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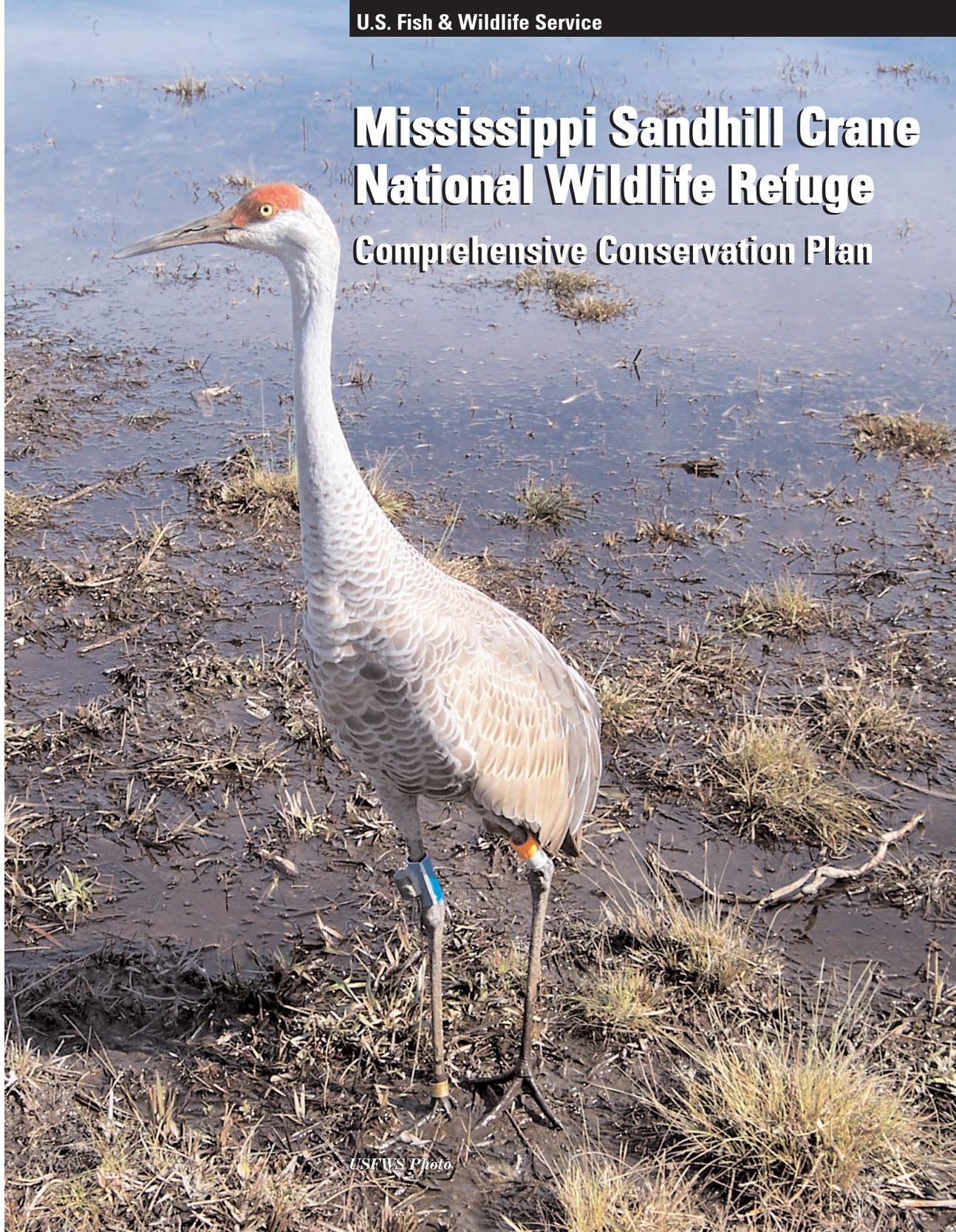
September 2007

Mississippi Sandhill Crane National Wildlife Refuge Comprehensive Conservation Plan

Mississippi Sandhill Crane National Wildlife Refuge

Comprehensive Conservation Plan



USFWS Photo

Comprehensive Conservation Plans provide long-term guidance for management decisions; set forth goals, objectives, and strategies needed to accomplish refuge purposes; and identify the Fish and Wildlife Service's best estimate of future needs. These plans detail program planning levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

Mississippi Sandhill Crane National Wildlife Refuge

Comprehensive Conservation Plan

U.S. Department of the Interior
Fish and Wildlife Service
Southeast Region

September 2007

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MISSISSIPPI SANDHILL CRANE NATIONAL WILDLIFE REFUGE

Comprehensive Conservation Plan

Jackson County, Mississippi

U.S. Department of the Interior
Fish and Wildlife Service
Southeast Region
Atlanta, Georgia

September 2007

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I. Background

INTRODUCTION

The U.S. Fish and Wildlife Service (USFWS, the Service) has developed this Comprehensive Conservation Plan to provide a foundation for the management and use of Mississippi Sandhill Crane National Wildlife Refuge in Jackson County, Mississippi (Figure 1). The plan is intended to serve as a working guide for the refuge's management programs and actions over the next 15 years.

This plan was developed in compliance with the National Wildlife Refuge System Improvement Act of 1997 and Part 602 (National Wildlife Refuge System Planning) of the Fish and Wildlife Service Manual. The actions described in this plan also meet the requirements of the National Environmental Policy Act (NEPA) of 1969. Compliance with NEPA was achieved through the involvement of the public and the inclusion of a Draft Environmental Assessment. When fully implemented, this plan will strive to achieve the vision and purposes of the refuge.

The plan's overriding consideration is to carry out the purposes for which the refuge was established. Fish and wildlife are the first priority in refuge management, and public use (e.g., wildlife-dependent recreation) is allowed and encouraged as long as it is compatible with, or does not detract from, the refuge's mission and purposes.

The plan was prepared by a planning team composed of representatives from the refuge, including the refuge manager, wildlife biologist, and fire management officer; a natural resources planner from the Service's Jackson, Mississippi, field office; biologists representing the Mississippi Department of Marine Resources and the Mississippi Department of Wildlife, Fisheries, and Parks; The Nature Conservancy, a nongovernmental conservation organization that is a partner and manager of adjacent lands; and the Mangi Environmental Group, a Service contractor. In developing this plan, the planning team and refuge staff incorporated the input and contributions of other federal, state, and local agencies; nongovernmental organizations; conservation groups; local citizens; the general public; and other stakeholders. This public involvement and the planning process itself are described in Chapter III, Plan Development.

The plan represents the Service's preferred alternative and is being put forward after considering three other alternatives, which were described in the draft environmental assessment. After reviewing the public comments and management needs, the planning team developed these alternatives in an attempt to determine how to best meet the goals and objectives of Mississippi Sandhill Crane National Wildlife Refuge. Alternative D, the preferred alternative, is the Service's recommended course of action for the management of the refuge, and is embodied in this plan.

Figure 1. Location of Mississippi Sandhill Crane National Wildlife Refuge.

PURPOSE OF AND NEED FOR THE PLAN

The purpose of this Comprehensive Conservation Plan is to identify the role that Mississippi Sandhill Crane National Wildlife Refuge will play in support of the mission of the National Wildlife Refuge System, and to provide long-term guidance to the refuge's management programs and activities. The plan is needed to

- provide a clear statement of direction for the future management of the refuge;
- provide neighbors, visitors, nongovernmental partners, and government officials with an understanding of the Fish and Wildlife Service's management actions on and around the refuge;
- ensure that the Service's management actions, including land protection and recreational and educational programs, are consistent with the mandates of the National Wildlife Refuge System Improvement Act of 1997;
- ensure that the management of the refuge considers federal, state, and county plans; and
- provide a basis for development of the refuge's budget requests for operational, maintenance, and capital improvement needs.

A critical management consideration for the Service is to communicate with the public and include public participation in its efforts to carry out the mission of the National Wildlife Refuge System. Many agencies, organizations, institutions, businesses, and private citizens have developed relationships with the Service to advance the goals of the Refuge System.

U.S. FISH AND WILDLIFE SERVICE

The mission of the U.S. Fish and Wildlife Service, working with others, is to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people.

The Service manages the 96 million-acre National Wildlife Refuge System, comprised of more than 540 national wildlife refuges, thousands of small wetlands, and other special management areas. It also operates 66 national fish hatcheries, 64 fishery resource offices, and 78 ecological services field stations. The agency enforces federal wildlife laws; administers the Endangered Species Act; manages migratory bird populations; restores nationally significant fisheries; conserves and restores wildlife habitat such as wetlands; and helps foreign governments with their conservation efforts. It also oversees the Federal Aid program that distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to state fish and wildlife agencies.

The Service is the primary federal agency responsible for conserving, protecting, and enhancing the Nation's fish and wildlife populations and their habitats. Although it shares some conservation responsibilities with other federal, state, tribal, local, and private entities, the Service has specific trustee responsibilities for migratory birds, threatened and endangered species, anadromous fish, and certain marine mammals.

NATIONAL WILDLIFE REFUGE SYSTEM

The National Wildlife Refuge System is the world's largest network of lands specifically managed for the benefit of fish and wildlife. The mission of the Refuge System, as defined by the National Wildlife Refuge System Improvement Act of 1997, 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."*

The National Wildlife Refuge System Improvement Act of 1997 established, for the first time, a clear mission of wildlife conservation for the Refuge System. The Act states that each refuge shall be managed to

- fulfill the individual purpose of each refuge;
- fulfill the mission of the Refuge System;
- consider the needs of fish and wildlife first;
- fulfill the requirement of developing a comprehensive conservation plan for each unit of the Refuge System, and fully involve the public in the preparation of these plans;
- maintain the biological integrity, diversity, and environmental health of the Refuge System;
- recognize that wildlife-dependent recreation activities, including hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation, are legitimate and priority public uses; and
- retain the authority of refuge managers to determine compatible public uses.

Following passage of the Act in 1997, the Service immediately began efforts to implement the direction of the new legislation, including the preparation of comprehensive conservation plans for all refuges. The development of these plans is ongoing nationally. Consistent with the Act, all plans are being prepared in conjunction with public involvement, and each refuge is required to complete its plan within a 15-year schedule.

Approximately 38 million people visited America's national wildlife refuges in 2002, mostly to observe wildlife in their natural habitats. As this visitation continues to grow, significant economic benefits are being generated to local communities that surround the refuges. Economists have reported that national wildlife refuge visitors contribute more than $400 million annually to the local economies. In 2001, 82 million U.S. residents aged 16 years and older fished, hunted, or observed wildlife, generating a national total of $108 billion. In a study completed in 2002 on 15 refuges in 14 states around the nation, visitation had grown 36 percent in seven years. At the same time, the number of jobs generated in surrounding communities grew to 120 per refuge, up from 87 jobs in 1995, pouring more than $2.2 million into the economies of local communities. Other findings also validate the belief that communities near refuges benefit economically. Expenditures on food, lodging, and transportation grew to $6.8 million per refuge, up 31 percent from $5.2 million in 1995. For each federal dollar spent on the National Refuge System, the surrounding communities have benefited with $4.43 in recreation expenditures and $1.42 in job-related income (Caudill and Laughland 2003).

Volunteerism continues to be a major contributor to the successes of the Refuge System. In 2002, thousands of volunteers contributed more than 1.5 million person-hours on refuges nationwide, a service valued at more than $22 million.

The wildlife and habitat vision for national wildlife refuges stresses the following principles:

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

LEGAL POLICY CONTEXT

Administration of national wildlife refuges is guided by the mission and goals of the National Wildlife Refuge System, congressional legislation, presidential executive orders, and international treaties. Policies for management options of refuges are further refined by administrative guidelines established by the Secretary of the Interior and by policy guidelines established by the Director of the Fish and Wildlife Service. Please refer to Appendix III for a complete list of the relevant legal mandates.

Lands within the National Wildlife Refuge System are closed to public use unless specifically and legally opened. The Service must evaluate all programs and uses based on the mandates set forth in the National Wildlife Refuge System Improvement Act of 1997. These mandates are to

- contribute to ecosystem goals, as well as refuge purposes and goals;
- conserve, manage, and restore fish, wildlife, and plant resources and their habitats;
- monitor the trends of fish, wildlife, and plants;

- manage and ensure appropriate visitor uses, as those uses benefit the conservation of fish and wildlife resources and contribute to the enjoyment of the public (these uses include hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation); and
- ensure that visitor activities are compatible with refuge purposes.

NATIONAL CONSERVATION PLANS AND INITIATIVES

This Comprehensive Conservation Plan supports the Partners in Flight initiative; the North American Waterfowl Management Plan; U.S. Shorebird and Wading Bird plans; American Woodcock Management Plan; North American Bird Conservation initiative; and Partners in Amphibian and Reptile Conservation.

PARTNERS IN FLIGHT

Growing concern about declines in many land bird species not covered by existing conservation initiatives led to the launching of Partners in Flight in 1990. Partners in Flight is an international, cooperative effort of government agencies, philanthropies, professional organizations, conservation groups, industry, academia, and private individuals. Its initial focus was on neotropical migratory birds—species that breed in North America and winter in Central and South America—but its emphasis has now expanded to encompass most land birds and other species requiring terrestrial habitats. Partners in Flight has a number of initiatives underway, including a North American Landbird Conservation Plan. This plan is voluntary and nonregulatory, and focuses on relatively common species in areas where conservation actions can be most effective, rather than the frequent local emphasis on rare and peripheral populations. Partners in Flight's main premise is that the resources of public and private entities in the Americas, both North and South, must be combined, coordinated, and increased if success in conserving hemispheric bird populations is to be achieved (Partners in Flight n.d.).

Partners in Flight has formed bird conservation plans by bird conservation regions that set conservation priorities and habitat and population objectives. Priority habitats found on Mississippi Sandhill Crane National Wildlife Refuge that are considered a priority in the East Gulf Coastal Plain physiographic area include the longleaf and slash pine savannas formerly found throughout the lower coastal plain, and the dry and wet prairies from southeastern Louisiana to the Florida panhandle. Currently, less than three percent of the original savanna can be found in the southeast. The largest remaining fragments of pine savanna (outside of Apalachicola National Forest in Florida) within the East Gulf Coastal Plain are Garcon Point, Florida; Grand Bay, Alabama; and Mississippi Sandhill Crane Refuge, Mississippi. High-priority bird species in East Gulf Coastal Plain pine habitat include the Mississippi sandhill crane, Henslow's sparrow, Bachman's sparrow, American kestrel, brown-headed nuthatch, prairie warbler, sedge wren, red-cockaded woodpecker, and northern bobwhite.

NORTH AMERICAN WATERFOWL MANAGEMENT PLAN

The North American Waterfowl Management Plan began in 1986 with the signing of an agreement between Canada and the United States; Mexico later joined the program in 1988. The Plan provides a policy framework for analyzing North American waterfowl issues. It also sets out a number of objectives relating to waterfowl habitat and populations, with a focus on conserving and expanding wetland areas (Environment Canada 2004).

The North American Waterfowl Management Plan is based on the principle of joint ventures that serve as a framework for the activities of its private and regional member agencies. These partners coordinate their efforts in pursuit of common objectives for waterfowl protection in each region, province, or state.

U.S. SHOREBIRD CONSERVATION PLAN AND WADING BIRD PLAN

The U.S. Shorebird Conservation Plan and Wading Bird Plan are partnership efforts throughout the United States to ensure that stable and self-sustaining populations of shorebird and wading bird species are restored and protected. Both plans were developed by a wide range of agencies, organizations, and experts for separate regions of the country. They identify conservation goals, critical habitat conservation needs, key research needs, and proposed education and outreach programs to increase awareness of shorebirds and the threats they face (USFWS n.d.a).

AMERICAN WOODCOCK MANAGEMENT PLAN

Woodcock trends in the United States have been declining annually for the last 15 years in spite of actions that have been taken to ensure that hunting does not substantially promote declines, such as reduced bag limits and limited season lengths. An American Woodcock Management Plan, initiated in the 1990s, points out the need for improved breeding, migration, and wintering habitat to enhance population growth and survival (McAuley and Clugston n.d.). Much of the decline is thought to be caused by land use changes and the maturing of forest habitats that result in less early successional scrub/shrub habitats preferred by woodcock.

Mississippi Sandhill Crane National Wildlife Refuge will contribute to the listed goals of the American Woodcock Management Plan by continuing to plant 4–5 food plots that will benefit these birds.

NORTH AMERICAN BIRD CONSERVATION INITIATIVE

The North American Bird Conservation Initiative is a broad coalition of governmental, nongovernmental, and academic organizations interested in coordinating efforts to conserve bird populations and the landscapes upon which they depend. The Initiative evolved in 1998, out of recognition among conservationists of the value of coordinating and integrating planning, implementation, and evaluation efforts of the North American Waterfowl Management Plan, Partners in Flight, the U.S. Shorebird Conservation Plan, and the Wading Bird Plan. The goal is to cause the combined effectiveness of these separate programs to exceed the total of their parts. The Mississippi Sandhill Crane Refuge is included in the Southeast Coastal Bird Conservation Region.

PARTNERS IN AMPHIBIAN AND REPTILE CONSERVATION

The Partners in Amphibian and Reptile Conservation (PARC) was founded in 1998 to address the need for conservation of herpetofauna—amphibians and reptiles—and their habitats (Partners in Amphibian and Reptile Conservation 2004). Its mission is to conserve amphibians, reptiles, and their habitats as integral parts of the ecosystem and culture through proactive and coordinated public/private partnerships. The first organizational meeting of this group was attended by more than 200 individuals from over 170 organizations and agencies, including representatives from federal and state agencies; conservation organizations; museums; nature centers; universities; research laboratories; the forest products industry; the pet trade industry; and environmental consultants and contractors, including participants from 33 states, the District of Columbia, Canada, and Mexico.

The Mississippi Sandhill Crane refuge will contribute to the following goals of PARC:

- Complete a baseline study of refuge amphibian and reptile populations.
- Maintain quality of wetlands (e.g., water quality).

RELATIONSHIP TO STATE CONSERVATION AGENCIES

A provision of the National Wildlife Refuge System Improvement Act of 1997, and subsequent agency policy, is that the Service shall ensure timely and effective cooperation and collaboration with other federal agencies, state fish and wildlife agencies, and tribal governments during the course of acquiring and managing refuges. This cooperation is essential in providing the foundation for the protection and sustainability of fish and wildlife throughout the United States. In Mississippi, two state conservation agencies—the Department of Marine Resources and the Department of Wildlife, Fisheries, and Parks—regularly partner with the Fish and Wildlife Service in efforts to conserve habitats and wildlife populations in the state.

The Mississippi Legislature created the Department of Marine Resources in 1994 as a separate governing agency to enhance, protect, and conserve the state's marine interests. Under the authority of the Commission on Marine Resources, the Department of Marine Resources manages all marine life, public trust wetlands, adjacent uplands, and waterfront areas in Mississippi. It also provides for the balanced commercial, recreational, educational, and economic uses of marine-related resources, consistent with environmental concerns and social changes (Mississippi Department of Marine Resources n.d.a). The Department of Marine Resources and the Commission on Marine Resources play an important role in implementing and administering Mississippi seafood laws, the Mississippi Coastal Wetlands Protection Act, the Public Trust Tidelands Act, the Boat and Water Safety Act, the Derelict Vessel Act, the Non-Point Source Pollution Act, the Magnuson Act, the Wallop-Breaux Sportfish Restoration Act, and Marine Litter Act, as well as other state and federal mandates (Mississippi Department of Marine Resources n.d.b). In addition, the Department of Marine Resources operates Mississippi's Coastal Preserves Program.

The Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP) is charged with enforcement responsibilities for migratory birds and endangered species, as well as managing the state's natural resources. The total area owned or managed by the MDWFP in support of wildlife, recreation, and fisheries is 828,408 acres. This includes 42 wildlife management areas and 29 state parks encompassing 823,297 acres, and 21 lakes totaling 5,111 acres. The MDWFP directs the state's wildlife conservation program and provides public recreation opportunities, including an extensive hunting and fishing program, on several wildlife management areas and parks located near the refuge. Overall, a combined total of nearly 100 wildlife management areas and national wildlife refuge areas provide the foundation for the protection of wildlife species throughout Mississippi, and contribute to the overall health and sustainability of fish and wildlife (Southeastern Outdoors 2004).

Each agency's participation and contribution throughout this planning process has been invaluable. They continue to work with the Service in providing ongoing opportunities for an open dialogue with the public to improve the ecological sustainability of fish and wildlife in Mississippi. A key aspect of the planning process is the integration of common objectives between the Service and both agencies, where appropriate.

II. Refuge Overview

INTRODUCTION

The sandhill crane (G*rus canadensis*) is a long-necked, grayish-brown bird that stands about four feet tall. It broadly resembles the great blue heron in size and shape but has a distinctive reddish crown and vocalizations often described as “loud and clattering” (USFWS 1991). Most of North America’s sandhill cranes are also noted for their long migrations. The Mississippi sandhill crane (*G. c. pulla*) is an endangered, *nonmigratory* subspecies of the sandhill crane.

Mississippi Sandhill Crane National Wildlife Refuge was established in 1975 in Jackson County in southeastern Mississippi (Figure 2) for the protection and recovery of this critically endangered bird and the restoration of its unique habitat, wet pine savanna (e.g., pitcher plant bogs). An estimated 95–97 percent of wet pine savanna habitat has been altered and the refuge plays a critical role as a representative remnant of this ecosystem. The Mississippi Sandhill Crane Refuge consists of three separate units totaling approximately 19,300 acres: the Gautier, Ocean Springs, and Fontainebleau units. Each unit lies within the limited nesting range of the endangered Mississippi sandhill crane (GORP n.d.).

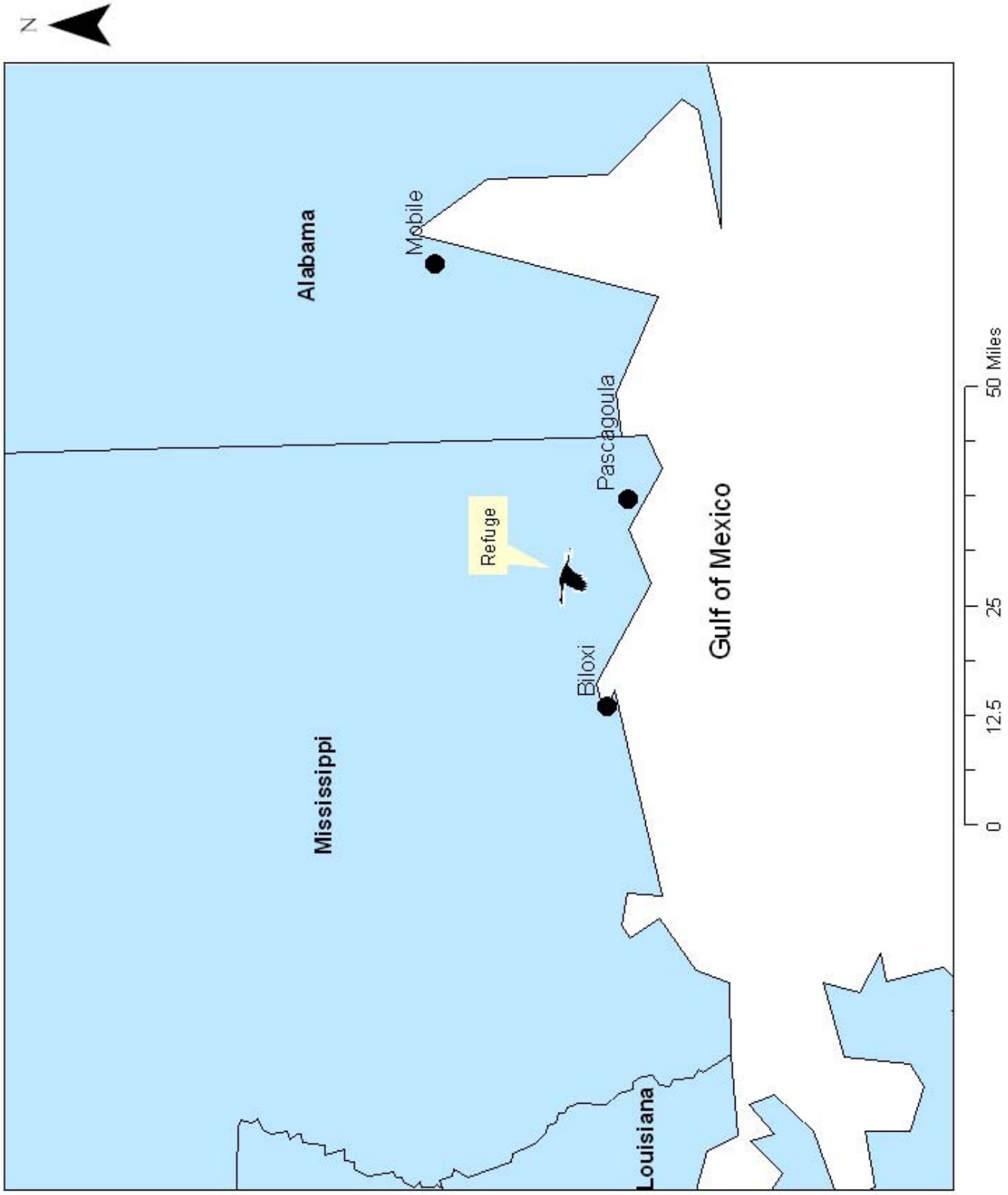
REFUGE HISTORY AND PURPOSES

Resident sandhill cranes formed a continuous population in Georgia and Florida and discontinuous populations along the Gulf Coastal Plain of Texas, Louisiana, Mississippi, and Alabama. Mississippi sandhill cranes originally occurred in small separate colonies along the Gulf Coast of Louisiana, Mississippi, Alabama, and Florida. Nesting sandhill cranes were so abundant in the marshes and wet prairies of southwestern Louisiana that they were considered a serious pest (USFWS 1991). Now, in contrast, nonmigratory sandhill cranes nest only in Mississippi and Florida.

The Mississippi sandhill crane was recognized as a separate subspecies in 1972, distinguished from the five other subspecies of sandhill cranes by morphological, physiological, and genetic traits (Gee and Hereford 1995). For example, Mississippi birds mature earlier and begin egg production about six weeks later than Florida sandhill cranes. They are consistently darker in color. Also, genetic studies have shown a level of heterozygosity (i.e., a measure of genetic variation in a population) in the wild Mississippi population about half that in other sandhill cranes. As in other small populations, Mississippi sandhill cranes appear to have certain genetic weaknesses. In the captive population, for example, 17 percent of all birds die from detectable heart murmurs; and when released to the wild, 36 percent with heart murmurs and 83 percent without heart murmurs survive for one year after release (Gee and Hereford 1995).

Historically, the Mississippi sandhill crane was found in semi-open, wet savanna habitat that was once prevalent in southern Jackson County. Savannas are meadows established on acidic water-logged soil, unsuitable for most land uses. Sharing the habitat with grazing cattle and sheep, the crane survived in the isolation provided by this unproductive land. By the mid-1950s, however, timber companies purchased the savanna tracts and converted them into pine plantations. Agricultural and industrial development, including World War II ship building, fire suppression on the pine plantations, and other forestry practices destroyed much of the sandhill crane's habitat in Jackson County. The Service added the Mississippi sandhill crane to the endangered species list in 1973 and established the Mississippi Sandhill Crane National Wildlife Refuge in 1975. Also, the Service began captive breeding at the Patuxent Wildlife Research Center in 1965 to protect the subspecies during habitat restoration and to provide stock for reintroduction.

Figure 2. Vicinity map of Mississippi Sandhill Crane National Wildlife Refuge.



The population decline of the Mississippi sandhill crane reflects the disappearance of the mesic (drier) and hydric (wetter) pine savannas that once abounded in the region. Savannas are found on coastal terraces, elevated ridges, and uplands. Fire frequency and intensity, along with soil type and hydrology, regulate succession in the savanna. Without fire, woody forested communities tend to replace the savanna. Before ditching to drain the lands, the flat topography of the terraces allowed sheet flow of water across the terraces and supported extensive areas of open savanna. When the refuge was first established, about 75 percent of the crane savannas had been eliminated by residential or commercial development or converted to one of several different forest types. At present, only five percent or less of the original savanna habitat that supported the cranes remains on the Gulf Coastal Plain. For this reason, Mississippi sandhill cranes now occur only on the refuge named for them, and on adjacent private lands in the vicinity of the refuge.

Both the Mississippi and the Florida sandhill crane were listed as rare on the 1968 list of Rare and Endangered Fish and Wildlife in the United States. Then, after being described as a distinct subspecies in 1972, the Mississippi sandhill crane was placed on the Endangered Species list on June 4, 1973. The Service published an emergency critical habitat determination in September 1975, consisting of approximately 100,000 acres (USFWS 2005). Approximately 26,000 acres were included by the Service in the 1977 final rule designating critical habitat for the Mississippi sandhill crane. In 1974, with a purchase of 1,709 acres, The Nature Conservancy (a nongovernmental conservation organization) began acquiring lands in the vicinity for the preservation of the endangered Mississippi sandhill crane.

Also in the 1970s, the proposed location for construction of an interchange on Interstate Highway 10 posed a threat to the crane and its habitat. The National Wildlife Federation and the Mississippi Wildlife Federation filed suit in the Southern District Federal Court against the U.S. Department of Transportation, Federal Highway Administration, and Mississippi Highway Department for violating Section 7 of the Endangered Species Act and Section 4(f) of the Department of Transportation Act. The National Wildlife Federation argued in court that as then proposed, I-10 would bisect the Mississippi sandhill crane's range and destroy or modify critical crane habitat, thereby jeopardizing its continued existence. The court ruled that I-10 would not jeopardize the cranes, but the plaintiffs appealed to the Circuit Court and the decision was reversed. Ultimately, the U.S. Department of the Interior ruled that the Department of Transportation should purchase 1,960 acres adjacent to the proposed interchange and the Gautier-Vancleave Road to protect crane habitat from commercial and residential development. These lands were acquired and construction of the I-10 interchange commenced (USFWS 1991).

The Mississippi Sandhill Crane Refuge was eventually established on November 25, 1975, with the purchase of 1,749 acres of land from The Nature Conservancy. The refuge was established under the authority of the Endangered Species Act of 1973 (Public Law 93-205), which calls for the federal government:

> "...to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth...
> " (16 U.S.C. 1533, 87 Stat. 885).

The Mississippi Sandhill Crane Refuge is the first national wildlife refuge in the country for which the Endangered Species Act was used as its establishing legislation. Additional purposes of the refuge are found in the Fish and Wildlife Act and the National Wildlife Refuge System Administration Act:

> "... for the development, advancement, management, conservation, and protection of fish and wildlife resources...." 16 U.S.C. 742f(a)(4) (Fish and Wildlife Act of 1956)
>
> "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude...." 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
>
> "... conservation, management, and restoration of the fish, wildlife, and plant resources and their habitats for the benefit of present and future generations of Americans... " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

Congressional action in 1978 provided an appropriation of $4 million to the U.S. Department of Transportation to acquire the lands in the interchange area, which would become part of the national wildlife refuge. Staffing of the Mississippi Sandhill Crane Refuge began in January 1978. In 1997, $9.7 million of Land and Water Conservation funds were also appropriated for land acquisition (U.S. Fish and Wildlife Service 2005).

The only formal objectives for the refuge were included in a one-page master plan published in 1981. These objectives were:

- To provide protection and management for the endangered Mississippi sandhill crane, by restoring, improving, and maintaining nesting, feeding, and roosting habitat within the refuge.
- To protect and conserve unique savanna habitat of south Mississippi.
- To provide opportunities for environmental education and interpretation and wildlife-dependent recreation to refuge visitors.

The Mississippi Sandhill Crane Recovery Plan was originally written in 1976, and amended in 1979 and 1984; the current approved version is dated September 6, 1991. It states: "The recovery objective is to maintain a genetically viable, stable, self-sustaining, free-living Mississippi sandhill crane population."

SPECIAL DESIGNATIONS

The refuge does not include any special designation sites such as Research Natural Areas.

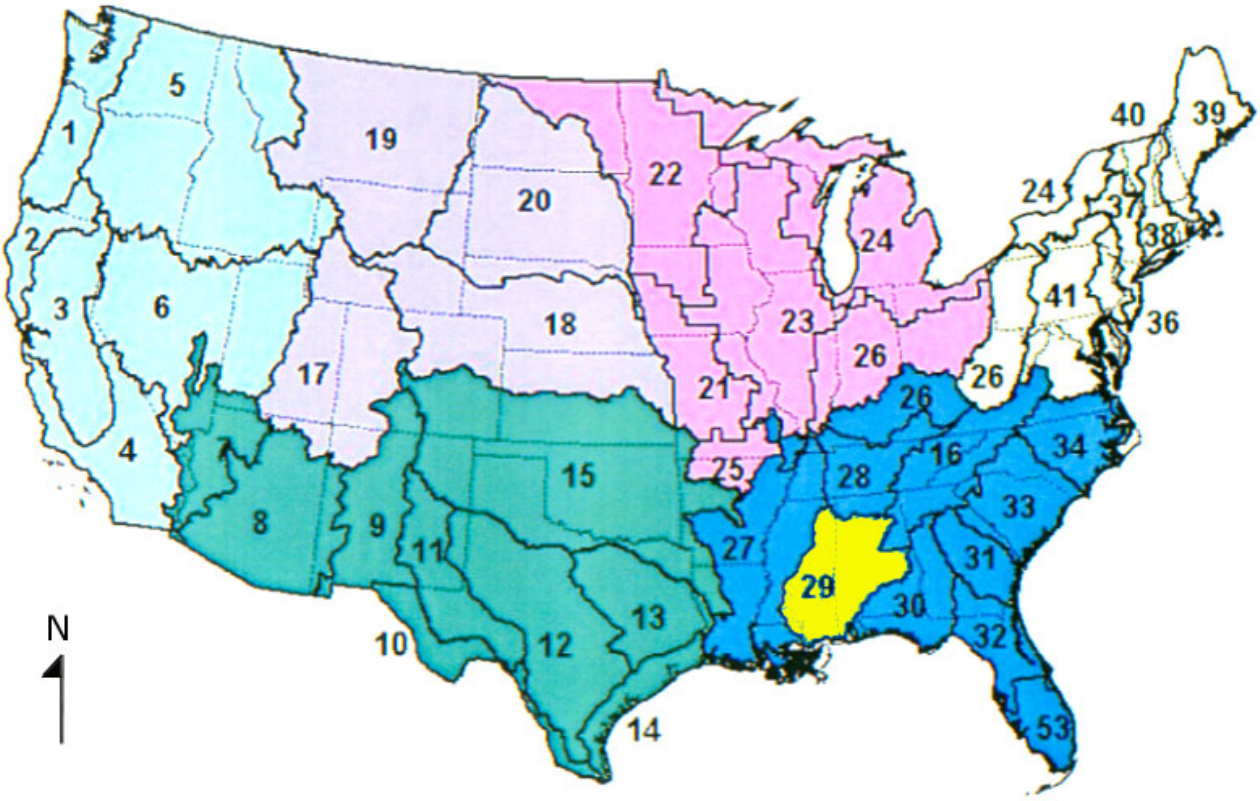
CENTRAL GULF COAST ECOSYSTEM CONTEXT

In approaching its mission to conserve wildlife and their habitats throughout the country, the Fish and Wildlife Service has found it useful to divide the country into 53 distinct ecosystems, drawn primarily along watershed boundaries (Figure 3). Mississippi Sandhill Crane National Wildlife Refuge lies within, and is an active participant of conservation efforts within the Central Gulf Coast Ecosystem, which spans portions of Mississippi, Alabama, and Georgia. As such, the refuge collaborates in pursuing goals and objectives of the ecosystem, as a whole, in addition to working toward achieving goals specific to itself.

Much of the Central Gulf Coast Ecosystem is characterized by flat to rolling topography broken up by numerous streams and river bottoms. Uplands are dominated by pine (longleaf and slash pines in the south, originally) and shortleaf pine mixed with hardwoods in the north. These are fire-maintained systems that give way to loblolly pine and hardwoods in damper areas and to bottomland hardwood forests in extensive lowland drainages. Within its southernmost reaches, the ecosystem encompasses estuaries and coastal waters and includes saline, brackish (e.g., mixed saline and fresh) and fresh waters, as well as coastlines and adjacent lands. Coastal dunes, strands, offshore barrier islands, and tidal marsh, in addition to the freshwater wetlands, pine woodlands, and live oak forests, are all interrelated parts of the functioning whole. As such, they each figure as crucial habitat for coastal fish and wildlife. Today, the ecological health of the Central Gulf Coast Ecosystem is significantly degraded in comparison to historical baselines. The refuge is located in the southern portion of the ecosystem.

Sustainable communities and species conservation and recovery require the joint efforts of private landowners and local communities, as well as state and federal governments. This synergy of federal, state, tribal, and private organizations working together will ensure that the Service not only protects the more important areas, but also reduces redundancy of effort, allowing precious resources to be directed where they are most needed.

Figure 3. Fish and Wildlife Service designated ecosystems in the conterminous United States. The Central Gulf Coast Ecosystem is No. 29.



CENTRAL GULF COAST ECOSYSTEM PLAN

The restoration, recovery, and protection of pine habitats and associated plant and animal communities are the goals of the Central Gulf Coast Ecosystem Plan. Historically, the longleaf pine community was the predominant vegetative community of the southeastern coastal plain, with roughly 60 percent coverage in upland areas. Currently, most of the remaining longleaf pine and pine savanna habitat is in private ownership. It is highly fragmented and degraded by logging, grazing, intensive site preparation, and fire suppression (USFWS 2003a).

The regional ecosystem priorities for 2003 were extracted from the ecosystem team activity guidance, and those that involved the Central Gulf Coast Ecosystem included:

- Waterfowl management and resident and neotropical migratory bird monitoring;
- Control of invasive/exotic species;
- Outreach and environmental education;
- Significant decline in longleaf pine ecosystem;
- Fish passage; and
- Fisheries program support.

Restoring the functions and values of wetlands in the Southeast Region is a top priority. The goal is to prioritize and manage wetlands to most effectively maintain the ecosystem and possibly restore its biological diversity. Some areas are prioritized as focus areas for reforestation.

It is widely recognized, however, that most of the acreage of forested wetlands that have been cleared and converted to other uses in the Central Gulf Coast Ecosystem will not be reforested. Some areas would have lower value for reforestation and so are targeted for intensive management for nonforest-dependent species, such as waterfowl and shorebirds. Through combining efforts, apportioning resources, and focusing on available programs, the ecosystem's biological diversity can be restored.

ECOLOGICAL THREATS AND PROBLEMS

HABITAT LOSS AND FRAGMENTATION

Over the past two centuries, as civilization has spread throughout the region, ever-increasing needs for transportation, housing, water supply, electricity, food, and waste disposal have led to dramatic alterations of the landscape. The greatest alterations have been from land clearing for agriculture and flood control projects.

Although these changes have allowed people to settle down and earn a living, they have had tremendous negative impacts on the biological diversity, biological integrity, and environmental health of the Central Gulf Coast Ecosystem. National wildlife refuges in this ecosystem have come to serve as part of the final safety net to support biological diversity—the greatest challenge, in fact, facing the Service.

For coastal habitats located along the Gulf, underlying threats to biological diversity include:

- Loss, alteration, and fragmentation of high-quality coastal habitat due to development;
- Loss of natural shoreline as a result of development, hydrologic modifications, natural erosion, bulkheading, shoreline armoring, and inadequate coastal engineering;
- Lack of monitoring and regulation to protect fish and wildlife resources; and
- Increased demand for beach access and use, resulting in increased disturbance to wildlife.

More generally, threats to biodiversity across the variety of habitat types represented in this ecosystem are posed by invasive species; overuse of resources; pollution; global climate change; improper practices of fire suppression; and, most of all, habitat loss and fragmentation.

As a consequence of these threats, all manner of habitats in this ecosystem have seen their acreages reduced. Forested wetlands, marshes, oyster reefs, and seagrass beds are disappearing rapidly. Immense areas of bottomland hardwood forests have been reduced to forest fragments. These range from a few large areas of more than 10,000 acres that have maintained many of the original functions and values of bottomland hardwood forests, to very small tracts just a few acres in size and possessing limited functional value.

Elimination and fragmentation of coastal habitats have decimated wildlife species throughout the Gulf Coast, and are recognized by the Service as serious threats to wildlife in Mississippi. The species most adversely affected by fragmentation are those that are area-sensitive or require special habitat, such as protected, undisturbed beach dunes that offer secure breeding habitat and a particular food source. Fragmentation affects migratory songbirds, sea turtles, beach mice, and many other species, primarily through high rates of nesting failure and predation. While more than 370 species of breeding migratory songbirds, shorebirds, waterfowl, and raptors are found in this region, some of these species or subspecies have declined significantly, such as the red-cockaded woodpecker, Bachman's warbler, and Mississippi sandhill crane. These species therefore need the benefits of large, managed forest blocks to recover and sustain their existence.

As a result of habitat loss and degradation, the Central Gulf Coast Ecosystem is experiencing biotic extinctions at a rate unparalleled elsewhere in the United States; within the last century, nearly 50 percent of United States' biotic extinctions have occurred in the region (USFWS n.d.b). Species once abundant in the ecosystem that have since become threatened or endangered include the threatened bald eagle and the endangered wood stork. The bald eagle is being proposed for de-listing. The most highly endangered of all is the ivory-billed woodpecker, dependent on once-extensive, old-growth swamp forests dominated by ancient cypresses and thought by many to be extinct. Until credible but still disputed sightings in early 2004 of at least one individual at Cache River National Wildlife Refuge in the Big Woods of eastern Arkansas, the last confirmed sighting of an ivory-billed woodpecker was in the 1940s.

The avian species most adversely affected by fragmentation include those that are area-sensitive (i.e., dependent on large continuous blocks of hardwood forest); those that depend on forest interiors; those that depend on special habitat requirements like mature forests or a particular food source; and those that depend on good water quality. Species such as the prothonotary warbler, cerulean warbler, and, in particular, Bachman's warbler, have declined significantly, and will require the benefits of large, managed forest blocks to recover and sustain their existence.

Fragmentation of bottomland hardwood forests has left many of the remaining forested tracts as biological oases surrounded by inhospitable agricultural lands. Intensive agriculture has removed most of the forested corridors along sloughs that formerly connected forest patches. The loss of connectivity between the remaining forested tracts hinders the movement of a large range of wildlife between tracts, and reduces the functional value of many remaining smaller forest tracts. The severed connections also result in a loss of gene flow needed to maintain genetic viability and diversity within wildlife populations. Thus, remaining populations are rendered even more vulnerable to habitat modification and degradation. Particularly for wide-ranging species, reestablishing travel corridors to allow movement is of critical importance.

The Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP) reports that the state's biodiversity has diminished due to a variety of threats, including habitat loss; proliferation of nonnative invasive species; disruption of ecological processes; and ecosystem degradation (Mississippi Department of Wildlife, Fisheries, and Parks n.d.a). According to the MDWFP, threats to the most important habitat at the Mississippi Sandhill Crane Refuge—wet pine savannas—include:

- Altered fire regime;
- Forestry conversion;
- Groundwater withdrawal;
- Incompatible forestry practices;
- Industrial development;
- Invasive species;
- Recreation activities;
- Urban/suburban development; and
- Road construction/management.

Mississippi's wet pine savannas are not associated with riverine floodplains, but are found on broad coastal flats and sloping plains with more than 60 inches of rainfall annually. They remain saturated for long periods during the growing season. The coastal region receives ample growing season rainfall from frequent convective thunderstorms, which results in the surface horizon remaining saturated for extended periods because of the slow permeability of the area's subsoils. Stands of wet savanna in good condition contain herbaceous ground cover that is exceptionally diverse. While plentiful rainfall and sunlight create ideal growing conditions, a lack of soil nutrients prevents any one species or suite of species from dominating. Of more than 200 under-story plant species, two-thirds are graminoids (i.e., grasses) and one-third consist of forbs and ferns. Prominent groups of herbs include grasses, asters, sedges, pipeworts, pitcherplants and lilies. Common grasses include beaksedge, toothache grass, switchgrass, and three-awn. Forbs include rayless goldenrod, one-flowered honeycombhead, sunflowers, pitcherplants, meadowbeauties, sundews, and orchids (MDWFP 2005).

ALTERATIONS TO HYDROLOGY

The natural hydrology of a region is directly responsible for the connectedness of forested wetlands and indirectly responsible for the complexity and diversity of habitats through its effects on topography and soils. Natural resource managers recognize the importance of dynamic hydrology to forested wetlands and waterfowl-habitat relationships.

In addition to the loss of vast acreages of bottomland-forested wetlands and other habitat types, significant alterations have occurred in the region's hydrology due to development; river channel modification; flood control levees; reservoirs; and deforestation, as well as degradation of aquatic systems from excessive sedimentation and contaminants.

Large-scale, man-made hydrological alterations have changed the spatial and temporal patterns of flooding throughout the entire watershed, in terms of both extent and duration of flooding, in comparison with the natural hydrology regime. This curtailment of the flooding regime has had an enormous impact on the forested wetlands and their associated wetland-dependent species.

In coastal estuaries, the saline stratification and location of the saltwater wedge can be impacted due to atypical levels of freshwater influxes. Factors affecting the level of freshwater inflow include erosion, sediment load changes, river runoff and pollution, dredging, and severe weather disturbances.

Southeastern states have the greatest numbers of imperiled and vulnerable freshwater fish species in the country. Channel modifications and pollution have gradually eliminated large populations of native aquatic species, including fish, mussels, snails, insects, and crustaceans. Barriers to movement prevent anadromous fish, including striped bass, Gulf sturgeon, and Alabama shad, from reaching spawning grounds and key habitat areas. Many other aquatic species have similarly become isolated. Without avenues for migration, impacts from land surface pollution runoff are exacerbated. Restoration of the structure and functions of a natural wetland is complicated by the fact that wetlands depend on a dynamic interface of hydrologic regimes to maintain water, vegetation, and animal complexes and processes.

PROLIFERATION OF INVASIVE AQUATIC PLANTS AND ANIMALS

Compounding the problems faced by aquatic systems is the growing threat from invasive aquatic vegetation like alligator weed and willows. Static water levels caused by the lack of annual flooding and reduced water depths, resulting from excessive sedimentation, have created conditions favorable for the establishment and proliferation of several species of invasive aquatic plants. Additionally, the introduction of exotic (nonnative) vegetation capable of aggressive growth is further threatening the viability of aquatic systems. These invasive aquatic plants threaten the natural aquatic vegetation important to aquatic systems, and choke waterways to a degree that often prevents recreational use.

Various species of nonnative wildlife and fish also flourish in this temperate climate. Animals such as nutria compete with native wildlife for limited resources; and many, like feral hogs, have caused extensive habitat damage and alterations.

HURRICANE KATRINA

After cutting across Florida and churning through the Gulf of Mexico, on August 29, 2005, Hurricane Katrina made landfall on the Gulf Coast near Buras, Louisiana, as a Category 4 hurricane, with sustained winds of 145 mph and higher gusts. Katrina made her way up the eastern Louisiana coastline with the eye wall passing just east of New Orleans. A few hours later, Katrina made landfall for a third time near the Mississippi-Louisiana border with 125 mph Category 3 sustained winds. However, because the storm was so large, extreme damaging eye wall winds and the strong northeastern quadrant of the storm pushed record storm surges onshore and smashed the entire Mississippi Gulf Coast, including towns such as Waveland; Bay St. Louis; Pass Christian; Long Beach; Gulfport; Biloxi; Ocean Springs; Gautier; and Pascagoula. As Katrina moved inland diagonally over Mississippi, high winds cut a swath of damage that affected almost the entire state.

After the hurricane, two dead Mississippi sandhill cranes were found and a third crane is missing and presumed dead; however, the cause or causes of these deaths have yet to be determined. The two dead cranes were females that accounted for 40 percent of the crane fledging in 1997. Only minor impacts on the habitat (e.g., downed trees) and facilities (e.g., field structure damage) at Mississippi Sandhill Crane National Wildlife Refuge have been assessed post-hurricane; however, the socioeconomic impacts to the area have been severe.

PHYSICAL RESOURCES

CLIMATE

As a general rule, Mississippi has hot, humid summers and relatively mild winters (U.S. Almanac 2004), and Jackson County, where the refuge is located, is no exception. Located on the Gulf of Mexico, the county has mild winters and long spring and summer seasons. Freezing temperatures

are rare and snowfall is even rarer. January's average temperature is 50 degrees, while summers reach into the 90s (Jackson County Economic Development Foundation 2003).

Weather records for nearby Pascagoula, Mississippi, indicate average maximum temperatures of 61 degrees in January, the coldest month of the year, and average minimum temperatures of 42 degrees for the same month (Southeast Regional Climate Center 2005). July and August are the hottest months, with an average maximum temperature of 90 degrees. Like most of Mississippi and the southeast, the area receives substantial rainfall, averaging more than 64 inches a year; of this a mere 0.1 inch on average falls as snow. Summer is the wettest season and July the wettest single month. In 2002, the most recent year for which there was an *Annual Narrative* report, 62 inches of rain fell on the refuge (USFWS 2003b).

GEOLOGY AND TOPOGRAPHY

Located in the Gulf Coastal Plain within five miles of the ocean, the refuge is characterized by flat topography and a low elevation just a few feet above mean sea level. The Mississippi-Alabama-Florida panhandle coasts result from a history of low-to-moderate sediment supply, with the primary sediment sources being the Mobile, Pascagoula, Pearl, and Mississippi rivers (Kindinger et al. 2004). Flat, weakly dissected alluvial plains and active coastlines predominate in this region. Quaternary geology and soils are typically Pliocene-Pleistocene sandy clay residuum (American Bird Conservancy n.d.).

The geologic units comprising the surface of Mississippi's coastal counties range in age from the late Pliocene Epoch (3.4 million years ago) to the present (Schmid and Otvos 2005). The oldest exposed unit in the area is the Citronelle Formation. This unit, which consists mostly of sand and silt, with some gravel, was deposited in coalescing river floodplains on the broad coastal plain from southern Louisiana to Florida. Following the Pliocene Epoch, coastal sediments during the Pleistocene Epoch (1.6 million to 10,000 years ago) were related to warm interglacial and cooler glacial periods. Sea level during the Sangamon interglaciation rose as high as 20–25 feet above the present. The Pleistocene surface formations of this period include the fluvial prairie deposits that formed level floodplains and the ridge-forming Gulfport coastal barrier formations. They are preceded and underlain by the muddy-sandy, fossil-rich Biloxi Formation, deposited in nearshore Gulf, bay, and lagoonal settings. The Gulfport Formation formed a wide belt of beach ridges representing a Sangamon age Gulf shoreline; it includes fine- to medium-grained sand and is often stained with humate, a dark brown to black organic-rich amorphous matter that formed after deposition and impregnated the lower Gulfport sand intervals.

In the Holocene Epoch of the last ten thousand years, the sea level has continued to rise from its very low late-glacial stand about twenty thousand years ago. This rise gradually drowned coastal river valleys and prevented coarse stream sediments from directly reaching the coast. Holocene sediments fill coastal estuaries and have built up locally wide marshlands, rich in organic matter. These deposits consist mostly of sandy fine-grained silts and clays with significant organic material (Schmid and Otvos 2005).

SOILS

The area of the refuge is characterized by poorly drained, acidic, nutrient-poor soils with a perched water table due to a subsurface clayey hard pan. The surface soils are generally sandy-to-loamy and the subsurface soils are silty-to-clayey.

Refuge soils are Ultisols of wet areas that have clayey horizons frequently impervious to groundwater percolation (Clewell and Raymond 1995). These soils tend to be strongly acidic and infertile. The following soil types and series, with recent soil classification, predominate on the refuge:

- Loamy sands: Scranton, Klej, Plummer;
- Very fine sandy loams: Lynchburg (Harleston);
- Loams: Rains (Atmore), Goldsboro (Harleston);
- Silt-loams: Bayboro (Hyde); and
- Undefined series supporting swamps and tidal marshes: (Croatan).

HYDROLOGY

As mentioned in the Climate section, Mississippi Sandhill Crane National Wildlife Refuge is located in a region with abundant annual rainfall, receiving more than 64 inches per year. There are three groundwater hydrologic sources for the savannas and flatwoods found on the refuge:

1. Hydrology driven by an apparent water table, where water arises from below. This occurs on the Plummer series of soils (e.g., loamy sands).

2. Hydrology driven by a perched water table, whereby water in saturated soil is lying above an impermeable and unsaturated subsurface horizon. This occurs on the Atmore series of soils (e.g., loams).

3. Hydrology driven by episodic rainfall events, causing temporary perching and ponding but without the benefit of impermeable subsoil. Nonetheless, flat topography and copious precipitation combine to allow periods of saturation long enough for redoximorphic features to develop (i.e., those associated with low oxygen levels), even though the soil is not considered as being hydric. This occurs on the Harleston series of soils, which are very fine sandy loams.

The refuge's three main units include portions of several intertidal creeks or bayous, including Bluff Creek, Bayou Castelle, and Davis Bayou, which range from fresh to slightly brackish in salinity.

Prior to American colonization, small shallow depressions may have been scattered throughout this mostly open grass-dominated pine savanna system, providing valuable aquatic microhabitats for a variety of taxa, including the cranes. Sandhill cranes tend to roost in shallow water, 3"–12" deep. Water management involves maintaining or restoring hydrological regimes, increasing water for crane nesting areas, and creating shallow water areas for nesting, roosting, and releases. There are five water control structures along roads that were designed to back up water to increase acreage of hydric drain edge for crane nesting and roosting. However, four of the five water control structures are no longer working and need minor to major maintenance.

Fifteen shallow ponds totaling about 100 acres have been created on the refuge; all have been used for roosting and 80 percent for nesting. These ponds may also furnish water to chicks for drinking. At least 18 Grady or Citronelle ponds have been located on the refuge, which may have served as important crane nesting sites in the past. Many have now become choked with woody understory and are therefore unsuitable for crane use.

Disruptions in drainage patterns by roads, ditches, fire lines, and other human manipulation has altered water flow and decreased water economy. Savannas have dried, and as a result, vegetation

composition has changed to include more undesirable species. Several old, pre-refuge ditches may be altering flow to key savannas. These have yet to be mapped and plugged.

AIR QUALITY

Under the Clean Air Act, the U.S. Environmental Protection Agency (EPA) has established primary air quality standards to protect public health. The EPA has also set secondary standards to protect public welfare. Secondary standards relate to protecting ecosystems from harm, including plants and animals, as well as protecting against decreased visibility and damage to crops, vegetation, and buildings.

The EPA has developed National Ambient Air Quality Standards for six principal air pollutants—also called "criteria pollutants." They are ground-level ozone (O_3); particulate matter (PM); nitrogen dioxide (NO_2); sulfur dioxide (SO_2); carbon monoxide (CO); and lead (Pb). The Mississippi Department of Environmental Quality (MDEQ) monitors all of these pollutants except lead. (Because the past lead concentrations reported were so much lower than the air quality standard, and because lead is no longer used in automobile fuels, it was determined by the EPA and MDEQ that lead no longer needs to be monitored in Mississippi.)

In general, Mississippi is meeting all of the National Ambient Air Quality Standards and has recently been designated in attainment with the new 8-hour ground-level ozone and fine particulate matter (PM2.5) standards. Mississippi is one of only three states east of the Mississippi River—the others being Florida and Vermont—that is meeting all of the standards (MDEQ 2004a).

Jackson County, in which the refuge is located, has two air quality monitoring stations, one in Vancleave and the other in Pascagoula. Data from 2004 from these two stations both indicate that Jackson County is also in attainment with all of the National Ambient Air Quality Standards.

WATER QUALITY AND QUANTITY

The Mississippi Department of Environmental Quality is responsible for monitoring and maintaining water quality and controlling water pollution in the state (MDEQ 2004b). It manages its water programs on a basin-wide scale, conducting regular assessments of water quality for the basin's streams, lakes, and estuaries. The refuge is situated in the Pascagoula River Basin (MDEQ 2001). Bluff Creek in its entirety has received an Aquatic Life Water Quality Condition Rating of "fair" from MDEQ on a scale that ranges from "very good," through "good," "fair," and "poor" (MDEQ 2005). There is no specific information on the particular status of water quality, or the causes of any impairment that may exist, on the reach of Bluff Creek inside the refuge. The MDEQ lists the general causes of water quality impairment on streams and lakes within the Pascagoula River Basin. Siltation is the leading cause of impairment, occurring in 22 percent of impaired streams/lakes. Nutrients are next, found in 20 percent of the cases, followed by pesticides (18 percent); pathogens (14 percent); and organic enrichment/low dissolved oxygen (12 percent). "Other" causes occur in 14 percent of the impaired water bodies (MDEQ 2001).

BIOLOGICAL RESOURCES

HABITAT

The refuge's vegetation communities are a mosaic of pine savannas and pinelands interspersed with wooded swamps and drainages, along with a small tract of estuarine marsh (Clewell and Raymond 1995). All terrestrial habitat types fall within the pine savanna plant communities of the southeastern outer coastal plain that develop on broad-level flats between 5 and 20 feet above sea level and within

10 miles of the Gulf of Mexico (Teaford et al. 1995). These communities have also been called "coastal prairies," "pine barrens," "wet prairies," "pitcher plant bogs," and "cypress flats."

As described above, the area is characterized by high rainfall, flat topography, and poorly drained, acidic, nutrient-poor soils with a perched water table due to a subsurface clayey hard pan. The surface soils are generally sandy-to-loamy and subsurface soils are silty-to-clayey. All the terrestrial plant communities have been shaped by frequent surface fires, due to a high fire-return interval, both from planned and unplanned ignitions. Fire has suppressed the growth of woody vegetation and stimulated the germination and even flowering of plant species, such as bunch-grasses.

Table 1 provides the refuge's current estimates of habitat acreages by type. Figure 4 shows the major habitats on the refuge.

Pine Savanna

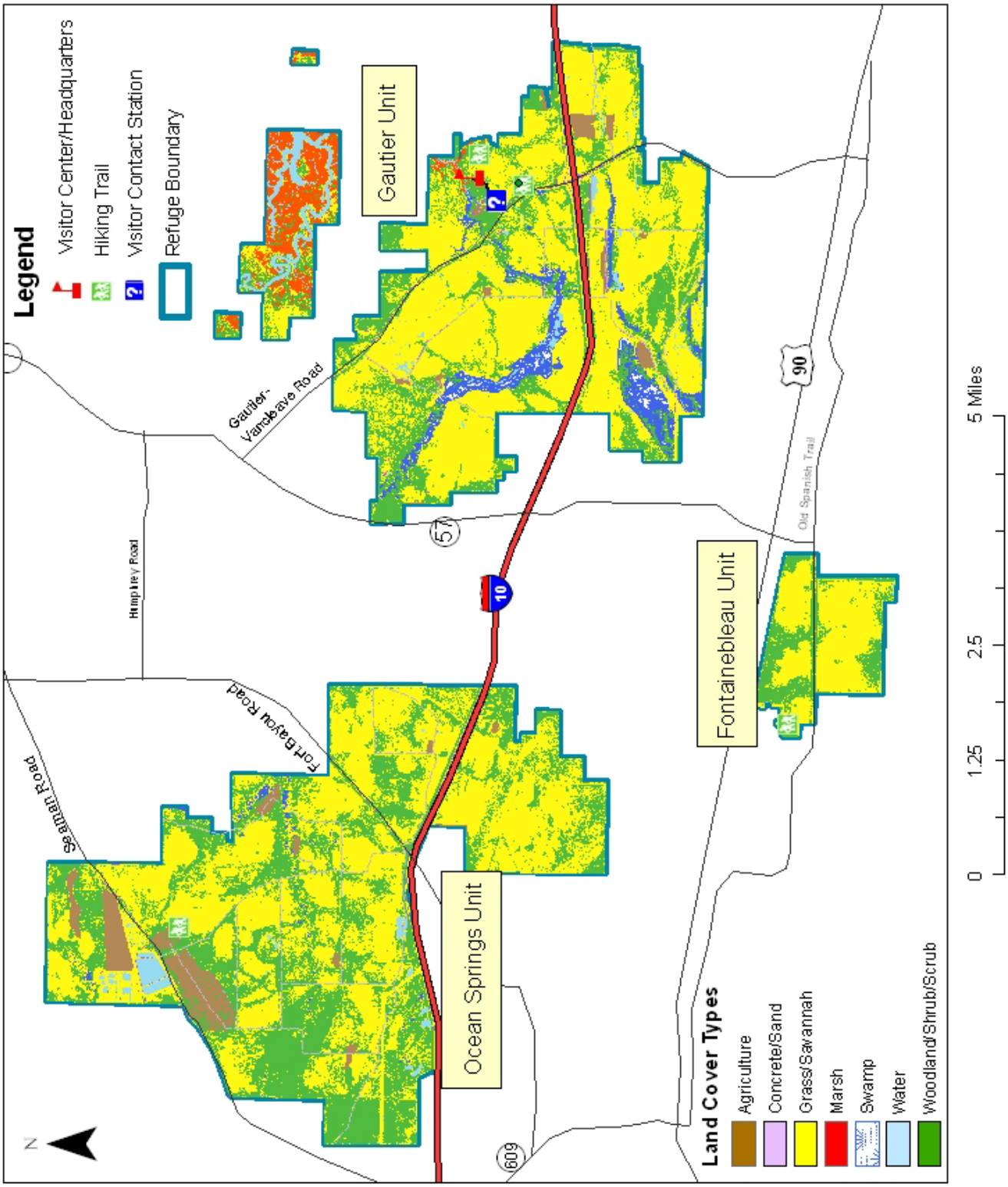
Pine savannas are open, nearly treeless, fire-dependent plant communities dominated by a well-developed ground cover and some low-growing shrubs with only scattered trees (*Pinus palustris* and *P. elliotii*), including pond cypress (a small variety of the bald cypress, *Taxodium distichum* var. *nutans*) in wet areas. Ground cover is 95–100 percent; shrub cover is 0–20 percent (10 percent desired max); and overstory cover is less than 10 percent. Frequent surface fires, carried principally by graminoid fuels, inhibit woody plants and maintain the characteristic openness of the savannas. The fire return interval is about 2 years in the Gautier savannas, and 2–3 years elsewhere.

Table 1. Currently estimated habitat acreages by type.

Habitat	Acres
Pine Savanna	5216
Pinelands (flatwoods and scrub)	11860
Hydric Drain	1354
Estuarine	581
Agricultural	860
Open Water	434
Other	310

The ground-level plant community is highly species-rich and consists of grasses (*Aristida, Ctenium, Muhlenbergia, Dicanthelium, Schiazachyrium*), sedges (*Dichromena, Rhynchospora, Scleria, Fuirena*), and rushes (*Juncus* spp.), interspersed with a highly diverse number of forbs, including (*Aletris, Aster, Balduina, Bigelowia, Calopogon, Carphephorus, Coreopsis, Eriocaulon, Eryngium, Eupatorium, Helianthus, Hypoxis, Lachnanthes, Ludwigia, Lobelia, Lophiola, Phlox, Polygala, Rhexia, Sabatia, Solidago, Tofieldia, Viola, Xyris, Zigadenus*) and featuring several insectivorous plants, such as pitcher plants (*Sarracenia* spp.), sundews (*Drosera* spp.), bladderworts (*Utricularia* spp.), and butterworts (*Pinguicula* spp.). There are low-growing shrubs, including *Gaylussacia*, *Hypericum*, and *Vaccinium,* as well as taller-growing species, such as *Ilex, Cyrilla, Lyonia, Clethra,* and *Myrica,* that are kept low by regular fire.

Figure 4. Current land cover types and visitor facilities at Mississippi Sandhill Crane National Wildlife Refuge units.



The original presettlement vegetation on what is now the refuge consisted mostly of pine savannas (USFWS n.d.c). Ecological characteristics which contributed to those communities included high rainfall, low flat topography, and clay soil with a hard subsurface pan leading to an infertile, acidic, waterlogged soil. The high natural fire frequency kept the areas open, with grasses like wiregrass providing much of the fuel. Fire suppression allowed pines and shrubs to invade and out-compete the native savanna plants. In the 1960s and 1970s, much of the remaining open savanna was converted to pine plantation by planting and ditching; the latter disrupted the natural water regime. Less than 5 percent of the original acreage of this habitat remains in the Atlantic/Gulf Coastal Plain, making it one of the most endangered ecosystems in the country. The refuge savannas are considered the last remaining large patches.

The savannas are large wet prairies with numerous species of low-growing grasses, sedges, and herbaceous wildflowers, with occasional longleaf pines, pond cypresses, or low-growing shrubs. The tree cover only ranges between 1 and 5 percent. The plant species diversity is large, one of the highest in North America, particularly those of the groundcover species. Of special interest are the orchids and many carnivorous plants. The wetter areas are also referred to by other names, such as pitcher plant bogs. The difference between mesic and wet savannas is mainly a matter of wetness.

Mesic Pine Savannas are found on generally nonhydric soils on slightly elevated ridges and flats with convex surfaces. There are a greater number of non-hydric indicators than in wet savannas. *Aristida* dominates in the Gautier Unit mesic savannas but is not found on the Ocean Springs or Fontainebleau Units.

Wet Pine Savannas are found generally on hydric soils, more poorly drained than the mesic savannas, with long periods (i.e., days or weeks) of soil saturation; soils are generally wet at the surface. They contain widely-spaced pond cypress (*Taxodium distichum*) and sometimes swamp tupelo, slash pine, and other hydric trees. Sedges are generally much more abundant than grasses. They experience surface fires with the same frequency as mesic savannas.

Carnivorous Plants abound in the refuge's wet pine savanna community, home to 10 species of carnivorous plants that fall into four main groups: sundews, butterworts, pitcher plants, and bladderworts. Wet pine savanna soils are acidic in nature and have very low nutrient capacity. Thus, the plants that grow in wet pine savannas are adapted for moist, high-acid, low-nutrient conditions. Some plants of the savannas make up the lack of nutrients in the soil by capturing, killing, and digesting animals—mostly insects.

The sundews and butterworts capture prey on small, sticky, glue-like pads on their leaves. Insects are attracted to the sticky substance. Once they land on a leaf they are trapped by the glue. The leaf will roll up around the insect to encase it, releasing chemicals to digest the insect and absorb its nutrients. Pitcher plants have their own unique method of capturing insects. The pitcher is actually a modified leaf that can hold water. Insects are attracted to nectar produced at the rim and on the inside of the pitcher. As the insect crawls into the pitcher to get more nectar, it is trapped by downward-pointing hairs that do not allow the insect to crawl back out. The insect falls down into the base of the pitcher, which is filled with digestive enzymes. Bladderworts possess one of the most elaborate and specialized methods for capturing prey. This plant has small bladders that have a trap door on one end. When the bladder is empty, the door is closed. If an insect brushes against the small hairs on the door, it swings open and water and insect rush into the bladder. The door closes, trapping the insect inside (USFWS n.d.d).

Table 2 lists the carnivorous plants that occur on Mississippi Sandhill Crane National Wildlife Refuge.

Table 2. Carnivorous plants on the refuge.

Scientific Name	Common Name
Drosera capillaris	pink sundew
Drosera filiformis	thread-leaf sundew
Drosera intermedia	spoonleaf sundew
Drosera tracyi	Tracy's sundew
Pinguicula lutea	yellow butterwort
Sarracenia alata	yellow trumpets pitcher plant
Sarracenia psittacina	parrot pitcher plant
Utricularia juncea	Southern bladderwort
Utricularia purpurea	eastern purple bladderwort
Utricularia resupinata	Bladderwort

Pine Flatwoods

Pine flatwoods are open park-like pine woodlands dominated by a low and species-rich ground cover of grasses, forbs, and small shrubs. Clewell and Raymond (1995) assert that the term flatwoods has little ecological significance, since the only difference between flatwoods and savannas is that once the former is clear-cut, it becomes the latter de-facto. In other words, flatwoods are savannas with a higher overstory cover. Thus, flatwoods and savannas are "merely different expressions of the same ecosystem." Be that as it may, the refuge still finds it useful to maintain flatwoods as a habitat category in order to track habitat restoration efforts; a major management objective at the Mississippi Sandhill Crane Refuge is to convert flatwoods to savannas.

Scattered longleaf pine (*Pinus palustris*) and clumps of saw palmetto (*Serenoa repens*) are considered conspicuous, but not abundant. Midstory hardwoods, such as bluejack oak, may occur as scattered individuals on better-drained soils. Soils are well oxygenated relative to other communities. More specifically, overstory cover is 50–75 percent; the mid-understory is 25–50 percent; and ground cover is 60–100 percent. Surface fires, with a return interval of about 2 years, maintain the open character. Grasses are the principal fuel, along with pine straw. Surface fires inhibit the establishment of trees, shrubs, and woody vines that would otherwise replace grasses and forbs. The difference between mesic and wet flatwoods is mainly a matter of wetness.

Mesic Pine Flatwoods are found on nonhydric soils and have a greater number of mesic herbaceous species than wet flatwoods. They are similar to wet pine savannas in physical aspects, but have a greater abundance of woody plant cover and less herbaceous cover.

Mixed (pine-hardwood) Forest became established in small colonies in fire-protected areas on better drained soils. Hardwood tree species include several oaks (*Quercus* spp.).

Wet Pine Flatwoods are found on wetter soils than mesic flatwoods and have a greater number of hydric herbaceous species. Although similar to wet pine savannas in species composition and wetter sites, they differ in having a greater number of pines and woody plants and fewer herbaceous species.

Pine Scrub habitats are former "flatwoods" or savannas or even-planted pine plantations that have degraded and become overgrown with woody vegetation due to silviculture and/or fire suppression. Brush, 1–3 meters or taller, has overtopped the herbaceous component and become dominant. The woody vegetation growth increases at the expense of the decrease in herbaceous ground cover. The shrub component includes inkberry (*Ilex glabra*), large gallberry (*I. coriacea*), and youpan *(I. vomitoria*), as well as titi, fetterbrush, wax myrtle, blackberry (*Rubus argutus*), and sweet pepperbush. Overstory cover is greater than 15 percent, mid-understory is greater than 15 percent, and ground cover is 0–20 percent.

Short scrub is characterized by a shrub layer less than two meters in height. **Tall scrub** has not experienced recent fire and is characterized by a shrub midstory and understory.

Hydric Drains or Swamps

These are forested wetlands that occupy low-gradient drains through the savannas. Gradients are slight and stream flow is diffuse. Soils are hydric and contain much organic matter. Vegetation is dominated by mid- and over-story trees above a shrub layer and a sparse herbaceous ground layer dominated by sedges and even peat moss mats. The overstory cover is 75–100 percent; the mid/understory is 40–100 percent; and ground cover is 10–60 percent. Common trees include cypress; sweetbay (*Magnolia virginiana*); swamp bay (*Perseus palustris*); titi (*Cyrilla racemiflora*, *Cliftonia monophylla*); slash pine; swamp tupelo (*Nyssa biflora*); red maple (*Acer rubrum*); sweetgum *(Liquidambar styraciflua*); and bottomland oaks. Important shrubs include several *Ilex* spp.; wax myrtle (*Myrica* spp.); titi; fetterbush (*Lyonia lucida*); sweet pepperbrush (*Clethra alnifolia*); and poison sumac (*Toxicodendron vernix*). Characteristic herbs include *Carex* spp., beakrushes *(Rhynchospora* spp.), and ferns. Although surface fires are frequent, they are less destructive to hydric trees owing to wetter site conditions.

Cypress-Tupelo Drains occupy broad, flat depressional areas lacking clearly defined drainage ways. Fires are not uncommon. Pond cypress, swamp tupelo, red maple, and sweet bay are common trees in the overstory. The midstory consists of hollies and overstory saplings. The ground cover consists of sedges and ferns.

Forested Bayheads occupy flat topography upstream from cypress-tupelo drains with narrow (5–10m), well-defined drainage ways. Fires are rarer here. The vegetation is like cypress-tupelo drains but sweet bay is more abundant and the midstory is far denser and contains titi, swamp bay, fetterbush, and large gallberry. There may be several grasses in the ground cover.

Estuarine or Tidal Marsh

Tidal marsh comprises much of the refuge's Dees Tract in the intertidal zone in Bluff Creek and Bayou Castelle. The water is fresh or slightly brackish. The most dominant tidal marsh species is sawgrass (*Cladium jamaicensis*). Sawgrass and a few other species occupy perennially saturated soils that sustain only hydrophilic (i.e., water-loving) trees like pond cypress. Nearer the coast, in Davis Bayou that is part of the northwest edge of the Fontainebleau Unit, saltmeadow cordgrass (*Spartina patens*) and black needlerush (*Juncus roemerianus*) predominate in the more saline conditions.

Agricultural Areas

Agricultural areas describe refuge food plots or crop units, pastures, and wastewater spray fields. They have very few to no trees, scattered shrubs, and are dominated by graminoids, consisting of agricultural crops, agricultural weeds, and some native species. Some agricultural areas that have not been disturbed with fire or mechanical means have developed a greater shrub (*Myrica*) layer.

Open Water

Open water on the refuge is found in the Dees Tract in Bluff Creek, interstate borrow pits, and larger ponds.

WILDLIFE

Mississippi Sandhill Crane

As noted in Chapter I, the plight of the Mississippi sandhill crane (*Grus canadensis pulla*) led to the creation of the refuge named after it (USFWS 2005). This nonmigratory species of sandhill crane is both a state and federally listed endangered species. It is also listed as Critically Endangered (C2b criteria) by the International Union for the Conservation of Nature.

The Mississippi sandhill crane is one of six subspecies of the sandhill crane. As a species, the sandhill is the most numerous of the fifteen crane species in the world, and is distributed throughout many parts of North America. The three migratory subspecies—lesser, greater, and Canadian—are abundant, nesting across a vast swath of northern North America (Canada, Alaska, and northern states like Minnesota) and far northeastern Siberia, and wintering in the southern United States and Mexico. The three nonmigratory subspecies (Florida, Mississippi, and Cuban) are all small populations with conservation status in the southeastern United States and Cuba (USFWS 2005).

At one time, there were scattered populations of the nonmigratory sandhill cranes all along the Gulf Coast adapted to the coastal prairies from as far west as Louisiana and possibly eastern Texas east into peninsular Florida, with the exception of the central Florida panhandle (Gee and Hereford 1995). By the 1960s, however, the only remaining population west of peninsular Florida and adjoining southern Georgia was a small one in Jackson County, Mississippi. Earlier estimates of this population, considered part of the Florida subspecies at the time, were only 50–100 birds.

With the imminent construction of Interstate10 in the area, Fish and Wildlife Service biologist Jake Valentine was assigned to assess the potential impacts to the crane and he began the first intensive study of this small population (Valentine and Noble 1970). He described the rare and declining plant communities on which the crane depended, and, seeing the direct and indirect impacts of the interstate, called for a refuge. The population was declared a separate subspecies in 1972 (Aldrich 1972) and was one of the first taxa placed on the endangered species list with the passage of the Endangered Species Act in 1973. By the time of the establishment of the Mississippi Sandhill Crane National Wildlife Refuge in 1975, just 30–35 cranes remained, including only five or six nesting pairs.

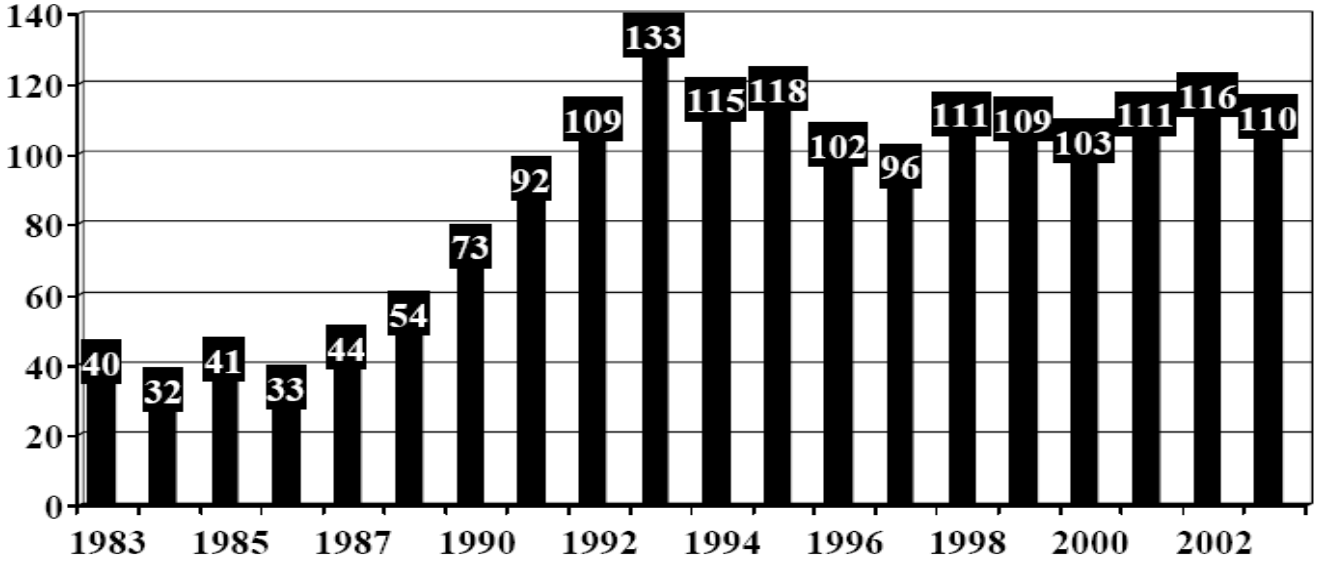
Beginning in 1965, “extra eggs” had been taken from Mississippi to begin a small captive population at the Patuxent Wildlife Research Center in Laurel, Maryland. The captive flock was useful as a genetic bank for certain behavioral and physiological research not feasible using the wild population, and as a source for eventual restocking to augment the population. By 1981, a restocking program began using captive-reared cranes released on the refuge in a gentle-release method developed for the refuge. The release program has continued annually and is the longest and largest of its kind in the world. By

February 2004, there had been 379 captive-reared cranes transferred to the refuge and 362 were released. These transfers and releases continue.

Due to augmentation along with protection and management, the crane population has increased from 30–35 to 110–120 (Figure 5). At the end of 2003, there were 110 known cranes. These included 48 males, 52 females, and 10 of unknown sex. Eighty-three (75 percent) were 3 years or older. With the recent releases, there are now 132 cranes on the refuge.

With habitat restoration along with restocking, crane use of the area that is now the refuge accounts for over 80 percent of the crane locations since the 1980s. Much crane feeding activity actually takes place on surrounding agricultural areas off the refuge. Use of the refuge for nesting has increased as an additional 27 crane territories have been added to the twelve at the time of refuge establishment. The number of nesting pairs has increased from 5 or 6 to 22 to 25. However, recruitment is very low, averaging around 2 to 3 fledging annually and the population is still maintained by the release program as annual mortality is about 15. Predation on chicks is a major factor limiting recovery (Seal and Hereford 1993); predators of chicks are both mammalian and avian, including coyotes, foxes, dogs, red-tailed hawks, and other carnivores.

Figure 5. Population trend of Mississippi sandhill cranes on the refuge.



Grassland Birds

Given the precipitous drop in fire-maintained savanna and grassland habitats in the southeastern coastal plain, it is not surprising that several disturbance-dependent bird species are declining (Table 3). Most of these species are benefiting from refuge management activities, such as frequent prescribed fire.

The Henslow's sparrow may be one of the most vulnerable of this group (Hunter et al. 2001) due to its area sensitivity and selection of frequently burned areas (Chandler and Woodrey 1995). A substantial proportion of the wintering Henslow's sparrows are found on recently burned refuge savannas (Thatcher 2003).

Other nongrassland conservation priority birds using the refuge include chuck-will's widow and swallow-tailed kites; the latter are observed over the savannas in March. Dickcissel and bobolink, both on the Watch List, are observed on the Weekly Wastewater Bird Survey using the Bermuda grass habitats.

Waterfowl

Waterfowl are not common in habitats of the savanna complex. Wood ducks, mottled ducks, and now Canada geese are residents and nest on the refuge in shallow ponds and swamps. During high water events, other species, like snow geese, have been observed in these areas. The refuge is now partnering with the North American Waterfowl Management Plan's Gulf Coast Joint Venture, Mississippi Coast Initiative, to create more shallow-water areas for waterfowl habitat. At least eight wood duck nest boxes were placed in created wastewater areas in compartment O-03, and two along Bayou Castelle, in compartment G-07.

Table 3. Declining grassland (and associated habitat) bird species of conservation importance found on Mississippi Sandhill Crane National Wildlife Refuge.

Species	National Watch List A	Partners in Flight score	Migratory Status B
Bachman's sparrow	EH	30	R
Henslow's sparrow	EH	25	W
American swallow-tailed kite	EH	28	T
Brown-headed nuthatch	MH	27	R
Southeastern American kestrel	MH	27	R
Prairie warbler	M	25	B
Chuck-will's widow	M	24	B
Northern bobwhite		22	R
Red-headed woodpecker	M	22	B
American woodcock	MH	22	W
Sedge wren		22	
Loggerhead shrike		21	R
Northern harrier		20	W

[A]EH=extremely high, M=moderately high, [B]R=resident, B=breeding, W=wintering, T=transient

There have been 28 species of waterfowl observed on the lagoons and constructed wetlands in the Weekly Wastewater Bird Survey since 1993, mostly during the winter where peak numbers were up to 1,700 waterfowl. These species include American black duck, American wigeon, blue-winged teal, bufflehead, Canada goose, canvasback, common goldeneye, common merganser, gadwall, greater scaup, greater white-fronted goose, green-winged teal, hooded merganser, lesser scaup, mallard, mottled duck, northern pintail, northern shoveler, old squaw, red-breasted merganser, redhead, ring-necked duck, Ross's goose, ruddy duck, snow goose, surf scoter, and wood duck. The most common are northern shoveler, blue-winged teal, green-winged teal, ruddy duck, and lesser scaup (USFWS 2005).

Shorebirds

Shorebirds are not numerous in the savanna complex but several species are found in the refuge's shallow ponds, including both species of yellowlegs and six sandpiper species. Killdeer nest on the refuge along the graveled roads. Common snipe occur year-round in the wetter savannas. American woodcock are uncommon in the savannas. They have been observed exhibiting mating displays in February, next to the kiosk along the entrance road (USFWS 2005).

Since 1993, 37 species of shorebirds have been observed along the lagoon edge, in the constructed wetlands, and pastures in the Weekly Wastewater Bird Survey: American avocet, American golden plover, Baird's sandpiper, black skimmer, black tern, black-bellied plover, black-necked stilt, Bonaparte's gull, buff-bellied sandpiper, Caspian tern, common snipe, dunlin, Forster's tern, greater yellowlegs, herring gull, killdeer, laughing gull, least sandpiper, least tern, lesser golden plover, lesser yellowlegs, long-billed dowitcher, pectoral sandpiper, ring-billed gull, ruddy turnstone, sanderling, semipalmated plover, semipalmated sandpiper, short-billed dowitcher, solitary sandpiper, spotted sandpiper, stilt sandpiper, upland sandpiper, western sandpiper, white-rumped sandpiper, willet, and Wilson's phalarope. Black-necked stilts, least sandpipers, and lesser yellowlegs are most numerous. Numbers peak in late summer with up to 1,500 shorebirds reported. Stilts nest on the refuge. Buff-breasted sandpipers are listed as moderately high on the Watch List.

Wading and Marsh Birds

More than 15 species of wading birds and marsh birds are found in the ponds and drain edges associated with refuge savannas. Great blue herons and green herons nest on the refuge. Great egrets and black-crowned night herons are also common.

Thirty-one species of marsh and wading birds have been observed in the lagoons and wetlands in the Weekly Wastewater Bird Survey: American bittern, American coot, American white pelican, anhinga, black rail, black-crowned night heron, cattle egret, common loon, common moorhen, double-crested cormorant, eared grebe, glossy ibis, great blue heron, great egret, green heron, horned grebe, king rail, least bittern, little blue heron, pied-billed grebe, purple gallinule, roseate spoonbill, sandhill crane, snowy egret, sora, tri-colored heron, Virginia rail, white ibis, white-faced ibis, yellow rail, and yellow-crowned night heron. American coots are by far the most numerous, followed by moorhens, cattle egrets, little blue herons, and sora. Marshbird numbers have peaked at over 900 on the survey (USFWS 2005).

Raptors

Sixteen species of diurnal raptors and four owl species are believed to be using the savanna habitats. Ospreys, red-shouldered hawks, red-tailed hawks, eastern screech owls, and great horned owls nest on the refuge. Bald eagles have been observed in fall and winter around refuge ponds and shallow-water areas. Golden eagles are rare winter visitors.
Seventeen species of raptors have been observed on the Weekly Wastewater Bird Survey: American kestrel, bald eagle, black vulture, broad-winged hawk, Cooper's hawk, merlin, Mississippi kite, northern harrier, osprey, peregrine falcon, red-shouldered hawk, red-tailed hawk, rough-legged hawk, sharp-shinned hawk, Swainson's hawk, swallow-tailed kite, and turkey vulture. Red-tailed hawks, American kestrels, and turkey vultures are the most common (USFWS 2005).

Other Birds

Wild turkey are not common but have been observed in food plots.

Mammals

The following mammals have been observed on the refuge: Virginia opossum, nine-banded armadillo, eastern cottontail, eastern gray squirrel, eastern fox squirrel, southern flying squirrel, American beaver, nutria, mink, northern river otter, common raccoon, hispid cotton rat, and feral hog. Several other rodents along with shrews and bats are expected to occur as well.

Anecdotal observations indicate a small but stable white-tailed deer population. Infrequent autopsies of refuge deer by the Southeast Cooperative Wildlife Disease Study Group indicated that the animals are healthy, but small, which is typical of deer in this part of the state. The wet pine savanna is not expected to be high-quality habitat (USFWS 2005).

Amphibians and Reptiles

Amphibian management and conservation are of great concern due to apparent global amphibian declines. Habitat loss, fragmentation, and degradation, as well as pollution, appear to be the primary factors in the declines. This group of animals requires quality wetland habitat for its survival and serves as an important indicator of environmental health.

The refuge's various terrestrial, wetland, and aquatic habitats support an abundance and variety of herpetological species. Table 4 lists the amphibians and reptiles known or likely to exist on the refuge.

The endangered Mississippi gopher frog is not found on the refuge but there are possibilities for reintroduction in several seasonal ponds, such as Grady ponds and created shallow-water areas. The only state record of the one-toed amphiuma is its occurrence on the refuge.

Table 4. Possible herpetological species list for Mississippi Sandhill Crane National Wildlife Refuge.

Amphibians	Reptiles-Turtles and Crocodilians	Reptiles-Lizards and Snakes
Southern cricket frog	American alligator#	Eastern slender Glass Lizard#
Oak toad	*Graptemys* unidentified #	Eastern Glass lizard*
Southern toad*	Common snapping turtle#	Southern fence lizard#
Gulf coast toad*	Alligator snapping turtle#	Green anole#
Eastern narrowmouth toad*	Eastern mud turtle#	Southern coal skink#
Bird-voiced treefrog*	River cooter#	Five-lined skink#
Cope's Gray treefrog#	Mississippi redbelly turtle#	Southeastern five-lined skink#
Green treefrog	Gulf coast box turtle#	Ground skink#
Pinewoods treefrog	Three-toed box turtle#	Six-lined racerunner#
Barking treefrog	Red-eared slider#	Northern scarlet snake#

Amphibians	Reptiles-Turtles and Crocodilians	Reptiles-Lizards and Snakes
Squirrel treefrog	Gopher tortoise	Southern black racer#
Gray treefrog		Corn snake#
Spring peeper*		Gray rat snake#
Southern chorus frog*		Rainbow snake
Crawfish frog		Western mud snake#
Pickerel frog		Eastern hognose snake#
Southern Leopard frog*		Speckled kingsnake#
Bullfrog		Scarlet kingsnake
Bronze frog		Eastern coachwhip
Pig frog		Green water snake#
One-toed amphiuma#		Broad-banded water snake#
Two-toed amphiuma#		Banded water snake#
Dwarf salamander#		Rough green snake#
Eastern Lesser siren#		Black pine snake*
		Gulf crayfish snake#
		Pinewoods snake*
		Eastern ribbon snake#
		Western earth snake#
		Southern copperhead*
		Western cottonmouth#
		Eastern diamondback rattlesnake*
		Dusky pygmy rattlesnake*

*Italics = Calling Frog survey. * Incidental. # TNC Fort Bayou tract survey. Rest: expected.*

Fisheries

Little is known about the fish populations in the refuge's relatively limited aquatic habitats: Bluff Creek, ponds, and wastewater wetlands. A few collections have been made for contaminant studies.

Savanna Invertebrates

Much remains to be learned about the invertebrates of the savanna system. Given their preference for open areas and the relative scarcity of these habitats, one might expect that several butterflies and moths are dependent on the savannas. In a recent visit to the refuge, endangered species expert and dragonfly enthusiast Michael Bean commented that the savannas, with their interspersed ephemeral ponded areas, are excellent habitat for the Odonata (dragonflies and damselflies).

Invertebrates, particularly orthopterans (e.g., grasshoppers, crickets, and katydids) and some coleopterans (e.g., beetles), are usually an important part of the sandhill crane diet. This is especially true during nesting season, as a large amount of protein is necessary for growth of crane chicks. These taxa may indeed be a factor limiting recruitment. As more data on the Mississippi sandhill crane diet become available, it will be appropriate to manage some areas to produce more of these invertebrates (USFWS 2005).

Threatened and Endangered Species

In addition to the Mississippi sandhill crane, two other listed species are known to occur on the refuge. Gopher tortoises were observed on a few high sites with sandier soils, including the Headquarters area (G-07); North Brown's Trail (G-05); South Halter Lane (G-13); and the East Cottonmouth Crop Unit (O-13). Alligators were observed at Martin's Pond, Glendale Blue Hole, and in Bayou Castelle. The federally listed endangered red-cockaded woodpecker is not found on the refuge at the present time.

CULTURAL RESOURCES

Cultural resources include historic properties as defined in the National Historic Preservation Act, cultural items as defined in the Native American Graves Protection and Repatriation Act, archaeological resources as defined in the Archeological Resources Protection Act, sacred sites as defined in Executive Order 13007, *Protection and Accommodation of Access To "Indian Sacred Sites"* to which access is provided under the American Indian Religious Freedom Act, and collections. As defined by the National Historic Preservation Act, a historic property or historic resource is any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places, including any artifacts, records, and remains that are related to and located on such properties. The term also includes properties of traditional religious and cultural importance (i.e., traditional cultural properties), which are eligible for inclusion in the National Register of Historic Places as a result of their association with the cultural practices or beliefs of an American Indian tribe. Archaeological resources include any material of human life or activities that is at least 100 years old, and that is of archaeological interest.

Between 25,000 and 30,000 Indians are believed to have inhabited the area now encompassed by the State of Mississippi when the Spanish explorer Hernando De Soto first discovered the Mississippi River in 1541. The principal tribes were the Chickasaw, Choctaw, and Natchez. Much later, in 1682, French explorers descended the Mississippi, claiming the entire Mississippi Valley for France, including the future State of Mississippi. French settlers first arrived in 1699, followed in 1716 by another near present-day Natchez. African slaves were first brought to Mississippi in 1719 to work in rice and

tobacco fields. All French possessions east of the Mississippi River were ceded to the British in 1763, and a few years later, after the Revolutionary War, to the United States. Spain retained control of the area below the 31st parallel as West Florida until 1810 (u-s-history.com n.d.).

In 1817, Congress divided the Mississippi Territory into two parts: the Territory of Alabama to the east and the State of Mississippi to the west. The state capital was located in various cities until Jackson was selected permanently in 1822. Most of Mississippi's Indian tribes were gradually forced off their land and onto reservations in Indian Territory, now Oklahoma. The land they left was often ideally suited for cotton farming, which had grown greatly since Eli Whitney's invention of the cotton gin in 1793. Mississippi became one of the wealthiest states in the nation, with an agricultural economy based on slavery and the export of cotton (u-s-history.com n.d.).

Southeastern coastal Mississippi had long been settled and used by humans, in good part because of its mild winters and abundant fish and wildlife resources. Prior to European settlement, a number of Indian tribes inhabited the area in the vicinity of the refuge. In the Mobile Bay-Delta Region, the so-named Pensacola Culture flourished prior to European contact. This culture, which was marked by elaborate ceramics, was practiced by two of many resident tribes of the area, the Mobile and the Tahome. These tribes, along with the Choctaw and the Naniabas, were the tribes met by DeSoto between 1540 and 1541. Indigenous interests in the region were officially terminated with the ceding of Choctaw lands in 1830, relegating them to "squatters" after centuries of at times productive, but most often uneasy or explosive coexistence with Europeans and their descendants.

Another local tribe, the Biloxi, is known from their earliest historical location on the lower reaches of the Pascagoula River. Individuals belonging to the tribe were met by Iberville on his first expedition to Louisiana in 1699, and in June of the same year his brother Bienville visited them. In 1700 Iberville found their town abandoned and does not mention encountering the people themselves, though they may have been sharing the Pascagoula village at which he made a short stop. A few years later, the Biloxi were said to have abandoned their village and settled on a small bayou near New Orleans. By 1722 they had returned a considerable distance toward their old home and were established on the former terrain of the Acolapissa Indians on the Pearl River (Access Genealogy 2005).

Later in the eighteenth century, the Biloxi moved to Louisiana and settled not far from Marksville. They soon moved farther up Red River and still later to Bayou Boeuf. Early in the nineteenth century they sold their lands, and, while part of them remained on the river, a large number migrated to Texas and settled on Biloxi Bayou, in Angelina County. All eventually left, either to return to Louisiana or to settle in Oklahoma. A few Biloxi are still living in Rapides Parish, Louisiana, and there are said to be some in the Choctaw Nation, but the tribe is now virtually extinct. Their name survives in the coastal town of Biloxi. The Siouan origin of the Biloxi language, unusual in this area, was established in 1886, by Dr. Gatschet of the Bureau of American Ethnology, and a considerable record of it was obtained by James O. Dorsey of the same institution in 1892-93.

Yet another small tribe that inhabited the general area in the vicinity of the refuge was the Pascagoula, who lived along the river that still bears its name. The tribe was closely associated with the Biloxi Indians, and is believed to have eventually been absorbed by the Biloxi and/or the Choctaw (Access Genealogy 2005). A colorful legend has it that members of the Pascagoula nation linked hands and walked into the Pascagoula River, drowning rather than be taken captive by hostile Indian tribes; their mournful death chant earned the Pascagoula the nickname "Singing River" (Mississippi Department of Wildlife, Fisheries and Parks n.d.b). Today, the name Singing River graces schools, credit unions, hospitals, and even yacht clubs and kennels in the area, commemorating the legend.

To date, the refuge has not been systematically surveyed for cultural and archaeological resources, but the presence of both prehistoric and historic resources would be expected.

SOCIOECONOMIC ENVIRONMENT

Mississippi Sandhill Crane National Wildlife Refuge is in Jackson County, a coastal county in the extreme southeastern corner of the state, bordering Alabama. The city of Mobile, Alabama, lies 40 miles to the east, and a rapidly developing string of coastal towns and small cities are just to the south of the refuge, including Gulfport, Biloxi, Ocean Springs, Gautier, and Pascagoula.

Jackson County is three times more densely populated than the state (181 persons per square mile vs. 61 persons per square mile) and is growing faster. In 2003, the county's estimated population was 133,928, about 5 percent of Mississippi's population of 2,881,281 (U.S. Census Bureau 2005). The county population grew by 1.9 percent from 2000 to 2003, compared to Mississippi's 1.3 percent growth in the same three years. From 1990 to 2000, Jackson County grew 14 percent compared to Mississippi's 10.5 percent in the same decade.

In terms of race and ethnicity, whites and blacks dominate both the county and state populations. Jackson County is 75 percent Caucasian and 21 percent African American, while Mississippi is 61 percent Caucasian and 36 percent African American. Other minorities make up much smaller percentages of the county and state populations: Asians 1.6 percent of the county and 0.7 percent of the state; American Indians 0.3 percent county and 0.4 percent state; and Latinos or Hispanics 2.1 percent of the county and 1.4 percent of the state (all figures from 2000 Census). Foreign-born persons accounted for 2.7 percent of the county population in 2000 and a language other than English was spoken in 5 percent of homes that same year.

Educational attainment in the county is similar to that of the state: 81 percent of the county population 25 years and older have obtained a high school diploma and 17 percent a Bachelor's degree, compared to 73 percent and 17 percent, respectively, for the state (U.S. Census Bureau 2005). Median household income in 1999 was $39,118 for the county and $31,330 for the state, while 13 percent of the county population and 20 percent of the state population lived below the poverty level.

Over the last decade, residential and commercial development has proceeded rapidly in the vicinity of the refuge, converting forest plantations and farm fields into developed lots with houses, businesses, and institutions. Open space and habitat are becoming more and more fragmented. This development is expected to continue over the foreseeable future, in part because of the desirability of living in a coastal county with beach and ocean access. However, recent recommendations by the Pentagon, if acted upon by the Base Realignment and Closure Commission, could temporarily reverse this trend. This commission is charged with streamlining U.S. military bases and operations around the country. The Pentagon has recommended the closure of the Pascagoula Naval Station, which would result in a loss of 844 military personnel, 112 civilian workers, and 7 contractors. In addition, the 81st Medical Group at Keesler Air Force Base in Biloxi (in neighboring Harrison County) is recommended for restructuring, with an associated reduction of 181 military, 31 civilian and 190 contractor positions (Anon. 2005a). These recommendations were scheduled for delivery to the President in September 2005, and to be sent to Congress shortly thereafter. The Pentagon would then have 6 years to close, relocate, or downsize bases on the final list.

There is growing awareness of the economic potential of ecotourism on the part of government and business interests in the area (Anon. 2005b). Jackson County conducted the Pascagoula River Ecotourism Study in 2002-2003. The Gautier Economic Development Council formed an Ecotourism Planning Committee, which published an "Ecotourism Master Plan" in 2004 (Gautier Economic

Development Council 2004). This plan acknowledges the Mississippi Sandhill Crane Refuge as one of the premier local nature destinations that can attract tourists to the area for outdoor activities, such as birding, biking, hiking, boating, fishing, crabbing, hunting, and camping. Other local attractions are Shepard State Park, Pascagoula River Marsh, Indian Point Campground and Recreational Vehicle Resort (privately owned), and Alf Dantzler Wildlife Preserve. The plan also presented a marketing strategy.

In late August 2005, Hurricane Katrina, a category 3 storm, slammed into Jackson County and coastal Mississippi, wreaking catastrophic destruction on human life and property. As of December 11, 2005, the confirmed death toll in Jackson County alone stood at 12, at 230 for Mississippi as a whole, and at least 1,383 altogether (most of which were in Louisiana). These figures may rise considerably, because thousands of individuals are still unaccounted for (Anon. 2005c). Hurricane Katrina was the most costly natural disaster in U.S. history. Its economic impact extends not just to destruction of homes, businesses, and infrastructure, but widespread and long-lasting adverse impacts on unemployment, oil production, the Mississippi gambling industry, agriculture and forestry, fisheries and aquaculture, tax revenues, and bankruptcies (Congressional Budget Office 2005). Reconstruction and recovery will take years or decades.

REFUGE ADMINISTRATION AND MANAGEMENT

LAND PROTECTION AND CONSERVATION

The refuge's ongoing management and research are aimed toward helping to recover the population of endangered Mississippi sandhill cranes and restoring the wet pine savanna on which the crane and other indigenous species depend. These efforts are organized under the topics of habitat management, population management, and people management.

Wet Pine Savanna

Restoration and maintenance of the rare wet pine savanna community is one of the primary purposes of the refuge. At the ground level, these habitats have some of the highest species packing rates (species per area) described, with 35–40 per square meter. A partial floristic list compiled by Clewell and Raymond (1995) included 170 species. Restoring and maintaining the health of the savannas means reducing the woody vegetation component, keeping the hydrology intact, and increasing or maintaining the high plant species diversity.

The decline of pine savanna was gradual at first but accelerated after World War II. Fire suppression, silvicultural practices, and development were the main causes. Wholesale fire suppression in the 20th century allowed the invasion of woody plants and decline of the sun-loving herbaceous flora and quickly caused a conversion of savanna to pine scrub. Silvicultural practices in the 1950–70s installed planting beds, ditched the savannas, and planted slash pine. Construction of I-10 in the 1960–70s directly destroyed some savannas. More importantly, the widespread availability of air conditioning proved a boon to coastal living; casinos and rapid residential and commercial growth ensued, with each of these developed land uses reducing the limited supply of wet pine savanna habitat (USFWS 2005).

By the time the refuge was established, the percentages of savanna and pineland had nearly reversed. Between 1942 and 1981, savanna declined from 74 percent to 14 percent in ten crane nesting areas; woodland increased from 18 percent to 70 percent; and urban land use increased from a trace to 6 percent (USFWS 2005). Without frequent burning, the savannas have reverted to pine scrub, also called pine and titi thickets.

As a result of the fire suppression and pine plantations just described, afforestation is a major problem as densely spaced trees and shrubs have supplanted the once-open savannas. Some ecologists believe up to 90 percent of the trees on the refuge, primarily slash pine, need to be removed. In many places, trees are too big to be suppressed by wildland or prescribed fire. In areas with a good site index, trees have grown to commercial size and can be removed by timber sales. Besides being an efficient tree removal method, timber sales can serve as a source of income for the local community.

The overall intent of the refuge's habitat management efforts is to return as much of the overgrown pine scrub back to open pine savanna as possible. Although the exact "original" character of the landscape may not be known, a reasonable benchmark would be a combination of what was described in the 1850s and the first aerial photographs of the area from 1942.

Restoration of the savannas since the late 1970s has included removal of trees using commercial tree contracts, chain saws, bulldozer only, and bulldozer with roller chopper; removal of shrubs and small trees using gyrotrac and roller chopper; and use of prescribed fire to restore and maintain openness, recycle nutrients, and reduce woody vegetation, encouraging growth of sun-loving savannas, graminoids, and forbs. Several thousand acres have been restored to date. Recent success in using growing season burning has led to reduced woody vegetation and the flowering of native bunchgrasses.

Given the poor soils over much of the refuge, many of the trees are of pre-commercial size. "Drum chopping" pushes over and crushes small, pre-commercial pines and shrubs. Due to the area's high rainfall and low topography, the soils are too wet for either of these tree removal methods because equipment would bog down and the soil would be disturbed. Hand-clearing with chain saws may be the only way to remove trees.

Fire Management

The Mississippi Sandhill Crane Refuge has an approved Fire Management Plan and a staffed, active fire management program (USFWS n.d.f). The refuge's specific fire management objectives are as follows:

1. Suppress all wildfire to protect human life, public and private property, crane nests and nesting habitat.

2. Use management-ignited prescribed fire to restore and maintain the natural coastal wet pine savanna fire sub-climax ecosystem toward endangered species survival.

3. Use management-ignited prescribed fire to improve or maintain nesting and roosting habitat for the Mississippi sandhill crane.

4. Use management-ignited prescribed fire as a wildfire prevention tool to reduce hazardous fuel accumulations along refuge boundaries and adjacent to refuge real property.

5. Provide for the education of the local population in the benefits of wildland fire management and prescribed burning.

The refuge's Fire Team actively uses prescribed fire as a habitat management tool, specifically on behalf of the habitat needs of the Mississippi sandhill crane. In a representative recent year, the team conducted 31 prescribed fires, treating more than 9,000 acres (USFWS 2003b). That same year (2001), the team suppressed 14 local wildfires.

As part of a contract with the Service's Ecological Services Field Office in Mississippi, eight long-term monitoring plots were established on the refuge, four in high-quality (F-02, F-03, G-05, O-06) and four in low-quality savannas (G-07, G-08, O-04, O-10) to monitor the effects of burning on woody vegetation and species richness. The frequencies of graminoids, forbs, and woody plants characteristic and uncharacteristic of wet pine savannas are determined. Plots are to be reinventoried in the twelve months after a burn (USFWS 2005).

Invasive Plant Species Management

The refuge has many invasive species, particularly on disturbed sites such as roadsides, ditches, and crop units. The most common invasive species located on the refuge are cogon grass (*Imperata cylindrica),* Chinese tallow tree (*Sapium sebiferum*), Johnsongrass (*Sorghum halepense*), Torpedo grass (*Panicum repens*), and Japanese climbing fern (*Lygodium japonica*).

The exotic invasive grass, cogon grass, had been spotty in various disturbed sites. Cogon grass has no wildlife value and displaces native vegetation, forming monoculture stands. Recently, it has become a problem by forming monotypic stands in refuge crop units and is now beginning to supplant native savanna vegetation. The refuge staff currently estimates the cogon grass infestation to be approximately 140 acres, ranging in size from small patches to six acres. No acreage estimates are available for any of the other invasive species located on the refuge.

Refuge staff and contract sprayers had been chemically and mechanically treating cogon grass with little success in the mid- to late 1990s. In the fall of 2002, a contract sprayer chemically treated 140 acres of cogon grass with glyphosate throughout the entire refuge. A year later, another contract sprayer chemically treated 105 acres with an arsenal/glyphosate mixture. Refuge staff also began treating Chinese tallow trees with injectable imazapyr capsules during the spring of 2003 (USFWS 2005).

Farming for Wildlife

Several upland sites have been cultivated to provide winter feeding areas for cranes within the safety of the refuge. There are now 13 food plots (or crop units) totaling about 113 acres and a 40-acre pasture on the refuge. Chufa, a sedge that produces a nut-like tuber, has been the major growing season crop. Corn, sunflowers, and a number of other crops have been attempted. Ryegrass, winter wheat, vetch, and other cover crops have been planted in the autumn. Deer, turkey, and other resident wildlife also use the crop units. These areas serve well as crane observation sites as they congregate at the crop units for concentrated food source (USFWS n.d.e).

Water Management

The radical changes in habitat and road construction have caused important changes in the natural water regime, resulting in drier habitats and disturbance to historic crane roosts. Refuge personnel have created roost ponds and constructed five water control structures to adjust water flow into savanna edges during nesting season.

In this mostly wet savanna system, water management involves restoring or maintaining hydrological regimes, increasing water for crane nesting areas, and creating shallow-water areas. There are five water-control structures along roads that, when closed, will back up water to increase acreage of hydric drain edge for crane nesting. Fifteen ponds have also been created. All of them have been used for roosting and 60 percent used for nesting. Four have been used as crane release sites for the smaller pond pens. Besides cranes, the ponds serve as microhabitats for several other taxa, including waterfowl, shorebirds, marshbirds, raptors, herps, and many more. The Gulf Coast Joint Venture is funding the construction of three more ponds totaling four acres.

Several old ditches, created before the refuge was established, may be altering flow to key savannas. They need to be mapped and plugged.

Crane Population Management

When the refuge was established in 1975, there were less than 30 free-flying cranes and no quick, easy way to increase their numbers. The refuge currently uses a variety of methods to directly manage the crane population.

Reintroduction

A restocking effort with captive-reared birds is used to bolster the wild population. Although cranes lay one or two eggs each season, very rarely is more than one chick reared successfully. Beginning in 1965, "extra" eggs, the second viable egg from a two-egg nest, were occasionally removed from the local nests and taken to the U.S. Geological Survey's Patuxent Wildlife Research Center in Maryland to become part of a captive flock. This flock was useful as a genetic reservoir and for physiological and behavioral research that would be difficult with wild birds. By 1980, there were enough captive breeding pairs to produce juveniles for release. Since 1981, captive-reared cranes have been released annually on the refuge. This program is the largest crane release program in the world and has been so successful that 90 percent of the free-flying cranes seen today are captive-reared. All but a few of the 22 breeding pairs are captive-reared cranes that are surviving and finally breeding. The captive flock established at the Patuxent Wildlife Research Center has been split and now about two-thirds of the cranes reside at the Audubon Institute's Species Survival Center near New Orleans, Louisiana, and about one-third reside at the White Oak Conservation Center near Jacksonville, Florida.

Monitoring

Refuge personnel monitor the cranes year-round to understand as much as possible about how they live and what they need to survive and nest successfully. Many of the cranes are marked in different ways so they may be identified individually. Fish and Wildlife Service bands, plastic leg bands, and leg band-mounted radio transmitters are used. The information obtained is stored in a refuge database and provides clues to habitat use, nesting, survival rates, cause of mortality, and many other aspects of crane life history.

Three surveys have been used to monitor the progress of the Mississippi sandhill cranes toward recovery. A Crane Nest Census has been conducted annually between March and June since 1965. All known crane nests are located and revisited to obtain information on nest site, habitat, and productivity. About 100 areas on or near the refuge are searched by ground or by air if a helicopter is available. A fixed-wing aircraft is not effective for discerning cranes or nests given habitat cover and crane plumage.

A semi-annual crane census (October and January) was initiated in 1983 to estimate the crane population at a time when most of the 40 cranes were unmarked. Up to 30 observers are placed in blinds at feeding areas before dawn and the cranes are counted until 10 a.m. The January census was discontinued in the 1990s. The fall census is now called the Autumn Crane Count and is conducted in early November. Although most of the population is marked and monitored year-round, the Autumn Crane Count is still useful as a snap-shot of the population, delineating trends, and as an educational tool, as many of the observers are volunteers.

Year-round crane monitoring was begun in the early 1980s with graduate students following the first releases and continued with refuge biological staff by the mid-1980s. Depending on staffing and other priorities, one to three locations weekly are obtained year-round. Information on location, observation type, time, age, behavior, and associates is collected. There are now over 32,000 crane observation records in a Mississippi Access database. Information on mortality is obtained by incidental discovery by staff and the public and homing on radio tag mortality signal. Since the 1970s, all fresh carcasses found are shipped to the National Wildlife Health Center for necropsy. Monitoring of the crane releases is more intensive. Brailed cranes are monitored daily during acclimation and twice daily immediately after debrailing. As they incorporate with other cranes, frequency of monitoring is gradually decreased over the first few months post-release.

Cranes are captured to change bands and refit them with operating leg band-mounted radio tags. The radio tags operate for around two years; some plastic bands fade or even fall off after several years. Devices used to capture the cranes include run down, walk-in trap, coffin, noose sets, and clap trap. The largest trapping efforts are usually in winter. Target cranes for capture include one of a nesting pair (outside the nesting season), fledged chicks prior to independence, unbanded birds, and those cranes of known identification that no longer have a unique band combination (USFWS 2005).

Nuisance Wildlife Management

Predation remains an important cause of mortality for nests and all age classes of cranes. In the report from the 1992 Population Viability Assessment (Seals and Hereford 1993), predation was identified as a leading factor limiting crane recovery. Coyotes, red and gray fox, bobcat, red-tailed hawks, and dogs are threats to cranes. Raccoons and opossums are additional predators for eggs. Red-tailed hawks have been found to kill young crane chicks. From 1998–2002, 78 percent of known deaths of radio-tagged crane chicks was from predation. Human-caused changes in habitats and the removal of top predators have led to high predator populations. Coyotes are nonnative in this region of the country. There is some evidence that red foxes and red-tailed hawks are far more abundant now than two or more generations ago (USFWS 2005).

Predator control began with refuge personnel in 1985 after 50 percent of one cohort was killed by predation soon after release and continued at various levels until 1999, when an agreement between the Service and the Wildlife Services division of the U.S. Department of Agriculture was begun to conduct predator management. Intensive removal began in 2000. Trapping effort (trap-nights) increased about 2.5 times over the previous six years. The number of known crane deaths annually from predation dropped during that time from 6.3 to 2.0.

In October 2000, the refuge began contracting with Wildlife Services for nearly full-time intensive predator management and this arrangement continued throughout 2001 (February–June, October–December). Snares (541 trap nights), foot-holds (5,524 trap nights), conibears (748 trap nights), and live traps (540 trap nights) were used. Sets were checked daily, first thing in the morning. The number of predators trapped suggested the severity of the problem that the Mississippi sandhill crane was facing (Table 5).

The refuge has a Fish and Wildlife Service depredation permit to remove up to ten red-tailed hawks per year. Three were removed in 2002. It is hoped that more will be removed from key hawk problem territories in 2004, where chicks are radio-tagged to detect differences in chick survival and cause of mortality.

Table 5. Results of predator control, 2000-2001.

Species	Number Removed
Coyote	31
Bobcat	17
Red fox	38
Gray fox	13
Raccoon	87
Opossum	41
Other	49
TOTAL	276

It is likely that an intensive predator management effort will be necessary for the foreseeable future. Other means will also be necessary to increase crane survival rates. Heatley (2003) developed an anti-predator conditioning technique that shows promise. Other innovative nontraditional techniques, such as using lure predator feeding sites, and deterring predators from nests and release site areas, continue to be needed.

Feral hogs are another threat to crane nests, as their incessant digging and rooting damages pine savannas and food plots. They were a problem in the early 1990s on the western Ocean Springs Unit and the Fontainebleau Unit; and the refuge staff had to initiate control measures by hiring a local trapper to remove several hogs.

Local Canada geese are also becoming a problem. This local population is increasing due to lack of hunting pressure and high fledging success. Geese are building nests on the refuge and the concern is that geese may start competing with cranes for nesting sites.

Other Surveys and Monitoring

Birds

The Weekly Wastewater Bird Survey was begun in April 1993 to inventory the birds using the wastewater habitats of the Mississippi Gulf Coast Regional Wastewater Authority on the edge of the northern Ocean Springs Unit. This site is considered one of the hottest birding spots on the Mississippi Gulf Coast. Refuge volunteers, mostly members of the Mississippi Coast Audubon Society, count all birds using the lagoons and constructed wetlands, and include incidental sightings of birds using the Bermuda grass pastures and flying overhead.

There is a need to initiate a survey for wintering grassland birds using point-count methods based on Project Prairie Bird, or a similar protocol.

Amphibians

A Calling Frog Survey route in the Gautier Unit was initiated in June 2003 using the state and North American Amphibian Monitoring Program guidelines. Surveys will be conducted a minimum of three times annually over the next 10 years.

The refuge has also participated in a Malformed Amphibian Study. Seven samples (e.g., southern cricket frogs, squirrel treefrogs, southern leopard frogs) of at least fifty metamorphs were collected in four different sites throughout the refuge. Metamorphs were processed and any with abnormalities were preserved for testing. Preliminary results indicated an incidence of abnormalities greater than background (3 percent).

Research

A fair amount of research has been conducted at the refuge over the last 20 years on the Mississippi sandhill crane and the pine savanna. Most work on the crane has centered on releases, survival rates, and causes of mortality.

Past Research

- Reproductive Success of Released Mississippi Sandhill Cranes: George Gee, Patuxent Wildlife Research Center.
- Post-release Survival Of Mississippi Sandhill Cranes: A Comparison of Rearing Techniques; David H. Ellis et al., Patuxent Wildlife Research Center.
- Biomonitoring Low-level Contaminants in Mississippi Sandhill Cranes to Assess Reproductive Failure: Glenn Olsen et al., Patuxent Wildlife Research Center
- Wildlife health monitoring: Nancy Thomas, USGS National Health Lab, Madison, Wisconsin.
- Contaminant analysis: Pete Douglas, FWS, Daphne, Alabama.
- Video monitoring of Mississippi sandhill crane nests: Cameron Kepler and Paul Sykes, Patuxent Wildlife Research Center, Athens, Georgia.
- Survey for carcinogenic mycotoxins in foods used by Mississippi sandhill cranes: Ed Couvillion, C.P. McCoy, J.R. Jackson and L.W. Bennett, Mississippi State University.
- Survey for selected bacterial pathogens in municipal wastewater on the MSCNWR: C.C. Wu, Mississippi State University.
- Monitoring of air pollution at the MSCNWR: Don White, Patuxent Wildlife Research Center; Athens, Georgia.
- Antipredator conditioning in Mississippi sandhill cranes: Jill Heatley, Louisiana State University.

- The impacts of prescribed fire on Henslow's sparrow winter home range, movements, and survival in coastal pine savanna habitats: Benny Thatcher, University of Arkansas; Dave Krementz, USGS Arkansas Cooperative Fish and Wildlife Research Unit; and Mark Woodrey, U.S. Fish and Wildlife Service, Jackson, Mississippi.

- Bird Community Dynamics in Coastal Pine Savannas: Mark Woodrey, Mississippi Museum of Natural Science. Funding: Nongame Wildlife Grant, Southeast Region, U.S. Fish and Wildlife Service.

- Survey for One-toed Amphiuma: Dr. Ed Kaiser, University of Mississippi, Oxford.

- Long-term Vegetation Monitoring: A.F. Clewell, Inc.

- Genetic aspects of wiregrass: Dexter Sowell, University of Virginia.

- How an Invasive Species, Cogon grass, Impacts Fire Behavior Compared to the Impacts on Fire Behavior of the Native Wiregrass Sites: Sharon King, University of Southwest Louisiana and James Grace, USGS-BRD National Wetlands Research Center.

- Field Indicators of Hydric Soils: Stephen Faulkner, Louisiana State University.

- Triclopyr for Gallberry Reduction: Andre F. Clewell and Marion Lasley, A.F. Clewell Inc.

- Use of Prescribed Fire Prior to Seedfall of Longleaf Pine to Increase Seedling Establishment: Susan Grace, USGS-BRD National Wetlands Research Center.

- Impact of Prescribed Late Spring Burn on Woody Vegetation: Susan Grace, USGS-BRD National Wetlands Research Center.

- Physical and chemical characteristics of managed and unmanaged pine savannas: Auburn University School of Forestry's Dr. Kathryn Flynn and graduate student Tyler Hill.

Current Research

- Causes of mortality in Mississippi sandhill crane chicks: Glenn Olsen, USGS Patuxent Wildlife Research Center and refuge biological staff.

- Causes of crane mortality in Mississippi sandhill cranes: Nancy Thomas, USGS National Wildlife Health Center, and Scott G. Hereford.

Farm Service Agency Tracts (formerly known as Farmers Home Administration Tracts)

During the period of 1991 through 1996, within the Mississippi Sandhill Crane Refuge's assigned 10-county area of southeastern Mississippi for handling Farm Service Agency acquisitions, 12 tracts totaling approximately 2,203 acres (1,975 in fee title and 228 in easements) were finalized. The largest fee title tract is 930 acres and the smallest is 40 acres. The easement tracts range from 6 to 100 acres in size. The wide range of habitat types include coastal pine savanna, wooded swamp/bayheads, deforested/cultivated bottomland hardwoods, riparian corridors, and abandoned catfish ponds, all forming a diversity of wetlands. In most of these tracts, wetland sites have been partially drained and/or cleared. Significant wetland values remain and opportunity for restoration

and enhancement will result from quality management. These scattered wetland tracts are critical to fulfillment of the federal trust responsibilities relating to endangered species and migratory bird management, including waterfowl and neotropical species.

Special Focus Area

In November 1996, the Mississippi Chapter of The Nature Conservancy acquired over 1,700 acres in Jackson County, Mississippi, to establish the Old Fort Bayou Mitigation Bank. Since then, The Nature Conservancy has worked with the Service and the Army Corps of Engineers to launch Mississippi's first coastal wetland mitigation bank. The Old Fort Bayou site adjoins the Ocean Springs and Gautier Units of the Mississippi Sandhill Crane Refuge. The mitigation bank offers wetland "credits" to developers to compensate for the unavoidable loss of wetlands associated with construction projects in four Mississippi counties. The proceeds from the sale of credits allow The Nature Conservancy to restore and maintain the area in its historical wet savanna habitat. This mitigation bank not only compensates for wetland losses of coastal habitats, but also provides a habitat corridor for the endangered Mississippi sandhill crane. Most of the property within the bank is formally designated critical habitat of the Mississippi sandhill crane.

By locating the Old Fort Bayou site in between the refuge units, the bank reaches several objectives. The bank site makes the refuge easier to manage, because it no longer has disconnected lands. Also, it furthers the objectives of the National Wildlife Refuge System by providing breeding ground and habitat for the sandhill crane. Finally, The Nature Conservancy receives valuable assistance from the Service in restoring and managing the bank lands.

In addition, a pond on the bank has been restored for use as a breeding site for the endangered Mississippi gopher frog. Gopher frog tadpoles and metamorphic frogs have been moved to this pond. This represents the first attempt to reestablish a breeding population for this highly endangered frog (only two breeding sites are known currently).

This mitigation bank is within the acquisition boundary of the refuge and may ultimately be transferred to the Service by The Nature Conservancy for management.

Cultural Resources

Section 106 of the National Historic Preservation Act provides the framework for federal review and consideration of cultural resources during federal project planning and execution. The implementing regulations for the Section 106 process (36 CFR Part 800) have been promulgated by the Advisory Council on Historic Preservation. The Secretary of the Interior maintains the National Register of Historic Places and sets forth significance criteria (36 CFR Part 60) for inclusion in the Register. Cultural resources may be considered “historic properties” for the purpose of consideration by a federal undertaking if they meet National Register of Historic Places’ criteria. The implementing regulations at 36 CFR 800.16(v) define an undertaking as “a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; those requiring a Federal permit, license or approval; and those subject to state or local regulation administered pursuant to a delegation or approval by a Federal agency.” Historic properties are those that are formally placed in the National Register of Historic Places by having met the criteria and eligibility for inclusion.

Like all federal agencies, the Fish and Wildlife Service must abide by Section 106 of the National Historic Preservation Act. Cultural resource management in the Service is the responsibility of the Regional Director, and is not delegated for Section 106 process when historic properties could be

affected by Service undertakings. The Service's Regional Historic Preservation Officer advises the Regional Director about procedures, compliance, and implementation of the several cultural resources laws. The refuge manager assists the Regional Historic Preservation Officer by informing him early of Service undertakings, by protecting archaeological sites and historic properties on Service-managed and administered lands, by monitoring archaeological investigations by contractors and permittees, and by reporting violations.

The Mississippi Sandhill Crane Refuge follows these procedures to protect the public's interest in preserving its cultural legacy. Whenever construction work is undertaken that involves any excavation with heavy earth-moving equipment like tractors, graders, and bulldozers, the refuge contracts with a qualified archaeologist/cultural resources expert to conduct an archaeological survey of the subject property. The results of this survey are submitted to the Service's Regional Historic Preservation Officer, as well as the State Historic Preservation Officer, who, in Mississippi, is with the Mississippi Department of Archives and History. The state officer reviews the surveys and determines whether cultural resources will be impacted, that is, whether any properties listed in or eligible or eligible for listing in the National Register of Historic Places will be affected. If cultural resources are actually encountered during construction activities, the refuge is to notify the state officer immediately. To date, no properties on the refuge have been determined to be eligible for the national register.

EDUCATION AND VISITOR SERVICES

Presidential Executive Order 12996 and the National Wildlife Refuge System Improvement Act of 1997 recognized six priority public uses on national wildlife refuges, as long as they are compatible with the purposes for which the refuge was established. These include hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation. However, these priority public uses are by no means the only permitted public uses of national wildlife refuges; other uses have been and can continue to be permitted, provided that they are determined to be compatible with refuge purposes.

Because the cranes are the main focus of this refuge, and they are sensitive to human disturbance and still highly endangered and vulnerable, most of the interior of the refuge is closed to the public for the crane's protection. Nevertheless, refuge managers recognize fully that management efforts on behalf of Mississippi sandhill cranes and their habitat need the support of people—the American public generally and local residents in particular. Various programs are in place to "get the word out" about the cranes, their habitat, and the refuge's efforts. The refuge's existing visitor facilities are shown in Figure 4.

The refuge does not yet have a general brochure for the public, nor does it have a current Visitor Services Plan. However, the refuge has a website that is maintained by staff and that provides general background on sandhill cranes, carnivorous plants, refuge habitats and management, as well as contact information. The Internet site is: http://mississippisandhillcrane.fws.gov/.
There are some directional signs along Interstate Highway 10 leading to the Gautier Unit and along U.S. Highway 90 leading to the Fontainebleau Unit. However, there are no directional signs to the Ocean Springs Unit and currently these are not needed because no public visitation is allowed in this closed unit. One collateral duty officer (.25 FTE) at the refuge and one full-time law enforcement officer at Grand Bay National Wildlife Refuge support law enforcement at the Mississippi Sandhill Crane Refuge.

Wildlife Observation and Photography

Observation and photography of wildlife and plants at the Mississippi Sandhill Crane Refuge are mainly limited to Dees Trail, a self-guided foot trail at the visitor center, and to staff-guided trips to permanent blinds located in areas of frequent crane use in the Gautier Unit.

The refuge has two interpretive foot trails open to the public, which provide opportunities for bird watching, wildlife photography, and wildlife observation. The Dees Trail, a three-quarter mile nature trail adjacent to the headquarters and visitor center, winds its way through pine savanna, tidal marsh, and pine scrub. Numbered posts correspond to descriptions of plants and habitat in a trail brochure. Plant life is abundant along the trail, especially in the spring when orchids and carnivorous plants like the conspicuous pitcher plant are in bloom. The alert visitor can also see and hear signs of wildlife. Wading birds visit the bayou, and many songbirds, including the eastern bluebird and Bachman's sparrow, frequent the savannas. Harriers, osprey, and red-tailed hawks hunt over the savanna and bayous. Visitors may also expect to see signs of resident mammals, including white-tailed deer, raccoon, and fox, or hear the distinctive clattering bugle of the crane, the grunting of the pig frog, a chorus of cricket frogs, or the unmistakable bleating of the narrow-mouthed toad. Benches and an observation platform at the edge of Bayou Castelle offer visitors the chance to rest and observe wildlife and habitat in a more leisurely fashion or just contemplate the beauty of the natural setting.

The Fontainebleau Unit also has a newly-built foot trail—the Ocean Springs Middle School Trail—that is still in the process of being developed. The goal of this trail is to interpret fire management. The trail incorporates marsh, savannah, and pine scrub habitats.

Since cranes are often most visible to the public when they are feeding in off-refuge pastures and farmland nearby, the refuge has prepared a map-flier for distribution to motorists depicting a driving route with recommended crane viewing areas. The text on the flier informs crane watchers that the crane observation areas listed on the driving route are on *private* lands, and reminds them to be respectful and considerate of landowners and other motorists by not trespassing, climbing fences, or stopping their vehicles in the road rather than off to the side.

Guided crane trips are offered by volunteers during January and February to provide an opportunity for visitors to view and photograph cranes. The trips occur on Tuesdays and Saturdays and require advance reservations. Utilizing concealed access routes, permanent blinds, and controlled/limited schedules, visitors have a good chance of sighting cranes (USFWS 2004).

The Spray Fields/wastewater treatment area of the Ocean Springs Unit offers some of the best refuge birding habitat. These waste treatment ponds are open to the public. Volunteers have been performing weekly bird surveys for about 11 years and also lead approximately six special birding trips annually in this area.

Environmental Education and Interpretation

The refuge's administrative headquarters also serves as a visitor center with exhibits on the life history and conservation status of the Mississippi sandhill crane and other natural history. The visitor center is open from Monday through Friday, 8 a.m. to 4 p.m., and has brochures, video-viewing, and dioramas to illustrate the refuge story. The headquarters/visitor center is at the end of Crane Drive, the refuge entrance road. It includes an information kiosk and small parking lot on the entrance road. There are outstanding views of pine savanna habitat from the parking lot and kiosk.

The refuge has an active environmental education program managed by the staff as a collateral duty. The following are a few of the environmental education opportunities available:

<u>On-site</u>

- Staff or volunteer-led walks on nature trail;
- Presentations in auditorium;
- Viewing videos in auditorium;

- Participating in radiotelemetry and prescribed fire demonstrations; and
- Assistance with developing appropriate curriculum for refuge field trips.

Off-site
- Presentations to schools, garden clubs, fraternal, and service organizations;
- Pre- and post-field trip briefings; and
- Participation in special events, such as Earth Day, Crane Festival, and National Wildlife Refuge Week.

Environmental education and interpretation programs are conducted upon request as staff availability permits. School groups, from elementary to college levels, frequently visit the refuge. Educational programs generally consist of a 1½- to 2-hour visit in which students rotate through a fire demonstration, a crane program/telemetry demonstration, and a trail walk. The refuge also interacts with the Ocean Springs Middle School at the refuge's nature trail, immediately adjacent to the school. In addition, the staff participates at schools, clubs, groups, and festivals, speaking about the refuge, wildlife resources, and environmental issues. Science teachers take environmental refresher courses taught at the refuge by a local university extension service. The video, exhibits, nature trail, and savanna at the visitor center offer a wealth of information (USFWS 2004).

Hunting

Hunting is not permitted on the refuge at this time because of the potential disruption to cranes and the risk of accidental take.

Fishing

There are few fishing opportunities on the refuge proper and the Service does not actively promote or manage sport fishing. However, water bodies under state jurisdiction, such as Bluff Creek, Bayou Castelle, and Perigal Bayou, cross the refuge. These waters are open to fishing by the general public, and are managed by the Mississippi Department of Wildlife, Fisheries, and Parks. Fishing from boats and canoes is known to occur within the refuge's boundaries; however, access is very limited due to the nature of the wetland habitats. Bank fishing on these watercourses within the refuge is not permitted. An abundance of excellent saltwater and freshwater fishing, crabbing, and oyster tonging opportunities are offered just minutes away in nearby Gulf coastal and river waterways (USFWS 2004).

PERSONNEL, OPERATIONS, AND MAINTENANCE

Refuge Staffing and Budget

Mississippi Sandhill Crane National Wildlife Refuge includes six full-time employees and one part-time employee. Table 6 lists these positions and the district fire-fighting personnel stationed at the refuge. The annual budget varies, but for Fiscal Year 2003, the basic refuge funding was $427,000 and fire program funding was $830,000.

Grand Bay National Wildlife Refuge has one full-time law enforcement officer who supports law enforcement at the Mississippi Sandhill Crane Refuge.

Table 6. Mississippi Sandhill Crane National Wildlife Refuge personnel.

Position Title	Grade
Complex Manager	GS-0485-13
Station Manager	GS-0485-12 (vacant)
Wildlife Biologist	GS-0486-11
Wildlife Biologist	GS-0486-07/09
Office Assistant	GS-0303-08 (1/2 FTE)
District Fire Crew (supports TN, KY, MS, AL, portions of LA, TX, and AR)	
District Fire Management Officer	GS-0460-12
Wildland Urban Interface Specialist	GS-0401-11
Wildland Fire Specialist	GS-0462-09
Prescribed Fire Specialist	GS-0401-09
Forestry Technician	GS-0462-07
Forestry Technician	GS-0462-05
Forestry Technician	GS-0462-04
Forestry Technician	GS-0462-04
Office Assistant	GS-0303-08 (1/2 FTE)
Engineering Equipment Operator	WG-5716-10
Engineering Equipment Operator	WG-0000-08

Partnerships and Volunteers

The Mississippi Sandhill Crane Refuge enjoys active, productive partnerships with a number of agencies, institutions and individuals. Among these are the White Oak Conservation Center; the U.S. Geological Survey's Patuxent Wildlife Research Center; National Wildlife Health Center; Audubon Nature Institute; U.S. Department of Agriculture, Wildlife Services; Mississippi Department of Marine Resources; Mississippi Department of Wildlife, Fisheries, and Parks; and the Grand Bay National Estuarine Research Reserve of Mississippi State University. The Nature Conservancy, a nonprofit conservation organization, was instrumental in establishing the refuge in the 1970s, and as a nearby landowner, continues to cooperate with the refuge today on resource management issues.

The refuge has an active and growing volunteer program managed by the wildlife biologist. The refuge website has a page dedicated to describing volunteer duties and recruitment. Thirty-seven volunteers contributed 1,399 hours conducting surveys, investigations, bird banding, and participating in reintroductions in 2003. Volunteer opportunities include working at the visitor center, conducting tours, helping office staff, speaking to school groups, maintaining trails, and conducting bird and amphibian surveys and crane censuses. College student interns volunteer to conduct research. Student Conservation Association volunteers have assisted with biological monitoring. One volunteer played a major role in the first-ever frog survey on the refuge and helped with the "Malformed Amphibian Collections" monitoring program. Two other volunteers participated in most of the bird surveys, lead nature trail walks, and public birding events. Refuge housing is available for volunteers (USFWS 2004).

Refuge volunteers and several participants in a local South Mississippi Master Naturalists Program, sponsored by the Mississippi State University Extension Service, have conducted occasional environmental educational walks on the Dees Trail. (After completing a course, volunteer Master Naturalists assist teachers and community groups in environmental education programs). Volunteers have also occasionally staffed booths at some special events.

The refuge also has a recently formed Friends group. This group holds meetings and stages events, while helping the refuge staff on a variety of efforts.

Law Enforcement

The refuge affords limited public access, no consumptive use, and is located on Mississippi's densely populated Gulf Coast; thus, law enforcement activities center on illegal entry. Law enforcement activities focus on a high degree of refuge personnel visibility and positive community relations. The typical areas of concern include trespass, trash/refuse dumping, boundary deer hunting, stray dogs, vandalism, arson wildfires, and crane disturbance. The frequency of citations and incidents has remained fairly constant in recent years.

The refuge's law enforcement staff began decreasing in 1995 and, at present, one dual-duty refuge officer provides enforcement for both the Mississippi Sandhill Crane and Grand Bay Refuges. The Service makes a continuing effort to foster increased state and county law enforcement cooperation along the refuge periphery. However, this is a one-way effort because no refuge officers have state authority. Cases made by county and state officers are carried through local courts.

An ever-increasing problem for law enforcement is the steady pressure of suburban development around the refuge. Recent residential development has been to the north in the vicinity of Vancleave. With most employment opportunities to the south along the coast, traffic along three state roads (e.g., Gautier-Vancleave; Old Fort Bayou; and Seaman) has increased substantially. Approximately 10 miles of roadway (excluding interstate) traverse refuge land. Increased speeding and littering by home/work-bound and shipyard employees have occurred. The proliferation of the gaming industry (casinos) on the coast has resulted in new law enforcement issues for the refuge, such as parked vehicles on back roads, pull-offs, and refuge entrances (i.e., "sleeping it off"), and increased driving violations.

Maintenance

The refuge has no maintenance staff of its own, but relies on two fire district engineering equipment operators to conduct habitat management and maintenance work on the ground. In general, more maintenance staff is needed to support biological needs, facilities, and infrastructure on the refuge, including roads, pens, etc. Four of the five water control structures are no longer working and need minor to major maintenance to become functional again.

III. Plan Development

PUBLIC INVOLVEMENT AND THE PLANNING PROCESS

Scoping is the gathering of input from a variety of internal and external sources on the identification of key issues, concerns, and opportunities that are likely to be associated with the conservation and management of the refuge. Sources of internal scoping include the refuge staff and other Service biologists and professionals. External scoping sources include concerned private citizens; research and educational institutions; members of conservation, sportsmen, and civic groups; refuge neighbors; citizens of the local community; and other federal, state, tribal, and local government agencies. These various interests are referred to collectively as "stakeholders," that is, those individuals and groups that have a stake in how the refuge is managed. In developing this comprehensive conservation plan, the planning team conducted both internal and external scoping.

The first step in developing the plan was a biological review that took place on February 23–27, 2004. The biological review team included 17 Service biologists, managers, foresters, and non-Service managers and biologists. The review involved onsite evaluations to assist the refuge in meeting its purpose and determining the role(s) the refuge could play regarding its wildlife needs and objectives at various geographical scales (local, ecosystem, regional, and national). The approach was to take a holistic look at achieving refuge and landscape-level conservation needs, while still giving priority to accomplishing the refuge's originally established purpose. The team presented its recommendations in a Biological Review Report, which was completed in May 2005. In keeping with the planning process, these recommendations took the form of goals, objectives, and strategies for managing the refuge's biological resources. These preliminary goals, objectives, and strategies were studied by the planning team and modified and adapted for this comprehensive conservation plan.

A visitor services review was also conducted in 2004. The four-member visitor services review team consisted of Service personnel from the Visitor Services and Outreach Division, the Southeast Regional Office, and Tensas National Wildlife Refuge; and a representative from the Grand Bay National Estuary Reserve, which is managed by the Mississippi Department of Marine Resources. This team met with refuge staff to discuss the refuge's visitor services program. After touring the refuge and reviewing its public use areas and interpretive and educational programs, the team presented its recommendations to the staff and held an open discussion of the pros and cons of the various recommendations. The team then submitted a report with recommendations for improving and expanding the refuge's visitor use facilities and operations.

The comprehensive planning team, comprised of the refuge manager, assistant manager and wildlife biologist; a natural resources planner from the Service's Jackson, Mississippi, field office; and an outside professional contractor (see Appendix IX, List of Preparers) met for the first time on November 16–17, 2004. The team toured the refuge and received an overview of its habitat, wildlife resources, and public use programs, facilities, and opportunities. It also conducted additional internal scoping and prepared a preliminary schedule, a mailing list, and plans for public involvement.

The planning team held a public scoping meeting and open house on January 12, 2005, at the Gautier Convention Center in Gautier, Mississippi, about five miles south of the refuge. The meeting was coordinated with officials of other government agencies, various organizations, and the surrounding communities. The meeting was publicized in advance in several ways. A letter and flyer were sent to those on the mailing list, which included refuge users, government and civic leaders,

congressional staff, private organizations, and other interested parties. Information announcing the public scoping meeting was also sent to the local newspaper, and a public service announcement was sent to the local radio station.

Fifteen citizens attended this meeting. The meeting began with a brief overview of the refuge and the comprehensive planning process, followed by a facilitated open-floor question and comment period. The attendees were given the opportunity to ask questions and voice their thoughts and concerns about the refuge and suggestions on how it should be managed in the future. In addition, a comment form was distributed for the attendees and other interested parties to submit written comments. The written comments could be submitted either at the meeting or by mail or e-mail. The issues, concerns, and suggestions received from this meeting were considered and evaluated in the preparation of the draft comprehensive conservation plan.

The Service completed the Draft Comprehensive Conservation Plan and Environmental Assessment for Mississippi Sandhill Crane National Wildlife Refuge and made it available for public review and comment from November 22, 2006 to December 22, 2006. The same methods that were used to publicize the public scoping meeting were also used to announce the availabilty of the draft plan for public review. In addition, a notice was published in the *Federal Register* on November 22, 2006, to inform the public of the availability of the document for review and comment. No comments were received on the Draft Comprehensive Conservation Plan and Environmental Assessment. Additional details on the scoping and planning process are provided in Appendix IV.

WILDERNESS REVIEW

Refuge planning policy requires a wilderness review as part of the comprehensive conservation planning process. The lands within the boundaries of Mississippi Sandhill Crane National Wildlife Refuge were reviewed for their suitability in meeting the criteria for wilderness, as defined by the Wilderness Act of 1964. Neither the refuge in its entirety, nor any of its constituent units, contains the required 5,000 contiguous roadless acres. Further, the proximity of Interstate Highway 10 and other well-traveled local roads, as well as ever-encroaching suburban sprawl and development, detract from any semblance of a wilderness setting. Therefore, the suitability of refuge lands for wilderness designation is not further analyzed in this plan.

SUMMARY OF ISSUES, CONCERNS, AND OPPORTUNITIES

The issues and concerns described below were identified during internal scoping, including the biological and public use reviews, and external scoping, in which the public participated.

WILDLIFE AND HABITAT MANAGEMENT

- Maintaining genetic diversity is a challenge in a small crane population with such limited ability to expand because of lack of suitable habitat left in its former range.

- Protecting habitat is one of the most important issues facing the refuge.

- Growing concerns surrounding the refuge's five most important resources: Mississippi sandhill crane, wet pine savanna, wintering grassland-dependent birds, reptiles and amphibians, and savanna invertebrates (e.g. butterflies, dragonflies, and crane food).

- Providing for protection and recovery of the maximum number of Mississippi sandhill cranes.

- Ongoing predation is a major obstacle to establishing a self-sustaining, viable population of cranes on the refuge.

- Restoring and maintaining the natural species richness of wet pine savanna flora and reducing the woody vegetation component.

- Invasive species of plants and animals are gradually encroaching on the refuge and displacing native species.

- Declining wet pine savanna habitat in recent decades along the Gulf Coast has been a decisive factor in the decline of the nonmigratory Mississippi sandhill crane.

- Maintaining the maximum level of species richness of grassland birds, particularly the Henslow's sparrow.

- Restoring and maintaining the native diversity of amphibian and reptile species within the savanna complex.

- Maintaining the native diversity of butterfly and dragonfly species and providing for high-quality orthoptera and related species numbers for food by the sandhill cranes and their young.

- Staffing and resource limits restrict the refuge's ability to carry out many recommendations on wildlife and habitat.

- Conducting prescribed fires is becoming more difficult because of increasing concerns about smoke/air quality, safety, and property as population grows and development around the refuge intensifies.

RESOURCE PROTECTION

- Land acquisition is a critical priority due to the rapid growth in the area, which is quickly consuming habitat that the cranes and other wildlife are dependent upon.

- The refuge does not have its own law enforcement officer and must depend on one based at Grand Bay National Wildlife Refuge.

- The potential for violations is growing with encroaching suburban sprawl and increasing traffic occurring in the Gautier-Vancleave area.

- The protection and preservation of the cultural resources on the refuge is a priority of the Service and the Federal Government.

PUBLIC USE AND ENVIRONMENTAL EDUCATION

- Being able to fish for bass in the slough is important to some anglers.

- The refuge should consider allowing deer hunting.

- Visitors at the visitor center area or along Dees Trail are unlikely to see sandhill cranes there; in general, the difficulty of seeing the bird for which the refuge was created and named.

- There are no photo blinds open to the public except on guided tours; it would be nice if they were more readily available.

- Rumor(s) being spread locally about dogs or other domestic pets being trapped on the refuge are false.

- Expanding times and hours that refuge and visitor center are open, such as weekends, should be a priority.

- Potential for ecotourism at refuge not being realized at present because of funding and staffing limitations.

- Public use staffing is critical to maintain public and popular support for the refuge in a rapidly growing area.

- Education of surrounding landowners is important (e.g., Private Lands Program).

- Educating the public on the importance of protecting species is one of the most important issues facing the refuge.

- Environmental education should be conducted publicly and often; more funds should be requested; there should be more onsite festivals, fairs, friends groups; more volunteers should be trained.

- There should be more interactive activities for visitors.

- Fund-raising and the Friends Group should be emphasized.

- Funding, public awareness, and public apathy are three of the refuge's most important issues.

- There is a need for more public education, such as field trips for local schools, to raise awareness of the benefits of the refuge, and subsequently increase support for it.

REFUGE ADMINISTRATION

- Staffing and budget are clearly inadequate for the refuge to realize its full potential either in habitat and wildlife management or accommodating more visitors.

- The full potential of volunteers and a Friends Group to fill in for and extend the reach of staff efforts has yet to be tapped.

- The headquarters/visitor center does not have adequate meeting facilities (i.e., there is no theatre, auditorium, or small conference room).

- Larger staff could do more outreach in the community (i.e., off-refuge outreach and environmental education).

IV. Management Direction

INTRODUCTION

This comprehensive conservation plan contains the goals, objectives, and strategies that will be used to achieve the refuge vision over the next 15 years.

Four alternatives for managing the refuge were considered and analyzed. The Service selected Alternative D, Optimize Biological Program and Visitor Services, as the preferred alternative. The other alternatives evaluated were Alternative A, No Action (Current Management Direction); Alternative B, Maximize Biological Services and Maintain Current Visitor Services; and Alternative C, Maintain Current Biological Program and Maximize Visitor Services. All of these alternatives were described and evaluated in the Draft Environmental Assessment.

This plan represents Alternative D, the preferred alternative. Its implementation is anticipated to result in a diversity of habitats for a variety of indigenous wildlife and fish species, while meeting the refuge's primary purpose of Mississippi sandhill crane recovery and protection and expansion of its wet pine savanna habitat. Specific results are expected to include increased grassland songbird use and production; increased diversity of butterfly and dragonfly species as indicators of biodiversity; enhanced resident wildlife populations; and greater opportunities for a variety of compatible wildlife-dependent public use.

An overriding concern reflected in this plan is that wildlife conservation—and specifically the recovery of a federally endangered species—is the first priority in refuge management. Public use is allowed only if it is compatible and appropriate with wildlife and habitat conservation. Four wildlife-dependent public uses—wildlife observation, wildlife photography, environmental education, and interpretation—are emphasized in this plan. Each is one of the priority public use activities specifically mentioned in the National Wildlife Refuge System Improvement Act of 1997 as being a generally appropriate use of national wildlife refuges. Hunting and fishing are two other priority public uses permitted and encouraged on many refuges. However, they are not appropriate on the Mississippi Sandhill Crane Refuge because they would likely increase disturbance to the cranes. Fishing will continue to be permitted when conducted on state waters that cross into the refuge, like Bluff Creek and Bayou Castelle, but not on the refuge's small ponds and creeks or from banks bordering state waters.

VISION

Mississippi Sandhill Crane National Wildlife Refuge was established to provide a sanctuary for the Mississippi sandhill crane. This refuge is the year-round home of this nonmigratory, endangered subspecies found nowhere else in the world. Refuge staff, working with partners, will focus efforts on restoring, improving, and maintaining nesting, feeding, and roosting habitat vital to the survival of the Mississippi sandhill crane. The refuge also contains, protects, and manages the largest remaining contiguous patches of the rare and vanishing wet pine savanna ecosystem. The refuge staff will focus on managing and enhancing the rich species diversity within the savanna. The savanna is a fire-maintained, sub-climax community, and the refuge will continue to be a leader in effectively using prescribed fire to manage rare habitats and species in the expanding wildland-urban interface. While managing a healthy refuge, the Mississippi Sandhill Crane Refuge will expand opportunities for environmental education, interpretation, and other wildlife-dependent recreation. The refuge's foreseeable future is one of increased staff and facilities, expanded partnerships working on behalf of habitat conservation and restoration, land protection, and public enjoyment of its rare and unique assets.

GOALS, OBJECTIVES, AND STRATEGIES

The goals, objectives, and strategies outlined below are the Service's responses to the issues, concerns, and needs expressed by the planning team, the refuge staff, other Service staff, other federal agencies, state agencies, and the general public. These goals, objectives, and strategies reflect the Service's commitment to achieve the mandates of the National Wildlife Refuge System Improvement Act of 1997; the mission of the National Wildlife Refuge System; Partners in Flight; the North American Waterfowl Management Plan; the Central Gulf Coast Ecosystem Plan; the U.S. Shorebird Conservation Plan for the Southeastern Coastal Plain/Caribbean Region; the Wading Bird Plan; Partners in Amphibian and Reptile Conservation; the American Woodcock Management Plan; and the purposes and vision for the Mississippi Sandhill Crane Refuge. The Service intends to accomplish these goals, objectives, and strategies during the next 15 years.

GOAL A – WILDLIFE AND HABITAT MANAGEMENT

Promote management actions that will support viable populations of native wildlife species and habitats, with special emphasis on the Mississippi sandhill crane and wet pine savanna.

Background: As noted in Chapter II, the crane was historically associated with and dependent upon the pine savanna ecosystem, particularly wet pine savanna. Because the refuge was established specifically to save the Mississippi sandhill crane from extinction and to recover its population to a self-sustaining, viable level, wildlife and habitat management efforts at the refuge will remain focused on this overriding purpose. However, many other species of wildlife and plants are also associated with the beleaguered pine savanna ecosystem, and thus will benefit from the refuge's management emphasis.

Sub-Goal A-1: Mississippi Sandhill Crane – Provide for the protection and recovery of a self-sustaining, viable population of Mississippi sandhill cranes.

Objective A-1-1: Population size and demographic factors

Provide for a self-sustaining crane population of 130 to 170 individuals, including 30–35 nesting pairs, fledging 10–15 young annually for at least 10 years.

Discussion: After increasing from a low of just 32 birds in 1984 to a high of 133 in 1993, the crane population has hovered at approximately 110 for the past decade or so. This population has been artificially maintained only by the steady reintroduction of captive-reared birds, and even so is still below the target range of 130 to 170 individuals in a self-sustaining population. Continuing predation, in particular, has taken a heavy toll on the cranes.

The first Recovery Plan for the Mississippi Sandhill Crane was completed in 1976, with revisions in 1979, 1984, and 1991. The current version of the recovery plan lists the recovery objective to be to "maintain a genetically viable, stable, self-sustaining, free-living Mississippi sandhill crane population." Criteria for attaining this "objective" include ceasing the need for captive-reared cranes, attaining a population that shows stability and is self-sustaining for 10 years, and providing necessary habitat. The recovery plan also included population modeling to provide some numerical targets. The refuge was estimated to eventually be able to support 30–34 breeding pairs. Using productivity data from the Florida sandhill crane, a total population of 127 to 166 cranes would be necessary.

The recovery plan also called for a workshop to estimate minimum viability requirements. The International Union for Conservation and Natural Resources' Captive Breeding Specialist Group facilitated a Population and Habitat Viability Assessment Workshop in September 1992, using

software tools and knowledge of the attending 18 biologists and managers to identify and rank extinction risk factors. The total population objective was adjusted to 130–170, including 30–35 breeding pairs. By the time of the 1992 Population and Habitat Viability Assessment Workshop, the population had increased from the 30–35 in 1980 to about 130 cranes. Workshop recommendations included continuing captive releases but reducing the number released annually from 35 to about 12–15 to replace annual mortality, until recruitment attained necessary levels. Since 1993, the crane population has remained at the 110–140 level with augmentations from annual releases. Although the number of breeding pairs has increased, recruitment (i.e., chicks and juveniles surviving to adulthood) remains low and releases will need to continue to replace annual mortality.

The recovery plan also calls for maximum genetic heterogeneity in the captive populations and release cohorts and to increase the captive population size. The refuge will need to select 1–3 viable eggs annually from selected pairs and transfer from the refuge to the captive sites to become part of captive population. Recovery plan task 3.2.3.1 is "Continue transfer of wild eggs." From 15–25 percent of nests do not have at least one viable egg. By replacing a nonviable egg with a similarly aged viable egg (i.e., either from a second viable egg from a refuge nest or one from a captive source), one may increase chances of hatching at 3–5 nests per year, leading to a 15–20 percent increase in hatchability.

Trauma deaths due to collision with human structures (e.g., fences and power lines) or vehicles constitute a secondary and increasingly important cause of crane mortality. Because of increased development outside the refuge and the concomitant increase in vehicle traffic, roads, power lines, towers, and fences, this issue will likely grow in importance.

Strategies:

1) Provide law enforcement protection by increasing full-time officers to 3.

2) Release 12–15 captive-reared cranes onto the refuge annually until the population is self-sustaining. Work with captive centers to maximize genetic heterozygosity.

3) Increase hatchability by egg moves. Consider use of real-time video surveillance technology to assess success.

4) Provide materials for genetic fingerprinting.

5) Maximize size and genetic variation in the captive flock by providing appropriate viable eggs from refuge.

6) Monitor progress towards recovery.

7) Work with captive crane centers to develop aversive conditioning protocols and evaluate success.

8) Work with utility companies to ensure marking of existing and new power lines with bird diverters.

9) Work with communications companies to minimize number of communication towers in crane range and reduce chances of crane strike by building stand-alone towers and placing bird diverter devices on those with support wires.

Objective A-1-2: Increase crane foraging areas

Expand chufa cultivation to 40–60 acres; plant winter cover crops and legumes on up to 20 acres within food plots. Create food plot in Fontainebleau Unit. Explore opportunities with partners to protect existing and extend potential foraging areas off-refuge.

Discussion: Although sandhill cranes nest in wet areas, they use upland areas like pastures for feeding, especially in fall and winter. They have been observed for generations in local corn fields, pastures, and lawns. Recovery plan task 2.4 is "Increase and improve winter foraging habitat" including 2.4.1 "Provide crop units at selected locations in all refuge units." Thirteen refuge crop units and one pasture totaling 152 acres were created to provide supplemental food and assist in keeping cranes within the safety of the refuge. When possible, a number of growing-season and winter crops have been planted in refuge crop units for extra food, increasing nitrogen and supplanting invasive exotic grasses. Chufa has been the main growing season crop while various cover grasses and legumes have been planted in late autumn. Until 2004, in most years the refuge planted approximately 8–12 acres of chufa in eight crop units during the summer. Rye, oats, red clover, white clover, and winter peas were also planted sporadically over areas ranging from 13 acres in four crop units to 30 acres in six crop units. Over the past five years, the refuge has bush-hogged approximately 120 acres biannually, usually in the spring and fall.

Crop units continue to be the cranes' most preferred habitat. Results of crane monitoring indicate a preference for use of these food plots at nearly 50 times their availability by area. Once chufa is discovered in a crop unit, cranes will visit the area regularly until the chufa crop has been consumed. Areas that are bush-hogged and maintained in a short-grass pasture are used by cranes for bugging. Crane nest success monitoring indicates a strong correlation between chick fledging success and proximity to a crop unit. However, the refuge's food plot acreage is apparently insufficient, as over a third of the population regularly or nearly exclusively forages off the refuge, where they are more at risk of mortality.

In Fiscal Year 2003, a Refuge Operating Needs System (RONS) project "Expand Farming Program" to increase the farming effort was approved and the refuge received $65,000. This effort was directed at attracting more cranes to refuge food plots, reducing foraging off-refuge, and increasing food for chicks. Unfortunately, the only known active farmer in southern Jackson County was not interested in farming on the refuge. Chufa and equipment were purchased and a record 40 acres (over three times the previous high) was planted in 2004. The RONS project was not funded in Fiscal Year 2005.

Since refuge crop units concentrate crane activity, they also serve as key spots for visual observation of cranes as part of regular monitoring. Observation blinds are situated at nearly all the crop units. They also are core areas for trapping cranes to affix bands and/or replace worn bands and radio-tags. Over 90 percent of cranes are captured in refuge crop units.

Because farming necessarily involves disturbing ground, invasive plants such as cogon grass, which thrive on disturbed soil, have gotten a foothold in crop units. The largest patches of cogon grass have developed in food plots. Treatment of portions of cogon grass using certain chemicals may necessitate not cultivating those sections for six months. Use of no-till farming methods will disturb less soil and reduce cogon grass infestation. No method has been identified to conduct no-till with chufa, but that needs further investigation.

Among the reasons the Service presumably entered into a memorandum of understanding with the Mississippi Gulf Coast Regional Wastewater Authority in the mid-1980s was that it would convert over 200 acres of pine scrub in the north Ocean Springs Unit into a pasture-like spray field favorable as crane foraging habitat. Because of a lack of vegetation management, the south spray fields have degraded into a wet shrub thicket. Research has documented changes in savanna vegetation composition on the north Ocean Springs Unit south to nearly Perigal Bayou as a likely consequence of wastewater application. There is recent anecdotal evidence that wastewater is affecting vegetation in the Sawdust Savanna in O-02. At a minimum, the memorandum of understanding should be re-visited, changed, and followed so that the south spray fields are properly managed as crane foraging habitat.

Strategies:

1) Plant chufa as a growing season crop in refuge crop units.

2) When possible, plant winter cover crops.

3) Increase number of food plots. Create a food plot in Fontainebleau Unit.

4) Bush-hog food plots to maintain short vegetation height pasture conditions.

5) Continue to explore possibilities for no-till farming.

6) Continue efforts to find a local farmer who would enter into a cooperative farming agreement.

7) Monitor crane use of food plots, including specific food items used. Erect observation blinds at all refuge food plots.

8) Explore opportunities with partners to extend potential foraging areas off-refuge.

9) Reduce invasive plants like cogon grass and torpedo grass.

10) Work with Mississippi Gulf Coast Regional Wastewater Authority to reclaim south spray fields and convert to grass-dominated area conducive for crane foraging.

11) Conduct research to assess crane food habits.

Objective A-1-3: Hydrology

Create 10 additional small, shallow ponds to provide additional roosting, feeding, and release pen habitat for Mississippi sandhill cranes. Clear overgrown interiors of five Grady ponds.

Discussion: Prior to European colonization, small shallow depressions may have been scattered throughout this mostly open grass-dominated pine savanna system, providing valuable aquatic microhabitats for a variety of taxa including the cranes. Sandhill cranes tend to roost in shallow water, 3”–12” deep. In this system, the cranes may have roosted in the nesting savannas during spring and summer, as well as these small seasonal or permanent ponds interspersed within the savanna system. Researchers found that several areas of western Bluff Creek were important roosting sites, particularly in fall and winter. Although most nests are in savanna, they are likely also to be found in shallow water.

Water management involves maintaining or restoring hydrological regimes, increasing water for crane nesting areas and creating shallow water areas for nesting, roosting, and releases. Recovery plan task 2.2.3.1 is "Monitor and improve water control structures." There are five water control structures along roads that were designed to back up water to increase acreage of hydric drain edge for crane nesting and roosting. Of recent nests, 25 percent were in wet edges of wooded drains. However, four of the five water control structures are no longer working and need minor to major maintenance.

Recovery plan task 2.2.3.3 is "to dig small ponds in the vicinity of nesting territories." Fifteen shallow ponds totaling about 100 acres have been created. All of them have been used for roosting, twelve (80 percent) for nesting, and four have been used as crane release sites for the smaller pond pens. Of recent nests, 18 percent were in ponds. These ponds may also provide drinking water to chicks. Ponded water is correlated with nesting success. Sufficient available roost habitat appears to be a limiting factor for the population. Healthy adult breeding cranes have been killed by predators during drought periods when the birds were limited in roosting areas to very small "puddles."

At least 18 Grady or Citronelle ponds have been located on the refuge, which may have served as important crane nesting sites in the past. Two open healthy Grady ponds have been used for nesting. Others have become choked with woody understory and are therefore unsuitable for crane use. Ponds are also necessary for the crane releases. Since 1997, other than those released at Fontainebleau, all captive-reared cohorts have been acclimated to and released in small (under one acre) temporary pens built in ponds. Since releases have been used to increase colonization rates of specific underutilized or recently restored areas of the refuge, the availability of suitable pond sites will continue to be necessary for the release program.

Disruptions in drainage patterns by roads, ditches, fire lines, and other human manipulations have and are continuing to alter water flow, decreasing water economy. Recovery plan task 2.2.3 is to "Improve water economy" and task 2.2.3.2 is "Reestablish water sheet flow." The result is a "drying" of the savannas with resulting change in vegetation to undesirable species. There are several old ditches, created before the refuge was established, that may be altering flow to key savannas. They need to be mapped and plugged. When conducting wildfire suppression, several techniques should be used, whenever possible, to reduce impacts that may accelerate or divert drainage, including avoiding use of a plow, using scratch lines, wet lines, disc, and indirect attack. If plowing is necessary to protect property or lives, those plow lines will be rehabilitated as soon as possible.

Strategies:

1) Maintain and create shallow ponds.

2) Replace or improve five existing water control structures.

3) Map all ditches that may alter hydrology regimes.

4) Plug ditches to restore hydrology.

5) Use solar-powered pumps to guarantee water to key seasonal ponds.

6) Whenever possible, use indirect attack in wildfire suppression.

7) Map, photograph, and catalog existing Citronelle or Grady ponds and clear those overgrown with vegetation.

8) Use low-impact, wildfire suppression techniques.

9) Rehabilitate temporary fire lines needed for fire management to reduce water loss from savanna.

10) Consider monitoring dragonflies as indicators of seasonal pond health.

Objective A-1-4: Predator management for Mississippi Sandhill Crane survival

Conduct predator control sufficient to allow for 60 percent hatching success, 67 percent fledging success, and greater than 80 percent survival of after-hatch-year birds. Remove up to 10 red-tailed hawks annually.

Discussion: Task 3 of the crane recovery plan is to: "Increase recruitment, reduce mortality…." In the crane population modeling conducted for the refuge, the best chance of crane recovery resulted from a combination of 60 percent hatchling production, 20 percent juvenile mortality, and 8 percent adult mortality annually.

Analysis of data at the 1992 Population and Habitat Viability Assessment workshop revealed that excess predation is the number one factor limiting Mississippi sandhill crane population recovery. Nesting failure, egg loss during incubation, and chick loss before fledging were found to be the key elements in crane recruitment failure. Predation continues to be number one cause of mortality today. Recent research on chick mortality indicates that over 85 percent of known causes of chick mortality are from predation. Nearly half of all mortality was from diurnal raptors, probably red-tailed hawks. Chicks appeared most susceptible to hawk predation during their first month.

Predator removal, using refuge personnel, was initiated in 1985. Since 2000, the Service has had an Interagency Agreement with the U.S. Department of Agriculture, Wildlife Services, to protect cranes using predator control. Post-release survival has increased but maximum predator control has not been fully funded. Also, poor road conditions limit effective predator trapping over large areas of the refuge. Some adjacent lands harbor predators that move onto the refuge at key crane nesting, release, and roosting sites. It may be productive to work with landowners and partners on predator control off-refuge. The refuge has a depredation permit to remove red-tailed hawks from key nesting areas. Since complete removal of predators is not possible or desirable, additional nonlethal methods should be developed and implemented to increase survival to meet recovery objectives. Anti-predator conditioning offers promise in reducing mortality of released captive-reared cranes.

Strategies:

1) Conduct effective predator control to provide maximum protection (multiple trappers during nesting season).

2) Reduce predator cover by reducing woody vegetation.

3) Minimize disturbance to nesting cranes.

4) Conduct research to determine correlates of crane nest success, especially chick food availability.

5) Use miniature camera surveillance to document causes of nest failure.

6) Increase access to allow greater area of protection, repair roads and improve fire lines.

7) Consider approval of M-44 for coyote control.

8) Within ten years, develop 1–2 nonlethal methods to reduce predation at nests and release sites (e.g., aversive conditioning and alternate feeding sites to lure predators away). Evaluate success.

9) Remove up to 10 red-tailed hawks from key nesting areas over a five-year period and evaluate changes in chick survival.

10) Coordinate predator control with neighbors (e.g., The Nature Conservancy).

Sub-Goal A-2: Migratory Birds – Provide migratory bird habitats sufficient to meet the goals and objectives of various national, regional and state plans.

Objective A-2-1: Grassland birds

Provide 15,000–17,000 acres of savanna habitat to benefit priority grassland bird species, such as the Henslow's sparrow.

Discussion: As mentioned in Chapter II, a secondary benefit of restoring pine savanna and increasing its acreage on behalf of the Mississippi sandhill crane is that other priority grassland species are also helped. These range from songbirds to raptors, and some are neotropical migratory birds. See Table 3 in Chapter II for a list of these birds. No specific population objectives have been established for these species within the pine savannas along the Central Gulf Coast. However, the implementation of a survey, inventory, and monitoring program would be valuable for tracking peak movements in and out of the refuge and to document responses to habitat management.

Overall, the desired condition for the southern pine communities (e.g., longleaf/slash savannahs and flatwoods) is to: (1) develop nearly treeless savannas and, where appropriate, open pine woodlands; and (2) emphasize retention of the larger and older trees with an uneven-aged structure for longleaf pine stands. Use of prescribed fire is essential in these communities, with clear emphasis needed on the use of growing-season over dormant-season burns. Dormant-season burns may severely affect survival of overwintering sparrows (e.g., Henslow's) by displacing them and by reducing overall habitat quality by not adequately reducing palmettos, gallberry, and ferns to favor grassy-herbaceous conditions preferred by breeding species (e.g., Bachman's sparrows). In addition, there is a growing body of evidence that the high plant species diversity typical of more pristine savannas will decline with the continued application of dormant-season burns.

Priority species include: Extremely High-Priority: yellow rail (ground, wintering), Bachman's sparrow (ground-nester), Henslow's sparrow (ground, wintering), southeastern American kestrel (pine cavity-nester, forages on ground); High-Priority: brown-headed nuthatch, field sparrow (ground, wintering), Le Conte's sparrow (ground, wintering); Moderate Priority: sedge wren (ground, wintering), grasshopper sparrow (ground, wintering), palm warbler (ground, wintering); Local and Regional Interest: eastern meadowlark, loggerhead shrike (tree or shrub nesting, forages on ground); also included in this community is the northern bobwhite (ground-nester). American woodcock (ground, shrub thickets and open grasslands, wintering) have also been observed in these habitats.

Strategies:

1) Restore hydrology.

2) Reduce stocking so that remaining pines are widely spaced (meeting definitions of being "non-stocked," or those describing crane habitat).

3) Promote grassy-herbaceous ground cover through appropriate use of prescribed fire.

4) Monitor bird population responses to habitat restoration using direct counts, point counts, transect protocols (i.e., project prairie bird) focusing on breeding Bachman's and wintering Henslow's sparrows.

5) Determine whether breeding southeastern American kestrels occur on refuge lands and determine whether placing nest boxes would attract more breeding kestrels.

6) Establish at least 10 point counts in each of 6 discrete savannas (3 savannas presently existing and 3 savannas to be restored; total of 60 point counts once per nesting season) to monitor breeding bird populations to measure whether increases in priority species populations occurs, focusing on breeding Bachman's sparrows.

7) Establish at least 3 transects of 100 m (at least 200 meters apart) in each of 6 discrete savannas (3 savannas presently existing and 3 savannas to be restored; total of 18 transects); use project prairie bird protocol to count wintering bird populations (as other areas are restored, add new transects), focusing on wintering Henslow's sparrows (www.tpwd.state.tx.us/nature/birding/prairie_birds).

Objective A-2-2: Other migratory birds

Increase knowledge base by developing and implementing monitoring programs while continuing to provide habitats for the benefit of other migratory birds, including waterfowl, shorebirds, marsh birds, colonial waterbirds, and landbirds.

Discussion: As mentioned in Chapter I, the North American Waterfowl Management Plan (NAWMP) is an international agreement to protect and restore North America's waterfowl populations and their habitats. The implementing mechanisms for the NAWMP are partnerships known as joint ventures, which are composed of federal, state, and local agencies and organizations concerned with conserving migratory birds and their habitats in a particular physiographic region. The Gulf Coast Joint Venture (GCJV) is one of the original focus areas and extends along the western Gulf of Mexico from the Alabama-Florida boundary across Texas.

The GCJV is the terminus of the Central and Mississippi Flyways and, therefore, one of the most important waterfowl wintering areas in North America. The GCJV also provides year-round habitat for over 90 percent of the continental population of mottled ducks. The GCJV is divided geographically into six initiative areas, each with a different mix of habitats, management opportunities, and species priorities. Mississippi Sandhill Crane National Wildlife Refuge lies within the Coastal Mississippi Wetlands Initiative Area.

The midwinter population objectives for this initiative area are as follows:

Species	Population goal
Mallard	619
Gadwall	268
American wigeon	191
Green-winged teal	413
Blue-winged teal	1,738
Northern shoveler	84
Mottled duck	397
Canvasback	174
Greater and lesser scaup	13,836

Habitat conservation is imperative to the success of both the NAWMP and the GCJV. Critical to meeting the goals and objectives of the Coastal Mississippi Wetlands Initiative is the maintenance and restoration of wetland habitat.

Although waterfowl are not common in many habitats of the savanna complex of Mississippi Sandhill Crane Refuge, wetland habitats used by waterfowl include cypress-tupelo drains, forested bayheads, tidal marshes, Bayou Castelle, sewage treatment facilities, and open water areas in the form of borrow pits and ponds. The refuge is now partnering with the GCJV to create more shallow-water areas for waterfowl. There have been 28 species of waterfowl observed on the Wastewater Bird Survey that has been conducted weekly since 1993. The most common species are northern shoveler, blue-winged teal, green-winged teal, ruddy duck, and lesser scaup. Wood ducks, mottled ducks, and Canada geese are residents and nest on the refuge in shallow ponds and swamps. The refuge erected eight wood duck nest boxes several years ago that are not maintained. Any work that can be done for waterfowl is encouraged.

The GCJV is sponsoring a multi-agency effort to monitor mottled duck populations through a significant pre-season banding program, particularly in Texas and Louisiana. All indications are that mottled duck populations in Texas have declined significantly, presumably as a result of changes in rice culture and land use. In Louisiana, the mottled duck population appears to be holding steady to slightly increasing. Little information is available for Mississippi and Alabama populations. In both Louisiana and Texas, the states have taken the lead in the banding effort and are provided significant support by Service personnel and equipment.

Resident Canada geese are not native to Mississippi and should not be encouraged to nest on the refuge. Canada geese can be territorial of nest sites, which are in habitats similar to those used by Mississippi sandhill cranes. Conflicts with cranes, and possibly other native wildlife, should be monitored. If there is a significant problem, the geese should be removed from the refuge.

As mentioned in Chapter II, shorebirds are not abundant in the refuge's savanna complex. Nevertheless, several species occur in the refuge's shallow ponds, including both species of yellowlegs and six sandpiper species. Killdeer and stilts nest on the refuge and common snipe occur year-round in the wetter savannas. American woodcock are uncommon in the savannas, but have been observed exhibiting mating displays in February.

Since 1993, 37 species of shorebirds have been observed along the lagoon edge, in the constructed wetlands, and pastures in the Weekly Wastewater Bird Survey. Shorebird numbers peak in late summer when up to 1,500 have been observed.

Marsh communities maintained by prescribed fire occur on the spray field impoundments and support marsh and associated avifauna. Priority species include High-Priority: black rail, yellow rail, king rail, short-eared owl, and sedge wren; Moderate-Priority: American bittern, least bittern, northern harrier, and barn owl.

Nesting colonial waterbird habitat is somewhat limited on the Mississippi Sandhill Crane Refuge with the best sites at the spray fields and adjacent water treatment plant. Priority species include High-Priority: brown pelican and white ibis; Local and Regional Interest: anhinga, great blue heron, great egret, snowy egret, little blue heron, tricolored heron, black-crowned night-heron, and yellow-crowned night heron.

Priority landbird species include Extremely High-Priority: red-cockaded woodpecker (pine cavity-nester, but not expected to occur on refuge anytime into the near future), Bachman's sparrow (ground-nester), Henslow's sparrow (ground, wintering); High-Priority: brown-headed nuthatch (pine cavity-nester), field sparrow (ground, wintering), Le Conte's sparrow (ground, wintering); Moderate-Priority: grasshopper sparrow (ground, wintering), palm warbler (ground, wintering), Carolina chickadee (cavity-nester), chuck-will's-widow (ground-nester), pine warbler (pine canopy), summer tanager (open canopy); Local and Regional Interest: red-headed woodpecker (pine cavity-nester), eastern wood-pewee (open canopy); the northern bobwhite (ground-nester) is also included as part of this community.

Collectively, forested wetland habitats are scattered in small patches or narrow corridors across the Mississippi Sandhill Crane Refuge. These patterns preclude the need for active management other than to potentially survey these habitats for priority species listed below. The general emphasis for forested wetlands should be on passive management, principally hammocks, bottomland hardwoods, and cypress domes. Remnant cypress domes indeed should be allowed to mature with little need for active management, though some thinning may be prudent to encourage release of the larger trees to become more dominant.

Overall if future active management is to be considered then future desired condition of hardwood forests would be to emphasize (1) increasing stand structural diversity by favoring retention of largest trees (removing surrounding potentially competing trees); (2) opening up stands allowing light to reach the ground in support of better understory structure; and (3) group selection-sized openings to further structural complexity and support regeneration of shade-intolerant tree species (oaks) where needed.

Priority species in the Mississippi Sandhill Crane Refuge's forested wetlands include Extremely High Priority: swallow-tailed kite; High Priority: Swainson's warbler (nest dense understory, forages on open moist ground), American woodcock (winter [breed?] dense understory, but forages on open moist ground), northern parula (breeding canopy, Spanish moss), hooded warbler (dense understory), yellow-throated warbler (breeding canopy, Spanish moss), and wood thrush (breeding midstory, forage moist ground); Moderate-Priority: Kentucky warbler (nest patches of dense ground cover), yellow-billed cuckoo (breeding midstory and canopy), prothonotary warbler (cavity-nesting, usually in trees over open water), Acadian flycatcher (breeding open midstory), yellow-throated vireo (breeding open canopy), and summer tanager (breeding open canopy); Local and Regional Interest: wood duck (cavity-nesting over or near open water), whip-poor-will (wintering ground, roost in trees), eastern wood-pewee (breeding open canopy), and black-and-white warbler (winter).

Strategies:

Waterfowl

1) Work with the GCJV to monitor and archive waterfowl habitat conditions, and to create additional shallow-water areas for waterfowl.

2) Continue to monitor and archive wintering waterfowl survey information at the wastewater ponds and, if possible, expand the survey to other areas of the refuge, particularly the tidal marshes. Survey data can be entered into a database supported by the South Atlantic Migratory Bird Initiative.

3) Support mottled duck population monitoring efforts if the geographic scope increases to include Mississippi and the Mississippi Department of Wildlife, Fisheries, and Parks becomes significantly involved in the effort.

4) Provide wood duck nesting structures on created shallow-water ponds exceeding 2 to 5 acres in size and other suitable habitats on the refuge. The number of wood duck nest boxes should not exceed the refuge staff's ability to routinely clean and repair at least once per year prior to nesting (January, if possible). Initially, perhaps only 10 or 20 boxes could be erected and the number expanded as box usage increases. However, if staff or volunteer time does not allow annual maintenance, the boxes should be boarded up or removed from the refuge.

5) Resident Canada geese are not native to the refuge and should not be encouraged to nest. Should conflicts between the geese and Mississippi sandhill cranes, and possibly other native wildlife, occur the refuge should take steps necessary to eliminate the geese from the refuge. The U.S. Department of Agriculture, Wildlife Services, can provide the necessary permits and assistance in removing the geese.

Shorebirds

6) Conduct shorebird monitoring surveys using the International Shorebird Survey protocol along levee roads bordering impoundments to track occurrence and relative abundance.

Marsh Birds

7) Determine marshbird use of impoundment habitats and responses to various water management and prescribed burning regimes, with special emphasis on black and yellow rails.

Nesting Colonial Waterbirds

8) Annually, determine locations of nesting colonies and as best as possible estimate number of pairs for each species present at each colony. Additional monitoring may not be necessary unless a specific need is identified to address other management activities.

Landbirds

9) Reduce stocking of slash pine plantations so that remaining pines are open enough to allow natural regeneration of longleaf in drier sites and slash on wetter sites.

10) Reduce saw palmetto, gallberry, and ferns and promote grassy-herbaceous ground cover through appropriate chopping and use of prescribed fire.

11) Monitor bird population responses to habitat restoration using direct counts, point counts, transects (i.e., project prairie bird) or area search protocols.

12) Establish at least 20 point counts in pine flatwoods (≥10 in longleaf and ≥10 in slash dominated; 3 presently existing sites; and 3 in sites to be restored) to monitor breeding bird populations; measure whether increases in priority species populations occur, focusing on brown-headed nuthatch and Bachman's sparrow.

13) Establish at least 3 transects of 100 m in discrete patches of flatwood habitats with grassy-dominated conditions and use project prairie bird protocol to count wintering bird populations (as other areas are restored, add new transects), focusing on Henslow's sparrows.

Sub-Goal A-3: Other Wildlife – Manage and where appropriate restore native biodiversity on the refuge.

Objective A-3-1: Amphibians and reptiles

Maintain and develop habitats (e.g., shallow ponds) and promote management actions, such as baseline surveys, that will support viable populations of native species of amphibians and reptiles.

Discussion: Mississippi Sandhill Crane National Wildlife Refuge has a mix of terrestrial and wetland communities that provide a wide array of habitats for amphibians and reptiles. Unfortunately, not much is known about the diversity of species that occur on the refuge or how abundant any particular species might be. A systematic amphibian and reptile survey of the available habitats on the refuge is needed. The threatened gopher tortoise is known to occur on the refuge. Another rare species, the endangered Mississippi gopher frog, was known historically from nearby areas. As a part of the recovery strategy for this species, ponds on the refuge could be used as translocation sites to establish new gopher frog populations.

Strategies:

1) Create shallow ponds for Mississippi gopher frogs (same ponds for cranes and ducks).

2) Create two release sites for Mississippi gopher frogs.

3) Work with the Service's Jackson, Mississippi, Ecological Services Field Office to monitor the use of ponds by gopher frogs and the possible occurrence of amphibian diseases.

4) Conduct a gopher tortoise habitat assessment by ground-truthing soils and determine the potential for establishment of a viable tortoise population on the refuge.

5) Continue the malformed frog survey.

6) Continue the frog call survey to contribute to state, regional, and refuge amphibian survey (crane food and habitat).

7) Conduct a systematic amphibian and reptile survey of available habitats on the refuge.

Objective A-3-2: Invertebrates

Maintain the native diversity of butterfly and dragonfly species as indicators of biodiversity. Provide for high-quality Orthoptera and related species numbers for food by the sandhill cranes and their young.

Discussion: As mentioned in Chapter II, a good deal remains to be learned about the invertebrates of the savanna community. In general, wet pine savanna, with its interspersed, ephemeral ponded areas, is excellent habitat for the Odonata (e.g., dragonflies and damselflies). In terms of the refuge purpose—restoring the Mississippi sandhill crane—invertebrates, particularly orthopterans (e.g., grasshoppers, crickets, and katydids) and some coleopteran (e.g., beetles), are usually an important part of the crane diet, especially during nesting season as a source of protein for growth of crane chicks. But invertebrates, or at least one in particular, the introduced fire ant, can also cause problems for cranes. There is documented pipped egg and chick mortality by fire ants and they may also be reducing other invertebrates available as food for chicks.

Strategies:

1) Initiate butterfly and dragonfly inventory by 2010.

2) Seek volunteers to begin summer North American Butterfly Association butterfly count by 2010.

3) Suggest to the entomological community that it research effects of fire ants on invertebrate populations at the refuge.

Sub-Goal A-4: Savanna – Restore and maintain the natural species richness and structural composition of the wet pine savanna.

Objective A-4-1: Savanna acreage

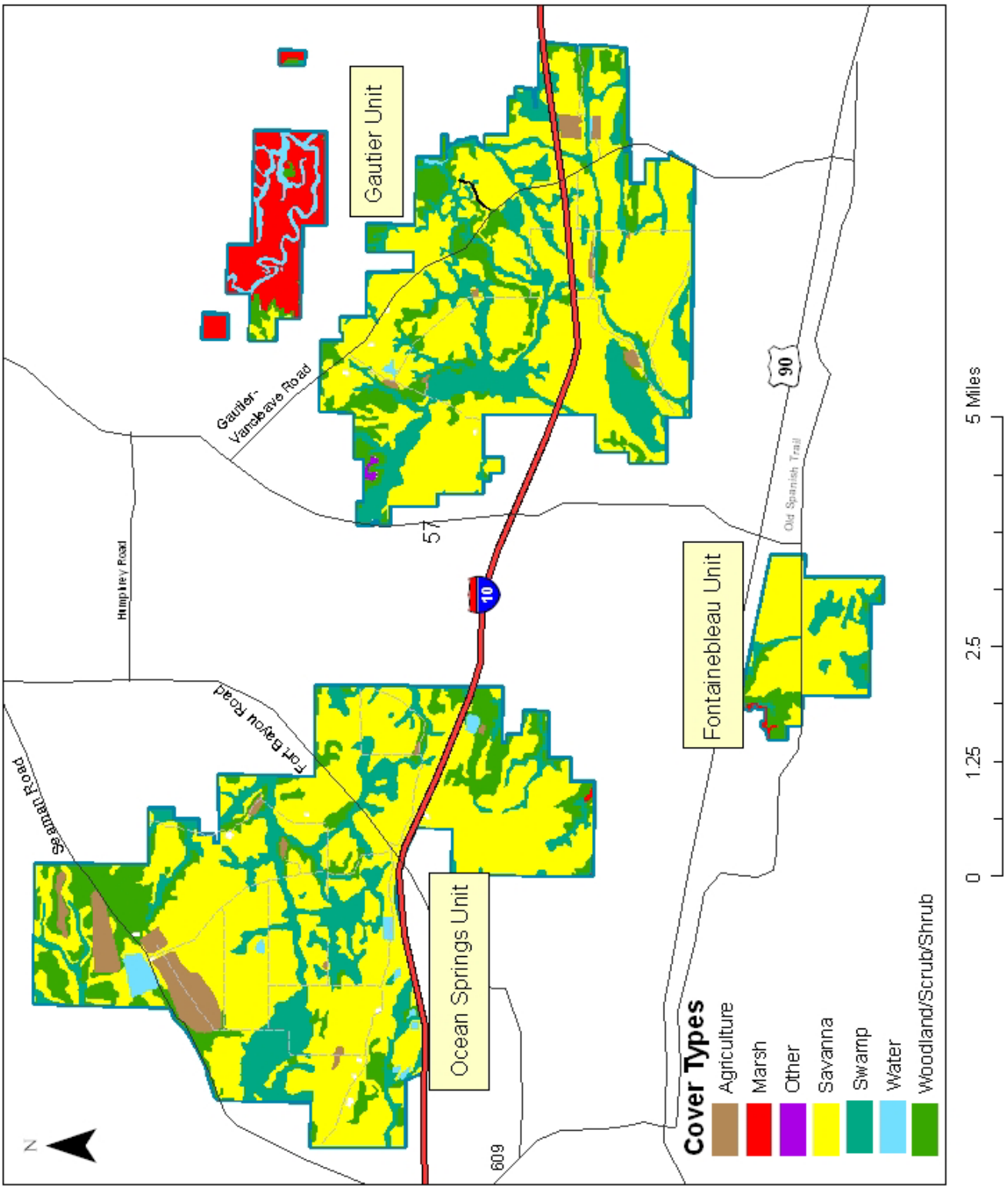
Within 15 years, provide 15,000–17,000 acres of savanna habitat containing <10 percent woody plant frequency, 10–15 percent tree cover, 90–100 percent desirable tree composition, 10 ft^2/acre tree basal area, and $\geq$99 percent graminoid frequency.

Discussion: Restoration and maintenance of the wet pine savanna is one of the primary purposes of the refuge. In addition to functioning as important habitat for key wildlife species, such as the sandhill cranes, the savanna system itself is considered a Resource of Concern. At the ground level, with 35–40 species per square meter, these habitats have some of the highest species "packing rates" (i.e., species per unit area) described in the literature. A partial floristic list compiled by Clewell and Raymond (1995) included 170 species. Unique and highly diverse, the wet pine savanna is also one of the most endangered ecosystems in the country, with only 2–3 percent of the original area remaining. The refuge probably contains some of the last large blocks of this system in the southeast.

The overall intent of habitat restoration efforts is to return as much of the overgrown pine scrub to open pine savanna as possible. See Figure 6 for desired habitat conditions. Although the exact "original" character of the landscape may not be known, a reasonable benchmark would be a combination of the description by Hilgard from the 1850s and the first aerial photographs of the area from 1942. These sources were used to construct this objective. Restoring and maintaining the health of the savannas means reducing the woody vegetation component, increasing or maintaining the high plant species diversity, and keeping the hydrology intact.

The decline of pine savanna was gradual at first but accelerated after World War II. Fire suppression, silviculture practices, and development were the main causes. Wholesale fire suppression in the 20th century allowed the invasion of woody plants and decline of the sun-loving herbaceous flora and quickly caused a conversion of savanna to pine scrub. Without frequent burning, the savannas have reverted to pine and titi thickets (e.g., pine scrub). Silviculture practices in the 1950s, 1960s, and 1970s installed

Figure 6. Desired habitat conditions on Mississippi Sandhill Crane National Wildlife Refuge.



planting beds, ditched and drained the savannas, and planted slash pine. Construction of I-10 in 1960s and 1970s directly destroyed some savannas and later rapid residential and commercial growth plus casino development have further magnified this habitat loss.

By the time of the establishment of the refuge in the mid-1970s, the percentages of savanna and pineland had nearly reversed. In five habitat types in ten crane nesting areas, savanna decreased from 74 percent to 14 percent between 1942 and 1981, while woodland increased from 18 percent to 70 percent and urban areas from a mere trace to 6 percent.

Restoration of the savannas since the late 1970s has included removal of trees using commercial tree contracts, chain saws, bulldozer only, bulldozer with roller chopper; removal of shrubs and small trees using gyrotrac and roller chopper, and use of prescribed fire to restore and maintain openness, recycle nutrients, and reduce woody vegetation, encouraging growth of sun-loving savanna graminoids and forbs. Several thousand acres have been restored on the refuge. Recent success in using growing season burning has led to reduced woody vegetation and flowering of native bunchgrasses.

The refuge has established eight long-term plots and a protocol to monitor and evaluate the floristic content, woody vegetation, and community structure in eight areas of savanna (four healthy, four degraded) in selected management compartments. Service fire ecologists, with fire management personnel and refuge biologists, began monitoring of fuels (woody vegetation, some community structure, not floristics) in these plots in 2002, as part of the fire monitoring process tracking hazardous fuels. Every plot will be assessed in October–November within a year of each treatment. It will be necessary to add plots in more compartments to further assess restoration progress related to different habitat types, crane nesting territories, hazardous fuel areas, and compartments needing north winds for burn (rare in growing season). Because of the expertise needed in this species-rich environment, it will be necessary to locate trained and experienced botanists (as consultants or from universities) to conduct the floristic part of vegetation monitoring. At a minimum, monitoring of a small suite of savanna herbaceous species that are identifiable in the autumn might be useful as an index of species diversity.

Strategies:

1) Conduct frequent prescribed burning.

2) Conduct mechanical and chemical treatments to reduce woody vegetation.

3) Monitor vegetation response to restoration and maintenance using eight established monitoring plots and protocol.

4) Use volunteers to monitor butterflies as savanna diversity indicators.

Objective A-4-2: Fire management

Continue to aim for conducting prescribed fires on all compartments on a 2- to 3-year rotation. Use growing-season burns on at least 50 percent of annual burns.

Discussion: Since the 1950s, suppression of wildfires in Jackson County has led to the decline and disappearance of Mississippi sandhill crane habitat and wet pine savannas. It also has led to an unnatural buildup of hazardous natural fuels in the form of flammable shrubs, vines, and planted pine on and around the refuge. Through the National Fire Plan (2001), the federal fire fighting agencies have been directed to manage fuels and reduce the threat to life, private and public property, and

natural resources posed by this condition. Prescribed fire will be one of the tools used to reduce the threat of unwanted wildland fires and restore and maintain the wet pine savannas.

There have been 275 wildfires on the refuge from 1980 to 2003. Sixty-two percent were caused by arson and twenty-one percent by debris pile burns. Areas where fuel loadings are high with fine dead fuels and thick loads of brush, common on the refuge, allow fires with rapid rates of spread and higher fire intensities. Since 1980, about half of the wildfires that have burned on or around the refuge have exceeded 10 acres; 84 percent of all fires have been contained at less than one acre. Forty-four fires, or approximately two per year, exceeded 100 acres, which are considered large fires. The average fire size is 59 acres and 13 percent reach 100 acres or more.

The hazardous fuels of the refuge consist of both dead and living fuels. Accumulations of fine dead fuels include pine litter and cured grasses, which provide the tinder to ignite fast-moving fires that spread through the crowns of woody shrubs and pines. These are the live fuels that then burn with long flame lengths. The invasive cogon grass increases the intensity and severity of fires. The increase in the quantity of hazardous fuels over time has also had a negative impact on the quality of nesting and rearing habitat for the Mississippi sandhill crane and wintering habitat for migratory birds, such as the Henslow's sparrow. Native savanna plant species, such as wiregrass, longleaf pine, pitcher plants and other unique carnivorous plant species, are also adversely impacted by accumulating fuels, as shrubs increase and spread into the wet savannas.

Prescribed fire activity, when combined with removal of planted slash pine, has allowed the Mississippi sandhill crane to use more areas of the refuge than at any other time in the past. This is evidenced by a record number of nests completed by pairs in each of the last few years.
A large part of savanna restoration lies in the ability to use fire to initially reduce the amount of unwanted trees and shrubs on the refuge, and then to use growing season burns to promote the growth of native plant species.

Many plant species in the pine savannas are fire-dependent, that is, they require growing season burns for reproduction or have adapted characteristics that enable them to better survive fire than other species. Wiregrass (*Aristida berychiana*) is a good example as it requires growing season fires for flowering, thus it cannot reproduce sufficiently without a growing season burn. The longleaf pine (*Pinus palustris*) has growth characteristics that allow it to survive fires in the seedling stage; this ability does not occur in any other tree species of Mississippi. In addition, there are many species that can only survive in areas that are open and provide full to mostly full sunlight for survival. Species, such as the carnivorous sundews, pitcher plants and butterworts, require sunny open habitats with little shrub or tree encroachment. Fire is a key management tool to keep areas opened and maintained as grass-dominated habitats.

Both seasonality and frequency play a role in effectively managing wet pine savannas as open, grass-dominated, species-rich plant habitats. While dormant season burns may be required for the initial treatment of fuels and reduction of woody growth in a savanna, frequent growing-season burns are required for maintaining open savanna habitat. It is believed that the natural fire frequency in the wet pine savannas was every 2–5 years, with fire naturally occurring most often during the growing season. Fires in this habitat type were thought to be in high frequency, but of lower intensity and severity. The refuge continues to strive towards achieving these burning conditions.

In addition to reducing the competition of woody vegetation into the savannas, fire is also used as a tool to reduce unwanted and/or invasive species. Fire has helped to reduce unwanted species, such as Chinese tallow tree (*Sabium sebiferum*), and others from encroaching into the refuge.

Strategies:

For fuel reduction:

1) Estimate fuel loads using established standardized protocols.

2) Prioritize areas with hazardous fuel build-up that pose a threat to life, property, and natural resources.

3) Use high-severity fires to initially reduce heavy fuel accumulations of shrubs and unwanted timber species.

4) Use low- to moderate-severity fires on a 2- to 5-year return interval in order to maintain acceptable fuel loads.

5) Use dormant or growing season burns to reduce and maintain fuel loads.

6) Coordinate all fire activities with resource specialist or biologist as needed on an individual-event basis. This includes review of burn plans, conducting surveys the day before burn events (growing-season only) for crane nesting and/or rearing activity to negate impacts on crane populations, and consultation with resource advisors during suppression activities.

7) Monitor results of burns using monitoring protocols, photo-points, and plots established throughout refuge.

For maintenance of pine savanna habitat:

8) Use 2- to 3-year fire return intervals in areas of acceptable fuel loads.

9) Use growing season fires every two years in wiregrass/savanna compartments and every three years on other non-wiregrass compartments. If growing-season burns are not possible in a given compartment, burn in the dormant season within the following year.

10) Use low to moderate severity fires to maintain plant species.

11) Monitor response of species with established monitoring protocols.

Sub-Goal A-5: Other Habitats – Maintain a diversity of native plant communities on the refuge, including flatwood forests, bayous, and forested wetlands.

Objective A-5-1: Other habitats

Maintain 2,000–5,000 acres in pine flatwood forests, 1,300 acres in forested wetlands, and 600 acres in open water (bayous and ponds).

Discussion: Of the existing 9,000 acres presently stocked to meet flatwood definitions on the refuge, between 4,000–7,000 acres will be converted to savanna conditions within the next 15 years (i.e., primarily grassy-herbaceous dominated ground conditions and open pine stands to support priority pine nesting, ground-nesting, and foraging species). The remaining 2,000–5,000 acres may truly be flatwoods and will be maintained as such.

Forested wetlands are dispersed in small patches or narrow corridors throughout the refuge. Emphasis should be on passive management of hammocks, bottomland hardwoods, and cypress domes. Remnant cypress domes should be allowed to mature with little need for active management, except for some thinning to encourage release of the larger trees. If future active management is to be undertaken, then the strategies listed below can be used.

The refuge's ponds and bayous, like Bluff Creek, provide important habitat for the sandhill crane; several areas of western Bluff Creek, for example, are important roosting sites in the fall and winter. Many ponds are used by cranes for nesting; 18 percent of recent nests were in ponds. These ponds may also provide drinking water to chicks. Ponded water is correlated with nesting success. Open water in ponds and bayous adds biotic diversity to the refuge.

Strategies:

Pine Flatwood Forest

See Strategies 9 through 13 in Objective A-2-2.

Forested Wetlands

1) Increase the stands' structural diversity by favoring retention of largest trees (i.e., removing surrounding potentially competing trees).

2) Open up stands to allow light to reach the ground in support of better understory structure.

3) Use group selection-sized openings to further structural complexity and support regeneration of shade-intolerant tree species (e.g., oaks) where needed.

Bayous and Ponds

See Strategies 1 through 10 under Objective A-1-3.

GOAL B – RESOURCE PROTECTION

Identify, conserve, and protect natural and cultural resources through partnerships, land protection programs, and law enforcement.

Background: Resource protection means safeguarding the integrity of the various resources present on the refuge, including wildlife, habitat, and cultural resources. Controlling invasive species is a type of resource protection because it aims to prevent the spread of organisms that displace, compete with, or harm native flora or fauna. This goal also includes protecting resources off-refuge through the Service's Private Lands Program. The need for law enforcement is expanding along with growth and development in the areas around the refuge. Finally, as a federal agency, it is the responsibility of the Fish and Wildlife Service to preserve historic and cultural resources under its ownership.

Objective B-1: Controlling invasive species

Reduce cogon grass by 80 percent within 10 years to total no more than 30 acres. Eliminate tallow trees and other invasive species opportunistically.

Discussion: As described in Chapter II, there are several invasive species on the refuge. They are most abundant on disturbed sites, particularly along roadsides, ditches, and crop units. The most common are cogon grass (*Imperata cylindrica),* Chinese tallow tree (*Sapium sebiferum*), Johnsongrass (*Sorghum halepense*), torpedograss (*Panicum repens*), and Japanese climbing fern (*Lygodium japonica*).

The exotic invasive cogon grass, now recognized as one of the world's worst weeds, is the biggest threat. Cogon grass has virtually no wildlife value and supplants native vegetation. It became a problem by colonizing roadsides, forming monotypic stands in refuge crop units, and is now beginning to spread out into adjacent savannas to supplant native vegetation (Bryson 1984). By 2000, the cogon grass infestation was at least 140 acres ranging in size from small patches to 6 acres, not counting that in the wastewater spray fields on the Ocean Springs Unit.

There is no single treatment that effectively eliminates cogon grass infestations. Refuge staff and contract sprayers had been unsuccessful in chemically and mechanically treating cogon grass in the mid- to late-1990s. Disking also had little success, as it must be done deeply into the soil, requiring special disking equipment. Spraying of 140 acres with glyphosate by a contractor in 2002 prevented flowering the next spring, but did not reduce affected acreage. Treatment with a mixture of glyphosate and imazapyr was conducted in the fall of 2003 and 2004 and holds better promise. Repeated chemical applications will be necessary. Mowing and burning will remove above-ground biomass but opens up areas for emergence of seedling and new stems. Indeed, burning seems to "aggravate" cogon grass. Mowing and burning may serve as an effective pre-treatment for chemical application. There are large patches of cogon grass in the south spray fields in compartment O-01 that have probably been aided in their development by high nutrient loads. Because of size and wet soil conditions, these areas have not yet been treated.

Although not as big a threat to savannas or as numerous, Chinese tallow trees are colonizing forested roadside buffers and hydric drains and can become a big problem if not addressed. In 2003, refuge staff began opportunistically mapping and treating tallow with injectable imazapyr capsules.

Strategies:

1) Map cogon grass and tallow locations and adjust with treatment.

2) Treat invasive species, repeatedly, if necessary, with approved chemicals.

3) When possible, use mechanical methods like deep disking.

4) Unless planning to follow-up with chemical treatment, do not burn cogon grass patches.

5) Work with the Mississippi Gulf Coast Regional Wastewater Authority to reduce cogon grass in south spray fields.

Objective B-2: Private lands

Refuge staff will work with private landowners on existing Farm Service Agency easement tracts to manage and improve habitats. Explore opportunities with partners to protect existing and extend potential foraging areas off-refuge. Partner with The Nature Conservancy and other nearby landowners on fire management issues and biological assistance.

Discussion: Many national wildlife refuges have implemented private lands programs to address broader ecosystem and landscape issues, problems, and opportunities (i.e., wetlands restoration and conservation corridors). Authorities for involvement with private landowners in developing and carrying out habitat improvement projects are found in the National Wildlife Refuge System Improvement Act of 1997 and in the policy documents for the Service's Partners for Fish and Wildlife Program. Additional authorities reside within the Fish and Wildlife Act and the Fish and Wildlife Coordination Act. Under the Partners for Fish and Wildlife Program, landowners may receive up to $25,000 for on-the-ground project implementation. Partners' projects typically receive a minimum 50 percent in-kind cost-share and require a minimum 10-year commitment from the landowner. Typically, landowner agreements are for more than 20 years.

The Farm Bill conservation programs, available through the U.S. Department of Agriculture under successive farm bills, provide significant opportunities for the development and implementation of habitat improvement projects on private lands. These programs include the Wetlands Reserve Program, the Conservation Reserve Program, the Wildlife Habitat Incentives Program, and the Environmental Quality Incentives Program. Many millions of dollars are available to eligible private landowners for habitat conservation under these programs.

Strategies:

1) Visit each Farm Service Agency tract and its owner(s) at least once a year to note progress in habitat restoration and compliance with terms of easement(s).

2) Consult with other national wildlife refuges that already have private lands programs in place to learn from their experiences.

3) Begin to meet with private landowners in the area either one-on-one or by inviting them to a group meeting where opportunities for cooperative land and resource management could be discussed, including funding opportunities and financial incentives for habitat management and restoration.

4) Cooperate closely with local landowners on fire and habitat management.

5) Maintain good communication with landowning neighbors in the area to stay abreast of pending plans to place properties with important or potential wildlife values (especially for cranes) on the market.

6) Continue to work with The Nature Conservancy to conserve and acquire habitats and properties of importance to the cranes.

Objective B-3: Law enforcement

Provide one full-time law enforcement officer.

Discussion: Law enforcement activity has remained fairly consistent in recent years; the frequency of incidents and citations has been relatively unchanged, with no trends up or down. At present, the Mississippi Sandhill Crane Refuge has only one dual duty refuge officer. This officer is based at and shared with Grand Bay National Wildlife Refuge. The refuge affords limited public access, virtually no consumptive use, and is located on Mississippi's densely populated Gulf Coast. Law enforcement activities center on illegal entry and have tried to focus on a high visibility of refuge personnel and positive community relations. The typical areas of concern include trespass, trash/refuse dumping, boundary deer hunting, stray dogs, vandalism, arson wildfires, and crane disturbance.

For the past couple of years, the overall animal trespass problem has been down by as much as 30 percent from the early 1990s, but is likely to continue as long as the deer dog/road hunting debate remains unaddressed by state regulations. The main problem is dogs, which are picked up during hunting season and returned to owners on the first offense; succeeding offenses are handled by the dog pound or with a Notice of Violation.

Strategies:

1) Continue to strive to maintain high visibility of refuge personnel in the community, not just law enforcement personnel, but all refuge staff in uniform; this will establish and maintain a presence and an image of being engaged in the community, as in "community policing."

2) Continue to cooperate with state and local police jurisdictions.

Objective B-4: Cultural resources

Within 15 years of plan approval, develop and begin to implement a Cultural Resources Management Plan.

Discussion: The Mississippi Sandhill Crane Refuge follows standard National Historic Preservation Act Section 106 procedures to protect the public's interest in preserving its cultural/historic legacy that may potentially occur on the refuge. Whenever construction work is undertaken that involves any excavation with heavy earth-moving equipment like tractors, graders, and bulldozers, such as for the development of moist-soil units, the refuge contracts with a qualified archaeologist/cultural resources expert to conduct an archaeological survey of the subject property. The results of this survey are submitted to the Service's Regional Historic Preservation Officer, as well as the State Historic Preservation Office, which in Mississippi is the Mississippi Department of Archives and History. The State Historic Preservation Office reviews the surveys and determines whether cultural resources will be impacted, that is, whether any properties listed in or eligible for listing in the National Register of Historic Places will be affected. If cultural resources are actually encountered during construction activities, the refuge is to notify the State Historic Preservation Office immediately. To date, no properties on the refuge have been determined to be eligible for the National Register of Historic Places.

Strategies:

1) Within 10 years of plan approval, conduct a Phase I archaeological survey of the non-flooded areas of the refuge, by qualified personnel, as a necessary first step in cultural resources management.

2) Conduct a Phase II investigation if archaeological resources are identified during the Phase I survey. In this, the eligibility of identified resources for listing on the National Register of Historic Places is evaluated prior to any disturbance.

3) Conduct a Phase III data recovery if resources identified in Phases I and II are determined to be eligible. This will recover data and mitigate adverse effects of any undertaking.

4) Within 15 years of plan approval, prepare a Cultural Resources Management Plan for the refuge.

5) Follow procedures outlined in Cultural Resources Management Plan for consultation with the Regional Historic Preservation Office, the State Historic Preservation Office, and potentially interested American Indian tribes.

6) Follow procedures detailed in Cultural Resources Management Plan for inadvertent discoveries of human remains.

7) Ensure that archaeological and cultural values are described, identified, and taken into consideration prior to implementing undertakings.

8) Develop a step-down plan for surveying lands to identify archaeological resources and for developing a preservation program.

GOAL C – PUBLIC USE AND ENVIRONMENTAL EDUCATION

Provide the public with quality wildlife-dependent recreation and environmental education and interpretation that lead to greater understanding, appreciation, and enjoyment of wildlife and their habitats, in particular the Mississippi sandhill crane and wet pine savanna.

Background: As described in Chapter II, the focus of public use and visitation at Mississippi Sandhill Crane Refuge is on four of the priority public uses encouraged at national wildlife refuges. These are wildlife observation, wildlife photography, and environmental education and interpretation. The refuge has several visitor facilities, including a visitor center with interpretive exhibits, two nature trails, and a blind. Guided tours are led by staff and volunteers upon request. Hunting is not permitted on the refuge and fishing opportunities are limited at present, though this plan aims to expand them somewhat.

Figure 7 depicts present and proposed public use facilities on the refuge.

Objective C-1: Visitor Services Plan

Within 3 years of this plan's completion, develop a Visitor Services Plan to be used in expanding public use facilities and opportunities on the refuge.

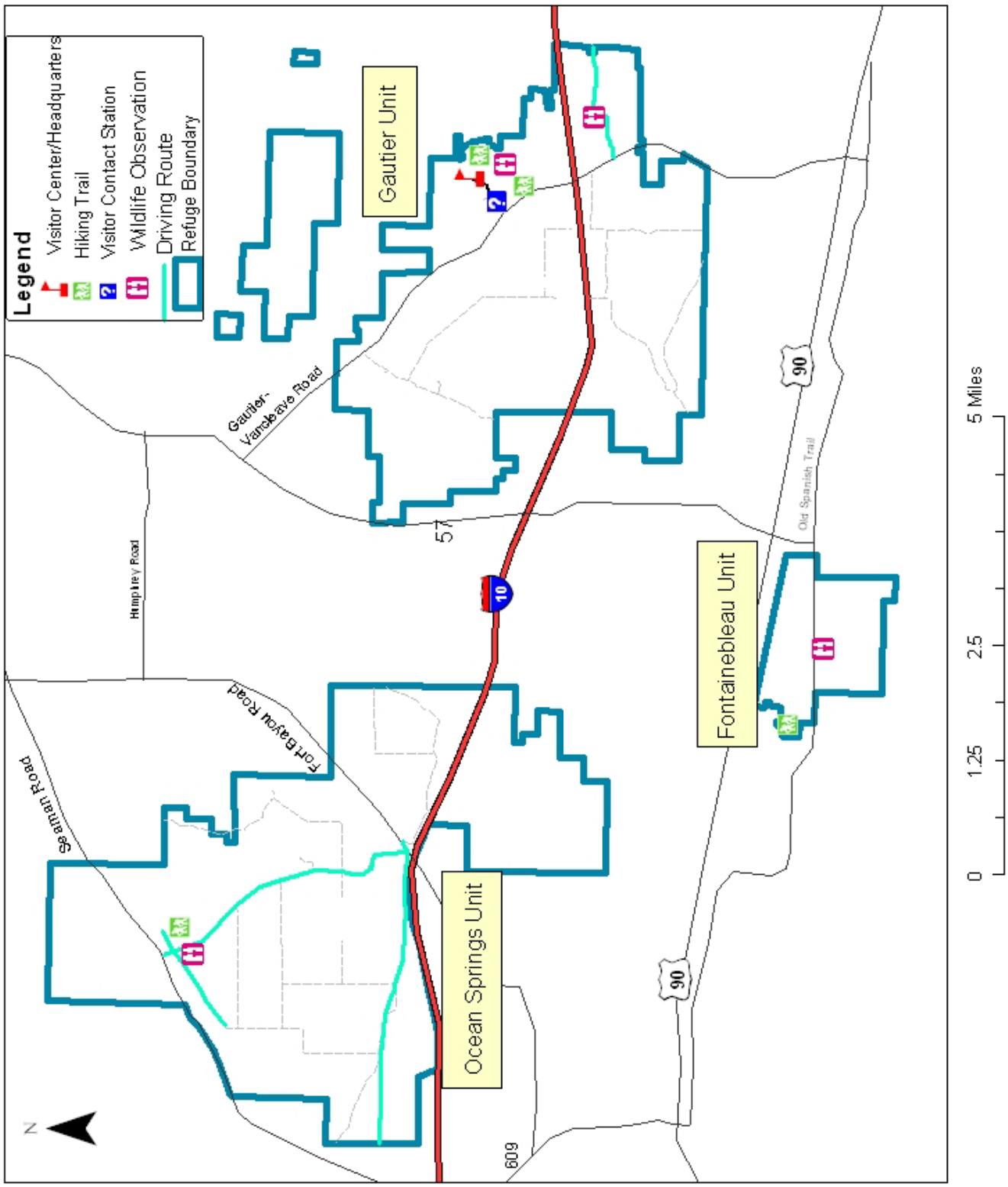
Discussion: A public use development plan was drafted by the refuge in 1985, but there is no record of this plan being submitted or approved. Thus, the refuge does not have a current Visitor Services Plan. After this comprehensive conservation plan is completed, the refuge will develop a step-down Visitor Services Plan. Issues related to refuge management will be addressed in this step-down plan. Current and future staffing needs to implement the recommendations within the plan will also be addressed. The final comprehensive conservation plan will include budgetary needs and current databases, such as SAMMS, and will explore opportunities for funding and partnerships to assist the refuge in accomplishing the recommendations within the plan. It will provide a system for monitoring and evaluating the effectiveness of the visitor services program annually.

Strategies:

1) Obtain the assistance of public use and recreation specialists in the Regional Office and throughout the Region in preparing a Visitor Services Plan that reflects current legislation, Director's orders, initiatives, policy, and the mission of Mississippi Sandhill Crane Refuge, the Refuge System and the Fish and Wildlife Service. Consult the July 2004 Visitor Services Review Report for information and ideas that should be incorporated into the plan.

2) Add Public Use Specialist position to develop and implement the plan.

Figure 7. Present and proposed public use facilities on Mississippi Sandhill Crane National Wildlife Refuge.



Objective C-2: Visitor Center

Within the 15-year planning horizon, construct a new visitor center near existing one and convert existing visitor center into refuge headquarters.

Discussion: The existing visitor center doubles as a refuge headquarters and is inadequately sized to house both. Exhibit and interpretive space in the current visitor center is very constrained, and there is no public meeting space, auditorium, or theater. Space exists to construct a new building, dedicated as a visitor center alone, in the proximity of the existing headquarters-visitor center building. Each could share the same parking lot. A new visitor center will help the refuge realize its educational potential for the public.

Strategies:

1) Place a directional sign to new visitor center at the kiosk area along the entrance road.

2) Collaborate with architects and landscape architects to design an innovative visitor center that emphasizes: a) conservation of resources, such as energy, through the use of passive and active solar features; b) blending new facility into the natural setting as much as possible; and c) offering views of nearby forest, pine savanna, and bayou habitats.

3) Collaborate with Regional Office and contractors specializing in exhibit development to plan and install interpretive exhibits that utilize the latest "hands-on" and interactive technologies in a designated area of the visitor center.

4) Include small auditorium in new visitor center for use in talks, meetings, films, videos, and other audio visual presentations.

Objective C-3: Wildlife observation and wildlife photography

Increase opportunities with photo blinds, observation site, and trails. Add one on-refuge auto tour.

Discussion: At present, the Mississippi Sandhill Crane Refuge offers limited opportunities for wildlife observation. The refuge offers the visiting public a ¾-mile nature trail (Dees Trail) for hiking and birding that includes savanna and bayou habitats. Birding is one of the most popular forms of wildlife observation on the refuge. Visitors may also see other common forms of wildlife, such as white-tailed deer, raccoons, snakes, and frogs.

All refuge lands, with the exception of the headquarters site, are closed to the public to minimize disturbance to the cranes. However, public roads cross through or border refuge lands and motorists may view a portion of the refuge daily as they travel Interstate 10, which bisects the Gautier and Ocean Springs Units of the refuge.

Observation and photography of wildlife and plants are mainly limited to the self-guided Dees Trail at the visitor center and to staff-guided trips to permanent blinds located in areas of frequent crane use in the Gautier Unit. The ¾-mile-long Dees Trail is open all year on weekdays from 8:00 a.m. to 3:00 p.m. The trail provides opportunities for plant and wildflower viewing and photography of several habitat types, as well as for associated native wildlife. It winds through pine savanna, marsh, and pine flatwoods. In the spring, blooming orchids and carnivorous plants, such as pitcher plants, sundews, and bladderworts, are prominent. A map/key with information about the vegetation along the trail is provided at the visitor center.

Birding and other wildlife viewing opportunities occur in a variety of refuge habitats. Wading birds may be found in bayous; songbirds, such as the eastern bluebird, Bachman's sparrow, or Henslow's sparrow, can be seen in the savanna, as can harriers, osprey, and red-tailed hawks. White-tailed deer, raccoon, and fox are also found on the refuge.

Guided crane trips are offered by volunteers during January and February to provide an opportunity for visitors to view and photograph the endangered Mississippi sandhill crane. Trips occur on Tuesdays and Saturdays and require advance reservations. Using concealed access routes, permanent blinds, and controlled/limited schedules, crane sightings had been common in the past. These crane tours led to the unofficial elevated blind that was created for the staff's use in observing cranes near a crane release site that was frequently used until 1995. The blind had also been used for pre-arranged crane tours where cranes were regularly observed in January and February. However, the crane biologist noted that cranes became increasingly sensitive to human presence after several years. Since 1997, seven or eight new release sites have been used. Volunteers may try to view cranes at two or three locations, but often do not see them.

There is an old photocopied general brochure that needs updating, a photocopied bird check list, a vascular plant list with scientific names, and a photocopied visitor center trail map. There are plans to create a pond in the headquarters savannah that will allow for wildlife observation and photography opportunities of the Mississippi sandhill crane and other wildlife.

The Ocean Springs Middle School trail on the Fontainebleau Unit is under construction behind the Ocean Springs Middle School. This is an approximately one-mile, double loop trail, the purpose of which is to interpret fire management, an indispensable habitat management tool on the refuge. The trail traverses marsh, savannah, and pine scrub habitats. A memorandum of understanding with the school board has been created to permit use of a parking lot adjacent to the refuge.

An informational kiosk is located along the headquarters entrance road. Displays and a general information video are available in the visitor contact center. The spray fields/wastewater treatment area of the Ocean Springs Unit offers some of the best refuge birding habitat. Ponds are open to the public. Volunteers have been performing weekly bird surveys for about 11 years. Volunteers also lead approximately six special birding trips annually in this area.

Strategies:

1) Continue January/February regular scheduled guided tours by van (Tuesday, Saturday reservation only-call in or email, limited to eight passengers).

2) Develop a trailhead kiosk at the Ocean Springs Middle School Trail on the Fontainebleau Unit.

3) Delete crane viewing areas on private property from all maps and brochures.

4) Develop a pond in savanna near the headquarters and proposed visitor center.

5) Expand the visitor center nature trail (Dees Trail) into savanna near the visitor center.

6) Develop an auto tour on the refuge (seasonal and hourly limits as appropriate). Prepare a brochure and corresponding signposts, waysides, and kiosks.

7) As appropriate, develop additional hiking/wildlife observation trails in other units of the refuge, especially to give visitors an opportunity to see cranes.
8) Construct a photo blind to allow opportunities for wildlife photography.

9) Work with volunteers to expand capacity of volunteers to lead guided tours of the refuge.

10) Add one additional full-time equipment operator to assist with the full implementation of this objective (and others).

Objective C-4: Environmental Education and Interpretation

Over the 15-year life of this plan, increase emphasis on environmental education and interpretation to lead to increased understanding of the importance of habitat and resources, especially the Mississippi sandhill crane and savanna.

Discussion: The refuge staff manages a small environmental education program at Mississippi Sandhill Crane Refuge as a collateral duty. On-site environmental education includes staff or volunteer-led walks on nature trails; presentations and video viewing in auditorium; participating in radiotelemetry and prescribed fire demonstrations; and assistance with developing appropriate curriculum for refuge field trips. Off-site environmental education includes presentations to schools, garden clubs, and organizations; pre- and post-field trip briefings; and participation in special events like Earth Day, Crane Festival, and National Wildlife Refuge Week.

The refuge staff frequently hosts school groups at the refuge, from elementary to college levels. The refuge interacts with the Ocean Springs Middle School at the refuge nature trail immediately adjacent to the school. In addition, the staff participates at schools, clubs, groups, and festivals, speaking about the refuge, wildlife resources, and environmental issues. Science teachers take environmental refresher courses taught at the refuge by a local university extension service. The video, exhibits, nature trail, and savanna at the visitor center offer a wealth of information.

Environmental education programs are given to on-site and off-site groups as time and staff availability permit. On-site environmental education programs mainly occur on the Gautier Unit. Current refuge staffing does not include a public use specialist, so different members of the staff conduct the public education and volunteer programs.

Several 5th grade classes from a local school (e.g., Taconi Elementary School) have visited the refuge for teacher-conducted educational programs in which the refuge staff assists by providing a fire demonstration and a crane telemetry demonstration. Approximately 400 5th graders come to the refuge in April or May, over 3–4 days, which has been conducted for approximately 10 years. Fire staff and refuge volunteers conduct the demonstrations.

Approximately 12–15 school-oriented groups visit the refuge each year in the spring and fall. Educational programs generally consist of a 1 ½- to 2-hour visit in which students rotate through a fire demonstration, a crane program/telemetry demonstration, and a trail walk. Available staff, refuge volunteers, and a teacher with the group lead these on-site programs.

Occasionally, the refuge wildlife biologist hosts college classes or special groups on crane tours down the closed Brown's trail road. The International Crane Foundation has provided the wildlife biologist with educational materials when requested.

With regard to interpretation, the refuge headquarters houses dioramas, exhibits, and a video about refuge operations. During January and February, the refuge staff offers the public an opportunity to view the cranes from select observation blinds.
One of the refuge's main interpretive themes is wet pine savannas. The refuge has unique wet pine savanna soils, which are acidic in nature and have very low nutrient capacity. The refuge is home to 10 species of carnivorous plants that fall into four main groups: sundews, butterworts, pitcher plants, and bladderworts.

Strategies:

1) Contract to develop "refuge activities" for the trails.

2) Develop interpretive signs for the refuge trails.

3) Work to have the Ocean View School "adopt" a trail and maintain it.

4) Contract to develop environmental education materials for fire ecology and other important education topics for the refuge.

5) Develop a burn demonstration area that shows the 3-year cycle with portable kiosk.

6) Place activities online on the refuge's website for teachers to download from the Internet.

7) Develop a fire ecology merit badge for the Boy Scouts.

8) Expand the 5th grade program with Taconi Elementary School to other schools.

9) Survey teachers to determine the usefulness of "loaner activity kits" (develop if useful).

10) Use existing materials and activities (i.e., WILD, WET, PLT, Crane.org) rather than developing new materials.

11) Develop portable exhibit for special events/presentations.

12) Develop a PowerPoint exhibit that demonstrates stages of crane management. Possible topics to consider for interpretive or educational materials, exhibits, and programs:
    - Cranes
    - Invasive species
    - Endangered species
    - Habitats
    - Henslow's sparrow and other birds of importance
    - Fire ecology

Objective C-5: Hunting and fishing

Within 5 years of this plan's approval, prepare a Fishing Plan that would outline permissible fishing opportunities within the refuge; construct canoe and kayak trail in bayou with access point.

Discussion: The refuge is currently closed to hunting and under this comprehensive conservation plan would remain closed. The potential for disturbance to cranes or even accidental shooting by hunters

during a gun hunt is too great to allow this public use, which is allowed and encouraged on many other national wildlife refuges. However, the possibility of a quota archery hunt will be explored.

The refuge is currently closed to bank fishing, although it is possible to fish on state-jurisdiction waters within the refuge from boats or canoes. Perigal Bayou, Bluff Creek, and Bayou Castelle are the only navigable watercourses bisecting the three separate management units of the refuge. These water bodies are managed by the state and access is very limited due to the nature of the wetland habitats. An abundance of excellent saltwater and freshwater fishing, crabbing, and oyster tonging opportunities are offered just minutes away in nearby gulf coastal and river waterways.

This comprehensive conservation plan will encourage a modest expansion in opportunities for anglers by developing a canoe and kayak trail in the bayou with one access or "put-in point" on the refuge. The aim is not to appeal to all fishing interests, but specifically to those individuals interested in pursuing low-impact, nonmotorized fishing from small, portable craft. The relatively small number of anglers likely to avail themselves of this opportunity will be manageable and not cause large-scale disruption to wildlife in general or cranes in particular.

Strategies:

1) Investigate the best place for an access point by considering such factors as: avoiding and minimizing potential disturbance to crane nesting, resting, and foraging sites; other wildlife values; proximity to road or existing trail; suitability of soils; potential for siting a small parking lot; ease of maintenance; and proximity to desirable aquatic habitat.

2) Select a canoe/kayak trail that will not disturb potentially sensitive sites yet provide access to desirable areas. If feasible, develop a loop trail with a tie-in to other routes off-refuge.

3) Place durable, conspicuous but not excessively large directional signs along the selected route.

4) Maintain route as necessary using minimum impact techniques and equipment.

GOAL D – REFUGE ADMINISTRATION

Develop and implement a comprehensive refuge program, including sufficient staff, facilities, equipment, and volunteers to protect and manage the natural, cultural, and historical resources and features that define the Mississippi Sandhill Crane National Wildlife Refuge.

Objective D-1: Within the 15-year life of the plan, provide a full complement of 18 permanent, full-time, well-trained staff to protect and manage the natural, cultural, and historical resources of the refuge.

Discussion: Figure 9 delineates the proposed organizational structure and staff for the refuge over the 15-year life of this comprehensive conservation plan.

Strategies:

1) Increase current staff from 15 to 18 with the addition of 3 full-time positions: one assistant refuge manager, one biological technician, and one law enforcement officer.

2) Manage a comprehensive employee training program to ensure expertise in all program areas.

V. Plan Implementation

INTRODUCTION

This comprehensive conservation plan outlines an ambitious course of action for the management of Mississippi Sandhill Crane National Wildlife Refuge over the next 15 years. The ability to enhance wildlife habitats on the refuge at the same time as expanding its recreational opportunities will require the dedicated commitment of staff. To continue to make progress, the refuge will seek additional venues for staffing and funding, such as through partners, volunteers, and grants.

Prior to Hurricane Katrina, significant funding was proposed to rehabilitate the office and construct an addition. However, after the damage caused by the storm and the high rehabilitation/addition estimates, a decision was made that the best value to the government would be to replace the existing office.

PROJECT SUMMARIES

To implement this comprehensive conservation plan, the refuge proposes projects that reflect the basic needs identified by Service staff, other governmental agencies, the public, and the planning team. These projects address the management of wildlife and habitat, resource protection, education and visitor services, and refuge administration.

The refuge already has several step-down management plans that address some of the proposed projects. These plans are individual and specific management plans that outline the refuge's proposed actions and their benefits. Some of these plans will need to be revised. For the other proposed projects, step-down plans will need to be developed.

WILDLIFE AND HABITAT MANAGEMENT

Project 1: Restore Hydrology

Ditches that were constructed prior to the establishment of the refuge have inflicted hydrologic changes throughout the refuge. These ditches facilitate drainage of refuge lands, and these unnaturally dry conditions affect the plant communities within the refuge. Also, these drier conditions can make it more difficult to implement prescribed burning, since the drier conditions reduce the time periods in which prescribed fire can be safely accomplished. Installing low-level weirs, constructing small dikes and shallow ponds, and repairing existing water control structures in the ditches and drainages will promote the restoration of natural plant communities and facilitate prescribed burning operations.

First Year: $130,000
Recurring: $10,000

Project 2: Improve Refuge Roads

Refuge roads are critical to habitat management operations, especially prescribed burning, as well as monitoring Mississippi sandhill crane populations. Presently, habitat management and wildlife surveys are hampered by a refuge road infrastructure that is often impassable during wet periods. Improving roads to support all-weather access will enhance the refuge's ability to implement habitat management and wildlife surveys, as well as reduce wear and tear on refuge vehicles and equipment.

This project will involve several elements. Dilapidated and inoperable equipment, including the excavator, motor grader, and dozer, must be replaced. Engineering assistance will be needed to design road beds that will support all-weather access without disrupting surface hydrology, including specifying the placement and size of culverts. Gravel and fill to improve roads will have to be procured, and an equipment operator should be added to the staff.

First Year: $394,000
Recurring: $100,000

Project 3: Maintain Foraging Areas and Food Plots

Fields and food plots are maintained to supplement food for the Mississippi sandhill cranes and provide good viewing areas to monitor the crane populations. This project will involve replacing dilapidated mowers and plows that are used to plant the food plots and mow the fields.

First Year: $12,000
Recurring: $1,000

Project 4: Rehabilitate Sandhill Crane Rehabilitation Pens

Captive-reared Mississippi sandhill cranes are not released into the wild until they have spent several weeks in fenced areas at four different locations on the refuge. These pens allow the cranes to become acclimated to their new surrounding while protecting them from predators. These pens need to be repaired and upgraded to improve maintenance efficiency and protection from predators.

First Year: $60,000
Recurring: $1,000

Project 5: Enhance Monitoring of Mississippi Sandhill Cranes

Outdated radio telemetry equipment needs to be replaced with new and improved equipment that will facilitate monitoring of the movement of cranes on and off the refuge. Boats and all-terrain vehicles that are used in following crane movements will also need to be replaced.

Additional staff time is needed to carry out crane monitoring. More seasonal biological technicians and interns are needed to accomplish field monitoring.

First Year: $150,000
Recurring: $30,000

Project 6: Restore Habitat by Thinning Pine Forests through Timber Sales

Pine forests need to be thinned to reduce fuel loads to a level where prescribed fire can be introduced on refuge areas, thus promoting the restoration of the rare pine savanna habitats. The proceeds of the sale would be deposited in the refuge revenue-sharing accounts.

This project will aim at restoring 300 acres of savanna each year through thinning. Therefore, a forester will need to be added to the refuge staff to plan and implement forest management projects and develop/administer timber sales.

First Year: $216,000
Recurring: $70,000

RESOURCE PROTECTION

Project 1: Protect Endangered Mississippi Sandhill Crane Chicks from Predation

Predation on chicks is a major factor limiting the recovery of the Mississippi sandhill crane. Coyotes, foxes, dogs, and red-tailed hawks are among the primary predators of chicks. Therefore, the continued control of these predators is essential to having any chance of restoring sandhill crane populations to the levels documented in recovery plans. Predator control activities will be emphasized during the two months before captive-reared birds are released, as well as the 2–4 months before and during nesting season

First Year: $115,000
Recurring: $10,000

Project 2: Control the Exotic, Invasive Cogon Grass

The invasive cogon grass has been spreading and displacing native vegetation, forming monoculture stands. Recent observations indicate that this exotic plant is now supplanting native savanna vegetation, with an estimated 140 acres of infestation. Continued control and eradication with herbicides are needed to contain and reduce the area affected by the invasive plants.

This project will involve eradicating at least 80 acres of cogon grass on the refuge, focusing on those areas near county road easements and the I-10 corridor where the worst infestations are located. An additional 400 acres will be treated adjacent to the refuge, requiring coordination, assistance, and outreach with state, county, and private landowners.

First Year: $216,000
Recurring: $20,000

Project 3: Restore and Protect Rare Habitats and Ecosystems

The restoration of rare fire-dependent habitats on which the endangered Mississippi sandhill crane relies will require continuous habitat monitoring and management to determine where and how restoration is feasible and to assess the impacts of habitat management techniques, especially techniques involving hydrologic restoration and fire management. These assessments will guide the continued adjustment of prescribed fire plans, forest management plans, and water management plans to facilitate overall habitat restoration and protection. These assessments will consist of hydrologic monitoring, as well as fuel and plant surveys, to measure the success of habitat treatments. This project will require the addition of a biologist or plant ecologist to plan, implement, and assess habitat management activities.

First Year: $430,000
Recurring: $70,000

EDUCATION AND VISITOR SERVICES

Project 1: Construct Visitor Center

The current headquarters and visitor contact station was constructed in 1980. The building was originally designed to be a visitor center, but it was ultimately retrofitted to serve as both an administrative headquarters, as well as visitor contact station. Unfortunately, administrative functions and visitor services have suffered by forcing both into the one building. Moreover, the building has deteriorated with age and damaged from Hurricanes Rita (2005) and Katrina (2005). There is a critical need to establish facilities that are designed specifically to support administrative operations and daily interpretation and education programs. This project will involve constructing and staffing a visitor center in the Gautier Unit.

First Year: $1,500,000
Recurring: $150,000

Project 2: Improve Existing Visitor Facilities and Services

Existing kiosks, walking trails, access roads, and parking areas are all in need of repair. Thus, this project will involve replacing and improving interpretive media in kiosks and along walking trails, repaving access roads, and repaving and possibly expanding parking areas that provide public access to the refuge. Improving facilities and services will attract more visitors, requiring the addition of refuge law enforcement officers to provide security for visitors and facilities and to protect wildlife resources.

First Year: $150,000
Recurring: $80,000

REFUGE ADMINISTRATION

Project 1: Replace Administrative Headquarters

Presently, administrative operations are housed in a retro-fitted visitor center that was not originally intended to be a refuge headquarters. The current building has deteriorated from age, as well as buffeting from two major hurricanes. The building is damaged, difficult to maintain, and detracts from the overall administrative efficiency by forcing staff to work in a building that was designed for housing interpretive displays. Therefore, this project will consist of constructing an administrative headquarters and adding administrative personnel (e.g., administrative officer, administrative clerk, and refuge operations specialist) to the staff.

First Year: $500,000
Recurring: $200,000

Project 2: Remove Abandoned Equipment and Debris

The refuge is littered with abandoned equipment, including a road grader that has accumulated over the three decades since the refuge's establishment. Some of the equipment was left from private landowners whose land was acquired by the refuge, and some of the equipment is military surplus that was barely functional when last used. Thus, the junk is an aesthetic eyesore, if not a potential environmental hazard. This project involves contracting the removal and disposal of this debris.

First Year: $50,000
Recurring: 0

STAFFING AND FUNDING

In the preceding chapters, the comprehensive conservation plan for Mississippi Sandhill Crane Refuge has set forth a vision for the refuge and outlined the management goals, objectives, and strategies needed to realize that vision. Implementing the vision will require additions to the organizational structure of the refuge. Existing staff will intensify their efforts and four new staff members will enable the refuge to expand its wildlife and habitat conservation, resource protection, enforcement, and public education and outreach endeavors. Objective B-3 recommends providing a full-time law enforcement officer (in place of the existing one law enforcement officer shared with Grand Bay National Wildlife Refuge). Objective C-3 calls for adding one full-time equipment operator to assist with implementing wildlife observation and wildlife photography strategies, as well as environmental education and interpretation development. The following table and organizational chart identifies the additional positions and future structure of the refuge. A total of 3 full-time staff will be needed to completely implement the comprehensive conservation plan.

Table 7. Additional personnel identified to implement the Comprehensive Conservation Plan for Mississippi Sandhill Crane National Wildlife Refuge

Position Title	Grade	Funding Required
Law Enforcement Officer	GS- 9	$70,864
Wildlife Technician	GS- 5/7	$52,231
Assistant Refuge Manager	GS-11	$94,000
Equipment Operator	WG-10	$58,012
Maintenance Mechanic	WG- 8	$51,148

Figure 8 shows a current staffing chart for the refuge and Figure 9 shows the proposed staffing chart, which includes the above positions.

PARTNERSHIP OPPORTUNITIES

Partnerships are essential for the successful pursuit of the refuge's goals, objectives, and strategies. Indeed, the refuge already cooperates with several organizations and individuals on important projects, including other agencies such as the U.S. Department of Agriculture; the Grand Bay National Estuary Reserve of the Mississippi Department of Marine Resources; the Mississippi Department of Wildlife, Fisheries and Parks; local jurisdictions; the Mississippi State University Extension Service; and The Nature Conservancy, a nongovernmental organization. In addition, the refuge has partnered with and will continue to partner with local police and volunteer fire departments. Furthermore, this plan supports the Partners in Flight Initiative; North American Waterfowl Management Plan; Shorebird and Wading Bird Plans; the Central Gulf Coast Ecosystem Plan; Partners in Amphibian and Reptile Conservation; and the American Woodcock Management Plan.

Figure 8. Mississippi Sandhill Crane National Wildlife Refuge current staffing chart.

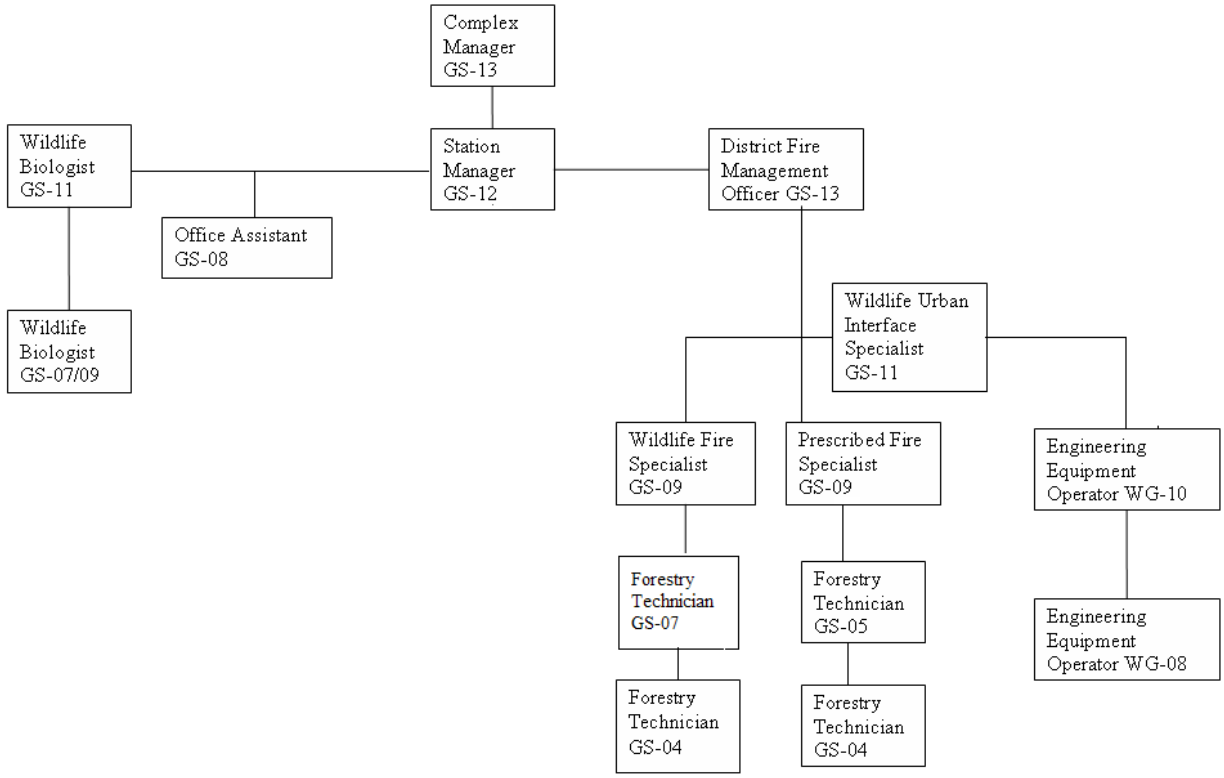
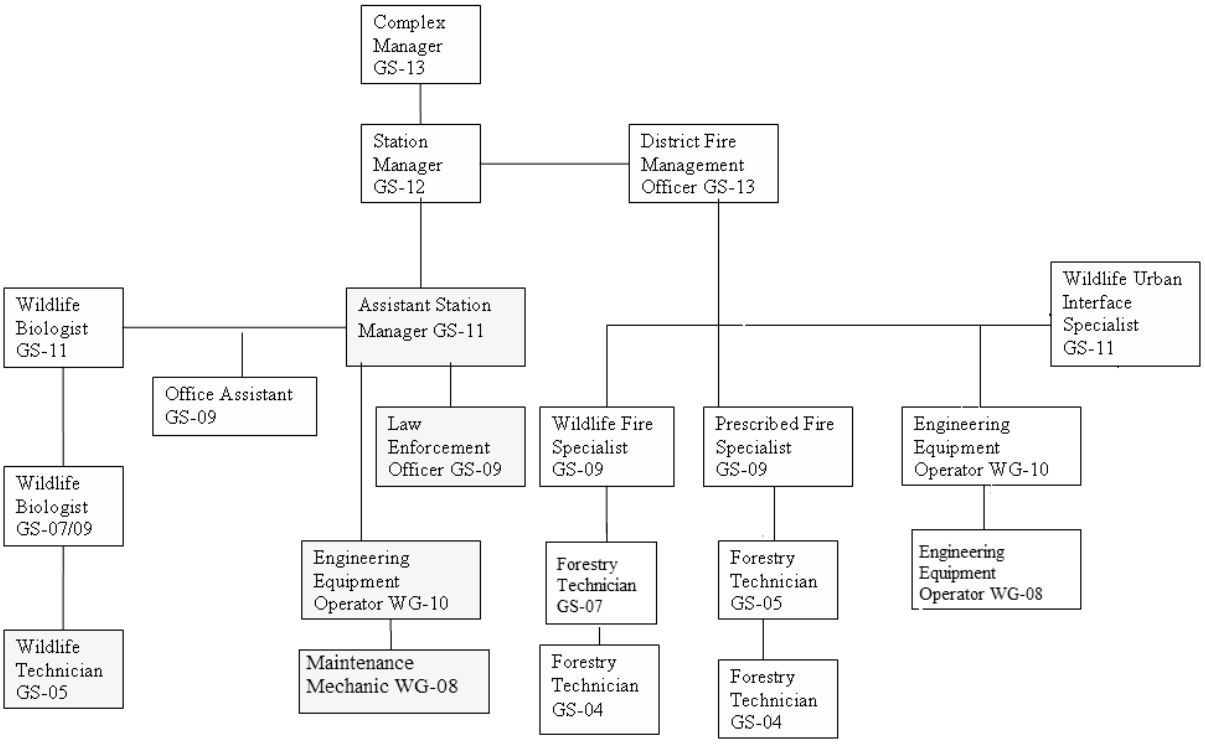


Figure 9. Mississippi Sandhill Crane National Wildlife Refuge proposed staffing chart.



If staff can be expanded to allow time for additional outreach to local communities, there may be opportunities to expand the existing volunteer opportunities on the refuge. The refuge already has an active and growing volunteer program, managed by the refuge's wildlife biologist. Properly supervised and directed, these volunteers could make even more valuable contributions to the refuge by assisting staff with any number of activities, including projects to monitor habitat and wildlife populations and environmental education both on and off the refuge.

Many national wildlife refuges have partnering non-profit organizations, often called Friends groups, which serve as advocates and assistants for a refuge. These civic associations have the ability to apply for grants, to reach out to the surrounding community for assistance on refuge projects, and to provide support on conservation issues. Mississippi Sandhill Crane National Wildlife Refuge has recently formed a Friends Group, which holds meetings and conducts refuge-related events, while helping staff on a variety of fronts.

The goals and objectives outlined in this plan need the support and the partnerships of federal, state, and local agencies, nongovernmental organizations, and private citizens. This broad-based approach to managing fish and wildlife resources extends beyond social and political boundaries and requires a foundation of support from many stakeholders. The refuge will continue to seek creative partnership opportunities to achieve its vision for the future.

STEP-DOWN MANAGEMENT PLANS

Several step-down management plans describe specific actions that support the accomplishment of refuge objectives. The management plans identified in Table 8 will be reviewed and revised as necessary to achieve the results anticipated in this comprehensive conservation plan.

Table 8. Step-down management plans.

Plan	Date Completed	Anticipated Revision
Fire Management	1996	2007
Visitor Services	2009	2019
Fishing	2011	2021
Cultural Resources Management	2021	2031
Habitat Management	2008	2018
Predator Control	1993	2008

MONITORING AND ADAPTIVE MANAGEMENT

Adaptive resource management is a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs, that is, by monitoring and adapting them.

The direction set forth in this comprehensive conservation plan, plus specifically identified strategies and projects, will be monitored throughout the life of the plan. The Service will adapt management as new information and research become available. Furthermore, on a periodic basis, the Service's Southeast Regional Office will assemble a review team whose purpose will be to visit the refuge and evaluate current activities in light of this plan. The team will review all aspects of refuge management, including direction, accomplishments, and funding. The goals and objectives presented in this plan will provide the baseline from which this refuge will be evaluated.

PLAN REVIEW AND REVISION

This Comprehensive Conservation Plan for Mississippi Sandhill Crane National Wildlife Refuge is meant to provide guidance to refuge management and staff over the coming 15 years. However, the plan is also a dynamic and flexible document, and some of the strategies it contains are subject to unpredictable phenomena such as droughts, floods, windstorms, hurricanes, and other uncontrollable natural events. In addition, other strategies may be subject to new research and information that may direct changes or cause additional objectives, strategies, and/or projects to be developed. Because of all these factors, the objectives, strategies, and recommendations will be reviewed periodically and, if necessary, will be revised to meet new circumstances.

Appendix I. Glossary

Alternative - A set of objectives and strategies needed to achieve refuge goals and the desired future condition.

Biological Diversity - The variety of life forms and their processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur.

Compatible Use - A wildlife-dependent recreational use, or any other use on a refuge, that will not materially interfere with or detract from the fulfillment of the mission of the Service or the purposes of the refuge.

Comprehensive Conservation Plan - A document that describes the desired future conditions of the refuge, and specifies management actions to achieve refuge goals and the mission of the National Wildlife Refuge System.

Community - A distinct assemblage of plants that develops on sites characterized by particular climates and soils, and the species and populations of wild animals that depend on the plants for food, cover and/or nesting.

Ecosystem - A dynamic and interrelated complex of plant and animal communities and their associated non-living environment.

Ecosystem Approach - A strategy or plan to protect and restore the natural function, structure, and species composition of an ecosystem, recognizing that all components are interrelated.

Ecosystem Management - Management of an ecosystem that includes all ecological, social and economic components that comprise the whole of the system.

Ecotone - Edge or transition zone between two or more adjacent but different plant communities, ecosystems, or biomes.

Endangered Species - Any species of plant or animal defined through the Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range, and published in the *Federal Register*.

Environmental Assessment - A systematic analysis to determine if proposed actions will result in a significant effect on the quality of the environment.

Extirpation - The localized extinction of a species that is no longer found in a locality or country, but still exists elsewhere in the world.

Goals - Descriptive statements of desired future conditions.

Issue - Any unsettled matter that requires a management decision. For example, a resource management problem, concern, a threat to natural resources, a conflict in uses, or in the presence of an undesirable resource condition.

National Wildlife Refuge System - All lands, waters, and interests therein administered by the Fish and Wildlife Service as wildlife refuges, wildlife ranges, wildlife management areas, waterfowl production areas, and other areas for the protection and conservation of fish, wildlife and plant resources.

Objectives - Actions to be accomplished to achieve a desired outcome or goal. Objectives are more specific, and generally more measurable, than goals.

Preferred Alternative - The Service's selected alternative identified in the comprehensive conservation plan.

Scoping - A process for determining the scope of issues to be addressed by a comprehensive conservation plan and for identifying the significant issues. Involved in the scoping process are federal, tribal, state and local agencies; private organizations (e.g., businesses and non-profit); and individuals.

Species - A distinctive kind of plant or animal having distinguishable characteristics, and that can interbreed and produce young. In taxonomy, a category of biological classification that refers to one or more populations of similar organisms that can reproduce with each other but is reproductively isolated from – that is, incapable of interbreeding with – all other kinds of organisms.

Strategies - A general approach or specific actions to achieve objectives.

Wildlife-dependent Recreational Use - A use of refuge that involves hunting, fishing, wildlife observation and photography, or environmental education and interpretation, as identified in the National Wildlife Refuge System Improvement Act of 1997.

Threatened Species - Those plant or animal species likely to become endangered species throughout all of or a significant portion of their range within the foreseeable future. A plant or animal identified and defined in accordance with the 1973 Endangered Species Act and published in the *Federal Register*.

Vegetation - Plants in general, or the sum total of the plant life in an area.

Vegetation Type - A category of land based on potential or existing dominant plant species of a particular area.

Watershed - The entire land area that collects and drains water into a stream or stream system.

Wetland - Areas such as lakes, marshes, bogs, and streams that are inundated by surface or ground water for a long enough period of time each year to support, and that do support under natural conditions, plants and animals that require saturated or seasonally saturated soils.

Wildlife Diversity - A measure of the number of wildlife species in an area and their relative abundance.

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Appendix III. Legal Requirements

Rivers and Harbor Act (1899) (33 U.S.C. 403): Section 10 of this Act requires the authorization by the U.S. Army Corps of Engineers prior to any work in, on, over, or under a navigable water of the United States.

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.

Migratory Bird Treaty Act (1918): Designates the protection of migratory birds as a federal responsibility. This Act enables the setting of seasons and other regulations, including the closing of areas, federal or non-federal, to the hunting of migratory birds.

Migratory Bird Conservation Act (1929): Establishes procedures for acquisition by purchase, rental, or gift of areas approved by the Migratory Bird Conservation Commission.

Fish and Wildlife Coordination Act (1934), as amended: Requires that the Fish and Wildlife Service and state fish and wildlife agencies be consulted whenever water is to be impounded, diverted or modified under a federal permit or license. The Service and state agency recommend measures to prevent the loss of biological resources, or to mitigate or compensate for the damage. The project proponent must take biological resource values into account and adopt justifiable protection measures to obtain maximum overall project benefits. A 1958 amendment added provisions to recognize the vital contribution of wildlife resources to the Nation and to require equal consideration and coordination of wildlife conservation with other water resources development programs. It also authorized the Secretary of the Interior to provide public fishing areas and accept donations of lands and funds.

Migratory Bird Hunting and Conservation Stamp Act (1934): Authorized the opening of part of a refuge to waterfowl hunting.

Historic Sites, Buildings and Antiquities Act (1935), as amended*:* Declares it a national policy to preserve historic sites and objects of national significance, including those located on refuges; provides procedures for designation, acquisition, administration, and protection of such sites.

Refuge Revenue Sharing Act (1935), as amended*:* Requires revenue sharing provisions to all fee-title ownerships that are administered solely or primarily by the Secretary of the Interior through the Service.

Transfer of Certain Real Property for Wildlife Conservation Purposes Act (1948):
Provides that upon a determination by the Administrator of the General Services Administration, real property no longer needed by a federal agency can be transferred without reimbursement to the Secretary of the Interior, if the land has particular value for migratory birds or to a state agency for other wildlife conservation purposes.

Federal Records Act (1950): Directs 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 Act (1956): Established a comprehensive national fish and wildlife policy and broadened the authority for acquisition and development of refuges.

Consolidated Farm and Rural Development Act (1961): Authorized a major expansion of U. S. Department of Agriculture lending activities, which at the time were administered by Farmers Home Administration (FmHA), but now through the Farm Service Agency. Major loan programs include farm ownership, farm operating, and emergency disaster loans.

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 funds are available to manage the uses.

Wilderness Act (1964), as amended*:* Directed the Secretary of Interior, within 10 years, to review every roadless area of 5,000 or more acres and every roadless island (regardless of size) within National Wildlife Refuge and National Park systems and to recommend to the President the suitability of each such area or island for inclusion in the National Wilderness Preservation System, with final decisions made by Congress. The Secretary of Agriculture was directed to study and recommend suitable areas in the National Forest System.

Land and Water Conservation Fund Act (1965): Uses the receipts from the sale of surplus federal land, outer continental shelf oil and gas sales, and other sources for land acquisition under several authorities.

National Wildlife Refuge System Administration Act (1966), as amended by the National Wildlife Refuge System Improvement Act (1997) 16 U.S.C. 668dd668ee. (Refuge Administration Act): Defines the National Wildlife Refuge System and authorizes the Secretary to permit any use of a refuge provided such use is compatible with the major purposes for which the refuge was established. The Refuge System Improvement Act clearly 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, and environmental education and interpretation); establishes a formal process for determining compatibility; established the responsibilities of the Secretary of the Interior for managing and protecting the Refuge System; and requires a comprehensive conservation plan for each refuge by the year 2012. The 1997 Act amended portions of the Refuge Recreation Act and National Wildlife Refuge System Administration Act of 1966.

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.

Architectural Barriers Act (1968): Requires federally owned, leased, or funded buildings and facilities to be accessible to persons with disabilities.

National Trails System Act (1968), as amended: Mandates the Secretary of the Interior and thus the Service to protect the historic and recreational values of congressionally designated national historic trail sites.

National Environmental Policy Act (1969): Requires the disclosure of the environmental impacts of any major federal action significantly affecting the quality of the human environment.

Uniform Relocation and Assistance and Real Property Acquisition Policies Act (1970), as amended: Provides for uniform and equitable treatment of persons who sell their homes, businesses, or farms to the Service. The Act requires that any purchase offer be no less than the fair market value of the property.

Endangered Species Act (1973): Requires all federal agencies to carry out programs for the conservation of threatened and endangered species.

Rehabilitation Act (1973): Requires programmatic accessibility in addition to physical accessibility for all facilities and programs funded by the federal government to ensure that anybody can participate in any program.

Archaeological and Historic Preservation Act (1974): Directs the preservation of historic and archaeological data in federal construction projects.

Clean Water Act (1977): Requires consultation with the Corps of Engineers (404 permits) for major wetland modifications.

Surface Mining Control and Reclamation Act (1977) as amended (Public Law 95-87) (SMCRA): Regulates surface mining activities and reclamation of coal-mined lands. Further regulates the coal industry by designating certain areas as unsuitable for coal mining operations.

Executive Order 11988 (1977): Each federal agency shall provide leadership and take action to reduce the risk of flood loss and minimize the impact of floods on human safety, and preserve the natural and beneficial values served by the floodplains.

Executive Order 11990 (1977)*:* Executive Order 11990 directs federal agencies to (1) minimize destruction, loss, or degradation of wetlands and (2) preserve and enhance the natural and beneficial values of wetlands when a practical alternative exists.

Executive Order 12372 (Intergovernmental Review of Federal Programs): Directs the Service to send copies of environmental assessments to state planning agencies for review.

American Indian Religious Freedom Act (1978): Directs agencies to consult with native traditional religious leaders to determine appropriate policy changes necessary to protect and preserve Native American religious cultural rights and practices.

Fish and Wildlife Improvement Act (1978): Improves the administration of fish and wildlife programs and amends several earlier laws including the Refuge Recreation Act, the National Wildlife Refuge System Administration Act, and the Fish and Wildlife Act of 1956. It authorizes the Secretary of the Interior to accept gifts and bequests of real and personal property on behalf of the United States. It also authorizes the use of volunteers on Service projects and appropriations to carry out a volunteer program.

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.

Federal Farmland Protection Policy Act (1981), as amended*:* Minimizes the extent to which federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses.

Emergency Wetlands Resources Act (1986): Promotes the conservation of migratory waterfowl and offsets or prevents the serious loss of wetlands by the acquisition of wetlands and other essential habitats.

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.

Native American Graves Protection and Repatriation Act (1990): Requires federal agencies and museums to inventory, determine ownership of, and repatriate cultural items under their control or possession.

Americans with Disabilities Act (1992): Prohibits discrimination in public accommodations and services.

Executive Order 12898 (1994): Establishes environmental justice as a federal government priority and directs all federal agencies to make environmental justice part of their mission. Environmental justice calls for fair distribution of environmental hazards.

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 use of Indian sacred sites by Indian religious practitioners, avoid adversely affecting the physical integrity of such sacred sites, and where appropriate, maintain the confidentiality of sacred sites.

National Wildlife Refuge System Improvement Act (1997): Considered the "Organic Act of the National Wildlife Refuge System." Defines the mission of the Refuge System, designates priority wildlife-dependent public uses, and calls for comprehensive refuge planning.

National Wildlife Refuge System Volunteer and Community Partnership Enhancement Act (1998): Amends the Fish and Wildlife Act of 1956 to promote volunteer programs and community partnerships for the benefit of national wildlife refuges, and for other purposes.

Appendix IV. Public Involvement

PUBLIC INVOLVEMENT PROCESS

Public involvement in the development of the Draft Comprehensive Conservation Plan and Environmental Assessment for Mississippi Sandhill Crane National Wildlife Refuge was sought throughout the planning process. A planning team composed of a contractor and representatives from various Service divisions (see Appendix IX, List of Preparers) was formed to prepare the draft comprehensive conservation plan and environmental assessment. Intially, the team focused on identifying the issues and concerns pertinent to refuge management. The team met on several occasions from November 2004 to June 2005.

The first step in developing the plan was a biological review, which was conducted on February 23–27, 2004. The biological review team included 17 Service biologists, managers and foresters, and non-Service managers and biologists. The review involved onsite evaluations to assist the refuge in meeting its purpose and determining the role(s) the refuge could play regarding its wildlife needs and objectives at various geographical scales (i.e., local, ecosystem, regional, and national). The team's approach was to take a holistic look at achieving refuge and landscape-level conservation needs, while still giving priority to accomplishing the original purpose of refuge establishment. The Biological Review Report, completed in May 2005, includes background information on the refuge that was evaluated by reviewers, as well as the recommendations developed by the biological review team. In keeping with the expected outcomes of the planning process, these recommendations took the form of goals, objectives, and strategies for the management of the refuge's biological resources. These preliminary goals, objectives, and strategies were studied by the planning team and modified and adapted for this comprehensive conservation plan.

A visitor services review was also conducted in 2004 in preparation for the comprehensive conservation plan. The four-member visitor services review team consisted of Service personnel from the Visitor Services and Outreach Division, the Southeast Regional Office, and Tensas National Wildlife Refuge; and a representative of the Grand Bay National Estuary Reserve, which is managed by the Mississippi Department of Marine Resources. The review team met with refuge staff to discuss the visitor services program. The staff explained what the visitor services program is currently doing to provide recreational, educational, and interpretive opportunities on the refuge. The refuge manager and wildlife biologist then took the review team to all the different public use areas on the refuge. Following the tour and discussions with some members of the staff, the review team met to discuss the current status of the programs and to make recommendations. On the final day of the review, the team presented its recommendations to the staff and held an open discussion of the pros and cons of the various recommendations. Later the team prepared a report with a number of recommendations for improving and expanding upon the refuge's visitor services facilities and operations.

Scoping continued with an open house and public meeting that was held on January 12, 2005. Because the refuge does not have meeting or conference facilities, the public scoping meeting was held at the Gautier Convention Center in Gautier, Mississippi, about five miles south of the refuge. The meeting was coordinated with officials of other government agencies, various organizations, and the surrounding communities. The meeting was publicized in advance in several ways. A letter and flyer were sent to those on the mailing list, which included refuge users, government and civil leaders, congressional staff, private organizations, and other interested parties. Information announcing the public scoping meeting was also sent to the local newspaper, and a public service announcement was sent to the local radio station.

Fifteen citizens attended the open house and scoping meeting. During the open house, the attendees were able to meet and talk with the refuge staff and look at exhibits and maps on hand. Refuge Manager Alan Schriver began the meeting with a brief slide show and overview of the refuge, followed by a slide presentation on the planning process by natural resource planner Mike Dawson. Leon Kolankiewicz, a consultant with the Mangi Environmental Group, facilitated an open-floor question and comment period. During this period, the attendees were given the opportunity to express their concerns about the refuge and their ideas and suggestions for its management. In addition, a comment form was distributed for the attendees and other interested parties to submit written comments. Written comments could be either submitted at the meeting, mailed subsequently, or sent via e-mail.

The issues generated from this public scoping meeting, coupled with the input of the planning team, were incorporated in the preparation of the draft comprehensive conservation plan. The issues are summarized in Chapter III, Plan Development.

The Service completed the Draft Comprehensive Conservation Plan and Environmental Assessment for Mississippi Sandhill Crane National Wildlife Refuge and made 100 copies available for public review and comment from November 22, 2006 to December 22, 2006. The same methods that were used to publicize the public scoping meeting were also used to announce the availabilty of the draft plan for public review. In addition, a notice was published in the *Federal Register* on November 22, 2006, to inform the public of the availability of the document for review and comment. Individuals reviewing this document represented landowners, conservation organizations, and state and local government agencies. No comments were received on the Draft Comprehensive Conservation Plan and Environmental Assessment.

Appendix V. Compatibility Determinations

Introduction

The Fish and Wildlife Service reviewed several uses for compatibility during the comprehensive conservation planning process for Mississippi Sandhill Crane National Wildlife Refuge. The descriptions and anticipated impacts of each of these uses are addressed in this appendix.

Uses: Several uses were evaluated to determine their compatibility with the Refuge System and the mission and purposes of the refuge: (1) beekeeping; (2) timber harvest/fuel reduction/habitat improvement; (3) Mississippi Gulf Coast Regional Wastewater Memorandum of Understanding; (4) farming food plots for crane use; (5) scientific research, studies, and surveys; and (6) invasive species control.

Refuge Name: Mississippi Sandhill Crane National Wildlife Refuge

Location: Jackson County, Mississippi

Establishing and Acquisition Authorities:

Endangered Species Act, Fish and Wildlife Act 1956, Refuge Administration Act

Refuge Purpose(s):

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. § 1534 (Endangered Species Act of 1973)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f(a)(4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)

"... conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans..." 16 U.S.C. § 668dd(a)(2) (National Wildlife Refuge System Administration Act)

National Wildlife Refuge System Mission:

The mission of the 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.

Description of Use: *Beekeeping*

Beekeeping has been practiced on the refuge since prior to its establishment in 1975. It is now a refuge management ecomonic activity. Private operators have maintained 200–400 colonies (hives) scattered over 20,000 acres. Refuge special use permits direct where in the areas operators may place bee yards, which normally contain up to 50 colonies. Special use permits may also provide detail such as (1) refuge access points and internal roads to be used; (2) operators/helpers allowed refuge access; (3) refuge restrictions, such as no dogs or guns permitted; (4) relocation of bee yards require approval of refuge manager; and (5) cancellation and modification or non-renewal of the permit is the option of the refuge manager. Operators pay an annual fee of $0.25 per colony. Special use permit operators are professional, full- or part-time, beekeepers and are permitted by the State of Mississippi, Department of Agriculture, as registered/licensed beekeepers. Their beekeeping operations are well within the state required limits with respect to disease control, colony care, and state and federal apiary laws and regulations.

Activities (i.e., bee yards) may be maintained at several locations within the 20,000-acre refuge. The acreage involved in each bee yard is minimal, less than 1/2 acre, and utilization of clear areas easily accessible by vehicles are preferred. Most beekeepers are interested in placing their hives in proximity to gallberry concentrations. These activities will be permitted year-round.

Access by the operators will be by assigned gates and internal roads. Impact to roads will be insignificant as compared with routine refuge operational road access/travel. Bee yards will require some minimal level of refuge operational planning and work (i.e., protection of yards during prescribed burning). These costs are negligible and not considered costs associated with this activity. Road work is necessary for refuge operations. Wet line/black line protection during prescribed and/or wildfire is also negligible, since crews will already be in the area performing similar activities for other structures.

This activity existed in the area before the refuge acquired the lands. The activity is permitted at the request of the permittees. The refuge has some of the last remaining wild areas in Jackson County. With increased development of the surrounding area, limited opportunity exists off refuge.

Availability of Resources:

Resources involved in the administration and management of the use: Minimal protection of bee yards will be necessary prior to prescribed burning activities. Crews will already be in the area providing the same protective treatments to observation blinds, telephone boxes, power poles, etc. The administrative costs of administering these special use permits are negligible, requiring only a few minutes each year.

Special equipment, facilities, or improvements necessary to support the use: All equipment needed for this activity will be provided by the beekeeper (e.g., hives and fencing). No special support is required as a direct result of this activity.

Maintenance costs: There will be a minimal cost to black line and/or wet line around yards prior to burning. This will be a small addition to similar activities in these areas, as protection around similar sturctures, such as observation blinds, utility sturctures, would already be occurring. Road improvement/maintenance is an ongoing activity in support of all refuge operations.

Monitoring costs: None

Offsetting revenues: A special use permit fee of $0.25 per hive is charged. These funds are forwarded to the Fish and Wildlife Service's finance center.

Anticipated Impacts of the Use:

Short-term impacts: With the general decline in wild bee populations, the Service views the presence of these bees as a potential benefit to the refuge. Although plants, such as gallberry, are the prefered target from the beekeeper's point of view, any incidental pollination of the great variety of native plants in the refuge habitats will benefit the habitat goals of the refuge.

Long-term impacts: With the general decline in wild bee populations, the Service views the presence of these bees as a potential benefit to the refuge. Although plants, such as gallberry, are the prefered target from the beekeeper's point of view, any incidental pollination of the great variety of native plants in the refuge habitats will benefit the habitat goals of the refuge.

Cumulative impacts: No direct and/or indirect cummulative impacts are expected.

Public Review and Comment: This compatibility determination was provided for public review and comment during the comment period for the Draft Comprehensive Conservation Plan and Environmental Assessment, which began on October 31, 2006 and ended on November 30, 2006.

Determination:

Beekeeping	Use is compatible with the following stipulations.

Stipulations Necessary to Ensure Compatibility:

IAW special use permit special requirements.

Justification:

Anticipated benefit to plants and habitats.

If the proposed use is an economic use of refuge natural resources, how would it contribute to the purposes of the refuge or the mission of the National Wildlife Refuge System?

Refuge habitats will benefit from increased pollination opportunities from bees in the area. Some bees will potentially be consumed by the carnivorous plants in the area.

NEPA Compliance for Refuge Use Decision: *Place an X in appropriate space.*

_____ Categorical Exclusion without Environmental Action Statement
_____ Categorical Exclusion and Environmental Action Statement
__X__ Environmental Assessment and Finding of No Significant Impact
_____ Environmental Impact Statement and Record of Decision

Mandatory 10- or 15-Year Re-Evaluation Date: ____06/07/17____

Description of Use: *Timber Harvest/Fuel Reduction/Habitat Improvement*

Removal of undesirable woody vegetation, predominately slash pine (*Pinus elliottii*). Removal will be by mechanical means through:

1. Commercial timber harvest

2. Noncommercial felling (cut and leave)
    - Chainsaw cutting
    - Whole tree mowing (Gyrotrac)

Refuge goals and objectives include improving nesting and foraging habitat for the endangered Mississippi sandhill crane and restoring degraded wet pine savanna habitats. Heavily thinning or clean felling of all slash pine trees growing on savannas will contribute to those objectives. An additional benefit of these treatments is a reduction of hazardous forest fuels.

This will occur in areas where tree numbers and density are in excess of desired quantities, and where species composition is not consistent with either desired crane habitat and/or pine savanna. It will also occur in areas of the refuge that are overstocked with slash pine from either past plantings by former landowners or over-abundant survival of natural seeding due to an irregular fire frequency. These areas are classified as either shrubland or woodland in the 2004 refuge vegetation classification map.

This will potentially occur year-round. All activities will also be weather-dependent. The timing of these activities will be coordinated with the refuge biologist to ensure that no disturbance of crane nesting and or rearing of chicks will occur. The mechanical activities will occur during the driest time of the year, which is usually in the fall (mid-September to mid-November). Chainsaw felling of trees will normally be conducted in the fall to winter months, within one year following a prescribed burn.

Standard silviculture methods and materials will be used. Commercial timber sales will be contracted to the high bidder (i.e., an individual or organization) for the right to remove and resale refuge trees.

Noncommercial cutting of trees will be contracted to the low bidder (i.e., an individual or organization) for the right to sever trees at the base and leave them lying on site. This includes chainsaw felling of trees on wet or fragile soils and mechanical mowing (e.g., gyrotrac) on drier sites. The trees in these activities have no commercial value or will cost more in habitat loss through soil degradation than could be gained by monetary return if the trees were sold.

This use is proposed by the refuge to more efficiently manage habitat. The refuge has limited resources to conduct habitat management and fuel reduction operations. Utilizing commercial harvests will provide an additional method to accomplish refuge goals.

Both the commercial and noncommercial activities are high risk from a personal safety standpoint and a low output from a productivity standpoint. By using contractors to perform these activities, refuge employees are removed from a high-risk work environment and are able to concentrate on more specialized areas of crane and habitat management.

Availability of Resources:

Resources involved in the administration and management of the use: Please refer to the following:

Forest Management Plan for Mississippi Sandhill Crane National Wildlife Refuge 1989.
Forest Management Plan 1995, Environmental Assessment, Amendment I, Mississippi Sandhill Crane National Wildlife Refuge.
Fire Management Plan for Mississippi Sandhill Crane National Wildlife Refuge 1992.

Special equipment, facilities, or improvements necessary to support the use: None

Maintenance costs: Road use by contractors will most likely require maintenance in order to complete these activities. This cost will be the responsibility of the contractor.

Monitoring costs: Some staff time in administrating this contract will be required.

Offsetting revenues: None

Anticipated Impacts of the Use:

Short-term impacts: Please refer to the following:
Forest Management Plan 1995, Environment Assessment, Amendment I, Mississippi Sandhill Crane National Wildlife Refuge.

Long-term impacts: Indirect impacts will be disturbance at operational site and removal of vegetation. Long-term impacts will include creation of more suitable crane and pine savanna habitats.

Cumulative impacts: Post-harvest fire treatments will create better habitats.

Public Review and Comment: This compatibility determination was provided for public review and comment during the comment period for the Draft Comprehensive Conservation Plan and Environmental Assessment, which began on October 31, 2006 and ended on November 30, 2006.

Determination:

Tree harvest (other)	Use is compatible with the following stipulations.

Stipulations Necessary to Ensure Compatibility:

See contract specifications.

Justification:

Activity supports refuge management goals and objectives.
Activity benefits endangered Mississippi sandhill cranes.
Activity increases biological integrity of the pine savanna habitat.
Activity does not impact wildlife-dependent public uses.

If the proposed use is an economic use of refuge natural resources, how would it contribute to the purposes of the refuge or the mission of the National Wildlife Refuge System?

Commercial harvest is one method of removing unwanted vegetation.

NEPA Compliance for Refuge Use Decision: *Place an X in appropriate space.*

_____ Categorical Exclusion without Environmental Action Statement
_____ Categorical Exclusion and Environmental Action Statement
__X__ Environmental Assessment and Finding of No Significant Impact
_____ Environmental Impact Statement and Record of Decision

Mandatory 10- or 15-Year Re-Evaluation Date: ____06/07/17____

Description of Use: *Mississippi Gulf Coast Regional Wastewater Memorandum of Understanding*

Please refer to the following:
Memorandum of Understanding between the U.S. Department of the Interior, Fish and Wildlife Service, and the Mississippi Gulf Coast Regional Wastewater Authority, dated 12 October, 1983.
Amendment #1, dated 12 December 1986.
Amendment #2, dated 30 August 1995.
Amendment #3, dated 17 September 2003.
Section 7 Consultation, dated 18 August 1983.
Environmental Assessment, dated 27 September 1983.
FONSI, dated 27 September 1983.

The memorandum of understanding covers Wastewater Authority lands north of Seaman Road and refuge lands south of Seaman Road. Approximately 250 acres of refuge lands and approximately 700 acres of Wastewater Authority lands will be involved in this project.

Availability of Resources:

Resources involved in the administration and management of the use: Please refer to the above references.

Special equipment, facilities, or improvements necessary to support the use: None

Maintenance costs: None

Monitoring costs: None

Offsetting revenues: None

Anticipated Impacts of the Use:

Short-term impacts: See references.

Long-term impacts: See references.

Cumulative impacts: See references.

Public Review and Comment: This compatibility determination was provided for public review and comment during the comment period for the Draft Comprehensive Conservation Plan and Environmental Assessment, which began on October 31, 2006 and ended on November 30, 2006.

Determination:

Sewage discharge	Use is compatible with the following stipulations.

Stipulations Necessary to Ensure Compatibility:

See memorandum of understanding, amendments, and references.

Justification:

See references.

If the proposed use is an economic use of refuge natural resources, how would it contribute to the purposes of the refuge or the mission of the National Wildlife Refuge System?

See references.

NEPA Compliance for Refuge Use Decision: *Place an X in appropriate space.*

_____ Categorical Exclusion without Environmental Action Statement
_____ Categorical Exclusion and Environmental Action Statement
__X__ Environmental Assessment and Finding of No Significant Impact
_____ Environmental Impact Statement and Record of Decision

Mandatory 10- or 15-Year Re-Evaluation Date: ____06/07/17____

Description of Use: *Farming food plots for crane use*

The use of private farmers to prepare land and plant food crops to provide supplemental food for Mississippi sandhill cranes in refuge field/food plot areas. Using private farmers to prepare land and plant food crops will enable these areas to be planted when refuge staffing is insufficient to accomplish these and other time-conflicting tasks. No crop will be harvested or removed from the refuge by the farmers.

Field preparation could occur year-round depending upon the task. This could include mowing, disking, application of soil amendments and pesticides, planting, cultivating, and other normal agricultural practices.

Availability of Resources:

Resources involved in the administration and management of the use: Equipment could be refuge equipment and/or equipment supplied by farmers. Seed and soil amendments will be provided by the refuge unless including this in the cost paid to the farmer will be in the best interest of the government. This activity was originally funded in Fiscal Year 2003, through a refuge RONS project. Completion of this activity could be dependent upon subsequent followup RONS funding.

Special equipment, facilities, or improvements necessary to support the use: All equipment necessary to support this activity is presently available at the refuge.

Maintenance costs: Normal routine maintenance of any refuge equipment used.

Monitoring costs: None

Offsetting revenues: None

Anticipated Impacts of the Use:

Short-term impacts: Provide crane feeding areas.

Long-term impacts: Less crane utilization of off-refuge sites. May have a positive impact to increased production and/or chick survival.

Cumulative impacts: Less crane utilization of off-refuge sites. May have a positive impact to increased production and/or chick survival.

Public Review and Comment: This compatibility determination was provided for public review and comment during the comment period for the Draft Comprehensive Conservation Plan and Environmental Assessment, which began on October 31, 2006 and ended on November 30, 2006.

Determination:

Farming	Use is compatible with the following stipulations.

Stipulations Necessary to Ensure Compatibility:

IAW cooperative farming agreement and/or special use permit.

Justification:

Supports refuge goals and objectives and crane recovery.

NEPA Compliance for Refuge Use Decision: *Place an X in appropriate space.*

_____ Categorical Exclusion without Environmental Action Statement
_____ Categorical Exclusion and Environmental Action Statement
__X__ Environmental Assessment and Finding of No Significant Impact
_____ Environmental Impact Statement and Record of Decision

Mandatory 10- or 15-Year Re-Evaluation Date: ____06/07/17____

Description of Use: *Scientific research, studies, and surveys*

Permitting qualified groups and individuals to conduct scientific research, studies, and surveys on the refuge that will increase the knowledge base of species, systems, and processes on, around, and affecting the refuge and its animals, habitats, and activities that would benefit the refuge. Field activities could be conducted year-round, with normal scientific methods and materials and within refuge rules and regulations.

This activity will free refuge staff to accomplish other duties and activities. These activities will augment the refuge knowledge base. Lack of refuge staffing may not permit conducting all the surveys, studies, and research that will be desirable. Permitting qualified groups and individuals to conduct scientific research, studies, and surveys on the refuge that will increase the knowledge base of species, systems, and processes on, around, and affecting the refuge and its animals, habitats and activities will benefit the refuge.

Availability of Resources:

Resources involved in the administration and management of the use: Routine administrative activities to implement, document, and monitor and permit these various activities.

Special equipment, facilities, or improvements necessary to support the use: None

Maintenance costs: Normal routine maintenance of any refuge facilities and equipment used.

Monitoring costs: Routine administrative activities associated with refuge permitted activities and the permitting processes.

Offsetting revenues: None

Anticipated Impacts of the Use:

Short-term impacts: Lack of refuge staffing may not permit conducting all the surveys, studies, and research that will be desirable. Permitting qualified groups and individuals to conduct scientific research, studies, and surveys on the refuge that will increase the knowledge base of species, systems, and processes on, around, and affecting the refuge and its animals, habitats, and activities will benefit the refuge.

Long-term impacts: Lack of refuge staffing may not permit conducting all the surveys, studies, and research that will be desirable. Permitting qualified groups and individuals to conduct scientific

research, studies, and surveys on the refuge that will increase the knowledge base of species, systems, and processes on, around, and affecting the refuge and its animals, habitats, and activities will benefit the refuge.

Cumulative impacts: Lack of refuge staffing may not permit conducting all the surveys, studies, and research that will be desirable. Permitting qualified groups and individuals to conduct scientific research, studies, and surveys on the refuge that will increase the knowledge base of species, systems, and processes on, around, and affecting the refuge and its animals, habitats, and activities will benefit the refuge.

Public Review and Comment: This compatibility determination was provided for public review and comment during the comment period for the Draft Comprehensive Conservation Plan and Environmental Assessment, which began on October 31, 2006 and ended on November 30, 2006.

Determination:

Surveys	Use is compatible with the following stipulations.

Stipulations Necessary to Ensure Compatibility:

IAW cooperative agreement and/or special use permit.

Justification:

Supports refuge goals and objectives and crane recovery.

If the proposed use is an economic use of refuge natural resources, how would it contribute to the purposes of the refuge or the mission of the National Wildlife Refuge System?

Less crane utilization of off-refuge sites. May have a positive impact on increased production and/or chick survival. Supports refuge goals and objectives and crane recovery plan.

NEPA Compliance for Refuge Use Decision: *Place an X in appropriate space.*

_____ Categorical Exclusion without Environmental Action Statement
_____ Categorical Exclusion and Environmental Action Statement
__X__ Environmental Assessment and Finding of No Significant Impact
_____ Environmental Impact Statement and Record of Decision

Mandatory 10- or 15-Year Re-Evaluation Date: ____06/07/17____

Description of Use: *Invasive species control*

Control of invasive species such as cogon grass, tallow tree, etc., by application of chemical pesticides. All chemicals used will be approved through normal Fish and Wildlife Service procedures. Control will occur throughout the refuge as needed and throughout the year, or as indicated on label information. To augment force account application, contract applicators will be hired to apply pesticides according to chemical label instructions.

Availability of Resources:

Resources involved in the administration and management of the use: Preparation of pesticide use proposal documentation is required by the Fish and Wildlife Service. Contract documentation as needed. Chemicals and equipment will be refuge owned for force account work and contractor supplied unless stipulated otherwise in contract agreement.

Special equipment, facilities, or improvements necessary to support the use: Refuge has necessary equipment. Chemicals are purchased as needed.

Maintenance costs: Normal maintenence on equipment.

Monitoring costs: Monitoring effects will be incidental to other field tasks.

Offsetting revenues: None

Anticipated Impacts of the Use:

Short-term impacts: Refuge Pesticide Use Proposals for current fiscal year will describe use and impacts.

Long-term impacts: Control invasive species to protect native habitats.

Cumulative impacts: Control invasive species to protect native habitats.

Public Review and Comment: This compatibility determination was provided for public review and comment during the comment period for the Draft Comprehensive Conservation Plan and Environmental Assessment, which began on October 31, 2006 and ended on November 30, 2006.

Determination:

Plant control (other)	Use is compatible with the following stipulations.

Stipulations Necessary to Ensure Compatibility:

All pesticide use IAW service regulations.

Justification:

Supports goals and objectives.

NEPA Compliance for Refuge Use Decision: *Place an X in appropriate space.*

_____ Categorical Exclusion without Environmental Action Statement
_____ Categorical Exclusion and Environmental Action Statement
__X__ Environmental Assessment and Finding of No Significant Impact
_____ Environmental Impact Statement and Record of Decision

Mandatory 10- or 15-Year Re-Evaluation Date: ____06/07/17____

Approval of Compatibility Determinations:

The signature of approval is for all compatibility determinations considered within the comprehensive conservation plan for Mississippi Sandhill Crane National Wildlife Refuge. If one of the descriptive uses is considered for compatibility outside of the plan, the approval signature becomes part of that determination.

Approval of Compatibility Determination

The signature of approval is for all compatibility determinations considered within the comprehensive conservation plan. If one of the descriptive uses is considered for compatibility outside of the plan, the approval signature becomes part of that determination.

Refuge Manager: /S/ 4-10-07
Mississippi Sandhill Crane NWR (Signature/Date)

Refuge Manager: /S/ 4/10/07
Gulf Coast NWR Complex (Signature/Date)

Regional Compatibility Coordinator: /S/ 8/21/07
(Signature/Date)

Refuge Supervisor: /S/ 8/30/07
(Signature/Date)

Regional Chief, National Wildlife Refuge System, Southeast Region: /S/ 8-31-07
(Signature/Date)

Appendix VI. Refuge Biota

Lists have been prepared for birds, amphibians, and reptiles at Mississippi Sandhill Crane National Wildlife Refuge. The list for birds includes species whose presence is documented, while the list for amphibians (Section A, Chapter II) and below includes both documented and expected occurrences. To date, no mammal or fish lists have been prepared.

BIRDS

Seasonal Appearance

W – Winter: Dec. - Feb.
s – Spring: March - May
S – Summer: June - August
F – Fall: Sept. - Nov.

Seasonal Abundance

a - abundant -- a common species which is very abundant
c - common -- certain to be seen or heard in suitable habitat
u - uncommon -- present, but not certain to be seen
o - occasional -- seen only a few times during a season
r - rare -- seen at intervals of 2-5 years
x - accidental -- has been seen once or twice
* - Nests on refuge

This checklist includes species of birds and is based on observations by refuge personnel, ornithologists, and members of the Mississippi Coast Audubon Society. Observations of birds at the West Jackson County Land Treatment Facility, which includes some refuge property, are not included on this checklist.

[Revised August 2000]

BIRDS

GREBES	W	s	S	F
Pied-billed Grebe	o	-	-	o
PELICANS	**W**	**s**	**S**	**F**
American White Pelican	-	o	-	o
Brown Pelican	r	-	-	-
CORMORANTS	**W**	**s**	**S**	**F**
D.C. Cormorant	o	o	-	-
FRIGATEBIRDS	**W**	**s**	**S**	**F**
Magnificent Frigatebird	-	-	-	r
BITTERNS & HERONS	**W**	**s**	**S**	**F**
American Bittern	-	o	-	o
Least Bittern	-	u	-	u
Great Blue Heron*	c	u	u	u
Great Egret	c	u	u	u
Snowy Egret	-	u	u	-
Little Blue Heron	u	u	u	u
Tricolored Heron	u	o	o	o
Cattle Egret	o	u	c	u
Green Heron*	u	u	u	u
B.C. Night-Heron	c	-	-	-
Y.C. Night-Heron	-	o	o	-
IBISES	**W**	**s**	**S**	**F**
White Ibis	-	o	-	o
AMERICAN VULTURES	**W**	**s**	**S**	**F**
Black Vulture	a	a	a	a
Turkey Vulture	c	c	c	c
WATERFOWL	**W**	**s**	**S**	**F**
Snow Goose	r	-	-	-
Canada Goose*	c	u	u	u
Wood Duck*	u	c	c	u
Gadwall	u	-	-	-
Mallard	r	-	-	r
Mottled Duck*	u	u	u	u
Blue-winged Teal	u	o	-	o
Northern Shoveler	u	-	-	-

WATERFOWL (Cont'd)	W	s	S	F
Redhead	o	-	-	-
Green-winged Teal	u	-	-	-
Hooded Merganser	u	-	-	u
KITES, HAWKS & EAGLES	**W**	**s**	**S**	**F**
Osprey*	o	c	c	o
Swallow-tailed Kite	-	o	-	o
Mississippi Kite	-	o	o	-
Bald Eagle	o	-	-	o
Northern Harrier	c	u	-	u
Sharp-shinned Hawk	u	u	-	u
Cooper's Hawk	u	u	o	u
Red-shouldered Hawk*	c	c	c	c
Broad-winged Hawk	-	u	u	-
Red-tailed Hawk*	c	c	c	c
Golden Eagle	r	-	-	-
FALCONS	**W**	**s**	**S**	**F**
American Kestrel	a	c	u	c
Merlin	o	-	-	-
Peregrine Falcon	o	-	-	-
PTARMIGANS	**W**	**s**	**S**	**F**
Wild Turkey*	u	u	u	u
Northern Bobwhite*	c	c	c	c
RAILS, GALLINULES, & COOTS	**W**	**s**	**S**	**F**
Yellow Rail	r	r	-	r
Clapper Rail	c	c	c	c
King Rail	u	u	u	u
Virginia Rail	o	o	-	o
Sora	-	u	-	u
Purple Gallinule	-	o	o	-
Common Moorhen	u	u	u	u
American Coot	c	c	o	c
CRANES	**W**	**s**	**S**	**F**
Sandhill Crane*	u	u	u	u
PLOVERS	**W**	**s**	**S**	**F**
Black-bellied Plover	u	o	-	o
Semipalmated Plover	u	-	-	o
Killdeer*	a	c	u	u

SANDPIPERS & PHALAROPES	W	s	S	F
Greater Yellowlegs	u	u	-	u
Lesser Yellowlegs	u	u	-	u
Solitary Sandpiper	-	u	-	-
Spotted Sandpiper	u	-	-	u
Semipalmated Sandpiper	u	u	-	u
Western Sandpiper	u	u	-	u
Least Sandpiper	u	u	-	u
Pectoral Sandpiper	u	u	-	u
Long-billed Dowitcher	-	o	o	o
Common Snipe	u	u	u	u
American Woodcock	u	u	-	u

GULLS & TERNS	W	s	S	F
Laughing Gull	o	o	o	o
Least Tern	-	-	u	-

DOVES	W	s	S	F
Rock Dove	o	o	o	o
Eurasian Collared-Dove	-	-	r	-
Mourning Dove*	a	a	a	a
Common Ground Dove	u	u	u	u

CUCKOOS	W	s	S	F
Black-billed Cuckoo	-	o	o	u
Yellow-billed Cuckoo	-	u	o	u

BARN OWLS	W	s	S	F
Barn Owl	o	o	o	o

OWLS	W	s	S	F
Eastern Screech Owl*	u	u	u	u
Great Horned Owl*	c	c	c	c
Barred Owl	u	u	u	u

NIGHTJARS	W	s	S	F
Common Nighthawk*	u	c	c	c
Chuck-will's widow*	u	c	c	c
Whip-poor-will	r	r	-	r

SWIFTS	W	s	S	F
Chimney Swift	-	c	c	c

HUMMINGBIRDS	W	s	S	F
Ruby-throated Hummingbird	-	c	u	u
KINGFISHERS	**W**	**s**	**S**	**F**
Belted Kingfisher*	a	a	u	a
WOODPECKERS	**W**	**s**	**S**	**F**
Red-headed Woodpecker*	c	c	c	c
Red-bellied Woodpecker*	c	c	c	c
Yellow-bellied Sapsucker	u	u	-	u
Downy Woodpecker*	c	c	c	c
Hairy Woodpecker	o	o	o	o
Northern Flicker*	c	c	c	c
Pileated Woodpecker*	c	c	c	c
TYRANT FLYCATCHERS	**W**	**s**	**S**	**F**
Eastern Wood-Pewee	-	c	u	c
Least Flycatcher	-	o	-	o
Eastern Phoebe	u	u	-	u
Great Crested Flycatcher	c	c	u	-
Eastern Kingbird*	-	c	c	c
SHRIKES	**W**	**s**	**S**	**F**
Loggerhead Shrike*	c	c	c	c
VIREOS	**W**	**s**	**S**	**F**
White-eyed Vireo*	c	c	c	c
Blue-headed Vireo	u	-	u	-
Yellow-throated Vireo	-	u	u	-
Red-eyed Vireo	-	u	u	-
JAYS & CROWS	**W**	**s**	**S**	**F**
Blue Jay*	c	c	c	c
American Crow*	a	a	a	a
Fish Crow	c	c	c	c
SWALLOWS	**W**	**s**	**S**	**F**
Purple Martin*	o	u	u	u
Tree Swallow*	-	u	u	u
N. Rough-winged Swallow	-	u	u	u
Bank Swallow	-	u	u	u
Cliff Swallow	-	u	u	u

SWALLOWS (Cont'd)	W	s	S	F
Barn Swallow	-	u	u	u
CHICKADEES & TITMICE	**W**	**s**	**S**	**F**
Carolina Chickadee*	c	c	c	c
Tufted Titmouse*	u	u	u	u
NUTHATCHES	**W**	**s**	**S**	**F**
Red-breasted Nuthatch	r	r	-	-
Brown-headed Nuthatch*	c	c	c	c
WRENS	**W**	**s**	**S**	**F**
Carolina Wren*	u	u	u	u
House Wren*	c	u	-	u
Winter Wren	u	u	-	u
Sedge Wren	c	c	-	c
Marsh Wren	u	u	-	u
THRUSHES	**W**	**s**	**S**	**F**
Golden-crowned Kinglet	u	u	-	u
Ruby-crowned Kinglet	c	u	-	u
Blue-gray Gnatcatcher	c	c	o	u
Eastern Bluebird*	a	c	c	c
Veery	u	-	-	u
Gray-cheeked Thrush	u	-	-	u
Swainson's Thrush	u	-	-	u
Hermit Thrush	c	u	-	u
Wood Thrush	-	u	u	-
American Robin*	a	c	u	c
MIMIC THRUSHES	**W**	**s**	**S**	**F**
Gray Catbird*	u	u	u	u
Northern Mockingbird*	c	c	c	c
Brown Thrasher*	a	a	a	a
STARLINGS	**W**	**s**	**S**	**F**
European Starling*	u	u	u	u
PIPITS	**W**	**s**	**S**	**F**
American Pipit	u	u	-	u

WAXWINGS	W	s	S	F
Cedar Waxwing	a	c	o	c

WARBLERS	W	s	S	F
Tennessee Warbler	-	u	-	u
Orange-crowned Warbler	u	-	u	-
Northern Parula*	-	u	u	-
Yellow Warbler	-	u	-	u
Magnolia Warbler	-	-	-	o
Yellow-rumped Warbler	a	c	u	c
Black-throated Green Warbler	-	-	-	o
Yellow-throated Warbler	o	-	-	-
Pine Warbler*	c	c	a	c
Prairie Warbler*	-	c	c	u
Palm Warbler	u	o	-	o
Black-and-white Warbler	-	u	-	u
American Redstart	-	u	-	u
Prothonotary Warbler*	-	o	u	o
Worm-eating Warbler	-	u	u	-
Ovenbird	o	o	-	-
Northern Waterthrush	o	o	-	-
Kentucky Warbler	-	u	-	u
Common Yellowthroat*	u	c	c	c
Hooded Warbler*	-	u	c	u
Yellow-breasted Chat*	-	o	u	o

TANAGERS	W	s	S	F
Summer Tanager	-	u	-	u
Scarlet Tanager	-	u	-	u

SPARROWS	W	s	S	F
Eastern Towhee*	a	a	a	a
Bachman's Sparrow*	c	c	c	c
Chipping Sparrow	c	u	o	u
Field Sparrow	u	u	u	u
Vesper Sparrow	u	-	-	u
Savannah Sparrow	c	c	o	c
Henslow's Sparrow	c	o	-	o
Le Conte's Sparrow	u	o	-	o
Fox Sparrow	u	u	-	u
Song Sparrow	c	u	-	u
Swamp Sparrow	u	u	-	u
White-throated Sparrow	u	-	u	u

JUNCOS	W	s	S	F
Dark-eyed Junco	c	u	-	u

GROSBEAKS & ALLIES	W	s	S	F
Northern Cardinal*	a	a	a	a
Rose-breasted Grosbeak	-	r	-	r
Blue Grosbeak*	o	c	c	c
Indigo Bunting*	-	c	c	u
Painted Bunting	-	r	-	-
Dickcissel	x	-	-	-
Bobolink	-	o	-	o
Red-winged Blackbird	a	c	c	c
Eastern Meadowlark*	c	c	u	c
Common Grackle	c	c	c	c
Boat-tailed Grackle*	c	c	c	c
Brown-headed Cowbird*	c	c	c	c
Orchard Oriole*	x	c	c	c
Baltimore Oriole	x	u	-	u

FINCHES	W	s	S	F
Purple Finch	u	u	-	r
House Finch	o	o	o	o
American Goldfinch	u	u	-	u

WEAVERS	W	s	S	F
House Sparrow	o	o	o	o

REPTILES AND AMPHIBIANS

List of possible herpetological species for Mississippi Sandhill Crane National Wildlife Refuge

Amphibians	Reptiles-Turtles and Crocodilians	Reptiles-Lizards and Snakes
Southern cricket frog	American alligator#	Eastern slender Glass Lizard#
Oak toad	*Graptemys* unidentified #	Eastern Glass lizard*
Southern toad*	Common snapping turtle#	Southern fence lizard#
Gulf coast toad*	Alligator snapping turtle#	Green anole#
Eastern narrowmouth toad*	Eastern mud turtle#	Southern coal skink#
Bird-voiced treefrog*	River cooter#	Five-lined skink#
Cope's Gray treefrog#	Mississippi redbelly turtle#	Southeastern five-lined skink#
Green treefrog	Gulf coast box turtle#	Ground skink#
Pinewoods treefrog	Three-toed box turtle#	Six-lined racerunner#
Barking treefrog	Red-eared slider#	Northern scarlet snake#
Squirrel treefrog		Southern black racer#
Gray treefrog		Corn snake#
Spring peeper*		Gray rat snake#
Southern chorus frog*		Rainbow snake
Crawfish frog		Western mud snake#
Pickerel frog		Eastern hognose snake#
Southern Leopard frog*		Speckled kingsnake#
Bullfrog		Scarlet kingsnake
Bronze frog		Eastern coachwhip
Pig frog		Green water snake#
One-toed amphiuma#		Broad-banded water snake#
Two-toed amphiuma#		Banded water snake#
Dwarf salamander#		Rough green snake#
Eastern Lesser siren#		Black pine snake*
		Gulf crayfish snake#

Amphibians	Reptiles-Turtles and Crocodilians	Reptiles-Lizards and Snakes
		Pinewoods snake*
		Eastern ribbon snake#
		Western earth snake#
		Southern copperhead*
		Western cottonmouth#
		Eastern diamondback rattle snake*
		Dusky pygmy rattle snake*

italics= *Calling Frog survey*, * incidental, # TNC Fort Bayou tract survey, rest: expected

Appendix VII. Priority Bird Species and Species Suites

Bird Conservation Region (BCR) 27 priority species
(B=Breeding, N=Non-breeding, T=Transient, PB=Post-breeding; FE=Federally Endangered, FT=Federally Threatened, SL=listed in at least one State within BCR)

Tier I. SPECIES OF HIGH CONTINENTAL AND/OR REGIONAL CONCERN (Regional Combined Score presented only for Tier I species, except waterfowl)

Immediate Management
25 Ivory-billed Woodpecker (B, N) also FE (extirpated?) SL
25 Bachman's Warbler (B) also FE (extirpated?), SL
25 Kirtland's Warbler (T) also FE, SL

23 Red-cockaded Woodpecker (B, N) also FE, SL
23 Henslow's Sparrow (N)
23 Saltmarsh Sharp-tailed Sparrow (N) also SL

22 Bermuda Petrel (N, pelagic) also FE
22 Audubon's Shearwater (N, pelagic)
22 Whooping Crane (T) also FE, SL
22 Piping Plover (B, N) also FT, SL
22 Florida Scrub-Jay (B, N) also FT (extirpated?), SL

20 Snowy Plover (B, N) also SL
20 Henslow's Sparrow (B) also SL

19 American Woodcock (N)
19 Whimbrel (N) also RS
19 Long-billed Curlew (N)

18 Sandhill Crane (B, N) also FE (MS), SL (AL, FL, MS)
18 Cerulean Warbler (B) also SL
18 Painted Bunting (B)

17 Purple Gallinule (B)

16 Wood Stork (B, N) also FE, SL
16 Limpkin (B, N) also SL
16 Common Ground-Dove (B, N) also SL
16 Loggerhead Shrike (B, N) also SL
16 Bewick's Wren (B, N) also SL
16 Black-throated Green Warbler (B) also SL

15 American Coot (B only) also SL
15 Common Tern (B only) also SL

Management Attention
22 Black Rail (B, N)
22 Bicknell's Thrush (T)

21 Black-capped Petrel (N, pelagic)
21 Yellow Rail (N)
21 American Oystercatcher (B, N) also SL
21 Bachman's Sparrow (B, N) also SL

20 Wilson's Plover (B) also SL
20 Buff-breasted Sandpiper (T)
20 Black Skimmer (B, N) also SL

20 Brown-headed Nuthatch (B, N)

19 Horned Grebe (N)
19 Semipalmated Sandpiper (T)
19 Short-billed Dowitcher
19 Least Tern (B) also FE (Interior subsp.) SL

18 Red-throated Loon (N)
18 King Rail (B, N) also SL
18 Upland Sandpiper (T)
18 Marbled Godwit (N)
18 Least Sandpiper (N)
18 Stilt Sandpiper (T)
18 Wilson's Phalarope (T)
18 Gull-billed Tern (B) also SL
18 Prairie Warbler (B)
18 Swainson's Warbler (B) also SL
18 Nelson' Sharp-tailed Sparrow (N)
18 Rusty Blackbird (N)

17 American Bittern (N) also SL
17 Tricolored Heron (B, N) also SL
17 American Golden-Plover (T)
17 American Avocet (N)
17 Lesser Yellowlegs (N)
17 Red Knot (N)
17 Sanderling (N)
17 Western Sandpiper (N)
17 Dunlin (N)
17 Sandwich Tern (B)
17 Common Tern (T)
17 Black Tern (T)
17 Le Conte's Sparrow (N)

16 Northern Bobwhite (B, N)
16 Northern Gannet (N)
16 Magnificent Frigatebird (N)
16 Swallow-tailed Kite (B) also SL

16 White Ibis (B, N) also SL
16 Black-bellied Plover (N)
16 Ruddy Turnstone (N)
16 Razorbill (N, pelagic)
16 Chuck-will's-widow (B)
16 Eastern Towhee (B, N)

15 Common Loon (N)
15 American White Pelican also SL
15 Little Blue Heron (B, N) also SL
15 Black-crowned Night-Heron (B, N) also SL
15 Yellow-billed Cuckoo (B)
15 Short-eared Owl (N)
15 Chimney Swift (B)
15 Northern Flicker (B, N)
15 Eastern Kingbird (B)
15 Brown Thrasher (B, N)
15 Wood Thrush (B)
15 Field Sparrow (B, N)
15 Grasshopper Sparrow (N)

14 Pied-billed Grebe (B only) also SL
14 Least Bittern (B) also SL
14 Snowy Egret (B, N) also SL
14 Yellow-crowned Night-Heron (B, N) also SL
14 Glossy Ibis (B, N) also SL
14 Northern Harrier (N)
14 American Kestrel (B) also SL
14 Common Moorhen (B, N) also SL
14 Eastern Wood-Pewee (B, N)
14 Vesper Sparrow (N)
14 White-throated Sparrow (N)
14 Eastern Meadowlark (B, N)

Brant (N)
Canada Goose (N) (Southern James Bay and Atlantic migratory pops.)
American Black Duck (N, B locally in NC, VA)
Northern Pintail (N)
Canvasback (N)
Redhead (N)
Lesser Scaup (N)
Black Scoter (N)

<u>Planning and Responsibility</u>
22 Seaside Sparrow (B, N) also SL
19 Wilson's Snipe (N) also RS
17 Solitary Sandpiper (N) also RS
16 Greater Shearwater (N, pelagic)

16 Band-rumped Storm-Petrel (N, pelagic)
16 Bridled Tern (N, pelagic)
16 Prothonotary Warbler (B)
16 Kentucky Warbler (B)

15 Red-headed Woodpecker (B, N) also SL
15 Blue-winged Warbler (B)
15 Worm-eating Warbler (B)

14 Cory's Shearwater (N, pelagic)
14 Manx Shearwater (N, pelagic)
14 Red Phalarope (N, pelagic)

13 Dickcissel (B)

Mottled Duck (B, N; not including introduced populations)

Tier II. SPECIES NOT OTHERWISE OF CONTINENTAL NOR REGIONAL CONCERN WHERE MONITORING (i.e., All Planning and Responsibility) ATTENTION IS NEEDED TO ENSURE POPULATION STABILITY

Planning and Responsibility
Tundra Swan (N)
Wood Duck (B, N)
Red-shouldered Hawk (B, N)
Clapper Rail (B, N)
Sandhill Crane (T) (eastern population segment of Greater subspecies)
Semipalmated Plover (N)
Killdeer (N)
Greater Yellowlegs (N)
Willet (B, N)
Spotted Sandpiper (N)
Pectoral Sandpiper (T)
Bonaparte's Gull (N)
Royal Tern (B, N)
Forster's Tern (B, N)
Red-bellied Woodpecker (B, N)
Acadian Flycatcher (B)
White-eyed Vireo (B)
Yellow-throated Vireo (B)
Carolina Chickadee (B, N)
Sedge Wren (N)
Marsh Wren (B, N) also SL
Carolina Wren (B, N)
Northern Parula (B)
Yellow-throated Warbler (B)
Cape May Warbler (T)
Black-throated Blue Warbler (T)
Pine Warbler (B, N)
Blackpoll Warbler (T)

Connecticut Warbler (T)
Hooded Warbler (B)
Summer Tanager (B)
Indigo Bunting (B)
Bobolink (T)
Orchard Oriole (B)

Tier III. SPECIES WHERE AT LEAST MONITORING ATTENTION IS NEEDED TO ENSURE POPULATION PERSISTENCE (i.e., All at least Planning and Responsibility), BUT MANAGEMENT ATTENTION MAY OR MAY NOT BE NECESSARY BASED ON LEGAL REQUIREMENTS AND POLITICAL BOUNDARIES

Tier III a. Additional Federally Listed

Brown Pelican (B, N) FE in MS and LA, also SL (FL, MS, LA, SC, VA)
Bald Eagle (B, N) FE also SL (AL, FL, GA, KY, LA, MS, NC, SC, TN, VA)
Roseate Tern (N, pelagic, casual B) FT also SL (FL, NC, VA)

Tier III b. Additional State Listed

Trumpeter Swan (N) KY
Blue-winged Teal (B) KY
Northern Shoveler (B) KY
Hooded Merganser (B) KY
Double-crested Cormorant (B) KY
Anhinga (B, N) TN
Great Blue Heron (B) KY
Great Egret (B) KY, TN, VA
Reddish Egret (B) AL, FL
Cattle Egret (B) KY
Black Vulture (B, N) NC
Osprey (B) KY
Mississippi Kite (B) KY, SC, TN
Northern Harrier (B) KY, TN, VA
Peregrine Falcon (N) KY, TN, LA, AL, FL, GA, SC, NC, VA
Cooper's Hawk (B) AL, NC, SC
Spotted Sandpiper (B) KY
Barn Owl (B, N) KY, SC, TN
Burrowing Owl (B) FL
Bell's Vireo (B) KY
Bank Swallow (B) KY
Sedge Wren (B) KY
Lark Sparrow (B) KY, TN
Bobolink (B) KY

Tier III c. Additional politically recognized species (e.g., natureserve s1, s2)

[REFER TO EACH STATE'S NATURAL HERITAGE DATABASE; MANY SPECIES ABOVE ARE LIKELY INCLUDED IN MANY OF THE DATABASES WITHIN THE STATES THEY OCCUR IN]

Tier IV. OTHER SPECIES OF CONSERVATION OR MANAGEMENT INTEREST, NOT OTHERWISE LISTED ABOVE (LOCAL OR REGIONAL INTEREST=LORI species; some species may be listed in more than one sub-tier below)

Tier IV a. Locally Rare or Peripheral Species of Interest (e.g., certain nonbreeding hummingbird species found in the Southeast U.S., Continental Concern species with RD=1)

Short-tailed Hawk (B)
Black-necked Stilt (B)
Purple Sandpiper (N)
Sooty Tern (B)
Common Nighthawk (B)
Willow Flycatcher (B)
Gray Kingbird (B)
Warbling Vireo (B)

Tier IV b. Game Species of Particular Local or State Management or Economic Interest (e.g., Wild Turkey, many species of waterfowl)

Snow Goose (N)
Gadwall (N)
American Wigeon (N)
Mallard (N)
Blue-winged Teal (N)
Green-winged Teal (N)
Ring-necked Duck (N)
Greater Scaup (N)
Common Goldeneye (N)
Bufflehead (N)
Wild Turkey (B, N)
Virginia Rail (N)
Sora (N)
American Coot (N)
Mourning Dove (B, N)

Tier IV c. Nongame Species of Particular Local or State Management or Economic Interest (e.g., Ruby-throated Hummingbird, Purple Martin, Eastern Bluebird)

Tier IV d. Species frequently occurring as a regional concern species in other BCRs, just not in this one, with RD>2 (good to keep track of species where they are doing well, when in many BCR's they are not doing well)

Louisiana Waterthrush (B)

Tier IV e. Species Important as Environmental Indicators (e.g., many species of raptors, such as Osprey, and herons, such as Great Blue Heron)

Tier IV f. Nuisance or Depredating Species (e.g., crows, grackles, cowbirds, most blackbirds, double-crested cormorants)

Local or Regional Population Control/Suppression
Canada Goose (resident populations, especially where they might compete for food resources with migratory populations)

Double-crested Cormorant (non-breeding populations associated with aquaculture in AL, MS)

American White Pelican (non-breeding populations associated with aquaculture in AL, MS)

Cattle Egret (colonies in developments, health and safety, replacing other species)

Laughing Gull (where depredation threatens the stability of other colonial waterbirds)

Herring Gull (where depredation threatens the stability of other colonial waterbirds)

Great Black-backed Gull (where depredation threatens the stability of other colonial waterbirds)

Tier IV g. Continental Stewardship Species high RD>3 or TB=1

***Action Level:**

IM=Immediate management needed to reverse or stabilize significant, long-term population declines in species with small populations, or to protect species with the smallest populations for which trends are poorly known. Lack of action may lead to extirpations or extinction. Generally species with a TB/TN=5 or a TB/TN=4+PT=5 fall under this action level.

MA=Management or other on-the-ground conservation actions needed to reverse or stabilize significant, long-term population declines in species that are still relatively abundant. All other Regional Concern species that are not IM, fall under this action level. Some Federally or State/Provincial listed species not otherwise meeting either Continental or Regional Concern criteria may fall under this action level.

PR=Long-term Planning and Responsibility needed for species to ensure that sustainable populations are maintained for species for which a region has high responsibility for that species. All Continental Concern species that are not also Regional Concern species fall under this action level, as well as any additional Regional Stewardship and Continental Stewardship species and any additional LORI species identified.

PC = Population Control/Suppression needed for species that are otherwise secure and increasing that may come into conflict with other species of higher conservation concern or other resources of interest.

PCL = Local or Regional Population Control/Suppression that generally are species listed as in need of Management Attention or Long-term Planning and Responsibility, but locally may be subject to population control measures to alleviate documented economic, environmental, or human health and safety conflicts, but only when economics and conservation implications have been thoroughly considered.

Appendix VIII. Budget Requests

MISSISSIPPI SANDHILL CRANE NATIONAL WILDLIFE REFUGE – SERVICE ASSET AND MAINTENANCE MANAGEMENT SYSTEM (SAMMS) PROJECT LIST

Project Name	Amount
1. Restore hydrology	$130,000
2. Improve refuge roads	$394,000
3. Maintain foraging areas and food plots	$12,000
4. Repair and upgrade sandhill crane rehabilitation pens	$60,000
5. Enhance monitoring of Mississippi sandhill cranes	$150,000
6. Restore habitat by thinning pine forests through timber sales	$216,000
7. Protect endangered Mississippi sandhill crane chicks from predation	$115,000
8. Control the exotic, invasive cogon grass	$216,000
9. Restore and protect rare habitats and ecosystems	$430,000
10. Construct visitor center	$1,500,000
11. Improve existing visitor facilities and services	$150,000
12. Replace administrative headquarters	$500,000
13. Remove abandoned equipment and debris	$50,000
Total (does not include routine vehicle/equipment replacement)	**$3,923,000**

ADDITIONAL PERSONNEL IDENTIFIED TO IMPLEMENT THE COMPREHENSIVE CONSERVATION PLAN FOR MISSISSIPPI SANDHILL CRANE NATIONAL WILDLIFE REFUGE

Position Title	Grade	Funding Required
Law Enforcement Officer	GS- 9	$70,864
Biological Technician	GS- 5/7	$52,231
Assistant Station Manager	GS-11	$94,000
Total		**$217,095**

Appendix IX. List of Preparers

MISSISSIPPI SANDHILL CRANE NATIONAL WILDLIFE REFUGE
COMPREHENSIVE CONSERVATION PLANNING TEAM

Durwin Carter, U.S. Fish and Wildlife Service, Grand Bay National Wildlife Refuge

Lloyd Culp, U.S. Fish and Wildlife Service, Mississippi Sandhill Crane National Wildlife Refuge

Mike Dawson, U.S. Fish and Wildlife Service, Jackson, Mississippi

Scott Hereford, U.S. Fish and Wildlife Service, Mississippi Sandhill Crane National Wildlife Refuge

Leon Kolankiewicz, Mangi Environmental Group, McLean, Virginia

Alan Schriver, U.S. Fish and Wildlife Service, Mississippi Sandhill Crane National Wildlife Refuge

Appendix X. Intra-Service Section 7 Biological Evaluation Form

Division/Office: Mississippi Sandhill Crane NWR

Refuge Manager/Phone #: Lloyd Culp (228)497-6322

Date: January 24, 2006 Conservation Conservation Plan

I. Proposed Action: Implementation of the Comprehensive Conservation Plan.

The U.S. Fish and Wildlife Service (Service) has developed a Draft Comprehensive Conservation Plan (CCP) to provide a foundation for the management and use of Mississippi Sandhill Crane NWR. The plan is intended to serve as a working guide for the Complex's management programs and actions over the next 15 years.

II. Location (County and State/attach project area map):

The refuge is located in Jackson County in southeastern Mississippi and consists of three separate units (Gautier, Ocean Springs and Fontainebleau) totaling approximately 19,300 acres.

III. Description of proposed action (describe in enough detail to allow proper evaluation of project impacts, attach additional pages as needed):

The plan's overriding consideration is to carry out the purposes for which the refuge was established. Fish and wildlife are the first priority in refuge management, and public use (wildlife-dependent recreation) is allowed and encouraged as long as it is compatible with, or does not detract from, the refuge's mission and purposes.

Individual consultations will occur under Section 7 for projects related to endangered species and are not intended to be covered in this document. This CCP prioritizes wildlife and habitat management, and proposes wildlife-dependent, compatible recreational opportunities. Chapter 4 of the CCP outlines specific goals, objectives and strategies to achieve an expanded wildlife and habitat management approach, while optimizing (making the best use of) public use and environmental education opportunities. While seeking concurrences on the general management direction of the refuge, as stated previously, individual consultations will occur for projects specifically related to endangered species and critical habitat.

IV. Species and Habitats Considered:

A. List all federally endangered, threatened, proposed, and candidate species, and describe any associated critical or proposed critical habitat that may be affected by the proposed action. Make a determination of how the proposed action may affect each:

SPECIES/CRITICAL HABITAT	STATUS[1]	DETERMINATION[2]			RESPONSE REQUESTED[3]
		NE	NA	AA	
Mississippi sandhill crane	E		X		
Gopher tortoise	T		X		

[1]STATUS: E = endangered, T = threatened, PE = proposed endangered, PT = proposed threatened, CH = critical habitat, PCH = proposed critical habitat, C = candidate species

[2]DETERMINATION:

NE = no effect. This determination is appropriate when the proposed action will not directly, indirectly or cumulatively impact, either positively or negatively, any listed, proposed, candidate species or designated/proposed critical habitat.

NA = not likely to adversely affect. This determination is appropriate when the proposed action is not likely to adversely impact any listed, proposed, candidate species or designated/proposed critical habitat or there may be beneficial effects to these resources.

AA = likely to adversely affect. This determination is appropriate when the proposed action is likely to adversely impact any listed, proposed, candidate species or designated/proposed critical habitat.

[3]RESPONSE REQUESTED: conference, concurrence, formal consultation

V. Determination of effects:

A. Explanation of effects of the action: include direct, indirect, interrelated, interdependent, and cumulative effects (attach additional pages as needed):

Definitions for Effects of the Action:

Direct Effects = are those that are an immediate result of the action.

Indirect Effects = are those that are caused by the action and are later in time but are still reasonably certain to occur. They include the effects of future activities that are induced by the action and that occur after the action is completed.

Interrelated = are those that are part of a larger action and depend on the larger action for their justification.

Interdependent = are those that have no significant independent utility apart from the action that is under consideration.

Cumulative Effects = are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area.

The proposed CCP should benefit the listed species.

B. Explanation of actions to be implemented to reduce adverse effects:

n/a

VI.

Project Leader: /S/ 1-24-06

Signature Date

No effect:_____

Is not likely to adversely affect: ✓

Is likely to adversely affect:_____

VII. Reviewing Ecological Services Office(ESO) Evaluation:

A. Concurrence ✓ **Nonconcurrence** ___

B. Formal Consultation Required ___

C. Conference Required ___

D. Remarks (attach additional pages if needed): ___

VIII. Signatory Approval:

ES Supervisor: /S/

Signature Date: 1-24-06

Note: The process ends here if the proposed action is "not likely to adversely affect".

Appendix XI. Finding of No Significant Impact

Mississippi Sandhill Crane National Wildlife Refuge
Comprehensive Conservation Plan
Jackson County, Mississippi

Introduction
The U.S. Fish and Wildlife Service (Service) prepared an Environmental Assessment to inform the public of the possible environmental consequences of implementing the Comprehensive Conservation Plan for Mississippi Sandhill Crane National Wildlife Refuge in Jackson County, Mississippi. A description of the alternatives, the rationale for selecting the preferred alternative, the environmental effects of the preferred alternative, the potential adverse effects of the action, and a declaration concerning the factors determining the significance of the effects, in compliance with the National Environmental Policy Act of 1969, are outlined below. The supporting information can be found in the Environmental Assessment.

Alternatives
In developing the Comprehensive Conservation Plan for Mississippi Sandhill Crane National Wildlife Refuge, the Service evaluated four alternatives: Alternatives A, B, C, and D.

The Service adopted Alternative D, the "Preferred Alternative," as the plan for guiding the direction of the refuge for the next 15 years. The overriding concern reflected in this plan is that wildlife conservation assumes first priority in refuge management; wildlife-dependent recreational uses are allowed if they are compatible with wildlife conservation. Wildlife-dependent recreation uses (fishing, wildlife observation, wildlife photography, and environmental education and interpretation) will be emphasized and encouraged.

Alternative A – Current Management (No Action)
Under Alternative 1, the No Action alternative, present management of the refuge would continue. Current approaches to managing cranes, other wildlife, and habitats, to protecting resources, and to allowing for public use would remain unchanged.

With regard to the endangered Mississippi sandhill crane, the refuge's objective would be to maintain a population of 110–130 individual cranes, including 20–25 nesting pairs, while fledging 2–4 young annually. Staff would cultivate 15–40 acres of chufa in multiple food plots to provide foraging areas for the cranes. The refuge would also maintain 14 existing ponds; these provide roosting, feeding and release pen habitat for cranes. Predator control would need to continue, since predation is one of the key factors in retarding successful recruitment of young and achievement of a self-sustaining population. The refuge's objective would be to conduct sufficient predator control to allow for 40% hatching success, 25% fledging success, and 75% survival of after-hatch-year birds. Two to three red-tailed hawks, one of the principal predators of nestling and juvenile cranes, would be removed annually.

The refuge would continue to furnish incidental benefits for other native wildlife species. It would provide 8,000–10,000 acres of savanna habitat to benefit priority grassland bird species such as the Henslow's sparrow. It would also maintain the current habitat mix for the benefit of other migratory birds, including waterfowl, shorebirds, marsh birds, and landbirds. Staff would continue existing amphibian surveys, to monitor the long-term population trends and health of these vertebrates.

Managers would continue to record casual sightings of invertebrates, while maintaining incidental benefits to invertebrates from various management actions.

Habitat objectives are oriented toward providing benefits to wildlife, and thus overlap wildlife objectives to some extent. The main habitat the refuge strives to restore and manage is pine savanna, particularly wet pine savanna. Under Alternative A, refuge management would continue to provide 8,000–10,000 acres of savanna habitat to benefit the Mississippi sandhill crane and priority grassland bird species like the Henslow's sparrow. Fire management, in particular prescribed fire, is an important ecological tool in maintaining savanna habitat against encroachment by woody vegetation and trees. The refuge would continue to aim for conducting prescribed fires on all compartments on a 2–3 year rotation, although attaining this objective would depend on the cooperation of weather. Other habitats on the refuge would be maintained at current levels and in the same locations as at present: approximately 9,000 acres in pine flatwood forest, 1,300 acres in forested wetlands, and 600 acres in open water (bayous and ponds).

Resource protection at Mississippi Sandhill Crane National Wildlife Refuge would continue to be carried out as it is now. One hundred acres of cogongrass would be targeted for annual spraying to reduce infestations of this non-native weed. Tallow trees and other invasives would be controlled or eliminated opportunistically. The refuge's Private Lands Program would remain the same, with passive management of seven Farmers Home Administration (FmHA) tracts on 216 acres under easement. At the moment, the refuge must share a single law enforcement officer with Grand Bay National Wildlife Refuge, but since this is a reduced level of protection than the Mississippi Sandhill Crane Refuge has enjoyed in the past, Alternative A assumes that the refuge would provide a 1.0 FTE law enforcement officer and one collateral duty officer (0.25 FTE). With regard to cultural resources, including those of an archeological or historical nature, there would be limited management based on known locations of resources. The refuge would follow standard Service protocol and procedures in conducting cultural resource surveys by qualified professionals, in consultation with the Regional and State Historic Preservation Officers, prior to commencing projects that entail extensive excavation.

The refuge's public use and environmental education programs would remain unaltered under Alternative A. The refuge would continue to serve the public without being guided by a Visitor Services Plan, relying instead on experience, general Service mandates and practices, and guidance and advice from recreation staff in the Regional Office. The visitor center would be expanded to create a staff/storage area, so as to "reclaim" the multipurpose room as a separate public use program area.

Current wildlife observation and wildlife photography programs and facilities would be maintained. These include guided crane tours in vans every January and February, two hiking/nature trails, and observation/photography blinds. The refuge would maintain environmental education and interpretation at their current levels, including participation in community events, off-site and on-site environmental education, guided tours, and interpretive trails. The refuge would technically remain closed to sport hunting and fishing, though the latter would continue to be available to anglers in watercraft (boats, canoes, kayaks, etc.) entering the refuge on bayous under State jurisdiction and management.

Alternative B – Maximize Biological Program and Maintain Current Visitor Services
Under Alternative B, the refuge would emphasize its biological program, applying maximum efforts to the enhancement of habitat conditions and the increase of wildlife populations, particularly the endangered crane, to their maximum sustainable levels. The visitor services program—both opportunities and visitor use facilities on the refuge—would remain as it is at present.

With regard to the endangered Mississippi sandhill crane, the refuge's objective would be to provide for a self-sustaining crane population of 130 to 170 individuals, including 30–35 nesting pairs, fledging 10–15 young annually for at least 10 years. This represents an increase from Alternative A. Chufa cultivation would expand to 40–60 acres, and winter cover crops and legumes would be planted on up to 20 acres within food plots. Staff would also create a food plot in the Fontainebleau Unit in addition to exploring opportunities with partners to protect existing and extend potential foraging areas off-refuge.

The refuge would continue to maintain 14 existing ponds, which provide roosting, feeding and release pen habitat for cranes. In addition to these 14 ponds, 10 new small, shallow ponds would be created. Staff would clear overgrown interiors of five Grady ponds.

As in Alternative A, predator management for Mississippi Sandhill Crane survival would take place. Under Alternative B, predator control would increase. The refuge would conduct predator control sufficient to allow for 60% hatching success, 67% fledging success, and over 80% survival of after hatch year birds. Up to 10 red-tailed hawks annually would be removed.

The refuge would also continue to furnish incidental benefits to other native wildlife species in Alternative B. It would provide 15,000–17,000 acres of savanna habitat to benefit priority grassland bird species like Henslow's sparrow, an increase of 7,000 acres over Alternative A. Alternative B would aim to increase the refuge's knowledge base about other migratory birds by developing and implementing monitoring programs, while continuing to provide habitats for the benefit of waterfowl, shorebirds, marsh birds, nesting colonial waterbirds, and landbirds. Staff would continue existing amphibian surveys, to monitor long-term population trends and health of these vertebrates. Management would increase for herptiles (reptiles and amphibians). The refuge would maintain and develop habitats (shallow ponds) and promote management actions, such as baseline surveys, that would support viable populations of native species of amphibians and reptiles.

The refuge would continue to record casual sightings of invertebrates, while maintaining incidental benefits to invertebrates from various management actions. Management of invertebrates would increase overall, by maintaining the native diversity of butterfly and dragonfly species as indicators of biodiversity, and by providing for high-quality orthoptera (crickets, grasshoppers, etc.) and related species numbers for food by the sandhill cranes and their young.

As in the first alternative, habitat objectives are oriented toward providing benefits to wildlife, and thus overlap wildlife objectives to some extent. The main habitat the refuge strives to restore and manage is pine savanna, particularly wet pine savanna. Under Alternative B, savanna acreage would increase. Within 15 years, the refuge would strive to provide 15,000–17,000 acres of savanna habitat containing with less than10% woody plant frequency, 10-15% tree cover, 90–100% desirable tree composition, 10 ft^2/acre tree basal area, and above or equal to 99% graminoid (grass) frequency. Fire management, in particular prescribed fire, is an important ecological tool in maintaining savanna habitat against encroachment by woody vegetation and trees. As in Alternative A, under Alternative B the refuge would continue to aim for conducting prescribed fires on all compartments on a 2–3 year rotation, although attaining this objective would depend on the cooperation of weather. Under this alternative, staff would use growing season burns on at least 50% of annual burns. Of the other habitats on the refuge, pine flatwood forest would be reduced in acreage, forested wetlands maintained, and open water increased. Pine flatwood forest would be reduced to 2,000–5,000 acres (from 9,000 acres currently), because the majority of this habitat would be converted to pine savanna (i.e., opened up and thinned out), which is more desirable to cranes and other indigenous species of management concern. Forested wetlands would be maintained at current levels (1,300 acre) and the acreage of open water, that is, bayous and ponds, would increase somewhat from the construction of 10 new ponds.

Under Alternative B, resource protection at Mississippi Sandhill Crane National Wildlife Refuge would be intensified from the level now maintained in the No Action Alternative. Efforts to control invasive species would increase from Alternative A. The main invasive species at present is cogongrass, and the refuge's objective would be to reduce cogongrass by 80% within five years to total no more than 30 acres. Tallow trees and other invasives would continue to be controlled or eliminated as opportunities are available. In the refuge's Private Lands Program, staff would work with private land owners of the seven existing FmHA tracts to manage and improve habitats. Staff would also explore opportunities with partners to protect existing and extend potential foraging areas off-refuge. The refuge would partner with The Nature Conservancy and other nearby landowners on fire management issues and biological assistance.

Presently the refuge shares a single law enforcement officer with Grand Bay National Wildlife Refuge, but since this is a reduced level of protection than the Mississippi Sandhill Crane Refuge has enjoyed in the past, Alternative A assumes that the refuge would provide a 1.0 FTE law enforcement officer and one collateral duty officer (0.25 FTE). Alternative B would be identical to Alternative A in this respect. With regard to cultural resources, including those of an archeological or historical nature, Alternative B would also be the same as Alternative A: there would be limited management based on known locations of resources. As it already does, the refuge would follow standard Service protocol and procedures in conducting cultural resource surveys by qualified professionals, in consultation with the Regional and State Historic Preservation Officers, prior to commencing projects that entail extensive excavation.

Because Alternative B emphasizes management of the refuge's biological resources, public use and environmental education programs at the refuge would virtually be identical to Alternative A. The refuge would continue to serve the public without the guidance of a Visitor Services Plan, relying instead on experience, general Service mandates and practices, and advice from recreation staff in the Regional Office. The visitor center would expand to create a staff/storage area, so as to "reclaim" the multipurpose room as a separate public use program area.

Current wildlife observation and wildlife photography programs and facilities would be maintained under Alternative B. These include guided crane tours in vans every January and February, two hiking/nature trails, and observation/photography blinds. The refuge would maintain environmental education and interpretation at their current levels, including participation in community events, off-site and on-site environmental education, guided tours, and interpretive trails. The refuge would technically remain closed to sport hunting and fishing, though the latter would continue to be available to those anglers in watercraft (boats, canoes, kayaks, etc.) entering the refuge on bayous under State jurisdiction and management.

Alternative C – Maintain Current Biological Program and Maximize Visitor Services
Under Alternative C, management of the refuge would focus on maximizing the opportunities for public visitation—increasing both facilities and activities—throughout the 15-year duration of the CCP. Current approaches to managing cranes, other wildlife, and habitats, and to protecting resources, would remain unchanged.

With regard to the endangered Mississippi sandhill crane, the refuge's objective would be to maintain a population of 110–130 individual cranes, including 20–25 nesting pairs, while fledging 2–4 young annually. Staff would cultivate 15–40 acres of chufa in multiple food plots to provide foraging areas for the cranes. The refuge would also maintain 14 existing ponds; these provide roosting, feeding and release pen habitat for cranes. Predator control would need to continue, since predation is one of the key factors in retarding successful recruitment of young and achievement of a self-sustaining population. The refuge's objective would be to conduct sufficient predator control to allow for 40% hatching success, 25%

fledging success, and 75% survival of after-hatch-year birds. Two to three red-tailed hawks, one of the principal predators of nestling and juvenile cranes, would be removed annually.

The refuge would continue to furnish incidental benefits for other native wildlife species. It would provide 8,000–10,000 acres of savanna habitat to benefit priority grassland bird species like Henslow's sparrow. It would also maintain the current habitat mix for the benefit of other migratory birds, including waterfowl, shorebirds, marsh birds, and landbirds. Staff would continue existing amphibian surveys, to monitor long-term population trends and health of these vertebrates. Managers would continue to record casual sightings of invertebrates, while maintaining incidental benefits to invertebrates from various management actions.

Habitat objectives are oriented toward providing benefits to wildlife, and thus overlap wildlife objectives to some extent. The main habitat the refuge strives to restore and manage is pine savanna, particularly wet pine savanna. Under Alternative A, refuge management would continue to provide 8,000–10,000 acres of savanna habitat to benefit the Mississippi sandhill crane and priority grassland bird species like the Henslow's sparrow. Fire management, in particular prescribed fire, is an important ecological tool in maintaining savanna habitat against encroachment by woody vegetation and trees. The refuge would continue to aim for conducting prescribed fires on all compartments on a 2–3 year rotation, although attaining this objective would depend on the cooperation of weather. Other habitats on the refuge would be maintained at current levels and in the same locations as at present: approximately 9,000 acres in pine flatwood forest, 1,300 acres in forested wetlands, and 600 acres in open water (bayous and ponds).

Under Alternative C, resource protection at Mississippi Sandhill Crane National Wildlife Refuge would mostly continue to be carried out as it is now. One hundred acres of cogongrass would be targeted for annual spraying to reduce infestations of this non-native weed. Tallow trees and other invasives would be controlled or eliminated opportunistically. The refuge's Private Lands Program would remain the same, with passive management of seven Farmers Home Administration (FmHA) tracts on 216 acres under easement. One difference between Alternative C and Alternative A is in the area of law enforcement: Alternative C would provide 4.0 FTE law enforcement officers to protect refuge resources and the public. With regard to cultural resources, including those of an archeological or historical nature, within 15 years of CCP approval, the refuge would develop and begin to implement a Cultural Resources Management Plan (CRMP). Until such time as the CRMP is completed and implemented, the refuge would follow standard Service protocol and procedures in conducting cultural resource surveys by qualified professionals, in consultation with the Regional and State Historic Preservation Officers, prior to commencing projects that entail extensive excavation.

Public use and environmental education would increase under Alternative C. Within three years of CCP completion, the refuge would develop a Visitor Services Plan to be used in expanding public use facilities and opportunities on the refuge. This step-down management plan would provide overall, long-term direction and guidance in developing and running a larger public use program at the Mississippi Sandhill Crane Refuge. Within the 15-year planning horizon, the Service would construct a new visitor center near the existing one and convert the existing visitor center into the refuge headquarters exclusively. The new visitor center would include a small auditorium for use in talks, meetings, films, videos, and other audio-visual presentations. Alternative C would also increase opportunities for visitors by adding facilities such as photo-blinds, observation sites, and trails, including boardwalks. One or more on-refuge auto tours would be developed as well.

Over the 15-year life of plan, refuge staff would increase the emphasis on environmental education and interpretation to lead to increased understanding of importance of habitat and resources, especially the Mississippi sandhill crane, savanna, fire ecology, invasive species, endangered

species, and migratory birds. Within five years of CCP approval, the refuge would prepare a Fishing Plan that would outline permissible fishing opportunities within the refuge. The refuge would also construct a fishing pier on the bayou and a canoe and kayak trail with access point. Staff would investigate opportunities for limited hunting possibilities.

Alternative D – Optimize Biological Program and Visitor Services (Preferred Alternative)
Under Alternative D, the preferred alternative, the refuge would strive to optimize both its biological program and visitor services program. Thus it would include certain elements of Alternative B, which emphasizes the biological program, as well as Alternative C, which focuses on the visitor services program. Alternative D recognizes that there may be tradeoffs and opportunity costs between the various elements of the biological and visitor services programs. That is, it might not be possible to equally pursue and achieve all objectives simultaneously because of budgetary and staffing constraints, or even because of intrinsic conflicts between certain objectives. Hence, Alternative D stresses the principle of optimization rather than maximization of wildlife, habitat and public use outputs.

With regard to the endangered Mississippi sandhill crane, the refuge's objective would be to provide for a self-sustaining crane population of 130 to 170 individuals, including 30–35 nesting pairs, fledging 10–15 young annually for at least 10 years. This represents an increase from Alternative A. Chufa cultivation would expand to 40–60 acres, and winter cover crops and legumes would be planted on up to 20 acres within food plots. Staff would also create a food plot in the Fontainebleau Unit in addition to exploring opportunities with partners to protect existing and extend potential foraging areas off-refuge.

The refuge would continue to maintain 14 existing ponds, which provide roosting, feeding and release pen habitat for cranes. In addition to these 14 ponds, 10 new small, shallow ponds would be created. Staff would clear the overgrown interiors of five Grady ponds.

As in Alternative A, predator management for Mississippi sandhill crane survival would take place. Under Alternative D, predator control would increase. The refuge would conduct predator control sufficient to allow for 60% hatching success, 67% fledging success, and over 80% survival of after-hatch-year birds. Up to 10 red-tailed hawks annually would be removed.

The refuge would also continue to furnish incidental benefits to other native wildlife species in Alternative D. It would provide 15,000–17,000 acres of savanna habitat to benefit priority grassland bird species like the Henslow's sparrow, an increase of 7,000 acres over Alternative A. Alternative D would aim to increase the refuge's knowledge base about other migratory birds by developing and implementing monitoring programs, while continuing to provide habitats for the benefit of waterfowl, shorebirds, marsh birds, nesting colonial waterbirds, and landbirds. Staff would continue existing amphibian surveys, to monitor the long-term population trends and health of these vertebrates. Management would increase for herptiles (reptiles and amphibians). The refuge would maintain and develop habitats (shallow ponds) and promote management actions, such as baseline surveys, that would support viable populations of native species of amphibians and reptiles.

The refuge would continue to record casual sightings of invertebrates, while maintaining incidental benefits to invertebrates from various management actions. Management of invertebrates would increase overall, by maintaining the native diversity of butterfly and dragonfly species as indicators of biodiversity, and by providing for high-quality orthoptera (crickets, grasshoppers, etc.) and related species numbers for food by the sandhill cranes and their young.

As in the first alternative, habitat objectives are oriented toward providing benefits to wildlife, and thus overlap wildlife objectives to some extent. The main habitat the refuge strives to restore and manage is

pine savanna, particularly wet pine savanna. Under Alternative D, savanna acreage would increase. Within 15 years, the refuge would strive to provide 15,000–17,000 acres of savanna habitat containing with less than10% woody plant frequency, 10–15% tree cover, 90–100% desirable tree composition, 10 ft^2/acre tree basal area, and above or equal to 99% graminoid (grass) frequency. Fire management, in particular prescribed fire, is an important ecological tool in maintaining savanna habitat against encroachment by woody vegetation and trees. As in Alternative A, under Alternative D the refuge would continue to aim for conducting prescribed fires on all compartments on a 2–3 year rotation, although attaining this objective would depend on the cooperation of weather. Under this alternative, staff would use growing season burns on at least 50% of annual burns. Of the other habitats on the refuge, pine flatwood forest would be reduced in acreage, forested wetlands maintained, and open water increased. Pine flatwood forest would be reduced to 2,000–5,000 acres (from 9,000 acres currently), because the majority of this habitat would be converted to pine savanna (i.e. opened up and thinned out), which is more desirable to cranes and other indigenous species of management concern. Forested wetlands would be maintained at current levels (1,300 acres) and the acreage of open water, that is, bayous and ponds, would increase somewhat from the construction of 10 new ponds.

Under Alternative D, resource protection at Mississippi Sandhill Crane National Wildlife Refuge would be intensified from the level now maintained in the No Action alternative. Efforts to control invasive species would increase from Alternative A. The main invasive species at present is cogongrass, and the refuge's objective would be to reduce cogongrass by 80% within five years to total no more than 30 acres. Tallow trees and other invasives would continue to be controlled or eliminated as opportunities are available. In the refuge's Private Lands Program, staff would work with private land owners of the seven existing FmHA tracts to manage and improve habitats. Staff would also explore opportunities with partners to protect existing and extend potential foraging areas off-refuge. The refuge would partner with The Nature Conservancy and other nearby landowners on fire management issues and biological assistance.

Alternative D would provide 3.0 FTE law enforcement officers in comparison with 1.0 FTE and one collateral duty officer (0.25 FTE) at the present time. With regard to cultural resources, including those of an archeological or historical nature, within 15 years of CCP approval, the refuge would develop and begin to implement a Cultural Resources Management Plan (CRMP). Until such time as the CRMP is completed and implemented, the refuge would follow standard Service protocol and procedures in conducting cultural resource surveys by qualified professionals, in consultation with the Regional and State Historic Preservation Officers, prior to commencing projects that entail extensive excavation.

Public use and environmental education would increase from the No Action alternative under Alternative D. Within three years of CCP completion, the refuge would develop a Visitor Services Plan to be used in expanding public use facilities and opportunities on the refuge. This step-down management plan would provide overall, long-term direction and guidance in developing and running a larger public use program at the Mississippi Sandhill Crane Refuge. Within the 15-year planning horizon, the Service would construct a new visitor center near the existing one and convert the existing visitor center into the refuge headquarters exclusively. The new visitor center would include a small auditorium for use in talks, meetings, films, videos, and other audiovisual presentations.

Alternative D would also increase opportunities for visitors by adding facilities such as photo-blinds, observation sites, and trails, but would not include boardwalks, as Alternative C does. One or more on-refuge auto tours would be developed as well.

Over the 15-year life of plan, refuge staff would increase the emphasis on environmental education and interpretation under Alternative D to lead to increased understanding of importance of habitat and resources, especially the Mississippi sandhill crane, savanna, fire ecology, invasive species,

endangered species, and migratory birds. Within five years of CCP approval, the refuge would prepare a Fishing Plan that would outline permissible fishing opportunities within the refuge. The refuge would also construct a fishing pier on the bayou and a canoe and kayak trail with access point. Staff would investigate opportunities for limited hunting possibilities.

Selection Rationale
Alternative D is selected for implementation because it directs the development of programs to best achieve the refuge purpose and goals; emphasizes the restoration of pine savanna habitat; collects habitat and wildlife data; and ensures long-term achievement of refuge and Service objectives. At the same time, these management actions provide balanced levels of compatible public use opportunities consistent with existing laws, Service policies, and sound biological principles. It provides the best mix of program elements to achieve desired long-term conditions.

Under Alternative D, refuge management actions will expand wildlife and habitat programs and enhance public use by focusing on the quality of experiences instead of a quantity of programs and facilities.

Environmental Effects
Implementation of the Service's management action is expected to result in environmental, social, and economic effects as outlined in the comprehensive conservation plan. Habitat management, population management, land conservation, and visitor service management activities on the Refuge will result in increased protection for threatened and endangered species; enhanced wildlife populations; habitat restoration; and enhanced opportunities for wildlife-dependent recreation and environmental education. These effects are detailed as follows:

1. Additional staff and resources will create and properly manage the diversity of habitats found on the refuge, including pine savanna, shrub/scrub, croplands, moist soil areas, and other wetlands. Active management of these communities will likely result in a greater species diversity and abundance of migratory birds. Baseline data will be collected on populations and habitats and monitoring protocols established. Invasive species will be controlled, which will have a positive effect on the biotic community.

2. High quality wildlife-dependent recreational activities (fishing, and wildlife observation and interpretation) will continue and environmental education programs will be developed. Improved interpretive and informational programs will increase awareness of the refuge and wildlife and of the mission of the National Wildlife Refuge System.

3. Cultural resources will be surveyed, documented, and protected on the refuge.

4. Habitat restoration and management, along with a focus on accessibility and facility developments, will result in improved wildlife-dependent recreational opportunities. While public use will result in some minimal, short-term adverse effects on wildlife and user conflicts may occur at certain times of the year, these effects are minimized by site design, time zoning, and implementing refuge regulations. Anticipated long-term impacts to wildlife and wildlife habitats of implementing the management action are positive. In the long run, wildlife habitat and increased opportunities for wildlife-dependent recreation opportunities could result in an increase in economic benefits to the local community.

5. Implementing the comprehensive conservation plan is not expected to have any significant adverse effects on wetlands and floodplains, pursuant to Executive Orders 11990 and 11988, as actions will not result in development of buildings and/or structures within floodplain areas, nor will they result in irrevocable, long-term adverse impacts.

Potential Adverse Effects and Mitigation Measures

Wildlife Disturbance

Disturbance to wildlife at some level is an unavoidable consequence of any public use program, regardless of the activity involved. Obviously, some activities innately have the potential to be more disturbing than others. The management actions to be implemented have been carefully planned to avoid unacceptable levels of impact.

As currently proposed, the known and anticipated levels of disturbance of the management action are considered minimal and well within the tolerance level of known wildlife species and populations present in the area. Implementation of the public use program will take place through carefully controlled time and space zoning such as establishment of sanctuary areas, establishment of protection zones around key sites, such as crane nests, closures of unauthorized trails, and routing of new trails to avoid direct contact with sensitive areas, such as nesting bird habitat, etc. All public use activities will be conducted within the constraints of sound biological principles and refuge-specific regulations established to restrict illegal or non-conforming activities. Monitoring activities through wildlife inventories and assessments of public use levels and activities will be utilized, and public use programs will be adjusted as needed to limit disturbance.

User Group Conflicts

As public use levels expand across time, some conflicts between user groups may occur. Programs will be adjusted, as needed, to eliminate or minimize these problems and provide quality wildlife-dependent recreational opportunities. Experience has proven that time and space zonings, such as establishment of separate use areas, use periods, and restricting numbers of users, are effective tools in eliminating conflicts between user groups.

Effects on Adjacent Landowners

Implementation of the management action should not impact adjacent landowners. Essential access to private property will continue to be allowed through issuance of special use permits.

Site Development

Proposed site development by the Service will result in changes in land and recreational use patterns, since all uses on national wildlife refuges must meet compatibility standards. Potential development of access points, trails, and visitor parking areas could lead to minor short-term negative impacts on plants, soil, and some wildlife species. When site development activities are proposed, each activity will be given the appropriate National Environmental Policy Act consideration during pre-construction planning. At that time, any required mitigation activities will be incorporated into the specific project to reduce the level of impacts to the human environment and to protect fish and wildlife and their habitats.

As indicated earlier, one of the direct effects of site development is increased public use; this increased use may lead to littering, noise, and vehicle traffic. While funding and personnel resources will be allocated to minimize these effects, such allocations make these resources unavailable for other programs.

The management action is not expected to have significant adverse effects on wetlands and floodplains, pursuant to Executive Orders 11990 and 11988.

Coordination
The management action has been thoroughly coordinated with all interested and/or affected parties. Parties contacted include:

All affected landowners
Congressional representatives
Governor of Mississippi
Mississippi Department of Wildlife, Fisheries, and Parks
Mississippi Department of Marine Resources
Mississippi State Historic Preservation Officer
Local community officials
Interested citizens

Findings
It is my determination that the management action does not constitute a major federal action significantly affecting the quality of the human environment under the meaning of Section 102(2)(c) of the National Environmental Policy Act of 1969 (as amended). As such, an environmental impact statement is not required. This determination is based on the following factors (40 C.F.R. 1508.27), as addressed in the Environmental Assessment for Mississippi Sandhill Crane National Wildlife Refuge:

1. Both beneficial and adverse effects have been considered and this action will not have a significant effect on the human environment (Environmental Assessment, pages 136–143).

2. The actions will not have a significant effect on public health and safety (Environmental Assessment, page 124.

3. The project will not significantly affect any unique characteristics of the geographic area such as proximity to historical or cultural resources, wild and scenic rivers, or ecologically critical areas (Environmental Assessment, page 123).

4. The effects on the quality of the human environment are not likely to be highly controversial (Environmental Assessment, pages 136–143).

5. The actions do not involve highly uncertain, unique, or unknown environmental risks to the human environment (Environmental Assessment, page 123).

6. The actions will not establish a precedent for future actions with significant effects nor do they represent a decision in principle about a future consideration (Environmental Assessment, pages 136–143).

7. There will be no cumulatively significant impacts on the environment. Cumulative impacts have been analyzed with consideration of other similar activities on adjacent lands, in past action, and in foreseeable future actions (Environmental Assessment, page 124).

8. The actions will not significantly affect any site listed in, or eligible for listing in, the National Register of Historic Places, nor will they cause loss or destruction of significant scientific, cultural, or historic resources (Environmental Assessment, page 123).

9. The actions are not likely to adversely affect threatened or endangered species, or their habitats (Environmental Assessment, pages 136–143).

10. The actions will not lead to a violation of federal, state, or local laws imposed for the protection of the environment (Environmental Assessment, page 123).

Supporting References

U.S. Fish and Wildlife Service. 2006. Draft Comprehensive Conservation Plan and Environmental Assessment for Mississippi Sandhill Crane National Wildlife Refuge, Jackson County, Mississippi. U.S. Department of the Interior, Fish and Wildlife Service, Southeast Region.

Document Availability

The Environmental Assessment was Section B of the Draft Compreh
ensive Conservation Plan for Mississippi Sandhill Crane National Wildlife Refuge and was made available in November 2006. Additional copies are available by writing: U.S. Fish and Wildlife Service, 1875 Century Boulevard, Atlanta, GA 30345.

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Sam D. Hamilton
Regional Director

6/7/07

Date