conservation of game and nongame species in Kansas.
- management alternative**—See alternative.
- migration**—Regular extensive, seasonal movements of birds between their breeding regions and their wintering regions; to pass usually periodically from one region or climate to another for feeding or breeding.
- migratory birds**—Birds that follow a seasonal movement from their breeding grounds to their wintering grounds. Waterfowl, shorebirds, raptors, and songbirds are all migratory birds.
- mission**—Succinct statement of purpose or reason for being.
- mitigation**—Measure designed to counteract an environmental effect or to make an effect less severe.
- mixed-grass prairie**—A transition zone between the tallgrass prairie and the shortgrass prairie dominated by grasses of medium height that are approximately 2–4 feet tall. Soils are not as rich as the tallgrass prairie and moisture levels are less.
- monitoring**—The process of collecting information to track changes of selected parameters over time.
- national wildlife refuge**—A designated area of land, water, or an interest in land or water within the National Wildlife Refuge System, but does not include coordination areas; a complete listing of all units of the Refuge System is in the current “Annual Report of Lands Under Control of the U.S. Fish and Wildlife Service.”
- National Wildlife Refuge System (Refuge System)**—Various categories of areas administered by the Secretary of the Department of the Interior for the conservation of fish and wildlife including species threatened with extinction, all lands, waters, and interests therein administered by the Secretary as wildlife refuges, areas for the protection and conservation of fish and wildlife that are threatened with extinction, wildlife ranges, game ranges, wildlife management areas, and waterfowl production areas.
- National Wildlife Refuge System Improvement Act of 1997 (Improvement Act)**—Sets the mission and the administrative policy for all refuges in the National Wildlife Refuge System; defines a unifying mission for the Refuge System; establishes the legitimacy and appropriateness of the six priority public uses (hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation); establishes a formal process for determining appropriateness and compatibility; establish the responsibilities of the Secretary of the Department of the Interior for managing and protecting the Refuge System; requires a comprehensive conservation plan for each refuge by the year 2012. This Act amended parts of the Refuge Recreation Act and National Wildlife Refuge System Administration Act of 1966.
- native species**—A species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem.

Neotropical migrant—A bird species that breeds north of the United States and Mexican border and winters primarily south of this border.

NEPA—National Environmental Policy Act of 1969.

nest success—The percentage of nests that successfully hatch one or more eggs of the total number of nests started in an area.

NOA—Notice of availability.

nongovernmental organization—Any group that is not comprised of Federal, State, tribal, county, city, town, local, or other governmental entities.

noxious weed, also invasive plant—Any living stage (including seeds and reproductive parts) of a parasitic or other plant of a kind that is of foreign origin (new to or not widely prevalent in the United States) and can directly or indirectly injure crops, other useful plants, livestock, poultry, other interests of agriculture, including irrigation, navigation, fish and wildlife resources, or public health. According to the Federal Noxious Weed Act (PL 93–639), a noxious weed (such as invasive plant) is one that causes disease or has adverse effects on humans or the human environment and, therefore, is detrimental to the agriculture and commerce of the United States and to public health.

NRCS—Natural Resources Conservation Service of the U.S. Department of Agriculture.

objective—An objective is a concise target statement of what will be achieved, how much will be achieved, when and where it will be achieved, and who is responsible for the work; derived from goals and provide the basis for determining management strategies. Objectives should be achievable and time specific and should be stated quantitatively to the extent possible. If objectives cannot be stated quantitatively, they may be stated qualitatively (Draft Service Manual 602 FW 1.5).

overwater species—Nesting species such as diving ducks and many colonial-nesting birds that build nests within dense stands of water-dependent plants, primarily cattail, or that build floating nests of vegetation that rest on the water.

OWLS—Outdoor wildlife learning site.

passerine—Pertaining to an order of birds, Passeriformes, that comprises more than half of all birds and that typically has feet adapted for perching.

patch—An area distinct from that around it; an area distinguished from its surroundings by environmental conditions.

perennial—Lasting or active through the year or through many years; a plant species that has a lifespan of more than 2 years.

plant community—An assemblage of plant species unique in its composition; occurs in particular locations under particular influences; a reflection or integration of the environmental influences on

the site such as soil, temperature, elevation, solar radiation, slope, aspect, and rainfall; denotes a general kind of climax plant community, such as ponderosa pine or bunchgrass.

prescribed fire—The skillful application of fire to natural fuels under conditions such as weather, fuel moisture, and soil moisture that allow confinement of the fire to a predetermined area and produces the intensity of heat and rate of spread to accomplish planned benefits to one or more objectives of habitat management, wildlife management, or hazard reduction.

priority public use—One of six uses authorized by the National Wildlife Refuge System Improvement Act of 1997 to have priority if found to be compatible with a refuge's purposes. This includes hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation.

proposed action—The alternative proposed to best achieve the purpose, vision, and goals of a refuge (contributes to the Refuge System mission, addresses the significant issues, and is consistent with principles of sound fish and wildlife management).

public—Individuals, organizations, and groups; officials of Federal, State, and local government agencies; American Indian tribes; and foreign nations. It may include anyone outside the core planning team. It includes those who may or may not have shown an interest in Service issues and those who do or do not realize that Service decisions may affect them.

public involvement—A process that offers affected and interested individuals and organizations an opportunity to become informed about, and to express their opinions on, Service actions and policies. In the process, these views are studied thoroughly and thoughtful consideration of public views is given in shaping decisions for refuge management.

purpose of the refuge—The purpose of a refuge is specified in or derived from the law, proclamation, Executive order, agreement, public land order, donation document, or administrative memorandum establishing authorization or expanding a refuge, refuge unit, or refuge subunit (Draft Service Manual 602 FW 1.5).

raptor—A carnivorous bird such as a hawk, a falcon, or a vulture that feeds wholly or chiefly on meat taken by hunting or on carrion (dead carcasses).

Reclamation—Bureau of Reclamation of the U.S. Department of the Interior.

refuge operations needs system (RONS)—A national database that contains the operational needs of each refuge that need money. Projects included

are those required to carry out approved plans and meet goals, objectives, and legal mandates.

refuge purpose—See purpose of the refuge.

Refuge System—See National Wildlife Refuge System.

refuge use—Any activity on a refuge, except administrative or law enforcement activity, carried out by or under the direction of an authorized Service employee.

resident species—A species inhabiting a given locality throughout the year; nonmigratory species.

rest—Free from biological, mechanical, or chemical manipulation, in reference to refuge lands.

restoration—Management emphasis designed to move ecosystems to desired conditions and processes, such as healthy upland habitats and aquatic systems.

riparian area or riparian zone—An area or habitat that is transitional from terrestrial to aquatic ecosystems including streams, lakes, wet areas, and adjacent plant communities and their associated soils that have free water at or near the surface; an area whose parts are directly or indirectly attributed to the influence of water; of or relating to a river; specifically applied to ecology, “riparian” describes the land immediately adjoining and directly influenced by streams. For example, riparian vegetation includes all plant life growing on the land adjoining a stream and directly influenced by the stream.

RONs—See refuge operations needs system.

rough fish—A fish that is neither a sport fish nor an important food fish.

SAMMS—See Service Asset Maintenance Management System.

scoping—The process of obtaining information from the public for input into the planning process.

seasonally flooded—Surface water is present for extended periods in the growing season, but is absent by the end of the season in most years.

sediment—Material deposited by water, wind, and glaciers.

Service—See U.S. Fish and Wildlife Service.

Service Asset Maintenance Management System (SAMMS)—A national database that contains maintenance projects for each refuge that need money; projects include those required to keep existing equipment and buildings, correct safety deficiencies for the implementation of approved plans, and meet goals, objectives, and legal mandates.

sheet flow—The overland flow of water, typically from precipitation to lower elevation areas.

shelterbelt—Single to multiple rows of trees and shrubs planted around cropland or buildings to block or slow down the wind.

shorebird—Any of a suborder (Charadrii) of birds such as a plover or a snipe that frequent the seashore or mudflat areas.

spatial—Relating to, occupying, or having the character of space.

special status species—Plants or animals that have been identified through Federal law, State law, or agency policy as requiring special protection of monitoring programs. Examples include federally listed endangered, threatened, proposed, or candidate species; State-listed endangered, threatened, candidate, or monitor species; Service’s species of management concern; species identified by the Partners in Flight program as being of extreme or moderately high conservation concern.

special use permit—A permit for special authorization from the refuge manager required for any refuge service, facility, privilege, or product of the soil provided at refuge expense and not usually available to the public through authorizations in Title 50 CFR or other public regulations (Refuge Manual 5 RM 17.6).

species of concern—Those plant and animal species, while not falling under the definition of special status species, that are of management interest by virtue of being Federal trust species such as migratory birds, important game species, or significant keystone species; species that have documented or apparent populations declines, small or restricted populations, or dependence on restricted or vulnerable habitats.

stepdown management plan—A plan that provides the details necessary to carry out management strategies identified in the comprehensive conservation plan (Draft Service Manual 602 FW 1.5).

strategy—A specific action, tool, or technique or combination of actions, tools, and techniques used to meet unit objectives (Draft Service Manual 602 FW 1.5).

submergent—A vascular or nonvascular hydrophyte, either rooted or nonrooted, that lies entirely beneath the water surface, except for flowering parts in some species.

surrogate species—A species used as an indicator of landscape habitat and system conditions. It represents multiple species and habitats within a defined landscape or geographic area.

threatened species, Federal—Species listed under the Endangered Species Act of 1973, as amended, that are likely to become endangered in the future throughout all, or a substantial part, of their range.

threatened species, State—A plant or animal species likely to become endangered in a particular state within the near future if factors contributing to

population decline or habitat degradation or loss continue.

travel corridor—A landscape feature that facilitates the biologically effective transport of animals between larger patches of habitat dedicated to conservation functions. Such corridors may facilitate several kinds of traffic including frequent foraging movement, seasonal migration, or the once in a lifetime dispersal of juvenile animals. These are transition habitats and need not contain all the habitat elements required for long-term survival or reproduction of its migrants.

trust resource—See Federal trust resource.

trust species—See Federal trust species.

USDA—U.S. Department of Agriculture.

U.S. Fish and Wildlife Service (Service, FWS)—The principal Federal agency responsible for conserving, protecting, and enhancing fish and wildlife and their habitats for the continuing benefit of the American people. The Service manages the 93-million-acre National Wildlife Refuge System comprised of more than 530 national wildlife refuges and thousands of waterfowl production areas. It also operates 65 national fish hatcheries and 78 ecological service field stations, the agency enforces Federal wildlife laws, manages migratory bird populations, restores national significant fisheries, conserves and restores wildlife habitat such as wetlands, administers the Endangered Species Act, and helps foreign governments with their conservation efforts. It also oversees the Federal aid program that distributes millions of dollars in excise taxes on fishing and hunting equipment to State wildlife agencies.

FWS—See U.S. Fish and Wildlife Service.

U.S. Geological Survey (USGS)—A Federal agency whose mission is to provide reliable scientific information to describe and understand the earth; decrease loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

USGS—See U.S. Geological Survey.

vision statement—A concise statement of the desired future condition of the planning unit, based primarily on the Refuge System mission, specific refuge purposes, and other relevant mandates (Draft Service Manual 602 FW 1.5).

visual obstruction—Pertaining to the density of a plant community; the height of vegetation that blocks the view of predators and conspecifics to a nest.

visual obstruction reading (VOR)—A method of visually quantifying vegetative structure and composition.

VOR—See visual obstruction reading.

wading birds—Birds having long legs that enable them to wade in shallow water including egrets, great blue herons, black-crowned night-herons, and bitterns.

Wage Grade Schedule—Pay rate schedule for certain Federal positions. Sometimes “WG.”

waterfowl—A category of birds that includes ducks, geese, and swans.

watershed—The region draining into a river, a river system, or a body of water.

wetland management district (WMD)—Land that the Refuge System acquires with Federal Duck Stamp money for restoration and management primarily as prairie wetland habitat critical to waterfowl and other wetland birds.

wildland fire—A free-burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands (Service Manual 621 FW 1.7).

wildlife-dependent recreational use—Use of a refuge involving hunting, fishing, wildlife observation, wildlife photography, environmental education, or interpretation. The National Wildlife Refuge System Improvement Act of 1997 specifies that these are the six priority public uses of the Refuge System.

woodland—Habitats dominated by trees.

Appendix A

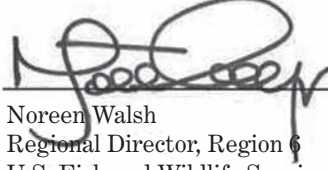
Environmental Compliance

Environmental Action Statement

U.S. Fish and Wildlife Service, Region 6
Lakewood, Colorado

Within the spirit and intent of the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act and other statutes, orders, and policies that protect fish and wildlife resources, I have established the following administrative record.

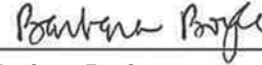
I have determined that the action of implementing the "Comprehensive Conservation Plan—Quivira National Wildlife Refuge" is found not to have significant environmental effects, as determined by the attached "finding of no significant impact" and the environmental assessment as found with the draft comprehensive conservation plan.



Noreen Walsh
Regional Director, Region 6
U.S. Fish and Wildlife Service
Lakewood, Colorado

10.23.13


Date



Barbara Boyle
Refuge Supervisor, Region 6
U.S. Fish and Wildlife Service
Lakewood, Colorado

9/27/13

Date



Will Meeks
Assistant Regional Director, Region 6
National Wildlife Refuge System
U.S. Fish and Wildlife Service
Lakewood, Colorado

10/17/13

Date



W. Mike Oldham
Refuge Manager
Quivira National Wildlife Refuge
U.S. Fish and Wildlife Service
Stafford, Kansas

9/25/13

Date

Finding of No Significant Impact

U.S. Fish and Wildlife Service, Region 6
Lakewood, Colorado

INTRODUCTION

This finding of no significant impact provides the basis for management decisions for the final comprehensive conservation plan and environmental assessment for the Quivira National Wildlife Refuge, Kansas. The comprehensive conservation plan was prepared along with an environmental assessment in compliance with the National Environmental Policy Act and relevant planning policies. We worked closely with the Kansas Department of Wildlife, Parks, and Tourism. Other Federal, State and local agencies, tribal governments, nongovernmental organizations, and individuals contributed input to the plan.

ALTERNATIVES

Based on an analysis of comments collected from the public, input from our staff, and a review of the needs of the National Wildlife Refuge System Improvement Act of 1997 and the National Environmental Policy Act, we identified several key issues for Quivira National Wildlife Refuge. These were addressed in the alternatives for future management, which are summarized below.

Alternative A

Alternative A is the no-action alternative, which represents the current management of Quivira National Wildlife Refuge. This alternative provides the baseline against which to compare the other alternatives. It also fulfills a need of the National Environmental Policy Act. Under alternative A, our management activity would continue unchanged. We would not develop any new management, restoration, or education programs at the refuge. Current habitat and wildlife practices benefiting migratory species and other wildlife would not be expanded or changed. Habitat management would remain focused primarily on benefiting migratory birds. Our staff would keep monitoring, inventory, and research activities at current levels. Budget and staff levels would remain the same with little change in overall trends. Programs would follow the same direction, emphasis, and intensity as they do now.

Alternative B

Alternative B places emphasis on restoring native communities and promoting the potential natural range of conditions on Quivira National Wildlife Refuge that help focal resources, or focal species and their respective habitats. Public use opportunities would continue to place importance on both consumptive

and non-consumptive activities. Limited deer and turkey hunting opportunities would be offered for the first time, following the development of a more detailed hunt plan. We would increase our attention and understanding of the connectedness of habitats and the effectiveness of our management as it relates to habitat conditions and associations with wildlife. To achieve this alternative, relatively minor changes in our operations; inventory, monitoring programs, and research; staff; and infrastructure would likely be required.

Alternative C

Alternative C promotes self-sustaining natural processes with less regard to the effects on focal species relative to alternative B. Key values for restoring natural ecological processes include achieving the long-term sustainability of native communities and lowering maintenance costs. Native plant communities tend to be more resilient to climate change and other environmental stressors than nonnative and highly managed ecosystems. Native wildlife species, including our trust resources, are also characteristically able to adapt to such changes. Efforts such as prescribed fire, grazing, and invasive species control would be focused on maintaining native plant community composition and diversity.

Relative to our other alternatives, habitat conditions would be allowed to fluctuate more with climatically driven wet and dry cycles. However, we would still need to mitigate the effects of past land uses on the refuge and in the watershed that have permanently altered some ecological processes. We would carry out this alternative in stages over many years, and changes in our research and monitoring programs, staff, operations, and infrastructure on the refuge would be required. Our success would be greatly influenced by our ability to develop new and expanded partnerships with stakeholders in the Rattlesnake Creek watershed.

PUBLIC INVOLVEMENT AND OUTREACH

The scoping period began on February 24, 2010, with the publication of a notice of intent in the Federal Register (FR75 (36): 8394–95). Before this, early in the preplanning phase, we outlined a process that would be inclusive of diverse stakeholder interests and would involve a range of activities for keeping the public informed and ensuring meaningful public input. Information was distributed through news releases, planning updates, and a series of public meetings.

During the initial scoping period, we received 80 written comments, including letters from 3 nongovernmental organizations.

Comments on the Draft Plan and EA

A notice of availability for the draft comprehensive conservation plan and environmental assessment was published in the Federal Register on April 22, 2013, (FR78 (77): 23778–80) announcing its availability, our intention to hold public meetings, and a request for comments. During the public review we held three public meetings, April 29–May 1, in Stafford, Wichita, and Great Bend, Kansas. Public participation in these meetings, and in the comprehensive conservation plan review process, was strong, with the meetings attended by more than 39 participants. In addition to oral comments recorded at the meetings, 60 emails and letters were received including letters from the Osage Nation, Federal and State agencies, and nongovernmental organizations.

The majority of comments indicated support for landscape conservation and native ecological community goals and objectives, including actions related to habitat and wildlife. Comments related to visitor services and, specifically, to hunting, however, varied widely. The comment period closed May 31, 2013.

DECISION

Based on this assessment and comments received, I have selected the following preferred alternative:

- a modified alternative B for refuge management

The preferred alternative was selected because it best meets the purposes for which the Quivira National Wildlife Refuge was established and is preferable to the “no-action” alternatives in light of physical, biological, economic, and social factors. The preferred alternative will achieve a reasonable balance among significant resource management issues, the refuge purposes, the National Wildlife Refuge System mission, our management policies, and the interests and perspectives of all stakeholders.

We have considered the environmental and relevant concerns presented by agencies, organizations, and individuals on the proposed action to develop and implement a comprehensive conservation plan for Quivira National Wildlife Refuge. The substantive issues and comments raised have been addressed in the final plan.

Alternative B was revised from the proposed action after our consideration of many comments received from agencies, tribes, other stakeholder organizations, and the public during the comment period. Revisions to the key management actions of alternative B for refuge management largely relate to hunting. The most significant revisions are listed below:

- Migratory waterfowl and upland bird hunting boundaries were revised to the same actions as alternative A. Thus, hunting opportunities will be provided in the North Lake area when whooping cranes are not present.
- In development of a more detailed hunt plan, consideration will be given to (1) the expansion of white goose hunting opportunities in the spring, and (2) allowing limited frogging opportunities only for bullfrogs and only during daylight hours when the refuge is open.
- General hunting activities will be closed on the refuge when whooping cranes are present. In developing a more detailed hunt plan, consideration will be given to one or few exceptions if those controlled activities are determined to have no or insignificant adverse effects to species of concern.
- Included among the nonhunnable species will be sandhill crane, rail, woodcock and snipe, and prairie chicken largely because (1) populations are low on the refuge, and (2) associations relate to the conservation of species of concern. For example, whooping cranes often occur with sandhill cranes on the refuge.
- Clarification that hunting opportunities, notably those related to turkey and mammals, will be controlled by both State and Federal (refuge) regulations. Management will have the authority to limit many aspects of deer, turkey, and furbearer hunting, such as the location, timing, methods, and allowable take. Consideration will be given to species and habitat conservation goals and objectives, public and employee safety, logistics, and balancing multiple compatible use activities. The refuge will work with Kansas Department of Wildlife, Parks, and Tourism in developing appropriate options.

Management of the refuge will comply with all Federal laws and regulations that provide direction for managing units of the National Wildlife Refuge System. Various methods that involve rest, water level control, prescribed grazing, burning, mechanical, chemical, and cultural-related activities will be used to accomplish refuge goals and objectives

FINDING AND BASIS FOR DECISION

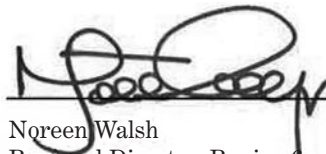
I find that the preferred alternative is not a major Federal action that would significantly affect the quality of the human environment within the meaning of Section 102(2) (C) of the National Environmental Policy Act. Accordingly, the preparation of an environmental impact statement on the proposed action is not required.

The following is a summary of anticipated environmental effects. The implementation of the preferred alternative will:

- manage for wildlife as a priority, with emphasis on providing for the needs of focal species as defined in the document;
- not adversely impact endangered or threatened species or their habitat;
- increase the sustainability and resiliency of the refuge and improve our ability to adjust to the uncertainty of climate change;
- continue to control invasive species, especially species not native to the region;
- initiate the conversion of refuge cropland areas (an estimated 850–900 acres typed as farmed) to appropriate native community types;
- reduce the amount of woody coverage (estimated to be up to 850 acres of trees) to increase the area of native sand prairie that supports many focal species, especially those that are area sensitive;
- reduce opportunities for the introduction and spread of diseases and pathogens;
- develop monitoring protocols to improve management decisionmaking, particularly related to the habitat relationships of focal species;
- improve the coordination of the refuge with the Great Plains Landscape Conservation Cooperative and other research groups to improve our understanding of the local impacts from climate change;
- not adversely impact archaeological or historical resources;
- increase interpretation of cultural resources, specifically of Native American historical use;
- preserve refuge water rights and explore opportunities to improve water use efficiency and other water-related factors within our water rights to support focal species;

- provide a balance between resource protection and providing wildlife-dependent recreational opportunities without negatively impacting natural resources;
- improve both consumptive and nonconsumptive use opportunities;
- enhance environmental education opportunities with improvements to facilities at Quivira National Wildlife Refuge and the Great Plains Nature Center;
- maintain staff at appropriate levels to accomplish goals and objectives;
- not have a disproportionately high or adverse human health or environmental effect on minority or low-income populations;
- maintain public and employee safety as a mission-critical factor;
- expand resource protection appropriately with increased public use opportunities.

The State of Kansas has been notified and given the opportunity to review the comprehensive conservation plan and associated environmental assessment.



Noreen Walsh
Regional Director, Region 6
U.S. Fish and Wildlife Service
Lakewood, Colorado

10-23-13

Date

Appendix B

Compatibility Determinations

B.1 Refuge Name

Quivira National Wildlife Refuge.

B.2 Date Established

May 3, 1955.

B.3 Establishing and Acquisition Authorities

Migratory Bird Conservation Act (16 U.S.C. § 715d)

Fish and Wildlife Act of 1956 (16 U.S.C. § 742f(a)4)

Fish and Wildlife Act of 1956 (16 U.S.C. § 742f(b)1)

B.4 Refuge Purposes

The establishing and acquisition authorities set out the purposes for the refuge, as described below:

- For use as an inviolate sanctuary, or for any other management purpose, for migratory birds.
- For the development, advancement, management, conservation, and protection of fish and wildlife resources.
- For the benefit of the United States Fish and Wildlife Service, in performing its activities and services.

B.5 National Wildlife Refuge System Mission

The mission of the Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

B.6 Description of Uses

The following uses are evaluated for compatibility within the Quivira National Wildlife Refuge:

- hunting
- fishing
- wildlife observation and photography, including bicycling, horseback riding, and commercial birding tours via special use permit
- environmental education and interpretation
- cooperative farming, haying, and grazing
- commercial filming, audio recording, and still photography
- research and monitoring
- dog training
- firewood cutting

Hunting

State and Federal site-specific regulations will apply. Hunters may only possess and use approved, nontoxic shot loads and vehicle travel and parking will be restricted to public roads, pullouts, and posted parking areas. The refuge Web site and public use brochures will provide guidance on site and species regulations. The general State hunting regulations are available from the KDWPT.

We will increase regulatory hunting signs, such as “closed to hunting area” and “nontoxic shot required,” and interpretive materials, like an updated, and more comprehensive, refuge hunting leaflet or tearsheet, in an effort to reduce unintentional hunting violations on the refuge.

The hunting of migratory gamebirds, including three dove species, duck, and goose, will continue in designated areas of the refuge on approximately 7,606 acres. Sandhill crane, snipe, woodcock, and rail hunting will be prohibited. The hunting of upland game, including pheasant and Northern bobwhite, will be allowed in designated areas of the refuge on approximately 9,289 acres of upland and wetland habitat. Hunting of prairie-chicken will be prohibited. Limited big-game hunting will be allowed by special use permit for white-tailed deer and turkey in designated sites within the approved 15,239-acre boundary. Small-game hunting will include rabbit and squirrel only, and will be allowed in the same designated areas as upland game hunting. Furbearer hunting and trapping by special use permit will be allowed on the same area as big-game hunting.

A universally acceptable hunting blind is located in Wetland Unit 30 and may be reserved through the refuge office.

Availability of Resources

Existing programs, such as current refuge directional signs and brochures, could be updated with available resources. Maintenance of access roads, parking, hunting and information kiosks, and public use signs, is closely tied to our Asset Maintenance Management System. The refuge’s base budget will pay for the update and printing of existing and new brochures.

More law enforcement staff time and resources will be required to manage substantial changes to the hunting program. Additions include (1) starting a deer and turkey hunting program; (2) changing hunt area boundaries, parking areas, signs, and hunt brochures; and (3) checking compliance with this new public use and managing whooping crane unit closures as necessary. Existing law enforcement staff is sufficient to manage the new programs.

Anticipated Effects of Use

The hunting program will continue to provide ample quality hunting opportunities without materially detracting from the mission of the Refuge System and the goals or establishing purposes of refuge lands. Public use brochures and the refuge Web site will be kept up to date and made readily available to hunters. Hunter success and satisfaction will be checked with random contacts with hunters in the field and at refuge headquarters.

Hunting is considered by many to be a legitimate, traditional, recreational use of renewable natural resources. The Administration Act, the Improvement Act, other laws, and our policy allow hunting on a national wildlife refuge when it is compatible with the purposes for which the refuge was established and acquired. National wildlife refuges exist primarily to safeguard wildlife populations through habitat preservation.

The word “refuge” includes the idea of providing a haven of safety for wildlife, and, as such, hunting might seem to be inconsistent with the National Wildlife Refuge System. However, habitat that normally supports healthy wildlife populations produces harvestable surpluses that are a renewable resource. As practiced on Quivira Refuge, hunting does not pose a threat to the wildlife populations and, in some instances, is actually necessary for sound wildlife management.

By its nature, hunting creates a disturbance to wildlife and directly affects the individual animals being hunted. However, it is well recognized that this activity has given many people a deeper appreciation of wildlife and a better understanding of the importance of conserving their habitat, which has ultimately contributed to the Refuge System mission.

Furthermore, despite the potential effects of hunting, a goal of the refuge is to provide opportunities for quality wildlife-dependent recreation. The hunting program will be designed and watched closely for safety and quality. The hunting program will continue to periodically close the entire refuge to hunting for the protection of whooping cranes, as determined by the refuge manager. Sandhill crane hunting could lead to the misidentification of the two bird species during a hunt, so it is not allowed on the refuge. Yet, whooping cranes are actually at higher risk of being accidental shot during hunting season off the refuge when they go out to feed where sandhill crane hunting is allowed.

Although hunting directly affects the hunted species and may indirectly disturb other species, limits on harvest and access for recreational hunting will make sure that populations do not fall to unsustainable levels. Closed areas on the refuge provide sanctuary to migratory birds during the hunting season.

In some cases, hunting can be used as a management tool to control elevated populations that are having a negative effect on wildlife habitat.

Added effects from hunting activity include conflicts with individuals participating in wildlife-dependent public uses such as wildlife observation and photography. This could decrease visitors' satisfaction during the hunting season if all users are restricted to the same parts of the refuge.

Public Review and Comment

This compatibility determination was presented for public review and comment as part of the 30-day public comment period for the draft comprehensive conservation plan and environmental assessment for the Quivira National Wildlife Refuge.

Determination

Recreational hunting is a compatible use on the Quivira Refuge in accordance with State, Federal and refuge-specific regulations.

Stipulations Necessary to Make Sure that There is Compatibility

Visitors participating in recreational hunting will follow our public use regulations, including site-specific regulations, and the State's hunting regulations.

- Hunters will continue to use approved non-toxic shot for migratory and upland game-bird hunting and turkey hunting on the lands we own.
- Vehicles will be restricted to county and public roads and parking areas on the refuge.
- Signs, brochures, and our Web site will be used to provide hunters information on where, and how, to hunt on the refuge to make sure that we have their compliance with public use regulations.

Justification

Hunting is identified as a priority public use in the Improvement Act of 1997 and will help meet Refuge System goals with only minimal conflicts. Recreational hunting can instill, in citizens of all ages, a greater appreciation for wildlife and its habitat. This appreciation may extend to the Refuge System and other conservation agencies.

In *Conserving the Future*, Recommendation 17 states: "The Service will work closely with State fish and wildlife agencies to conduct a review of its current hunting and fishing opportunities, especially opportunities offered for youth and people with disabilities. Based on this review, the Service and states will work cooperatively to prepare a strategy for increasing quality hunting and fishing opportunities on national wildlife refuges." (Refuge System 2011)

Based on the anticipated biological effects described above, we have found that recreational hunting on the refuge will not interfere with our habitat goals and objectives or purposes for which the refuge was established. Limiting access and checking the use could help limit any adverse effects.

Mandatory 15-year Reevaluation Date: 2028

Fishing

Fishing is defined as wildlife-dependent recreation under the Improvement Act. As one of the six priority recreational activities noted therein, fishing provides a traditional recreational activity on the refuge with no definable adverse effects to biological resources.

Refuges may be opened to sportfishing only after a determination is made that the activity is compatible with the purposes for which the refuge was established. In addition, the sportfishing program must be consistent with principles of sound fishery management and otherwise be in the public interest.

The CCP includes continued recreational fishing on the refuge in accordance with State, Federal, and refuge regulations. Frogging and the collection of crayfish and live bait will be prohibited.

Availability of Resources

The fishing program could be administered using current resources.

Anticipated Effects of Use

Fishing and other human activities cause disturbance to wildlife and the trampling of vegetation along the bank of rivers and streams. Littering can also become a problem.

Public Review and Comment

This compatibility determination was presented for public review and comment as part of the 30-day

public comment period for the draft comprehensive conservation plan and environmental assessment for the Quivira National Wildlife Refuge.

Determination

Fishing is a compatible use on Quivira Refuge in accordance with State, Federal, and refuge regulations.

Stipulations Necessary to Make Sure that There is Compatibility

- Visitors participating in recreational fishing will follow our public use regulations and State fishing regulations and limits.
- No bait collecting and no live bait use except for night crawlers will be allowed.
- Vehicles will be restricted to county and public roads and parking areas on the refuge.
- The use of boats will be prohibited.
- Fishing equipment and all other personal property must be removed at the end of each day.
- Fish stocking to support fishing will only occur in the Kid's Fishing Pond as necessary.
- The collection of crayfish or frogs will be prohibited.
- Fishing from on top of water control structures will be prohibited for safety reasons.

Justification

Fishing is listed as a priority public use in the Improvement Act. Based on the biological effects addressed above and in the environmental assessment, we have found that recreational fishing will not interfere with the habitat goals and objectives of the refuge or with the purposes for which the refuge was established.

Mandatory 15-year Reevaluation Date: 2028

Wildlife Observation and Photography

As two of the six priority recreational uses identified in the National Wildlife Refuge System Improvement Act of 1997, wildlife observation and photography provide recreational activities on the refuge with no definable adverse effects to biological resources.

We will continue to provide wildlife observation and photography opportunities on the refuge and support them with observation towers and blinds, an up-to-date bird species list for the refuge, and portable viewing and photography blinds issued by special use permits. Such facilities and support will help bring people closer to wildlife.

The auto tour and Wildlife Drive will provide year-round opportunities for wildlife viewing and photography via auto, foot, dog walking, bicycling, and horseback. Hazardous road conditions, such as the flooding of emergency spillways on the route may occasionally require closures for safety. The Wildlife Drive area may also occasionally close because of whooping crane use to avoid disturbance.

All roads and trails are open for foot traffic year round, from sunrise to sunset, unless short-term closures are enacted to prevent wildlife disturbance or maintenance. All refuge lands are open to foot traffic except for periodic closures during the nesting season and other closures for various reasons, such as wildlife protection, human safety, law enforcement, or maintenance. Two areas are routinely closed during nesting season on the salt flats for interior least tern nesting and in the South Big Salt Marsh unit around the bald eagle nest site. The observation tower road and photo blind on the LSM have been occasionally closed because of whooping crane use near the blind and tower. Other areas may be closed in the future depending on changes in wildlife use.

Facilities providing more opportunities for wildlife observation and photography include the LSM photo and observation blind and observation tower, the trail between the observation tower and the Kid's Fishing Pond, and the Migrants Mile hiking trail and photo and observation blind. Spotting scopes are available at the LSM observation tower and on the Wildlife Drive. A binocular loan program is also available for checkout at refuge headquarters.

More observation opportunities will be available through the proposed tower-mounted, remote camera at the BSM and bald eagle nest site. The movable tower camera will be installed near the bald eagle nest. It will allow Internet viewing of the nesting activity and provide viewing of wildlife on the BSM year round.

Commercial birding will be allowed with a special use permit obtained at the refuge headquarters.

Availability of Resources

The only money required for a new facility will go toward buying and installing an Internet-connected tower camera at the BSM. Money will be acquired from various sources, such as the Friends of Quivira, outside donations, local utilities, grants, and refuge sources. Other refuge money for visitor facilities are received as visitor facility enhancement projects through our Asset Maintenance Management System and through Visitor Facility Enhancement grants. Existing programs, such as current directional signs and brochures, can be updated with available resources.

More staff time will be required to manage the tower camera and for maintenance.

Anticipated Effects of the Use

Effects associated with the wildlife observation and photography uses of the refuge resources. These uses are ongoing, and potential disturbances are being managed with temporary closures without issue. Law enforcement is available to enforce closures, and the Internet and temporary signs at headquarters and closed areas announce closures.

Sanctuary will be provided for migrating waterfowl and other waterbirds during the waterfowl hunting season at Quivira Refuge.

Public Review and Comment

This compatibility determination was presented for public review and comment as part of the 30-day public comment period for the draft comprehensive conservation plan and environmental assessment for the Quivira National Wildlife Refuge.

Determination

Wildlife observation and photography are compatible uses on Quivira Refuge.

Stipulations Necessary to Make Sure that There is Compatibility

- Visitors participating in wildlife observation and photography will follow all public use regulations.
- Commercial photography will require a special use permit.
- Seasonal closures to protect sensitive wildlife areas and reduce disturbance to fish and wildlife will be kept.
- Non-Service vehicles will be restricted to county and public access roads on the refuge.
- All-terrain vehicle or utility terrain vehicle use on the refuge will be compatible with State and county regulations on county roads. All-terrain vehicle or utility terrain vehicle use by the public is prohibited off public roads, unless allowed under a special use permit.
- Viewing areas will be designed to decrease disturbance effects to wildlife and all refuge resources while providing a good opportunity to view wildlife in their natural environments. Visitors using the refuge's permanent blinds or their own portable observation and photography blinds will be provided with information on their suitable use and on the etiquette of these structures to decrease disturbance to wildlife and their natural environments and to other refuge visitors.
- Horseback riding and biking will be prohibited on hiking trails, off roads, or in closed areas.
- Pets must be leashed and under owners' control at all times, unless for purposes approved by the refuge manager.

Justification

Wildlife observation and photography are identified as priority public uses in the Improvement Act and will help meet Refuge System goals with only minimal conflict. Wildlife observation and photography can instill, in citizens of all ages, a greater appreciation for wildlife and its habitat. This appreciation may extend to the Refuge System and other conservation agencies.

Based on anticipated biological effects described above, we have found that wildlife observation and photography on the refuge will not interfere with our habitat goals and objectives or with the purposes for which the refuge was established. Limiting access and watching use closely could help limit any adverse effects.

Mandatory 15-year Reevaluation Date: 2028

Environmental Education and Interpretation

As two of the six priority recreational uses identified in the Improvement Act, environmental education and interpretive activities on the refuge and offsite programming and events at schools, fairs, and expo centers provide activities with no definable adverse effects to biological resources.

- Interpretive panels and auto tour brochures provide information about habitat, wildlife, management actions, and activities. Interpretation is passive in nature, from self-guided opportunities to interpretive panels, brochures, Web sites, and tearsheets. We will continue to offer binocular and Let's Go Outside! backpack loan programs at the refuge and at the GPNC. We will continue to use social media, and update it weekly, to increase contact with, and exposure to, the refuge.
- We will continue to provide interpretive programs at Quivira Refuge and the GPNC on a variety of refuge management and wildlife-oriented subjects, both by request and as scheduled activities, and we will increase programs as staff and time allow.
- We will continually evaluate our interpretive media, such as brochures, signs, and displays, for relevancy, effectiveness, and timeliness, and we will update them as needed, provided we have the money to do it.

This CCP proposes to continue environmental education and interpretation and add the following to improve these programs:

- Replace the refuge environmental education classroom with a new one near the headquarters. The location already has several facilities nearby that will be used in conjunction with the classroom, including trails, an observation tower, a pavilion, restrooms, wetlands, sand prairie uplands, meadows and other habitats.
- We will expand the opportunities for environmental education and interpretation to foster appreciation and understanding of the National Wildlife Refuge System and the resources of Quivira Refuge. More interpretive panels will be developed for the refuge,

and accessible observation sites will be developed on the refuge. The mammal, reptile and amphibian lists will be updated for the refuge, and a brochure will be developed.

- We will interpret the cultural history of the Quivira Refuge area, including tribal uses, and early settlement.
- Refuge staff will continue to take part in offsite special events and activities to bring the refuge message to many people, including at-risk youth. Participation in these events will occur as staff and time allow.
- Environmental education programs will be provided to teach curriculum-based programs for all grade levels that meet State educational standards.
- We will encourage the use of both Quivira Refuge and GPNC facilities by educational organizations as outdoor classrooms.
- We will continue to support the GPNC through its partnership with the City of Wichita Department of Park and Recreation and the KDWPT. We will use educational kits and discovery boxes, and continue to promote current and future national initiatives, such as America's Great Outdoors and Let's Go Outside!
- Participation by teachers and students in the Junior Federal Duck Stamp program will continue to increase through more outreach and marketing efforts. Artwork will be displayed throughout the year at various locations—at least 10 venues per year, including the Kansas State Fair—to further promote interest in wildlife and art.
- We will encourage virtual geocaching to enhance the appreciation of refuge resources.

Availability of Resources

Payment for environmental education and interpretation activities, directional signs, and brochures will come from annual operations and maintenance money. Other sources, such as grants, regional project proposals, challenge cost-share agreements, deferred maintenance and others will also be sought and used as they became available.

Requests to pay for new facilities will be submitted as visitor facility enhancement projects through our Asset Maintenance Management System.

Anticipated Effects of the Use

The use of the refuge for onsite activities by groups of teachers and students for environmental education or interpretation may minimally affect the immediate and surrounding areas in the short term. Effects may include the trampling of vegetation and temporary disturbance to nearby wildlife species.

Refuge brochures, interpretive panels, and other educational materials will continue to be updated as needed to meet our needs. Features such as the auto tour route and accessible observation sites will continue to provide access to the refuge.

A new, relocated environmental education classroom will have a small effect on lands near the Kid's Fishing Pond, but this will be offset by a reduction of the footprint area where the existing environmental education classroom is located. All facilities at the current location except for the public restrooms and area of the parking lot will be removed, including the bunkhouse and trailer pads, which will be relocated at the headquarters administrative site, and the area will be restored to upland habitat.

We will continue to promote a greater public understanding and appreciation of refuge resources, programs, and issues through interpretive, outreach, and environmental educational programs. Working with our Friends groups and other local groups, we will continue to provide environmental education and interpretation both on and off the lands we own. Presentations, both on and off our lands, will be provided to refuge visitors, school groups, and organizations, allowing us to reach a broader audience. Onsite presentations will be managed to decrease disturbance to wildlife, habitat, and cultural resources. Environmental education and interpretation activities taking place at the GPNC and offsite by GPNC staff will not affect wildlife or habitat in the urban setting.

Public Review and Comment

This compatibility determination was presented for public review and comment as part of the 30-day public comment period for the draft comprehensive conservation plan and environmental assessment for the Quivira National Wildlife Refuge.

Determination

Environmental education and interpretation will be a compatible use on Quivira Refuge.

Stipulations Necessary to Make Sure that There is Compatibility

- Visitors participating in environmental education and interpretation programs will follow all of our regulations. Onsite activities will be held where minimal effect to wildlife and habitats will occur.
- We will review new environmental education and interpretation activities to make sure that these activities meet program objectives and are compatible.

Justification

Environmental education and interpretation are identified as priority public uses in the Improvement Act and will help meet Refuge System goals with only minimal conflicts. Environmental education and interpretation will be used to encourage an understanding in citizens of all ages to act responsibly to protect wildlife and their habitats. These are tools used in building a land ethic, developing support of the refuge, and decreasing wildlife violations.

Environmental education is an important tool for the refuge to provide visitors with an awareness of its purposes, values, and specific issues such as wetland ecology, water quality, effects of nonnative species, and migratory bird management. This tool will also provide visitors and students a greater understanding of the mission of the Refuge System and its importance to the American people.

Based on anticipated biological effects described above, we have found that environmental education and interpretation on the refuge will not interfere with our habitat goals and objectives or with the purposes for which the refuge was established. Limiting access during certain times of the year and checking the uses will limit any adverse effects.

Mandatory 15-year Reevaluation Date: 2028

Cooperative Farming, Haying, and Grazing

We will continue to use cooperative farming and prescriptive livestock grazing and haying as manage-

ment tools on the refuge. These tools will be used to meet habitat objectives, control vegetative litter, promote native plant production and diversity, control the spread of invasive plant species, and help convert disturbed grasslands back to native plant species.

The refuge uses cooperative farming and haying as tools to manage habitats, including the control of invasive plant species, grassland reconstruction and wet meadow management. We will enter into an agreement with a local landowner to (1) help restore cropland and poor quality habitat to quality native grassland or wetland habitat for wildlife or (2) cut grasslands to promote native seed harvest the following growing season and to rejuvenate vegetation growth. A farming cooperator will be issued a cooperative farming agreement or special use permit by the refuge manager and will be allowed to till seed, harvest small grain, control invasive plants, or harvest hay on the lands we own. The choice is reserved to use genetically modified crops only for the reconstruction of native prairie plants to create more weed-free seedbeds and has been approved through an environmental assessment. The agreement will generally be issued for a 1- to 4-year management prescription.

Cooperative farming of our lands is usually done on a share basis where we and the cooperator each receive a share of the crop. We will maintain our share as standing cover for wildlife forage or in exchange for more work from the cooperator, such as seed harvesting, invasive plant control, grass seeding, or for supplies such as herbicides and fence materials for habitat protection and improvement on the management unit. Any fees or cash received by us will be deposited into the Refuge Revenue Sharing Account.

This CCP proposes to continue using cooperative farming and haying to manage habitats. Farming will gradually be phased out as those lands are planted back into native species. Furthermore, this CCP establishes goals and objectives for specific habitat types where cooperative farming and haying may be used. In addition, we have identified focal wildlife species, such as eastern meadowlark and dickcissel, and their habitat needs. This has resulted in objectives that will guide management to achieve the habitat needs of these species.

The refuge uses prescriptive livestock grazing as a tool to manage a variety of uplands and wetlands. Grazing by livestock has been a preferred management tool because of the potential effects on habitat. Livestock grazing has been used in a variety of ways including high intensity and short duration, rest rotation, and complete rest. Grazing may occur throughout the year as management needs dictate. Where

applicable, a rotation schedule using multiple grazing units is used to manage characteristics of grazing.

Fencing and controlling livestock is the responsibility of the cooperating rancher. We provide instruction and guidance in the special use permit for the placement of fences, water tanks, and livestock supplements to make sure that sensitive habitats and refuge assets are protected. A temporary electric fence is used where there is not an existing fence. Current forage conditions, habitat objectives, and available water will determine stocking rates in each grazing unit.

This CCP proposes to continue using prescriptive livestock grazing to meet habitat objectives. Furthermore, the CCP establishes goals and objectives for specific habitat types where prescriptive livestock grazing may be used. In addition, the Service has identified focal wildlife species and their habitat needs, which has resulted in objectives that will guide the prescriptive grazing program to achieve the habitat needs of these species while helping many others. The refuge will improve the monitoring and research programs to assess habitat responses to prescriptive livestock grazing. Different grazing rates and management strategies will be investigated to decide on the best methods for meeting habitat goals and objectives.

Availability of Resources

Existing resources will be sufficient to administer the farming, haying, and grazing programs at current levels. These programs will continue to be conducted through special use permits or cooperative farming agreements, which decrease the need for staff time and our assets to complete the work. A refuge biologist will be needed to plan and oversee monitoring and research programs to assess the effects and effectiveness of these management programs. One or two temporary biological technicians likely will be necessary to help with on-the-ground monitoring programs.

Rehabilitation of existing stock water wells and the drilling of more wells in strategic locations will increase the effectiveness of the grazing program by spreading out grazing use and reducing the effects caused by livestock watering in wetlands and canals and by cooperators hauling water to grazing cells on a daily basis.

Anticipated Effects of the Use

The cooperative farming and haying program and prescriptive livestock grazing program will be used to meet habitat goals and objectives identified in the CCP. These programs are intended to support and enhance habitat conditions for the benefit of a wide

variety of migratory birds and other wildlife that use the refuge. Minimal negative effects are expected through the use of these tools. Control of invasive plant species through these programs would be a long-term benefit.

Some wildlife disturbance will occur during operation of noisy farming equipment and some animals may be temporarily displaced. Wildlife would receive the short-term benefit of standing crops or stubble for food and shelter and the long-term benefit of having cropland or other poor-quality habitat converted to native prairie plants. In addition, the restoration of cropland to grassland cover would prevent soil erosion, improve water quality, and reduce the need for chemical use.

Some trampling of areas by livestock may occur around watering areas, mineral licks or trees and wood lots. Cattle congregating under the shade of trees would increase invasive cheatgrass establishment. If fences are not kept up, it may be difficult to meet habitat objectives. It is anticipated that grazing will be in a mosaic pattern, with some areas being more intensively grazed than others in certain years. Grazing, like fire, is known to increase the nutrient cycling of nitrogen and phosphorous (Hauer and Spencer 1998, McEachern et al. 2000). Hoof action may improve conditions to allow native plant seeds to become established. However, cattle grazing would also increase the risk of invasive plants getting established. Grazing in the spring could have adverse effects on grassland bird nests because of trampling and the loss of vegetation. In addition, the presence of livestock would be disturbing to some wildlife species and some visitors. The long-term benefits of this habitat management tool should outweigh the short-term negative effects.

Public Review and Comment

This compatibility determination was presented for public review and comment as part of the 30-day public comment period for the draft CCP and EA for Quivira Refuge.

Determination

Cooperative farming, haying, and grazing as habitat management tools are compatible uses on the Quivira Refuge.

Stipulations Necessary to Make Sure that There is Compatibility

For consistency with management objectives, we will require general, and specific conditions, for each farming, haying, or grazing permit.

Only areas that have a prior crop history will be included in the farming and haying program. To decrease effects to nesting birds and other wildlife, the refuge manager will decide on, and incorporate, any needed timing constraints on the permitted activity into the cooperative farming agreement or special use permit. For example, haying will not be permitted on our lands until after August 1 to avoid destroying bird nests on the management unit unless the refuge manager deems it necessary to hay earlier to control invasive plants or restore grasslands.

The cooperative farming agreement or special use permit will specify the type of crop to be planted. Farming permittees will be required to use our approved chemicals that are less detrimental to wildlife and the environment.

Control and confinement of livestock are the responsibility of the permittee, but we will decide where fences, water tanks, and livestock supplements will be placed within the management unit. Temporary electric fence will be used to keep livestock within grazing cells as well as to protect sensitive habitat areas and refuge assets such as water control structures or public use areas. Cooperators will be required to remove fences at the end of the permit.

Grazing fees will be based on the current-year USDA Statistics Board publication for Grazing Fee Rates for Cattle by Selected States and Regions, as provided annually by the regional office, or will be established by bid. Standard deductions for labor associated with the grazing permit will be included on the special use permit.

The refuge will carry out a vegetation monitoring program to assess if habitat needs of focal species are being met. A minimum of one temporary biological technician will be necessary to check and document these activities. A biologist will be necessary to plan and oversee the monitoring program and to assess the effects of these management programs.

Justification

Some habitat management needs to occur to support and enhance habitat for migratory birds and other wildlife. When effectively managed and checked, prescriptive farming and haying are options that can be used to improve wildlife cover and to restore disturbed habitats to desirable grassland cover. Prescriptive livestock grazing can rejuvenate native grasses and help control the spread of some invasive plant species. Each of these tools can be controlled, and the results will be watched closely, as with vegetation monitoring programs, so that adjustments can be made to meet habitat goals and objectives.

Using local cooperators to accomplish the work is a cost-effective method to accomplish the habitat

objectives. The long-term benefits of habitat restoration and management far outweigh the short-term effects caused by cooperative farming, haying, and grazing.

Mandatory 10-year Reevaluation Date: 2023

Commercial Filming, Audio Recording, and Still Photography

Commercial filming is the digital, or film, recording of a visual image or of a sound—and commercial still photography is the capture of a still image on film or in a digital format—by a person, business, or other entity for a market audience such as for a documentary, television, feature film, advertisement, or similar project. It does not include news coverage or visitor use.

Quivira Refuge provides tremendous opportunities for commercial filming and still photography of migratory birds and other wildlife. Each year, the refuge staff receives requests to conduct commercial filming or photography on our lands. Our staff will continue to evaluate each request on an individual basis, and, if the use is allowed, the requesting individual or group will be issued a special use permit. The permit will designate what areas may be accessed and what activities are, and are not, allowed, to decrease the possibility of damage to cultural or natural resources or to limit interference with other visitors.

Permittees will be able to access all areas of the refuge that are open to the public and must abide by all public use regulations. In rare cases, and through the special use permit process, we may allow access to areas closed to the public.

Availability of Resources

The commercial filming, audio recording, and still photography uses could be administered with current resources. Administrative costs for review of applications, issuance of special use permits, and staff time to conduct compliance checks may be offset by a fee system designated for the agencies within the DOI.

Anticipated Effects of Use

Wildlife filmmakers and photographers tend to create the greatest disturbance of all wildlife observers (Dobb 1998, Klein 1993, Morton 1995). While observers frequently stop to view wildlife, photogra-

phers are more likely to approach the animals (Klein 1993). Even a slow approach by photographers tends to cause behavioral consequences with wildlife (Klein 1993). Photographers often remain close to wildlife for extended periods of time in an attempt to habituate the subject to their presence (Dobb 1998). Furthermore, photographers with low-power lenses tend to get much closer to their subjects (Morton 1995). This usually results in increased disturbance to wildlife, as well as habitat, including the trampling of plants. Handling of animals and disturbing cultural artifacts or vegetation, such as cutting plants and removing flowers, is prohibited on our lands.

The issuance of special use permits with strict guidelines and close checking by our refuge staff for compliance could help decrease or avoid these effects. Permittees who do not follow the stipulations of their special use permits could have their permits revoked, and further applications for filming or photographing on refuge lands will be denied.

Public Review and Comment

This compatibility determination was presented for public review and comment as part of the 30-day public comment period for the draft comprehensive conservation plan and environmental assessment for the Quivira National Wildlife Refuge.

Determination

Commercial filming, audio recording, and still photography are compatible uses on Quivira Refuge.

Stipulations Necessary to Make Sure that There is Compatibility

Commercial filming or still photography must (1) show a means to extend public appreciation and understanding of wildlife or natural habitats; (2) enhance education, appreciation, and understanding of the Refuge System; or (3) facilitate the outreach and education goals of the refuge. Failure to show any of these criteria will result in a special use permit being denied.

All commercial filming will require a special use permit that will (1) identify conditions that protect the refuge's values, purposes, resources, and public health and safety; and (2) prevent unreasonable disruption of the public's use and enjoyment of the refuge. Such conditions may be, but are not limited to, specifying road conditions when access will not be allowed, establishing time limitations, and finding routes of access. These conditions will be identified to prevent excessive disturbance to wildlife, damage to

habitat or refuge infrastructure, or conflicts with other visitor services or management activities.

The special use permit will stipulate that imagery produced on refuge lands will be made available for use in environmental education and interpretation, outreach, internal documents, or other suitable uses. In addition, any commercial products must include credits to the Quivira National Wildlife Refuge, the National Wildlife Refuge System, and the U.S. Fish and Wildlife Service.

Still photography requires a special use permit, with specific conditions as outlined above, if one or more of the following occur:

- It takes place at locations where, or when, members of the public are not allowed.
- It uses models, sets, or props that are not part of the location's natural or cultural resources or administrative facilities.
- We incur more administrative costs to check the activity.
- We need to provide management and oversight to avoid the impairment of the resources and values of the site, limit resource damage, or to decrease health and safety risks to the visiting public.
- The photographer intends to intentionally manipulate vegetation to create a shot, such as cutting vegetation to create a blind.

To decrease the effect on our lands and resources, our refuge staff will make sure that all commercial filmmakers and commercial still photographers, regardless of whether or not a special use permit is issued, comply with policies, rules, and regulations. Our staff will check and assess the activities of all filmmakers, audio recorders, and still photographers.

Justification

Commercial filming, audio recording, and still photography are economic uses that must contribute to the achievement of the refuge purposes, the mission of the Refuge System, or the mission of the FWS. Providing opportunities for these uses should result in increased public awareness of the refuge's ecological importance as well as in advancing the public's knowledge and support for the Refuge System and the Service. The stipulations outlined above and conditions imposed in the special use permits issued to commercial filmmakers, audio recorders,

and still photographers will make sure that these wildlife-dependent activities occur with minimal adverse effects to resources or visitors.

Mandatory 10-year reevaluation date: 2023

Research and Monitoring

The Quivira Refuge receives an estimated 5 to 10 requests each year to conduct scientific research or monitoring programs on our lands. Priority is given to studies that contribute to the enhancement, protection, preservation, and management of the refuge's native plant, fish, and wildlife populations and their habitats. Applicants who are not employees of ours must submit a proposal that outlines the following:

- objectives of the study
- justification for the study
- detailed method and schedule
- potential effects on wildlife and habitat including short- and long-term disturbance, injury, or mortality
- description of measures the researcher will take to reduce disturbances or effects
- staff required and their qualifications and experience
- status of necessary permits, such as scientific collection permits and endangered species permits
- costs to the Service, including staff time requested, if any
- anticipated progress reports and end products, such as reports or publications

Our refuge staff or others will review research proposals case by case and issue special use permits if approved. Criteria for evaluation will include, but will not be limited to, the following:

- Research that would contribute to specific refuge management issues will be given higher priority over other requests.

- Research that would conflict with other ongoing research, monitoring programs, or management programs will not be approved.
- Research that would cause undue disturbance or would be intrusive will likely not be approved. The degree and type of disturbance will be carefully weighed when evaluating a research request.
- Proposals will be evaluated to decide if any effort was made to decrease disturbance through study design, including adjusting the location, timing, number of permittees, study methods, and the number of study sites.
- The length of the project will be considered, and agreed on, before approval.
- Research proposals involving threatened and endangered species will require concurrence and Section 7 Endangered Species Act review before approval.

Availability of Resources

Current resources will be adequate to administer research and monitoring programs on a limited basis. A refuge biologist will be necessary to administer large and long-term projects, which generally require more indepth evaluation of applications, management of permits, and oversight of research projects. The biologist will identify research and monitoring needs and work with our other staff, universities, and scientists to develop studies that will help the refuge and address the goals and objectives in this CCP.

Anticipated Effects of Use

Some degree of disturbance is expected with all research activities because researchers may use our roads or enter areas that are closed to the public. In addition, some research may require the collection of samples or the handling of wildlife. However, research studies will be expected to minimally affect wildlife and habitats because special use permits will include conditions on their effects.

Public Review and Comment

This compatibility determination was presented for public review and comment as part of the 30-day public comment period for the draft comprehensive

conservation plan and environmental assessment for the Quivira National Wildlife Refuge.

Determination

Research and monitoring are compatible uses on Quivira Refuge.

Stipulations Necessary to Make Sure that There is Compatibility

Extremely sensitive wildlife habitats and species will be sufficiently protected from disturbance by limiting research activities in these areas. All refuge rules and regulations will be followed unless otherwise exempted by our refuge management. Projects will be reviewed annually.

Our refuge staff will use the above criteria for evaluating and determining whether to approve a proposed study. If research methods were found to have potential effects on habitat or wildlife, it must be shown that the research is necessary for the conservation management of resources on the refuge. Measures to decrease potential effects will need to be developed and included as part of the study design; these measures will be conditions on the special use permit.

Our refuge staff will watch research activities for compliance with conditions of the special use permit. At any time, staff may accompany the researchers to look for potential effects. They may decide that research that was approved for special use permits before is terminated because of observed effects. Our refuge manager will also have the ability to cancel a special use permit if the researcher was out of compliance or for wildlife and habitat protection.

Justification

Potential effects of research activities on refuge resources will be decreased through restrictions included as part of the study design, and research activities will be checked by our refuge staff. Results of research projects will contribute to the understanding, enhancement, protection, preservation, and management of the refuge's wildlife populations and their habitats.

Mandatory 10-year reevaluation date: 2023

Dog Training

Dog training during the non-nesting season by noncommercial dog owners is an existing use at Quivira Refuge. The use of dogs for hunting is encouraged. Depending on future demand and conflicts, dog training on the refuge may require a special use permit.

Availability of Resources

Sufficient staff exists to issue the required permits, and oversee this periodic use. Facilities and staff are now available to provide access, support roads, parking lots, and secondary access roads.

Anticipated Effects of Use

There will be minimal disturbance to wildlife as a result of the activity, and effects will be temporary.

Public Review and Comment

This compatibility determination was presented for public review and comment as part of the 30-day public comment period for the draft comprehensive conservation plan and environmental assessment for the Quivira National Wildlife Refuge.

Determination

Dog training is a compatible use on the Quivira National Wildlife Refuge.

Stipulations Necessary to Make Sure that There is Compatibility

- Depending on future demand and conflicts, dog training on the refuge may require a special use permit.
- Immediately before training activity, trainers must check in with refuge staff at the headquarters for permitted opportunities to decrease disturbances to wildlife and other public uses and to maximize trainer safety.
- Training will be allowed when most bird breeding activities do not occur: September 1–March 1.
- Training will only be allowed in wetland areas along public use roads and where disturbance to wildlife can be decreased. For

instance, we will encourage the use of wetland areas that do not provide foraging or resting habitat for waterbirds at that time.

- Training will not be allowed in the Kids' Fishing Pond area.
- Training will use areas in a way that avoids or decreases unwanted, direct interactions with visitors, such as with those who are allergic or uncomfortable with dogs. Training will also use areas in a way that decreases potential conflict with visitor use activities that may be occurring in the area before training activities begin.
- Only artificial props, such as canvas or plastic dummies, may be used in training.

Justification

This activity encourages people to get outside and promotes quality and responsible hunting and the appreciation of natural resources. There is little other public land available, particularly during the non-nesting season when hunting is allowed. Use of private land with water for training dogs is difficult to find, as most is either cropland or rangeland. Most adjacent land is private farm ground that is not available to the public for this activity. The use is proposed only for individuals doing noncommercial dog training. Commercial dog training will not be allowed because of the overwhelming demand and its potential for too many dogs, trainers and vehicles on the refuge. Dog training may occur with minimal, temporary disturbance, and no permanent effect to the refuge is anticipated. The use will not materially detract from the National Wildlife Refuge System mission or purposes of the refuge.

Mandatory 10-year Reevaluation Date: 2023

Firewood Cutting

Firewood cutting will be a new use at Quivira Refuge. Firewood cutting will be an economic use of the refuge's natural resources. The use will facilitate and aid with habitat management and grassland restoration through the removal of undesirable invasive woody vegetation. The public will be permitted to cut and collect firewood on the refuge. The timber could either be removed as cut wood or as whole trees. The public will acquire a permit and a map with designated areas on the refuge to cut firewood. Unlimited

permits will be available with a \$25 annual fee. The public will be allowed to remove only trees that have been marked for removal, that had been chemically treated earlier by refuge staff, or that are dead timber. All cutting will be required to be at ground level. Access will be limited to areas along roads and trails to prevent habitat destruction and wildlife disturbance.

The use will potentially occur on all wooded upland and partially wooded upland acres of the refuge totaling approximately 15,000 acres. Specific areas will be chosen by the refuge manager to not interfere with habitat management or threatened and endangered species, and areas on the refuge will not be open to firewood cutting when threatened or endangered species are present. Affected wildlife could include deer, small mammals, raptors such as bald and golden eagles and various hawks, upland gamebirds, quail and pheasants, and other upland migratory birds. Migratory waterfowl using wetlands and marshes might also be affected.

Firewood cutting will be permitted from August 1 to April 30 to prevent effects to migrating bird nesting seven days a week from sunrise to sunset. Areas will be designated by the refuge manager and subject to closure at any time. Firewood cutting will not be permitted during periods of fire danger reaching red flag warnings as issued by the National Weather Service.

The public will be required to obtain a special use permit. Power chainsaws, handsaws, or axes will be the only means permitted to cut trees and firewood. All permittees will be required to have spark arrestors on power chainsaws and have a shovel or fire extinguisher available to aid with extinguishing fire. The public will be permitted to pull trailers or vehicles on established roads, trails, and designated areas with refuge manager approval with exact locations stated on permit and map. All firewood and equipment will be removed daily.

The use will facilitate and aid habitat management and grassland restoration by removing undesirable invasive woody vegetation. Removal of invasive tree species would prevent further seed distribution, reduce fuel load, restore native prairie, clean up fallen and cut tree piles, and provide an economic benefit to the public. Most adjacent land is private farm ground that is not available to the public.

Availability of Resources

- Resources involved in the administration and management of the use: minimal administrative costs for the issuance of permits and maps.

- Special equipment, facilities, or improvements necessary to support the use: none.
- Maintenance costs: held to a minimum. Expected costs include installing signs when necessary to inform the public on temporary closures.
- Monitoring costs: held to a minimum. Expected costs include 1–2 hours per week by the refuge manager to monitor the wood-cutting progress and potential wildlife disturbance. Monitoring will be done while conducting routine management monitoring. Refuge Law Enforcement officer could spend three to four hours per week monitoring illegal activity or noncompliance with the special use permits. This activity will be done while conducting routine refuge law enforcement.
- Offsetting revenues: an annual fee of \$25 will be assessed for a special use permit to cover administrative costs and maps.

Anticipated Effects of Use

- Short-term effects: the use will support the refuge mission by restoring grassland acres, increasing the nesting habitat of migratory grassland species, reducing invasive tree species, reducing hazardous fuel, and reducing labor hours and equipment use for mechanical tree removal resulting in cost savings for the Service. Through the management of the activity, negative direct or indirect effects would be reduced. The disturbance activity would not be any greater than what would be conducted by refuge staff conducting the same activity. Short term activity may increase as the public learns about the availability of firewood.
- Long-term effects: the use will be applied primarily in the short term, 3–10 years, until invasive tree populations have been eradicated or are at manageable levels. The duration and frequency of firewood cutting will be reduced over time and may be phased out completely. Long-term beneficial effects would include increasing the nesting habitat for migratory grassland species, controlling invasive tree species, and increasing native plant diversity.

- Cumulative effects: the use will provide beneficial effects by increasing nesting habitat of migratory grassland species, eradicating invasive tree species, and increasing native plant diversity. The combustion of the wood will be required to allow for restoration of the native plant communities on the refuge. The activity of burning the wood can either be performed by the refuge or by the public. The benefit of allowing the public to cut and use the firewood will help reduce the amount of petroleum products required to heat their homes.

Public Review and Comment

This compatibility determination was presented for public review and comment as part of the 30-day public comment period for the draft comprehensive conservation plan and environmental assessment for the Quivira National Wildlife Refuge.

Determination

Firewood cutting is a compatible use on Quivira Refuge.

Stipulations Necessary to Make Sure that There is Compatibility

Refuge staff will mark trees or spray trees in designated areas before firewood cutting. The refuge manager will monitor the use and close areas during red flag fire danger, when threatened or endangered species are present, or when it would interfere with management activities such as grazing or prescribed fire. Woodcutting equipment will be limited to power chainsaws with spark arrestors, axes, and hand saws. Heavy equipment and tractors owned by the public will not be permitted to aid with firewood cutting. Monitoring the activity will be performed by refuge staff on a regular basis. Law enforcement staff will visit sites regularly during routine patrols to monitor that activities are conducted within special use permit guidelines and refuge regulations.

Justification

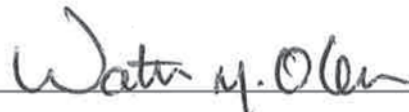
Firewood cutting will help us reach and meet the overall goal of managing habitat for migratory birds. It will aid refuge staff and provide a cost savings to the Government by reducing labor, equipment, and fuel costs to remove trees. It will help reduce hazardous fuel and fuel load to help prevent or manage wild-

fires. By managing locations, firewood cutting will not interfere with other wildlife-dependent uses. Temporary disturbance of the wooded areas may cause minimal disturbance to wildlife in the area but will be necessary to increase quality habitat for migratory birds and other refuge species. It will help promote diverse grass stands, may increase water reserves on the refuge through tree reduction, and provide enhanced nesting habitat for upland birds.

Mandatory 10-year reevaluation date: 2023

B.7 Signatures

Submitted by:

 9/25/13

W. Mike Oldham, Project Leader
Quivira National Wildlife Refuge
Stafford, Kansas

Date

Reviewed by:

 9/27/13

Barbara Boyle, Refuge Supervisor
U.S. Fish and Wildlife Service, Region 6
National Wildlife Refuge System
Lakewood, Colorado

Date

Approved by:

 10/17/13

Will Meeks, Assistant Regional Director
U.S. Fish and Wildlife Service, Region 6
National Wildlife Refuge System
Lakewood, Colorado

Date

Appendix C

Intra-Service Section 7 Biological Evaluation

Intra-Service Section 7 Biological Evaluation Form - Region 6

Originating Person: Mike Oldham

Date Submitted: September 20, 2013

Telephone Number: 620-486-2393

- I. **Service Program and Geographic Area or Station Name:**
Quivira NWR and Great Plains Nature Center
- II. **Flexible Funding Program** (e.g. Joint Venture, etc) if applicable:
N/A
- III. **Location:** Location of the project including County, State and TSR (township, section & range):
The location of proposed actions largely occurs within the boundaries of Quivira National Wildlife Refuge. The refuge consists of 22,135 acres in Stafford, Rice, and Reno Counties in south-central Kansas. The majority of the refuge lies in Stafford County, while the eastern edge falls in Reno and the northeast section into Rice County. Its purposes are to provide migration, nesting, resting, and feeding habitat for migratory birds and to develop, advance, manage, conserve, and protect fish and wildlife resources.
- Additionally, Refuge staff manages the Great Plains Nature Center (GPNC) in partnership with the Kansas Department of Wildlife, Parks, and Tourism (KDWPT), and the City of Wichita Department of Park and Recreation. The GPNC is located within the city of Wichita, entirely within Sedgwick County. The GPNC is a Service administrative site and an urban educational facility, but it is not a unit of the National Wildlife Refuge System.
- IV. **Species/Critical Habitat:** List federally endangered, threatened, proposed, and candidate species or designated or proposed critical habitat that may occur within the action area.
- A. Federally listed species/critical habitat which may be affected by the action:
- › **Whooping Crane (E)/Quivira National Wildlife Refuge (QNWR)**
 - › **Interior Least Tern (E)/all lands and waters on QNWR**
 - › Piping Plover (T)/No Critical Habitat in KS
 - › Eskimo Curlew/No Critical Habitat in KS
- B. Proposed species which may be affected by the action:
- › Lesser Prairie-Chicken (T) (Stafford County)
- C. Candidate species which may be affected by the action:
- › Arkansas Darter (Reno, Rice, and Stafford County)
 - › Sprague's Pipit/No Critical Habitat in KS
- V. **Project Description:** Describe proposed project or action or, if referencing other documents, prepare an executive summary (attach additional pages as needed):

Refuge and regional staff have developed a Comprehensive Conservation Plan and Environmental Assessment (CCP) that will serve as a working guide for management plans and activities throughout the refuge, and at the GPNC over the next 15 years. Because of the nature of the Plan, it is intended to be a multi-year general guidance document, but lacks some detailed actions that will be provided in step-down management plans as part of carrying out the final CCP. All of the management actions within the plan meet specific goals developed for the refuge and GPNC (see below).

A. Summary of Goals

Our goals for the refuge and GPNC are consistent with the National Wildlife Refuge System Improvement Act of 1997, the refuges purposes, and information gathered during the planning process.

Landscape Conservation Goal - Actively protect, preserve, manage, and restore the functionality of the diverse ecosystems of the Rattlesnake Creek watershed.

Native Ecological Community Conservation Goal - Actively conserve and improve environmental conditions within refuge boundaries to promote sustainable, native ecological communities and support species of concern associated with this region of the Great Plains.

Visitor Services Goal - See that visitors enjoy quality, wildlife-dependent recreational opportunities.

Public Outreach Goal - Help visitors of all abilities understand, appreciate, and support our mission, the refuge's unique habitats, and the refuge's importance to migratory birds and other wildlife and plant species.

Cultural Resources Goal - Name, value, and preserve the cultural resources and cultural history of the refuge and connect staff, visitors, and the community to the area's past.

Visitor and Employee Safety and Resource Protection Goal - Provide for the safety, security, and protection of visitors, employees, natural and cultural resources, and facilities of the refuge and the Great Plains Nature Center.

Administration Goal - Provide and support facilities, strategically fill approved positions and allocate staff, increase volunteer opportunities and partnerships, and effectively raise and use money to keep the long-term integrity of infrastructure, habitats, and wildlife resources at the refuge and at the Great Plains Nature Center.

B. Summary of the Proposed Action

Alternative B (Proposed action)

We would focus on restoration and maintenance of native communities, promoting the potential natural range of conditions on Quivira National Wildlife Refuge that support focal resources, or focal species and their respective habitats. The Management Uses - Section 4.7 of the CCP describes a range of general action types typically used to accomplish goals and objectives: rest, water management, prescribed fire, grazing, mechanical treatments (haying, mowing, tree cutting, farming activities, disking of wetlands), and chemical treatments as natural resource management techniques.

Management would continue to allow compatible public use opportunities that are a priority of the

Refuge System: hunting, fishing, wildlife observation, photography, interpretation, and education. The proposed action includes some expanded public use opportunities, such as the ability to allow state- and federally-regulated deer hunting of a high-density and increasing local population. Relatively minor changes in our operations; inventory, monitoring, and research; and infrastructure would likely be required to accomplish the proposed actions.

C. Key Elements Included in Our Management of Quivira and the GPNC

Management actions used on the refuge, such as grazing and prescribed burning, are necessary to maintain native communities given current landscape conditions, uses, and constraints.

Implementation of the proposed actions (alternative B) will involve compliance with all Federal laws and regulations that provide direction for managing units of the Refuge System.

Management would continue to actively support species recovery plans.

All wildfires will be managed in accordance with Federal Wildland Fire and Service policy. The initial action on a human-caused wildfire will be to suppress the fire at the lowest cost with the fewest negative consequences with respect to firefighter and public safety. A naturally occurring wildfire may be concurrently managed for one or more refuge objectives. Further, objectives can change as the fire spreads across the landscape. Wildfire would be viewed as playing a more natural role in the environment. Prescribed fire may be utilized in all habitat types at any time of the year based on refuge objectives, and related to hazardous fuels reduction and/or habitat management.

We will attempt to control invasive species through an integrated pest management (IPM) approach that uses approved biological, chemical, cultural, and mechanical treatment methods as part of a Pesticide Use Plan.

We will protect and manage all cultural resources.

We will support our own research efforts and those of others to help achieve management objectives.

As appropriate, we will assess conditions that indicate signs of wildlife disease, such as cholera, chronic wasting disease, avian influenza, and botulism.

We will promote strong and diverse partnerships to help meet the objectives and goals of the refuge.

We will maintain current water rights throughout the refuge.

Our approach to climate change adaptation in the next 15 years will result in specific differences in management capacity (constraints) and ecosystem resiliency (adaptability) potential as indicated throughout the CCP under various goals and topic headings. Many of our actions address key findings of climate change adaptations listed by Staudinger et al. (2012). Our management actions would:

- promote sustainability of ecosystems, biodiversity of organisms, and wildlife-dependent ecosystem services.
- reduce or alleviate environmental stressors or vulnerabilities, such as grassland fragmentation and the effects of invasive species, which may be magnified with climate change.
- implement an adaptive management process that involves the experimentation and modification of management actions and monitoring to increase success in achieving goals and objectives. For example, timing of management actions may require adjustments for success with changing climate conditions. Regardless, there remains uncertainty in the effects of climate change, such as how system variability and vulnerability will change and affect land use and environmental regulations at landscape scales that collectively influence refuge management planning. For example, we are uncertain of how water use and rights issues within the watershed and western

Kansas aquifers will be affected with climate change and what the consequences will be for refuge resources and management (e.g., Rosenberg 2010, Schlager and Heikkila 2011). Over the time of this plan, knowledge will be gained of anticipated future changes that inform management strategies and decision-making.

Our management actions would not:

- manage to stabilize natural conditions; instead, all manage system transitions and promote strategies that closer emulate or support natural processes.

Rosenberg, N.J. 2010. Climate change, agriculture, water resources: what do we tell those that need to know? *Climate Change* 100:113-117.

Schlager, E.; Heikkila, T. 2011. Left high and dry? Climate change, common-pool resource theory, and the adaptability of western water compacts. *Public Administration Review* May/June 461-470.

Staudinger, M.D.; Grimm, N.B.; Staudt, A.; Carter, S.L.; Chapin III, F.S.; Kareiva, P.; Ruckelshaus, M.; Stein, B.A. 2012. Impacts of climate change on biodiversity, ecosystems, and ecosystem services: technical input to the 2013 national climate assessment. Cooperative report to the 2013 national climate assessment. [Internet]. <http://assessment.globalchange.gov> [date accessed unknown]. 296 p.

VI. Determination of Effects:

(A) Description of Effects: Describe the action(s) that may affect the species and critical habitats listed in item IV. Your rationale for the Section 7 determinations made below (B) should be fully described here.

1. Explanation of effects of the action on species and critical habitats in Items IV. A, B and C:

The proposed action (Alternative B) has the intent to support species of concern and associated habitats. Among the various conditions provided, management actions would restore and maintain habitat composition and structure characteristically used by the species of concern listed above (IV). As described in the objectives, management would provide open, shallowly-flooded wetlands and shoreline/beach-like areas used by shorebirds, cranes, and terns, as well as a mosaic of open and dense cover in upland prairie that has the potential for use by prairie-chickens. The boiling springs area would be managed with the intention of supporting the existing Arkansas darter population. Management would appropriately encourage continued use of sites selected by interior least terns during the breeding season, presuming current and anticipated future conditions support success.

Other refuge programs identified in the CCP that could have neutral, or minimal effects on threatened and endangered species include (visitor services) hunting, fishing, wildlife observation and photography, environmental education, interpretation, special events, and general public outreach. Management of public use programs would consider conservation of species of concern a priority. For example, temporary closures and/or other regulations would be used by management to minimize disturbance of nesting least terns and migrating whooping cranes resulting from public use activities. Certain species would not be huntable species within the boundaries largely for the protection of species of concern, such as sandhill crane that often occur with whooping crane on the refuge. Limited disturbance of species of concern may occur as a result of permitted activities, such as those related to education, outreach, monitoring, research, and/or management, that largely have the potential of increasing support of species conservation and protection at a larger level.

At the beginning of the planning process, specific issues of concern were identified by the public, and requests were made to effect suggested changes toward the management of the refuge. None of the

suggested changes were implemented in this plan that would directly adversely impact Threatened and Endangered Species. The following list identifies the issues raised by the public during the initial planning meetings, followed by a focused objective on how the refuge will proceed under the plan's proposed action.

Tree Management

Identified Issue: There are differences of opinion about tree management on Quivira National Wildlife Refuge. Prairie restoration, with a reduction in current tree coverage, is generally understood and supported. Yet, some would prefer that we keep tree coverage at a higher level for a variety of reasons.

Proposed Action: Management of tree areas would continue as it supports the purpose, goals, and objectives of the refuge, especially those pertaining to the conservation of native communities and species of concern. The plan clearly identifies the allowable coverage or removal of trees during the life of the plan, and describes various benefits to native wildlife and public use opportunities. Overall, the area of woody vegetation on the refuge would decrease, which would be potentially beneficial to species in Items IV. A, B and C. There would be no or insignificant adverse effects to species in Items IV. A, B and C.

Whooping Crane Closures

Identified Issue: When whooping cranes are present, Quivira National Wildlife Refuge has been closed to hunting to avoid disturbance and prevent accidental shooting. Whooping crane arrivals and departures are unpredictable, which makes it difficult for hunters to plan ahead. Public lands for hunting in Kansas are also limited, which exacerbates their frustration. And yet, while disappointing hunters, whooping cranes do attract birders. We at the refuge have received many requests to reconsider our refuge-wide closures. At the nearby Cheyenne Bottoms Wildlife Area, Kansas Department of Wildlife, Parks and Tourism has successfully protected whooping cranes by using partial area closures.

Proposed Action: The whooping crane closure modification, as suggested in the proposed draft Alternative B, would not be implemented. The revised proposed action would continue to maintain general hunt closures (waterfowl and upland game hunts) with the presence of whooping crane. Limited exceptions may be considered as the refuge develops a hunt plan for potential deer and turkey hunting opportunities, such as the limited use of archery in selected tree groves. There would be no or insignificant adverse effects to species in Items IV. A, B and C.

Prohibiting the Collection of Shed Antlers

Identified Issue: We are aware of limited interest in deer antler collection on the refuge. However, collecting or taking of any plant, wildlife, or parts thereof from a national wildlife refuge without a permit is specifically prohibited under Title 50 Code of Federal Regulations Part 27.61. Further, the decision to prohibit antler collecting on the refuge is consistent with other Kansas refuges. This consistency among Kansas refuges facilitates associated law enforcement and public communication activities.

Proposed Action: The refuge would not allow the collection of shed deer antlers under special use permit. There would be no adverse effects to species in Items IV. A, B and C.

Deer and Turkey Hunting

Identified Issue: Deer and turkey hunting have never before been approved as a public use activity or management strategy on Quivira National Wildlife Refuge, but there is interest in allowing these hunting activities in the future. Long-term trends show populations of these species continue to increase. Recent research suggests that effective population management may require or benefit from control that involves areas on- and off- refuge lands.

Proposed Action: The refuge would implement deer and turkey hunting under a highly controlled and limited basis through special use permit. The hunts would only be allowed after developing a step down hunt plan. Permitting would minimize indirect or unintended adverse disturbance to species of concern with control of the timing, location, and method of hunting. There would be no or insignificant adverse effect to species in Items IV. A, B and C.

Water Quantity and Quality

Identified Issue: Agriculture and oil production in the area help set water resource and land use trends that raise concerns about the current and future characteristics of water quality. Future water availability and quality may

not be assured, yet adequate water quantity and chemistry are important factors of refuge saltmarsh and wetland communities. Substantial declines in the water table would also likely affect grassland and meadow habitats.

Proposed Action: The refuge would continue to work toward solutions with other partnering agencies and organizations on improving and/or conserving water quantity and quality. Management would provide direct benefits to water quantity and quality, such as in decreasing the coverage of non-native woody phreatophytes along the creek and in wetland areas. Also, the refuge would continue monitoring related to water use and characteristics. Because this issue involves activities beyond refuge boundaries and management control, there are potential risks of localized and seasonal effects to species in Items IV. A, B and C. However, with respect to water quantity and quality, the proposed action of refuge management has the intent of minimizing adverse effects and providing benefits to species in Items IV. A, B, and C if and when possible.

Increasing Public Use and Wildlife Compatibility

Identified Issue: We are aware of potential benefits and harm to natural resource conservation brought on by an increasing interest in birding and ecotourism. Whooping cranes and rare birds quickly attract many birders and photographers when they appear on the refuge. According to the National Wildlife Refuge System Compatibility Policy, these wildlife-dependent recreational use activities are welcome as long as they are found not to interfere with, or detract from, the fulfillment of the Refuge System mission or the purposes of the refuge.

Proposed Action: The refuge would continue to manage public use activities according to the proposed Alternative B as developed in the CCP. The refuge would not allow public uses that encourage or enhance adverse effects on T & E species. There would be no or insignificant adverse effects to species in Items IV. A, B and C.

(B) Determination: Determine the anticipated effects of the proposed project on species and critical habitats listed in item IV. Check all applicable boxes and list the species (or attach a list) associated with each determination.

Determination

No Effect: This determination is appropriate when the proposed project will not directly or indirectly affect (neither negatively nor beneficially) individuals of listed/proposed/candidate species or designated/proposed critical habitat of such species. **No concurrence from ESFO required.**

May Affect but Not Likely to Adversely Affect: This determination is appropriate when the proposed project is likely to cause insignificant, discountable, or wholly beneficial effects to individuals of listed species and/or designated critical habitat. **Concurrence from ESFO required.**

_____ X

May Affect and Likely to Adversely Affect: This determination is appropriate when the proposed project is likely to adversely impact individuals of listed species and/or designated critical habitat. **Formal consultation with ESFO required.**

May affect but Not Likely to Jeopardize candidate or proposed species/critical habitat: This determination is appropriate when the proposed project may affect, but is not expected to jeopardize the continued existence of a species proposed for listing or a candidate species, or adversely modify an area proposed for designation as critical habitat. **Concurrence from ESFO optional.**

Likely to Jeopardize candidate or proposed species/critical habitat:

This determination is appropriate when the proposed project is reasonably expected to jeopardize the continued existence of a species proposed for listing or a candidate species, or adversely modify an area proposed for designation as critical habitat. Conferencing with ESFO required.

Signature Walter M. Olsen Date 9/25/13
[Supervisor at originating station]

Reviewing Ecological Services Office Evaluation (check all that apply):

A. Concurrence X Nonconcurrence _____
Explanation for nonconcurrence:

B. Formal consultation required _____
List species or critical habitat unit

C. Conference required _____
List species or critical habitat unit

Name of Reviewing ES Office Kansas ES Office

Signature Samuel W. Muller Date 10/31/13

Appendix D

Public Involvement

D.1 Public Involvement

We started public scoping for Quivira Refuge with a notice of intent published in the Federal Register on February 24, 2010. It announced our plan to prepare a CCP and EA for the refuge and to solicit suggestions and information on the range of issues to be considered in the planning process.

In February 2010 a planning update was sent to each individual, organization, and government representative on the CCP mailing list, see section D.2. This update provided information on the history of the Refuge System and on the CCP process along with an invitation to attend one of three listed open houses.

We informed local newspapers, radio, and television stations about our open houses. Flyers were also posted and announcements were made via email and at the meetings of local organizations.

Open houses were held from March 8 to March 10, 2010, in the local communities of Great Bend, Stafford, and Wichita, Kansas. A PowerPoint presentation was given at each, and informational posters, maps, and handouts were made available to provide a history of the Refuge System, an orientation of the planning area, and an overview of the CCP and NEPA processes. We presented the refuge's draft vision statement, and our staff was on hand to provide additional information. Turnout was moderate, 5–15 people attended each meeting and were encouraged to ask questions and offer comments.

We accepted written comments through March 26, 2010, and received more than 80 comments, orally and in writing, during the scoping process. Letters came from three organizations—the National Wild Turkey Federation, Defenders of Wildlife, and the Great Bend Convention and Visitors Bureau—and from 12 individuals. Comments identified biological, social, and economic concerns about our refuge management, and we used these in developing the draft CCP and EA.

Availability of the draft CCP for Quivira Refuge was announced in the Federal Register on April 22, 2013, and comments on this document were collected through May 31, 2013. Three public meetings to discuss the draft CCP and EA were announced in a planning update released in April 2013. These meet-

ings were held from April 29 to May 1, 2013, in Great Bend, Stafford, and Wichita, Kansas. Attendees were given the opportunity to submit comments. We also collected comments online, by email, and by mail.

Our planning team's response to public comments on the draft CCP and EA are included in this appendix.

D.2 Public Mailing List

Following is the mailing list for the Quivira Refuge CCP.

Federal Officials

U.S. Senator Pat Roberts, Washington, DC
U.S. Senator Jerry Moran, Washington, DC
U.S. Congresswoman Lynn Jenkins, Topeka, KS
U.S. Congresswoman Lynn Jenkins, Washington, DC
U.S. Congressman Tim Huelskamp, Hutchinson, KS
U.S. Congressman Tim Huelskamp, Washington, DC
U.S. Congressman Kevin Yoder, Overland Park, KS
U.S. Congressman Kevin Yoder, Washington, DC
U.S. Congressman Mike Pompeo, Wichita, KS
U.S. Congressman Mike Pompeo, Washington, DC

Federal Agencies

FWS—Atlanta, GA, Anchorage, AK, Sacramento, CA, Arlington, VA, Shepherdstown, WV, Portland, OR, Hadley, MA, Albuquerque, NM, Washington, DC, Fort Snelling, MN
USGS—Fort Collins, CO
National Park Service—Denver, CO, Omaha, NE
NRCS—Saint John, KS

Tribal Officials

Osage Nation Tribal Council, Pawhuska, OK

State Officials

Governor Sam Brownback, Topeka, KS
 Representative Mitch Holmes, Saint John, KS
 Representative Michael O'Neal, Hutchinson, KS
 Representative Janice Pauls, Hutchinson, KS
 Representative Joe Seiwert, Pretty Prairie, KS
 Senator Terry Bruce, Hutchinson, KS
 Senator Jay Emler, Lindsborg, KS
 Senator Ruth Teichman, Stafford, KS

State Agencies

Kansas Department of Wildlife, Parks and Tourism—Great Bend, KS, Pratt, KS, Topeka, KS

Local Government

Big Bend Groundwater Management District 5—
 Haviland, KS, Macksville, KS
 City Manager, Sterling, KS
 Clerk Bell Township, Rice County, Raymond, KS
 Clerk Stafford County, Saint John, KS
 Commissioner Reno County, District 2, Hutchinson, KS
 Commissioner Rice County, District 2, Sterling, KS
 Commissioner Stafford County, District 2,
 Macksville, KS
 Commissioner Stafford County, District 3, Saint
 John, KS
 Mayor, Great Bend, KS
 Mayor, Hudson, KS
 Mayor, Saint John, KS
 Mayor, Stafford, KS
 Treasurer Bell Township, Rice County, Ray-
 mond, KS
 Trustee, Putnam Township, Stafford County,
 Ellinwood, KS

Local Businesses

Alden State Bank, Sterling, KS
 ANR Pipeline Co., Alden, KS

Cole Body Shop, Great Bend, KS
 Hoisington Main Street Inc., Hoisington, KS
 Jayhawk Pipeline, McPherson, KS
 White Eagle Resources Corporation, Louisville,
 KS

Organizations

American Bird Conservancy, The Plains, VA
 Audubon Society, Washington, DC
 Defenders of Wildlife, Washington, DC
 Ducks Unlimited, Memphis, TN
 Friends of Great Plains Nature Center, Wichita,
 KS
 Friends of Quivira—Hudson, KS, Larned, KS,
 Saint John, KS, Stafford, KS, Sterling, KS
 Great Bend Convention and Visitors Bureau,
 Great Bend, KS
 Izaak Walton League, Gaithersburg, MD
 Kansas Herpetological Society, Wakarusa, KS
 Kansas Ornithological Society, Prairie Village,
 KS
 National Trappers Association, New Martins-
 ville, WV
 National Wildlife Federation, Reston, VA
 National Wildlife Refuge Association, Washing-
 ton, DC
 Quail Unlimited, Wichita, KS
 Sierra Club, San Francisco, CA
 Sierra Club Southwind Group, Wichita, KS
 Smokey Hills Audubon Society, Salina, KS
 Stafford County Ducks Unlimited, Saint John,
 KS
 The Nature Conservancy, Ellinwood, KS
 The U.S. Humane Society, Washington, DC
 The Wilderness Society, Washington, DC
 Wichita Audubon Society, Wichita, KS

Universities and Schools

Colorado State University, Fort Collins, CO

Media

Great Bend Tribune, Great Bend, KS
 Hays Daily News, Hays, KS
 Saint John News, Saint John, KS
 Wichita Eagle, Wichita, KS

Individuals

55 private individuals

D.3 Public Comments on the Draft Plan

The Draft CCP and EA for Quivira Refuge were presented for public review from April 22 to May 20, 2013. Three public meetings were held from April 29 to May 1 in Great Bend, Stafford, and Wichita, Kansas, and were attended by 39 people, total. The comment period was extended 11 days at the request of Audubon of Kansas, Incorporated, and closed May 31. A total of 60 comment letters were received during the period.

We reviewed all comments and found the following to be substantive. As defined by NEPA compliance guidelines, comments are considered substantive if they.

- question, with reasonable basis, the accuracy of the information in the document;
- question, with reasonable basis, the adequacy of the environmental analysis;
- present reasonable alternatives other than those presented in the environmental assessment;
- cause changes or revisions in the proposal.

In compliance with the spirit of the Privacy Act of 1974, it is our policy in Region 6 to not publish the names, addresses, or other personal information of individuals. Agencies, businesses, and organizations are excluded from this policy. Rather than print every letter from individuals and redact, or black out, all personal information, we have summarized the general nature of the comments received and responded to each substantive comment. Some of the comments do not meet the definition of “substantive,” as defined previously. Those are shown as “comment noted.” In some instances, we have opted to respond to specific nonsubstantive comments where the public displayed a strong interest.

We developed responses to comments after grouping them under the following topics.

- measurable objectives
- water resources
- tree management
- grazing
- whooping cranes
- bison
- general hunting
- waterfowl hunting
- upland game hunting
- deer hunting
- turkey hunting
- sandhill crane hunting
- snow geese hunting
- furbearer hunting
- trapping
- wildlife observation
- antler collecting
- boating
- public outreach
- Friends of Quivira
- tourism
- facilities
- planning process

Measurable Objectives

Comment. *The plan should identify positive results expected from habitat management activities (i.e., burning, grazing, and mowing). Conduct baseline assessments and measure effects of the final plan. The plan should include adaptive management to be able to learn from successes and failures over the coming years.*

Response. As indicated early in the CCP and EA, the Service and Refuge System promote use of adaptive management. Guidance and policy associated with adaptive management is in place, and continues to be refined in recent years. Positive results expected from habitat management activities are captured in measurable objectives, such as those developed for native communities in chapter 6. The general effects of disturbance types used to manage communities are discussed in the CCP and EA in chapter 5. More specific details of management strategies and associated effects are outside of the scope of this plan and are typically included as part of a habitat management plan. In addition, an inventory and monitoring plan is developed after the approval of the CCP that describes protocols used to inform management and measure success in achieving objectives.

Water Resources

Comment. *I acknowledge importance of water in Kansas and urge the protection and continued use of existing water rights.*

Response. Thank you for supporting the sustainability of water resources and water rights in Kansas. Water quantity and quality are critical to current and future generations.

Comment. *With regard to water rights, I don't believe the basin is over appropriated.*

Response. We respect different perspectives and opinions and understand that some may be due to context. For clarification, we use the term “over appropriation” to mean that existing water use cannot be sustained with the continuation of long-term declines in water supplies. For more detail, several documents published by representatives outside of the Federal Government provide descriptions of local water history and declining trends in water levels that indicate uncertainty in the long-term sustainability of water resources in the basin. A few examples include published articles authored by a past manager of the Big Bend Groundwater Management District, or GMD5, (Falk 2006), a professor of law at the University of Kansas (Peck 2006), and a scientist at the University of Kansas-Kansas Geological Survey (Sophocleous 2012). The GMD5 manager explains, “In December 1998, the District (Big Bend or GMD5) recommended to the Chief Engineer that the remainder of the District be closed to further appropriation. Further evaluations had revealed each of the remaining basins to be over-appropriated, based upon a comparison of the amount of groundwater development to the recharge value. As of December 1998, the whole District was closed to large-scale development.”

Tree Management

Comment. *I support tree removal on the refuge.*

Response. We appreciate the positive feedback.

Comment. *I support some tree removal, but less than the current rate and amount.*

Response. We believe that the rate and amount referred to in this comment has lessened. Few trees have been removed this past year. Previous years' management was more aggressive partly due to the temporary availability of added resources to accomplish the work. Refuge stations

are federally funded, and the amount can change annually. Thus, opportunities to make progress in achieving goals and objectives will vary from year to year.

Comment. *I oppose tree removal on the refuge.*

Response. Thank you for sharing your opinion. Much explanation of tree removal is included in the CCP and EA.

Comment. *I support preservation of woodlots identified in Figure 17. Wooded areas provide habitat for many types of wildlife, and provide wildlife viewing opportunities for people.*

Response. We promote public appreciation of natural resources and encourage the feedback.

Comment. *Walnut trees were here when buffalo were, and should remain on the refuge.*

Response. A purpose of the CCP and EA is to provide context to guide refuge management planning, not necessarily to address specific situations case by case. With respect to tree management, several factors are considered, as described in the CCP and EA and in appendix E. Whether or not a tree is native to the region and where it naturally would have occurred in the landscape are among those factors. Furthermore, details involved in decisionmaking are not always simple and straightforward. It is likely, for example, that a planted shelterbelt (linear landscape feature) of native trees fragmenting a large block of prairie and possibly serving as ‘a predator lane’ would be viewed differently than a naturally established small grove of native trees characteristic of a natural landscape setting.

Comment. *Cottonwood is a native species of Kansas, and should remain on the refuge.*

Response. Yes, we agree that cottonwood is a native species and should remain on the refuge. This does not mean that management should, or will, protect every cottonwood seedling, sapling, or tree. Natural processes such as fire historically limited the amount of native woody vegetation on the prairie landscape. Management will allow cottonwood to occur on the refuge as described in the proposed alternative and approved final plan.

Comment. *Aerial spraying by the Service in prior years has killed the catalpa trees on the refuge and some on adjacent lands to the east.*

Response. Current staff has also noticed the change in appearance of the trees in that grove—not completely dead, but certainly affected—and cannot provide an explanation. We are not aware of aerial spraying of the catalpa grove or any other area on

the refuge by management in recent years. Several ice and hail storms, a destructive tornado, and drought are natural events that have affected many trees and wooded areas in recent years.

Grazing

Comment. *I support the current lower cattle allowances which have improved habitat conditions on the refuge.*

Response. We appreciate the observation of desired habitat conditions. The effects of drought in recent years combined with other land management activities often resulted in unintended or undesirable conditions. At the same time, more intensive treatments can have beneficial results in some cases. A recent example is the conversion of a large, monotypic stand of dense cattail to a meadow dominated by various sedges and rushes that now provides diverse structure for wildlife.

Whooping Cranes

Comment. *Cranes like Quivira Refuge because it is one of the few places they are not disturbed.*

Response. Yes, we presume that whooping cranes use Quivira Refuge and certain areas off the refuge in part because of limited disturbance. All alternatives in this document support visitor use activities that are compatible with wildlife.

Comment. *Excited to have the opportunity to reliably see this species at a location other than wintering grounds in Texas.*

Response. It is always great to hear about positive experiences with wildlife. We will continue to support the conservation of this species.

Comment. *Where do the cranes roost on the refuge?*

Response. The most common roosting areas on the refuge are in and around the Big and Little Salt Marshes.

Comment. *How far do cranes feed from the marsh?*

Response. They have been observed foraging in refuge marshes and have been reported using areas within many miles of the marshes or roosting sites. Known observations often occur within ten miles of the refuge.

Bison

Comment. *I support reintroduction of bison on the refuge.*

Response. We appreciate and share your general interest in bison and their associated effects. As indicated in the draft CCP and EA, the reintroduction of bison would require the consideration of many factors, including substantial increases to staff and budget. Our proposed action, alternative B, received much public support but does not include such increases in staff and budget. Furthermore, recent Federal budgets have not included increases that would encourage the initiation of a bison reintroduction program.

Comment. *I oppose reintroduction of bison on the refuge.*

Response. As indicated in the CCP and EA, we acknowledge the tradeoffs and complexities associated with the reintroduction of bison.

General Hunting

Comment. *Wildlife conservation should be the paramount goal, with limited hunting on the refuge as appropriate to achieve ecological health. Hunting should be used as a management tool for wildlife health based on scientific research. Recreation should not be the primary factor for allowing hunting on the refuge.*

Response. Our priority, included in the mission of the Refuge System, is to conserve wildlife and their habitats. Legitimate and appropriate wildlife-dependent uses of refuges, however, are in our guiding principles and include compatible hunting, fishing, wildlife observation, photography, interpretation, and education. Therefore, we will continue to support both compatible consumptive and nonconsumptive uses on Quivira Refuge. The challenge will be to appropriately balance multiple use activities that are compatible with wildlife and habitat conservation as things change.

Comment. *I oppose hunting in general, and all hunting at Quivira Refuge.*

Response. Thank you for sharing your opinion.

Comment. *There should be less emphasis on hunting and more emphasis on wildlife viewing and environmental education.*

Response. Thank you for sharing your opinion.

Comment. *Refuge hunting programs should be managed for the good of the public, not for adjacent landowners looking out for their investments.*

Response. Thank you for sharing your opinion. National wildlife refuges are public lands managed with wildlife and their associated habitats as a priority for the benefit of current and future generations. We desire positive working relationships with all interested parties, both local and nonlocal, especially with those who could potentially influence the conservation of natural resources and when support is needed across multiple administrative boundaries.

Comment. *I am concerned for wildlife viewing and photographer safety during hunting season since the entire refuge is open to wildlife viewing and photography.*

Response. Public safety for visitors and management staff is a critical factor in refuge operations and will remain a primary consideration when we plan visitor use activities. Signs, information resources, and more-detailed stepdown management plans will continue to promote public safety. We also encourage people to be aware of the regulations associated with refuges and of what is going on around them in all public areas.

Comment. *The State is losing hunting opportunities on private lands putting pressure on public lands to provide hunting opportunities.*

Response. It is possible that this is true in certain cases and not in others. For instance, there are different opportunities available for wetland- and upland-associated hunting opportunities on private lands. Also, certain public lands might receive, or are thought to receive, more pressure than others, depending on their mission or purposes and their relative importance to natural resources and visitor use opportunities.

Comment. *If hunting is permitted on the refuge, potential user conflicts between hunters and other refuge visitors need to be minimized.*

Response. We agree that all visitor use activities need to be considered collectively and that potential conflicts should be reasonably limited to assure safety and wildlife compatibility.

Comment. *Spotlighting and poaching is occurring on the refuge. There is a need for more law enforcement to address this issue.*

Response. We agree that law enforcement is an important need and appreciate the information. It has been unfortunate that recent changes in law enforcement staff and hiring restrictions limited surveillance frequency this past year.

Comment. *Has the Service received input from State game wardens on how to enforce the proposed programs?*

Response. We have received input and will continue to work with State partners on hunt plans that consider law enforcement and other factors. Both State and Federal regulations apply to refuge hunting, and management staff periodically consult and work with State game wardens and other law enforcement officers. It may be relevant to note that refuge law enforcement officers have the same qualifications as those who serve outside of the Service.

Waterfowl Hunting and Whooping Cranes

Comments.

- *I support alternative A which maintains current situation of closing the refuge when whooping cranes are present and maintaining North Lake within hunt area and available for hunting when the refuge is open to hunting.*
- *I support "No Hunting Window" October 10–November 20 to protect whooping cranes.*
- *Cranes are too important to allow hunting on the refuge when they are present. The risk of an accidental (or purposeful) shooting is too great.*
- *I support alternative B which allows some hunting when whooping cranes are present.*
- *Oppose closing North Lake area to waterfowl hunting.*
- *Keep North Lake in the hunt area and selectively close any unit occupied by cranes on any day. For example, if whooping cranes are in the Big Salt Marsh the Little Salt Marsh could be open and vice versa.*
- *Manage the refuge similar to Cheyenne Bottoms Wildlife Area. Close the areas being used by whooping cranes and leave the rest of the refuge open to hunting.*
- *Allow hunting on the south end of the refuge to remain open when cranes present. Suggest Units 10 and 11 could remain open to hunting.*
- *Do not close the refuge to hunting when whooping cranes are present. Hunting opportunities are limited in Kansas. Thousands of acres are available for Whooping*

Cranes. Sad to see waterfowl hunting disappear as whooping cranes stay on the refuge longer and longer.

Response. Verbal and written responses on the topic of whooping cranes and hunting boundaries and closures were numerous and varied. We appreciate the interest and the constructive feedback. It should be noted that both consumptive and non-consumptive user responses support reducing the risk to whooping cranes. Also, many hunters said they preferred the opportunity to hunt the North Lake area for a limited number of days over hunting in areas outside of the North Lake area for more days where there has traditionally been little-to-no whooping cranes use.

In discussing these topics, we applied an objective approach by evaluating public use activities within the context of Service laws, policies, and guidance. Key considerations were the Refuge System mission and the refuge's establishing legislation, or purposes. Such evaluation included, but was not limited to, (a) reducing risk to threatened and endangered species and species of concern; (b) safety; and (c) logistics, or the ability to carry out actions that facilitate compliance with laws and regulations. Among many factors, we discussed observations of whooping crane behavior and habitat use that are unique or specific to an area of the refuge. At times, a given crane individual or family has used more than one location daily on the refuge, such as the Big Salt Marsh, at the north end, and the Little Salt Marsh, at the south end. Also, based on personal staff and research experience, whooping cranes have been present but undetected by people as a result of vegetation cover or other obstructions. Issues were identified with the use of time frames, or "windows," due to changing factors, such as increasing populations, migration trends or shifts, landscape conditions, and weather or climate patterns.

Additional details are provided in our responses under other hunting-related topics in this section. We will continue to evaluate how we balance public use opportunities and natural resource conservation as conditions change and new information becomes available.

Upland Hunting

Comment. *When deer season is open will the refuge be closed to upland bird hunting?*

Response. Details related to hunting will be addressed in a hunt plan developed following the approval of the final CCP. It is likely that refuge-specific regulations will apply in order to accomplish natural resource objectives, balance public use opportunities, facilitate law enforcement, and ensure the safety of the public and refuge staff. It is possible that separate areas and times will be designated to allow for various consumptive and nonconsumptive activities.

Deer Hunting

Comment. *Support deer hunting on the refuge. In a state with limited hunting opportunities, those without financial resources for private hunts are dependent on public lands for recreational hunting.*

Response. Thank you for your comment.

Comment. *Deer hunting should be based on herd management objectives and scientific data, not solely as a recreation opportunity.*

Response. Yes, there are several reasons to allow deer hunting. The local population has continued to grow since refuge establishment, which is a long-term trend, and current densities are high relative to other areas of the state. Increases to these high deer densities may adversely affect the health of deer or other wildlife.

Comment. *Suggest limited special hunts such as governor's tag, youth hunt, wounded warriors, etc.*

Response. The Service supports special hunt opportunities, and we will consider these when developing the more-detailed hunt plan.

Comment. *Suggest limited deer hunting on refuge such as archery and shotgun only. Restrict high-powered cartridges to address safety concerns for neighboring landowners.*

Response. We appreciate the feedback and can say that safety will be a high priority in the more-detailed hunt plan.

Comment. *Suggest smaller hunt area same as the proposed area for waterfowl and upland game.*

Response. The proposed deer hunt boundary delineates the area where deer hunting might be allowed in the future, but this does not mean that the entire area would be opened at any one time. Deer movement patterns change, and there are other factors to consider, such as other consumptive and nonconsumptive use activities. Refuge-

specific regulations will limit where, when, and how deer hunting will occur within the proposed (approved) boundary.

Comment. *Proposed hunting boundary goes right to the border of the refuge creating safety issues for adjacent landowners, especially in the south end of the refuge where the boundary is narrow. Suggest hunting boundary be moved back to create a buffer area between refuge boundary and private properties for safety purposes.*

Response. Public safety concerns and potential use conflicts exist in refuge areas near administrative boundaries, especially during hunting seasons, and boundary and safety concerns exist regardless of whether or not hunting occurs on, or adjacent to, private or public lands. Refuge-specific regulations will limit where, when, and how deer hunting will occur within the proposed (approved) boundary, and safety will remain a priority in the development of a more-detailed hunt plan. Law enforcement will support public safety and the protection of natural resources.

Comment. *Oppose deer hunting on refuge. Deer herd is decreasing; fawn survival is currently low due to drought and disease.*

Response. We respect your opinion. The CCP guides management direction for the next 15 years and considers both short- and long-term trends. The current long-term trend is that the local deer population is increasing. Management needs the ability to make appropriate annual adjustments to refuge-specific hunting regulations that are consistent with management goals and objectives.

Comment. *I am concerned that deer hunting would lower the value of adjacent private property. Rates gained from leasing the hunting rights are a key consideration for landowners.*

Response. We understand the concern. We do not know if, or how, deer hunting on the refuge will influence adjacent private property values. According to current staff, property values were not affected when other hunting opportunities were offered on the refuge.

Comment. *The refuge provides wonderful deer viewing opportunities which may be negatively impacted by hunting on the refuge.*

Response. We support both consumptive and nonconsumptive opportunities that are compatible with wildlife and our conservation goals and objectives. We acknowledge that potential conflicts exist when we support multiple visitor use opportunities and will consider them when refuge-specific

hunting regulations are enacted to limit things like areas and seasons.

Comment. *Opening deer season will jeopardize ecotourism, especially if rifles, shot guns, or muzzle loaders are allowed.*

Response. We believe that, with appropriate management, ecotourism and hunting programs can coexist. Management can develop specific regulations that apply within the boundaries of Quivira Refuge that are different from other lands, such as State or private lands. We can limit how, where, and when hunting occurs. With the careful development of refuge-specific regulations, we can successfully provide compatible consumptive and nonconsumptive visitor use opportunities.

Comment. *If population control is needed, work with private landowners to take more does off their land.*

Response. We agree that this is a strategy to consider.

Comment. *What did Kansas State and Sterling College deer research indicate? Are the deer destroying habitat?*

Response. Highlights of the research findings are provided in chapter 4 of the draft CCP and EA.

Comment. *Are there population targets for deer hunting?*

Response. We do not have targets at the moment.

Turkey Hunting

Comment. *Support turkey hunting on the refuge. Start with limited-basis special hunts such as youth only, wounded warrior, etc.*

Response. Thank you for your supportive comment. Limited special hunts, such as for youth or wounded warriors, seem to be popular options. We will consider them as a starting point.

Comment. *Restrict high-powered cartridges to address safety concerns for neighboring landowners. Limit to archery and shotgun only.*

Response. We will consider this in the development of the hunt plan.

Comment. *Suggest smaller hunt area for turkey; use same area as proposed for waterfowl and upland game.*

Response. For clarification, the boundary map in the draft CCP and EA shows only where we might

allow turkey hunting in the next 15 years. After approval of the turkey hunt boundary, management will have the authority to restrict hunting to any area(s) within that boundary. Sites do not have to remain the same year after year as long as they are within the approved boundary.

Comment. *Proposed hunting boundary goes right to the border of the refuge, creating safety issues for adjacent landowners, especially in the south end of the refuge where the boundary is narrow. Suggest hunting boundary be moved back to create a buffer area between refuge boundary and private properties for safety purposes.*

Response. Public safety concerns and potential use conflicts exist in refuge areas near administrative boundaries, especially during hunting seasons, and boundary and safety concerns exist regardless of whether or not hunting occurs on, or adjacent to, private or public lands. Refuge-specific regulations will limit where, when, and how turkey hunting will occur within the proposed (approved) boundary, and safety will remain a priority in the development of a more-detailed hunt plan. Law enforcement will support public safety and the protection of natural resources.

Comment. *Oppose turkey hunting on the refuge. I am concerned whether the turkey population is large enough to support a hunt.*

Response. We presume that the local turkey population fluctuates and will consider that in the development of the more-detailed hunt plan as well as when providing opportunities for nonconsumptive use associated with turkey and factors related to wildlife conservation.

Comment. *Fall turkey hunting would be disruptive to wildlife viewing and photography opportunities on the refuge.*

Response. Seasonal restrictions and possible conflicts among visitor use opportunities will be considered in development of the more-detailed hunt plan.

Comment. *Opening turkey season will jeopardize ecotourism, especially if rifles, shot guns, or muzzle loaders are allowed.*

Response. Potential conflicts among visitor use opportunities will be considered in the development of the more-detailed hunt plan.

Comment. *Proposed turkey hunting conflicts with upland game hunting.*

Response. Federal and refuge-specific regulations often apply to hunt programs that occur on refuge lands. When developing more-detailed hunt plans, we will consider the potential conflicts among

hunt programs, among visitor use activities, and factors influencing wildlife conservation.

Sandhill Crane Hunting

Comments.

- *Support sandhill crane hunting on refuge.*
- *Oppose sandhill crane hunting on refuge.*

Response. Sandhill crane hunting will remain prohibited on the refuge in order to reduce the risk to the endangered whooping crane. One of the Service's primary responsibilities is to protect endangered species, and Quivira Refuge provides designated critical habitat for whooping cranes. Conditions among areas of critical habitat in the State and flyway are not necessarily the same. At Quivira Refuge, sandhill and whooping cranes often occur together. Local habitat use by crane species and the detectability of cranes on the refuge are relevant factors for us to consider.

Snow Geese Hunting

Comment. *I would like to see a spring hunt for snow geese.*

Response. This will be considered in the development of the more-detailed hunt plan. If allowed, it may be limited by refuge-specific regulations.

Furbearer Hunting

Comment. *Oppose furbearer hunting on the refuge.*

Response. Thank you for sharing your opinion.

Trapping

Comment. *Oppose trapping on the refuge.*

Response. We respect different opinions on public use activities. Refuge-specific regulations will restrict aspects of trapping activities, such as the number, location, and types of traps used, and will require the approval of a special use permit by the refuge manager. This approach should facilitate enforcement and alleviate safety concerns.

Wildlife Observation

Comment. *Wildlife watching increased 67 percent from 2001 to 2011. More emphasis is needed on nonconsumptive activities such as wildlife viewing and photography, interpretation, and environmental education.*

Response. Quivira Refuge has, and will continue to promote, nonconsumptive use activities. As described in chapter 4, a recent visitor use survey conducted by the USGS indicated that most use on the refuge was nonconsumptive. Over 90 percent of respondents were satisfied with the recreational activities and opportunities and the services provided by employees or volunteers.

Comment. *Support nonintrusive wildlife observation and citizen science on the refuge.*

Response. We will continue to support both consumptive and nonconsumptive visitor use activities on the refuge. Management will also consider the potential conflicts of multiple use activities in decisionmaking in order to strike an appropriate balance that is compatible with wildlife conservation and associated refuge goals and objectives.

Public Outreach

Comment. *Use Quivira Refuge Web site for more outreach.*

Response. We agree that outreach via the Internet is important. Recently, the Service redesigned web-sites for a more unified system-wide appearance in part to facilitate use. Quivira Refuge was one of the first refuges to activate a Web site under this new design. Management provides regular updates to the site, such as recent sightings on the refuge and scheduled events, throughout the year. Links on the site lead not only to documents and maps, but also to social sites such as Facebook and Flickr, where additional information and photographs are updated several times weekly.

Antler Collecting

Comment. *Would like to see antler collecting permitted on the refuge.*

Response. The collecting or taking of any plant, wildlife, or parts thereof from a national wildlife refuge without a permit is specifically prohibited

under Title 50 CFR Part 27.61. Prohibiting antler collecting is consistent with, and facilitates associated public communications and law enforcement activities on, other Kansas refuges.

Boating

Comment. *I would like to be able to use non-motorized small boats (canoe, float tube) on the refuge in support of fishing activities.*

Response. There are many reasons why nonmotorized boats are not permitted for use on the refuge. These include the potential for increased disturbance to wildlife, law enforcement and safety concerns, and environmental health hazards like the spread of zebra mussels, pathogens, and more. While we support many public use opportunities, wildlife and habitat conservation is the highest priority of the Refuge System mission.

Tourism

Comment. *Nature-based tourism provides important economic benefit to the State of Kansas and local communities.*

Response. Yes, we agree.

Comment. *Kansas could enjoy tourism benefits if Whooping Cranes were protected and promoted.*

Response. Refuge management supports whooping crane conservation and compatible use activities. Numerous visits to Quivira Refuge and Kansas by the public are associated with opportunities to view whooping cranes. News of the presence of whooping cranes in the area of the refuge spreads quickly via media, Internet, and phone.

Facilities

Comment. *Please provide better information and signage to let people know biking and hiking on roads closed to vehicle traffic is allowed.*

Response. Thank you for this feedback. We will continue to improve the communication of refuge use opportunities and regulations.

Comment. *A restroom facility is needed at the north end of the refuge. Suggest it be located near the North Lake and Salt Flats areas.*

Response. We will keep this in mind but will not make any commitments based on current maintenance needs, previously proposed infrastructure improvements, and budget or time constraints.

Comment. *Why is the refuge open from dawn to dusk?*

Response. The refuge is open to the public when law enforcement, safety, and conservation concerns can be met.

Comment. *I would like to camp on the refuge.*

Response. Recreational activities that are not wildlife dependent and not appropriate and compatible with the conservation of wildlife and their habitat do not support the mission and priorities of the Refuge System. Restricted camping may occur on refuges under certain circumstances, such as when access and location are not concerns, and usually requires an approved special use permit.

Comment. *Is the ADA (Americans With Disability Act) blind in an area that might be closed to hunting when whooping cranes are on the refuge?*

Response. Yes.

Comment. *No Action is a bad term; should be “Continued Management.”*

Response. Thank you for your comment.

Comment. *Parts of each alternative might work. Is it an all or nothing approach?*

Response. Based on comments we received on the draft CCP and EA, our planning team will review all of the actions proposed in all of the alternatives and pull actions from alternatives not selected to craft the management direction to be contained in the final CCP.

Comment. *The plan was developed behind the scenes with no transparency or public involvement.*

Response. We followed NEPA guidelines in reaching out to the public to encourage their involvement and to inform them on the progress of this plan. Our efforts are outlined in the beginning of this appendix and in chapter 1.

Comment. *Chapter 4 should come before chapter 3 to make it easier to understand the alternatives.*

Response. Thank you for your comment.

D.4 Comments from Tribes, Agencies and Organizations

We received formal comments from the following tribal, Federal, State, and local government agencies and organizations.

1. Osage Nation, Tribal Historic Preservation Office
2. Kansas Department of Wildlife, Parks and Tourism
3. U.S. Environmental Protection Agency
4. Audubon of Kansas, Incorporated

Letters from these agencies and organizations are shown on the following pages. Beside each reproduced letter are our responses, numbered to correspond to specific comments in the letter.

Friends of Quivira

Comment. *I would like to see increased involvement by the Friends group.*

Response. Thank you. Support for the Friends of Quivira group is much appreciated.

Planning Process and Public Notice

Comment. *Little notice of the public meetings was provided.*

Response. We followed NEPA guidelines in reaching out to the public to encourage their involvement. Our efforts are outlined in the beginning of this appendix and in chapter 1.



TRIBAL HISTORIC PRESERVATION OFFICE

Date: May 30, 2013 File: 1213-393KS-10
RE: US Fish and Wildlife Service Quivira National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment in Stafford, Rice, and Reno counties, Kansas

Division of Refuge Planning, FWS
Toni Griffin
P.O. Box 25486, DFC
Denver, CO 80225-0486

Dear Ms. Griffin,

The Osage Nation Historic Preservation Office has reviewed the **Draft Comprehensive Conservation Plan and Environmental Assessment for US Fish and Wildlife Service, Quivira National Wildlife Refuge in Stafford, Rice, and Reno counties, Kansas** and has no comments at this time. The Osage Nation is very pleased with the level of consultation between representatives of the Osage Nation and the Quivira National Wildlife Refuge and FWS Mountain-Prairie Regional staff during the development of the Comprehensive Conservation Plan and Environmental Assessment and anticipates receiving the Final drafts of those documents.

In accordance with the National Historic Preservation Act, (NHPA) [16 U.S.C. 470 §§ 470-470w-6] 1966, undertakings subject to the review process are referred to in S101 (d)(6)(A), which clarifies that historic properties may have religious and cultural significance to Indian tribes. Additionally, Section 106 of NHPA requires Federal agencies to consider the effects of their actions on historic properties (36 CFR Part 800) as does the National Environmental Policy Act (43 U.S.C. 4321 and 4331-35 and 40 CFR 1501.7(a) of 1969).

The Osage Nation has a vital interest in protecting its historic and ancestral cultural resources. In addition to reviewing the Final Comprehensive Conservation Plan and Environmental Assessment for US Fish and Wildlife Service, Quivira National Wildlife Refuge in Stafford, Rice, and Reno counties, Kansas, the Osage Nation anticipates working collaboratively in the identification and protection of historic and ancestral cultural resources of significance to the Osage Nation in the future.

The Osage Nation requests that this collaboration includes:

- The development of a consultation protocol agreement between the Osage Nation and Quivira National Wildlife Refuge;
- Historic property identification and management that exceeds regulatory requirements;
- A complete cultural resource survey of the Refuge;
- The development of a Refuge Cultural Resource Management Plan;
- Monitoring of significant cultural resources on the Refuge;
- Enhanced training of Refuge Law Enforcement and other staff in the identification of prehistoric artifacts and responsibilities under the Archaeological Resources Protection Act;

Comment
number

LETTER #1—Osage Nation, Tribal Historic Preservation Office, page 2 of 2

RESPONSE

- Installing, or improving, interpretive signage throughout the Refuge regarding the prehistory of the Refuge and reflecting the relationship between Indian Tribes, specifically the Osage Nation, and the Refuge, and its surroundings; and
- The installation of interpretive and informative displays at the Refuge's Environmental Education Classroom and Visitor Center.

The Osage Nation suggests that these efforts, accompanied by compliance with Section 106 of the National Historic Preservation Act and other relevant regulations and guidance, will improve visitor experience while protecting its historic and ancestral cultural resources.

Should you have any questions or need any additional information please feel free to contact me at the number listed below. Thank you for consulting with the Osage Nation on this matter.


Dr. Andrea A. Hunter
Tribal Historic Preservation Officer


James Munkres
Archaeologist I

2-1. We appreciate the offer to provide assistance in implementing new hunting opportunities on Quivira Refuge. We are confident that our partnership will benefit the conservation of natural resources now and in the future.

2-2. We are pleased that KDWPT supports our desire to “increase hunter use and satisfaction while continuing to safeguard whooping cranes.” In the early stages of CCP and EA development, representatives of the hunting community requested that the planning team explore the option of partial hunting closures during whooping crane migration, as described in the proposed alternative B. Public reviews of the draft CCP and EA indicate that many hunters and nonconsumptive users largely prefer current management (alternative A) to the proposed option (alternative B) with respect to hunting opportunities and whooping crane closures. While there were exceptions, it was the opinion of many hunters that satisfaction would be higher with fewer days of hunting the North Lake area (alternative A) due to the presence of whooping cranes compared to more days of hunting areas outside the current hunt boundary (alternative B) that have had little-to-no use by whooping cranes. Personal ties (tradition, memories), knowledge, and experience were common considerations. Many public responses from both hunters and nonconsumptive users also expressed deep concern regarding whooping crane safety. Because the protection of endangered species is one of our primary responsibilities, comments related to this topic were carefully deliberated.

When evaluating public use activities on the refuge, we applied an objective approach by placing discussions within the context of Refuge System laws, policies, and guidance. Key considerations were the Refuge System mission, priorities found in the Improvement Act, and



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Robin Jamison, Secretary

Sam Brownback, Governor

Mike Oldham, Refuge Manager
Quivira National Wildlife Refuge
1434 NE 80th St
Stafford, KS 67578

Mike,

Thank you for the opportunity to comment on the Quivira National Wildlife Refuge (QNWR) Draft Comprehensive Conservation Plan and Environmental Assessment. Due to the unique habitats of QNWR, it is an important area of conservation in Kansas, and the recreational and educational opportunities it provides makes QNWR and Kansas Department of Wildlife, Parks and Tourism (KDWPT) important partners in conservation.

KDWPT applauds the inclusion of expanded hunting opportunities and access as part of the recommended alternative (Alternative B) of the conservation plan. We support the recommended introduction of deer and turkey hunts on QNWR, and would be happy to provide input on the most appropriate manner to initiate those hunts. Providing opportunities for hunters is an important and popular visitor service, especially in landscapes with limited public land like central Kansas. Hunting is also an important tool for the management of wildlife populations on the refuge, and we look forward to participating in discussions regarding the most appropriate ways to manage deer, turkey, and furbearer populations. KDWPT also supports the recommendation to eliminate the closure of the entire refuge to all hunting when whooping cranes are present. Allowing upland hunting or waterfowl hunting in units other than where whooping cranes are present, as is proposed in the preferred alternative, would increase hunter use and satisfaction while continuing to safeguard whooping cranes.

We recognize and support the intent to continue providing quality waterfowl hunting opportunities on the refuge while limiting hunter conflicts resulting from areas closures. However, we ask that you reconsider the recommended closure of the salt flats/north lake region of the current waterfowl hunting zone. This area is the most popular and productive area open to waterfowl hunting at QNWR. There is no evidence included that indicates the proposed waterfowl hunting area would provide the same waterfowl hunting opportunities, as it does not appear to contain the same quantity or quality of waterfowl hunting habitat. Furthermore, although proposed changes to the water management of the new hunt zone may increase waterfowl use and hunter success, they also have the potential to encourage increased whooping crane usage, resulting in situations not unlike what the refuge currently faces regarding area closures. KDWPT maintains that greater waterfowl hunter satisfaction could be achieved by continuing waterfowl hunting in the salt flats/north lake area, even with periodic spot closures to that unit due to the presence of whooping cranes in the pool. The north lake area is popular during the September Teal Season and is very popular later in the duck/goose seasons (December-February), which are outside of normal whooping crane migration period.

In addition to these changes to the waterfowl hunting zone on the refuge, KDWPT would like for consideration be given to expanding hunter opportunities for light goose hunting during the spring conservation order, particularly in late February and early March when light geese are most abundant on the refuge but before the spring migration of most birds, including whooping cranes. The population expansion of mid-continent light geese has been a concern for all federal and state wildlife agencies. The USFWS and Canadian Wildlife Service have been at the forefront in management decision to abate the impacts of light geese on their wintering, migration and nesting grounds. Hunting has been the primary

2-1

2-2

2-3

2-4

the purposes of Quivira Refuge. Applying these principles included, but was not limited to, (1) reducing risk to threatened, endangered, and protected species; (2) considering the safety of refuge staff and the public, which is mission critical; and (3) carrying out actions that ensure compliance with laws and regulations.

2-5

tool to reduce the growing light goose population, primarily with the initiation of the Spring Conservation Order. By opening the refuge to light goose hunting during early spring, QNWR would be acting in the best interest of the light goose populations, other species that rely on the same arctic nesting grounds, and other species utilizing wetland habitat on QNWR.


We also suggest greater consideration be given to Alternative C regarding sandhill crane hunting. QNWR is one of the larger migratory stopovers for sandhill cranes in Kansas. It is also an area of Kansas from which KDPWT receives the most complaints of crane agricultural depredation. Sandhill crane hunting regulations are designed to provide recreational opportunities and relief from crop depredation while continuing whooping crane conservation. KDPWT has taken several conservative measures in the season structure to meet these objectives (delayed season dates, mandatory annual crane identification testing for all sandhill crane hunters, and limited shooting hours). Sandhill crane hunting is a biologically justified activity, and is permitted on many US NWR and state wildlife areas throughout the Central Flyway that also provide important whooping crane stopover locations.

2-6

Finally, we support the recommendation to allow furbearer harvest from the perspective of both management and recreation. However, the recommended alternative only permits furbearer hunting with firearms and archery equipment on the basis of "safety concerns". We suggest that trapping also be included as a method of furbearer harvest. Modern trapping equipment does not pose a threat to people. In Kansas, furbearers spend over 100,000 user days trapping annually, and no bystanders are injured by traps. Nationally, the user days are in the millions, and there simply are no human injuries. If the safety concern is for dogs, we would encourage allowing the use of certain trap types that do not pose a risk to dogs. Most notably, cage traps can be used effectively on several important furbearer species without fear for the safety of dogs. There is also a very popular group of foot encapsulating "dog-proof" raccoon traps that would also be suitable for trapping what is likely the most abundant furbearer on QNWR. Finally, certain types of submerged traps for beaver and other semi-aquatic furbearers that are not effectively hunted may be very beneficial to refuge management objectives, and can also be compatible with dogs when used properly. We encourage you to consider these additional opportunities for furbearer harvest, and would be happy to discuss trapping options further at your request.

Thank you for taking the time to considering this input. We recognize the difficult task the refuge faces, and look forward to further collaboration as this process moves forward.

Sincerely,


Joe Kramer
Director, Fisheries and Wildlife Division
Kansas Department of Wildlife, Parks & Tourism

CC: Tonni Griffin

2-3. As requested by KDPWT and others, closure of the North Lake area to hunting was re-evaluated. With the North Lake area included as part of an approved hunt boundary, other areas proposed for hunting under proposed alternative B will be closed to hunting. According to the CFR, no more than 40 percent of the refuge may be open for waterfowl hunting. When determining hunt boundaries, we consider other wildlife and public uses, safety, law enforcement, public access and opportunity, and multiple logistical factors, especially those related to the periodic closure of hunting areas when whooping cranes are present.

2-4. As requested, we will consider "expanding hunter opportunities for light goose hunting during the spring conservation order, particularly in late February and early March when light geese are most abundant on the refuge, but before the spring migration of most birds, including whooping cranes" when we develop the more-detailed hunt plan. We agree that reducing the growing light goose population is a concern of Federal and State conservation agencies. Things to consider are (1) the potential effects on other wildlife using refuge lands at this time; (2) multiple, sometimes conflicting, public use activities; and (3) the relative level of success in reducing populations by expanding this opportunity to include refuge lands. In February and March, geese typically occur in large numbers with other waterfowl and sandhill cranes. The number and diversity of birds using the refuge at this time attract public use activities such as birding and photography. Geese commonly use the ref-

uge at this time of year and also visit surrounding lands in the region daily, offering numerous opportunities for hunting and population reduction as well as nonconsumptive public use activities. Allowing light goose hunting opportunities on parts of the refuge during the spring conservation order might be viewed by some as compensation for days closed to hunting due to the presence of whooping cranes.

2-5. We reviewed opportunities for sandhill crane hunting and considered that many public responses we received from hunters and nonhunters expressed deep concern about hunting activities' increased risk to whooping cranes. This applies to sandhill crane hunting because whooping cranes on the refuge commonly occur in, or near, flocks of sandhill cranes. With the protection of endangered species being one of our primary responsibilities, it would be difficult to justify increasing sandhill crane hunting opportunities on the refuge.

2-6. Furbearer hunting options were reconsidered in the development of the final CCP. Furbearer hunting will only be allowed under a special use permit within the same area allowed for big game hunting. Specifics will be provided in a more-detailed hunt plan. Options, including species, methods, areas, and season lengths, will be more fully developed in cooperation with KDWP and within the context of the Refuge System mission and priorities and the refuge's purposes. We will consider the logistics of law enforcement and the safety of staff and the public among other things.

2-7. We thank KDWP for their continued input throughout the planning process and look forward to future collaboration.

- 3-1.** Thank you for your thoughtful review and support.
- 3-2.** We agree that management practices should prioritize the conservation of wildlife and their associated habitat, and adverse conditions to these should be reduced. We also agree that communications with the Kansas State Historic Preservation Office and tribal historic preservation officers should remain important for increasing knowledge and improving the interpretation of cultural resources on the refuge.
- 3-3.** We considered including a timeline as part of the Freshwater Springs strategies for the development and implementation of an associated management plan for this unique resource in the final CCP. Meetings with local experts and a review of available information would be initiated within the first 5 years to help guide management.



Griffin, Toni <toni_griffin@kws.gov>

EPA Review Comments: Quivira National Wildlife Refuge Draft CCP & EA

1 message

Tucker, Amber <Tucker.Amber@epa.gov>
To: "toni_griffin@kws.gov" <toni_griffin@kws.gov>

Tue, May 28, 2013 at 9:29 AM

Dear Ms. Griffin:

RE: Draft Comprehensive Conservation Plan and Environmental Assessment for the Quivira National Wildlife Refuge

This letter responds to your Notice of Availability and request for comments, concerning the Draft Comprehensive Conservation Plan and EA for Quivira National Wildlife Refuge in Stafford, Rice, and Reno counties in south-central Kansas. Thank you for involving the Environmental Protection Agency (EPA) during the consideration of environmental impacts either to or from this project.

The Draft EA adequately outlines the purpose, need, and general conservation plan. The overall benefit of implementing an adaptive management plan to the Quivira National Wildlife Refuge is sufficiently stated in this document. We also would like to thank you for addressing the potential direct, indirect, and cumulative effects. Though environmental impacts included in the EA were overall minimal, EPA offers the following comments for additional considerations of potential environmental impacts and a focus on minimization and mitigation of these impacts:

EPA continues to support avoiding and minimizing adverse impacts to air, land, and water quality, including wildlife and their habitat. We would like to suggest that any potential effects or disturbance of fish and wildlife species be minimized to the extent possible through the use of BMPs for such activity. Additionally, we commend your efforts to increase the interpretation of cultural resources on the Refuge and would recommend continued efforts to contact and involve Tribes that may be able to offer additional information on these resources. In addition to coordinating with the Kansas State Historic Preservation Office, you may also want to establish communication with any Tribal Historic Preservation Officers that may have information or investment in the region.

The only other comment we would offer is regarding the 15-year management plan mentioned for the Freshwater Springs Strategies; if you have a timeline for the development &/or implementation of this plan, it would be helpful to include that in this section.

If you have any other questions, you can contact me at 913-551-7565, or via email at tucker.amber@epa.gov.

Amber Tucker
US EPA R7
ENSV/NEPA Team
11201 Renner Blvd
Lenexa, KS 66219

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Neil Rasmussen, Administrative Assistant
Lana Michael, On-site Sanctuary Coordinator

May 29, 2013

To: **Toni Griffin, Acting Chief, Division of Refuge Planning, U.S. Fish and Wildlife Service, Region 6,**
Mountain-Prairie Region, 134 Union Blvd., Lakewood, CO 80228
Email address: Toni_Griffin@fws.gov

From: **Ron Klatske, Executive Director, Audubon of Kansas, Inc.,**
210 Southwind Place, Manhattan Kansas 66503
Email address: Ron_Klatske@audubonofkansas.org

Regarding: **Comments on behalf of Audubon of Kansas on the**
Draft Comprehensive Conservation Plan and Environmental Assessment
Quivira National Wildlife Refuge

Audubon of Kansas supports the aspects of Alternative B (Proposed action) that "focus on restoring native communities and promoting the potential natural range of conditions on Quivira National Wildlife Refuge that help focal resources, or focal species and their respective habitats." "The primary purpose of the Refuge System is to conserve wildlife."

Audubon of Kansas is detailing a series of observations and concerns regarding the "Draft Comprehensive Conservation Plan and Environmental Assessment," and we are offering a series of recommendations and/or requests for revisions that will hopefully be incorporated in the final plan.

We strongly support the "Native Ecological Community Conservation Goal" and the U.S. Fish and Wildlife Service plan to:

"Actively conserve and, as appropriate, improve environmental conditions within refuge boundaries to promote sustainable native ecological communities and support species of concern associated with this region of the Great Plains."

However, we do not support the wholesale effort to increase "public use opportunities for hunting," and to a significant degree to do that at the expense of wildlife conservation and other visitor opportunities and uses. The plan almost appears to be an attempt to discard and/or diminish opportunities for nonconsumptive uses of the refuge—including wildlife viewing and photography. The Quivira National Wildlife Refuge has become one of the nation's premier wildlife viewing destinations. Nearly 71.8 million people engaged in wildlife watching, according to the 2011 national Survey of Fishing, Hunting, and Wildlife-Associated Recreation. That type of recreation has been increasing nationally at a rate far exceeding the recruitment of hunters (where numbers are unfortunately declining). Overall trip-related expenditures pursuant to wildlife watching increased 67% from 2001 to 2011. This type of nature-based tourism is the most promising prospect for future visitation to Quivira, and for economic benefits for surrounding communities.

The plan does correctly acknowledge the importance of wildlife observation and photography in one section on page 98, with the following paragraphs:

"Quivira Refuge is a premiere birdwatching site in Kansas, and one of the top sites in North America. Birders travel to the refuge from across Kansas, as well as the United States, and many return to Quivira Refuge on a regular basis. Peak birder visitation usually coincides with the peak shorebird and waterfowl migration seasons in the spring and fall."

CITIZENS COMMITTED TO CONSERVATION

Audubon of Kansas is a nonprofit 501(c)(3) organization devoted to promoting the enjoyment, understanding, restoration and stewardship of natural ecosystems in America's heartland. We work with many conservation partners, including Audubon chapters in Kansas: Burroughs A. S. of Kansas City, Jayhawk A. S. of Lawrence, Leavenworth A. S., Northern Plains Field A. S. of Manhattan, Smoky Hills A. S. of Salina, Sperry-Gallager A. S. of Pittsburg, Southeast Kansas A. S. of Parsons, Topeka A. S., and Wichita A. S.

4-1. Thank you agreeing with aspects of the proposed alternative B and for providing additional observations and thoughts to help us complete the plan.

4-2. Your support for the Native Ecological Community Conservation Goal is appreciated. Of utmost importance to us, as part of the overall mission of the Refuge System, is the conservation of wildlife and their habitats. Our guiding principles also include legitimate and appropriate uses of refuges, including compatible wildlife-dependent activities involving hunting, fishing, wildlife observation, photography, interpretation, and education. The appropriate balance of consumptive and nonconsumptive use activities and their potential effects on natural resources is affected by changing and interacting factors and elicits wide-ranging opinions, perceptions, and uncertainties. We presume that the perceived emphasis on hunting activities may have been due, in part, to the page length used to describe them relative to nonconsumptive use activities among the alternatives. Page length does not indicate the level of importance we place on each subject. With hunting, it may have had more to do with addressing the many public requests we received to discuss this complex subject. In fact, based on a recent visitor survey, there is general satisfaction with nonconsumptive activities and their management on Quivira Refuge. We will support these popular activities on the refuge as long as they remain compatible with wildlife. We have two and a half positions on Quivira Refuge devoted to both consumptive and nonconsumptive visitor services as their main responsibility and most of our other staff members dedicate some time to visitor use opportunities, interpretation, and education. This would not change under alternative B. We thank you for the recognition and support of these visitor use opportunities, and we will continue to consider potential conflicts among use activities.

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4-3. Regardless of the alternative, we agree that whooping cranes should be protected from disturbance while they are present and be able to use the full range of habitats on the refuge. Protecting and supporting endangered species, such as whooping cranes, is one of our primary responsibilities. To clarify our intent, in the draft CCP and EA, alternative B originally would have closed areas of the refuge to hunting when whooping cranes are present. At any time, the refuge manager would still have had the authority to close the entire refuge to hunting activities for the protection of whooping cranes. The manager also would have had the option to open a part of the 22,135-acre refuge to hunting only if it was determined that it would not disturb the whooping cranes present on, or near, the refuge. Decisions would have been based on things like potential buffer distance, time in whooping crane migration, current habitat conditions, and whooping crane behavior. For all visitor use activities, we will continue to put up closed area signs and post other necessary information, such as safe approach distances.

4-4. We applaud the joint efforts of many in the conservation of whooping cranes, as you demonstrate in your discussion of the Whooping Crane Conservation Action Plan. These collaborations and the status of the whooping crane are also described in our Ecological Services 5-year review, signed 2011–2012. It is our intent that management actions on Quivira Refuge will continue to support whooping crane conservation and recovery plans, regardless of the alternative.

Besides birders, Quivira Refuge is popular with more general wildlife observers who visit to view deer, beaver, bald eagles, and the considerable amount of geese, ducks, and cranes that regularly visit during the same period.

A large percentage of visiting birders and general wildlife enthusiasts are also photographers. Many professional and experienced photographers use the refuge on a regular basis."

The Quivira National Wildlife Refuge is regarded by many people, especially wildlife enthusiasts, as the closest public land area that Kansas has to the type of wildlife attractions that Yellowstone offers the State of Wyoming. Quivira NWR has become a statewide, regional and national destination for wildlife viewing and photography.

Unfortunately, very little attention is given to maintaining the quality of and future enhancement of wildlife observation and photography opportunities. The priority given to this resource use under "actions" is summed up with two feeble sentences (page 62): "Encourage wildlife observation and photography except in seasonally closed areas. Keep the auto tour route, the observation towers, scopes and two photography blinds." The additional bullet points in the document principally focus on developing "displays, social media, and handout literature" rather than minimizing disturbances to wildlife and interactions between general "nonconsumptive" refuge visitors and potentially conflicting hunting activities.

The "Visitor Services Goal" for "Implementation of the Proposed Action" (starting on page 177) is largely dominated by "Hunting Objective 1," "Hunting Objective 2," and "Hunting Objective 3" in terms of dedicating refuge resources of land, expenditures and staff assignments.

Whooping Crane Conservation and Migratory Habitat Needs should become Paramount for Future Stewardship of the Quivira NWR.

One of the most important purposes served by the Quivira NWR is as a safe, relatively "low disturbance" migratory stopover area for the one self-sustaining and recovering population of endangered Whooping Cranes. Based on records of use in recent decades, as well as the absence of sufficient wetland complexes with a similar history of use, Quivira NWR appears to be the most important migratory stopover, resting, night roosting and "recharging" area for Whooping Cranes in the central Great Plains of the United States. Quivira stands out as a "Critical Habitat" between the Aransas NWR on the Texas Coast and the nesting areas in and around the Wood Buffalo National Park in northern Alberta and the Northwest Territories of Canada.

To the fullest extent possible, Whooping Cranes should be protected from disturbance while they are present and should be able to use the full range of suitable habitats at the Quivira NWR. The various management strategies to accomplish this objective should include reduction or elimination of vehicle activities in the immediate vicinities of the night roosting, loafing and any feeding habitats they are using, restrictions on human access and various activities that may result in disturbance. This should include restrictions on wildlife viewing and photography that infringe on the birds and threaten to disrupt their behavior or sense of security. There has been a consensus that people should not attempt to approach closer than a quarter mile of Whooping Cranes, and that greater distance separations are advisable—depending on the nature of the human activity, landscape setting and other factors.

In 2009-2010, Whooping Crane biologists from throughout this country and Canada involved in a yearlong effort to develop a Whooping Crane Conservation Action Plan (CAP) identified a number of conservation measures that are important to the species and relevant to management choices for the Quivira NWR.

On behalf of Audubon of Kansas, I participated in the collaborative planning meetings held in Saskatchewan and Texas, and the overall project. A number of U.S. Fish and Wildlife Service officials were involved, including representation from the Quivira NWR. The Nature Conservancy, Crane Trust, and others associated with management of migratory habitat in Nebraska (especially the Platte River) and Whooping Crane habitat elsewhere were also involved in CAP leadership. Unfortunately, the KDWP and other entities stationed in Kansas did not participate. For purposes of highlighting the importance of migratory habitat, I am including a couple headings and a few sentences from a summary of the report < <http://www.gbo.org/html/1000Whoopers.pdf> >. I have highlighted some statements in red for emphasis because of their relevance to the COMPREHENSIVE CONSERVATION PLAN and the guidance it will provide for management of the Quivira NWR during the next 15 years.

THE IMPERATIVE FOR ACTION

"The conservation of Whooping Cranes is often referred to as a success story – a job well done. What many may not realize is that the story of the long-term success and viability of the North American Whooping Crane has only just begun. Recovery efforts by the U.S. Fish and Wildlife Service, the Canadian Wildlife Service, and several other public and private stakeholders are over 75 years in the making.

While portions of the breeding and wintering habitat frequented by the wild population are generally protected from human disturbance, a growing population of birds are already venturing out into areas currently unprotected. In addition, migration corridor habitat is largely unprotected."

The culmination of the work of the Whooping Crane Conservation action planners is reflected in this Executive Summary. The group entered into the planning endeavor with a shared mission:

Permanently remove Whooping Cranes from the endangered species list through well-defined, strategic conservation actions

A 5,000-MILE COMMITMENT

"Whooping Cranes spend the winter along the Gulf Coast of Texas at Aransas National Wildlife Refuge. They arrive during October through December and depart from mid-March through April to migrate to their breeding grounds in northern Canada at Wood Buffalo National Park and remain there from May through September. Hence, the wild population is often called the "Aransas-Wood Buffalo population" or "AWBP" referring to their wintering and breeding grounds.

Fall migration occurs during October and November until the cranes arrive again at their wintering ground. Adult cranes that had a successful breeding season in Canada migrate with their chick(s).

Whooping Cranes move between the Gulf Coast and the Canadian wilderness every spring and fall – averaging 200 miles a day – under highly unpredictable conditions. It is critical for the Whooping Crane to have safe and accessible stopover wetland habitat along its travel route. Suitable habitat must provide the bird with security, seclusion, and food and water resources, allowing for rest and recovery from the long day's flight. Many factors, such as climate, weather, and human disturbance can significantly impact Whooping Cranes and their stopover habitat

MIGRATION

"The journey between Texas and the Northwest Territories of Canada spans a continent. There are many dangers in the approximately 5,000 miles this species must travel annually. The birds must stop daily for rest and feeding opportunities. The stops must have an adequate supply of freshwater and food to improve the odds of their survival during migration. Generally speaking, these daily stopovers should be located every 50-100 miles along the migratory corridor to account for varying weather patterns that can force the birds down unexpectedly. Birds having to fly too far in a day are reducing their overall health and fitness. Birds flying at night or in bad weather are increasing their likelihood of injury or death.

Unfortunately, we only know where some birds stop over and when. Developing a comprehensive analysis of their migratory flight patterns that identifies the most critical areas and suitable habitat ensures the cranes continue to be viable. We must create a shared multi-conservation partner monitoring system throughout the migration corridor to increase our understanding of flight patterns. It is critical we work collectively to promote the creation of "Whooping Crane friendly" habitats as well as avoid destroying or degrading already well documented crane stopover sites"

I. RELATIVE TO THE IMPORTANT MISSION OF WHOOPING CRANE CONSERVATION, AS IT RELATES TO THE COMPREHENSIVE CONSERVATION PLAN for the Quivira National Wildlife Refuge, Audubon of Kansas Requests the following:

(1) Close the Quivira NWR to all hunting from October 10 to November 20.

4-5. We appreciate the recommendations. The following considerations relate to the various discussion points mentioned.

- The period of whooping crane presence is not a given and would be expected to change due to factors such as changing landscape and climate conditions and with fluctuations in the whooping crane population.
- For clarification, hunting closures on the refuge due to the presence of whooping cranes have typically not changed daily in recent years. The refuge has been closed from nearly one week to two consecutive weeks or more.
- Yes, in this context, more resources would be required to implement alternative B due to proposed changes in hunt boundaries and opportunities, as stated in the draft CCP and EA. There are tradeoffs associated with each alternative.
- Regardless of the alternative, we will continue to refine communication strategies for increased understanding.
- We agree that numerous questions exist regarding real or perceived wildlife behaviors and potential human disturbances. Others have questioned the success of long-term conservation if public lands are closed to use activities in order to avoid risk to some or all wildlife. As a result, potential opportunities for education are lost that could influence public support for natural resource conservation. Again, there are tradeoffs associated with any balance of natural resource conservation and human activity. The

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appropriate balance of natural resource and human needs largely supports the function of Federal and State policies and regulations, such as those related to the protection of natural resources under the Migratory Bird Treaty and Endangered Species Acts. Education and enforcement activities for these regulations would be an important part of the approved management direction.

- Several of your recommendations involve specifics beyond the scope of a CCP. More-detailed stepdown plans and protocols are developed following the approval of a final CCP. These plans are consistent with the goals and intent of an approved management direction. Public review of the draft CCP and EA will be considered in the development of stepdown plans.

This is the period when Whooping Cranes are most likely to be on the refuge in the fall. A standard closing will diminish the sense of dashed expectations and the perception that Whooping Cranes create an ever-present (but somewhat unpredictable) potential "conflict" with hunters and their plans.

This regular standard closing will help to avoid the type of disappointment that has occurred when people plan to hunt on the refuge, only to be turned away at the last moment because Whooping Cranes are present. In some cases, as was acknowledged by USFWS staff at the Wichita meeting, sometimes hunters have elected to ignore the closed signs in the early morning and proceed to hunt, even shooting waterfowl relatively close to Whooping Cranes. This creates an unacceptable situation for Whooping Cranes and an unfortunate situation (and possibly a citation for violations) for hunters.

If hunting on the refuge is closed during this period of frequent use by Whooping Cranes, rather than just when Whoopers are documented as "present," refuge staff do not have to be as vigilant to the potential evening (at dusk or even after dark) arrival of Whooping Cranes on the refuge, and they will not have to expend additional resources posting signs and closing the refuge to hunting prior to the pre-dawn arrival of hunters the next morning, and law enforcement.

In spite of the claims in the report that the eleven-hour closure approach of specific sections of an area where Whooping Cranes are present has worked well at the Cheyenne Bottoms Wildlife Area, we question the validity of the state agency's claims and the wisdom of USFWS adopting it for inclusion in the Plan for Quivira. The cost to the USFWS (all taxpayers) will increase as described in the text provided below from the Draft:

"More law enforcement, signage and communications would be required."

"There would be more parking areas and roads for access and more costs related to changing hunt areas, signage, parking lots, brochures and adding law enforcement."

As indicated above we specifically question the validity of the statement--and the wisdom of the suggestion--in the plan where it states that:

"At the nearby Cheyenne Bottoms Wildlife Area, Kansas Department of Wildlife, Parks and Tourism has successfully protected Whooping cranes by using partial area closures. This may prove to be effective for us as well."

It may be true that Whooping Cranes have not been shot or shot at within the Cheyenne Bottoms Wildlife Area in recent years, but we wouldn't likely know if either had occurred. Most hunting violations are never detected or reported. The prospect of disturbance may have a greater adverse impact on the Whooping Crane population. The impact of disturbance is difficult to document. If Whooping Cranes bypass an area such as Cheyenne Bottoms in the afternoon or evening as Sandhill Cranes are being shot, other shooting is occurring and other human activities such as people moving and vehicles with lights on as hunters and others are leaving, it is not likely that it would be "documented" as disturbance. The same applies to earlier morning activities that likely start an hour to an hour and a half before sunrise. If Whooping Cranes that roosted in the wetland (alone or with Sandhill Cranes) leave the area and possibly go to Quivira or some other place, or proceed on migration, it is difficult to know if they are reacting to disturbance or naturally anxious to proceed.

If they don't linger in an area throughout the day, and roost another night, it is conceivable (but certainly not documented) that site-specific disturbance is a factor. Quivira NWR is not and has not been without various disturbance factors. However, once Whooping Cranes are known to be present, hunting activities have been largely curtailed. One measure of the impact of disturbance is a comparison of the length of stay at the two locations. The data suggests that length of stay during the fall migration is greater at Quivira NWR. The fidelity and length-of-stay for Sandhill Cranes may also suggest that disturbance (and shooting) at Cheyenne Bottoms is driving cranes from that area to night-roosting at Quivira. That may become more pronounced now that the KDWPPT (in 2012) eliminated the shooting hours restrictions regarded as "safeguards for Whooping Cranes" and the management protocol for Sandhill Cranes. Following the shooting of three Whooping Cranes near Quivira in 2004, Sandhill Crane shooting was delayed until a half hour after sunrise to diminish the prospect of mistaken identity under low light conditions and/or sunrise backlighting when both species of cranes appear the same when viewed as

4-6. As part of the proposed action, Quivira Refuge will be closed to all hunting activities when whooping cranes are present. However, we will consider some exceptions related to special, controlled, permitted hunts, such as the limited use of archery in hunting deer in specifically designated upland areas of refuge, when we develop a more-detailed hunt plan.

silhouettes. The same consideration is applicable at and near sunset. Afternoon closing of crane shooting at 2 p.m. (prior to 2012) allowed Sandhill Cranes to return to night-roosting wetland habitats, loaf and likely remain in the vicinity longer. However, in 2012 KDWPT changed shooting hours for Sandhill Cranes to open at sunrise and close at sunset.

The two sites differ, and in some cases it is likely that Cheyenne Bottoms provides better habitat and food resource conditions, on other occasions the reverse may be true (certainly last year with drought conditions at Cheyenne Bottoms). Thus, it is difficult to know if the differential disturbance of hunting associated activities at Cheyenne Bottoms is the primary reason of more extended Whooping Crane stays at Quivira. However, **this factor cannot and should not be discounted in development of the final Comprehensive Conservation Plan for the Quivira NWR.** Although Cheyenne Bottoms is designated as critical habitat for Whooping Cranes, the mission of the KDWPT and the operating plan for a Wildlife Area differ from the mission of the USFWS and the established conservation/management plan for the Quivira NWR.

As pointed out in the CAP, migrating Whooping Cranes must travel 2,500 miles each fall and they have a daily need for secure roosting areas, resting opportunities, fresh water and suitable feeding habitat. Family groups cannot be unintentionally "harassed" by human activities (and anthropomorphic disturbances of many kinds) for much of the length of the arduous migration and arrive on their wintering grounds in optimal condition for winter survival. On some recent occasions, depleted freshwater flows into the Gulf Coastal estuaries and other factors have dramatically diminished the supply of Blue Crabs, clams and other food staples that many Whooping Crane rely on during their winter stay. Body condition at the end of the wintering period, and sustained through migration is vital during the spring migration and for breeding in Canada. Migratory stopover habitats are important both fall and spring.

Recent records indicate that increasing numbers of Whooping Cranes are staying at the Quivira NWR during fall migration, stopping there in greater numbers and for more extended stays. A contributing factor, possibly the most important factor, in this increase may be due to the closure of hunting on the refuge during their presence.

Although shooting of Whooping Cranes mistaken for Sandhill Cranes may be a greater threat now beyond the boundaries of Quivira, disturbance caused by the proposed increase in hunting activities on the refuge (as included in Alternative B) is our greatest concern on the refuge. In essence, Alternative B transforms much of the Quivira National Wildlife Refuge from its core mission devoted to wildlife conservation of imperiled species and waterfowl to that of becoming the equivalent of a "public hunting area." If Alternative B is adopted as included in the Draft, the potential disturbance while Whooping Cranes are using the refuge will include the arrival of vehicles up to an hour and a half before sunrise (with lights and noises) associated with preparation for hunting, placement of decoys, etc. Shooting starts a half hour before sunrise. Upland game bird hunting often involves the use of dogs and whistles, as well as less restraint on talking (or hollering at dogs). With more parking areas called for in the plan and needed with this approach, the cumulative influence on the visual and audio landscape of the refuge may change substantially and change wildlife reaction and behavior. With this in mind, Audubon of Kansas requests that USFWS:

(2) Continue to close the Quivira NWR to all hunting activities when Whooping Cranes are using the refuge.

Two sentences included in the section under Alternative C that need to be recognized and incorporated in the management and hunting protocols selected in the final draft include the following:

"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."

Therefore, whooping cranes may use other areas, such as wide-open meadows, more often during migration."

Maintaining a "refuge" or "wildlife sanctuary" where hunting is seldom and/or very selectively allowed does not necessarily diminish hunting opportunities overall in the region. In fact, it often enhances wildlife conservation in ways that improves hunting within the surrounding area and region. Waterfowl, for example, are often more likely to remain in an area if there is a refuge for periodic retreat. This principle is probably even more essential for Sandhill Cranes. Cranes need shallow water areas for secure night roosting, and there aren't many such suitable habitats in Kansas—and even fewer that are not subject to hunting or other disturbances. Without refuge areas these

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4-7. Based on our interpretation of these statements and other parts of the review, it seems that some clarification of the proposed action (alternative B) for the refuge is necessary. The review by Audubon of Kansas, Incorporated, states that we are proposing a “paradigm shift in management...devoted primarily to...wildlife conservation and non-consumptive use to one...for the purpose of public hunting access.” In short, this is inaccurate. Management philosophies associated with each alternative may not have been adequately communicated in the draft CCP and EA. In fact, the relative importance of wildlife conservation and nonconsumptive uses under alternative B will at least be the same as that under alternative A (current management). Alternative B, as a whole, has the potential to increase benefits for both wildlife conservation and nonconsumptive activities. It includes goals and objectives that support the improvement of these uses and increased efforts to inform management. Additional discussion and details may be found in our response 4-2.

4-7

4-8

birds are further stressed and often pushed out of an area, even to another state (if there is any other place to go). In times of drought, as in the past few years, it is difficult for cranes to find suitable wetland and playa sites for roosting, loafing and as a source of fresh water. In some instances the migration distances and demands of Sandhill Cranes is twice that of the 5,000-mile annual round trip of Whooping Cranes.

II. RELATIVE TO THE IMPORTANT MISSION OF WILDLIFE CONSERVATION AND WILDLIFE VIEWING OPPORTUNITIES, AS THEY RELATE TO THE COMPREHENSIVE CONSERVATION PLAN for the Quivira National Wildlife Refuge, Audubon of Kansas Requests that the USFWS:

- (3) Reject the paradigm shift in management proposed for the Quivira NWR that would dramatically transform most of the refuge land for much of each year from its historical purpose devoted primarily to its unique public interest values of wildlife conservation and non-consumptive enjoyment to one (as proposed with Alternative B) primarily managed for the purpose of public hunting access.

If the public hunting recommendations included in Alternative B are adopted, public hunting of various game birds could be encouraged and allowed in one form or another nine months each year from September 1 to May 31 if the spring Wild Turkey season is included. Year-round hunting would be permitted if the full length of state squirrel and rabbit seasons are also included and the current closure of hunting from March 1 to August 31 is abandoned.

Public hunting areas provide opportunities of importance to users and the State of Kansas, and the state has invested handsomely in those opportunities. As a result, public hunting is available on approximately 300,000 acres of state lands, plus federal lands including 108,000 acres at the Cimarron National Grassland, 72,000 acres at Fort Riley, 22,072 acres at the three OTHER federal refuges, along with sixteen Army Corps of Engineers (USACE) and six Bureau of Reclamation (USBR) reservoir areas. In addition, about 1.1 million acres of private land is open to public hunting with Walk-In-Hunting Area agreements. The federally-funded USDA Conservation Reserve Program enhances the habitat values and hunting potential of many of these acres under contract, as well as other lands within the 2.3 million acre total enrolled in the program in Kansas.

“Hunting with permission” opportunities exist on most of the rural lands within Kansas, the vast majority of the state’s 52 million acres.

Our nation’s general funds pay for USDA, USACE and USBOR programs, and USFWS management of the national wildlife refuges. Thus, even those among us who do not annually purchase KDWP hunting, fishing or trapping licenses are equal stakeholders in stewardship decisions involving the Quivira National Wildlife Refuge.

- (4) Audubon of Kansas requests that rail hunting, and hunting of other webless migratory birds, not be permitted on the Quivira NWR. KDWP authorizes shooting of Sora and Virginia Rails with an extraordinary bag limit of 25 per hunter per day. However, very little if any practical attempt is made to educate hunters of the risk of shooting other rail species. None of the rail species are abundant in Kansas and some species (including Virginia Rails) have “suffered considerable declines in the past....” (Thompson et al. 2011, Birds of Kansas, p. 125). Black Rails are designated as a State Species in Need of Conservation in Kansas.

Black Rail populations have been declining in the eastern United States for over a century resulting in a retraction of its breeding range, an overall reduction in the number of breeding locations within its core range, and a loss of individuals within historic strongholds. Over the past 10-20 years, some reports indicate that populations have declined 75% or greater and have become dangerously low.

The best-known and most consistent (nesting) colony (in the state of Kansas) is in a flooded field near the edge of the Quivira NWR. “Here birders have successfully heard (and occasionally seen) summering (and probably breeding) individuals since 1981. Preferred nesting sites appear to be marshy areas with stable water levels, a feature not common at most Kansas wetlands.” (Thompson et al. 2011, Birds of Kansas, p. 123).

The same authors indicate that King Rails “presumably nest at Quivira NWR.” In the last 60 years, King Rails have all but disappeared from areas where they were once locally common, including Missouri’s river marshes, the southern shores of the Great Lakes, and Delaware’s Snyrna River valley. Between 1994 and 2003, the breeding

4-8. Thank you for the comments and information. These will be considered in the development of the final CCP and in more-detailed stepdown management plans. During initial scoping, the public identified these primary, hunting-specific factors for us to address in planning: (1) the consideration of opportunities for deer and turkey hunting; and (2) partial closures of hunting when whooping cranes are present. Therefore, the planning team addressed these specific requests and focused on broad differences among hunting alternatives in terms what may and may not be allowable, as directed by the refuge manager. Because there are many complex planning details that require further consideration, like safety, law enforcement, conflicts with other use activities, and natural resources, a stepdown hunt plan will be developed following the approval of the final CCP.

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Bird Survey indicated acute declines, with significant losses in former strongholds like Texas, Louisiana, and Florida. Christmas Bird Count data confirm this trend.

Black Rails and King Rails are classified as "rare" on the refuge, and Virginia Rails are classified as "uncommon."

There are no compelling reasons why hunting of rails, snipe (classified as "uncommon" on the refuge) or woodcock (classified as "rare" on the refuge) should be encouraged or permitted on the Quivira NWR. There are compelling conservation and public use incompatibility reasons why shooting of these species should not be allowed on the refuge. The refuge is a migratory stopover habitat for many similar species, often using the same wet habitat. Minimizing disturbance of these species, especially considering that there are so few alternative wetlands in Kansas, should be a USFWS priority.

Audubon of Kansas opposes Sandhill Crane hunting on the Quivira NWR. Thus, we do not support the suggestion that Sandhill Crane hunting be allowed as included in Alternative C. That would further jeopardize Whooping Cranes.

Although there may not be any species-specific conservation concern associated with dove hunting on the refuge, most dove hunting occurs near agricultural fields, roosting sites and water sources. The agricultural fields (885.24 acres) within Quivira NWR may eventually be phased out in favor of prairie restoration. Most of the invasive trees throughout the refuge are being removed, and the twelve woodland groves identified for retention are either located near the refuge edge, or at a couple locations farther within (Migrant's Mile and Warbler) where walking trails and wildlife viewing are popular. Encouraging a lot of shooting at the boundary groves may not be helpful in terms of maintaining harmony with neighboring landowners. Those woodlands may prove to be particularly attractive to woodland and woodland edge birds, and for wildlife viewing and photography. Shooting of doves at watering sites within the refuge is inconsistent with diverse other refuge purposes and values. Fortunately for prospective dove hunters, almost all other public lands in the state (including major portions of the three other national wildlife refuges) are open for dove hunting and countless opportunities for good hunting sites exist throughout the state on private lands with hunting by permission. Minimizing disturbance of other wildlife and allowing some element of priority for other wildlife users on this one national wildlife refuge within the state seems consistent with the mission.

As a life-long hunter and professional wildlife biologist, I find the document statement suggesting that if Prairie-chicken populations can be miraculously reestablished on the refuge that hunting will be allowed "if refuge population can support it or for health purposes, as decided by the State." First, it is highly unlikely that a substantial population of Greater (or Lesser) Prairie-chickens will be reestablished on the refuge within the foreseeable future. It is less likely if the refuge implements the transformation of management to that more in line with a public hunting area. Prairie-chickens are very sensitive to excessive human activity. The late Robert J. Robel stated in conversation that all the activity of researchers and their vehicles at Konza Prairie is likely a major contributing factor to the decline of the Prairie-chicken population on that 8,600-acre research natural area near Manhattan. If Alternative B is adopted, there will be a lot more human activity as a result of the increased hunting permitted, and as the document states, "There would be more parking areas and roads for access...signage, parking lots...and...law enforcement." All of these management elements will have an impact, and the physical infrastructural changes will further fragment the grassland habitat.

Second, to the best of our knowledge, there is no reason to believe that Prairie-chickens will have to be hunted for "health purposes." Are there any known instances of record where it has been necessary to initiate a hunting season on Prairie-chickens for health purposes? Finally, the suggestion that this decision should be "decided by the State" implies that USFWS management staff at the refuge would be unable to make a determination on the need for a Prairie-chicken hunting season, and that the KDWPT is the appropriate authority for determination of refuge management for sensitive species like Greater Prairie-chickens and would give conservation priority over the perception of maximizing hunting opportunities. Currently the KDWPT annually sets a hunting season of more than 100 days on Greater Prairie-chickens and the season even includes two-dozen counties where the species has been extirpated in recent decades or only survives in remnant at-risk populations. The season for Prairie-chicken hunting (even in the area where the range of *Lessers* and *Greater*s overlap) exceeds the season length of Pheasants and Quail by three weeks.

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After further review, some hunting-related public comments were addressed under the proposed action or will be considered in the development of the more-detailed hunt plan. When evaluating public use activities on the refuge, we applied an objective approach that placed discussions within the context of Refuge System laws, policies, and guidance. Key considerations were the Refuge System mission, priorities found in the Improvement Act, and the purposes of Quivira Refuge. Applying these principles included, but was not limited to, (1) reducing risk to threatened, endangered, and protected species; (2) considering the safety of refuge staff and the public, which is mission critical; and (3) carrying out actions that ensure compliance with laws and regulations. With this in mind, the following bulleted responses address more-specific comments regarding hunting.

- Certain species that are not common on the refuge or are closely associated with potential impacts to species of conservation concern would not be huntable species on the refuge, such as rail, woodcock, snipe, sandhill crane, and prairie chicken. For example, not allowing rail hunting should reduce the potential for disturbing or accidentally taking black or king rails. As a result of the limited occurrence of most of these species on the refuge, hunting opportunities would not be significantly reduced. At the same time, we would promote educational opportunities on the conservation of these species and their associated communities.
- Control, such as by hunting, of furbearers and small game will involve refuge-specific regulations. Furbearer hunting or trapping will be controlled and only allowed with an approved

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special use permit. Among various factors considered will be certain species, such as beaver, that sometimes cause significant impacts to refuge infrastructure and compromise management plan implementation and success.

- The hunting of wild turkey would involve refuge-specific regulations that carefully consider potential conflicts with other public use activities and wildlife. For example, the refuge manager may allow limited special youth or veteran hunting opportunities at restricted times and only in specific areas within the approved boundary.
- In the final plan, northern bobwhite would remain a huntable species within the approved hunt boundary, which includes less than 40 percent of the refuge's area. Under the proposed action, the refuge manager would have the authority to develop special refuge regulations pending future conservation concerns. Bobwhite occurrence on the refuge regularly includes areas outside of the hunt boundaries, and over 60 percent of the refuge excludes the hunting of upland game birds. Thus, Quivira Refuge would continue "enhancing the breeding populations within the surrounding landscape."

To restore and retain the full range of wildlife conservation purposes of the Quivira NWR and its unique prominence as one of the nation's foremost wildlife viewing areas, Audubon of Kansas recommends that hunting should be allowed for waterfowl, Pheasants, White-tailed Deer (but not Mule Deer if they repopulate the refuge as it is restored to more open grassland), and specific furbearers that may have a substantial detrimental impact on reproductive success of species in special need of conservation on the refuge. Hunting and/or regulated trapping to manage populations of Raccoons, Coyotes, Opossums, Striped Skunks and possibly Mink may be consistent with the refuge mission, however it is unlikely that there should be a need to allow take of Beavers, River Otters or Muskrats. Beaver and Muskrats often enhance wetland areas in ways that have the potential of increasing species richness and biodiversity. In the process of removing trees, it will be beneficial to avoid piling tree trunks and limbs into large piles (as has been done recently), because they may serve as denning sites and habitats used by mammalian nest predators within the grasslands and wetlands.

Hunting of species designated as "rare" or "uncommon" on the refuge diminishes other refuge purposes and values.

The refuge has been closed to turkey hunting, and we recommend that it continue to be closed. Wild Turkeys are common throughout much of the landscape of Kansas and are by no means an at-risk species in the area. However, maintaining this closed status should be in recognition of the contribution that they provide for wildlife viewing and the enjoyment of many, many visitors to the refuge. They are a prominent, highly visible species. "Charismatic mega fauna" is a phrase that many people use for wildlife of this nature. The relatively unique Wild Turkeys and White-tailed Deer viewing opportunities contribute to the enjoyment of refuge visitors, and are among the species that are familiar to the general public of all backgrounds. Many other species of wildlife are elusive and/or are overlooked by the casual visitor. Most will never see a Least Bittern or listen for a Black Rail.

The question that should be addressed is whether the presence of a few Wild Turkeys that are accustomed to people, and not terribly wary, is a wildlife viewing and photography opportunity resource that should be maintained, and if this type of resource contributes to frequency of visitation, the length of stay and the economic value of tourism to the surrounding communities. To use a word from Benjamin Franklin's famous phrase, it is "self-evident." Although hunting also provides a similar benefit, the issue is whether the public benefit of giving a succession of visitors an opportunity to view and photograph a gobbler repeatedly over a period of months or years is more or less significant than for that bird to be shot and removed from the refuge.

Limitations on shooting of some resident species, including Northern Bobwhites, may have the added benefit of enhancing the breeding populations within the surrounding landscape. Northern Bobwhites are classified as "uncommon" on the refuge. Retaining those that occur on the refuge may offer greater opportunities for visitors to see and hear this iconic woodland edge species that was once common and now rare in many areas. Research has demonstrated that reductions in the number of Northern Bobwhites below ten in a covey reduces winter survival. As the number of birds in a covey drop further, prospects of survival diminishes further.

From the standpoint of hunting, the "law of diminishing returns" may not apply for some species within popular public hunting areas. The "law of diminishing returns" suggests that a cessation in hunting will occur when a game population in an area has diminished, allowing for survival of numbers sufficient to maintain breeding population. Within a popular public hunting area, however, the number of hunters and the arrival of a succession of hunting parties are not really limited. Excellent hunting skills and the use of good sporting dogs are effective at harvesting quail. The length of the season is also a factor. Quail hunting seasons extend for two and a half months (from the second Saturday in November to January 31) in Kansas.

As expressed by two hunters at the May 1 meeting in Wichita hosted by the USFWS on the draft plan, some neighboring landowners and the hunters who lease hunting privileges on their lands value the presence of an abundant deer population on the refuge. The deer population reportedly even adds to the market value of adjacent lands. Their primary interest is the presence of mature bucks and the prospect that they can be lured or naturally leave the refuge. By the same token, mature bucks—especially those that are relatively docile on the refuge—are an attractive resource for wildlife photographers. Visitors to the refuge are often treated with an opportunity to view deer at relatively close range. For youngsters or grandparents alike, and for many people of all ages in between, the opportunity to see and watch deer in the wild is a thrill. Deer are part of the special attraction of the Quivira NWR. As stated in the draft, with deer hunting, "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."

4-9

The best way to trim the herd, while maintaining most of the unique opportunities and values of the present and recent past, may be to allow some harvest during the early January antlerless season. On the subject of site-relevant science-based information and education, the ridiculous cartoon-like "Deer Trail to Disaster" display on the Kiosk at the intersection of NE 140th St. and NE 140th Ave. should be revised or removed. It illustrates the theme that when "large predators are gone," hunting has been banned, "deer numbers explode," "food supplies dwindle and...starvation results." Considering the past closure of Quivira for deer hunting, it portrays the USFWS's existing management as leading to a "Disaster." Although the theme has merit in some places, it is not likely that closure of deer hunting on 22,135 acres in the middle of an agricultural landscape in the middle of Kansas is going to lead to widespread deer starvation. The desirability of having a limited area closed to hunting, and also the desirability of where hunting for population control can be justified for "health purposes." However, deer baiting (a common practice currently not regulated) for hunting purposes throughout the state may be or become a factor far more significant as a portal for deer disease transmission.

III. RELATIVE TO THE IMPORTANT MISSION OF RESTORING NATIVE ECOLOGICAL COMMUNITIES TO PROVIDE HABITAT FOR SPECIES OF CONCERN associated with the Quivira National Wildlife Refuge. Audubon of Kansas Requests that the USFWS address a major omission of national significance, and incorporate a conservation plan for the species and complex involved in the final implementation plan:

Although the plan states that the USFWS will, "Actively conserve and, as appropriate, improve environmental conditions within refuge boundaries to promote sustainable native ecological communities and support species of concern associated with this region of the Great Plains", there are obvious gaps in the ecological overview.

The obvious gap in planning is for the conservation and management of Black-tailed Prairie Dogs and the diverse and numerous associated species, including species somewhat or largely dependent on the presence of prairie dogs for prey, or for the habitat of burrows and short vegetation that they create. At present there is one small colony on the very northeast edge of the refuge, and because of its severely limited size it is of little significance even as a potential breeding area for Burrowing Owls. Grazing does not appear to be sufficient to allow expansion within the refuge, and illegal shooting appears to occur (based on observations of shell casings). Under current management conditions (benign neglect at best) the prairie dog colony may not be sustainable, and any potential for it to serve as a source breeding area for Burrowing Owls will be lost, along with benefits for other associated wildlife. Burrowing Owls are not mentioned as a focal species, but the species should be. Burrowing Owls prefer large prairie dog colonies over smaller colonies, and reproductive success is higher at the former.

Prairie dogs would, if reasonably abundant within an area of the refuge, provide a reliable food source for Ferruginous Hawks when they are present in winter and/or during migration. The list of birds, mammals, reptiles and amphibians that benefit from the presence of prairie dog colonies is lengthy and can be reviewed in the book *Conservation of the Black-tailed Prairie Dog: Saving North America's Western Grasslands*, edited by John L. Hoogland, 2006, Island Press.

As detailed in this and other publications, Black-tailed Prairie Dogs are recognized as a keystone species and a foundation species. According to Hoogland (2006), "Their disappearance drastically affects ecosystems..." Black-tailed Prairie Dogs should be a focal species, for conservation of grassland communities, and recognized as a valuable resource for wildlife viewing and photography.

The draft provides the following relevant information:

"There are about 9,512 acres of native, grass-dominated vegetation associations outside of what is defined as wetland, based on GIS calculations of recent coverage.

Quivira Refuge is recognized for wetland and waterbird resources, but the refuge is also comprised of thousands of acres of upland, native sand prairie habitat that commonly support grassland obligates and species of concern, such as grasshopper sparrow and dickcissel. The decline of grassland bird populations are of serious conservation concern.

4-9. We agree that prairie dogs and associated species and habitat are important components of Great Plains ecosystems. And, we support the management of prairie dog colonies in the recovery of the black-footed ferret, which involves many refuges, states, and regions. Past management of Quivira Refuge has proactively encouraged the expansion of prairie dog colonies, including the introduction of prairie dogs to different areas of the refuge. There have been failures attributed to high groundwater levels and the periodic flooding of colonies. The refuge cannot contain all aspects of fully functioning Great Plains ecosystems within the 22,135-acre boundary. We consider the relative contribution of refuge resources to larger landscapes and ecosystems that expand beyond refuge boundaries. Prairie dog colonies and more heavily grazed areas currently exist on surrounding private uplands. We continue to evaluate the tradeoffs of actions that favor certain species and habitat conditions over others. Habitat in the same area of the existing prairie dog colonies on the refuge is used by dickcissel, prairie chicken, and other species that prefer habitat conditions that are limited in the surrounding landscape.

In February 2010 a planning update was sent to each individual, organization, and government representative on the CCP mailing list. The planning update provided information on the history of the Refuge System and on the CCP process, along with an invitation to attend listed open houses.

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Provide a minimum of 70 percent of the estimated 4,163 acres of predominantly native-short-mid, sparse-medium-grassland habitat, including at least 1 area on, or near, a prairie dog town on, or next to, refuge lands to support associated focal species, such as breeding burrowing owl, field sparrow, lark sparrow, grasshopper sparrow, upland sandpiper, and western meadowlark.”

It is obvious that there are sufficient grassland areas within the Quivira NWR to support larger colonies of Black-tailed Prairie Dogs for conservation purposes. This goal can be achieved uniquely in this “mid-grass prairie” area without presenting any significant problems to neighboring landowners by utilizing vegetative buffers, selective control and fencing similar to what Audubon of Kansas has utilized at the Hutton Nabrara Ranch Wildlife Sanctuary.

(5) It is important for USFWS to recognize that the Quivira NWR presents an opportunity to establish a prairie dog colony complex of national significance that goes far beyond that envisioned in the draft plan. If half of the 4,163 acres of predominantly “native-short-mid, sparse-medium-grassland” habitat described in the report is devoted to establishment of a prairie dog complex over the next ten years, it could be ecologically significant for many of the associated wildlife species, including all of the focal bird species mentioned in the paragraph. In addition, the complex could become a suitable site for reintroduction of Black-footed Ferrets.

One of the most severe limitations for success of Black-footed Ferret reintroductions, and recovery of this endangered species, is the impact of Sylvatic Plague across most of the western grasslands. Fortunately, it has not been discovered anywhere within 150 miles or more of Quivira. Thus, within the foreseeable future, prairie dog colonies (and ferrets) should be secure from that threat.

We envision the future of the Quivira NWR as a refuge of continuing and increasing importance for Whooping Cranes, other wetland and grassland species in special need of conservation, and possibly, a site contributing to the recovery of Black-footed Ferrets.

Ron Kintaske
Executive Director
Audubon of Kansas, Inc.

Citations:

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Appendix E

Key Legislation and Policy

This appendix briefly describes the guidance for the National Wildlife Refuge System and other policies and key legislation that guide the management of the Quivira National Wildlife Refuge.

E.1 National Wildlife Refuge System

The mission of the Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

(National Wildlife Refuge System Improvement Act of 1997)

Goals

- A. Conserve a diversity of fish, wildlife, and plants and their habitats, including species that are endangered or threatened with becoming endangered.
- B. Develop and maintain a network of habitats for migratory birds, anadromous and inter-jurisdictional fish, and marine mammal populations that is strategically distributed and carefully managed to meet important life history needs of these species across their ranges.
- C. Conserve those ecosystems, plant communities, wetlands of national or international significance, and landscapes and seascapes that are unique, rare, declining, or under-represented in existing protection efforts.
- D. Provide and enhance opportunities to participate in compatible wildlife-dependent recreation (hunting, fish, wildlife observation and photography, and environmental education and interpretation).
- E. Foster understanding and instill appreciation of the diversity and interconnectedness of fish, wildlife, and plants and their habitats.

Guiding Principles

There are four guiding principles for management and general public use of the Refuge System established by Executive Order 12996 (1996):

- *Public Use*—The Refuge System provides important opportunities for compatible wildlife-dependent recreational activities involving hunting, fishing, wildlife observation, photography, environmental education, and interpretation.
- *Habitat*—Fish and wildlife will not prosper without quality habitat and without fish and wildlife, traditional uses of refuges cannot be sustained. The Refuge System will continue to conserve and enhance the quality and diversity of fish and wildlife habitat within refuges.
- *Partnerships*—America's sportsmen and women were the first partners who insisted on protecting valuable wildlife habitat within wildlife refuges. Conservation partnerships with other Federal agencies, State agencies, tribes, organizations, industry, and the general public can make significant contributions to the growth and management of the Refuge System.
- *Public Involvement*—The public should be given a full and open opportunity to participate in decisions regarding acquisition and

management of our national wildlife refuges.

E.2 Legal and Policy Guidance

Management actions on national wildlife refuges are circumscribed by many mandates including laws and Executive orders.

American Indian Religious Freedom Act (1978)—Directs agencies to consult with native traditional religious leaders to figure out proper policy changes necessary to protect and preserve Native American religious cultural rights and practices.

Americans with Disabilities Act (1992)—Prohibits discrimination in public accommodations and services.

Antiquities Act (1906)—Authorizes the scientific investigation of antiquities on Federal land and provides penalties for unauthorized removal of objects taken or collected without a permit.

Archaeological and Historic Preservation Act (1974)—Directs the preservation of historic and archaeological data in Federal construction projects.

Archaeological Resources Protection Act (1979), as amended—Protects materials of archaeological interest from unauthorized removal or destruction and requires Federal managers to develop plans and schedules to locate archaeological resources.

Architectural Barriers Act (1968)—Requires federally owned, leased, or financed buildings and facilities to be accessible to persons with disabilities.

Clean Water Act (1977)—Requires consultation with the U.S. Army Corps of Engineers (404 permits) for major wetland modifications.

Dingell–Johnson Act (1950)—Authorized the Secretary of the Department of the Interior to provide financial help for State fish restoration and management plans and projects. Financed by excise taxes paid by manufacturers of rods, reels, and other fishing tackle. Known as the Federal Aid in Sport Fish Restoration Act.

Endangered Species Act (1973)—Requires all Federal agencies to carry out programs for the conservation of endangered and threatened species.

Executive Order No. 7168 (1935)—Establishes Arrowwood Migratory Waterfowl Refuge “as a refuge and breeding ground for migratory birds and other wild life...to effectuate further the purposes of the Migratory Bird Conservation Act....”

Executive Order 11988 (1977)—Requires Federal agencies to provide leadership and take action to reduce the risk of flood loss, decrease the effect of floods on human safety, and preserve the natural and beneficial values served by the floodplains.

Executive Order 12996, Management and General Public Use of the National Wildlife Refuge System (1996)—Defines the mission, purpose, and priority public uses of the National Wildlife Refuge System. It also presents four principles to guide management of the Refuge System.

Executive Order 13007, Indian Sacred Sites (1996)—Directs Federal land management agencies to accommodate access to and ceremonial uses of American Indian sacred sites by American Indian religious practitioners, avoid adversely affecting the physical integrity of such sacred sites, and where proper, keep the confidentiality of sacred sites.

Federal Noxious Weed Act (1990)—Requires the use of integrated management systems to control or contain undesirable plant species and an interdisciplinary approach with the cooperation of other Federal and State agencies.

Federal Records Act (1950)—Requires the preservation of evidence of the Government’s organization, functions, policies, decisions, operations, and activities, as well as basic historical and other information.

Fish and Wildlife Coordination Act (1958)—Allows the U.S. Fish and Wildlife Service to enter into agreements with private landowners for wildlife management purposes.

Migratory Bird Conservation Act (1929)—Establishes procedures for acquisition by purchase, rental, or gifts of areas approved by the Migratory Bird Conservation Commission.

Migratory Bird Hunting and Conservation Stamp Act (1934)—Authorizes the opening of part of a refuge to waterfowl hunting.

Migratory Bird Treaty Act (1918)—Designates the protection of migratory birds as a Federal responsibility; and enables the setting of seasons and other

regulations, including the closing of areas, Federal or non-Federal, to the hunting of migratory birds.

National Environmental Policy Act (1969)—Requires all agencies, including the Service, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate this Act with other planning requirements, and prepare proper documents to facilitate better environmental decisionmaking. [From the Code of Federal Regulations (CFR), 40 CFR 1500]

National Historic Preservation Act (1966), as amended—Establishes as policy that the Federal Government is to provide leadership in the preservation of the Nation's prehistoric and historic resources.

National Wildlife Refuge System Administration Act (1966)—Defines the National Wildlife Refuge System and authorizes the Secretary of the Department of the Interior to allow any use of a refuge, provided such use is compatible with the major purposes for which the refuge was established.

National Wildlife Refuge System Improvement Act of 1997—Sets the mission and administrative policy for all refuges in the National Wildlife Refuge System; mandates comprehensive conservation planning for all units of the Refuge System.

Native American Graves Protection and Repatriation Act (1990)—Requires Federal agencies and museums to inventory, find ownership of, and repatriate cultural items under their control or possession.

Refuge Recreation Act (1962)—Allows the use of refuges for recreation when such uses are compatible with the refuge's primary purposes and when sufficient money is available to manage the uses.

Rehabilitation Act (1973)—Requires programmatic accessibility and physical accessibility for all facilities and programs paid for by the Federal Government to make sure that any person can take part in any program.

Rivers and Harbors Act (1899)—Section 10 of this Act requires the authorization of U.S. Army Corps of Engineers before any work in, on, over, or under navigable waters of the United States.

Volunteer and Community Partnership Enhancement Act (1998)—Encourages the use of volunteers to help in the management of refuges within the Refuge System; facilitates partnerships between the Refuge System and non-Federal entities to promote public awareness of the resources of the Refuge System and public participation in the conservation of the resources; and encourages donations and other contributions.

Appendix F

List of Preparers and Contributors

This CCP is the result of extensive, collaborative, and enthusiastic efforts by the members of our planning team, listed below.

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Appendix G

Species Lists

What follows are the common and scientific names of animals and plants found on Quivira Refuge.

G.1 List of Bird Species

These are the bird species found on Quivira Refuge.

<i>Common name</i>	<i>Scientific name</i>	<i>Spring March– May</i>	<i>Summer June– August</i>	<i>Fall September– November</i>	<i>Winter December– February</i>
Ducks, geese, and swans					
Black-bellied whistling-duck	<i>Dendrocygna autumnalis</i>		accidental		
Fulvous whistling-duck	<i>Dendrocygna bicolor</i>		accidental		
Greater white-fronted goose	<i>Anser albifrons</i>	common	rare	common	common
Snow goose	<i>Chen caerulescens</i>	common	rare	common	common
Ross's goose	<i>Chen rossii</i>	uncommon		uncommon	uncommon
Brant	<i>Branta bernicla</i>	accidental			
Cackling goose	<i>Branta hutchinsii</i>	common	rare	common	common
Canada goose*	<i>Branta canadensis</i>	common	common	common	common
Trumpeter swan	<i>Cygnus buccinator</i>	occasional		occasional	occasional
Tundra swan	<i>Cygnus columbianus</i>	occasional		occasional	occasional
Wood duck*	<i>Aix sponsa</i>	common	common	common	occasional
Gadwall*	<i>Anas strepera</i>	common	uncommon	common	occasional
Eurasian wigeon	<i>Anas penelope</i>	accidental			
American wigeon*	<i>Anas americana</i>	common	uncommon	common	occasional
American black duck	<i>Anas rubripes</i>	rare	rare	rare	rare
Mallard*	<i>Anas platyrhynchos</i>	common	common	common	common
Mottled duck	<i>Anas fulvigula</i>	rare	rare	rare	
Blue-winged teal*	<i>Anas discors</i>	common	common	common	
Cinnamon teal	<i>Anas cyanoptera</i>	uncommon	rare	occasional	rare
Northern shoveler*	<i>Anas clypeata</i>	common	uncommon	common	uncommon
Northern pintail*	<i>Anas acuta</i>	common	uncommon	common	common
Green-winged teal*	<i>Anas crecca</i>	common	occasional	common	uncommon
Canvasback*	<i>Aythya valisineria</i>	common	occasional	common	uncommon
Redhead*	<i>Aythya americana</i>	common	occasional	common	uncommon
Ring-necked duck	<i>Aythya collaris</i>	common	occasional	common	uncommon
Greater scaup	<i>Aythya marila</i>	occasional		occasional	occasional
Lesser scaup*	<i>Aythya affinis</i>	common	occasional	common	uncommon
Surf scoter	<i>Melanitta perspicillata</i>	accidental			
White-winged scoter	<i>Melanitta fusca</i>	accidental			

<i>Common name</i>	<i>Scientific name</i>	<i>Spring March– May</i>	<i>Summer June– August</i>	<i>Fall September– November</i>	<i>Winter December– February</i>
Black scoter	<i>Melanitta americana</i>	accidental			
Long-tailed duck	<i>Clangula hyemalis</i>	rare		rare	rare
Bufflehead	<i>Bucephala albeola</i>	uncommon		common	common
Common goldeneye	<i>Bucephala clangula</i>	common		common	common
Barrow's goldeneye	<i>Bucephala ialandica</i>	accidental			
Hooded merganser*	<i>Lophodytes cucullatus</i>	uncommon	rare	uncommon	uncommon
Common merganser	<i>Mergus merganser</i>	uncommon		rare	common
Red-breasted merganser	<i>Mergus serrator</i>	rare		occasional	rare
Ruddy duck*	<i>Oxyura jamaicensis</i>	common	uncommon	common	uncommon
Grouse and quail					
Ring-necked pheasant*	<i>Phasianus colchicus</i>	common	common	common	common
Greater prairie-chicken*	<i>Tympanuchus cupido</i>	rare	rare	rare	rare
Wild turkey*	<i>Melagris gallopavo</i>	common	common	common	common
Northern bobwhite*	<i>Colinus virginianus</i>	uncommon	uncommon	uncommon	uncommon
Loons and grebes					
Common loon	<i>Gavia immer</i>	occasional	rare	occasional	rare
Pied-billed grebe*	<i>Podilymbus podiceps</i>	common	common	common	occasional
Horned grebe	<i>Podiceps auritus</i>	uncommon		uncommon	occasional
Red-necked grebe	<i>Podiceps grisegena</i>	accidental			
Eared grebe*	<i>Podiceps nigricollis</i>	common	occasional	common	rare
Western grebe	<i>Aechmophorus occidentalis</i>	occasional	rare	occasional	rare
Clark's grebe	<i>Aechmophorus clarkii</i>	accidental			
Pelicans and miscellaneous					
American flamingo	<i>Phoenicopterus ruber</i>	accidental			
Neotropic cormorant	<i>Phalacrocorax brasilianus</i>	occasional	occasional	rare	
Double-crested cormorant*	<i>Phalacrocorax auritus</i>	common	common	common	occasional
American white pelican	<i>Pelecanus erythrorhynchos</i>	common	common	common	occasional
Brown pelican	<i>Pelecanus accidentalis</i>	accidental			
Hérons, egrets, and ibis					
American bittern*	<i>Botaurus lentiginosus</i>	uncommon	uncommon	uncommon	occasional
Least bittern*	<i>Ixobrychus exilis</i>	occasional	uncommon	occasional	
Great blue heron*	<i>Ardea herodias</i>	common	common	common	uncommon
Great egret*	<i>Ardea alba</i>	common	common	common	
Snowy egret*	<i>Egretta thula</i>	common	common	common	
Little blue heron*	<i>Egretta caerulea</i>	uncommon	uncommon	occasional	
Tricolored heron*	<i>Egretta tricolor</i>	rare	rare		
Reddish egret	<i>Egretta rufescens</i>	accidental			
Cattle egret*	<i>Bubulcus ibis</i>	common	common	common	
Green heron*	<i>Butorides virescens</i>	uncommon	uncommon	occasional	
Black-crowned night-heron*	<i>Nycticorax nycticorax</i>	common	common	common	rare
Yellow-crowned night-heron*	<i>Nyctanassa violacea</i>	uncommon	uncommon	occasional	
White ibis	<i>Eudocimus albus</i>	rare	rare		

<i>Common name</i>	<i>Scientific name</i>	<i>Spring March– May</i>	<i>Summer June– August</i>	<i>Fall September– November</i>	<i>Winter December– February</i>
Glossy ibis	<i>Plegadis falcinellus</i>	rare	rare	rare	
White-faced ibis*	<i>Plegadis chihi</i>	common	common	common	rare
Roseate spoonbill	<i>Platalea ajaja</i>	accidental			
Wood stork	<i>Mycteria americana</i>	accidental			
Birds of prey					
Turkey vulture*	<i>Cathartes aura</i>	uncommon	uncommon	uncommon	
Osprey	<i>Pandion haliaetus</i>	occasional	rare	occasional	
Mississippi kite*	<i>Ictinia mississippiensis</i>	uncommon	uncommon	occasional	
Bald eagle*	<i>Haliaeetus leucocephalus</i>	uncommon	uncommon	uncommon	common
Northern harrier*	<i>Circus cyaneus</i>	common	occasional	common	common
Sharp-shinned hawk	<i>Accipiter striatus</i>	uncommon		occasional	uncommon
Cooper's hawk*	<i>Accipiter cooperii</i>	uncommon	occasional	uncommon	uncommon
Northern goshawk	<i>Accipiter gentilis</i>			rare	rare
Red-shouldered hawk	<i>Buteo lineatus</i>			rare	
Broad-winged hawk	<i>Buteo platypterus</i>			rare	
Swainson's hawk*	<i>Buteo swainsoni</i>	common	common	occasional	
Red-tailed hawk*	<i>Buteo jamaicensis</i>	common	common	common	common
Ferruginous hawk	<i>Buteo regalis</i>	occasional		rare	occasional
Rough-legged hawk	<i>Buteo lagopus</i>	uncommon		rare	uncommon
Golden eagle	<i>Aquila chrysaetos</i>	occasional		occasional	occasional
American kestrel*	<i>Falco sparverius</i>	common	uncommon	common	uncommon
Merlin	<i>Falco columbarius</i>	occasional	rare	uncommon	uncommon
Peregrine falcon	<i>Falco peregrinus</i>	occasional	occasional	occasional	occasional
Prairie falcon	<i>Falco mexicanus</i>	rare	rare	occasional	occasional
Rails and cranes					
Yellow rail	<i>Coturnicops noveboracensis</i>	accidental			
Black rail*	<i>Laterallus jamailaris</i>	uncommon	uncommon	rare	
King rail*	<i>Rallus elegans</i>	uncommon	uncommon	rare	rare
Virginia rail*	<i>Rallus limicola</i>	common	common	uncommon	occasional
Sora*	<i>Prozana carolina</i>	common	uncommon	common	
Common moorhen*	<i>Gallinula chloropus</i>	uncommon	uncommon	occasional	
American coot*	<i>Fulica americana</i>	common	common	common	uncommon
Sandhill crane	<i>Grus canadensis</i>	common		common	occasional
Common crane	<i>Grus grus</i>	accidental			
Whooping crane	<i>Grus americana</i>	occasional		occasional	rare
Shorebirds					
Black-bellied plover	<i>Pluvialis squatarola</i>	uncommon	uncommon	uncommon	rare
American golden-plover	<i>Pluvialis dominica</i>	uncommon	occasional	uncommon	
Snowy plover*	<i>Charadrius alexandrinus</i>	common	common	common	
Wilson's plover	<i>Charadrius wilsonia</i>	accidental			
Semipalmated plover	<i>Charadrius semipalmatus</i>	common	uncommon	common	
Piping plover	<i>Charadrius melodus</i>	uncommon	occasional	occasional	
Killdeer*	<i>Charadrius vociferis</i>	common	common	common	occasional

<i>Common name</i>	<i>Scientific name</i>	<i>Spring March– May</i>	<i>Summer June– August</i>	<i>Fall September– November</i>	<i>Winter December– February</i>
Mountain plover	<i>Charadrius montanus</i>	rare		rare	
Black-necked stilt*	<i>Himantopus mexicanus</i>	common	common	uncommon	
American avocet*	<i>Recurvirostra americana</i>	common	common	common	
Spotted sandpiper*	<i>Actitis macularius</i>	common	uncommon	common	
Solitary sandpiper	<i>Tringa solitaria</i>	uncommon	uncommon	occasional	
Greater yellowlegs	<i>Tringa melanoleuca</i>	common	common	common	occasional
Willet	<i>Tringa semipalmata</i>	uncommon	uncommon	uncommon	
Lesser yellowlegs	<i>Tringa flavipes</i>	common	common	common	rare
Upland sandpiper*	<i>Bartramia longicauda</i>	common	occasional	occasional	
Whimbrel	<i>Numenius phaeopus</i>	occasional	occasional	occasional	
Long-billed curlew	<i>Numenius americanus</i>	occasional	occasional	occasional	
Hudsonian godwit	<i>Limosa haemastica</i>	uncommon	rare	uncommon	
Marbled godwit	<i>Limosa fedoa</i>	uncommon	uncommon	uncommon	
Ruddy turnstone	<i>Arenaria interpres</i>	occasional	occasional	occasional	
Red knot	<i>Calidris canutus</i>	rare	rare	rare	
Sanderling	<i>Calidris alba</i>	occasional	occasional	occasional	
Semipalmated sandpiper	<i>Calidris pusilla</i>	common	common	common	
Western sandpiper	<i>Calidris mauri</i>	common	common	common	
Least sandpiper	<i>Calidris minutilla</i>	common	common	common	
White-rumped sandpiper	<i>Calidris fuscicollis</i>	common	common	uncommon	
Baird's sandpiper	<i>Calidris bairdii</i>	common	common	common	
Red-necked stint	<i>Calidris ruficollis</i>	accidental			
Pectoral sandpiper	<i>Calidris melanotos</i>	uncommon	uncommon	uncommon	
Dunlin	<i>Calidris alpina</i>	uncommon	occasional	uncommon	rare
Curlew sandpiper	<i>Calidris ferruginea</i>	accidental			
Stilt sandpiper	<i>Calidris himantopus</i>	common	common	common	
Buff-breasted sandpiper	<i>Tryngites subruficollis</i>	occasional	rare	uncommon	
Ruff	<i>Philmachus pugnax</i>	rare	rare		
Short-billed dowitcher	<i>Limnodromus griseus</i>	uncommon	uncommon	occasional	
Long-billed dowitcher	<i>Limnodromus scolopaceus</i>	common	common	common	
Wilson's snipe	<i>Gallinago delicata</i>	uncommon	rare	uncommon	occasional
American woodcock	<i>Scolopax minor</i>	rare		rare	
Wilson's phalarope*	<i>Phalaropus tricolor</i>	common	common	common	
Red-necked phalarope	<i>Phalaropus lobatus</i>	occasional	rare	occasional	
Red phalarope	<i>Phalaropus fulicarius</i>	rare		rare	
Gulls and terns					
Black-legged kittiwake	<i>Rissa tridactyla</i>	accidental			
Sabine's gull	<i>Xema sabini</i>	rare	rare	rare	
Bonaparte's gull	<i>Chroicocephalus philadelphia</i>	occasional	rare	occasional	occasional
Laughing gull	<i>Leucophaeus atricilla</i>	rare	occasional	rare	
Franklin's gull	<i>Leucophaeus pipixcan</i>	common	uncommon	common	rare
Black-headed gull	<i>Chroicocephalus ridibundus</i>	accidental			
Ring-billed gull	<i>Larus delawarensis</i>	common	uncommon	common	uncommon

<i>Common name</i>	<i>Scientific name</i>	<i>Spring March– May</i>	<i>Summer June– August</i>	<i>Fall September– November</i>	<i>Winter December– February</i>
California gull	<i>Larus californicus</i>	accidental			
Herring gull	<i>Larus argentatus</i>	occasional		occasional	occasional
Lesser black-backed gull	<i>Larus fuscus</i>	accidental			
Least tern*	<i>Sternula antillarum</i>	uncommon	uncommon	occasional	
Gull-billed tern	<i>Gelochelidon nilotica</i>	accidental			
Caspian tern	<i>Hydroprogne caspia</i>	rare	rare	rare	
Black tern*	<i>Chidonias niger</i>	common	common	uncommon	
Common tern	<i>Sterna hirundo</i>	occasional	occasional	occasional	
Arctic tern	<i>Sterna paradisaea</i>	accidental			
Forster's tern*	<i>Sterna forsteri</i>	common	common	occasional	
Parasitic jaeger	<i>Stercorarius parasiticus</i>		rare	rare	
Pigeons and doves					
Rock pigeon*	<i>Columba livia</i>	rare	rare	rare	rare
Eurasian collared-dove*	<i>Streptopelia decaocto</i>	occasional	occasional	occasional	occasional
White-winged dove	<i>Zenaida asiatica</i>	accidental			
Mourning dove*	<i>Zenaida macroura</i>	common	common	common	occasional
Yellow-billed cuckoo*	<i>Coccyzus americanus</i>	occasional	uncommon	rare	
Black-billed cuckoo	<i>Coccyzus erythrophthalmus</i>	rare	rare		
Greater roadrunner	<i>Geococcyx californianus</i>	rare	rare	rare	rare
Owls					
Barn owl*	<i>Tyto alba</i>	occasional	occasional	occasional	occasional
Eastern screech-owl*	<i>Megascops asio</i>	uncommon	uncommon	uncommon	uncommon
Great horned owl*	<i>Bubo virginianus</i>	common	common	common	common
Snowy owl	<i>Bubo scandiacus</i>			rare	rare
Burrowing owl*	<i>Athene cunicularia</i>	rare	rare	rare	
Barred owl	<i>Strix varia</i>	occasional	occasional	occasional	occasional
Long-eared owl*	<i>Asio otus</i>	rare	rare	rare	rare
Short-eared owl*	<i>Asio flammeus</i>	rare		rare	occasional
Northern saw-whet owl	<i>Aegolius acadicus</i>	accidental			
Nightjars and miscellaneous					
Common nighthawk*	<i>Chordeiles minor</i>	uncommon	common	uncommon	
Common poor-will	<i>Phalaenoptilus nuttallii</i>	rare	rare		
Chuck-will's-widow*	<i>Caprimulgus carolinensis</i>	occasional	occasional		
Whip-poor-will	<i>Caprimulgus vociferus</i>	accidental			
Chimney swift*	<i>Chaetura pelagica</i>	uncommon	uncommon	uncommon	
Ruby-throated hummingbird	<i>Archilochus colubris</i>	occasional	occasional	occasional	
Belted kingfisher	<i>Megaceryle alcyon</i>	uncommon	uncommon	uncommon	occasional
Woodpeckers					
Red-headed woodpecker*	<i>Melanerpes erythrocephalus</i>	common	common	common	
Red-bellied woodpecker*	<i>Melanerpes caroline</i>	uncommon	uncommon	uncommon	uncommon
Yellow-bellied sapsucker	<i>Sphyrapicus varius</i>	rare		rare	rare
Downy woodpecker*	<i>Picoides pubescens</i>	uncommon	uncommon	uncommon	uncommon

<i>Common name</i>	<i>Scientific name</i>	<i>Spring March– May</i>	<i>Summer June– August</i>	<i>Fall September– November</i>	<i>Winter December– February</i>
Hairy woodpecker*	<i>Picoides villosus</i>	uncommon	uncommon	uncommon	uncommon
Northern flicker*	<i>Colaptes auratus</i>	common	common	common	common
Flycatchers					
Olive-sided flycatcher	<i>Contopus cooperi</i>	occasional		occasional	
Eastern wood-pewee*	<i>Contopus virens</i>	uncommon	uncommon	occasional	
Willow flycatcher	<i>Empidonax traillii</i>	occasional		occasional	
Least flycatcher	<i>Empidonax minimus</i>	uncommon		uncommon	
Eastern phoebe*	<i>Sayornis phoebe</i>	uncommon	uncommon	uncommon	occasional
Say's phoebe	<i>Sayornis saya</i>	occasional		occasional	
Great crested flycatcher*	<i>Myiarchus crinitus</i>	uncommon	uncommon	occasional	
Cassin's kingbird	<i>Tyrannus vociferans</i>	accidental			
Western kingbird*	<i>Tyrannus verticalis</i>	common	common	uncommon	
Eastern kingbird*	<i>Tyrannus tyrannus</i>	common	common	uncommon	
Scissor-tailed flycatcher*	<i>Tyrannus forficatus</i>	occasional	occasional	occasional	
Shrikes and vireos					
Loggerhead shrike*	<i>Lanius ludovicianus</i>	uncommon	uncommon	uncommon	uncommon
Northern shrike	<i>Lanius excubitor</i>	rare		occasional	occasional
Bell's vireo*	<i>Vireo bellii</i>	uncommon	uncommon	occasional	
Yellow-throated vireo	<i>Vireo flavifrons</i>	accidental			
Blue-headed vireo	<i>Vireo solitarius</i>	accidental			
Warbling vireo*	<i>Vireo gilvus</i>	uncommon	uncommon	uncommon	
Philadelphia vireo	<i>Vireo philadelphicus</i>	accidental			
Red-eyed vireo*	<i>Vireo olivaceus</i>	occasional	occasional	rare	
Corvids					
Blue jay*	<i>Cyanocitta cristata</i>	common	common	uncommon	occasional
Western scrub jay	<i>Aphelocoma californica</i>	accidental			
Black-billed magpie	<i>Pica hudsonia</i>	rare	rare	rare	rare
American crow*	<i>Corvus brachyrhynchos</i>	common	occasional	common	occasional
Larks					
Horned lark*	<i>Eremophila alpestris</i>	occasional	occasional	occasional	occasional
Swallows					
Purple martin*	<i>Progne subis</i>	occasional	occasional		
Tree swallow*	<i>Tachycineta bicolor</i>	common	common	uncommon	
Violet-green swallow	<i>Tachycineta thalassina</i>	accidental			
Northern rough-winged swallow*	<i>Stelgidopteryx serripennis</i>	uncommon	occasional	occasional	
Bank swallow*	<i>Riparia riparia</i>	common	common	uncommon	
Cliff swallow*	<i>Petrochelidon pyrrhonota</i>	common	common	common	
Barn swallow*	<i>Hirundo rustica</i>	common	common	common	
Parids, wrens, and miscellaneous					
Carolina chickadee	<i>Poecile carolinensis</i>	accidental			
Black-capped chickadee*	<i>Poecile atricapillus</i>	occasional	occasional	occasional	occasional
Tufted titmouse	<i>Baeolophus bicolor</i>	rare		occasional	occasional

<i>Common name</i>	<i>Scientific name</i>	<i>Spring March– May</i>	<i>Summer June– August</i>	<i>Fall September– November</i>	<i>Winter December– February</i>
Red-breasted nuthatch	<i>Sitta canadensis</i>	rare		rare	rare
White-breasted nuthatch*	<i>Sitta carolinensis</i>	uncommon	uncommon	uncommon	uncommon
Brown creeper	<i>Certhia americana</i>	rare		occasional	occasional
Rock wren	<i>Salpinctes obsoletus</i>	occasional		occasional	
Carolina wren*	<i>Thryothorus ludovicianus</i>	occasional	occasional	occasional	occasional
Bewick's wren*	<i>Thryomanes bewickii</i>	rare	rare		
House wren*	<i>Troglodytes aedon</i>	common	common	uncommon	
Winter wren	<i>Troglodytes hiemalis</i>	rare		occasional	occasional
Sedge wren	<i>Cistothorus platensis</i>	occasional	occasional	occasional	
Marsh wren	<i>Cistothorus palustris</i>	uncommon		uncommon	uncommon
Blue-gray gnatcatcher*	<i>Polioptila caerulea</i>	uncommon	uncommon	occasional	
Golden-crowned kinglet	<i>Regulus satrapa</i>	uncommon		uncommon	uncommon
Ruby-crowned kinglet	<i>Regulus calendula</i>	uncommon		uncommon	occasional
Thrushes, pipits, waxwings, and miscellaneous					
Eastern bluebird*	<i>Sialia sialis</i>	common	common	common	uncommon
Mountain bluebird	<i>Sialia currucoides</i>	rare		rare	rare
Townsend's solitaire	<i>Myadestes townsendi</i>	rare		rare	rare
Veery	<i>Catharus fuscescens</i>	accidental			
Gray-cheeked thrush	<i>Catharus minimus</i>	accidental			
Swainson's thrush	<i>Catharus ustulatus</i>	occasional		occasional	
Hermit thrush	<i>Catharus guttatus</i>	accidental			
Wood thrush	<i>Hylocichla mustelina</i>	rare			
American robin*	<i>Turdus migratorius</i>	common	common	common	uncommon
Gray catbird*	<i>Dumetella carolinensis</i>	common	common	occasional	
Northern mockingbird*	<i>Mimus polyglottos</i>	occasional	occasional	occasional	occasional
Brown thrasher*	<i>Toxostoma rufum</i>	common	common	occasional	rare
European starling*	<i>Sturnus vulgaris</i>	common	common	common	common
American pipit	<i>Anthus rubescens</i>	uncommon		uncommon	
Sprague's pipit	<i>Anthus spragueii</i>	rare		rare	
Bohemian waxwing	<i>Bombycilla garrulus</i>	accidental			
Cedar waxwing	<i>Bombycilla cedrorum</i>	occasional	occasional	occasional	occasional
Longspurs					
McCown's longspur	<i>Rhynchophanes mccownii</i>	accidental			
Lapland longspur	<i>Calcarius lapponicus</i>	rare		occasional	uncommon
Smith's longspur	<i>Calcarius pictus</i>	accidental			
Chestnut-collared longspur	<i>Calcarius ornatus</i>	rare			rare
Snow bunting	<i>Plectrophenax nivalis</i>	accidental			
Wood warblers					
Golden-winged warbler	<i>Vermivora chrysoptera</i>	accidental			
Tennessee warbler	<i>Oreothlypis peregrina</i>	occasional			
Orange-crowned warbler	<i>Oreothlypis celata</i>	uncommon		uncommon	
Nashville warbler	<i>Oreothlypis ruficapilla</i>	occasional		occasional	
Northern parula	<i>Parula pitiayumi</i>	accidental			

Common name	Scientific name	Spring March– May	Summer June– August	Fall September– November	Winter December– February
Yellow warbler*	<i>Dendroica petechia</i>	uncommon	uncommon	occasional	
Chestnut-sided warbler	<i>Dendroica pensylvanica</i>	accidental			
Magnolia warbler	<i>Dendroica magnolia</i>	accidental			
Black-throated blue warbler	<i>Dendroica caerulescens</i>	accidental			
Yellow-rumped warbler	<i>Dendroica coronata</i>	common		common	uncommon
Black-throated green warbler	<i>Dendroica virens</i>	rare		rare	
Blackburnian warbler	<i>Dendroica fusca</i>	accidental			
Palm warbler	<i>Dendroica palmarum</i>	occasional			
Blackpoll warbler	<i>Dendroica striata</i>	rare			
Cerulean warbler	<i>Dendroica cerulea</i>	accidental			
Black-and-white warbler	<i>Mniotilta varia</i>	rare		rare	
American redstart	<i>Setophaga ruticilla</i>	occasional		occasional	
Prothonotary warbler	<i>Protonotaria citrea</i>	accidental			
Worm-eating warbler	<i>Helmitheros vermivorum</i>	accidental			
Ovenbird	<i>Seiurus aurocapilla</i>	accidental			
Northern waterthrush	<i>Parkesia novboracensis</i>	occasional			
Mourning warbler	<i>Oporornis philadelphia</i>	accidental			
MacGillivray's warbler	<i>Oporornis tolmiei</i>	accidental			
Common yellowthroat*	<i>Geothypis trichas</i>	common	common	uncommon	occasional
Wilson's warbler	<i>Wilsonia pusilla</i>	occasional		occasional	
Canada warbler	<i>Wilsonia canadensis</i>	accidental			
Painted redstart	<i>Myioborus pictus</i>	accidental			
Yellow-breasted chat*	<i>Icteria virens</i>	occasional	rare	rare	
Sparrows and towhees					
Spotted towhee	<i>Pipilo maculatus</i>	common		common	rare
Eastern towhee	<i>Pipilo erythrophthalmus</i>	accidental			
Cassin's sparrow	<i>Peucaea cassinii</i>	rare			
American tree sparrow	<i>Spizella arborea</i>	uncommon		common	common
Chipping sparrow	<i>Spizella passerina</i>	common	rare	common	
Clay-colored sparrow	<i>Spizella pallida</i>	common		common	
Field sparrow*	<i>Spizella pusilla</i>	common	uncommon	common	uncommon
Vesper sparrow	<i>Poocetes gramineus</i>	common	rare	common	
Lark sparrow*	<i>Chondestes grammacus</i>	common	uncommon	occasional	
Lark bunting	<i>Calamospiza melanocrys</i>	occasional	rare	occasional	
Savannah sparrow	<i>Passerculus sandwichensis</i>	common		common	occasional
Grasshopper sparrow*	<i>Ammodramus savannarum</i>	uncommon	uncommon	uncommon	
Henslow's sparrow	<i>Ammodramus henslowii</i>	accidental			
Le Conte's sparrow	<i>Ammodramus leconteii</i>	occasional		occasional	rare
Nelson's sharp-tailed sparrow	<i>Ammodramus nelsoni</i>	occasional		occasional	
Fox sparrow	<i>Passerella iliaca</i>	uncommon		uncommon	uncommon
Song sparrow	<i>Melospiza melodia</i>	common		common	common

<i>Common name</i>	<i>Scientific name</i>	<i>Spring March– May</i>	<i>Summer June– August</i>	<i>Fall September– November</i>	<i>Winter December– February</i>
Lincoln's sparrow	<i>Melospiza lincolnii</i>	uncommon		uncommon	rare
Swamp sparrow	<i>Melospiza georgiana</i>	uncommon		uncommon	uncommon
White-throated sparrow	<i>Zonotrichia albicollis</i>	uncommon		uncommon	occasional
Harris's sparrow	<i>Zonotrichia querula</i>	common	rare	common	common
White-crowned sparrow	<i>Zonotrichia leucophrys</i>	uncommon		uncommon	occasional
Golden-crowned sparrow	<i>Zonotrichia atricapilla</i>	accidental			
Dark-eyed junco	<i>Junco hyemalis</i>	common		common	common
Summer tanager	<i>Piranga rubra</i>		rare		
Scarlet tanager	<i>Piranga olivacea</i>	accidental			
Grosbeaks and buntings					
Northern cardinal*	<i>Cardinalis cardinalis</i>	uncommon	uncommon	uncommon	uncommon
Pyrrhuloxia	<i>Cardinalis sinuatus</i>	accidental			
Rose-breasted grosbeak	<i>Pheucticus ludovicianus</i>	occasional			
Black-headed grosbeak*	<i>Pheucticus melanocephalis</i>	occasional	rare		
Blue grosbeak*	<i>Passerina caerulea</i>	uncommon	uncommon	rare	
Lazuli bunting	<i>Passerina ameona</i>	rare			
Indigo bunting*	<i>Passerina cyanea</i>	uncommon	occasional	rare	
Painted bunting	<i>Passerina ciris</i>	accidental			
Dickcissel*	<i>Spiza americana</i>	common	common	rare	
Blackbirds and allies					
Bobolink*	<i>Dolichonyx oryzivorus</i>	uncommon	uncommon		
Red-winged blackbird*	<i>Agelaius phoeniceus</i>	common	common	common	common
Eastern meadowlark*	<i>Sturnella magna</i>	common	common	common	common
Western meadowlark*	<i>Sturnella neglecta</i>	uncommon	occasional	uncommon	common
Yellow-headed blackbird*	<i>Xanthocephalus xanthocephalus</i>	common	common	uncommon	rare
Rusty blackbird	<i>Euphagus carolinus</i>	accidental			
Brewer's blackbird	<i>Euphagus cyanocephalus</i>	occasional	occasional	occasional	occasional
Common grackle*	<i>Quiscalus quiscula</i>	common	occasional	common	occasional
Great-tailed grackle*	<i>Quiscalus mexicanus</i>	uncommon	uncommon	uncommon	rare
Brown-headed cowbird*	<i>Molothrus oryzivorus</i>	common	common	uncommon	uncommon
Orchard oriole*	<i>Icterus spurius</i>	common	common	occasional	
Bullock's oriole	<i>Icterus bullockii</i>	accidental			
Baltimore oriole*	<i>Icterus galbula</i>	common	common	occasional	
Finches					
Purple finch	<i>Carpodacus purpureus</i>	occasional		rare	occasional
House finch*	<i>Carpodacus mexicanus</i>	occasional	occasional	occasional	occasional
Common redpoll	<i>Acanthis flammea</i>	accidental			
Pine siskin	<i>Spinus pinus</i>	occasional		occasional	occasional
American goldfinch*	<i>Spinus tristis</i>	common	common	common	common
Evening grosbeak	<i>Coccothraustes verpertines</i>	accidental			
House sparrow*	<i>Passer domesticus</i>	occasional	occasional	occasional	occasional

* Reported nesting on refuge. NOTE: Abundance is indicated as follows: common (certain to be seen in suitable habitat), uncommon (present, but not certain to be seen), occasional (seen a few times during season), rare (seen every 2–5 years).

G.2 List of Fish Species

These are the fish species found on Quivira Refuge.

<i>Common name</i>	<i>Scientific name</i>
Bass, largemouth	<i>Micropterus salmoides</i>
Bluegill	<i>Lepomis macrochirus</i>
Bullhead, black	<i>Ictalurus melas</i>
Bullhead, yellow	<i>Ictalurus natalis</i>
Carp	<i>Cyprinus carpio</i>
Carp sucker, river	<i>Carpiodes carpio</i>
Catfish, channel	<i>Ictalurus punctatus</i>
Catfish, flathead	<i>Pylodictis olivaris</i>
Crappie, black	<i>Pomoxis nigromaculatus</i>
Crappie, white	<i>Pomoxis annularis</i>
Darter, Arkansas	<i>Etheostoma cragini</i>
Goldfish	<i>Carassius auratus</i>
Killifish, plains	<i>Fundulus kansae</i>
Minnow, fathead	<i>Pimephales promelas</i>
Minnow, plains	<i>Hybognathus placitus</i>
Minnow, suckermouth	<i>Phenacobius mirabilis</i>
Mosquitofish	<i>Gambusia affinis</i>
Shiner, red	<i>Notropis lutrensis</i>
Shiner, sand	<i>Notropis stramineus</i>
Sunfish, green	<i>Lepomis cyanellus</i>
Sunfish, orangespotted	<i>Lepomis humilis</i>

G.3 List of Mammal Species

These are the mammal species found on Quivira Refuge.

<i>Common name</i>	<i>Scientific name</i>
Armadillo, nine-banded	<i>Dasypus novemcinctus</i>
Badger, American	<i>Taxidea taxus</i>
Beaver, American	<i>Castor canadensis</i>
Bobcat	<i>Lynx rufus</i>
Cottontail, eastern	<i>Sylvilagus floridanus</i>
Coyote	<i>Canis latrans</i>
Deer, mule	<i>Odocoileus hemionus</i>
Deer, white-tailed	<i>Odocoileus virginianus</i>
Fox, red	<i>Vulpes vulpes</i>
Gopher, plains pocket	<i>Geomys bursarius</i>
Ground squirrel, Franklin's	<i>Spermophilus franklinii</i>

<i>Common name</i>	<i>Scientific name</i>
Ground squirrel, thirteen-lined	<i>Spermophilus tridecemlineatus</i>
Jackrabbit, black-tailed	<i>Lepus californicus</i>
Mink	<i>Mustela vison</i>
Mole, eastern	<i>Scalopus aquaticus</i>
Muskrat	<i>Ondatra zibethicus</i>
Opossum	<i>Didelphis virginiana</i>
Porcupine	<i>Erthizon dorsatum</i>
Prairie dog, black-tailed	<i>Cynomys ludovicianus</i>
Raccoon	<i>Procyon lotor</i>
Rat, hispid cotton	<i>Sigmodon hispidus</i>
Rat, Ord's kangaroo	<i>Dipodomys ordii</i>
Skunk, eastern spotted (not known on refuge in recent decades)	<i>Spilogale putorius</i>
Skunk, striped	<i>Mephitis mephitis</i>
Squirrel, eastern fox	<i>Sciurus niger</i>
Wood rat, eastern	<i>Neotoma floridana</i>

G.4 List of Amphibian and Reptile Species

These are the amphibian and reptile species found on Quivira Refuge.

<i>Common name</i>	<i>Scientific name</i>
Bullfrog	<i>Rana catesbiana</i>
Frog, Blanchard's cricket	<i>Acris blanchardi</i>
Frog, plains leopard	<i>Rana blairi</i>
Frog, western chorus	<i>Pseudacris maculata</i>
Kingsnake, prairie	<i>Lampropeltis calligaster</i>
Lizard, prairie (fence)	<i>Sceloporus undulatus</i>
Massasauga	<i>Sistrurus catenatus</i>
Racer	<i>Coluber constrictor</i>
Racerunner, six-lined	<i>Aspidoscelis sexlineata</i>
Salamander, tiger	<i>Ambystoma tigrinum</i>
Slider, red-eared	<i>Trachemys scripta</i>
Snake, brown	<i>Storeria dekayi</i>
Snake, common garter	<i>Thamnophis sirtalis</i>
Snake, glossy	<i>Arizona elegans</i>
Snake, gopher (bull)	<i>Pituophis catenifer</i>
Snake, Graham's crayfish	<i>Regina grahamii</i>
Snake, plains garter	<i>Thamnophis radix</i>
Snake, western hognose	<i>Heterodon nasicus</i>
Snake, western ribbon	<i>Thamnophis proximus</i>
Toad, Great Plains	<i>Bufo cognatus</i>
Toad, plains spadefoot	<i>Spea bombifrons</i>

<i>Common name</i>	<i>Scientific name</i>
Toad, Woodhouse's	<i>Bufo woodhousei</i>
Turtle, ornate box	<i>Terrapene ornata</i>
Turtle, painted	<i>Chrysemys picta</i>
Turtle, snapping	<i>Chelydra serpentina</i>
Turtle, spiny softshell	<i>Apalone spinifera</i>
Turtle, yellow mud	<i>Kinosternon flavescens</i>
Water snake, diamondback	<i>Nerodia rhombifer</i>
Water snake, northern	<i>Nerodia sipedon</i>

G.5 List of Odonate Species

These are the odonate species found on Quivira Refuge.

<i>Common name</i>	<i>Family</i>	<i>Scientific name</i>
Amberwing, eastern	Libellulidae	<i>Perithemis tenera</i>
Bluet, familiar	Coenagrionidae	<i>Enallagma civile</i>
Clubtail, jade	Gomphidae	<i>Arigomphus submedianus</i>
Clubtail, plains	Gomphidae	<i>Gomphus externus</i>
Darner, blue-eyed	Aeschnidae	<i>Rhionaeschna multicolor</i>
Darner, common blue	Aeschnidae	<i>Anax junius</i>
Dasher, blue	Libellulidae	<i>Pachydiplax longipennis</i>
Forktail, black-fronted	Coenagrionidae	<i>Ischnura denticollis</i>
Forktail, citrine	Coenagrionidae	<i>Ischnura hastata</i>
Forktail, desert	Coenagrionidae	<i>Ischnura barberi</i>
Forktail, eastern	Coenagrionidae	<i>Ischnura verticalis</i>
Forktail, fragile	Coenagrionidae	<i>Ischnura posita</i>
Glider, spot-wing	Libellulidae	<i>Pantala hymenaea</i>
Glider, wandering	Libellulidae	<i>Pantala flavescens</i>
Meadowhawk, band-wing	Libellulidae	<i>Sympetrum semicinctum</i>
Meadowhawk, blue-faced	Libellulidae	<i>Sympetrum ambiguum</i>
Meadowhawk, ruby	Libellulidae	<i>Sympetrum rubicundulum</i>
Meadowhawk, variegated	Libellulidae	<i>Sympetrum corruptum</i>
Pennant, halloween	Libellulidae	<i>Celithemis eponina</i>
Pondhawk, Eastern	Libellulidae	<i>Erythemis simplicicollis</i>
Rubyspot, American	Calopterygidae	<i>Hetaerina americana</i>
Saddlebags, black	Libellulidae	<i>Tramea lacerata</i>
Saddlebags, red	Libellulidae	<i>Tramea onusta</i>
Skimmer, twelve-spotted	Libellulidae	<i>Libellula pulchella</i>
Skimmer, widow	Libellulidae	<i>Libellula luctuosa</i>
Spreadwing	Lestidae	<i>Lestes rectangularis</i>
Spreadwing, southern	Lestidae	<i>Lestes australis</i>
Whitetail, common	Libellulidae	<i>Libellula lydia</i>

G.6 List of Butterfly Species

These are the butterfly species found on Quivira Refuge.

<i>Common name</i>	<i>Scientific name</i>
Admiral, red	<i>Vanessa atalanta</i>
Azure, summer	<i>Celastrina ladon</i>
Blue, eastern tailed	<i>Everes comyntas</i>
Blue, marine	<i>Leptotes marina</i>
Blue, reakit's	<i>Hemiargus isola</i>
Blue, western pygmy	<i>Brephidium exile</i>
Buckeye	<i>Junonia coenia</i>
Checkerspot, gorgone	<i>Chlosyne gorgone</i>
Cloak, mourning	<i>Nymphalis antiopa</i>
Cloudywing, southern	<i>Thorybes bathyllus</i>
Comma, eastern	<i>Polygonia comma</i>
Copper, bronze	<i>Lycaena hylus</i>
Copper, gray	<i>Lycaena dione</i>
Crescent, painted	<i>Phyciodes picta</i>
Crescent, pearl	<i>Phyciodes tharos</i>
Crescent, phaon	<i>Phyciodes phaon</i>
Duskywing, afranius	<i>Erynnis afranius</i>
Duskywing, funereal	<i>Erynnis funeralis</i>
Duskywing, Horace's	<i>Erynnis horatius</i>
Duskywing, juvenalis	<i>Erynnis juvenalis</i>
Duskywing, wild indigo	<i>Erynnis baptisiae</i>
Emperor, hackberry	<i>Asterocampa celtis</i>
Emperor, tawny	<i>Asterocampa clyton</i>
Fritillary, great spangled	<i>Speyeria cybele</i>
Fritillary, gulf	<i>Agraulis vanillae</i>
Fritillary, regal	<i>Speyeria idalia</i>
Fritillary, variegated	<i>Euptoieta claudia</i>
Hairstreak, coral	<i>Satyrium titus</i>
Hairstreak, gray	<i>Strymon melinus</i>
Hairstreak, juniper	<i>Callophrys gryneus gryneus</i>
Lady, American	<i>Vanessa virginiensis</i>
Lady, painted	<i>Vanessa cardui</i>
Leafwing, goatweed	<i>Anaea andrea</i>
Monarch	<i>Danaus plexippus</i>
Orange, sleepy	<i>Euremia nicippe</i>
Queen	<i>Danaus gilippus</i>
Question mark	<i>Polygonia interrogationis</i>
Sachem	<i>Atalopedes campestris</i>
Scallopwing, Hayhurst's	<i>Staphylus hayhurstii</i>
Skipper, common checkered	<i>Pyrgus communis</i>
Skipper, Delaware	<i>Anatrytone logan</i>

<i>Common name</i>	<i>Scientific name</i>
Skipper, eastern dun	<i>Euphyes vestris</i>
Skipper, fiery	<i>Hylephila phyleus</i>
Skipper, nysa roadside	<i>Amblyscirtes nysa</i>
Skipper, silver-spotted	<i>Epargyreus clarus</i>
Snout, common	<i>Libytheana carinenta</i>
Sootywing, common	<i>Pholisora catullus</i>
Sulphur, clouded	<i>Colias philodice</i>
Sulphur, cloudless	<i>Phoebis sennae</i>
Sulphur, dainty	<i>Nathalis iole</i>
Sulphur, orange	<i>Colias eurytheme</i>
Swallowtail, black	<i>Papilio polyxenes</i>
Swallowtail, eastern tiger	<i>Papilio glaucus</i>
Swallowtail, pipevine	<i>Battus philenor</i>
Viceroy	<i>Limenitis archippus</i>
White, cabbage	<i>Pieris rapae</i>
White, checkered	<i>Pontia protodice</i>
Wood nymph, common	<i>Cercyonis pegala</i>
Yellow, little	<i>Eurema lisa</i>

G.7 List of Plant Species

These are the plant species found on Quivira Refuge.

<i>Common name</i>	<i>Family</i>	<i>Scientific name</i>
Wild petunia	Acanthaceae	<i>Ruellia humilis</i>
Boxelder	Aceraceae	<i>Acer negundo</i>
Silver maple	Aceraceae	<i>Acer saccharinum</i>
Soapweed yucca	Agavaceae	<i>Yucca glauca</i>
Sea purslane	Aizoaceae	<i>Sesuvium verrucosum</i>
Northern water plantain	Alismataceae	<i>Alisma triviale</i>
Grassleaf arrowhead	Alismataceae	<i>Sagittaria graminea</i> var. <i>graminea</i>
Broadleaf arrowhead	Alismataceae	<i>Sagittaria latifolia</i>
Sandhill amaranth	Amaranthaceae	<i>Amaranthus arenicola</i>
Careless weed	Amaranthaceae	<i>Amaranthus palmeri</i>
Tall waterhemp	Amaranthaceae	<i>Amaranthus tuberculatus</i>
Snake-cotton	Amaranthaceae	<i>Froelichia floridana</i>
Slender snake-cotton	Amaranthaceae	<i>Froelichia gracilis</i>
Fragrant sumac	Anacardiaceae	<i>Rhus aromatica</i>
Smooth sumac	Anacardiaceae	<i>Rhus glabra</i>
Poison ivy	Anacardiaceae	<i>Toxicodendron rydbergii</i>
Cut-leaf water parsnip	Apiaceae	<i>Berula erecta</i>
Common water hemlock	Apiaceae	<i>Cicuta maculata</i>

<i>Common name</i>	<i>Family</i>	<i>Scientific name</i>
Floating marsh pennywort	Apiaceae	<i>Hydrocotyle ranunculoides</i>
Red River scaleseed	Apiaceae	<i>Spermolepis inermis</i>
Indian hemp	Apocynaceae	<i>Apocynum cannabinum</i>
Blunt-leaved milkweed	Asclepiadaceae	<i>Asclepias amplexicaulis</i>
Sand milkweed	Asclepiadaceae	<i>Asclepias arenaria</i>
Swamp milkweed	Asclepiadaceae	<i>Asclepias incarnata</i> ssp. <i>incarnata</i>
Showy milkweed	Asclepiadaceae	<i>Asclepias speciosa</i>
Slimleaf milkweed	Asclepiadaceae	<i>Asclepias stenophylla</i>
Butterfly milkweed	Asclepiadaceae	<i>Asclepias tuberosa</i> ssp. <i>interior</i>
Whorled milkweed	Asclepiadaceae	<i>Asclepias verticillata</i>
Green antelopehorn	Asclepiadaceae	<i>Asclepias viridis</i>
Common yarrow	Asteraceae	<i>Achillea millefolium</i>
Western ragweed	Asteraceae	<i>Ambrosia psilostachya</i>
Giant ragweed	Asteraceae	<i>Ambrosia trifida</i>
Common sagewort	Asteraceae	<i>Artemisia campestris</i>
Cudweed sagewort	Asteraceae	<i>Artemisia ludoviciana</i> ssp. <i>ludoviciana</i>
Baccharis	Asteraceae	<i>Baccharis neglecta</i>
Willow baccharis	Asteraceae	<i>Baccharis salicina</i>
Spanish needles	Asteraceae	<i>Bidens bipinnata</i>
Star boltonia	Asteraceae	<i>Boltonia asteroides</i>
Tall thistle	Asteraceae	<i>Cirsium altissimum</i>
Wavyleaf thistle	Asteraceae	<i>Cirsium undulatum</i>
Bull thistle	Asteraceae	<i>Cirsium vulgare</i>
Horseweed	Asteraceae	<i>Conyza canadensis</i>
Plains coreopsis	Asteraceae	<i>Coreopsis tinctoria</i>
Hooker's scratchdaisy	Asteraceae	<i>Croptilon hookerianum</i> var. <i>validum</i>
Eclipta	Asteraceae	<i>Eclipta prostrata</i>
Philadelphia fleabane	Asteraceae	<i>Erigeron philadelphicus</i>
Daisy fleabane	Asteraceae	<i>Erigeron strigosus</i>
Boneset	Asteraceae	<i>Eupatorium perfoliatum</i>
Alkali yellowtops	Asteraceae	<i>Flaveria campestris</i>
Indian blanket	Asteraceae	<i>Gaillardia pulchella</i>
Curly-cup gumweed	Asteraceae	<i>Grindelia ciliata</i>
Gumweed	Asteraceae	<i>Grindelia squarrosa</i>
Annual sunflower	Asteraceae	<i>Helianthus annuus</i>
Maximilian sunflower	Asteraceae	<i>Helianthus maximiliani</i>
Prairie sunflower	Asteraceae	<i>Helianthus petiolaris</i>
Jerusalem artichoke	Asteraceae	<i>Helianthus tuberosus</i>
Goldenaster	Asteraceae	<i>Heterotheca latifolia</i>
Camphorweed	Asteraceae	<i>Heterotheca subaxillaris</i> ssp. <i>latifolia</i>
Carolina woolywhite	Asteraceae	<i>Hymenopappus scabiosaeus</i>
Marshelder	Asteraceae	<i>Iva annua</i>
Prickly lettuce	Asteraceae	<i>Lactuca serriola</i>
Lanceleaf blazing star	Asteraceae	<i>Liatris lancifolia</i>
Dotted blazing star	Asteraceae	<i>Liatris punctata</i>

<i>Common name</i>	<i>Family</i>	<i>Scientific name</i>
Prairie blazing star	Asteraceae	<i>Liatris pycnostachya</i>
Scaly blazing star	Asteraceae	<i>Liatris squarrosa</i> var. <i>glabrata</i>
Marsh fleabane	Asteraceae	<i>Pluchea odorata</i>
Rabbit-tobacco	Asteraceae	<i>Pseudognaphalium obtusifolium</i>
Tuberous desert-chicory	Asteraceae	<i>Pyrrhopappus grandiflorus</i>
Prairie coneflower	Asteraceae	<i>Ratibida columnifera</i>
Viscid tansyaster	Asteraceae	<i>Rayjacksonia annua</i>
Canada goldenrod	Asteraceae	<i>Solidago altissima</i> spp. <i>altissima</i>
Canada goldenrod	Asteraceae	<i>Solidago canadensis</i>
Missouri goldenrod	Asteraceae	<i>Solidago missouriensis</i>
Downy goldenrod	Asteraceae	<i>Solidago petiolaris</i>
Sow thistle	Asteraceae	<i>Sonchus asper</i>
White heath aster	Asteraceae	<i>Symphotrichum ericoides</i> var. <i>ericoides</i>
White paniced aster	Asteraceae	<i>Symphotrichum lanceolatum</i> ssp. <i>lanceolatum</i>
Calico aster	Asteraceae	<i>Symphotrichum lateriflorum</i>
Annual saltmarsh aster	Asteraceae	<i>Symphotrichum subulatum</i> var. <i>ligulatum</i>
Red-seed dandelion	Asteraceae	<i>Taraxacum erythrospermum</i>
Common dandelion	Asteraceae	<i>Taraxacum officinale</i>
Green threads	Asteraceae	<i>Thelesperma megapotamicum</i>
Common salsify	Asteraceae	<i>Tragopogon dubius</i>
Western ironweed	Asteraceae	<i>Vernonia baldwinii</i>
Prairie ironweed	Asteraceae	<i>Vernonia fasciculata</i>
Cocklebur	Asteraceae	<i>Xanthium strumarium</i>
Trumpet creeper	Bignoniaceae	<i>Campsis radicans</i>
Southern catalpa	Bignoniaceae	<i>Catalpa bignonioides</i>
Northern catalpa	Bignoniaceae	<i>Catalpa speciosa</i>
Little catseye	Boraginaceae	<i>Cryptantha minima</i>
Bindweed heliotrope	Boraginaceae	<i>Euploca convolvulacea</i>
Salt heliotrope	Boraginaceae	<i>Heliotropium curassavicum</i> var. <i>curassavicum</i>
Seaside heliotrope	Boraginaceae	<i>Heliotropium curassavicum</i> var. <i>obovatum</i>
Stickseed	Boraginaceae	<i>Lappula occidentalis</i>
Fringed puccoon	Boraginaceae	<i>Lithospermum incisum</i>
Spring forget-me-not	Boraginaceae	<i>Myosotis verna</i>
Shepherd's purse	Brassicaceae	<i>Capsella bursa-pastoris</i>
Whitetop	Brassicaceae	<i>Lepidium draba</i>
Western tansymustard	Brassicaceae	<i>Descurainia pinnata</i> spp. <i>brachycarpa</i>
Common pepperweed	Brassicaceae	<i>Lepidium densiflorum</i>
Peppergrass	Brassicaceae	<i>Lepidium virginicum</i>
Water-cress	Brassicaceae	<i>Nasturtium officinale</i>
Winged rockcress	Brassicaceae	<i>Planodes virginica</i>
Prickly-pear	Cactaceae	<i>Opuntia humifusa</i>
Plains prickly-pear	Cactaceae	<i>Opuntia phaeacantha</i>
Waterstarwort	Callitrichaceae	<i>Callitriche heterophylla</i>
Cardinal flower	Campanulaceae	<i>Lobelia cardinalis</i>
Great blue lobelia	Campanulaceae	<i>Lobelia siphilitica</i>

<i>Common name</i>	<i>Family</i>	<i>Scientific name</i>
Holzinger's Venus' looking-glass	Campanulaceae	<i>Triodanis holzingeri</i>
Narrowleaf rombopod	Capparaceae	<i>Cleomella angustifolia</i>
Rocky Mountain beeplant	Capparaceae	<i>Peritoma serrulata</i>
James' clammyweed	Capparaceae	<i>Polanisia jamesii</i>
American elder	Caprifoliaceae	<i>Sambucus nigra</i> ssp. <i>canadensis</i>
Coralberry	Caprifoliaceae	<i>Symphoricarpos orbiculatus</i>
Thymeleaf sandwort	Caryophyllaceae	<i>Arenaria serpyllifolia</i>
Mouse-ear chickweed	Caryophyllaceae	<i>Cerastium brachypodium</i>
Nailwort	Caryophyllaceae	<i>Paronychia jamesii</i>
Sleepy catchfly	Caryophyllaceae	<i>Silene antirrhina</i>
Silverscale	Chenopodiaceae	<i>Atriplex argentea</i>
Saline saltbush	Chenopodiaceae	<i>Atriplex dioica</i>
Halberd-leaved orache	Chenopodiaceae	<i>Atriplex patula</i>
Lamb's quarters	Chenopodiaceae	<i>Chenopodium album</i>
Mexican tea	Chenopodiaceae	<i>Chenopodium ambrosioides</i>
Oakleaf goosefoot	Chenopodiaceae	<i>Chenopodium glaucum</i>
Narrowleaf goosefoot	Chenopodiaceae	<i>Chenopodium leptophyllum</i>
Desert goosefoot	Chenopodiaceae	<i>Chenopodium pratericola</i>
Red goosefoot	Chenopodiaceae	<i>Chenopodium rubrum</i>
Maple-leaf goosefoot	Chenopodiaceae	<i>Chenopodium simplex</i>
Winged pigweed	Chenopodiaceae	<i>Cycloloma atriplicifolium</i>
Kochia, fireweed	Chenopodiaceae	<i>Kochia scoparia</i>
Red saltwort	Chenopodiaceae	<i>Salicornia rubra</i>
Russian thistle	Chenopodiaceae	<i>Salsola tragus</i>
Western seepweed	Chenopodiaceae	<i>Suaeda calceoliformis</i>
Poison suckleya	Chenopodiaceae	<i>Suckleya suckleyana</i>
Common Saint John's wort	Clusiaceae	<i>Hypericum perforatum</i>
Dayflower	Commelinaceae	<i>Commelina erecta</i>
Bracted spiderwort	Commelinaceae	<i>Tradescantia bracteata</i>
Prairie spiderwort	Commelinaceae	<i>Tradescantia occidentalis</i>
Field bindweed	Convolvulaceae	<i>Convolvulus arvensis</i>
Prostrate evolvulus	Convolvulaceae	<i>Evolvulus nuttallianus</i>
Bush morning-glory	Convolvulaceae	<i>Ipomoea leptophylla</i>
Pickering's dawnflower	Convolvulaceae	<i>Stylisma pickeringii</i> var. <i>pattersonii</i>
Roughleaf dogwood	Cornaceae	<i>Cornus drummondii</i>
Buffalo-gourd	Cucurbitaceae	<i>Cucurbita foetidissima</i>
Eastern redcedar	Cupressaceae	<i>Juniperus virginiana</i> var. <i>virginiana</i>
Cusp dodder	Cuscutaceae	<i>Cuscuta cuspidata</i>
Rope dodder	Cuscutaceae	<i>Cuscuta glomerata</i>
Field dodder	Cuscutaceae	<i>Cuscuta pentagona</i>
Cosmopolitan bulrush	Cyperaceae	<i>Bolboschoenus maritimus</i> ssp. <i>paludosus</i>
Sturdy bulrush	Cyperaceae	<i>Bolboschoenus robustus</i>
Southern sedge	Cyperaceae	<i>Carex austrina</i>
Shortbeak sedge	Cyperaceae	<i>Carex brevior</i>
Buxbaum sedge	Cyperaceae	<i>Carex buxbaumii</i>

<i>Common name</i>	<i>Family</i>	<i>Scientific name</i>
Emory's sedge	Cyperaceae	<i>Carex emoryi</i>
Fescue sedge	Cyperaceae	<i>Carex festucacea</i>
Smooth-cone sedge	Cyperaceae	<i>Carex laeviconica</i>
Smoothsheath sedge	Cyperaceae	<i>Carex laevivaginata</i>
Wooly-fruit sedge	Cyperaceae	<i>Carex lasiocarpa</i>
Mead's sedge	Cyperaceae	<i>Carex meadii</i>
Troublesome sedge	Cyperaceae	<i>Carex molesta</i>
Wooly sedge	Cyperaceae	<i>Carex pellita</i>
Clustered field sedge	Cyperaceae	<i>Carex praegracilis</i>
Awlfruit sedge	Cyperaceae	<i>Carex stipata</i> var. <i>stipata</i>
Tuckerman's sedge	Cyperaceae	<i>Carex tuckermanii</i>
Fox sedge	Cyperaceae	<i>Carex vulpinoidea</i>
Taperleaf flatsedge	Cyperaceae	<i>Cyperus acuminatus</i>
Poorland flatsedge	Cyperaceae	<i>Cyperus compressus</i>
Globe flatsedge	Cyperaceae	<i>Cyperus echinatus</i>
Yellow nutsedge	Cyperaceae	<i>Cyperus esculentus</i>
Great Plains flatsedge	Cyperaceae	<i>Cyperus lupulinus</i>
Sand flatsedge	Cyperaceae	<i>Cyperus schweinitzii</i>
Lean flatsedge	Cyperaceae	<i>Cyperus setigerus</i>
Awned flatsedge	Cyperaceae	<i>Cyperus squarrosus</i>
Flat-stem spikerush	Cyperaceae	<i>Eleocharis compressa</i>
Bald spikerush	Cyperaceae	<i>Eleocharis erythropoda</i>
Pale spikerush	Cyperaceae	<i>Eleocharis macrostachya</i>
Sand spikerush	Cyperaceae	<i>Eleocharis montevidensis</i>
Common spikerush	Cyperaceae	<i>Eleocharis palustris</i>
Beaked spikerush	Cyperaceae	<i>Eleocharis rostellata</i>
Hairy fimbry	Cyperaceae	<i>Fimbristylis puberula</i> var. <i>interior</i>
Hairy fimbry	Cyperaceae	<i>Fimbristylis puberula</i> var. <i>puberula</i>
Hardstem bulrush	Cyperaceae	<i>Schoenoplectus acutus</i> var. <i>acutus</i>
Common threesquare	Cyperaceae	<i>Schoenoplectus pungens</i>
Common threesquare	Cyperaceae	<i>Schoenoplectus pungens</i> var. <i>longispicatus</i>
Softstem bulrush	Cyperaceae	<i>Schoenoplectus tabernaemontani</i>
Pale bulrush	Cyperaceae	<i>Scirpus pallidus</i>
Hanging bulrush	Cyperaceae	<i>Scirpus pendulus</i>
Persimmon	Ebenaceae	<i>Diospyros virigiana</i>
Russian olive	Elaeagnaceae	<i>Elaeagnus angustifolia</i>
Smooth horsetail	Equisetaceae	<i>Equisetum laevigatum</i>
Geyer's sandmat	Euphorbiaceae	<i>Euphorbia geyeri</i>
Rip-seed sandmat	Euphorbiaceae	<i>Euphorbia glyptosperma</i>
Sand spurge	Euphorbiaceae	<i>Euphorbia missurica</i>
Sand croton	Euphorbiaceae	<i>Croton glandulosus</i> var. <i>septrionalis</i>
Texas croton	Euphorbiaceae	<i>Croton texensis</i>
Heartleaf sandmat	Euphorbiaceae	<i>Euphorbia cordifolia</i>
David's spurge	Euphorbiaceae	<i>Euphorbia davidii</i>
Toothed spurge	Euphorbiaceae	<i>Euphorbia dentata</i>

<i>Common name</i>	<i>Family</i>	<i>Scientific name</i>
Snow-on-the-mountain	Euphorbiaceae	<i>Euphorbia marginata</i>
Eyebane	Euphorbiaceae	<i>Euphorbia nutans</i>
Roughpod spurge	Euphorbiaceae	<i>Euphorbia spathulata</i>
Leadplant	Fabaceae	<i>Amorpha canescens</i>
False indigo	Fabaceae	<i>Amorpha fruticosa</i>
Platte milkvetch	Fabaceae	<i>Astragalus plattensis</i>
Blue wild indigo	Fabaceae	<i>Baptisia australis</i> var. <i>minor</i>
Partridge pea	Fabaceae	<i>Chamaecrista fasciculata</i>
Purple prairie-clover	Fabaceae	<i>Dalea purpurea</i> var. <i>purpurea</i>
Hairy prairie-clover	Fabaceae	<i>Dalea villosa</i> var. <i>villosa</i>
Illinois bundleflower	Fabaceae	<i>Desmanthus illinoensis</i>
Prairie bundleflower	Fabaceae	<i>Desmanthus leptolobus</i>
Sessileleaf ticktrefoil	Fabaceae	<i>Desmodium sessilifolium</i>
Honeylocust	Fabaceae	<i>Gleditsia triacanthos</i>
Wild licorice	Fabaceae	<i>Glycyrrhiza lepidota</i>
Kentucky coffeetree	Fabaceae	<i>Gymnocladus dioicus</i>
Round-head lespedeza	Fabaceae	<i>Lespedeza capitata</i>
American birdsfoot trefoil	Fabaceae	<i>Acmispon americanus</i> var. <i>americanus</i>
Alfalfa	Fabaceae	<i>Medicago sativa</i>
White sweetclover	Fabaceae	<i>Melilotus albus</i>
Yellow sweetclover	Fabaceae	<i>Melilotus officinalis</i>
Sensitive briar	Fabaceae	<i>Mimosa microphylla</i>
Catclaw sensitive-briar	Fabaceae	<i>Mimosa nuttallii</i>
Palmleaf Indian breadroot	Fabaceae	<i>Pedimelum digitatum</i>
Dune scurfpea	Fabaceae	<i>Psoralegium lanceolatum</i>
Black locust	Fabaceae	<i>Robinia pseudoacacia</i>
Stick-seed fuzzybean	Fabaceae	<i>Strophostyles leiosperma</i>
Goat's-rue	Fabaceae	<i>Tephrosia virginiana</i>
Hairy vetch	Fabaceae	<i>Vicia villosa</i> ssp. <i>villosa</i>
Bur oak	Fagaceae	<i>Quercus macrocarpa</i>
Smallflower fumewort	Fumariaceae	<i>Corydalis micrantha</i>
Prairie gentian	Gentianaceae	<i>Eustoma exaltatum</i> ssp. <i>russellianum</i>
Carolina geranium	Geraniaceae	<i>Geranium carolinianum</i>
Golden currant	Grossulariaceae	<i>Ribes aureum</i> var. <i>villosum</i>
American watermilfoil	Haloragaceae	<i>Myriophyllum sibiricum</i>
Common waternymph	Hydrocharitaceae	<i>Najas guadalupensis</i>
Blue-eyed grass	Iridaceae	<i>Sisyrinchium montanum</i>
Black walnut	Juglandaceae	<i>Juglans nigra</i>
Tapertip rush	Juncaceae	<i>Juncus acuminatus</i>
Baltic rush	Juncaceae	<i>Juncus balticus</i>
Tuftedstem rush	Juncaceae	<i>Juncus brachyphyllus</i>
Leathery rush	Juncaceae	<i>Juncus coriaceus</i>
Dudley rush	Juncaceae	<i>Juncus dudleyi</i>
Inland rush	Juncaceae	<i>Juncus interior</i>
Grassleaf rush	Juncaceae	<i>Juncus marginatus</i>

<i>Common name</i>	<i>Family</i>	<i>Scientific name</i>
Lopsided rush	Juncaceae	<i>Juncus secundus</i>
Field rush	Juncaceae	<i>Juncus tenuis</i>
Torrey rush	Juncaceae	<i>Juncus torreyi</i>
False pennyroyal	Lamiaceae	<i>Hedeoma hispida</i>
Henbit	Lamiaceae	<i>Lamium amplexicaule</i>
American bugleweed	Lamiaceae	<i>Lycopus americanus</i>
Wild bergamot	Lamiaceae	<i>Monarda punctata</i> ssp. <i>occidentalis</i>
Catnip	Lamiaceae	<i>Nepeta cataria</i>
Blue sage	Lamiaceae	<i>Salvia azurea</i>
Lanceleaf blue sage	Lamiaceae	<i>Salvia reflexa</i>
Blue skullcap	Lamiaceae	<i>Scutellaria lateriflora</i>
American germander	Lamiaceae	<i>Teucrium canadense</i> var. <i>canadense</i>
Lesser duckweed	Lemnaceae	<i>Lemna aequinoctialis</i>
Common duckweed	Lemnaceae	<i>Lemna minor</i>
Minute duckweed	Lemnaceae	<i>Lemna perpusilla</i>
Turion duckweed	Lemnaceae	<i>Lemna turionifera</i>
Wild onion	Liliaceae	<i>Allium canadense</i>
Wild asparagus	Liliaceae	<i>Asparagus officinalis</i>
False lily-of-the-valley	Liliaceae	<i>Maianthemum stellatum</i>
Wild flax	Linaceae	<i>Linum rigidum</i>
Purple ammannia	Lythraceae	<i>Ammannia coccinea</i>
Grand redstem	Lythraceae	<i>Ammannia robusta</i>
California loosestrife	Lythraceae	<i>Lythrum californicum</i>
Velvetleaf mallow	Malvaceae	<i>Abutilon theophrasti</i>
Plains poppymallow	Malvaceae	<i>Callirhoe alcaeoides</i>
Purple poppymallow	Malvaceae	<i>Callirhoe involucrata</i>
Common mallow	Malvaceae	<i>Malva neglecta</i>
Hairy waterclover	Marsileaceae	<i>Marsilea vestita</i>
Moonseed	Menispermaceae	<i>Menispermum canadense</i>
Carpetweed	Molluginaceae	<i>Mollugo verticillata</i>
Osage-orange	Moraceae	<i>Maclura pomifera</i>
White mulberry	Moraceae	<i>Morus alba</i>
American lotus	Nelumbonaceae	<i>Nelumbo lutea</i>
Smooth four-o'clock	Nyctaginaceae	<i>Mirabilis glabra</i>
Four-o'clock	Nyctaginaceae	<i>Mirabilis linearis</i>
Heart-leaved four-o'clock	Nyctaginaceae	<i>Mirabilis nyctaginea</i>
Green ash	Oleaceae	<i>Fraxinus pennsylvanica</i>
Yellow sundrops	Onagraceae	<i>Oenothera serrulata</i>
Velvetweed	Onagraceae	<i>Oenothera curtiflora</i>
Bushy seedbox	Onagraceae	<i>Ludwigia alternifolia</i>
Common evening primrose	Onagraceae	<i>Oenothera biennis</i>
Hooker's evening primrose	Onagraceae	<i>Oenothera elata</i> ssp. <i>hirsutissima</i>
Largeflower evening primrose	Onagraceae	<i>Oenothera grandis</i>
Cut-leaf evening primrose	Onagraceae	<i>Oenothera laciniata</i>
Four-point evening primrose	Onagraceae	<i>Oenothera rhombipetala</i>

<i>Common name</i>	<i>Family</i>	<i>Scientific name</i>
Hairy evening primrose	Onagraceae	<i>Oenothera villosa</i> ssp. <i>villosa</i>
Great Plains ladies-tresses	Orchidaceae	<i>Spiranthes magnicamporum</i>
Slender yellow woodsorrel	Oxalidaceae	<i>Oxalis dillenii</i>
Yellow woodsorrel	Oxalidaceae	<i>Oxalis stricta</i>
Prickly-poppy	Papaveraceae	<i>Argemone polyanthemus</i>
Devil's claw	Pedaliaceae	<i>Proboscidea louisianica</i>
Pokeweed	Phytolaccaceae	<i>Phytolacca americana</i> var. <i>americana</i>
Austrian pine	Pinaceae	<i>Pinus nigra</i>
Longleaf plantain	Plantaginaceae	<i>Plantago elongata</i>
Wooly plantain	Plantaginaceae	<i>Plantago patagonica</i>
Dwarf plantain	Plantaginaceae	<i>Plantago pusilla</i>
Virginia plantain	Plantaginaceae	<i>Plantago virginica</i>
Goatgrass	Poaceae	<i>Aegilops cylindrica</i>
Redtop bent	Poaceae	<i>Agrostis gigantea</i>
Winter bentgrass	Poaceae	<i>Agrostis hyemalis</i>
Creeping bentgrass	Poaceae	<i>Agrostis stolonifera</i>
Carolina foxtail	Poaceae	<i>Alopecurus carolinianus</i>
Big bluestem	Poaceae	<i>Andropogon gerardii</i>
Sand bluestem	Poaceae	<i>Andropogon hallii</i>
Broomsedge	Poaceae	<i>Andropogon virginicus</i>
Forked three-awn	Poaceae	<i>Aristida basiramea</i>
Longspike three-awn	Poaceae	<i>Aristida longespica</i>
Prairie three-awn	Poaceae	<i>Aristida oligantha</i>
Red three-awn	Poaceae	<i>Aristida purpurea</i> var. <i>longiseta</i>
Caucasian bluestem	Poaceae	<i>Bothriochloa bladhii</i>
King Ranch bluestem	Poaceae	<i>Bothriochloa ischaemum</i> var. <i>songarica</i>
Silver bluestem	Poaceae	<i>Bothriochloa saccharoides</i>
Sideoats grama	Poaceae	<i>Bouteloua curtipendula</i>
Blue grama	Poaceae	<i>Bouteloua gracilis</i>
Rescue grass	Poaceae	<i>Bromus catharticus</i>
Smooth brome	Poaceae	<i>Bromus inermis</i>
Japanese brome	Poaceae	<i>Bromus japonicus</i>
Cheatgrass	Poaceae	<i>Bromus tectorum</i>
Buffalograss	Poaceae	<i>Buchloe dactyloides</i>
Bluejoint reedgrass	Poaceae	<i>Calamagrostis canadensis</i>
Narrowspike reedgrass	Poaceae	<i>Calamagrostis stricta</i>
Prairie sandreed	Poaceae	<i>Calamovilfa gigantea</i>
Sandbur	Poaceae	<i>Cenchrus longispinus</i>
Coastal sandbur	Poaceae	<i>Cenchrus spinifex</i>
Windmill grass	Poaceae	<i>Chloris verticillata</i>
Rigid oanic grass	Poaceae	<i>Coleataenia longifolia</i> ssp. <i>rigidula</i>
Bermudagrass	Poaceae	<i>Cynodon dactylon</i>
Orchardgrass	Poaceae	<i>Dactylis glomerata</i>
Tapered rosette grass	Poaceae	<i>Dichanthelium acuminatum</i> var. <i>acuminatum</i>
Western panic grass	Poaceae	<i>Dichanthelium acuminatum</i> ssp. <i>fasciculatum</i>

<i>Common name</i>	<i>Family</i>	<i>Scientific name</i>
Scribner panicum	Poaceae	<i>Dichanthelium oligosanthes</i>
Carolina crabgrass	Poaceae	<i>Digitaria cognata</i>
Slender crabgrass	Poaceae	<i>Digitaria filiformis</i>
Hairy crabgrass	Poaceae	<i>Digitaria sanguinalis</i>
Inland saltgrass	Poaceae	<i>Distichlis spicata</i> var. <i>stricta</i>
Barnyard grass, millet	Poaceae	<i>Echinochloa crus-galli</i> var. <i>crus-galli</i>
Rough barnyard grass	Poaceae	<i>Echinochloa muricata</i> var. <i>microstachya</i>
Goosegrass	Poaceae	<i>Eleusine indica</i>
Canada wild rye	Poaceae	<i>Elymus canadensis</i>
Quackgrass	Poaceae	<i>Elymus repens</i>
Virginia wild rye	Poaceae	<i>Elymus virginicus</i>
Stinkgrass	Poaceae	<i>Eragrostis cilianensis</i>
Weeping lovegrass	Poaceae	<i>Eragrostis curvula</i>
Tufted lovegrass	Poaceae	<i>Eragrostis pectinacea</i>
Red lovegrass	Poaceae	<i>Eragrostis secundiflora</i> ssp. <i>oxylepis</i>
Purple lovegrass	Poaceae	<i>Eragrostis spectabilis</i>
Sand lovegrass	Poaceae	<i>Eragrostis trichodes</i>
Prairie cupgrass	Poaceae	<i>Eriochloa contracta</i>
Tall fescue	Poaceae	<i>Schedonorus pratensis</i>
Foxtail barley	Poaceae	<i>Hordeum jubatum</i>
Little barley	Poaceae	<i>Hordeum pusillum</i>
Rice cutgrass	Poaceae	<i>Leersia oryzoides</i>
Sprangletop	Poaceae	<i>Leptochloa fusca</i>
Alkali muhly	Poaceae	<i>Muhlenbergia asperifolia</i>
Nodding muhly	Poaceae	<i>Muhlenbergia bushii</i>
Tumblegrass	Poaceae	<i>Muhlenbergia paniculata</i>
Wirestem muhly	Poaceae	<i>Muhlenbergia racemosa</i>
Witchgrass	Poaceae	<i>Panicum capillare</i>
Fall panicum	Poaceae	<i>Panicum dichotomiflorum</i>
Switchgrass	Poaceae	<i>Panicum virgatum</i>
Western wheatgrass	Poaceae	<i>Pascopyrum smithii</i>
Sand paspalum	Poaceae	<i>Paspalum setaceum</i> var. <i>stramineum</i>
Yellow bristlegrass	Poaceae	<i>Pennisetum glaucum</i>
Timothy	Poaceae	<i>Phleum pratense</i>
Common reed	Poaceae	<i>Phragmites australis</i>
Texas bluegrass	Poaceae	<i>Poa arachnifera</i>
Plains bluegrass	Poaceae	<i>Poa arida</i>
Canada bluegrass	Poaceae	<i>Poa compressa</i>
Kentucky bluegrass	Poaceae	<i>Poa pratensis</i>
Rabbit's-foot grass	Poaceae	<i>Polypogon monspeliensis</i>
Tall fescue	Poaceae	<i>Schedonorus arundinaceus</i>
Little bluestem	Poaceae	<i>Schizachyrium scoparium</i>
Cultivated rye	Poaceae	<i>Secale cereale</i>
Marsh foxtail	Poaceae	<i>Setaria parviflora</i>
Green foxtail	Poaceae	<i>Setaria viridis</i>

<i>Common name</i>	<i>Family</i>	<i>Scientific name</i>
Indiangrass	Poaceae	<i>Sorghastrum nutans</i>
Johnsongrass	Poaceae	<i>Sorghum halepense</i>
Alkali cordgrass	Poaceae	<i>Spartina gracilis</i>
Prairie cordgrass	Poaceae	<i>Spartina pectinata</i>
Prairie wedgegrass	Poaceae	<i>Sphenopholis obtusata</i>
Alkali sacaton	Poaceae	<i>Sporobolus airoides</i>
Composite dropseed	Poaceae	<i>Sporobolus compositus</i> var. <i>compositus</i>
Sand dropseed	Poaceae	<i>Sporobolus cryptandrus</i>
Puffsheath dropseed	Poaceae	<i>Sporobolus neglectus</i>
Texas dropseed	Poaceae	<i>Sporobolus texanus</i>
Intermediate wheatgrass	Poaceae	<i>Thinopyrum intermedium</i>
Purpletop	Poaceae	<i>Tridens flavus</i>
Longspike tridens	Poaceae	<i>Tridens strictus</i>
Purple sandgrass	Poaceae	<i>Triplasis purpurea</i> var. <i>purpurea</i>
Eastern gamagrass	Poaceae	<i>Tripsacum dactyloides</i>
Wheat	Poaceae	<i>Triticum aestivum</i>
Sixweeks fescue	Poaceae	<i>Vulpia octoflora</i>
Annual eriogonum	Polygonaceae	<i>Eriogonum annuum</i>
Climbing false buckwheat	Polygonaceae	<i>Fallopia scandens</i>
Water knotweed	Polygonaceae	<i>Persicaria amphibia</i>
Pink smartweed	Polygonaceae	<i>Persicaria bicornis</i>
Marshpepper knotweed	Polygonaceae	<i>Persicaria hydropiper</i>
Swamp smartweed	Polygonaceae	<i>Persicaria hydropiperoides</i>
Curlytop knotweed	Polygonaceae	<i>Persicaria lapathifolia</i>
Spotted ladysthumb	Polygonaceae	<i>Persicaria maculosa</i>
Pennsylvania smartweed	Polygonaceae	<i>Persicaria pennsylvanica</i>
Prostrate knotweed	Polygonaceae	<i>Polygonum aviculare</i>
Bushy knotweed	Polygonaceae	<i>Polygonum ramosissimum</i> ssp. <i>prolificum</i>
Yellow-flowered knotweed	Polygonaceae	<i>Polygonum ramosissimum</i> ssp. <i>ramosissimum</i>
Pleatleaf knotweed	Polygonaceae	<i>Polygonum tenue</i>
Curly dock	Polygonaceae	<i>Rumex crispus</i>
Dock	Polygonaceae	<i>Rumex fueginus</i>
Narrowleaf dock	Polygonaceae	<i>Rumex stenophyllus</i>
Blue mudplantain	Pontederiaceae	<i>Heteranthera limosa</i>
Prairie fameflower	Portulacaceae	<i>Phemeranthus rugospermus</i>
Common purslane	Portulacaceae	<i>Portulaca oleracea</i>
Kiss-me-quick	Portulacaceae	<i>Portulaca pilosa</i>
Long-leaf pondweed	Potamogetonaceae	<i>Potamogeton nodosus</i>
Pondweed	Potamogetonaceae	<i>Stuckenia pectina</i>
Western rock-jasmine	Primulaceae	<i>Androsace occidentalis</i>
Carolina anemone	Ranunculaceae	<i>Anemone caroliniana</i>
Prairie larkspur	Ranunculaceae	<i>Delphinium carolinianum</i> ssp. <i>penardii</i>
Tiny mousetail	Ranunculaceae	<i>Myosurus minimus</i>
Celeryleaf buttercup	Ranunculaceae	<i>Ranunculus sceleratus</i> var. <i>sceleratus</i>
New Jersey tea	Rhamnaceae	<i>Ceanothus herbaceus</i>

<i>Common name</i>	<i>Family</i>	<i>Scientific name</i>
Agrimony	Rosaceae	<i>Agrimonia parviflora</i>
White avens	Rosaceae	<i>Geum canadense</i>
American plum	Rosaceae	<i>Prunus americana</i>
Sand plum	Rosaceae	<i>Prunus angustifolia</i>
Peach	Rosaceae	<i>Prunus persica</i>
Chokecherry	Rosaceae	<i>Prunus virginiana</i>
Pear	Rosaceae	<i>Pyrus communis</i>
Prairie rose	Rosaceae	<i>Rosa arkansana</i>
Multiflora rose	Rosaceae	<i>Rosa multiflora</i>
Buttonbush	Rubiaceae	<i>Cephalanthus occidentalis</i>
Bedstraw	Rubiaceae	<i>Galium aparine</i>
Spiral ditchgrass	Ruppiaceae	<i>Ruppia cirrhosa</i>
Plains cottonwood	Salicaceae	<i>Populus deltoides</i> ssp. <i>monilifera</i>
Peachleaf willow	Salicaceae	<i>Salix amygdaloides</i>
Sandbar willow	Salicaceae	<i>Salix interior</i>
Black willow	Salicaceae	<i>Salix nigra</i>
Western soapberry	Sapindaceae	<i>Sapindus saponaria</i> var. <i>drummondii</i>
Slenderleaf false-foxglove	Scrophulariaceae	<i>Agalinis tenuifolia</i>
Roundleaf monkeyflower	Scrophulariaceae	<i>Mimulus glabratus</i> var. <i>jamesii</i>
Texas toadflax	Scrophulariaceae	<i>Nuttallanthus texanus</i>
Common mullein	Scrophulariaceae	<i>Verbascum thaspus</i>
Purslane speedwell	Scrophulariaceae	<i>Veronica peregrina</i>
Tree-of-heaven	Simaroubaceae	<i>Ailanthus altissima</i>
Bristly greenbrier	Smilacaceae	<i>Smilax tamnoides</i>
Jimsonweed	Solanaceae	<i>Datura stramonium</i>
Sacred datura	Solanaceae	<i>Datura wrightii</i>
Groundcherry	Solanaceae	<i>Physalis hispida</i>
Long-leaf groundcherry	Solanaceae	<i>Physalis longifolia</i> var. <i>longifolia</i>
Longleaf groundcherry	Solanaceae	<i>Physalis longifolia</i> var. <i>subglabrata</i>
Virginia groundcherry	Solanaceae	<i>Physalis virginiana</i> var. <i>virginiana</i>
Horsenettle	Solanaceae	<i>Solanum carolinense</i>
Deadly nightshade	Solanaceae	<i>Solanum interius</i>
Black nightshade	Solanaceae	<i>Solanum nigrum</i>
Buffalo-bur	Solanaceae	<i>Solanum rostratum</i>
Saltcedar	Tamaricaceae	<i>Tamarix ramosissima</i>
Narrow-leaf cattail	Typhaceae	<i>Typha angustifolia</i>
Southern cattail	Typhaceae	<i>Typha domingensis</i>
Broadleaf cattail	Typhaceae	<i>Typha latifolia</i>
Hackberry	Ulmaceae	<i>Celtis occidentalis</i>
Dwarf hackberry	Ulmaceae	<i>Celtis tenuifolia</i>
American elm	Ulmaceae	<i>Ulmus americana</i>
Chinese elm	Ulmaceae	<i>Ulmus parvifolia</i>
Siberian elm	Ulmaceae	<i>Ulmus pumila</i>
Slippery elm	Ulmaceae	<i>Ulmus rubra</i>
False nettle	Urticaceae	<i>Boehmeria cylindrica</i>

<i>Common name</i>	<i>Family</i>	<i>Scientific name</i>
Pennsylvania pellitory	Urticaceae	<i>Parietaria pensylvanica</i>
Dakota vervain	Verbenaceae	<i>Glandularia bipinnatifida</i> var. <i>bipinnatifida</i>
Fog-fruit	Verbenaceae	<i>Phyla lanceolata</i>
Prostrate vervain	Verbenaceae	<i>Verbena bracteata</i>
Blue vervain	Verbenaceae	<i>Verbena hastata</i>
Hoary vervain	Verbenaceae	<i>Verbena stricta</i>
Field pansy	Violaceae	<i>Viola bicolor</i>
Common blue violet	Violaceae	<i>Viola sororia</i>
Virginia creeper	Vitaceae	<i>Parthenocissus quinquefolia</i>
Riverbank grape	Vitaceae	<i>Vitis riparia</i>
Horned pondweed	Zannichelliaceae	<i>Zannichellia palustris</i>
Puncture-vine	Zygophyllaceae	<i>Tribulus terrestris</i>

Appendix H

Grassland Fragmentation Assessment

To determine the optimal distribution and area of grasslands on Quivira Refuge, a quantitative analysis comparing the benefits of current and future grassland areas and distribution was conducted on refuge and private lands within 2 miles of the refuge boundary using GIS. The analysis was based on the spatial needs of area-sensitive grassland birds reported in literature and on the refuge's digital NVCS map.

Species considered in the analysis are known to occur on the refuge and included upland sandpiper, grasshopper sparrow, bobolink, western meadowlark, and dickcissel (Helzer and Jelinski 1999). It is assumed that meeting the area needs of these species also would result in sufficient area to support other grassland-dependent birds. Further, similar landscape factors such as connectedness (tree cover), road density, and isolation, have been shown to affect certain wetland birds as well (Whited et al. 2000).

To assess current benefits, three separate maps were created from the 2008 NVCS data: (1) a coverage of suitable breeding habitats that included all NVCS associations dominated by upland and facultative upland grasses, including areas that now support plum that could be removed by management; (2) neutral habitats that do not provide suitable habitat but are not avoided, which included areas dominated by saltgrass and sedge meadows; and (3) hostile habitats that species avoid, which included trees, roads, croplands, buildings, wetlands greater than 437.45 yards (400 meters) wide, and tall dense plum stands that are expected to persist on the refuge.

Roads and trees were buffered by 54.68 yards (50 meters) to account for edge effects (nest parasitism and predation) that negatively affect breeding success (Johnson and Temple 1990, Winter et al. 2000, Herkert et al. 2003). The 54.68-yard (50-meter) buffer may actually be conservative as edge and patch effects vary temporally, spatially, and among species (Bakker et al. 2002; Winter et al. 2006a, 2006b) and some research suggest greater buffer distances (Bollinger and Gavin 2004).

The maps of suitable and neutral habitats were combined and intersected with the hostile habitat map to determine the area and perimeter-to-area ratio of individual grassland tracts (patches, for example). These metrics were compared to those reported for area-sensitive species to determine the suitability of individual patches.

To determine potential future benefits, the same analysis was conducted except that the planning team identified hostile habitats that could be realistically restored to increase the area of suitable grassland habitat. Treed areas and cropland were the only habitats that met this criterion. County roads and existing buildings could not be removed because of legal and budget constraints, respectively. Wetlands greater than 437.45 yards (400 meters) wide and tall dense plum stands could not be removed because they provide important habitats for other species.

A 54.68-yard (50-meter) buffer was placed around those features that could not be removed or restored, and all trees and agricultural fields that did not occur within the buffer area were removed from the map of hostile habitats. Trees within the buffer were kept because removal would not increase the area of grassland habitat.

In addition, treed areas on the perimeter of the refuge were evaluated relative to adjacent habitats on private lands. Treed areas on the refuge that extended onto private land were kept because removal would not substantially increase area of grassland tracts; all other perimeter woody vegetation was removed. A map of historical vegetation that was developed based on ecological site descriptions and historical botanical information (Heitmeyer et al. 2012) was used to assign new habitat types to treed areas and croplands that were slated for removal. These habitat types were then reclassified as either suitable or neutral before the analysis.

The results of the current habitat analysis show the refuge has 41 patches of suitable or neutral habitat that encompass 9,770 acres (44 percent) of grassland. Of these, 11 patches are of sufficient size and have suitable perimeter-to-area ratios necessary to support the area-sensitive species based on measures used in the analysis. However, the composition of most suitable patches are dominated (less than 50 percent) by neutral habitat, suggesting that suitable breeding habitat may be limited within these patches. For example, some patches considered to be of suitable size were dominated by saltgrass, which does not provide the plant height or litter depth necessary for nesting species in the analysis.

In comparison, the analysis of potential future habitats shows appropriate management could dramatically improve grassland habitats for area-sensi-

tive grassland species and, therefore, other grassland-dependent birds. Restoration of designated treed areas (about 850 acres) and agricultural fields (about 866 acres) to historical habitat types would result in 12 grassland patches, 9 of which would be more than 500 acres and 6 more than 1,000 acres with lower perimeter-to-area ratios (less edge) that exceed the needs for the species considered in the analysis. Furthermore, 5 of the 6 patches that are greater than 1,000 acres would have more than 50 percent of the habitat area suitable for breeding grassland birds.

H.1 Current Conditions: 54.68-Yard Analysis

Black areas in figure 19 are hostile to grassland birds, as defined by: area within 54.68 yards (50 meters) of all tress, agricultural fields, primary roads, wetlands greater than 437.45 yards (400 meters) across, and plum stands not expected to change because of various management constraints. Total acres are 9,770, or about 44 percent of the refuge.

Current suitable habitat for grassland birds includes: grasslands, including meadows and sandhills, and plum. Total acres are 5,633, or about 25 percent of the refuge.

Current unsuitable habitat for grassland birds includes tall emergents, saltgrass, water, salt flats and bare areas, secondary roads, and prairie dog towns. Total acres are 6,739, or about 30 percent of the refuge.

H.2 Future Conditions: 54.68-Yard Analysis

Black areas in figure 20 are hostile to grassland birds, as defined by: area within 54.68 yards (50 meters) around remaining trees, primary roads, wetlands greater than 437.45 yards (400 meters) across, and plum stands not expected to change because of various management constraints. Total acres are 4,138, or about 18.6 percent of the refuge.

Future, suitable, habitat for grassland birds by removing trees and restoring agricultural fields totals 9,780 acres, or about 40 percent of the refuge.

Current unsuitable habitat for grassland birds includes: tall emergents, saltgrass, water salt flats and bare areas, secondary roads, and prairie dog towns. Total acres are 8,222, or about 37 percent of the refuge.

H.3 Current Conditions: 54.68-Yard Analysis of Patches Greater Than 1 Acre

Current patches of nonhostile habitats were created by dissolving features labeled as suitable or unsuitable. Forty one patches greater than one acre are shown on figure 21. Perimeter-to-area ratios were computed for each patch. White space is area hostile to grassland birds.

H.4 Future Conditions: 54.68-Yard Analysis of Patches Greater Than 1 Acre

Future patches of nonhostile habitats were created by dissolving features labeled as suitable or unsuitable. Patches were expanded from current conditions by restoring agricultural fields and removing most, but not all, trees. The result is twelve patches greater than one acre. Perimeter-to-area ratios were computed for each patch. White space is remaining area hostile to grassland birds.

H.5 Summary

If we choose to remove 850 acres of trees and restore 886 acres of agricultural fields to native habitats at Quivira Refuge over the next 15 years, the resulting gain in suitable grassland bird habitat would be approximately 4,163 acres—3,845 acres of grassland and 318 acres of plum. We propose to leave 125 acres of trees in 13 patches ranging in size from less than 1 acre to 21 acres.

Even after restoration activities, approximately 19 percent of the refuge would remain hostile to grassland birds primarily because of the BSM, the LSM, and the presence of primary roads, which would not change.

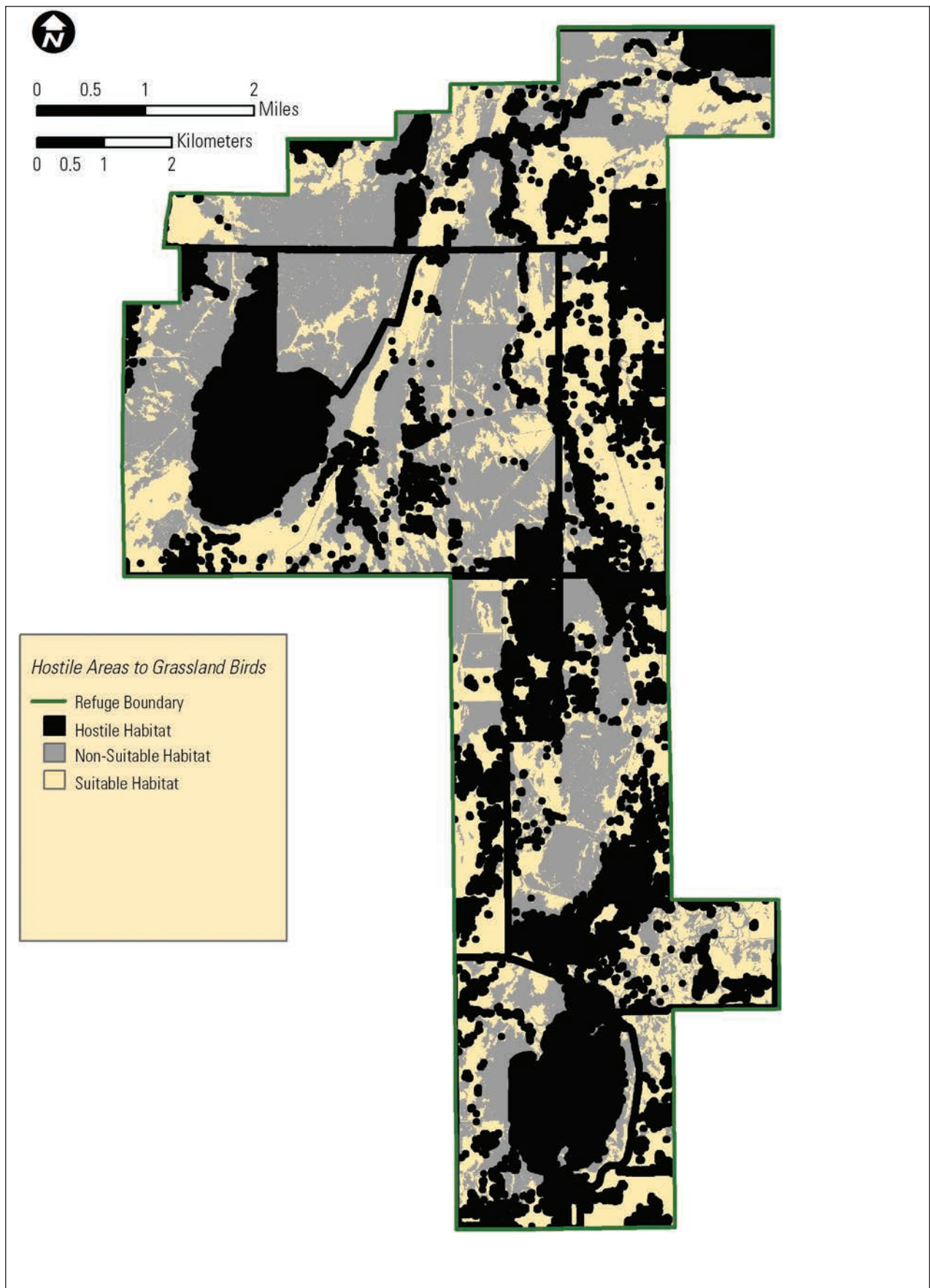


Figure 19. Current grassland conditions at Quivira National Wildlife Refuge, Kansas.

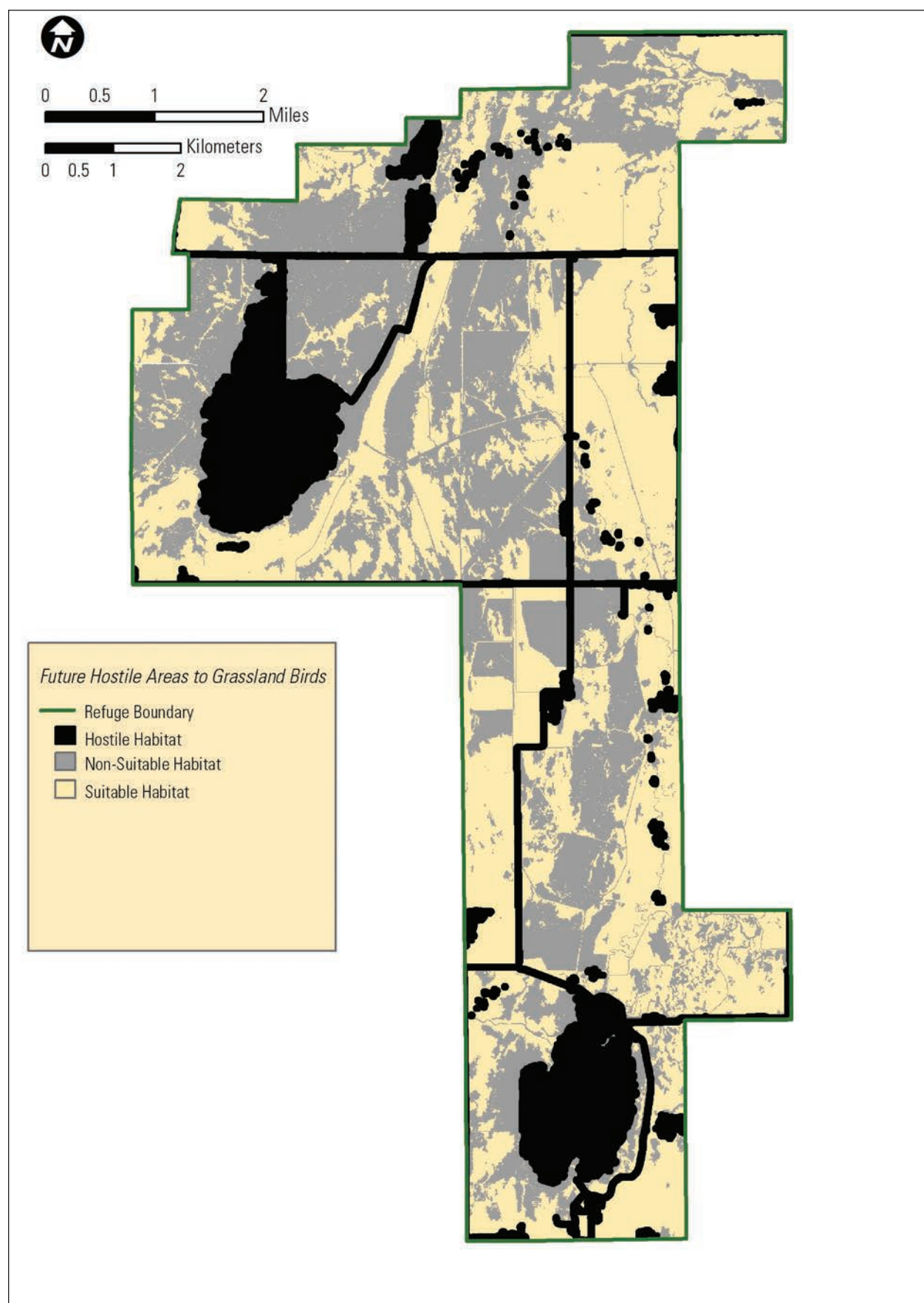


Figure 20. Future grassland conditions at Quivira National Wildlife Refuge, Kansas.

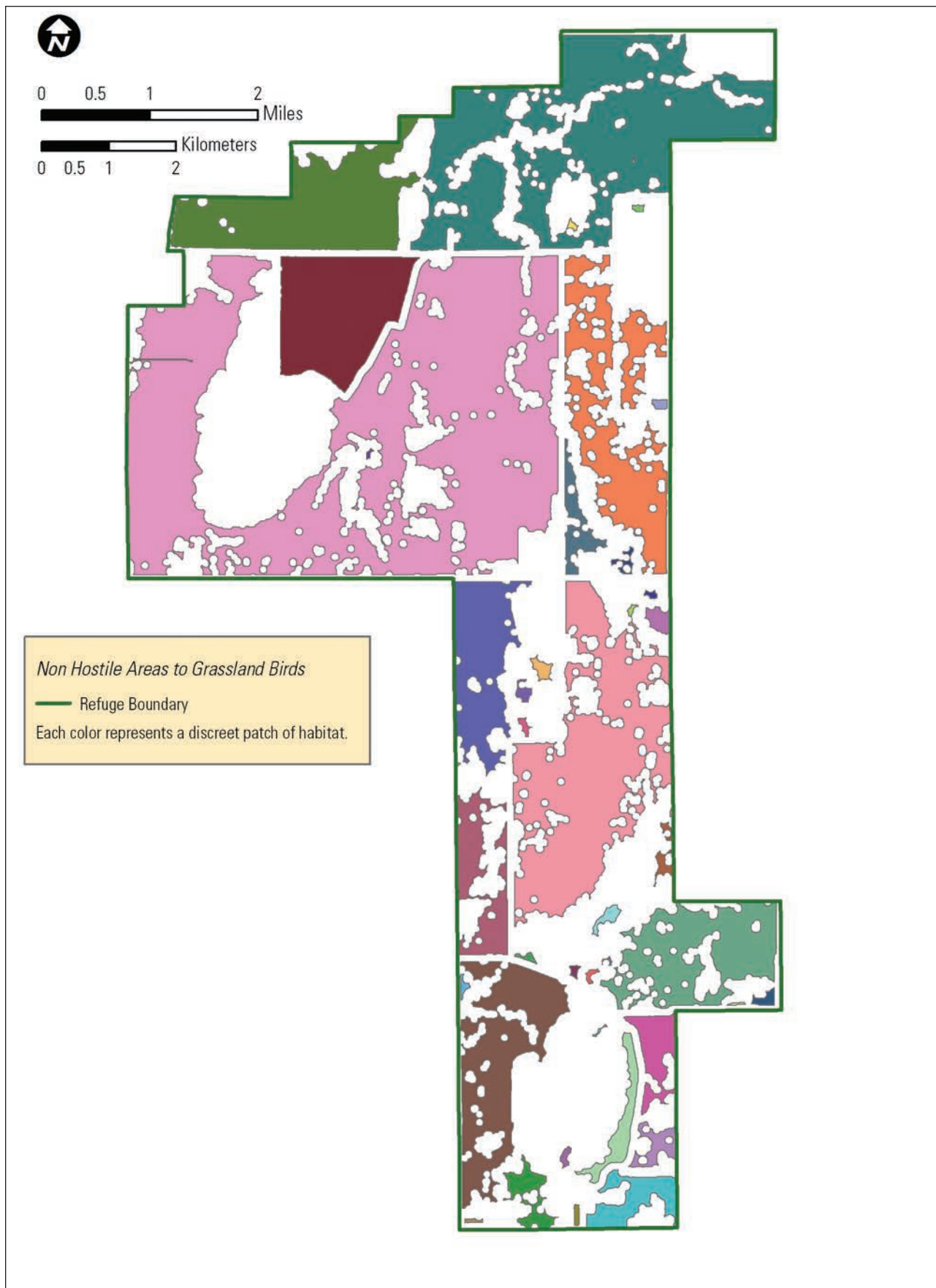


Figure 21. Current nonhostile grassland conditions at Quivira National Wildlife Refuge, Kansas.

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