**DRAFT COMPREHENSIVE CONSERVATION PLAN**
**AND ENVIRONMENTAL ASSESSMENT**

# CAROLINA SANDHILLS NATIONAL WILDLIFE REFUGE

*Chesterfield County, South Carolina*

**U.S. Department of the Interior**
**Fish and Wildlife Service**

*Southeast Region*
**Atlanta, Georgia**

**December 2009**

## TABLE OF CONTENTS

## SECTION A. DRAFT COMPREHENSIVE CONSERVATION PLAN


I. BACKGROUND ..... 1

Introduction ..... 1
Purpose and Need for the Plan ..... 1
Fish and Wildlife Service ..... 1
National Wildlife Refuge System ..... 2
Legal and Policy Context ..... 4
National and International Conservation Plans and Initiatives ..... 5
Relationship to State Wildlife Agency, South Carolina Department of Natural Resources ..... 6

II. REFUGE OVERVIEW ..... 7

Introduction ..... 7
Refuge History and Purpose ..... 7
Special Designations ..... 13
Ecosystem Context ..... 15
Regional Conservation Plans and Initiatives ..... 21
Ecological Threats and Problems ..... 23
Physical Resources ..... 23
Climate ..... 23
Geology and Topography ..... 29
Soils ..... 31
Hydrology ..... 33
Water Quality ..... 40
Biological Resources ..... 41
Habitat ..... 41
Wildlife ..... 46
Cultural Resources ..... 48
Socioeconomic Environment ..... 51
Refuge Administration and Management ..... 56
Land Protection, Conservation, and Management ..... 56
Visitor Services ..... 64
Personnel, Operations, and Maintenance ..... 65

III. PLAN DEVELOPMENT ..... 67

Overview ..... 67
Public Involvement and the Planning Process ..... 67
Summary of Issues, Concerns, and Opportunities ..... 69
Fish and Wildlife Population Management ..... 69
Habitat Management ..... 70
Resource Protection ..... 71
Visitor Services ..... 72
Refuge Administration ..... 72

IV. MANAGEMENT DIRECTION ..... 75

Introduction ..... 75
Vision ..... 76

Goals, Objectives, and Strategies ..... 77
Fish and Wildlife Population Management ..... 77
Habitat Management ..... 87
Resource Protection ..... 98
Visitor Services ..... 101

**SECTION B. ENVIRONMENTAL ASSESSMENT**

V. PLAN IMPLEMENTATION ..... 109
Introduction ..... 109
Proposed Projects ..... 109
Fish And Wildlife Population Management ..... 109
Habitat Management ..... 110
Resource Protection ..... 113
Visitor Services ..... 114
Refuge Administration ..... 114
Partnership and Volunteer Opportunities ..... 118
Step-Down Management Plans ..... 118
Monitoring and Adaptive Management ..... 118
Plan Review and Revision ..... 119

I. BACKGROUND ..... 121
Introduction ..... 121
Purpose and Need for Action ..... 121
Decision Framework ..... 122
Planning Study Area ..... 122
Authority, Legal Compliance, and Compatibility ..... 122
Public Involvement and the Planning Process ..... 123

II. AFFECTED ENVIRONMENT ..... 125

III. DESCRIPTION OF ALTERNATIVES ..... 127
Formulation of Alternatives ..... 127
Features and Management Common to all Alternatives ..... 127
Description of Alternatives ..... 127
Alternative A - (Current Management - No Action) Longleaf Pine Forest/Wildlife Management with RCW Focus and Visitor Services ..... 128
Alternative B - Maximizing Native Wildlife and Habitat Diversity While Providing Visitor Services ..... 130
Alternative C - (Proposed Alternative) Optimizing Ecosystem Management with Enhanced Visitor Services ..... 132
Comparison of the Alternatives by Issue ..... 134
Alternatives Considered but Eliminated from Further Analysis ..... 148

IV. ENVIRONMENTAL CONSEQUENCES ..... 149
Overview ..... 149
Effects Common to All Alternatives ..... 149
Environmental Justice ..... 149
Climate Change ..... 149

Other Management ....150
Land Acquisition ....150
Cultural Resources ....150
Refuge Revenue-Sharing ....151
Other Effects ....151
Summary of Effects by Alternative ....151
Unavoidable Impacts and Mitigation Measures ....162
Water Quality from Soil Disturbance and Use of Herbicides ....162
Wildlife Disturbance ....162
Vegetation Disturbance ....162
User Group Conflicts ....163
Effects on Adjacent Landowners ....163
Land Ownership and Site Development ....163
Cumulative Impacts ....163
Direct and Indirect Effects or Impacts ....164
Short-term Uses versus Long-term Productivity ....165

V. CONSULTATION AND COORDINATION ....167

Overview ....167

**APPENDICES**

APPENDIX A. GLOSSARY ....169

APPENDIX B. REFERENCES AND LITERATURE CITATIONS ....179

APPENDIX C. RELEVANT LEGAL MANDATES AND EXECUTIVE ORDERS ....187

APPENDIX D. PUBLIC INVOLVEMENT ....201

Summary of Public Scoping Comments ....201

APPENDIX E. APPROPRIATE USE DETERMINATIONS ....205

APPENDIX F. COMPATIBILITY DETERMINATIONS ....223

APPENDIX G. INTRA-SERVICE SECTION 7 BIOLOGICAL EVALUATION ....247

APPENDIX H. WILDERNESS REVIEW ....253

Summary of Refuge Wilderness Review ....253

APPENDIX I. REFUGE BIOTA ....255

APPENDIX J. BUDGET REQUESTS ....263

APPENDIX K. LIST OF PREPARERS ....267

## LIST OF FIGURES

Figure 1. Refuge location and boundary map....8
Figure 3. Public lands in Chesterfield County, South Carolina....14
Figure 4. Level III ecoregions of the eastern United States
Source:(http://edc2.usgs.gov/LT/LCCEUS.php)....16
Figure 5. Level III and IV ecoregions of South Carolina....17
Figure 6. Watershed-based ecosystem units, U.S. Fish and Wildlife Service....19
Figure 7. Daily average temperature and precipitation, Cheraw, Chesterfield County,
South Carolina (1971-2000)....26
Figure 8. Daily average temperature and precipitation, Pageland, Chesterfield County,
South Carolina (1971-2000)....26
Figure 9. Generalized geologic map of South Carolina....30
Figure 10. Generalized soil map of Chesterfield County, South Carolina....32
Figure 11. Average annual precipitation, evapotranspiration, and annual water yield....34
Figure 12. Generalized hydrogeologic cross-section for South Carolina....35
Figure 13. South Carolina watersheds....37
Figure 14. Population growth in Chesterfield County, South Carolina 1900-2005....54
Figure 15. Red-cockaded woodpecker population data 1998 through 2009 on
Carolina Sandhills NWR....63
Figure 16. Proposed organizational chart—Carolina Sandhills NWR....116

## LIST OF TABLES

Table 1. Cheraw, SC1588 (1971-2000) Chesterfield County, South Carolina....24
Table 2. Pageland, SC 6616 (1971-2000) Chesterfield County, South Carolina....25
Table 3. Air quality statistics by city/county, 2007....38
Table 4. Regional air quality trends – Charlotte – Columbia – Florence MSA, 1990-2007....39
Table 5. Summary of habitat types on Carolina Sandhills NWR....45
Table 6 Demographics of Chesterfield County, South Carolina....53
Table 7 Activities in South Carolina by U.S. residents....55
Table 8. Proposed positions to achieve desired future conditions and optimally manage refuge natural, cultural, and administrative resources....115
Table 9. Summary of projects (not in priority order; organized by goal, e.g., wildlife, habitat, resource protection, and visitor services)....117
Table 10. Carolina Sandhills NWR step-down management plans related to the goals and objectives of the CCP....118
Table 11. Comparison of alternatives by management issues for Carolina Sandhills NWR....135
Table 12. Summary of environmental effects by alternative, Carolina Sandhills NWR....155
Table I-1. Commonly observed reptiles and amphibians of Carolina Sandhills NWR....255
Table I-2. Conspicuous flowering plants at Carolina Sandhills NWR....256
Table I-3. Carolina Sandhills NWR bird list....257
Table I-4. Species of special concern and state threatened that occur on Carolina Sandhills NWR....260
Table I-5. Priority aquatic species of the Southeastern Plains Ecobasin (Pee Dee Watershed portion only)....261

**SECTION A. DRAFT COMPREHENSIVE CONSERVATION PLAN**

# *I. Background*

## INTRODUCTION

This Draft Comprehensive Conservation Plan and Environmental Assessment (Draft CCP/EA) for Carolina Sandhills National Wildlife Refuge (NWR) was prepared to guide refuge management actions and direction for the next 15 years. Fish and wildlife conservation will receive first priority in refuge management; wildlife-dependent recreation will be permitted and encouraged as long as it is compatible with, and does not detract from, the mission of the refuge or the purposes for which it was established.

A planning team developed a range of alternatives that best met the goals and objectives of the refuge and that could be implemented within the 15-year planning period. This Draft CCP/EA describes the Fish and Wildlife Service's (Service) proposed plan, as well as other alternatives considered and their effects on the environment. The Draft CCP/EA will be made available to state and federal government agencies, conservation partners, and the general public for review and comment. Comments from each entity will be considered in the development of the final CCP.

## PURPOSE AND NEED FOR THE PLAN

The purpose of the CCP is to develop a management action that best achieves the refuge purpose; attains the vision and goals developed for the refuge; contributes to the National Wildlife Refuge System (Refuge System) mission; addresses key problems, issues and relevant mandates; and is consistent with sound principles of fish and wildlife management.

Specifically, the CCP is needed to:

- Provide a clear statement of refuge management direction;
- Provide refuge neighbors, visitors, and government officials with an understanding of Service management actions on and around the refuge;
- Ensure that Service management actions, including land protection and recreation/education programs, are consistent with the mandates of the Refuge System; and
- Provide a basis for the development of budget requests for operations, maintenance, and capital improvement needs.

## FISH AND WILDLIFE SERVICE

The Service traces its roots to 1871 and the establishment of the Commission of Fisheries involved with research and fish culture. The once-independent commission was renamed the Bureau of Fisheries and placed under the Department of Commerce and Labor in 1903.

The Service also traces its roots to 1886 and the establishment of a Division of Economic Ornithology and Mammalogy in the Department of Agriculture. Research on the relationship of birds and animals to agriculture shifted to delineation of the range of plants and animals so the name was changed to the Division of the Biological Survey in 1896.

The Department of Commerce, Bureau of Fisheries, was combined with the Department of Agriculture, Bureau of Biological Survey, on June 30, 1940, and transferred to the Department of the Interior as the Fish and Wildlife Service. The name was changed to the Bureau of Sport Fisheries and Wildlife in 1956 and finally to the Fish and Wildlife Service in 1974.

The Fish and Wildlife Service, working with others, is responsible for conserving, protecting, and enhancing fish and wildlife and their habitats for the continuing benefit of the American people through federal programs relating to migratory birds, endangered species, interjurisdictional fish and marine mammals, and inland sport fisheries (142 DM 1.1).

As part of its mission, the Service manages more than 540 national wildlife refuges covering more than 95 million acres. These areas comprise the National Wildlife Refuge System, the world's largest collection of lands set aside specifically for fish and wildlife. The majority of these lands, 77 million acres, is in Alaska. The remaining acres are spread across the other 49 states and several United States territories. In addition to refuges, the Service manages thousands of small wetlands, national fish hatcheries, 64 fishery resource offices, and 78 ecological services field stations. The Service enforces federal wildlife laws, administers the Endangered Species Act, manages migratory bird populations, restores nationally significant fisheries, conserves and restores wildlife habitat, 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.

## NATIONAL WILDLIFE REFUGE SYSTEM

The mission of the National Wildlife Refuge System, as defined by the National Wildlife Refuge System Improvement Act (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 (Improvement Act) established, for the first time, a clear legislative mission of wildlife conservation for the Refuge System. Actions were initiated in 1997 to comply with the direction of this new legislation, including an effort to complete comprehensive conservation plans for all refuges. These plans, which are completed with full public involvement, help guide the future management of refuges by establishing natural resources and recreation/education programs. Consistent with the Improvement Act, approved plans will serve as the guidelines for refuge management for the next 15 years. The Improvement Act states that each refuge shall be managed to:

- Fulfill the mission of the Refuge System;
- Fulfill the individual purposes of each refuge;
- Consider the needs of wildlife first;
- Complete comprehensive conservation plans for each unit of the Refuge System;

- Maintain the biological integrity, diversity, and environmental health of the Refuge System; and
- 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 authorize refuge managers to determine compatible public uses.

The following are just a few examples of your national network of conservation lands. Pelican Island National Wildlife Refuge, the first refuge, was established in 1903 for the protection of colonial nesting birds in Florida, such as the snowy egret and the brown pelican. Western refuges were established for American bison (1906), elk (1912), prong-horned antelope (1931), and desert bighorn sheep (1936) after over-hunting, competition with cattle, and natural disasters decimated once-abundant herds. The drought conditions of the 1930s "Dust Bowl" severely depleted breeding populations of ducks and geese. Refuges established during the Great Depression focused on "waterfowl production areas" (i.e., protection of prairie wetlands in America's heartland). The emphasis on waterfowl continues today and now includes protection of wintering habitat in response to a dramatic loss of bottomland hardwoods. By 1973, the Service had begun to focus on establishing refuges for endangered species.

Approximately 38 million people visited national wildlife refuges in 2002, most to observe wildlife in their natural habitats. As the number of visitors grows, there are significant economic benefits to local communities. In 2001, 82 million people, 16 years and older, fished, hunted, or observed wildlife, generating $108 billion. In a study completed in 2002 on 15 refuges, 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 local economies. The 15 refuges in the study were Chincoteague (Virginia); National Elk (Wyoming); Crab Orchard (Illinois); Eufaula (Alabama); Charles M. Russell (Montana); Umatilla (Oregon); Quivira (Kansas); Mattamuskeet (North Carolina); Upper Souris (North Dakota); San Francisco Bay (California); Laguna Atacosa (Texas); Horicon (Wisconsin); Las Vegas (Nevada); Tule Lake (California); and Tensas River (Louisiana), the same refuges identified for the 1995 study. Other data validate the finding 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 dollar spent on the Refuge System, surrounding communities benefited with $4.43 in recreation expenditures and $1.42 in job-related income (Caudill and Laughland 2002).

Volunteers continue to be a major contributor to the success of the Refuge System. In 2002, volunteers contributed more than 1.5 million hours on refuges nationwide, a service valued at more than $22 million.

The wildlife and habitat vision for national wildlife refuges stresses that wildlife comes first; that ecosystems, biodiversity, and wilderness are vital concepts in refuge management; that refuges must be healthy and growth must be strategic; and that the Refuge System serves as a model for habitat management with broad participation from others.

The National Wildlife Refuge System Improvement Act of 1997 (Improvement Act) stipulates that comprehensive conservation plans be prepared in consultation with adjoining federal, state, and private landowners and that the Service develop and implement a process to ensure an opportunity for active public involvement in the preparation and revision (every 15 years) of the plans.

All lands of the Refuge System will be managed in accordance with an approved comprehensive conservation plan that will guide management decisions and set forth strategies for achieving refuge

unit purposes. The plan will be consistent with sound resource management principles, practices, and legal mandates, including Service compatibility standards and other Service policies, guidelines, and planning documents (602 FW 1.1).

## LEGAL AND POLICY CONTEXT

### Legal Mandates, Administrative and Policy Guidelines, and Other Special Considerations

Administration of national wildlife refuges is guided by the mission and goals of the 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. Select legal summaries of treaties and laws relevant to administration of the Refuge System and management of the Carolina Sandhills NWR are provided in Appendix C.

Treaties, laws, administrative guidelines, and policy guidelines assist the refuge manager in making decisions pertaining to soil, water, air, flora, fauna, and other natural resources; historical and cultural resources; research and recreation on refuge lands; and provide a framework for cooperation between Carolina Sandhills NWR and other partners, such as the South Carolina Department of Natural Resources, South Carolina Forestry Commission, Sand Hills State Forest, Friends of Carolina Sandhills NWR, and private landowners, etc.

Lands within the Refuge System are closed to public use unless specifically and legally opened. No refuge use may be permitted unless it is determined to be compatible. A compatible use is a use that, in the sound professional judgment of the refuge manager, will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge. All programs and uses must be evaluated based on mandates set forth in the Improvement Act. Those 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; and
- Ensure that visitor activities are compatible with refuge purposes.

The Improvement Act further identifies six priority wildlife-dependent recreational uses. These uses are: hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation. As priority public uses of the Refuge System, they receive priority consideration over other public uses in planning and management.

### Biological Integrity, Diversity, and Environmental Health Policy

The Improvement Act directs the Service to ensure that the biological integrity, diversity, and environmental health of the Refuge System are maintained for the benefit of present and future generations of Americans. The policy is an additional directive for refuge managers to follow while achieving refuge purpose(s) and the Refuge System mission. It provides for the consideration and protection of the broad spectrum of fish, wildlife, and habitat resources found on refuges and associated ecosystems. When evaluating the appropriate management direction for refuges, refuge managers will use sound professional judgment to determine the refuges' contribution to biological

integrity, diversity, and environmental health at multiple landscape scales. Sound professional judgment incorporates field experience, knowledge of refuge resources, refuge role within an ecosystem, applicable laws, and best available science, including consultation with others both inside and outside the Service.

## NATIONAL AND INTERNATIONAL CONSERVATION PLANS AND INITIATIVES

Multiple partnerships have been developed among government and private entities to address the environmental problems affecting regions. There is a large amount of conservation and protection information that defines the role of the refuge at the local, national, international, and ecosystem levels. Conservation initiatives include broad-scale planning and cooperation between affected parties to address declining trends of natural, physical, social, and economic environments. The conservation guidance described below, along with issues, problems, and trends, was reviewed and integrated where appropriate into Draft CCP/EA.

This Draft CCP/EA supports, among others, the Partners-in-Flight Plan, the North American Waterfowl Management Plan, the Western Hemisphere Shorebird Reserve Network, and the National Wetlands Priority Conservation Plan.

**North American Bird Conservation Initiative.** Started in 1999, the North American Bird Conservation Initiative is a coalition of government agencies, private organizations, academic institutions, and private industry leaders in the United States, Canada, and Mexico, working to ensure the long-term health of North America's native bird populations by fostering an integrated approach to bird conservation to benefit all birds in all habitats. The four international and national bird initiatives include the North American Waterfowl Management Plan, Partners-in-Flight, Waterbird Conservation for the Americas, and the U.S. Shorebird Conservation Plan.

**North American Waterfowl Management Plan.** The North American Waterfowl Management Plan is an international action plan to conserve migratory birds throughout the continent. The plan's goal is to return waterfowl populations to their 1970s levels by conserving wetland and upland habitat. Canada and the United States signed the plan in 1986 in reaction to critically low numbers of waterfowl. Mexico joined in 1994, making it a truly continental effort. The plan is a partnership of federal, provincial/state and municipal governments, non-governmental organizations, private companies, and many individuals, all working towards achieving better wetland habitat for the benefit of migratory birds, other wetland-associated species and people. Plan projects are international in scope, but implemented at regional levels. These projects contribute to the protection of habitat and wildlife species across the North American landscape.

**Partners-in-Flight Bird Conservation Plan.** Managed as part of the Partners-in-Flight Plan, the Carolina Sandhills NWR represents a scientifically based land bird conservation planning effort that ensures long-term maintenance of healthy populations of native land birds, primarily non-game land birds. Non-game land birds have been vastly under-represented in conservation efforts, and many are exhibiting significant declines. This plan is voluntary and non-regulatory, 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.

**U.S. Shorebird Conservation Plan.** The U.S. Shorebird Conservation Plan is a partnership effort throughout the United States to ensure that stable and self-sustaining populations of shorebird species are restored and protected. The plan was developed by a wide range of agencies, organizations, and shorebird experts for separate regions of the country, and identifies 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.

**Northern American Waterbird Conservation Plan.** This plan provides a framework for the conservation and management of 210 species of waterbirds in 29 nations. Threats to waterbird populations include destruction of inland and coastal wetlands, introduced predators and invasive species, pollutants, mortality from fisheries and industries, disturbance, and conflicts arising from abundant species. Particularly important habitats of the southeast region include pelagic areas, marshes, forested wetlands, and barrier and sea island complexes. Fifteen species of waterbirds are federally listed, including breeding populations of wood storks, Mississippi sandhill cranes, whooping cranes, interior least terns, and Gulf Coast populations of brown pelicans. A key objective of this plan is the standardization of data collection efforts to better recommend effective conservation measures.

## RELATIONSHIP TO STATE WILDLIFE AGENCY, SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES

A provision of the Improvement Act and subsequent agency policy is that the Service shall ensure timely and effective cooperation and collaboration with other state fish and game agencies and tribal governments during the course of acquiring and managing refuges. State wildlife management areas and national wildlife refuges provide the foundation for the protection of species, and contribute to the overall health and sustainability of fish and wildlife species in the State of South Carolina.

The South Carolina Department of Natural Resources (SCDNR) (http://dnr.sc.gov/index.html), as organized on July 1, 1994 under the South Carolina Restructuring Act, is composed of the former Wildlife and Marine Resources Department, Water Resources Commission (non-regulatory programs), Land Resources Commission (non-regulatory programs), State Geological Survey (State Geologist), and South Carolina Migratory Waterfowl Committee. The SCDNR's mission is to serve as the principal advocate for and steward of South Carolina's natural resources. Its vision for South Carolina is an enhanced quality of life for present and future generations through improved understanding, wise use, and safe enjoyment of healthy, diverse, sustainable and accessible natural resources. SCDNR is divided into an executive group and five divisions: Land, Water and Conservation; Law Enforcement, Marine Resources, Outreach and Support Services, and Wildlife and Freshwater Fisheries.

The state's participation and contribution throughout this planning process will provide for ongoing opportunities and open dialogue to improve the ecological sustainability of fish and wildlife in the State of South Carolina. An essential part of comprehensive conservation planning is integrating common mission objectives where appropriate. For example, the SCDNR finalized its Comprehensive Wildlife Conservation Strategy in 2005. This Draft CCP/EA dovetails with that plan by integrating appropriate elements.

# II. Refuge Overview

## INTRODUCTION

The Carolina Sandhills NWR is in Chesterfield County, South Carolina. Work on the Carolina Sandhills NWR Draft CCP/EA was initiated in January 2007, and is scheduled for completion in September 2009. The CCP contains concepts to guide development and implementation of land use and management programs and associated facilities for the next 15 years. Consideration of the refuge's physical, biological, and cultural resources; the socioeconomic environment; and refuge management and administration is taken into account and analyzed to produce an overview of the refuge and the challenges it faces. The EA is prepared in compliance with the National Environmental Policy Act (NEPA) guidelines. In addition to documenting the existing environmental and socioeconomic setting, the EA evaluates the impact of the proposed and alternative actions including a no action alternative in order to facilitate selection of the alternative most suitable for implementation.

The Carolina Sandhills NWR is in a rural area in the northeastern region of South Carolina. The refuge is comprised of 47,850 acres, including fee ownership of 45,348 acres, and nine conservation easements totaling 2,502 acres. The majority of the refuge lies in Chesterfield County, South Carolina, with one fee title tract totaling 210 acres in Marlboro County. The refuge is managed by the Service. Its primary use is hunting; although wildlife observation, hiking, and fishing are also popular.

The refuge was established by Executive Order 8067, dated March 17, 1939, under the authority of the 1933 National Industrial Recovery Act and the Emergency Relief Appropriations of 1935. The Federal Government purchased land from willing sellers through the Resettlement Administration. The badly eroded land supported few populations of wildlife species; initial conservation efforts focused on restoring the barren land. Today, the refuge is managed to restore the longleaf pine/wiregrass ecosystem.

Within the refuge there are 30 small man-made impoundments, 1,200 acres of fields and forest openings, and more than 42,000 acres of forested woodland, habitats which contribute to the refuge's diversity of flora and fauna. Management of the refuge's unique blend of pinelands, pocosin bottoms, freshwater ponds and lakes, croplands, openings, and small food plots provide havens for nearly 200 species of birds, 42 species of mammals, 41 species of reptiles, 25 species of amphibians, and more than 750 plant species. The largest population of endangered red-cockaded woodpeckers within the Refuge System; rare plants, including several species of carnivorous pitcher plants; and the unusual Pine Barrens treefrog are all found in the refuge. Figure 1 illustrates the refuge location and boundary.

## REFUGE HISTORY AND PURPOSE

### HISTORY

South Carolina is composed primarily of four physiographic provinces (Atlantic Coastal Plain/Coastal Zone, Sandhills, Piedmont Plateau, and Blue Ridge Mountains) (Figure 2). The Atlantic Coastal Plain/Coastal Zone is nearly flat and composed entirely of geologically recent sediments such as sand, silt, and clay. The Piedmont Plateau contains the roots of an ancient, eroded mountain chain. Along the southeastern edge of the Piedmont is the Fall Line, where rivers drop to the Coastal Plain. The Sandhills region, a strip of ancient beach dunes, divides the Coastal Plain from the higher Piedmont. The Coastal

**Figure 1. Refuge location and boundary map**

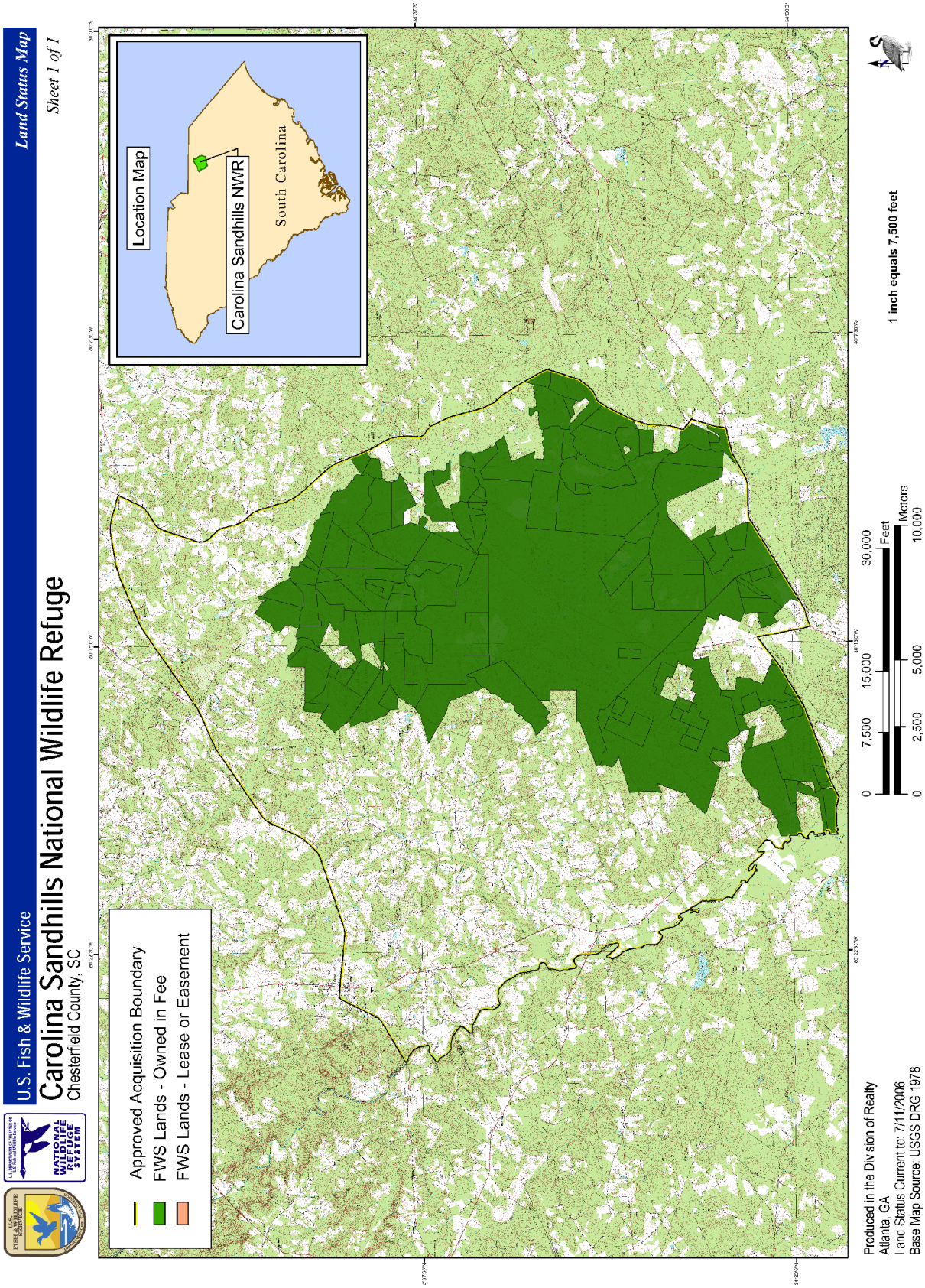
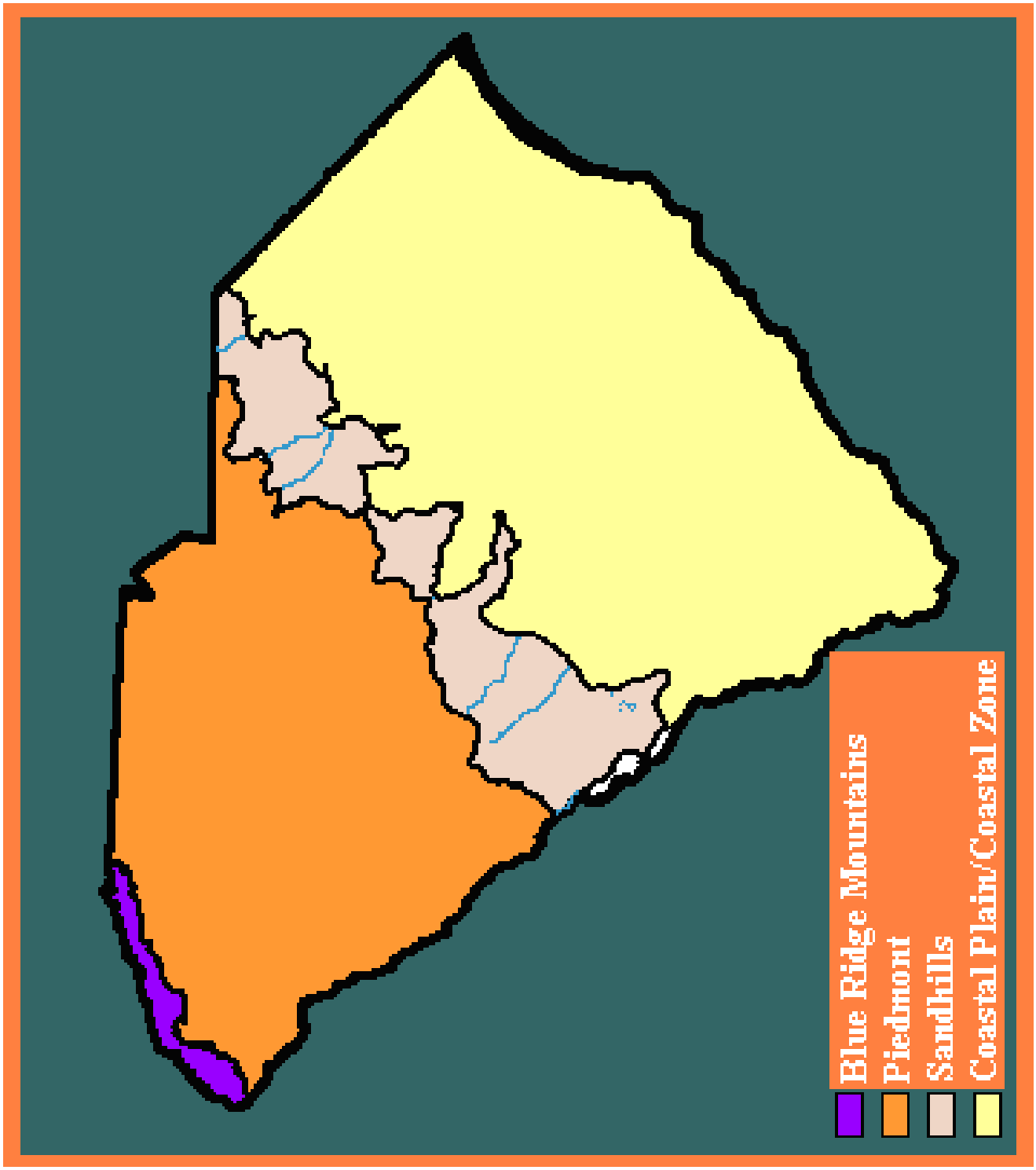


**Figure 2. Physiographic provinces of South Carolina**



Plain is remnant of a former inland coastline formed during the Miocene Epoch. Rivers and streams drained the Piedmont, depositing silt and sand, eventually forming bands of sand dunes. These rolling beds of deep sandy soil are now host to an extensive longleaf forest. The Carolina Sandhills NWR lies along this Fall Line. (South Carolina Department of Natural Resources 2005a).

Human habitation of the Sandhills has probably existed for more than 10,000 years. Before the arrival of European man, scattered Native American tribes, which were later known as the Catawba Indian Nation, sparsely populated the region. Little information is available concerning the early history of European settlement in this area. Not until the 16th century did explorers visit the area and for the next 150 years, the only people to visit the region on a regular basis were trappers and traders in search of furs and hides. Welsh settlers from Pennsylvania and Delaware first moved into this region and began to establish permanent settlements in inland South Carolina in the mid-1700s (USFWS 2007a). The settlers were later joined by Scotch-Irish and English. The oldest town in the immediate area of the refuge is Cheraw, Chesterfield County, which was settled around 1748 and was a center for transportation along the Pee Dee River. Chesterfield County was formed in 1785, and is now largely agricultural. General Sherman's troops passed through this area during the Civil War, briefly occupying the towns of Cheraw and Chesterfield (South Carolina State Library 2006).

Vast longleaf pine forests dominated the landscape of the Sandhills when Europeans first settled the area. By the late 1800s, the forests supported major lumber and naval store industries. However, by the early 1900s, the forests were depleted and farming became the predominant lifestyle in the region. (A discussion of the demise of the longleaf pine/wiregrass ecosystem can be found in Chapter II.

Fire suppression and over-harvesting of longleaf pine, along with poor agricultural practices and deep infertile soils led to the collapse of the timber and agricultural industries. In contrast to the settlement pattern for most of South Carolina, the Sandhills were not settled primarily by farmers. Due to the inability of Sandhills soils to hold water, only a small percentage of this region is considered good for farmland, even with modern practices. In the 1700s, it was nearly worthless from an agricultural perspective. In fact, George Washington, after passing through the Sandhills from Augusta to Columbia, remarked that the land was probably the poorest that he had ever seen. This region is by no means a desert, but the native plants are adapted for quick use of the abundant but periodic rain water in ways which most agricultural crops are not (SCDNR 2000).

The Old Wire Road -- The Old Wire Road is a remnant of an early stage coach route that had one of South Carolina's first telegraph wires strung alongside of it. The road is not paved and in certain segments within the refuge it is closed to vehicular traffic. In most places, Old Wire Road follows the top of a sand ridge to avoid problems with stream crossings. This is said to be the route followed by General Sherman's army during the Civil War when it marched from Columbia, South Carolina, into North Carolina. Old breastworks can be found in the woods along Old Wire Road near its intersection with State Highway 102. A grave marker for a confederate soldier is located on Scotch Road near the turnoff for the Sugarloaf Mountain Recreation Area (SCDNR 2000).

The Bombing of Patrick -- An unusual clearing in the Carolina Sandhills NWR, just south of Rogers Branch and east of State Highway 145, holds a special historical significance. During World War II, this part of the refuge was used as a U.S. Army Air Force bombing range where pilots could practice their skills. The cleared area was mowed in such a way as to generate a large "X" shaped feature that pilots could use as their target. The "X" was lit up at night so pilots could practice after dark. On one occasion, a plane accidentally bombed the nearby town of Patrick, mistaking street lighting at the town crossroads for the intended target. Fortunately, the practice bombs contained flour instead of gunpowder, and no damage was done. Today, the old

bombing field still displays the "X" shaped pattern, but the lights have been removed. The north and east quarters are planted to wildlife food crops, while the south and west quarters are planted to grass. Dove hunts annually take place on the site (SCDNR 2000).

Transfer of lands to the SC Forestry Commission -- In the 1930s, the Federal Government acquired lands in Chesterfield and Darlington Counties as part of the land utilization project. This program acquired eroded and abused lands and provided owners with more productive lands elsewhere. On March 17, 1939, Executive Order 8067 established the Carolina Sandhills NWR. In April 1939, a Cooperative and License Agreement between the Secretary of Agriculture and the South Carolina Forestry Commission was signed, which established the use of a portion of the property by the Forestry Commission as a demonstration-conservation area. This area, encompassing 46,339 acres, became known as the Carolina Sandhills Wildlife Management Area. The primary concern at the time was developing and rehabilitating the land, providing short- and long-term employment opportunities, and establishing a resource base for a permanent rural economy. Other objectives provided for the development of wildlife populations sufficient to allow public hunting, recreational opportunities of all types, research and demonstration for forest conservation practices, and production of timber crops. In January 1989, legislation was proposed to transfer title of these lands from the Federal Government to the Forestry Commission in exchange for basic fire protection for 50 years; prescribed burning services for 5 years; and designated reforestation services for converting 2,300 acres of slash pine to native longleaf pine not to exceed a 25-year-period. The transfer was completed in 1991 (South Carolina Forestry Commission 2004).

## PURPOSE

Franklin D. Roosevelt established the Carolina Sandhills NWR by Executive Order 8067, on March 17, 1939, under authority of the 1933 National Industrial Recovery Act and the Emergency Relief Appropriation of 1935 and designated management of the refuge to the Service. The original purposes of the refuge were to provide habitat for migratory birds, to demonstrate sound management practices that would enhance natural resources conservation, and to provide wildlife-dependent recreation opportunities.

Over time, restoration efforts have reestablished this once-damaged, barren land to a healthy, rich habitat for plants and animals. The responsibilities of the Service have expanded to help restore and enhance the longleaf pine habitat for the benefit of the red-cockaded woodpecker, designated as an endangered species in 1970. Today, the refuge operates under mandates to provide environmental education and interpretation of its work. Improving habitat and restoring native plant communities, monitoring populations of the red-cockaded woodpecker and other species, and assessing the impacts of management actions on wildlife and habitats are all critical elements in the refuge's operations.

In keeping with the mission of the Refuge System " to preserve a national network of lands and waters for the conservation and management of fish, wildlife, and plant resources of the United States for the benefit of present and future generations" (Executive Order 12996, March 1996), the Carolina Sandhills NWR has five primary objectives:

1) To restore, maintain, and enhance longleaf pine habitat and associated plant and animal species:

   The longleaf pine/wiregrass ecosystem, the characteristic habitat of the Carolina Sandhills NWR, once covered more than 90 million acres across the southeastern United States, stretching from Virginia to Texas. This unique ecosystem, shaped by thousands of years of natural fires that burned through the area every 2 to 4 years, has been reduced to fewer than 2 million acres.

Today, only scattered patches of this once-immense forest remain, with most occurring on public lands. Factors contributing to the demise of the ecosystem include aggressive fire suppression efforts, deforestation for agriculture and development, and conversion to other pine types.

Carolina Sandhills NWR serves as a demonstration site for land management practices, which conserve and enhance the diminishing longleaf pine/wiregrass ecosystem.

2) To conserve, restore, and enhance threatened or endangered species, with special emphasis on the red-cockaded woodpecker (RCW):

Several state and federal listed threatened and endangered species are found on the refuge, including the Pine Barrens tree frog, white wicky, and the RCW. Unlike other woodpeckers, the RCW roosts and nests in cavities of living southern pines. The RCW serves as an indicator species for the health of the longleaf pine/wiregrass ecosystem. The RCW is also referred to as a "keystone" species," having dozens of other animals use its cavity either as a convenience or as a requirement of survival.

3) To provide habitat for migratory birds:

The Carolina Sandhills NWR provides stop-over or nesting habitat for many species of neotropical migratory birds and resident songbirds, including the prairie warbler, Bachman's sparrow, American redstart, and Kentucky warbler.

Several species of waterfowl may be found in the fall and winter, including mallards, black ducks, pintails, green-winged teal, American widgeon, ring-necked ducks, and hooded mergansers. Canada geese and wood ducks may be seen in the refuge pools year-round.

4) To provide opportunities for environmental education, interpretation, and wildlife-oriented recreation:

Environmental education programs are conducted throughout the year for school children, civic organizations, and the general public. Wildlife interpretive displays and literature are available on-site to help the visitor better understand the refuge and its objectives. Several of these items can also be downloaded from the Carolina Sandhills NWR website (www.fws.gov/carolinasandhills).

5) To demonstrate sound land management practices that enhance natural resource conservation:

The staff at the Carolina Sandhills NWR uses a number of management techniques in support of its stated objectives. These include prescribed burning, which mimics the natural fires that historically burned through the longleaf pine/wiregrass ecosystem every few years. These fires suppress the growth of hardwood trees, creating an open park-like condition preferred by the red-cockaded woodpecker and many other animals and plants native to this ecosystem.

Pond and lake water levels are also manipulated seasonally to encourage the growth of desired emergent aquatic vegetation and control unwanted submergent vegetation, which left unchecked, could degrade pond habitat over time. Water level manipulation can also enhance resource availability for fish and waterfowl.

## SPECIAL DESIGNATIONS

Carolina Sandhills NWR is one of the 14 Land Management Research and Demonstration (LMRD) Areas managed by the Service. These sites serve as institutions of investigation, innovation, and instruction in wildlife and habitat management. Carolina Sandhills and St. Mark's NWRs were chosen as LMRD areas that are restoring and managing the range of subtypes of longleaf pine forest, from xeric sandhills to mesic flatwoods and hydric savannahs. In the future, a specialized biologist will oversee the research, development, and testing of new management techniques at each demonstration site. Through wildlife inventorying and habitat monitoring, the sites will become a repository of data and information about featured habitats or management issues (USFWS 2007b).

Lands within the Carolina Sandhills NWR were reviewed for their suitability in meeting the criteria for wilderness areas, as defined by the Wilderness Act of 1964. No areas in the refuge were found to meet those criteria. Therefore, the suitability of refuge lands for wilderness designation is not further analyzed in this Draft CCP/EA (National Wilderness Preservation System 2004).

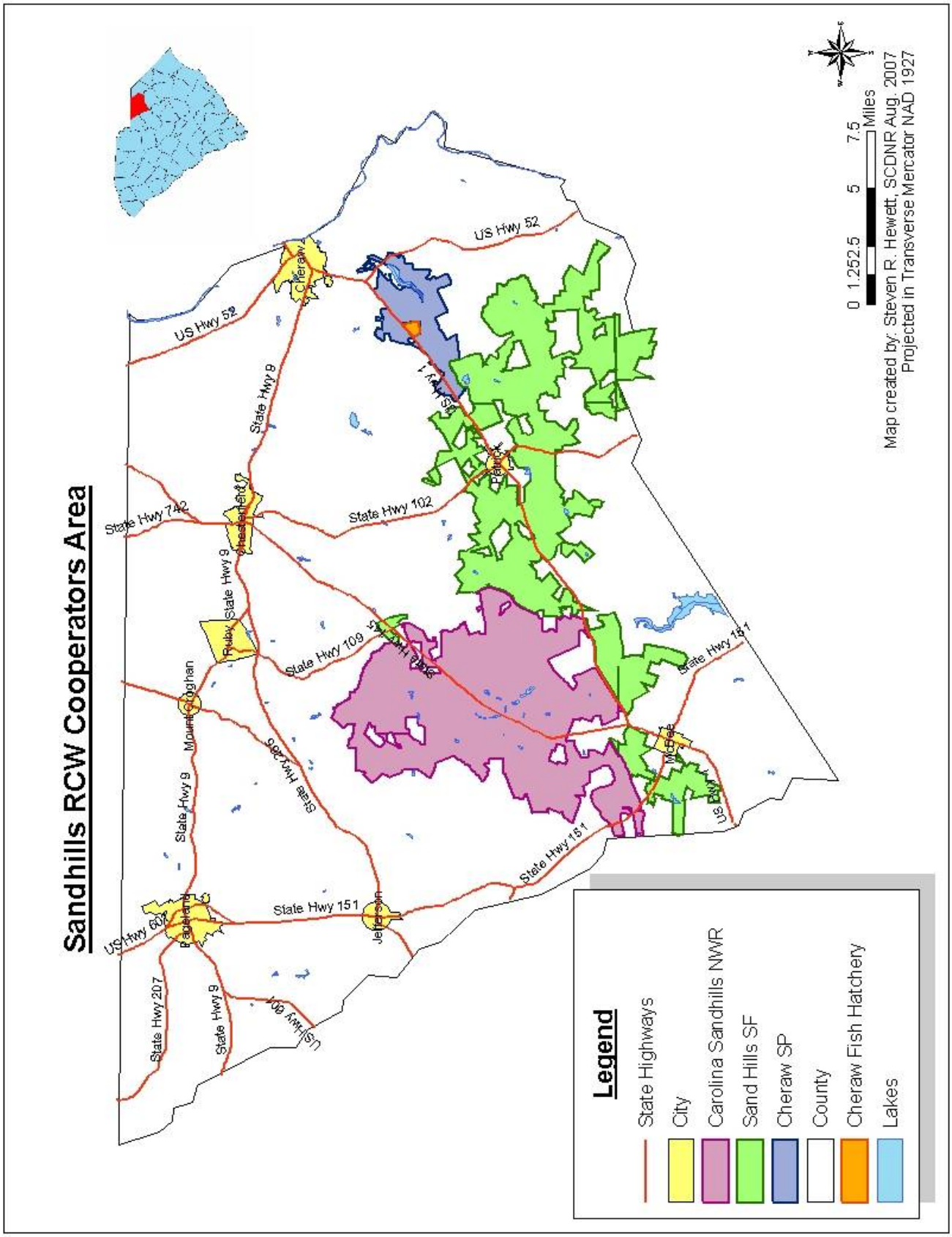
There are no Outstanding Resource Waters (ORW) designated by the State of South Carolina, [nor Outstanding National Resource Waters (ONRW)] in the Carolina Sandhills NWR (South Carolina Department of Health and Environmental Control 2004). However, the State of South Carolina does designate the upper Lynches River (which flows along the western boundary of the Carolina Sandhills NWR) and its sandhills tributaries which drain the refuge (Rocky Creek, Big Sandy Creek, Little Sandy Creek, and Swift Creek) as an area of primary conservation concern (SCDNR 2005a). In addition, a 54-mile segment of the Lynches River is a designated Scenic River, from U.S. 15 near Bishopville to the eastern boundary of Lynches River State Park (in Darlington and Lee Counties), just downstream of the refuge (SCDNR 2009a).

Also considered in nearby Chesterfield County, were a state forest and two state parks (Figure 3). Along with the refuge, this aggregate of public lands encompasses nearly 100,000 acres of longleaf pine forests and plant assemblages:

- The Sand Hills State Forest, which adjoins the Carolina Sandhills NWR to the south and east, is a unit of the South Carolina Forestry Commission and a designated Wildlife Management Area in the SCDNR system. The Sand Hills State Forest encompasses 46,000 acres of forest, which provide hiking and nature trails, camping sites, birding, picnic shelters, a fishing lake, mountain biking and horseback trails, wildlife observation, and ponds. The Sand Hills State Forest is a demonstration area for forest management. During the early years, the forest was leased from the Federal Government, with the objective to restore the land and demonstrate conservation forestry. In 1991, the lands were transferred in fee title to the State of South Carolina. The forest is managed for longleaf pine, red-cockaded woodpeckers, and sustained multiple uses such as pine straw production, timber, and recreation (SCFC 2004). The Sand Hills State Forest, along with the Carolina Sandhills NWR, constitutes a secondary core population of RCW within the Sandhills Recovery Unit (USFWS 2003b).

- Part of the Cheraw State Park is the H. Cooper Black Jr. Memorial Field Trial and Recreation Area which is used for national-level field trial and retriever competitions. This area includes 7,000 acres of rolling acres of longleaf pine forest and fields managed by the South Carolina Forestry Commission and recreation facilities, including stables, kennels, corrals, arenas, campgrounds and a kitchen/meeting hall, managed by the South Carolina Department of Parks, Recreation and Tourism [SCPRT]. There also are more than 20 miles of equestrian trails and sand roads for riders in the park, some that lead into Sand Hills State Forest and Cheraw State Park (SCPRT 2009a).

**Figure 3. Public lands in Chesterfield County, South Carolina**



- Cheraw State Park (i.e., Cheraw State Recreation Area), founded in 1934, is the oldest state park in South Carolina. Its 7,361 acres are managed by the SCPRT. It was developed by the Civilian Conservation Corps (CCC), a New Deal Program created by President Franklin D. Roosevelt. The program was designed to provide employment during the Great Depression, while addressing national needs in conservation and recreation. The park offers a championship golf course, cabins, camping, boating, fishing, hiking and other recreational activities. Significant natural features of Cheraw State Park are its longleaf pine forest that supports red-cockaded woodpeckers and extensive wetlands with stands of Atlantic white cedar trees. In addition, the Hudsonia Flats Heritage Trust Site protects populations of rare plants, including golden heather, pyxie moss, as well as other species (SCPRT 2009a).

- The Cheraw Fish Hatchery was constructed in 1937 with federal funds and assigned to the state for operation and maintenance. However, the facility was returned to the Federal Government in Fiscal year 1947, and renamed Cheraw National Fish Hatchery. Ownership of the hatchery was returned to the state in 1983 as part of the Service's effort to reduce warm water hatchery operations throughout the federal system. Over 3 million sport fish are produced annually for release into South Carolina's public lakes and rivers. Species produced include striped bass, largemouth bass, smallmouth bass, bluegill, redear, redbreast sunfish, and channel catfish (SCDNR 2007).

**ECOSYSTEM CONTEXT**

An ecosystem is a geographical area that includes and interconnects all the living (biotic) organisms, their physical (abiotic) surroundings, and the natural cycles that sustain them.

The United States (including Alaska, Hawaii, and Puerto Rico) is comprised of 14 Ecosystem Divisions. Of these 14, the Subtropical Division includes the Southern Atlantic and Gulf Coast states. Within the Subtropical Division are two Provinces: the Southeastern Mixed Forest Province (an area of about 193,000 square miles, comprising the Piedmont and parts of the Gulf Coastal Plains); and the Outer Coastal Plain Mixed Province (an area of about 174,000 square miles, comprising the Middle Atlantic and Southern Coastal Plains (Bailey 1978).

The Southeastern Plains (Level III) Ecoregion, shown in Figure 4 as area 65, overlies and straddles parts of these two provinces. The Southeastern Plains is the largest ecoregion in the southeast, covering about 130,000 square miles. The Southeastern Plains are a mosaic of cropland, pasture, woodland, and forest. Natural vegetation is predominantly longleaf pine, with smaller areas of oak-hickory-pine and Southern mixed forest. Much of the natural forest has been replaced by managed timberlands. The ecoregion is characterized by a long growing season and abundant rainfall, but relatively poor sandy soils, which limit agricultural competitiveness with many other Ecoregions. The Cretaceous or Tertiary-age sands, silts, and clays of the ecoregion contrast geologically with the older metamorphic and igneous rocks of the Piedmont (area 45), and with the Paleozoic limestone, chert, and shale found in the Interior Plateau (area 71). Elevations and relief are greater than in the Southern Coastal Plain (area 75), but generally less than in much of the Piedmont. Streams in this area are relatively low-gradient and sandy-bottomed (Griffith et. al. 2002, U.S. Geological Survey 2008).

The Carolina Sandhills NWR sits astride a most remarkable longleaf pine range: the Sandhills (Level IV) Ecoregion. The Sandhills Ecoregion (area 65c) of the Southeastern Plains is wedged between the Middle Atlantic/Southern Coastal Plains and the Piedmont, as shown in Figure 5. The sandhills is a rolling-to-hilly region composed primarily of Cretaceous age marine sands and clays, capped in places with Tertiary sands, deposited over the crystalline and metamorphic rocks of the Piedmont.

**Figure 4. Level III ecoregions of the eastern United States**
**Source: (http://edc2.usgs.gov/LT/LCCEUS.php)**

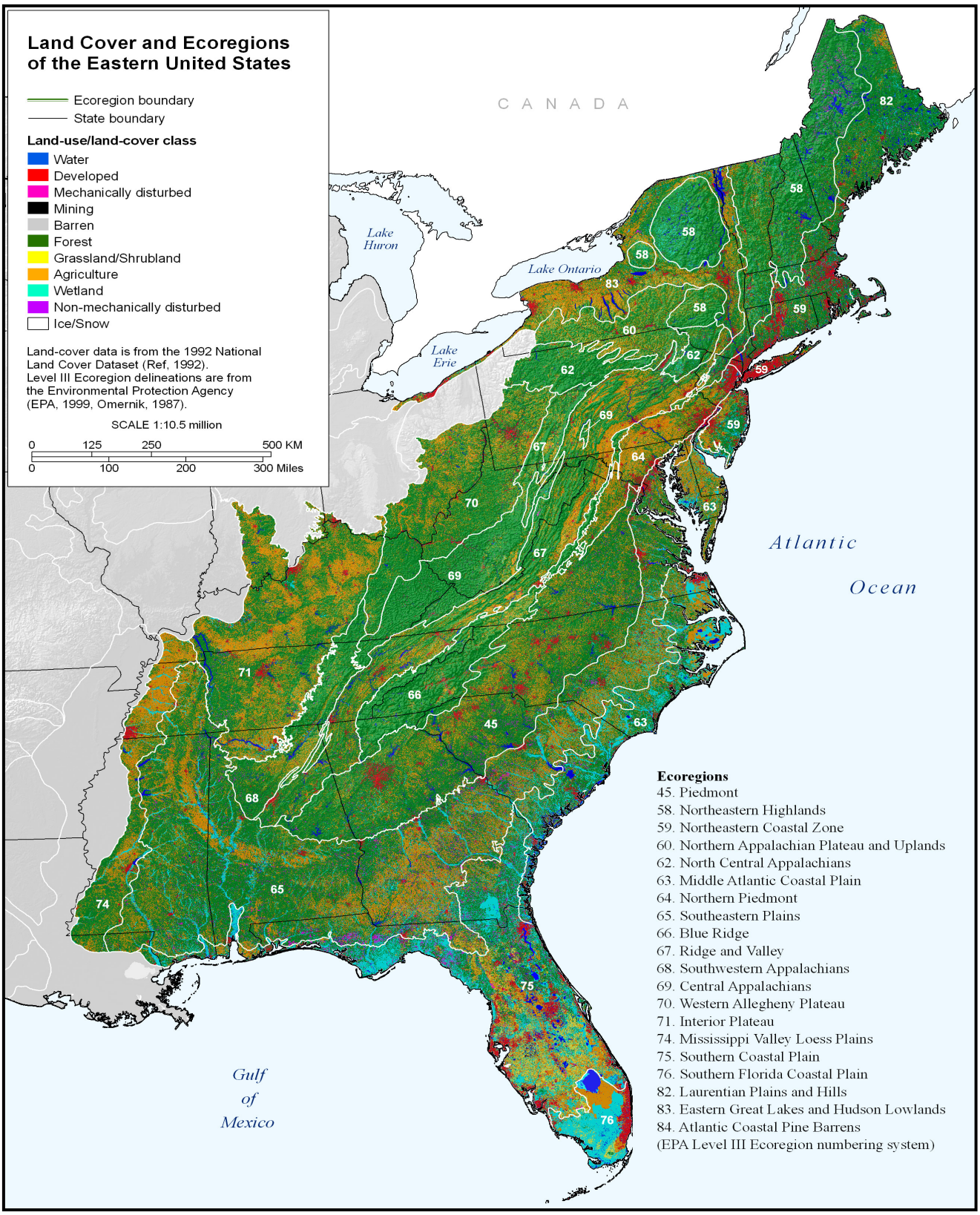
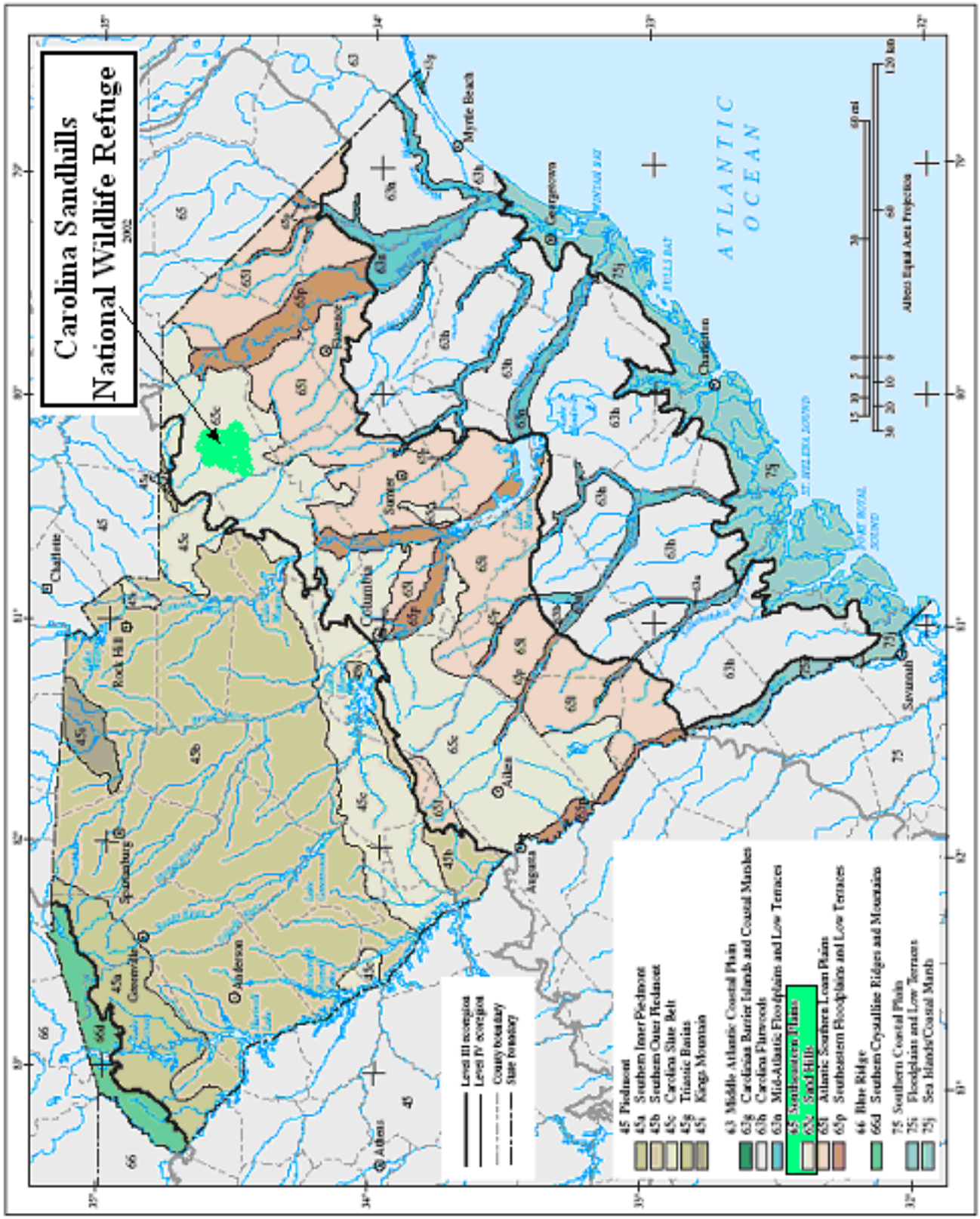


**Figure 5. Level III and IV ecoregions of South Carolina**



Many of the droughty, low-nutrient soils formed in thick beds of sand, although some soils contain more loamy and clayey horizons. Some upland areas are underlain by plinthite, and side slopes tend to have fragipans that perch water and cause lateral flow and seepage. Stream flow is consistent; larger streams seldom flood or dry up because of the large infiltration capacity of the sandy soil and the vast ground-water storage capability of the sand aquifer. On drier sites, turkey oak and blackjack oak occur with longleaf pine and a wiregrass ground cover. Loblolly pine forests and other oak-pine forests are now more widespread due to fire suppression and logging.

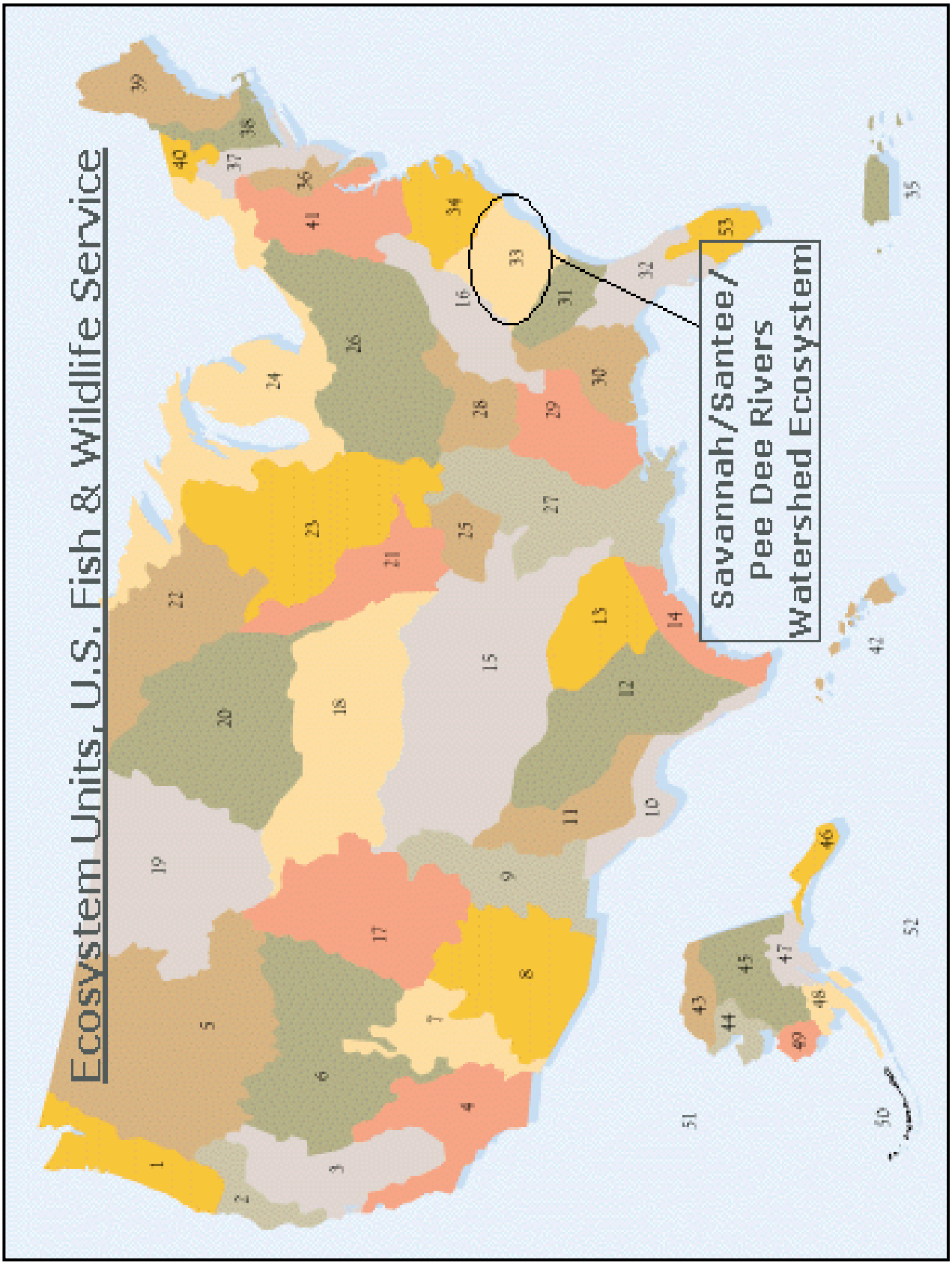
Ecosystems are experiencing increasing impacts from human activities, the threat of which will require extraordinary flexibility and innovation to successfully conserve and manage them. In recent years, conservationists have fostered the idea that resource conservation can best be achieved by taking a holistic approach to management. The Service is working with divergent interests on ecosystem-based approaches to conserve the variety of life and its processes. Sustainable communities and species conservation and recovery require joint efforts of private landowners and local communities, as well as state and federal governments. The Service has developed cooperative partnerships in an effort to reduce the declining trends of fish and wildlife populations and biological diversity within ecosystems. There are 53 ecosystem units identified by the Service and all of the Service's field units (National Wildlife Refuges, National Fish Hatcheries, Law Enforcement, Ecological Services offices, and Fishery Resources offices) combine forces to tackle projects, improving efficiency and effectiveness. The Carolina Sandhills NWR is in the Savannah/Santee/Pee Dee Rivers watershed ecosystem unit (Unit 33), which is shown in Figure 6.

*THE LONGLEAF PINE/WIREGRASS ECOSYSTEM*

The longleaf pine/wiregrass ecosystem, the characteristic habitat of Carolina Sandhills NWR, once covered approximately 90 million acres in the southeastern United States. This unique ecosystem, shaped by thousands of years of natural fires that burned through every 2 to 4 years, has been reduced to fewer than 2 million acres, representing a 97 percent decline in this important ecosystem. Today, only scattered patches of the longleaf pine/wiregrass ecosystem occur, primarily in the coastal plains of the Carolinas, Georgia, Florida, Alabama, Louisiana, and Texas. About half of these surviving stands of longleaf pine exist on public lands. (A discussion of the factors affecting the decline of the longleaf pine/wiregrass ecosystem is given in Chapter II.)

The longleaf pine is valuable in many ways. It is a hardy species, relatively wind firm and resistant to many insects that attack other pines, such as the pine tip moth and southern pine beetle, and diseases such as fusiform rust and root rot. The wood of the longleaf pine is dense and strong; its long, straight boles yield high-value wood products. Longleaf pine is not only more tolerant of fire than is loblolly pine or slash pine; it actually requires frequent, low intensity fires for reproduction and expansion. The frequent fires reduced the amount of litter on the ground, so resulting fires were mostly low-intensity, surface blazes that killed few trees. Fires in the spring or early summer play a critical role by clearing the ground of grasses and needles so that seeds, dropping from their cones in the autumn, can quickly absorb the nutrients in the ash. Germination of the longleaf pine seedlings occurs within 2 weeks. After several years of developing a strong tap root system, the longleaf pines begin to grow in amazing spurts, 2 or 3 feet during each growing season. This fast growth quickly lifts their growing tips above the level of most ground fires, and they add a thick bark that protects the tree from fire. In time, the trees become tolerant to all but the hottest fires. This species grows and survives well on poor, sandy soils. The old-growth longleaf pine is an impressive specimen, topping 120 feet on the better soils, and sometimes exceeding 3 feet in diameter. Mature trees can achieve extreme ages, 300 to 400 years. It thrives in a variety of conditions; a few feet from the ocean or on mountain ridges of 2,500 feet elevation and more than 200 miles inland.

**Figure 6. Watershed-based ecosystem units, U.S. Fish and Wildlife Service**



From a botanical perspective, longleaf forests are incredibly diverse. Researchers studying one coastal plain longleaf pine community identified 124 plant species in a plot of 100 square feet. Another study in Alabama identified 40 species per square meter. This ranks longleaf pine communities among the most diverse habitat types on earth. Within the sandhills region, due to poorer soils, the plant diversity on a micro scale is much less than in the coastal plain; however, the uneven topography is responsible for diversity across the landscape, on a macro scale. More than 750 species of plants have been identified on Carolina Sandhills NWR. More than 30 plant and animal species associated with longleaf pine ecosystems, including the red-cockaded woodpecker, are listed as threatened or endangered. The management practices used at the Carolina Sandhills NWR seek to conserve and enhance the plant and animal species dependent on the diminishing longleaf pine/wiregrass ecosystem (Kush 2003).

| Watershed-Based Ecosystem Units | Unit Number | Watershed-Based Ecosystem Units | Unit Number |
|---|---|---|---|
| NORTH PACIFIC COAST | 1 | TENNESSEE/CUMBERLAND RIVER | 28 |
| KLAMATH/CENTRAL PACIFIC COAST | 2 | CENTRAL GULF WATERSHEDS | 29 |
| CENTRAL VALLEY-CALIFORNIA/SAN FRANCISCO BAY | 3 | FLORIDA PANHANDLE WATERSHEDS | 30 |
| SOUTHERN CALIFORNIA | 4 | ALTAMAHA WATERSHEDS | 31 |
| COLUMBIA BASIN | 5 | PENINSULAR FLORIDA | 32 |
| INTERIOR BASIN | 6 | **SAVANNAH/SANTEE/PEE DEE RIVERS** | **33** |
| LOWER COLORADO RIVER | 7 | ROANOKE/TAR/NEUSE/CAPE FEAR RIVERS | 34 |
| GILA/SALT/VERDE RIVER | 8 | CARRIBEAN | 35 |
| MIDDLE AND UPPER RIO GRANDE | 9 | DELAWARE RIVER/DELMARVA COASTAL AREA | 36 |
| LOWER RIO GRANDE | 10 | HUDSON RIVER/NEW YORK BIGHT | 37 |
| PECOS RIVER | 11 | CONNECTICUT RIVER/LONG ISLAND SOUND | 38 |
| EDWARDS PLATEAU | 12 | GULF OF MAINE RIVERS | 39 |
| EAST TEXAS | 13 | LAKE CHAMPLAIN | 40 |
| TEXAS GULF COAST | 14 | CHESAPEAKE BAY/SUSQUEHANNA RIVER | 41 |
| ARKANSAS/RED RIVERS | 15 | PACIFIC ISLANDS | 42 |
| SOUTHERN APPALACHIANS | 16 | ARCTIC ALASKA | 43 |
| UPPER COLORADO RIVER | 17 | NORTHWEST ALASKA | 44 |
| PLATTE/KANSAS RIVERS | 18 | INTERIOR ALASKA | 45 |
| UPPER MISSOURI/YELLOWSTONE RIVERS | 19 | SOUTHEAST ALASKA | 46 |
| MISSOURI MAIN STEM | 20 | SOUTH CENTRAL ALASKA | 47 |
| LOWER MISSOURI RIVER | 21 | BRISTOL BAY/KODIAK | 48 |
| MISSISSIPPI HEADWATERS/TALLGRASS PRAIRIE | 22 | YUKON-KUSKOKWIM DELTA | 49 |
| UPPER MISSISSIPPI RIVER/TALLGRASS PRAIRIE | 23 | BERING SEA/ALEUTIAN ISLANDS | 50 |
| GREAT LAKES BASIN | 24 | BEAUFORT/CHUKCHI SEAS | 51 |
| OZARK PLATEAU | 25 | NORTH PACIFIC/GULF OF ALASKA | 52 |
| OHIO RIVER VALLEY | 26 | SOUTH FLORIDA | 53 |
| LOWER MISSISSIPPI RIVER | 27 | | |

## REGIONAL CONSERVATION PLANS AND INITIATIVES

Comprehensive conservation plans are being prepared for the eight Service refuges in the State of South Carolina. The plans will provide refuge managers with a 15-year strategy and broad direction to conserve wildlife and their habitats; to achieve refuge purposes; and, to contribute to the mission of the Refuge System. In addition, the plans identify wildlife-dependent recreational opportunities available to the public, including opportunities for hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation. The plans for these eight refuges (Waccamaw, Santee, Carolina Sandhills, ACE Basin, Cape Romain, Pinckney Island, Tybee, and Savannah) are currently in various stages of preparation.

Many regional conservation plans and initiatives are derivatives of national plans. These regional plans are developed by a variety of cooperating regional agencies and organizations and are being planned and implemented in the southeastern United States. Some of the more notable are listed below:

NABCI – North American Bird Conservation Initiative

Populations and habitats of North America's birds are protected, restored, and enhanced through coordinated efforts at international, national, regional, state, and local levels, guided by sound science and effective management. Bird Conservation Regions encompass landscapes having similar bird communities, habitats, and resource issues (NABCI-US 2002).

PIF – Partners in Flight Bird Conservation Plans

PIF is a cooperative partnership between government agencies, private organizations, individuals, academic communities, and industry. Bird Conservation Plans have been developed for Physiographic Areas in the Northeast by PIF. These plans identify priority species for conservation efforts in each area, recommend population and habitat objectives for managing these priority species, and provide implementation and management strategies for reaching objectives (Hunter et. al. 2001, Ruth 2006).

NAWCP – The North American Waterbird Conservation Plan

The plan provides an overarching continental framework and guide for conserving waterbirds. It sets forth goals and priorities for waterbirds in all habitats, at nesting sites, during annual migrations, and during nonbreeding periods. It advocates continent-wide monitoring; provides an impetus for regional conservation planning; proposes national, state, provincial, and other local conservation planning and action; and gives a larger context for local habitat protection (Kushlan et. al. 2002).

NAWMP – The North American Waterfowl Management Plan

The vision of the North American Waterfowl Management Plan is to recover waterfowl populations by restoring and managing wetland ecosystems; to conserve biological diversity in the western hemisphere; to integrate wildlife conservation with sustainable economic development; and, to promote partnerships of public and private agencies, organizations, and individuals for conservation. Canada, the United States, and Mexico are committed to the ongoing continental effort to restore North America's waterfowl and wetland resources (NAWMP, Plan Committee 2004).

ACJV – The Atlantic Coast Joint Venture

The ACJV is a partnership focused on the conservation of habitat for native birds in the Atlantic Flyway of the United States from Maine south to Puerto Rico. The joint venture is a partnership of the 18 states, commonwealths, and key federal and regional habitat conservation agencies and organizations in the joint venture area. The joint venture was originally formed as a regional partnership focused on the conservation of waterfowl and wetlands under the North American Waterfowl Management Plan (see above) and has since broadened its focus to the conservation of habitats for all birds consistent with major national and continental bird conservation plans and the North American Bird Conservation Initiative (see above) (ACJV 2005).

SAMBI – The South Atlantic Migratory Bird Initiative

This plan represents one of the initial efforts in North America to integrate the objectives of four major bird conservation plans (the North American Waterfowl Management Plan, United States Shorebird Conservation Plan, North American Waterbird Conservation Plan, and Partners in Flight) under the North American Bird Conservation Initiative into a single plan that land managers, biologists, administrators, and private landowners can use to achieve common goals and objectives for bird conservation across a regional landscape. The primary objectives are to develop population and habitat goals for priority species, delineate “all bird” focus areas, develop a long-term framework for bird conservation in the Southeastern Coastal Plain, and develop and seek funding for "all bird" projects (Watson and Malloy 2006).

CWCS – South Carolina's Comprehensive Wildlife Conservation Strategy

The CWCS identifies the challenges facing the State of South Carolina's diverse wildlife species and devises strategies to conserve those "species with the greatest conservation need," and their habitats. It is a guide to conserving the 1,240 species of fish and wildlife that have immediate conservation needs or are key indicators of the diversity and health of the state’s wildlife. The CWCS emphasizes a cooperative, proactive approach to conservation, inviting local governments, businesses, and conservation-minded organizations and individuals to join in the task of maintaining fish and wildlife resources (SCDNR 2005a).

The Red-Cockaded Woodpecker (RCW) Recovery Plan

The ultimate recovery goal is red-cockaded woodpecker (*Picoides borealis*) viability. Once this goal is achieved, the size, number, and distribution of populations will be sufficient to counteract threats of demographic, environmental, genetic, and catastrophic stochastic events, thereby maintaining long-term viability for the species as defined by current understanding of these processes (USFWS 2003b, USFWS 2006a).

NBCI – Northern Bobwhite Conservation Initiative

The NBCI's charge is to develop a quantitative habitat-oriented plan to restore bobwhites to the density they enjoyed during the baseline year 1980 (Dimmick et. al. 2002).

208 Water Quality Management Plan of South Carolina

This plan is developed for the purpose of encouraging and facilitating the development and implementation of area-wide waste treatment management plans. It requires states to identify areas with water quality problems and designate an entity to develop area-wide waste treatment

management plans so as to attain the national goal of "fishable-swimmable waters" as required by the Clean Water Act (SCDHEC 1997).

South Carolina Water Plan

The purpose of this plan is to establish guidelines for the effective management of the state's surface and ground water resources; to sustain the availability of the water resource for present and future use; to protect public health and natural systems; and, to enhance the quality of life for all citizens (Badr et. al. 2004).

## ECOLOGICAL THREATS AND PROBLEMS

National wildlife refuges serve as part of the last safety net to supporting biological diversity – the greatest challenge facing the Service. Impacts and underlying causes and threats to biological diversity include:

- Loss or reduction of species with specific habitat requirements;
- Loss, alteration, and fragmentation of habitat due to development and other human activities;
- Simplification and degradation of remaining habitats, including alteration and fragmentation;
- Introduction and spread of exotic, nuisance, and invasive species;
- Lack of environmental regulation and enforcement;
- Cumulative effects of land and water resource development projects;
- Wildlife disturbance due to development and other human activities;
- Increased air quality standards and population density in the wildland urban interface that threaten the ability to apply prescribed fire on the landscape.

Habitat loss is the greatest threat facing wildlife habitat in South Carolina today. As of 2006, South Carolina's population had grown to more than 4 million people, up 7 percent from 2000. As a result, thousands of acres of wildlife habitat are lost each year to accommodate the expanding human population. The longleaf pine ecosystem once dominated much of the forest landscape in the coastal plain of South Carolina. The conversion of undeveloped land to residential and commercial uses is one of the biggest threats to this ecosystem. As the population grows, traffic increases and more roads are planned and built. Conservation lands surrounded by development become very difficult to manage with prescribed fire. Smoke management for air quality, health, and safety becomes more difficult and results in increased costs of managing land for conservation.

## PHYSICAL RESOURCES

### *CLIMATE*

The Carolina Sandhills NWR experiences a humid subtropical climate, with long, hot, sultry summers and short, mild winters. The subtropical climate arises from a combination of the region's relatively low latitude and elevation, the proximity of the warm Gulf Stream in the Atlantic, and the Appalachian Mountains, which in winter help to buffer cold air from the interior of the United States. The average temperature in Chesterfield County is about 61ºF, with average daily temperatures ranging from 30º-55ºF in January and from 70º-91ºF in July.

The area receives, on average, 47-48 inches of precipitation per year. There is little difference in the amount of precipitation between summer and winter seasons; however, the greatest amounts of rain usually occur in July (a result of summer thunderstorm activity) and the least amounts of rain occur in

April. During the summer, South Carolina's weather patterns are dominated by a maritime tropical air mass known as the Bermuda high. The air passing over the land is heated more quickly than the ocean and becomes unstable, resulting in the formation of afternoon and evening thunderstorms. The heaviest 1-day rainfall during the period of record (1893-2008) was 11.0 inches on October 10, 1990. Nearly all precipitation falls as rain, with winter snowfall totaling only about 2 inches (SCDNR 2008, SCPRT 2009c).

Tables 1 and 2, and Figures 7 and 8, show temperature and precipitation data for the Carolina Sandhills NWR as recorded at the Cheraw and Pageland (Chesterfield County) weather stations for the period 1971 to 2000.

The average relative humidity in mid-afternoon is about 51 percent. Humidity is higher at night, and the average at dawn is about 87 percent. The sun shines 66 percent of the time in summer and 58 percent in winter. The prevailing wind is from the southwest for most of the year, except during September and October when it is from the northeast. Average wind speed is highest, around 8 miles per hour, in March and April (U.S. Department of Agriculture Natural Resources Conservation Service, National Water and Climate Center).

**Table 1. Cheraw, SC1588 (1971-2000) Chesterfield County, South Carolina**

| Month | Temperature | | | Precipitation | | |
|---|---|---|---|---|---|---|
| | Average daily maximum | Average daily minimum | Average | Average | Average number of days with 0.10 inch or more | Average snowfall |
| | ºF | ºF | ºF | In | | In |
| January | 52.9 | 30.1 | 41.5 | 4.49 | 7 | 0.4 |
| February | 57.1 | 32.0 | 44.6 | 3.50 | 6 | 1.1 |
| March | 65.2 | 39.1 | 52.2 | 4.42 | 7 | 0.4 |
| April | 74.2 | 46.6 | 60.4 | 2.92 | 4 | 0.0 |
| May | 81.0 | 55.8 | 68.4 | 3.45 | 6 | 0.0 |
| June | 87.4 | 64.5 | 75.9 | 4.73 | 6 | 0.0 |
| July | 90.6 | 69.1 | 79.8 | 5.33 | 8 | 0.0 |
| August | 88.5 | 68.0 | 78.2 | 4.94 | 7 | 0.0 |
| September | 83.2 | 61.8 | 72.5 | 4.17 | 5 | 0.0 |
| October | 73.9 | 48.7 | 61.3 | 3.70 | 4 | 0.0 |
| November | 65.1 | 39.5 | 52.3 | 2.91 | 5 | 0.0 |
| December | 56.0 | 32.5 | 44.3 | 3.17 | 6 | 0.2 |
| | | | | | | |
| Yearly: | | | | | | |
| Average | 72.9 | 49.0 | 61.0 | --- | --- | --- |
| **Total** | **---** | **---** | **---** | **47.73** | **71** | **2.1** |

**Table 2. Pageland, SC 6616 (1971-2000) Chesterfield County, South Carolina**

| Month | Temperature | | | Precipitation | | |
|---|---|---|---|---|---|---|
| | Average daily maximum | Average daily minimum | Average | Average | Average number of days with 0.10 inch or more | Average snowfall |
| | ºF | ºF | ºF | In | | In |
| January | 53.7 | 32.4 | 43.0 | 4.74 | 7 | 1.1 |
| February | 58.8 | 35.3 | 47.1 | 3.79 | 6 | 0.0 |
| March | 67.0 | 41.7 | 54.4 | 4.68 | 7 | 0.6 |
| April | 75.1 | 49.1 | 62.1 | 3.02 | 5 | 0.0 |
| May | 81.7 | 57.7 | 69.7 | 3.15 | 6 | 0.0 |
| June | 87.8 | 65.3 | 76.5 | 4.17 | 6 | 0.0 |
| July | 90.8 | 69.3 | 80.1 | 5.76 | 7 | 0.0 |
| August | 88.9 | 67.8 | 78.3 | 4.42 | 6 | 0.0 |
| September | 83.8 | 62.4 | 73.1 | 4.01 | 5 | 0.0 |
| October | 74.9 | 50.4 | 62.7 | 3.69 | 4 | 0.0 |
| November | 65.5 | 42.2 | 53.8 | 3.57 | 5 | 0.0 |
| December | 56.5 | 35.0 | 45.8 | 3.34 | 6 | 0.4 |
| | | | | | | |
| Yearly: | | | | | | |
| Average | 73.7 | 50.7 | 62.2 | --- | --- | --- |
| **Total** | **---** | **---** | **---** | **48.33** | **70** | **2.0** |

**Figure 7. Daily average temperature and precipitation, Cheraw, Chesterfield County, South Carolina (1971-2000)**

*Source: (SCDNR 2008)*

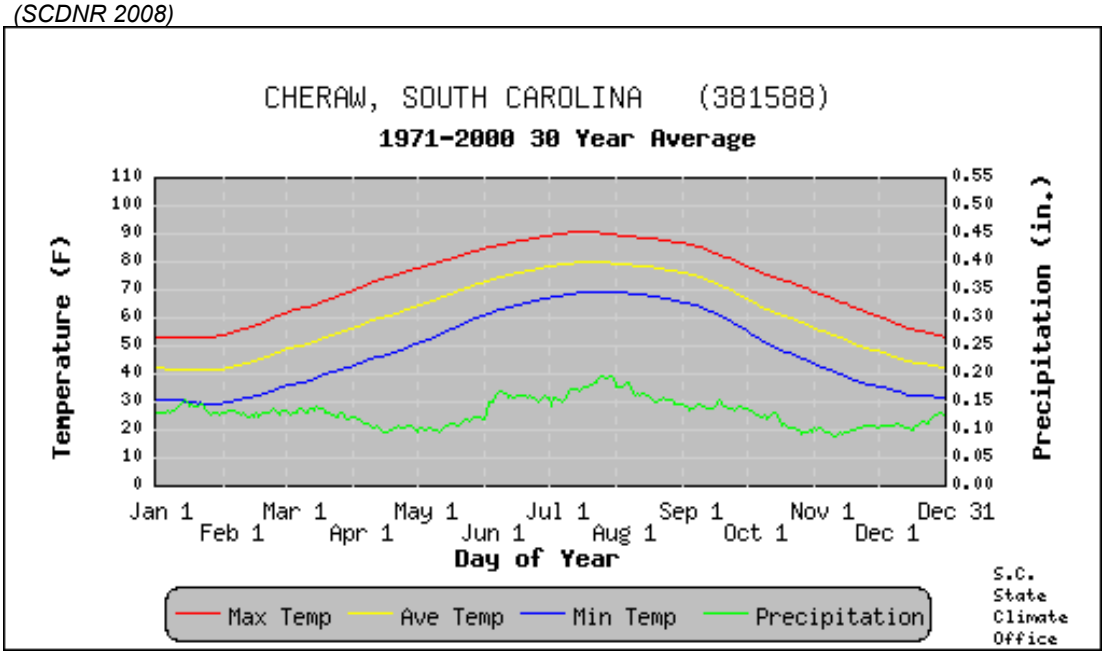
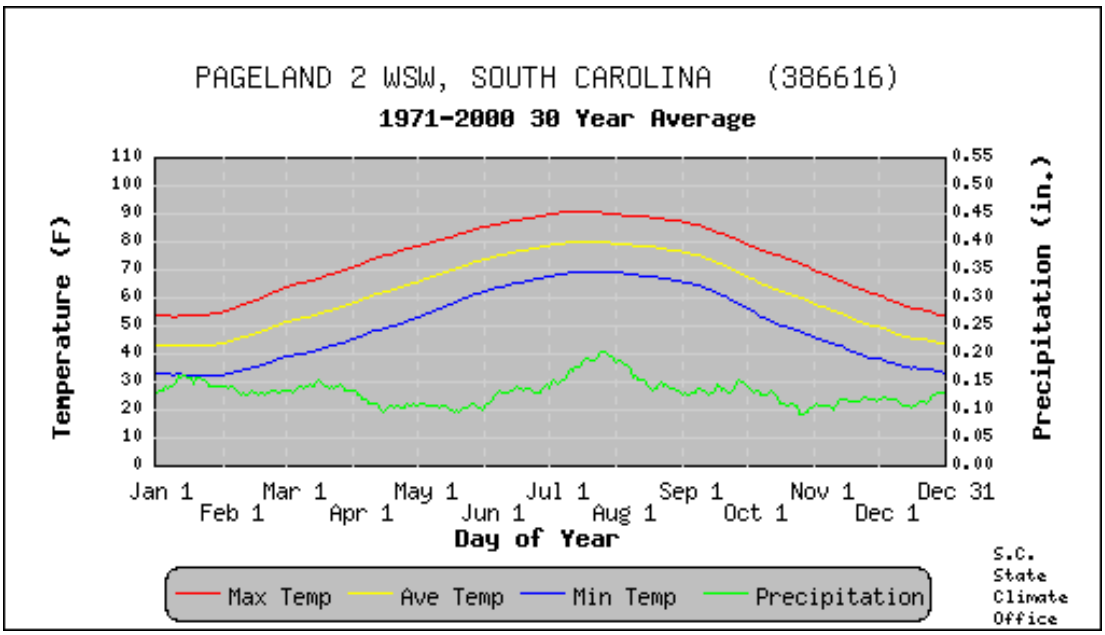



**Figure 8. Daily average temperature and precipitation, Pageland, Chesterfield County, South Carolina (1971-2000)**




Data is smoothed using a 29 day running average.

- Max. Temp. is the average of all daily maximum temperatures recorded for the day of the year
- Ave. Temp. is the average of all daily average temperatures recorded for the day of the year
- Min. Temp. is the average of all daily minimum temperatures recorded for the day of the year
- Precipitation is the average of all daily total precipitation recorded for the day of the year

*CLIMATE CHANGE AND GLOBAL WARMING*

According to NOAA and NASA data, the Earth's average surface temperature has increased by about 1.2 to 1.4ºF since 1900. The ten warmest years in the 20th century have all occurred within the past 15 years, with the warmest two years being 1998 and 2005. Some climate models, based on emissions of greenhouse gases, primarily carbon dioxide, methane, and nitrous oxide, predict that average surface temperatures could increase from 2.5 to 10.4ºF by the end of this century. This increase in $CO_2$ is attributed largely to human activities since 1945. The burning of fossil fuels adds 5.6 billion tons of carbon to the atmosphere each year; and deforestation contributes another 0.4 to 2.5 billion tons (Environmental Protection Agency 2009, SCDNR 2009b).

Since 1957, the climate of South Carolina has been characterized by warmer and drier conditions. According to recent observations (1957-1991), the annual average temperature increased by nearly 1ºF. The largest temperature increase resulted during the 1980s from warmer than average wintertime temperatures. Precipitation decreased 6 percent or 3.2 inches primarily due to lower than average springtime rainfall. Thus, the current trend in South Carolina's climate is warmer and drier conditions (SCDNR 2009b).

Global warming, resulting in melting of glaciers and ice sheets, will cause sea levels to rise. Globally, sea level has risen 4–10 inches during the past century. NASA estimates that yearly, 50 billion tons of ice is melting from the Greenland ice sheet. NASA aerial surveys show that more than 11 cubic miles of ice is disappearing from the ice sheet annually (Krabill et. al. 2000). Land less than 10 meters above sea level contains 2 percent of the world's land surface and 10 percent of its population. In the United States, major impacts will be felt by coastal populations, particularly in the Gulf and East Coast states.

In addition to the rising seas, the effects of climate change and global warming include changes in weather and rainfall patterns, decreases in snow and ice cover, rising sea levels, and stressed ecosystems. For the southeastern United States and the Carolina Sandhills, effects may include extreme precipitation events; greater likelihood of warmer and dryer summers and wetter and reduced winter cold; and, alterations of ecosystems and habitats – to name but a few possibilities. For example, a recent study of the effects of climate change on eastern United States' bird species concluded that as many as 78 bird species could decrease by at least 25 percent, while as many as 33 species could increase in abundance by at least 25 percent due to climate and habitat changes (U.S. Global Change Science Program 2006).

The South Carolina Department of Natural Resources, Office of the State Climatology, details some of the changes the state might expect (SCDNR 2009b):

<u>Agriculture and the fishing industry</u> – While experts estimate that United States' agricultural production will be adequate for domestic needs even under the most extreme scenario, major regional changes in the production and quality of food commodities are expected. Production is generally predicted to shift northward, with crops in the southeast particularly vulnerable.

<u>Productivity</u> – Although warmer temperatures may lead to increased yields in some parts of the country, South Carolina already has a high baseline temperature. Crops may be subject to increases in moisture and heat-stress. The wettest scenario does not offset crops' increased water needs, and drier scenarios suggest yield could decrease by nearly 80 percent. Even the direct positive effects on photosynthesis of a $CO_2$-enriched atmosphere cannot, in such cases, make-up for the indirect effects of moisture-stress resulting from climatic change.

Irrigation – Under the wet scenario, it is estimated that the southeast will require increased irrigation. Irrigated land will require more water, and more land will require irrigation.

Crop mix – With warmer temperatures, crops such as corn would become less profitable in the southeast, while profitability of heat-tolerant crops, such as cotton, could increase. Adjustments might also be made in varieties planted (e.g., peach farmers in Saluda, Lexington, Edgefield, and Aiken Counties might find themselves favoring varieties like May Gold and Early Amber over their present Red Globe and Jefferson trees) to ensure the necessary dormancy period is achieved.

Disease and pest vulnerability – Warmer conditions may accelerate the life cycles of insect pests, leading to attacks on plants at earlier and more susceptible stages of growth. The range of some Gulf Coast pests could also shift northwards if winters became less severe.

Cultivated acreage – Because many South Carolina farms are already marginal enterprises, farmers may not be able to compete in a changed environment. The amount of land under cultivation could decrease.

Fish and shellfish populations – Both increased water temperatures and changes in the salinity of habitats could reduce the population of species profitable to the state's fishing industry.

Forestry – With over 60 percent of the state classified as forested, it is not surprising that forestry and forest-related industry are key sectors in South Carolina's economy. Only tourism brings more money into the state and, as sites for fishing, hunting, hiking, and camping, forests also contribute to tourism. The economic benefits forests bring are not just important to the state, but to individuals in the state: almost two-thirds of the forests remain in private, non-industrial ownership. Studies indicate climate change could cause significant changes in South Carolina's forests.

- Dieback of forests in 30 to 80 years. Even modest warming could cause significant changes, but a $CO_2$-induced warming poses the additional threat of occurring so quickly that forests would not be able to adjust in time.
- Loss of species. Southern hardwoods (e.g., black gum, laurel oak, and elm) might replace loblolly pines as the dominant species.
- Conversion of Forest to Grasslands. The drier scenarios suggest that sections of the southeast might not support forests at all. Abandoned farms that have traditionally reverted to forest might now remain in grass.
- Increased vulnerability to pests and disease. Not only is the range of pests likely to increase, but climate-stressed stands are more susceptible to attack by disease, pests, and fire.

Water Resources – Exactly how water resources will be affected by climate change is difficult to ascertain. Global climate models vary widely in precipitation projections (i.e., the supply of water and projections for water demand are also difficult to predict), but climate changes will also influence the demand for water.

- Studies indicate the regional availability and reliability of water resources may be responsible for the most dramatic effects of climate change. With warmer temperatures, demand for water is likely to increase for agriculture, energy, cooling, and recreation. It is not certain whether the supply will be able to meet the demand.
- Regardless of precipitation changes, water quality could be affected. Drier scenarios create oxygen-starved lakes and streams and wet scenarios increase the threat of pollution from runoff.
- The capacity of the current drainage system to handle an increase in the frequency of large amounts of precipitation could be exceeded.

Energy – Demand for electricity is sensitive to the weather and to industrial growth. Changes in weather patterns result in changes in energy consumption. Higher temperatures could result in:

- An increased demand for air conditioning as the cooling season would last longer.
- Decrease in demand for heating due to warmer winters.
- An increase in electrical capacity; higher demands for air conditioning in the summer would be partially offset by lower wintertime temperatures, affecting total consumption only moderately. But the periods could require a significant increase in South Carolina's electrical capacity.

*GEOLOGY AND TOPOGRAPHY*

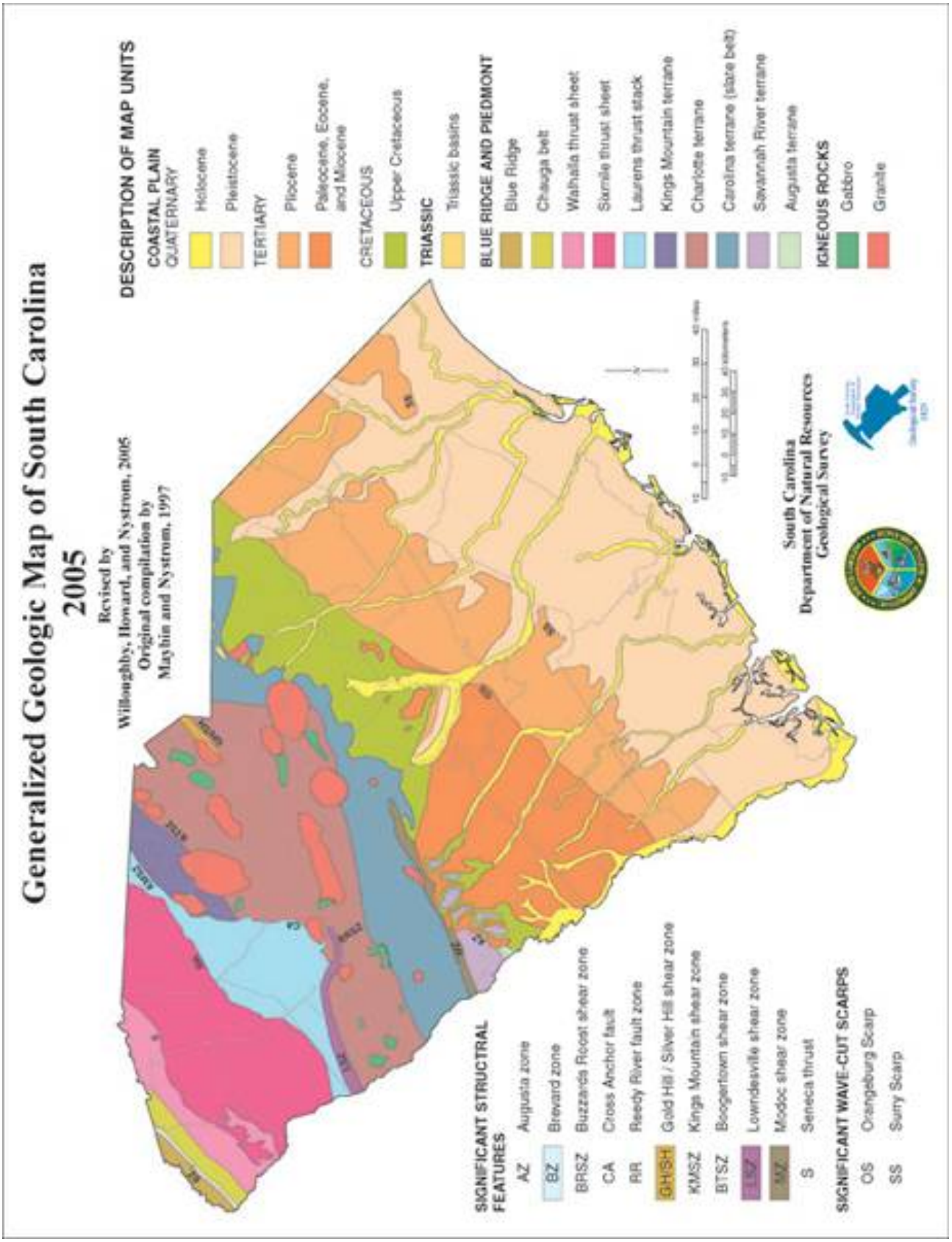
The primary factor determining topography and landscape features in South Carolina is the underlying geology. Differences in rock types and rock structures are responsible for many of the differences seen in the four major landform regions (Blue Ridge, Piedmont, Sandhills, and Coastal Plain/Coastal Zone).

The Sandhills consist of Cretaceous and Tertiary marine, fluvial, and eolian sediments. Some geologists believe the Fall Line Sandhills developed due to the erosion of the Tuscaloosa Formation that was exposed during the Cretaceous uplift about 100 million years ago, resulting in higher elevations along Fall Line Province than those of the adjacent Piedmont Province (Madden et. al. 2003). This is in contrast to a popular hypothesis that the sandhills are ancient beach dunes and that the Atlantic shoreline, during the Cretaceous Period, went through the middle of the state and is responsible for the sand deposited in what is now called the Sandhills. Regardless, the geology and topography of the Carolina Sandhills NWR is a product of the events of the Cretaceous/Tertiary Period (Leigh 1998).

Figure 9 illustrates the area of Upper Cretaceous geology in the Sandhills region. Here alternating beds of sand and clay of Upper Cretaceous age overlie bedrock. The bedrock has been associated with the Tuscaloosa Formation, but more recently the formation has been called Middendorf, after its geologic type locality in Chesterfield County. Sand and clay beds of greatly varying thickness and lateral extent make up the Middendorf Formation. These materials are of continental origin and were deposited in a deltaic environment by rivers carrying sediments eroded from the Appalachian highlands and Piedmont area. As the formation dips toward the coast, the next successively overlying formations are the Black Creek and Pee Dee formations (SCDNR 2002, Newcome 2004).

The Cretaceous and Tertiary-age sands, silts, and clays of the Sandhills region contrast with the older metamorphic and igneous rocks of the Blue Ridge and Piedmont, and with the Paleozoic limestone, chert, and shale found in the interior of the U.S. The Sandhills composed of Cretaceous-age marine sands and clays, are capped in places with Tertiary sands, deposited over the crystalline and metamorphic rocks of the Piedmont. The maximum thickness for the Middendorf formation in Chesterfield County is estimated to be about 450 feet (Newcome 2004). The surficial material and bedrock can be described as Quaternary medium to coarse sand decomposition residuum, loamy sand, sandy loam, and sandy clay decomposition residuum; Cretaceous sand, sandstone, and mudstone; and, Tertiary sand and clayey sand (Griffith et. al. 2002).

**Figure 9. Generalized geologic map of South Carolina**



The Sandhills are a rolling to hilly region with elevations varying from about 100 to 700 feet above mean sea level (MSL). Elevations in Chesterfield County range from 70' MSL along the Pee Dee River in the eastern part of the county to 725' MSL in the northwest corner of the county (Newcome 2004), and are usually higher than the adjacent Piedmont or Coastal Plain regions. Elevations on the refuge range from 250 to 500 ' MSL. The topography of the refuge is characterized by gently rolling hills and deep sandy soils, with occasional outcroppings of red and kaolin clays (USFWS 2007a). Maximum elevations in the immediate area of the Carolina Sandhills NWR are 513' MSL on Sugarloaf Mountain and 520' MSL on Hebron Hill. Relief is greater than in the low lying Coastal Plains, but less than in much of the Piedmont, and typically varies between 100 and 300 feet.

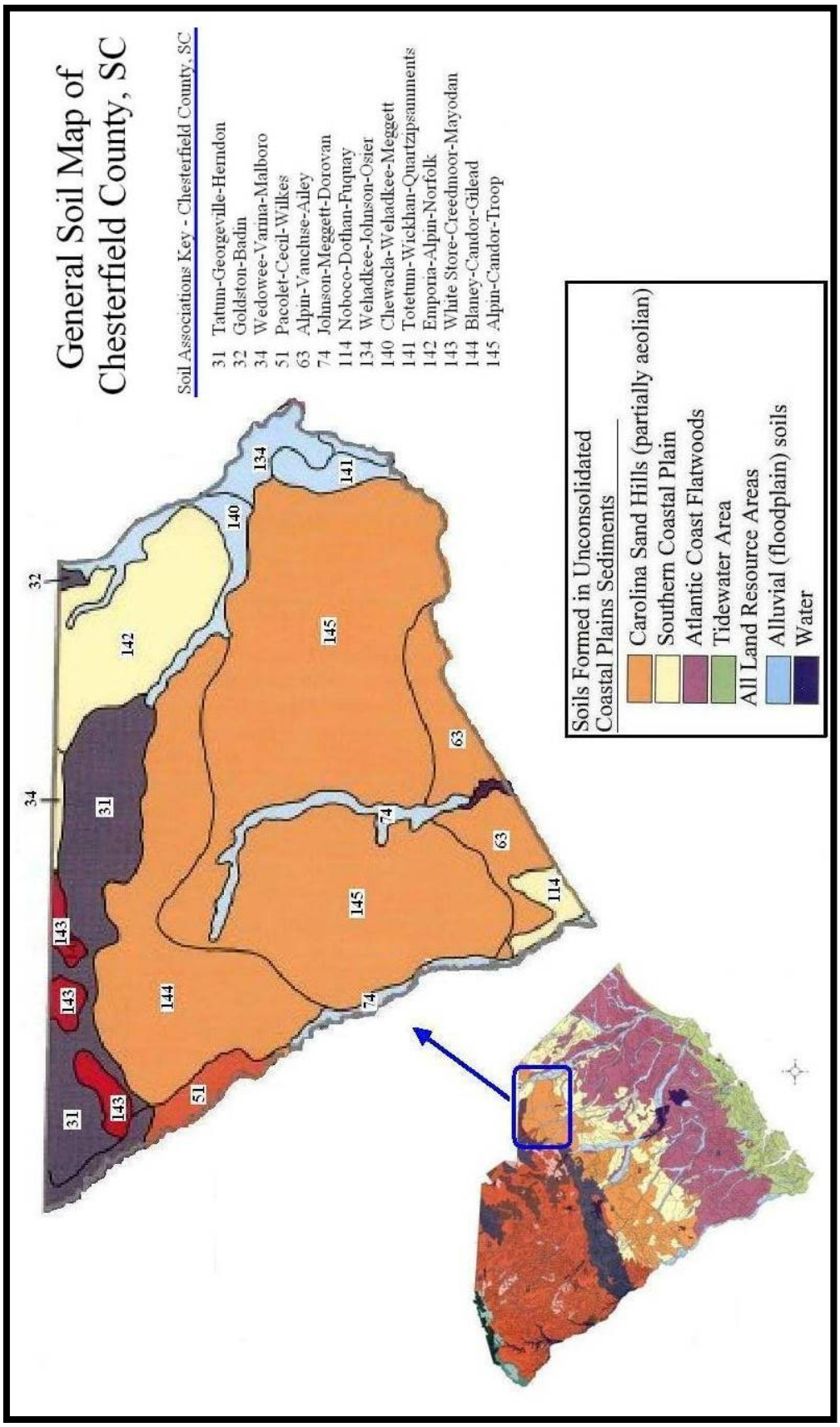
*SOILS*

The Sandhills consist primarily of Cretaceous and Tertiary marine, fluvial, and eolian sediments, the majority of which is unconsolidated marine sediment (Leigh 1998). The soils of the Carolina Sandhills are among the oldest in the Coastal Plain of South Carolina. Coastal Plain soils increase in age with distance from the ocean since soils cannot be in formation until sea level has fallen sufficiently to expose the former ocean floor to surface weathering conditions. Extensive weathering, over time, has removed much of the original nutrient content of the soil and almost all soil fertility has been lost. The only material left is the original quartz mineral grains, which are highly resistant to weathering. The rolling nature of the topography and the sandy parent material combine to permit good surface and internal drainage so that the majority of soils are very well drained, sometimes too well drained to hold sufficient moisture for typical agricultural use. Because the soil texture allows for rapid leaching, soils are also strongly acidic. It is not uncommon to find lenses or horizons in Sandhills soils where sand grains have been cemented together with iron oxides, forming a barrier to root growth and water movement (SCDNR 2000).

Soils are organized into a taxonomic classification system by the U.S. Department of Agriculture, Natural Resources Conservation Service in which each soil is categorized by order, suborder, great group, subgroup, family, and soil series. Nationwide, there are 12 orders of soil, two of which (*Entisols and Ultisols*) dominate the Sandhills landscape. Quartzipsamments (a great group of *Entisols*), and Kandiudults and Paleudults (great groups of *Ultisols*) are most common in the Carolina Sandhills NWR (USDA NRCS 2008b).

Deep sandy soils with occasional outcroppings of red and kaolin clays are found on the Carolina Sandhills NWR (USFWS 2007a). As shown in Figure 10, the predominant soil types on the refuge consist of an association of the Alpin-Candor-Troup soil series, very sandy soils with a texture of loamy sand to sand. These soils have thick surface horizons composed of sand. Much of the original parent material was sand, but these upland soils may also have received eolian (carried by wind) material over the years. The Alpin soil series (Quartzipsamments) is almost entirely sand. Quartzpsamments are extremely sandy soils with little or no soil profile. The Alpin soil series consists of very deep, excessively drained, rapidly permeable soils located on uplands of the Coastal Plain. They formed in thick beds of sandy eolian or marine deposits. The Candor soil series (Kandiudults) has loamy subsoil that holds adequate water for use by plants. The Candor series is established for soils in a sandy family that have sufficient clay increase to qualify for a clay horizon within 40 inches and have loamy or finer texture from 40 to 80 inches. The Troup soil series (Kandiudults/Paleudults) consists of deep, well drained, moderately permeable soils with thick sandy surface layers and loamy subsoils (USDA NRCS 2008a). As indicated, these soils have high percentages of sand (greater than 85 percent), low soil moisture, and low soil nutrient content (Madden et. al. 2003). The erodibility of these soils (K) averages about 0.10 and the slope of the terrain averages about 7 percent (SCDHEC 2007a). Figure 10 illustrates the general soil associations of Chesterfield County, which completely encompasses the refuge (USDA NRCS 2008b).

**Figure 10. Generalized soil map of Chesterfield County, South Carolina**



*HYDROLOGY*

The hydrologic resources of South Carolina and the Carolina Sandhills NWR are abundant. As discussed above, the refuge receives an average of 47 to 48 inches of precipitation a year, from which 30 inches are returned to the atmosphere through evapotranspiration, leaving an average annual water yield of approximated 17 inches which includes runoff and groundwater infiltration Figure 11 (Cherry et. al. 2001).

Groundwater – The vast majority of South Carolina's water resources are contained as groundwater in the Southeastern Coastal Plain Aquifer System, and in general, reliance on groundwater for irrigation, industrial uses, and public water supply increases dramatically as one moves southeasterly away from the Fall Line. Figure 12 illustrates a generalized hydrogeologic cross-section for South Carolina, highlighting the six major aquifers in the state.

Chesterfield County has two markedly different sources of ground water. About 20 percent of the county is in the Piedmont physiographic province, where the crystalline rocks beneath a thin weathered zone contain ground water only in fractures. Wells in these rocks generally provide very low yields, often less than 5 gpm (gallons per minute). The rest of the county, including the Carolina Sandhills NWR, lies below the Fall Line and contains sand and clay beds of the Middendorf Formation, one of the region's most important sources of water supply. The Middendorf Aquifer is a prolific source of water throughout the majority of the coastal plain and consists of coarse-grained fluvial sands near the Fall Line that grade to fine-grained marine sands and clay in the northern and eastern Lower Coastal Plain. The majority of the Pee Dee region, including Chesterfield, Darlington, Florence, and Marlboro Counties, relies heavily on the Middendorf for irrigation, public supply, and industrial use (SCDHEC 2007b). The sand aquifers of the Middendorf occur to depths as great as 450 feet near the southern border of the county. Surface water tends to sink rapidly into the soil.

Wells in these aquifers yield as much as 900 gpm, but the potential exists for yields of 2,000-3,000 gpm. All water in the sand aquifers is fresh. Generally, it is under artesian conditions of occurrence, but there are some sites where a thick sand bed and deep static water level combine to produce water-table (unconfined) conditions, and the static (nonpumping) water level is below the top of the aquifer (Newcome 2004). In these cases, the extremely high porosity of the soil combines with the generally high elevation to produce ground water levels which lie fairly deep below the land surface.

Surface Water – There are four major river systems which drain the State of South Carolina: The Pee Dee River watershed, the Santee River watershed, the Savannah River watershed and the Coastal Plain/Edisto River watershed, as illustrated in Figure 13 (Cherry et. al. 2001). The Pee Dee River basin, which drains about 25 percent of South Carolina, has the largest annual discharge of the four major basins -- 10.5 billion gallons per day (16,245 cfs) (SCDNR 2005a).

The Carolina Sandhills NWR lies within the drainage basin of the Pee Dee River. The eastern portion of the Carolina Sandhills NWR is drained by a tributary to the Pee Dee; i.e., Black Creek and its western tributaries (Skipper Creek, Long Branch, Ham Creek, and Little Alligator Creek). Surface water in these streams is clear but stained due to the presence of organic acids. Flood plain swamps occur along some of the larger streams. The western portion of the refuge is drained by another tributary to the Pee Dee; i.e., Lynches River and its eastern tributaries (Rocky Creek, Sandy Creek, and Swift Creek-North and South Prongs). The tributaries of Lynches River are similar to those of Black Creek except that they are deeper and swifter. The mainstream of Lynches River originates in the Piedmont Plateau near the refuge. This stream is characterized by slightly stained and turbid water with predominantly clay banks. Pocosin ecotones, swamp hardwood forests, and dense stands

**Figure 11. Average annual precipitation, evapotranspiration, and annual water yield**

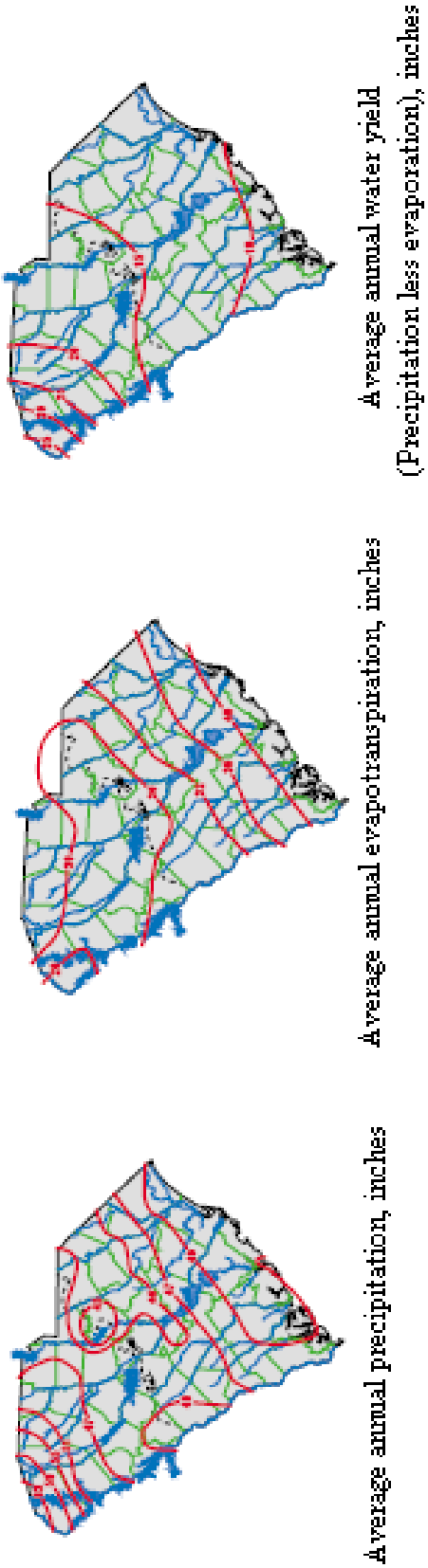
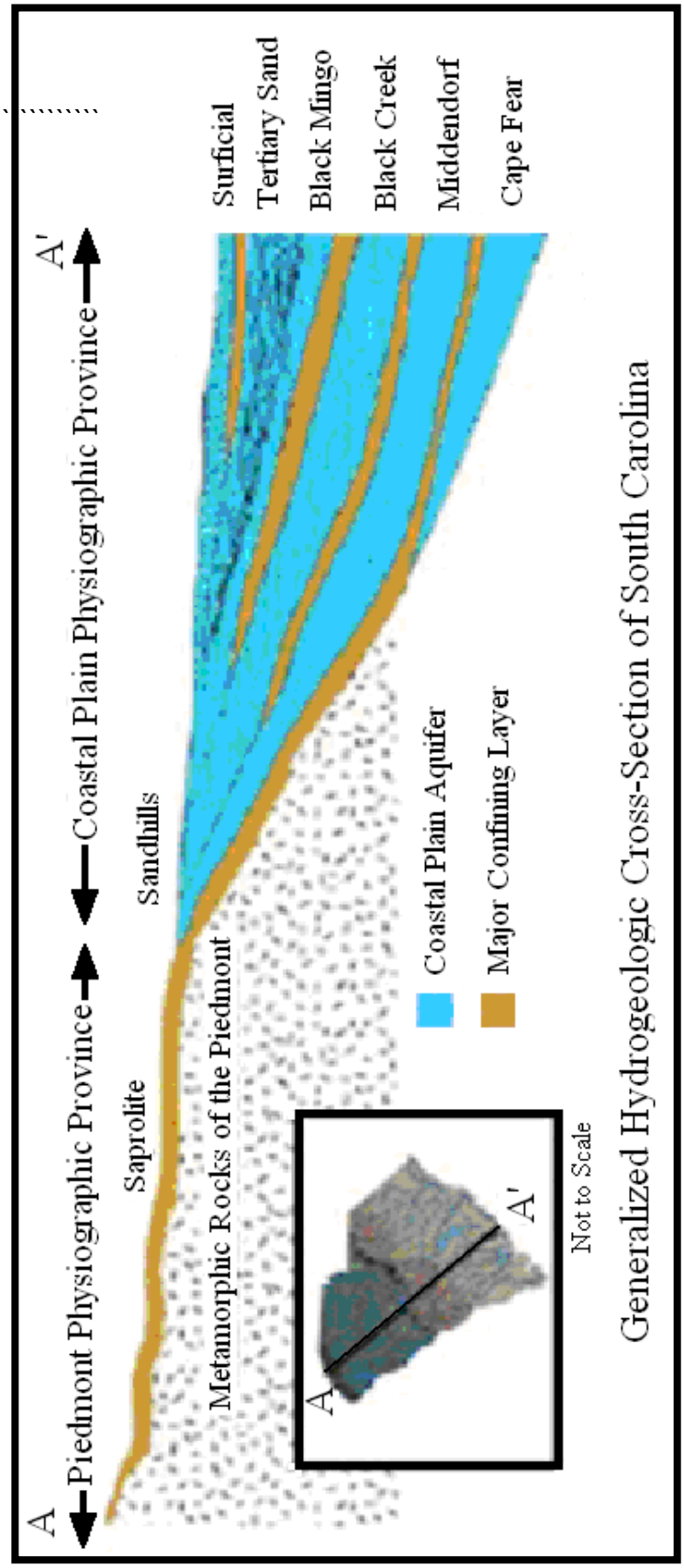


**Figure 12. Generalized hydrogeologic cross-section for South Carolina**



of evergreen shrubs border these streams, producing some of the best wildlife habitat found on the refuge. Black Creek (USGS gage 02130900 near McBee) and Lynches River (USGS gage 02131500 near Bishopville) have average annual discharges of about 150 cfs and 500 cfs, respectively (U.S. Geological Survey [USGS] 2009). (These streams seldom flood or dry up because of the large infiltration capacity of the sandy soil and the large ground-water storage capacity of the sand aquifer) (SCDNR 2005b).

Air Quality

The Clean Air Act (CAA) of 1970 (as amended in 1990 and 1997), requires the U.S. Environmental Protection Agency (EPA) to implement air quality standards to protect public health and welfare. National Ambient Air Quality Standards (NAAQS) were set for six pollutants commonly found throughout the United States: lead, ozone, nitrogen oxides ($NO_x$), carbon monoxide (CO), sulfur dioxide ($SO_2$), and particulate matter less than 10 and 2.5 microns in diameter ($PM_{10}$ and $PM_{2.5}$) (EPA Office of Air Quality Planning and Standards 2009d). The South Carolina Department of Health and Environmental Control (DHEC), Bureau of Air Quality (BAQ) operates National Ambient Monitoring Stations (NAMS), State and Local Ambient Monitoring Stations (SLAMS), and industrial monitoring sites to measure concentrations of these pollutants. The BAQ currently (2005) operates a network of 133 monitors/samplers at 56 sites throughout the state. "South Carolina currently meets, and has met since the early 1990's, all national ambient air quality standards. . . Since 2000, air quality in South Carolina has continued to demonstrate a steady trend of improvement" (SCDHEC, Bureau of Air Quality 2006).

In the vicinity of the Carolina Sandhills NWR, there are two DHEC-BAQ monitoring sites: McBee (site 450250001), Chesterfield County, SC and Darlington (site 450310003), Darlington County, South Carolina. In addition, data are also available at a nearby monitoring site operated by the North Carolina Department of Environment and Natural Resources (DENR), Division of Air Quality in Monroe (site 371790003), Union County, NC (NCDENR 2009). Areas that meet the NAAQA standards are designated “attainment areas,” while areas not meeting the standards are termed “non-attainment” areas. The 2005 monitoring results indicate that the areas surrounding the Carolina Sandhills NWR qualify as attainment areas for all monitored pollutants, and that regional air quality is improving; see Tables 3 and 4.

The Air Quality Index (AQI) is a summary index for reporting daily air quality to convey how clean or polluted the air is, and what associated health effects might be of concern. The AQI focuses on health effects that may be experienced within a few hours or days after breathing polluted air. EPA calculates the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. Because all areas of the United States are currently attaining the NAAQS for lead, the AQI does not specifically address lead. For each of these pollutants, EPA has established national air quality standards to protect public health (EPA 2003). Based on this Air Quality Index, EPA categorizes air quality as "good" in Chesterfield County and the Carolina Sandhills NWR area, with air pollution posing little or no risk (EPA 2009a, c).

**Figure 13. South Carolina watersheds**

*Source: (Cherry et. al. 2001)*

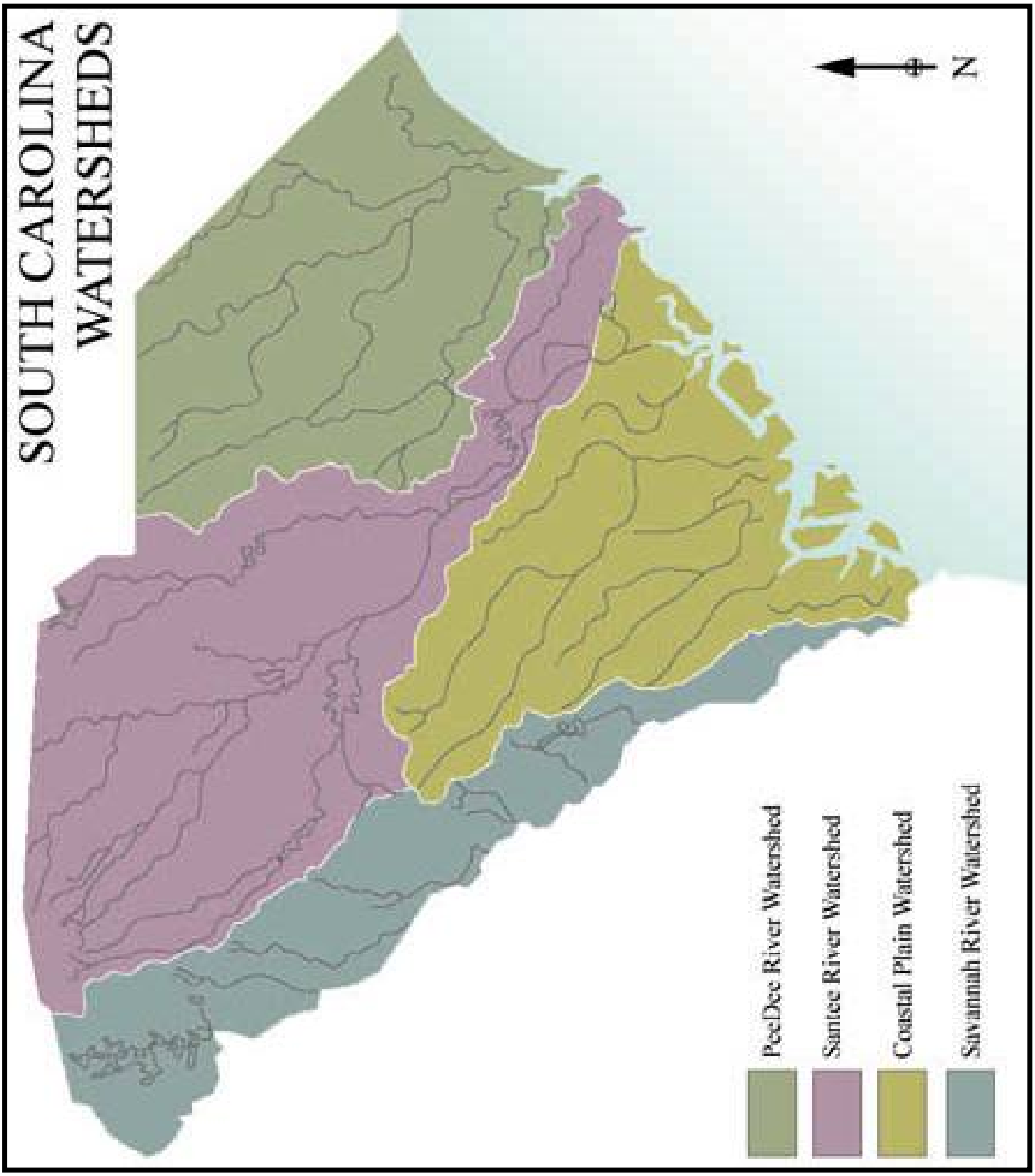


**Table 3. Air quality statistics by city/county, 2007**

| Air Quality Statistics by City/County, 2007[a] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Metropolitan Statistical Area | 2000 Population | CO 8-hr (ppm) | Pb Qmax ($\mu g/m^3$) | $NO_2$ AM (ppm) | $O_3$ 8-hr (ppm) | $PM_{10}$ 24-hr ($\mu g/m^3$) | $PM_{2.5}$ Wtd AM ($\mu g/m^3$) | $PM_{2.5}$ 24-hr ($\mu g/m^3$) | $SO_2$ AM (ppm) | $SO_2$ 24-hr (ppm) |
| **Charlotte--Gastonia--Rock Hill, NC--SC MSA** | 1,499,293 | 2 | 0 | 0.014 | 0.096 | 59 | 14.0 | 31 | 0.003 | 0.013 |
| **Columbia, SC MSA** | 536,691 | 2 | 0.01 | 0.011 | 0.084 | 100 | 13.7 | 32 | 0.003 | 0.017 |
| **Florence, SC MSA** | 125,761 | ND | 0 | ND | ND | ND | 12.4 | 32 | ND | ND |
| **Chesterfield County, SC** | 42,768 | ND | ND | ND | 0.073 | 36 | 12.3 | 26 | ND | ND |
| **Darlington County, SC** | 67,394 | ND | ND | ND | 0.073 | ND | ND | ND | ND | ND |
| **Union County, NC** | 123,677 | ND | ND | ND | 0.082 | ND | ND | ND | ND | ND |
| **National Ambient Air Quality Standards --** | | **9** | **1.50** | **0.053** | **0.075** | **150** | **15** | **35** | **0.030** | **0.140** |

CO - Maximum 8-hour average concentration must not exceed 9 ppm more than once per year.

Pb - Quarterly maximum concentration must not exceed 1.50 $\mu g/m^3$.

$NO_2$ - Maximum annual average concentration must not exceed 0.053 ppm.

$O_3$ - The fourth-highest daily maximum 8-hour average concentration measured must not exceed 0.075 ppm (Effective May 27, 2008)

$PM_{10}$ - Maximum 24-hour concentration must not exceed 150 $\mu g/m^3$, more than once per year.

$PM_{2.5}$ - The weighted annual mean concentration must not exceed 15.0 $\mu g/m^3$.

- The 98th percentile of 24-hour concentrations must not exceed 35 $\mu g/m^3$ (Effective December 17, 2006).

$SO_2$ - Maximum annual average concentration must not exceed 0.030 ppm.

- Maximum 24-hour concentration must not exceed 0.140 ppm more than once a year.

**(Footnotes Continued on Next Page)**

ND - Indicates data not available

AM - Annual mean

Qmax - Quarterly maximum

$\mu g/m^3$ - Units are micrograms per cubic meter

ppm - Units are parts per million

Notes: Data from exceptional events are not included. The monitoring data represent the quality of air in the vicinity of the monitoring site and, for some pollutants, may not necessarily represent city/county-wide air quality.

[a] U.S. Environmental Protection Agency, http://www.epa.gov/airtrends/factbook.html

## Table 4. Regional air quality trends – Charlotte – Columbia – Florence MSA, 1990-2007

**Regional Air Quality Trends - Charlotte - Columbia - Florence MSA, 1990-2007[a]**

| Metropolitan Statistical Area | Pollutant | Trend Statistic | Number of Trend sites | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Charlotte** | $O_3$ | 4th Max | 2 | 0.098 | 0.091 | 0.085 | 0.098 | 0.089 | 0.094 | 0.099 | 0.098 | 0.107 | 0.104 | 0.094 | 0.093 | 0.101 | 0.081 | 0.080 | 0.088 | 0.086 | 0.092 |
| **-Gastonia-** | $PM_{10}$ | 2nd Max | 3 | 56.0 | 55.3 | 54.3 | 50.7 | 49.0 | 51.3 | 48.0 | 55.0 | 60.0 | 50.0 | 54.0 | 55.7 | 43.7 | 44.7 | 44.7 | 48.3 | 51.7 | 48.7 |
| **-Rock Hill,NC-SC** | $PM_{2.5}$ | Weighted Annual Mean | 4 | | | | | | | | | | 16.1 | 15.8 | 14.7 | 14.2 | 14.1 | 14.7 | 15.4 | 14.8 | 14.3 |
| | Pb | qmax | 1 | 0.04 | 0.02 | 0.08 | 0.02 | 0.03 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 | 0.04 | 0.01 | 0.01 | 0.01 | 0 | 0 | 0 | 0 |
| **Columbia,SC** | $NO_2$ | Annual Mean | 1 | 0.013 | 0.009 | 0.011 | 0.013 | 0.011 | 0.013 | 0.013 | 0.011 | 0.014 | 0.014 | 0.014 | 0.014 | 0.012 | 0.012 | 0.013 | 0.012 | 0.012 | 0.011 |
| | $O_3$ | 4th Max | 1 | 0.093 | 0.074 | 0.070 | 0.089 | 0.082 | 0.079 | 0.077 | 0.086 | 0.098 | 0.094 | 0.096 | 0.082 | 0.084 | 0.075 | 0.082 | 0.082 | 0.082 | 0.077 |
| | $PM_{10}$ | 2nd Max | 3 | 92.3 | 92.3 | 98.0 | 96.3 | 92.0 | 90.3 | 91.0 | 99.7 | 129.0 | 103.7 | 92.0 | 90.3 | 83.0 | 90.0 | 83.7 | 82.3 | 69.7 | 67.3 |
| | $PM_{2.5}$ | Weighted Annual Mean | 3 | | | | | | | | | | 15.9 | 15.9 | 13.8 | 13.2 | 12.7 | 14.2 | 14.6 | 14.5 | 13.4 |
| | Pb | qmax | 1 | 0.02 | 0.03 | 0.01 | 0.01 | 0.01 | 0.01 | 0 | 0.01 | 0.01 | 0.01 | 0.07 | 0.02 | 0 | 0 | 0 | 0 | 0 | 0 |
| | $SO_2$ | Annual Mean | 3 | 0.0027 | 0.0026 | 0.0028 | 0.0027 | 0.0021 | 0.0018 | 0.0026 | 0.0025 | 0.0032 | 0.0031 | 0.0030 | 0.0032 | 0.0028 | 0.0031 | 0.0028 | 0.0029 | 0.0026 | 0.0024 |
| **Florence,SC** | $PM_{2.5}$ | Weighted Annual Mean | 1 | | | | | | | | | | 14.4 | 14.4 | 13.1 | 12.2 | 12.1 | 12.6 | 13.0 | 12.6 | 12.4 |

Pb - Quarterly maximum concentration must not exceed 1.50 $\mu g/m^3$.
$NO_2$ - Maximum annual average concentration must not exceed 0.053 ppm.
$O_3$ - The fourth-highest daily maximum 8-hour average concentration measured must not exceed 0.075 ppm (Effective May 27, 2008).
$PM_{10}$ - Maximum 24-hour concentration must not exceed 150 $\mu g/m^3$ more than once per year.
$PM_{2.5}$ - The weighted annual mean concentration must not exceed 15.0 $\mu g/m^3$.
$SO_2$ - Maximum annual average concentration must not exceed 0.030 ppm.

Note: Data from exceptional events are not included. These trends are based on sites having an adequate record of monitoring data during the trend period.
The values shown are the composite averages among these trend sites.
Units for CO, $NO_2$, $O_3$, and $SO_2$ are ppm. Units for $PM_{2.5}$ and $PM_{10.0}$ are $ug/m^3$.

[a] U.S. Environmental Protection Agency, http://www.epa.gov/airtrends/factbook.html

*WATER QUALITY*

The eastern portion of the Carolina Sandhills NWR is drained by Black Creek and its western tributaries (Skipper Creek, Long Branch, Ham Creek, and Little Alligator Creek). Surface water in these streams is clear but stained black due to the presence of organic acids. Black Creek originates near the town of Pageland.

The western portion of the refuge is drained by Lynches River and its eastern tributaries (Rocky Creek, Sandy Creek, and Swift Creek-North and South Prongs). The tributaries of Lynches River are similar to those of Black Creek except that they are deeper and swifter. The Lynches River originates in the Piedmont Plateau near the refuge and is characterized by slightly stained and turbid water with predominantly clay banks (USFWS 2007a).

Very little water quality information has been collected or is available for the surface waters (streams, ponds, etc.) of the refuge. Based on soil geology of the region and the natural setting, the streams and ponds on the refuge are expected to be soft and poorly buffered with low alkalinities, low pH's, and low conductivities. Nutrient concentrations (phosphorus and nitrogen) and dissolved concentrations of ionic species (sulfates, chlorides, and metals) are thought to be low; while oxygen demands are expected to be low with dissolved oxygen concentrations near saturation, at least 5.0 mg/l, or higher. Fecal coliform bacteria concentrations are most likely low and as would be expected in streams in a natural habitat.

Black Creek and its tributaries upstream of State Route 33, in the northern portion of the refuge, are classified by the State of South Carolina as "FW" [or, freshwaters which are suitable for primary and secondary contact recreation; as a source for drinking water supply (after conventional treatment); suitable for fishing, and the survival and propagation of a balanced indigenous aquatic community of fauna and flora; and, also suitable for industrial and agricultural uses]. Improvements in several water quality characteristics have been noted in the upstream portions of Black Creek, prior to its flowing onto the refuge. Higher dissolved oxygen concentrations and lower oxygen demands have been noted, as well as lower phosphorus concentrations and higher pH levels. Downstream from SR 33, Black Creek is classified as FW* (i.e., dissolved oxygen not less than 4.0 mg/l and pH between 5.0 and 8.5), and the tributaries (Skipper Creek, Long Branch, Ham Creek, and Little Alligator Creek) are classified FW. Monitoring data collected at three sites within the refuge by the State of South Carolina (PD-670, PD-613, and PD-251) indicate that the water quality (DO, pH, and toxins) of Black Creek supports aquatic life and recreational use. The water quality of Skipper Creek (and most likely other tributaries to Black Creek) supports aquatic life (SCDHEC 2007a).

The Lynches River and its tributaries are also classified by the State of South Carolina as FW. Monitoring data collected on the Lynches River at U.S. Highway 1 (PD-009), indicate that the water quality (DO, pH, and toxins) supports aquatic life; however, recreational use is only partially supported due to occasionally high fecal bacteria concentrations. Data also show small improvements in nutrients, with decreasing phosphorus and nitrogen concentrations (SCDHEC 2007a).

Sand mining activities in the headwaters of both Black Creek and Lynches River present a threat to aquatic resources in the watersheds. Sand mining causes bank stability problems, loss of riparian area, and altered in-stream habitats. Increased bedloads, higher turbidity, disturbed substrates and changing stream morphology result in decreasing reproduction and survival of fish and benthos (SCDNR 2005a).

## BIOLOGICAL RESOURCES

*HABITAT*

### Ecoregion Habitat

Because of the "Sandhills" location between the Piedmont and the Coastal Plains, the refuge offers a great diversity of habitat and consequently a great diversity of flora and fauna not found in other parts of the region. In particular, the Sandhills is one of the last great strongholds of the rare longleaf pine/wiregrass habitat.

The Sandhills Region displays a unique assemblage of vegetation, classified as xerophytic, or adapted to dry conditions. The dryness of the area is related to the extremely rapid drainage through the predominantly sandy soils. Xerophytic vegetation is distinguished by a short broken canopy, a dispersed distribution of plants, and in some cases, wide expanses of bare soil. The predominant forest cover consists of longleaf pine and turkey oak, the latter usually in a stunted form when within the driest uplands. Over time, large areas have been burned, cleared, and cultivated. Today, much of the area surrounding the refuge is planted in loblolly or slash pine, neither of which is native to the area. A number of shrubs and herbaceous plants, including species of sparkleberry, wild rosemary, gopherweed, and sand myrtle, are distinctive elements of the region's vegetation (SCDNR 2000).

Sands deposited up to 10 million years ago form the top layer of the Sandhills. These sands are a very pure and high-quality source of silica and are mined throughout the sandhills. These deep sands have created a xeric environment that supports a distinctive type of vegetation dominated by longleaf pine and turkey oak. This fire-adapted community burns with a frequency interval of 2 to 4 years and may be one of the oldest communities of this type in the southeast. Major brownwater rivers cut their way through the sandhills on their way from the mountains and piedmont to the sea. Deep sand ridges, ranging from 300 to over 600 feet above mean sea level, are one of the most striking and dominant features of the Sandhills. Ridge tops of pure Lakeland and Kershaw Sands, some up to 30 feet deep, support the most extreme xeric scrub communities of longleaf pine and turkey oak. The sandy soils on the ridges, excessively drained with low available water capacity, are low in fertility due to rapid leaching and possess little to no leaf litter. The drier sand ridges are suitable for agriculture only when managed through fertilization and irrigation. These ridges can support timber production, particularly of longleaf pine, which is well adapted to deep, dry sandy soils. Fire is a dominant factor in the ecology of this region. Sandhills pine forests are a fire climax community; as such, these forests depend on frequent ground fires to reduce hardwood competition and to perpetuate pines and grasses. Sand ridges that have more clay and silt mixed with sand support subxeric sandhill scrub vegetation and mesic pine flatwoods. Increased plant diversity is a result of the more moderate growing conditions. Due to the increase in leaf litter, fire is an important factor in the maintenance of the subxeric scrub forest and woodlands. These subxeric to mesic communities can grade into oak-hickory forests or, in the absence of fire, they may succeed to oak-hickory forests.

Rainwater rapidly percolates through the sand ridges until it reaches clay layers, at which point it moves laterally until emerging at the surface on side slopes or near the base of sand ridges. These natural seepage areas result in distinctive wetland habitats embedded within the xeric forests and woodlands. The community type that develops is determined by the amount of water, the position on the slope and, especially, by fire. In the absence of fire, this wetland habitat can be forested with longleaf or pond pines growing over a dense evergreen pocosin-like shrub layer or, with frequent fire, it can be an open hillside herb bog. Seepage accumulating at the base of the sand ridges results in a saturated zone that supports a streamside pocosin forest.

The following is a summary and brief description of the six principle habitat types found in the Sandhills (Level IV) Ecoregion (SCDNR 2005a). Each of these habitats supports a wide diversity of flora and fauna found on the refuge, which are discussed in CHAPTER II.

- Grassland and early successional habitats -- Grasslands or early successional fields, with cover provided by grasses, herbs, and shrubs and with few, if any, trees. Also managed open areas such as meadows, pastures, with or without damp depressions.
- Sandhills Pine Woodland -- A complex of xeric pine and pine-hardwood forest types adapted to sandy soils. Principally in the Sandhills but also on fluvial sand ridges in the Coastal Plain. Absent frequent fire, a canopy of longleaf pine (*Pinus paulustris*) and a sub canopy of turkey oak (*Quercus cerris*) prevails, interspersed with scrub oak species and scrub/shrub cover. Frequent burning leads to development of longleaf pine/wiregrass (*Aristida* sp.) communities. On lower slopes sufficiently protected from fire, succession can proceed to oak-hickory forests similar to those of the Piedmont.
- Seepage Slopes -- Steep slopes with a hard clay pan or fragipan below the sandy soil. Water percolating downhill is forced to the surface, which results in seasonally or permanently saturated soils. Vegetation is variable, depending on position on the slope, the amount of peat accumulation and fire history. Pond pine (*Pinus serotina*) shrubland is representative, intergrading with fire-maintained hillside herb bogs on wetter seeps. Steeper slopes support a mixture of pine species, including longleaf pine and Virginia pine (*Pinus virginiania*) and a characteristic shrub layer of titi *(Cyrilla racemiflora)*, sand myrtle *(Leiophyllum buxifolium)*, mountain laurel *(Kalmia latifolia)* and inkberry *(Ilex glabra).*
- Ponds and Depressions -- A variety of permanently and semi-permanently flooded isolated freshwater wetlands, with open or closed canopy forest cover, including Depression Meadows, Pond Cypress Ponds, Swamp Tupelo Ponds, Pocosins, and Pond Pine Woodlands. Landforms include natural and artificial ponds dominated by cypress and/or swamp tupelo, and Carolina Bays.
- Blackwater Stream Systems -- Tributary streams rising in the sandhills and coastal plain are commonly known as “blackwater streams” for the color of tannins leaching from decaying vegetation. Forests on the narrow floodplains formed by these streams typically have a canopy dominated by swamp tupelo *(Nyssa sylvatica var. biflora)* and red maple *(Acer rubrum)*. On broader sites, bald cypress *(Taxodium distichum)* can become an important canopy species. Tulip poplar *(Liriodendron tulipifera)*, sweet gum *(Liquidambar styraciflua)*, pond pine, loblolly pine *(Pinus taeda)*, and laurel oak *(Quercus laurifolia)* are important associates. The shrub layer is open in areas subjected to the most flooding, or it can be fairly dense and pocosin-like in areas subject to infrequent flooding. Headwaters and wet flats immediately above the floodplain can support dense, pocosin-like shrub thickets or, under suitable fire conditions, pure stands of Atlantic white cedar (*Chamaecyperus thyoides*).
- River Bottoms -- Hardwood-dominated woodlands with moist soils that are usually associated with the floodplains of major rivers that dissect sandhills strata and form a floodplain on underlying sediments extending into the Coastal Plain. Characteristic trees include sweetgum, loblolly pine, water oak (*Quercus nigra*), willow oak (*Quercus phellos*), laurel oak, cherrybark oak (*Quercus pagoda*), and American holly (*Ilex opaca*). The Cypress-tupelo swamp subtype occurs on lower elevation sites as seasonally flooded swamps. It is usually transected by tannic-acid rivers and creeks and contain oxbow lakes and pools. Dominant trees are bald cypress and water tupelo (*Nyssa aquatica*), swamp tupelo, water elm (*Planera aquatica*) and red maple.

Land cover changes within the Southeastern Plains (Level III) Ecoregion are very high compared with most other eastern United States ecoregions, which have experienced deforestation and change. Planted pine was rarely found in the region in 1950, but now comprises nearly 50 percent of pine forests in the southeastern U.S. The primary land cover transition is "forest" to "mechanically

disturbed," a transition that primarily represents clear-cutting of forest lands. In 2000, the major land-use/land-cover classes in the Southeastern Plains Ecoregion were: forest – 51.8 percent; agriculture and farmland – 21.5 percent; wetlands – 10.3 percent; urban and developed – 10.3 percent; and, mechanically disturbed (unvegetated) – 4.9 percent (Griffeth et. al. 2003).

For the Sandhills Region, generally, agricultural production is low due to rapid loss of nutrients, organic materials, and water from the soil. The loose sandy texture of the soil makes it almost impossible to retain moisture near the surface. Only 8 percent of the soils in this region are classified as prime farmland. About two-thirds of the area is forested, and one-third is planted in crops or pasture (SCDNR 2000). Land use in the upper Black Creek watershed (above Lake Robinson) which drains the refuge is 68.2 percent forested land, 18.3 percent agricultural land, 7.3 percent scrub/shrub land, 2.6 percent water, 1.5 percent urban, 1.3 percent barren land, and 0.8 percent forested wetland (SCDHEC 2007a).

**Aquatic Habitats**

Wadeable streams (generally, streams that can be waded comfortably throughout most of the year) are the dominant aquatic habitat in the Southeastern Plains (Level III) Ecoregion and provide most of the habitat for aquatic animals on South Carolina's Priority Species List. These wadeable streams, such as Black Creek, are often bordered with pondlike backwaters and swamps. Wadeable streams in the Southeastern Plains are mostly low gradient, although some near the Fall Line have swifter flows. In moderate flowing areas, the substrate is chiefly clean shifting sand with the absence of rocks in most streams; logs and debris jams provide habitat for aquatic fauna. In slow flowing areas, substrate is comprised of finer materials such as mud, clay, silt, and fine detritus. Most Southeastern Plains streams that receive ample sunlight are well-vegetated with aquatic macrophytes. The streams that flow through the ecoregion are often termed "blackwater" due to their tannin-stained waters. Navigable streams are not common in the Southeastern Plains, but provide habitat for many priority species. These streams are generally defined as large enough to operate watercraft, if only a canoe, and are usually too deep to be waded throughout most of the year. The Lynches River is the only navigable stream in the Southeastern Plains in the immediate vicinity of the Carolina Sandhills NWR. These lazy meandering streams have substrates of mostly shifting sand in the flowing areas while finer materials (silt, clay, and detritus) are deposited in the pools. As with the smaller streams in the ecobasin, the navigable streams are also "blackwater," stained by the decomposition of organic materials (SCDNR 2005a).

In the numerous perennial and intermittent streams or drains, pine pocosins are found, with pond pine, tulip poplar, gallberry, titi, redbay, and sweetbay magnolia as the predominant species. A pocosin is a swamp on a hill dominated by a dense, shrubby plant community and deep organic soil. These areas and the many small creeks and tributaries that transect the refuge, feed into Black Creek on the east side of the refuge or into Lynches River on the west side. The water is clear, but stained black due to natural organic acids. The larger creeks have steep banks, deep channels, and moderate flows. Narrow bands of hardwood swamps and pocosin ecotones border the streams and produce some of the best wildlife habitat found on the refuge.

**Carolina Sandhills NWR Habitat**

Presently, woodlands cover over 95 percent of the Carolina Sandhills NWR, as shown in Table 5. The major forest type is longleaf pine (approximately 35,000 acres of longleaf pine stands occur on the refuge) with a scattered understory of scrub oak. Where clay outcroppings occur, longleaf pine may be replaced by loblolly pine and blackjack oak may be more common in the understory. Slash pine plantations, which were planted in the 1950s and 1960s, are being harvested and replanted with

longleaf pine. The habitat is enhanced by approximately 1,100-1,300 acres of open fields and clearings and about thirty man-made surface water impoundments. The fields range in size from less than one acre to over one hundred acres, and add tremendously to the habitat diversity of the refuge. The majority of the open fields have been planted in perennial legumes or grasses or have been permitted to revert to early succession natural vegetation. Elevations range from 250 feet to 500 feet above sea level.

Although the refuge landscape is dominated by upland, xeric pine woodlands, there are important, but less common plant communities of management concern. Among them are hillside seepage bogs, canebrakes, streamhead pocosin and Atlantic White Cedar embedded within the refuge's extensive, pine upland landscape matrix. None of these habitat types were historically a major component of the ecosystem, and they are generally restricted to narrow drainages within the landscape. The appropriate use of prescribed fire has allowed these fire-dependent communities to persist on the refuge landscape.

Currently, the hillside herb bog at the Oxpen Unit is the most significant known herb bog on the refuge. Other smaller seepages are likely to be present on the refuge, but they may be difficult to locate within the landscape due to their small size and past land use and disturbance (i.e., agriculture and intensive forestry.) Herb bogs contain carnivorous plants, such as pitcher plants and sundews, and support communities of Pine Barrens tree frog.

Canebrakes occur along the upper reaches of drainages**.** The presence of scattered stems and patches of cane often indicate a formerly dense canebrake, now reduced to remnants as a result of fire suppression. Where fires have burned, dense stands of switch cane (*Arundinaria* sp.) replace shrubs as the dominant vegetation in the transition zone between the uplands and wetlands. Atlantic white cedar, which is not fire tolerant, exists in wet portions (often near the centers) of streamhead pocosins as long narrow stands adjacent to drainages. The refuge lies along the western (interior) edge of the historic geographic range for Atlantic white cedar.

While not representing a large percentage of the habitat acreage in the Carolina Sandhills NWR, pocosins are natural seepage areas embedded within the xeric forests and woodlands of the Sandhills. Pocosins are unusual wetlands because they are generally higher than their surroundings with deep, acidic, sandy, peat soils. (Native Americans recognized this and called these communities "swamps on a hill." Pocosin is the Algonquin word for that phrase.) Pocosins are formed when rainwater rapidly percolates through the sand ridges until it reaches clay layers, at which point it moves laterally until emerging and accumulating at the surface, on side slopes or near the base of sand ridges. The community type that develops is determined by the amount of water, the position on the slope and, especially, by the frequency of fire. These groundwater seeps saturate the soil except during brief seasonal dry spells and during prolonged droughts. Since pocosins occur in the poorly drained higher ground between streams and floodplains, they are often underlain by perched water tables. Pocosin soils are nutrient deficient especially in phosphorus.

Shrub vegetation is common and pocosins are sometimes called *shrub bogs*. Pond pine and longleaf pine are often associated with pocosin forests. With infrequent fire, this wetland habitat can be forested with a dense evergreen shrub layer or, with frequent fire, it can have a scattered pine canopy with switch cane or an herb bog. Pocosins provide habitat conducive to supporting: Atlantic White-cedar, Swainson's warbler, Kentucky warbler, wood thrush, American woodcock, prothonotary warbler, Acadian flycatcher, American woodcock, Pine Barrens treefrog, White-Wicky, and several species of pitcher plants and sundews – to name just a few (Kuchler 1964, USFWS 2007b).

Nonnative species, some of which are classified as invasive, do occupy areas of the Carolina Sandhills NWR. During the early years of the refuge, non-native legumes (e.g., sericia and bi-color lespedeza) were planted to enrich the infertile soil. Weeping love grass was planted to prevent erosion and stabilize the highly erodible soils. Some former agricultural and pasture lands, now managed as wildlife openings, have Johnson grass, fescue, and bahiagrass. The presence of these nonnative species impacts refuge management and restoration efforts. For example, weeping love grass burns at a higher temperature than native wiregrass, thus affecting fire intensity and behavior (J. Walker, personal communication). The extent of non-native species is unknown.

**Table 5. Summary of habitat types on Carolina Sandhills NWR**

| Habitat Type | Acres |
|---|---|
| **Natural Pine (longleaf)** | 15,024 |
| **Pine Plantation (planted)** | 13,434 |
| **Pine Scrub-Oak** | 6,341 |
| **Scrub-Oak** | 294 |
| **Pine Bottomland** | 4,991 |
| **Pine Hardwood** | 1,346 |
| **Upland Hardwood** | 448 |
| **Bottomland Hardwood** | 1,690 |
| **Managed Openings (Open Fields and Clearings)** | 1,202 |
| **Water (Lakes and Ponds)** | 279 |
| **Open** | 89 |
| **Total** | **45,138*** |

* Not including one fee title tract in Marlboro County totaling 210 acres.

*(Source: USFWS 2007b)*

*WILDLIFE*

**Terrestrial Wildlife**

The Sandhills Region is home to several rare and endangered species that require special habitat conditions for continued survival. The largest population of endangered red-cockaded woodpeckers within the Refuge System is found on the Carolina Sandhills NWR, with more than 140 family groups (USFWS 2007b). Rare plants, including several carnivorous plants, are found on the refuge along with the unusual pine barrens treefrog. The Carolina Sandhills NWR is a haven for almost 200 species of birds, 42 species of mammals, and over 750 species of plants. The sandhills support many reptile and amphibian species (41 species of reptiles and 25 species of amphibians) that are adapted to the habitat's dry, sandy conditions.

- Mammals -- Historically, bison, eastern cougar, red wolf, and black bear were all found in the sandhills region. Although these species have been extirpated from the area, an abundance of other wildlife species is found on the refuge. Commonly observed mammals are: eastern fox squirrels, river otters, beavers, raccoons, opossums, cottontail rabbits, and white-tailed deer. Bobcat, red and gray fox, mink, muskrat, coyote, and skunk are also present on the refuge (USFWS 2007a).
- Amphibians and Reptiles -- Amphibians at Carolina Sandhills NWR include toads, “true” frogs, tree frogs, and salamanders. All these species share a fundamental attachment to water. Amphibians place their eggs either in the water or in very moist places and are found in the many tributaries or the man-made ponds that exist on the refuge. Many of the reptiles are found close to the many small bodies of water on the refuge; however, unlike the amphibians, reptiles are not linked to the water to reproduce and deposit eggs. Appendix I lists reptiles and amphibians commonly observed on the refuge.
- Plants -- Although the sandhills contain dry, nutrient poor soils, a surprising diversity of plants persist. To date, more than 750 species of plants (many with extensive root systems and fire-resistant adaptations such as longleaf pine, turkey oak, and wiregrass) have been identified in the refuge. Appendix I lists many of the refuge's more common flowering plants.
- Birds -- Approximately 192 species of birds have been recorded by refuge personnel and visiting ornithologists since the Carolina Sandhills NWR was established in 1939. Another 18 species of accidental or extremely rare occurrence have also been observed. These species of birds are listed in Appendix I. Migrating ducks and geese begin to arrive in October and remain through early March. Wood ducks and a small flock of Canada geese are resident on the refuge and nest here in spring and summer. Many species of water birds, predacious, and songbirds are found on the refuge throughout the year. Carolina Sandhills NWR has one of the largest remaining populations of the endangered red-cockaded woodpecker.

Carolina Sandhills NWR is recognized as a Globally Important Bird Area by the Audubon Society because of its red-cockaded woodpecker population and breeding population of Bachman’s sparrow. The mosaic of habitats found on the refuge supports a diversity of bird species, many of which are listed as priority species by the SCDNR (*Italics* indicate probable occurrence on the refuge although undocumented) (SCDNR 2005a).

- Grassland and early successional habitats
  - Highest Priority: Common Ground-dove, Eastern Meadowlark, Field Sparrow, Grasshopper, Sparrow, Loggerhead Shrike, Northern Bobwhite
  - High Priority: Barn Owl
  - Moderate Priority: American Woodcock, Meadow Vole, Eastern Woodrat

- Sandhills Pine Woodland
  - Highest Priority: American Kestrel, Bachman's Sparrow, Brown-headed Nuthatch, Eastern, Wood Pewee, Northern Bobwhite, Red-cockaded Woodpecker, Wood Thrush, Pine Snake, Southern Hognose Snake
  - Moderate Priority: Eastern woodrat, Eastern Fox Squirrel
- Seepage Slopes
  - Highest Priority: Pine Barrens Treefrog
  - High Priority: *Southern Dusky Salamander (*Northern Dusky Salamander*)*
- Ponds and Depressions
  - Highest Priority: Little Blue Heron, Tiger Salamander
  - High Priority: Black Swamp Snake, Florida Cooter, Yellowbelly Turtle, Mink, *Southeastern Bat*
  - Moderate Priority: Great Blue Heron, Great Egret, Spotted Turtle, Common Snapping Turtle
- Blackwater Stream Systems
  - Highest Priority: Kentucky Warbler, Eastern Wood Pewee, Rusty Blackbird, Swainson's Warbler, Wood Thrush
  - High Priority: Acadian Flycatcher, Black Swamp Snake, Mink, *Rafinesque's Big-eared Bat*, *Southeastern Bat*
  - Moderate Priority: American Woodcock, Louisiana Waterthrush, Wood Duck, Spotted Turtle
- River Bottoms
  - Highest Priority: Black-throated Green Warbler, Kentucky Warbler, Little Blue Heron, Rusty Blackbird, Swainson's Warbler, Black Bear, *Northern Yellow Bat*
  - High Priority: Acadian Flycatcher, Black Swamp Snake, Mink, *Rafinesque's Big-eared Bat, Southeastern Bat, Star-nosed Mole*
  - Moderate Priority: American Woodcock, Great Blue Heron, Great Egret, Louisiana Waterthrush, Wood Duck, Common Snapping Turtle, Spotted Turtle, Eastern Woodrat, Eastern Fox Squirrel

Scattered wetlands, including streamhead pocosin, cane breaks, herb bogs, Atlantic white cedar bogs and bottomland hardwood swamp, provide habitat to support the following species: Swainson's warbler, Kentucky warbler, hooded warbler, wood thrush, American woodcock, prothonotary warbler, and Acadian flycatcher (USFWS 2007b).

One federally endangered species (Red-cockaded woodpecker, *Picoides borealis*) is known to occur within the Carolina Sandhills NWR. In addition, two State of South Carolina threatened species, eight State of Carolina Species of Concern, and one species (White-Wicky) of National Special Concern occur on the refuge. The southern bald eagle (*Haliaeetus leucocephalus*) was downlisted from federally threatened to "listed taxon protected under the Migratory Bird Treaty Act and Golden Eagle Protection Act" (USFWS 2007e). Species are listed in Appendix I (USFWS 2007b).

**Aquatic Wildlife**

The Southeastern Plains (Level III) Ecoregion contains the greatest number of imperiled fish species in the State of South Carolina. There are 32 priority fish species within the ecoregion, of which 11 are of the highest conservation need (representing 92 percent of the fish species of highest conservation need in the state). There are 15 priority mussel species, 11 priority crayfish species, and 2 priority snail species in the Southeastern Plains Ecoregion. The State of South Carolina considers the upper Lynches River (a tributary to the Pee Dee River) and its sandhills tributaries (of which Big Sandy Creek, Little Sandy Creek, and Swift Creek drain the western portion of the refuge) to be aquatic habitats of primary conservation concern. The upper Lynches River is home to several aquatic priority species including fish (sandhills chub, "thinlip" chub and "broadtail" madtom) and mussels

(brook floater, creeper, notched rainbow and the federally endangered Carolina heelsplitter). (SCDNR 2005a). Priority aquatic species in the Pee Dee watershed portion of the Southeastern Plains Ecoregion are listed in Appendix I.

One survey in 2004 found 12 fish species from five families in six impoundments included in the sample (Pool L, Lake Bee, Lake 16, Pool G, Mays Lake, and Oxpen 1). Creek chubsucker (*Erimyson oblongus*) was the most abundant species captured, while the most diversity was represented by the Centrarchidae (bass) family with seven species. Species sampled included creek chubsucker, pirate perch (*Aphredoderus sayanus*), blackbanded sunfish (*Enneacanthus chaetodon*), bluespotted sunfish (*Enneacanthus gloriosus*), flier (*Centrarchus macropterus*), warmouth (*Lepomis gulosus*), yellow bullhead (*Ictalurus natalis*), chain pickerel (*Esox niger*), redfin pickerel (*Esox americanus*), largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), and redear sunfish (*Lepomis microlophus*) (USFWS 2004).

*Non-native Species*

Introductions of non-native species have had a significant impact on native aquatic fauna in the Southeastern Plains Ecoregion. Buffalo (fish), common carp, flathead catfish, and blue catfish are established in several drainages. Flathead catfish and blue catfish introductions probably pose the greatest direct risks to native fauna. Flathead catfish have been shown to prey on bullheads, darters, shad, suckers, and sunfish. Severe declines in native species, particularly bullheads and sunfish, have been observed after the introductions of flathead catfish. It is not well known what effects buffalo have on the native community, but it has been suggested that they may be a factor in the decline of some catostomids in the Pee Dee River. Common carp occur in every South Carolina drainage and are considered a pest; however, their impact on native fauna is not well known. Common carp disrupt aquatic habitats by rooting around in the substrate where they uproot aquatic plants and increase turbidity and siltation. Common carp have also been shown to prey on the eggs of other fish species (SCDNR 2005a).

The Asian clam, *Corbicula fluminea*, has been introduced and has widely spread throughout the United States, including South Carolina. The effects of *Corbicula* on native species are not particularly well understood. According to a review of the literature on interactions between *Corbicula* and native mussels, most field studies fail to find any significant negative effects on [native] mussels, although a few detect reductions in growth (SCDNR 2005a).

The red swamp crayfish (*Procambarus clarkia*) has been introduced to South Carolina and has been observed at several locations in the Southeastern Plains and Coastal Plain, but it is unclear how widespread it is in the state. The lack of survey work since its introduction and the difficulty distinguishing the red swamp crayfish from one of the native species have made it particularly difficult to determine the extent of its introduced range. In North Carolina, it has become established in all drainages in the Coastal Plain and eastern piedmont plateau and appears to have extirpated all the native crayfish at one location. Introduced crayfish are thought to be the biggest threat to native crayfish species; the risk to our native species is great if further introductions or extensive spread of the red swamp crayfish occur (SCDNR 2005a).

## CULTURAL RESOURCES

(Excerpted from: Wright 1978)

The Sandhills region lies along the Fall Line in South Carolina and is part of the Tuscaloosa geological formation, which dates from the Cretaceous Period. Rivers flowing to the sea deposited

weathered materials from the mountains that formed dunes in the Sandhills. Some archaeologists studying the palynological evidence believe that the Sandhills have been relatively stable and that Pleistocene vegetation is much like the present. This theory suggests that some minor modifications of species ranges may have occurred; however, climatic changes of the Pleistocene did not greatly affect biota of the southeast. However, some pollen studies in North Carolina show the displacement of temperate deciduous forests from the southeast. If the vegetation did change, this would have had major affects on the culture of humans inhabiting the area.

Around 30,000 B.C., open xeric woodlands with oak and pine dominated the Sandhills. Between 28,000 and 22,000 B.P., oak-hickory forests replaced these xeric oak-pine woodlands. Studies in North Carolina and Georgia indicate boreal forests between 23,000 and 13,500 B.P. This suggests that flora and fauna would have been quite different from today. Between 15,000 and 10,000 years ago, temperatures rose rapidly, causing glacial retreat. Between 8,500 and 5,000 B.P., the vegetation in the coastal plain of Georgia was oak-savanna, with patches of prairie. The climate may have been warmer and drier and the water table determined the type of vegetation. From 5,000 years ago to present, a progressive change in vegetation took place. Pine became the dominant species, replacing the dry-oak forest, and hammocks (wet-oak forests) developed. Also during this time, cypress swamps and shrub bogs developed due to a rising water table.

Cultural habitation followed this environmental sequence. The earliest evidence of human occupation is during the Holocene between 10,000 and 8,000 B.C. during the development of the dry-oak forest. Bluestem prairies would have encouraged the movement of Paleo-Indian hunters while the later presence of deciduous forests would have stimulated Archaic cultural traits. It is difficult to determine with certainty the effect of the vegetation sequence on cultural habitation from 3,000 B.C. and 1500 A.D. During the Woodland and Mississippian Periods, the environment became progressively more diverse partially due to anthropogenic forces. This environmental diversity increased cultural complexity until A.D. 1000, when agriculture began to play a major role in subsistence.

Early European travelers described the physical environment of the Sandhills. Bernhard described thick woods, pine trees, and sand observed during his travels from Cheraw to Camden in 1825. Botanist Francois Michaux reported in 1805 that hardwoods dominated the Piedmont and that pines grew in the sandy soils. In 1826, Mills observed that pitch pine, black jack, and dwarf oaks dominated the Sandhills. This forest community supported white-tailed deer, squirrels, rabbits, wolves, lions, turkeys, quail, and reptiles.

*Cultural History*

Paleo-Indian (Pre-8,000 B.C.)
The exploitation of now extinct large Pleistocene fauna, including mammoth, mastodon, bison, horse, and sloth, characterizes the Paleo-Indian stage of cultural development. The archaeological record reflects this adaptation to big game hunting with hunting and meat processing tools. In South Carolina, scattered surface finds of projectile points define the Paleo-Indian period, but evidence is scarce.

The big-game hunting orientation probably resulted in relatively small groups of nomadic settlers in scattered short-term camps. The temporary nature of these camps along with the erosion and deposition characteristics of the Sandhills makes recovery of artifacts unlikely. The distribution of artifacts from the Paleo-Indian occurs along five major river drainages in the Coastal Plain. No Paleo-Indian cultural remains have been found in the refuge.

Archaic (8,000 B.C. to 2,000-1,000 B.C.)
Small game hunting, fishing, and gathering of plants define the cultural adaptations of the Archaic period. In South Carolina, there are few stratified sites from which to interpret. Prior to the introduction of ceramics, evidence relies heavily on projectile points. A gradual transition from the lanceolate projectile point forms to broad-shouldered points. Other lithic artifacts include side-scrapers and hafted end-scrapers. This morphological change suggests the shift from the use of the spear for stabbing in grassland hunting to the use of the atlatl and stalking techniques of the forest. The increased dependency on plants also supports the shift from open soak-savanna to a forested environment. The wealth and variety of woodland foods supported seasonal cultural developments. Likely habitat included banks of creeks and rivers, bottomlands, ridges, hillsides near streams, and river islands. The Piedmont and Fall Line would have been very attractive to Archaic peoples.

The tool kit during the early Archaic changed very little from the earlier Paleo-Indian, which is not surprising since early tools would support hunting a broad range of fauna rather than the development of species-specific implements. The lithic assemblage includes bifacial and unifacial flake knives, end-scrapers, side-scrapers, and drills. The appearance of well-made chipped stones suggests woodworking was important during the Archaic.

In the Kirk complex, Stanley points with wide blades and narrow, straight, or concave based stems replaced serrated points and corner notching. Stanley points fall between 6,000 and 4,000 B.C. Also associated with this time are tools for milling and grinding stones and axes.

By the late Archaic, use of diverse and plentiful forest resources enabled the development of semi-permanent to permanent settlements and increasingly complex social organizations. Complex tools and artifacts supporting this include atlatl, ground-stone tools, mortars, steatite vessels, polished and grooved axes, chipped stone tools, and bone-fishing implements. Pottery appeared towards the end of the Archaic.

Woodland (2,000-1,000 B.C. to A.D. 900)
Although ceramics appeared during the latter part of the Archaic, only during the Woodland Period was their occurrence widespread; therefore, they are a marker for that period. In addition to ceramics, mound construction and horticulture appeared during the Woodland. Hunting and gathering as a means of subsistence continued and maize and cucurbits were cultivated.

Research from the Uwharrie area of North Carolina provides a glimpse to the Woodland traditions of the Sandhills and Piedmont areas of South Carolina. During the transition from the Archaic to Woodland, known as the Badin, population density was greater and subsistence relied heavily on horticulture. Small triangular projectile points and ceramic jars with conoidal bases represent this period. These ceramics are sand tempered and either plain or decorated by impressing the wet clay with cord, fabric or net. Following the Badin was the Yadkin, which also included small triangular projectile points and ceramics. However, Yadkin ceramics included crushed quarts, rather than sand as the temper. Coastal elements influence the design motif. The Uwharrie focus, the last of the Woodland is characterized by brushed and net-impressed ceramics and narrow, triangular projectile points. During the focus, very intensive agriculture developed and population increased.

Mississippian (A.D. 900 to European Contact)
The Mississippian Period began around A.D. 900 and became the dominant culture in many areas of the southeast. Cultural traits associated with this period are intensive agriculture, permanent large villages, temple mounds, plazas, and shell-tempered pottery. Near the refuge, Mississippian sites are located along the Pee Dee River in North Carolina, and the Wateree River near Camden.

*Ethnohistory*

Soon after Columbus's discovery of the New World, there are reports of Aboriginal inhabitants. The French and Spanish explored the coast and the Spaniard de Allyon established a short-lived colony in the Winyah Bay. In the 1540s, De Soto passed through South Carolina. He described Cofitachequi at the confluence of the Wateree and Congaree rivers. In 1567, Juan Pardo built a fort known as Guatari for the Wateree who either lived on the Pee Dee or Catawba rivers. The next European influence on the aboriginal peoples occurred during colonial establishment. Traders entered the area after 1670. The Wateree, Santee, Congaree, Waxhaw, and Pee Dee Indians, who later were known collectively as the Catawba Indians influenced the European traders. Early settlers were dependent on hunting and gathering for subsistence.

The Catawba could not compete with Europeans as they rapidly settled vast expanses of land and were forced to move to Cherokee land. Problems with the Cherokees resulted in some Catawba returning and establishing a community near Rock Hill.

*History*

The history of European activity in the Sandhills and Piedmont regions of South Carolina is vague. Traders traveled through the area trading for deer hides and furs, which they obtained from the Indians. Trading was extremely profitable and peaked in the mid-eighteenth century. Europeans did not permanently settle the area until the 1730s. Europeans established townships along major inland rivers. The first Europeans to arrive were Scotch-Irish settlers from Delaware, Pennsylvania, and Virginia. People from the lowcountry of South Carolina migrated inland in search of rich farmlands and summer homes on the Pee Dee River in lieu of remaining in the malaria-infested coast during the summer.

Farmers grew diversified crops until the invention of the cotton gin. Despite the poor soils, cotton became the dominant crop. Intensive cotton farming depleted already poor soils necessitating further land clearing. There was a need for a large labor force to support this type of agriculture.

The Civil War ended slavery that along with ecological depletion spelled the end of cotton farming and forced economic and social changes in the area. Tenant farming and sharecropping replaced the plantation. Finally, people left farms to work in factories and farmlands reverted to forests. The return of the forest and the need for forest products gave rise to the current system of forest management and the production of pine.

The oldest town in the immediate area of the refuge is Cheraw, Chesterfield County, which was settled around 1748 and was a center for transportation along the Pee Dee River. Chesterfield County was formed in 1785, and is now largely agricultural. General Sherman's troops passed through this area during the Civil War, briefly occupying the towns of Cheraw and Chesterfield (S.C. State Library 2006).

## SOCIOECONOMIC ENVIRONMENT

### Regional Demographics and Economy

The Carolina Sandhills NWR is located in Chesterfield County, South Carolina, 4 miles north of the town of McBee, SC on U.S. Highway 1. The nearest large metropolitan areas are Columbia, South Carolina, to the southwest and Charlotte, North Carolina, to the north west, both about 65 miles distant from geographic center of the refuge. Florence, South Carolina, a city with a population of about 200,000 is about 36 miles southeast of the refuge.

According to the 2000 U.S. Census (U.S. Census Bureau 2003), the population of Chesterfield County was 42,768 (Table 6), with estimates of about 43,435 in 2005. The population is roughly 73 percent rural versus 27 percent urban; and, 64 percent white versus 36 percent nonwhite. There are only eight small municipalities in Chesterfield County. These eight (with their 2000 census populations) are: Cheraw (5,524); Pageland (2,521); Chesterfield (1,318); McBee (714); Jefferson (704); Patrick (354); Ruby (348); and Mt. Croghan (155). For the 30-year period, 1970 to 2000, the population of Chesterfield County grew by about 27 percent. The population growth in Chesterfield County lags behind U.S. and state trends (Figure 14).

The per-capita income of Chesterfield County is only about 76 percent and 66 percent of the state and U.S. averages, respectively. Poverty is comparatively high in Chesterfield County, with 17 percent of families and 20 percent of individuals having incomes below the poverty level. Details are given in Table 6. The labor force decreased from 19,638 in 2003 to 18,515 in 2004, while the unemployment rate has remained high at about 10.0 percent (South Carolina Employment Security Commission 2008). The three largest areas of employment are: manufacturing (34 percent); educational, health and social services (16 percent); and retail trade (12 percent) (South Carolina Employment Security Commission 2008).

According to the South Carolina Industrial Directory (City-Data.com 2008), approximately 6,300 people are employed by industries in Chesterfield County. The largest employers are Conbraco valves (1,031), A.O. Smith water heaters (740), Highland synthetics (378), DuPont protective apparel (300), and Stanley tools (300). Of the 21 industrial plants employing at least 75 people, nine are in Cheraw with 1,770 employees, seven in Pageland with 1,908, four in McBee with 1,335, and one in Chesterfield with 76. Some industries in the neighboring counties also employ substantial numbers of Chesterfield County residents. Farming is also an important part of the county's economy. Major crops are corn, soybeans, and hay. Some wheat and cotton also are grown. The McBee area is well known for its peach production, both the amount and the variety (Newcome 2004).

**Outdoor Recreational Economics**

The resources of the Carolina Sandhills NWR are economically important. The refuge provides numerous sites for hiking, recreational fishing, hunting, and wildlife observation. As the country's population increases and the number of places left to enjoy wildlife decreases, the refuge will become even more important to the community. The refuge benefits the community directly by providing recreational and employment opportunities for the local population and indirectly by attracting tourists from outside the area to generate additional income to the local economy. Whether it is gas used to travel to and from the refuge, a meal at a local restaurant, ammunition, or an overnight at a local motel, visitors to Carolina Sandhills NWR add substantially to the regional economy.

Table 7 presents information summarizing the economic value of hunting, fishing, and wildlife watching in South Carolina by U.S. residents.

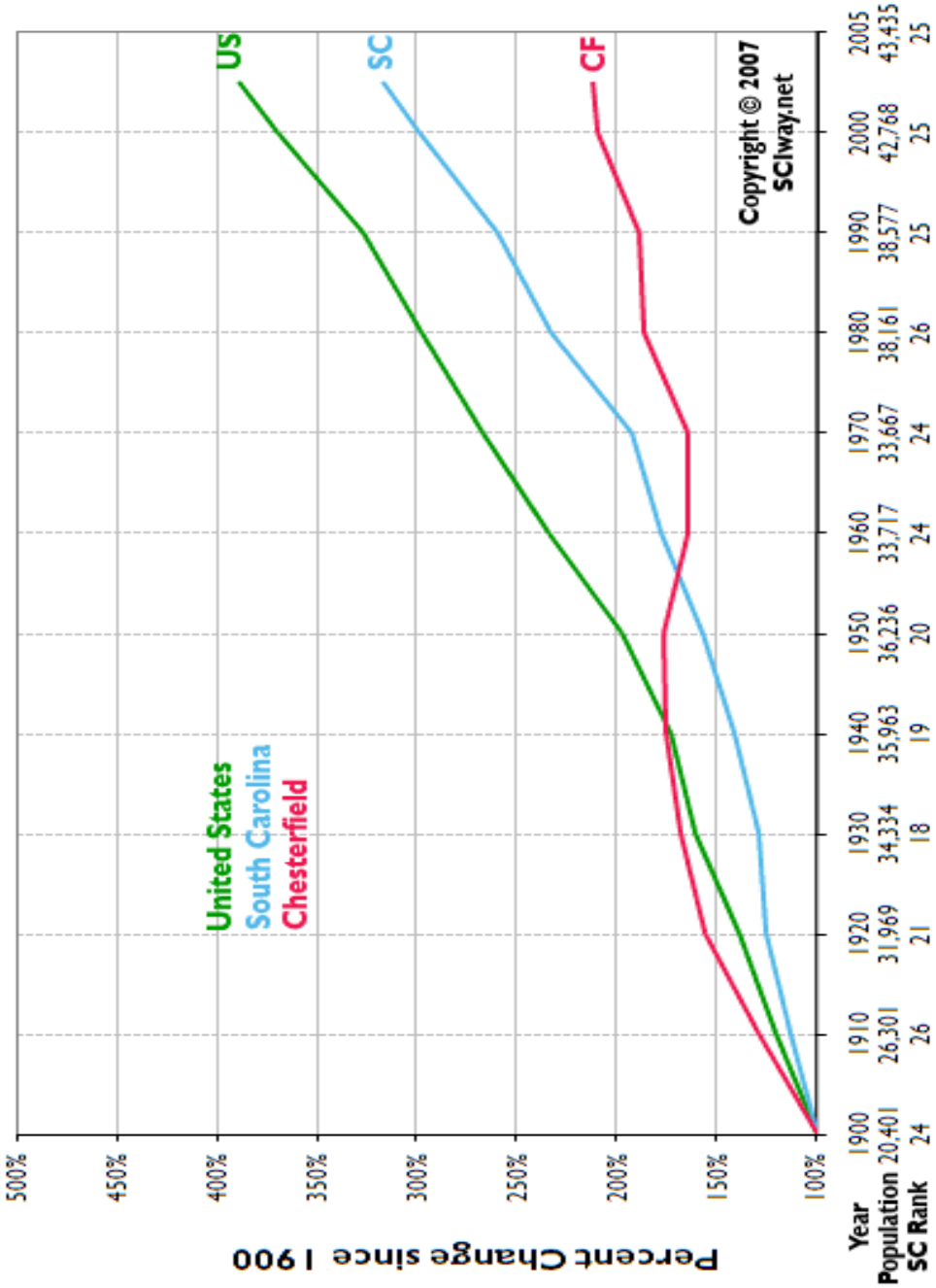
**Table 6 Demographics of Chesterfield County, South Carolina**

| Characteristic | Chesterfield County | South Carolina | United States |
|---|---|---|---|
| Demographic | | | |
| Population (number) | 42,768 | 4,021,012 | 281,421,906 |
| Total Land Area (sq. miles) | 798.6 | 30,109.5 | 3,537,438.0 |
| Population Density (pop./sq. mile) | 54 | 133 | 80 |
| Race/Ethnicity (% of Population) | | | |
| White | 64.3 | 67.2 | 75.1 |
| Black/African American | 33.2 | 29.5 | 12.3 |
| Hispanic/Latino (of any race) | 2.3 | 2.4 | 12.5 |
| Education (% of population over 25) | | | |
| High School degree | 65.2 | 76.3 | 80.4 |
| College degree | 9.7 | 20.4 | 24.4 |
| Economic (1999 dollars) | | | |
| Median Household Income | $ 29,483 | $ 37,082 | $ 41,994 |
| Per capita Income | $ 14,233 | $ 18,795 | $ 21,587 |
| Families below poverty level (%) | 16.7% | 10.7% | 9.2% |
| Individuals below poverty level (%) | 20.3% | 14.1% | 12.4% |

*(Source: U.S. Census Bureau 2003)*

**Figure 14. Population growth in Chesterfield County, South Carolina 1900-2005**

*(Source: S.C. Information Highway 2007)*




1. *The red line illustrates how the population of Chesterfield County has changed since 1900. During this time the population of South Carolina more than tripled, and the population of the United States almost quadrupled. The actual population of Chesterfield County of each decennial census year is shown below the graph.*
2. *The rankings below the population figures illustrate how Chesterfield County's population ranked among South Carolina's 46 counties (28 counties in 1900, 37 in 1910). 1 = highest population; 46 = lowest population.*
3. *Data sources: US Census Bureau, 1900-1990, 2000, and 2005 estimates*

**Table 7 Activities in South Carolina by U.S. residents**

| | |
|---|---|
| **Fishing** | |
| Anglers | 812,000 |
| Days of fishing | 10,679,000 |
| Average days per angler | 13 |
| Total expenditures | $558,731,000 |
| Trip-related | $317,966,000 |
| Equipment and other | $240,765,000 |
| Average per angler | $632 |
| Average trip expenditure per day | $30 |
| Trip and equipment expenditures by nonresidents in South Carolina | $117,077,000 |
| **Hunting** | |
| Hunters | 265,000 |
| Days of hunting | 4,744,000 |
| Average days per hunter | 18 |
| Total expenditures | $305,272,000 |
| Trip-related | $95,643,000 |
| Equipment and other | $209,629,000 |
| Average per hunter | $1,141 |
| Average trip expenditure per day | $20 |
| Trip and equipment expenditures by nonresidents in South Carolina | $30,515,000 |
| **Wildlife Watching** | |
| Total wildlife-watching participants | 1,186,000 |
| Nonresidential | 331,000 |
| Residential | 1,045,000 |
| Total expenditures | $256,372,000 |
| Trip-related | $89,045,000 |
| Equipment and other | $167,327,000 |
| Average per participant | $216 |
| Trip and equipment expenditures by nonresidents in South Carolina | $48,396,000 |

*(Source: U.S. Department of the Interior, Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau. 2001)*

## REFUGE ADMINISTRATION AND MANAGEMENT

*LAND PROTECTION, CONSERVATION, AND MANAGEMENT*

### History and Restoration of the Longleaf Pine/Wiregrass Ecosystem

The longleaf pine/wiregrass ecosystem and the associated flora and fauna are diminishing across the southeastern United States. The longleaf pine/wiregrass ecosystem, the characteristic habitat of Carolina Sandhills NWR, once covered approximately 90 million acres in the southeast. This unique ecosystem, shaped by thousands of years of natural fires that burned through every 2 to 4 years, has been reduced to fewer than two million acres, representing a 97 percent decline in this ecosystem. Today, only scattered patches of the longleaf pine/wiregrass ecosystem occur, primarily in the coastal plains of the Carolinas, Georgia, Florida, Alabama, Louisiana, and Texas.

In the course of its evolutionary history, the longleaf pine forest has adapted to frequent natural fires. These low intensity fires reduce the accumulation of large amounts of forest liter and facilitate the growth and reproduction of many species of grasses, legumes, and forbs. The frequent fires prepare the soil for the seeding of the longleaf pine by making nutrients available and by reducing competition from other tree species -- that if not eliminated would absorb needed nutrients and shade out sunlight needed by the young longleaf seedlings. From a botanical perspective, longleaf pine forests are incredibly diverse. Today, more than 30 plant and animal species associated with longleaf pine ecosystems, including the red-cockaded woodpecker, are listed as threatened or endangered.

In the nineteenth century, naval stores ( i.e., tar, pitch, turpentine, and rosin) were highly sought after by boat builders. Also, in the late nineteenth century, longleaf pine, because of its great strength, was among the most sought after timber in the country. Longleaf lumber was shipped all over the world for use in building bridges, factories, and wharves. Thousands of heartwood crossties were made from longleaf pine and used by railroads throughout the country. In harvesting the trees, loggers left mounds of flammable debris that frequently fueled catastrophic firestorms, destroying both the remaining trees and seedlings. The bare, exposed earth left behind by clear-cutting operations was highly susceptible to erosion, and nutrients were washed from the already porous soils, thus further hampering the natural seeding process. At the peak of the timber cutting in the 1890s and the first decade of the new century, the longleaf pine forests were providing millions of board feet of lumber each year.

The timber sawyers gradually moved across the South; and by the 1920s, most of the “limitless” virgin longleaf pine forests were gone. The wildlife accustomed to the open longleaf pine/wiregrass ecosystem -- wild turkeys, fox squirrels, bobwhite quail, and red-cockaded woodpeckers -- virtually disappeared, replaced by the inhabitants of denser pine forests. The intricate interplay of life adapted to the longleaf pine ecosystem was interrupted.

In an attempt to protect the remaining longleaf pines forests and encourage their regeneration, turn-of-the-century foresters made a classic mistake: they condemned the frequent, natural fires and turned instead to a policy of fire suppression. Without frequent, natural fires, the diverse ground cover was slowly smothered beneath the dense carpet of pine needles and oak leaves. Longleaf pine seeds could no longer germinate because they could not reach the mineral soil. This accumulation of natural fuels (needles, limbs, cones, and scrub-oak leaves and twigs) on the forest floor resulted in intense, hot fires which killed many longleaf pines. Further complicating things, without frequent, natural fires, scrub oak, normally shrub-sized in the natural longleaf forests swept by frequent fires, grew into dense, tall thickets, further preventing light to the forest floor and competing with the longleaf seedlings for soil nutrients and moisture.

## Forest Management

All timber management practices carried out on Carolina Sandhills NWR serve to provide wildlife habitat to best meet the needs of native species. Special attention is given to the needs of threatened and endangered species. Maintaining a diversity of forest habitat types that mirror the historic and natural distribution of species is an important goal for the forest management program.

Forest management needs are planned and scheduled using management prescriptions which are prepared for each of the refuge's 21 timber compartments. These prescriptions describe the management techniques proposed along with an inventory and description of the forest resources occurring within the area. The special needs of the endangered red-cockaded woodpecker are provided for and included in these plans. Emphasis is placed on management techniques that maintain present and future foraging habitat for these birds.

Carolina Sandhills NWR serves as a demonstration site for land management practices which conserve and enhance the diminishing longleaf pine/wiregrass ecosystem to provide habitat for native species.

*Tree Removal*
Improvement cuts or thinnings are used in timber stands to:
• reduce competition between desirable tree species
• permit more light to reach the forest floor (encourages growth of low growing plants)
• encourage better crown development
• ensure continued vitality of dominant, over-mature, and larger trees
• permit better root development
• remove offsite species
• reduce diseased, damaged, weak, or malformed stems (except as may provide unique wildlife values)
• focus site resources to the healthiest, most vigorous stems.
• enhance conditions for the public to see and enjoy the wide variety of wildlife species present

*Forest Reproduction*
Natural reproduction or regeneration is the preferred method for new growth. When natural regeneration cannot be accomplished, artificial methods such as direct seeding or planting are used.

*Prescribed Burning*
Fire is an important management tool for longleaf pine management at Carolina Sandhills NWR. Prescribed burning is conducted throughout the year on different portions of the refuge. This mimics the natural fires that historically burned through longleaf pine/wiregrass areas on a 3- to 5-year interval. Those natural fires were of low intensity, fueled by grasses and pine litter. The prescribed fires used at Carolina Sandhills NWR suppress the growth of hardwood trees, creating open park-like conditions preferred by the red-cockaded woodpecker and many other animals and plants native to this ecosystem.

The very mention of the word "fire" may conjure up visions of flames, heat, and destruction to timber, wildlife, and personal property. However, fire is a force of nature which benefits many plant and animal species. Land managers must understand the critical role forest fire management plays in maintaining healthy ecosystems.

How can fire in a woodland setting be considered good at one time and bad at another? The answer can be found in almost all facets of nature. Most people will agree that rain is good. Without rain, the forest would not be able to grow. The same can be said for sunshine. However, excessive amounts of either of these two elements can be devastating. The same formula applies to fire. The right amount is as necessary to the forest and the animals that live there as are rain and sunshine.

Before humans appeared in the Carolina Sandhills region, wildfires were largely controlled by the climate. As a result, land-based ecosystems adapted to wildfires. In other words, fire was the dominant ecological process for change in the forests. Rather than being a destructive element in the pre-history forests, fire was critical to maintaining healthy forests with a diversity of species.

For thousands of years, natural fires burned almost unimpeded from the Coastal Plain, through the Sandhills, and into the Piedmont. Lighting strikes were responsible for the first fires; then, beginning 8,000 to 10,000 years ago, Native Americans began to burn the woods to clear agricultural fields or to hunt game. The pine needles, wire grass, and other plants fueled these low-intensity fires that moved slowly across the landscape for days or even weeks at a time, extinguished by a drenching rain or after running into a watercourse.

Today, scientists and land managers are still learning about the beneficial aspects of fire, often using data such as that gathered at Carolina Sandhills NWR. In the 1930s, researchers began to challenge the negative notions about fire. They argued that in some regions, fire was an essential element to allow wildlife and forests to thrive. Fire ecology concentrates on the origins of wildland fires and their relationship to the living and nonliving environment. It recognizes that fire is a natural process operating as a component of an ecosystem.

Fire dependence is a key concept of fire ecology. It is based on the idea that fire is an essential element that allows some ecosystems of wildlife and forests to thrive. Some plant species, including the longleaf pine, rely on the effects of fire to prepare their surrounding environment for their regeneration and growth. For example, fire prepares the soil for the seeding of the longleaf pine by making nutrients more available, and by reducing competition from other species such as the scrub oak that may absorb needed nutrients or shade out necessary sunlight.

A second concept of fire ecology is the fire environment. Fire is controlled by three factors: fuels, weather, and topography. An area's fire environment is determined by the interactions of climate conditions, the types of fuels available, and ignition sources. Together these conditions determine the frequency and intensity of fires, fire size, and the amount of fuel consumed. The frequency of wildfires depends on ignition sources and weather conditions which may help a fire spread. The intensity depends on the quantity of fuel available and how easily it will burn. These factors are quite interdependent, and their interaction is influenced by wind, humidity, and topography.

A third concept of fire ecology is fire history -- how often has fire occurred in a given region. Trees actually record fire history. Each year a tree adds a layer of cells, increasing the width of its trunk. You may have seen the cross-section of a tree that has been cut down, and noticed the “rings” which indicate this annual addition of cells. When a fire passes through a forest, some trees are only scorched. This adds a layer of charcoal which is eventually enveloped by a layer of new growth. Over time, these charcoal layers provide a record that scientists can use to determine when and how often fires have occurred.

The Carolina Sandhills NWR staff uses fire as a catalyst that promotes changes in the ecosystem. They anticipate the changes that will occur after a prescribed burn, and study the processes that take the ecosystem from one stage to the next. Regular prescribed fires reduce

the amount of ground fuels, which means that if a wildfire did occur on the refuge, it would be less intense and easier to control. Fuel reduction helps prevent crown fires which burn at high intensity and are capable of causing unacceptable change. It is crown fires that we generally think of when we envision an out-of-control forest fire.

Fire returns valuable nutrients to the soils. Certain pathogens that reduce growth in pines and other species can be controlled or eliminated by the use of prescribed burning. A classic example is brown spot needle blight in the longleaf pine. Once the diseased needles on young pine trees have been consumed by fire, the blight is controlled, and the seedlings can continue to store carbohydrates in their roots.

In planning a prescribed burn, fire managers on the refuge write a "prescription" for the fire to be ignited only when certain weather, fuel, and moisture conditions occur that will make the fire manageable. The refuge maintains a complete weather station that collects hourly data including temperature, humidity, wind, fuel moisture, and other climatic factors. Fire is mainly applied in the winter and spring. Winter (dormant season) fires are used to reduce fuel loads of pine needles and oak leaves, and also to keep understory hardwoods at bay. Spring (growing season) fires are used to control taller midstory hardwoods and to prepare the ground for longleaf pine seedlings. Prescribed fires are often set using a helicopter; the aircraft carries a supply of incendiary devices that are dropped from the helicopter to set small spot fires along a predetermined fire line. This allows for a very predictable and accurate prescribed burn. For smaller prescribed burns, a hand-torch is used to light the fires.

*Other Forest Management Practices*
Other practices used by forest managers at Carolina Sandhills NWR include roller chopping and hydro-axing in locations where prescribed fire is not controlling scrub oaks. This removal of midstory helps to maintain the open stand condition required by red-cockaded woodpeckers.

On rare occasions, it becomes necessary to conduct unplanned, salvage timber sales to prevent the spread of diseases and/or insect infestations. These problems generally occur after a natural event such as tornadoes, windstorms, ice storms, or rarely hurricanes. Prompt action is usually required to prevent the spread of these problems into unaffected areas.

**Fields and Openings**

Although most of the area of Carolina Sandhills NWR is forested, it also contains nearly 1,200 acres of old field and grassland habitat. The staff employs several agricultural practices to maintain these areas to benefit wildlife. Objectives for this program include meeting basic wildlife needs for food, shelter, and cover. Conservation and restoration of the existing soil base are also important objectives.

Many of our open areas are planted in soil-building legumes to help control erosion in the predominantly sandy soils of the refuge. The staff and cooperative farmers also plant some of our fields in crops beneficial to wildlife species. In many cases, food crops are planted in strips along the edge or in the center of these fields to maintain cover and shelter for smaller mammals and ground nesting birds.

Typical crops planted to benefit waterfowl include wheat and millet. These crops provide foods high in nutritional value during the coldest, most stressful periods in the winter. Green browse in the form of wheat, ryegrass, and clover meet the less stringent nutritional requirements for waterfowl.

A few refuge fields are annually planted with a mixture of crops preferred by mourning doves, including black sunflower, brown-top millet, sorghum, Japanese millet, and switchgrass. Many acres of perennials have been established on the refuge to provide food and cover for bobwhite quail.

Since Carolina Sandhills NWR already provides excellent habitat for the wild turkey, little additional management is needed to maintain and increase this population. Since turkey will benefit from the majority of the crops produced on the refuge to benefit other wildlife, little farming effort needs to be directed specifically for turkeys. Plantings of a peanut-like tuber producing plant known as chufa in fields along the Wildlife Drive helps to attract these birds for the public's viewing.

Another species that occurs in the longleaf pine ecosystem is the white-tailed deer. Management practices, such as prescribed burning and selective thinning in natural and planted pines, benefit most native wildlife species, especially white-tailed deer, wild turkey, and bobwhite quail. The staff conduct supplemental plantings of fall and winter forage such as winter wheat, clover, and ryegrass.

**Wetlands**

The Carolina Sandhills NWR maintains 27 ponds and lakes, which provide water for many wildlife species. Some also serve as resting and feeding areas for waterfowl and water birds. Many of the refuge's less conspicuous wildlife species (e.g., reptiles, amphibians, and fishes) depend on these water areas for homes and breeding areas.

Wooden nest boxes are erected and maintained in many of our ponds for wood ducks. Loss of suitable natural cavities in dead trees threatened these ducks in the early sixties. Thanks to the erection and management of thousands of nest structures such as these, the wood duck has made an amazing recovery.

Several refuge ponds and lakes, including Martin's Lake, Pool D, and Lake 12, are being managed extensively to provide habitat for wintering waterfowl, shorebirds, water birds, and aquatic species. Water levels are lowered in the spring to encourage the growth of emergent aquatic vegetation. Lowered water levels also help to concentrate invertebrate foods in shallow areas, creating good feeding areas for water birds and shorebirds. In the fall, the water levels are gradually raised to flood portions of this vegetation used as food by ducks and geese.

**Red-cockaded Woodpecker Management**

In the vast stands of centuries-old pines that once stretched from the Atlantic Coast to the forests of eastern Oklahoma, the red-cockaded woodpecker (*Picoides borealis*) once thrived. But the farming practices of the European settlers and the progressive changes in timber management combined to drive this territorial, non-migratory bird nearly to extinction. The red-cockaded woodpecker was placed on the endangered species list in 1970. While recovery efforts continue, the population is currently estimated by the Service to be roughly 12,500 birds living in about 5,000 family groups.

The red-cockaded woodpecker is about the size of the common cardinal or robin, approximately 7 inches long, with a wingspan of about 15 inches. Its back is barred with black and white horizontal stripes. The red-cockaded woodpecker's most distinguishing feature is a black cap and nape that encircle large white cheek patches. Rarely visible, except perhaps during the breeding season and when defending its territory, the male has a namesake small red streak -- called a cockade -- on each side of its black cap.

These small woodpeckers are unique in two ways. First, it is the only woodpecker that excavates its nesting and roosting cavities in living trees: preferably old-growth longleaf or loblolly pines. Second, the red-cockaded woodpecker lives within a tight-knit extended family community of breeding birds and helper birds.

To survive and prosper, the red-cockaded woodpecker requires open, park-like forested landscapes of longleaf pine and home ranges from 75 to 500 acres depending on habitat quality, which foster group interactions and population expansion. Mature longleaf pine trees are a necessity because the older trees often fall prey to a fungus called red-heart disease. This fungus softens the core of the tree, making it easier for the woodpecker to create its nesting and roosting cavities.

The red-cockaded woodpecker feeds primarily on wood-boring insects, beetles, wood roaches, ants, centipedes, caterpillars, and spiders; occasionally, the adults will be observed feeding on blueberry, sweet bay berries, and poison ivy. Older, larger trees, when available, are preferred for foraging.

The red-cockaded woodpecker makes its home in mature pines. Longleaf pine trees are preferred, but other species of southern pine, such as the loblolly, are also used. While other woodpeckers bore out cavities in dead trees where the wood is rotten and soft, the red-cockaded woodpecker is the only woodpecker that excavates its cavities exclusively in living pine trees. The mature pines favored by the red-cockaded woodpecker often suffer from a fungus called red heart disease, which attacks the center of the tree, causing the inner wood – or heartwood -- to become soft.

Red-cockaded woodpeckers practice an advanced social system, cooperative breeders, living in extended-family groups. There is only one pair of breeding birds within each group, and they normally raise only a single brood each year. The other group members, called “helpers,” are usually males from the previous breeding season. Though helpers are non-breeders, they participate in incubation, feeding nestlings and fledglings, territory and cavity defense, and cavity excavation. Groups may contain as many as seven helpers, but it is more common to see only one or two helpers per group.

A family group of red-cockaded woodpeckers will create a collection of cavity trees, called a “cluster.” Each bird in the group maintains its own cavity tree. Each group normally occupies and defends only one cluster.

Red-cockaded family groups defend territories that cover an average of 200 acres, though some group territories are as small as 60 acres, and others as large as 600 acres have been observed. The size of a given territory is related to both habitat suitability and population density. This arrangement promotes continuity among family groups: Should the patriarch die, one of his offspring stands ready to inherit the family territory.

Red-cockaded woodpeckers often have the same mate for several years. The nesting season lasts from April through June. The group helps to construct a nest made of wood chips in the breeding male’s roost cavity. The breeding female usually lays two to four small white eggs in this nest. All members of the group incubate the eggs for 10 to 12 days. Once hatched, the nestlings remain in the nest cavity for about 26 days. Rearing the fledglings is a shared responsibility of the group. However, a single pair of red-cockaded woodpeckers can breed successfully without a group of helpers.

After several weeks, the fledges are largely independent. Juvenile females generally leave the group in the fall or winter, before the next breeding season, in search of solitary male groups. Some of the young males will leave at the same time in search of their own territory.

The red-cockaded woodpecker excavates an entrance hole of around 2 inches in diameter, leading to a gourd-shaped cavity, roughly 8 to 12 inches in diameter, into the heart of the tree. This is no small undertaking…each cavity can take from 1 to 7 years to construct.

Once a cavity is completed, the red-cockaded woodpecker pecks numerous small holes -- called resin wells -- around the tree under the cavity. This causes large quantities of sap to run down the tree in rivulets, coating the tree and giving it a candle-like appearance. The sap theoretically deters rat snakes and other predators from reaching the cavity. The woodpeckers spend a significant amount of time and energy maintaining the flow of the resin wells especially during the breeding season. If the tree should die, or the damage from maintaining the wells becomes so great that the sap stops flowing, the woodpeckers will eventually abandon the cavity tree, potentially to other forest dwellers.

A number of other birds and small mammals use the cavities excavated by red-cockaded woodpeckers. Chickadees, bluebirds, nuthatches, and titmice will happily take up housekeeping in a woodpecker cavity. Several other woodpecker species, including the downy, hairy, red-headed and red-bellied woodpeckers, may take over a red-cockaded woodpecker cavity, sometimes enlarging the hole enough to allow screech owls, wood ducks, fox squirrels and other mammals to later move in. Flying squirrels, several species of reptiles and amphibians, and insects, primarily bees and wasps, will also use woodpecker cavities. Accordingly, the red-cockaded woodpecker an important part of the forest ecosystem, providing homes for many animals which would not normally create a home in a living pine. However, cavity competition is a major concern for species recovery. Small mammals such as southern flying squirreld (*Glaucomys volans*) or larger woodpeckers usurp occupied cavities. Once a red-bellied, red-headed, or pileated woodpecker enlarges the cavity entrance, it is rendered unsuitable for the red-cockaded woodpecker.

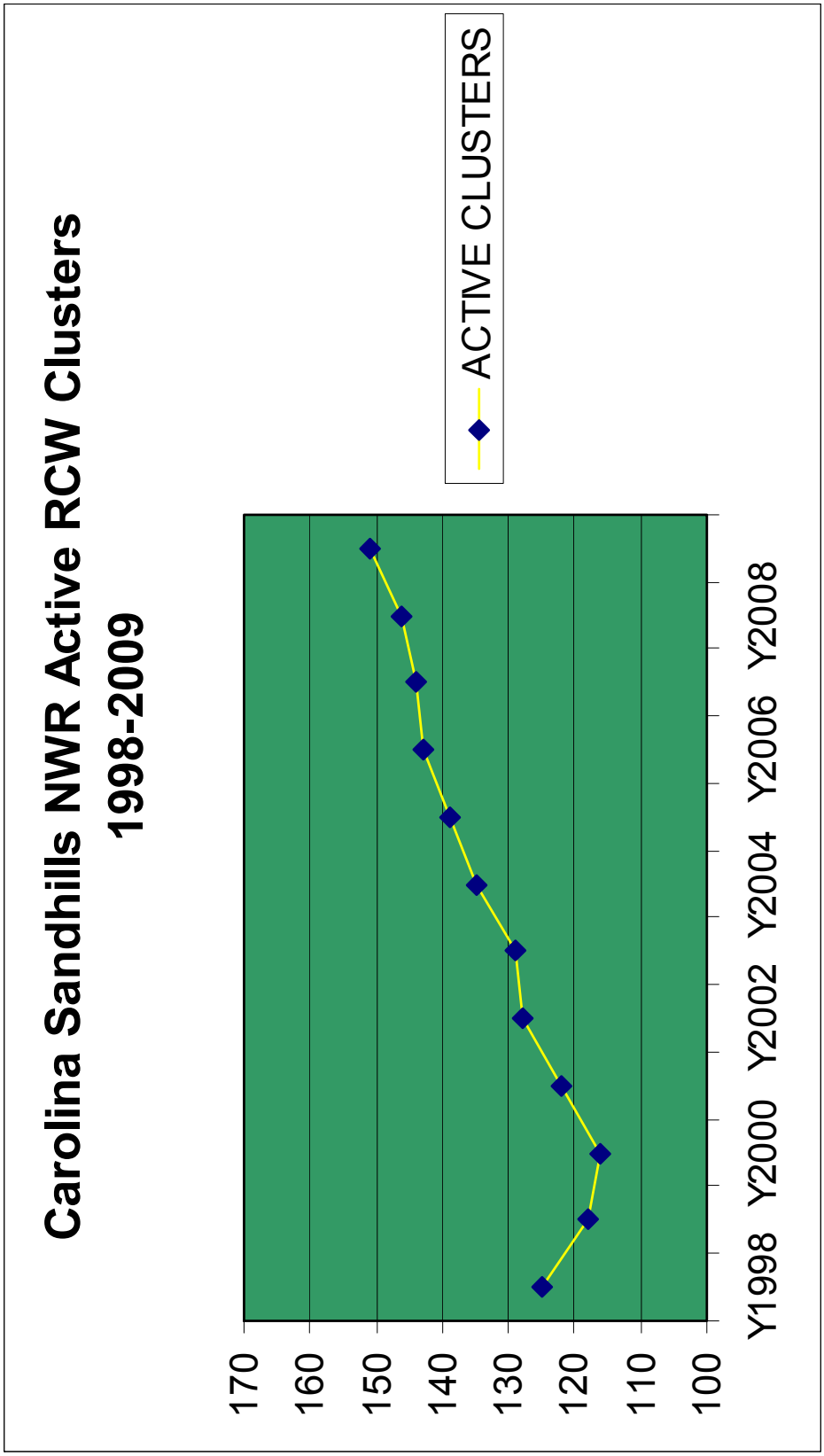
The amount of time it takes a red-cockaded woodpecker to excavate a cavity (from 1 to 7 years) is a huge detriment to any recovery program. Refuge staff use artificial cavities as a part of their management plan to encourage population expansion of the red-cockaded woodpecker.

The most common artificial cavity method used on the refuge are insert boxes. Inserts are prefabricated wooden boxes containing a cavity similar to blue bird boxes. First, an appropriate longleaf pine is chosen, and a plug of the tree is removed using a chain saw. The complete cavity assembly – dubbed “government woodpecker housing” by one staff member -- is then inserted and secured. Once the artificial cavity is installed in the tree, wood putty is heaped on and modeled to mimic the look and texture of a longleaf pine. Approximately 40 percent of cavities used by red-cockaded woodpeckers at Carolina Sandhills NWR have been artificially constructed.

The refuge is home to the largest population of red-cockaded woodpeckers on Service lands. Although not a primary recovery population, the refuge, along with the Sand Hills State Forest, is designated a secondary recovery population. The refuge’s population goal is 165 active clusters.

In 2009, the refuge managed 165 clusters. Of those, 151 were active compared with 146 in 2008. In 2009, 121 groups attempted nesting as compared with 116 in 2008. One hundred nine nests fledged young in 2009, while 89 nests were successful in 2008. As evidenced in Figure 15, the refuge’s red-cockaded woodpecker population is stable to increasing between 1998 and 2009.

**Figure 15. Red-cockaded woodpecker population data 1998 through 2009 on Carolina Sandhills NWR**



Refuge staff monitor nests and band nestlings with a USFWS aluminum band and a unique combination of color bands. One of the most important functions of color banding is that it allows staff to locate birds of a known age and sex so that they may be used to augment single bird clusters or for translocations of birds to other recipient populations. Biological staff band 170 to 220 chicks annually. Staff band nestlings at 5 to 9 days old and conduct sex determinations at 17 to 19 days old.

Refuge staff complete group observation and composition checks in red-cockaded woodpecker clusters as required by the Red-cockaded Woodpecker Recovery Plan (USFWS 2003b). The purpose of group composition checks is to build a robust data set to provide information about the population's relative fitness aside from nesting and to provide information for translocating birds to other populations.

*VISITOR SERVICES*

Presently, the refuge has an up-to-date Visitor Services Plan. The hunting and fishing plans were updated in 2001, and have been reviewed annually to meet notification requirements of 50 CFR.

Following the completion of this Comprehensive Conservation Plan, a revision of the Visitor Services Plan will be developed to reflect current legislation, Director's orders, initiatives, policy, and the mission of the refuge, the Refuge System, and the Service. That plan will address the current and future visitor services and recreation needs of refuge visitors. For example: directional signage at major entry points to the refuge and refuge intersections; informational brochures (hunting, fishing, wildlife observation, unique flora and fauna, etc.); designated visitor parking areas; road improvements; kiosks and exhibits; educational videos; and facilities maintenance (graffiti, handrails, bathrooms, etc.) are areas that will be addressed in the Visitor Services Plan.

Approximately 44,000 of the total 45,348 acres within the refuge are open for some type of hunting. Public hunting for white-tailed deer, hog, turkey, quail, woodcock, mourning dove, raccoon, opossum, and rabbit is permitted. Except for the turkey hunts, hunter quotas were not established for the harvesting of these species.

Fishing on Carolina Sandhills NWR is permitted on approximately 310 acres of water. Thirty ponds are open to fishing year-round, with the exception of Martin's Lake, which closes seasonally to provide a waterfowl resting area.

The refuge issues special use permits for photographers wishing to set up photo blinds and enter/exit the refuge outside of normal visitor hours. A photo blind is located on the north side of Martin's Lake and is accessed via a quarter-mile trail (Tripod Trail) or for mobility-impaired visitors by vehicular access.

The refuge has a 9-mile paved Wildlife Drive with access to an interpretive trail (Longleaf Pine Trail) and hiking trails (Woodland Pond Trail and Tate's Trail); observation towers (Martins Lake and Oxpen Observation towers); a photo blind (Martin's Lake); handicapped accessible docks and parking areas at Lake Bee; and a gravel access road to May's Lake in a more remote part of the refuge (May's Lake has two docks, one of which is handicap accessible). The Wildlife Drive receives much use from visitors wishing to observe wildlife. The drive, winding through the various habitat types of the refuge, allows visitors the opportunity to view such species as white-tailed deer, wild turkey, fox squirrel, red and gray fox, and numerous species of birds including wood ducks and geese. The drive also receives use by local bicyclists who enjoy the remoteness of the area, along with its challenging rolling hills.

The refuge does not have a dedicated environmental education program coordinator. However, the refuge is a frequent destination site and outdoor "lab" for class field trips. Several schools, church groups, and civic groups visit the refuge and are welcomed and introduced to the refuge by staff as time and work schedules allow.

*PERSONNEL, OPERATIONS, AND MAINTENANCE*

Carolina Sandhills NWR has a 10-person staff, with 3 to 5 additional seasonal employees, 1 to 2 college interns, and 2 Youth Conservation Corps employees each summer. The annual operations and maintenance budget was $980,000 in 2006 and $1,300,000 in 2007. Special projects supplemented this budget in 2006 by $562,000 and by $821,900 in 2007. There are approximately 50,000-60,000 visitors annually to the refuge. Revenue sharing payments to Chesterfield County average $200,000 a year, and timber sales receipts average $200,000 - $250,000 a year (USFWS 2007a).

# III. Plan Development

## OVERVIEW

Although Carolina Sandhills NWR has several step-down management plans (Forestry, Red-cockaded Woodpecker, and Fire Management plans to name a few), no comprehensive plan exists to address all refuge programs. The comprehensive conservation planning process allows the Service, governmental and non-governmental partners, and the public the opportunity to take a detailed look at refuge programs, resources, and management. The Service's comprehensive conservation planning process provides for public involvement in developing a plan for future actions. These plans are revised every 15 years or earlier, if monitoring and evaluation determine that significant changes are needed to achieve the refuge's purposes, vision, goals, and/or objectives. The basic steps of the planning process involve the gathering of information, scoping for public input, developing a draft plan, gathering public input on the draft plan, developing a final plan, and implementing and monitoring the actions identified in the final plan.

## PUBLIC INVOLVEMENT AND THE PLANNING PROCESS

The planning process began in 2006, with various data-gathering sessions. As part of that process, the Service conducted several reviews: wildlife management (2006), visitor services (2006), wilderness (2007), and habitat (2007, forestry and fire). These reviews were conducted to determine the status, trends, and condition of the refuge's resources and facilities. The interdisciplinary teams possessed expertise in wildlife biology, nongame management, game management, migratory bird biology, private lands initiatives, forest management, fire and plant ecology and management, conservation biology, ecological research, environmental education, and visitor services. The information garnered from these reviews helped the planning team analyze and develop recommendations for this Draft CCP/EA. The following individuals served on one (or more) review teams and provided input and guidance in the development of the Draft CCP/EA.

Jason Ayers, USFWS, Ecological Services, Fish and Wildlife Biologist
Laurel Barnhill, SCDNR, Bird Conservation Coordinator
Judy Barnes, SCDNR, Wildlife Biologist
Dave Brownlie, USFWS, Regional Fire Ecologist
Joe Cockrell, USFWS, Ecological Services, Fish and Wildlife Biologist
Brian Davis, South Carolina Forestry Commission, Sand Hills State Forest, Forester and Director
Keith Fisher, The Nature Conservancy – Florida Chapter, Ecologist
Shawn Gillette, USFWS, Okefenokee NWR, Refuge Ranger
Sharon Hermann, Auburn University, Ecologist
Julie Hovis, U.S. Air Force , Shaw AFB, Wildlife Biologist
Chuck Hunter, USFWS, Division of Planning and Resource Management, Chief
Darryl Jones, South Carolina Forestry Commission, Forest Protection, Director
Ray Paterra, USFWS, Cape Romain NWR, Refuge Ranger
Carl Schmidt, USFWS, Piedmont NWR, Forester
John Stanton, USFWS, Columbia Migratory Bird Field Office, Wildlife Biologist
Johnny Stowe, SCDNR, Wildlife Biologist and Forester
Garry Tucker, USFWS, Visitor Services and Outreach, Chief
Joan Walker, USDA Forest Service, Southern Research Station, Botanist

In addition, the Service established a Core Planning Team that obtained input from the public and governmental and non-governmental partners. This team was the primary decision-making team for the Draft CCP/EA. The key tasks of this group involved defining and refining the vision; identifying, reviewing, and filtering the issues; defining the goals; outlining the alternatives; and providing a conceptual framework for the plan (objectives and strategies to accomplish the vision). The following individuals served on the Core Planning Team:

Allyne Askins, USFWS, Carolina Sandhills NWR, Refuge Manager
Jason Ayers, USFWS, Ecological Services, Wildlife Biologist
Don Cockman, USFWS, Carolina Sandhills NWR, Deputy Refuge Manager
Jack Culpepper, USFWS, Carolina Sandhills NWR, Forester
Brian Davis, South Carolina Forestry Commission, Sand Hills State Forest, Forester and Director
Nancy Jordan, USFWS, Carolina Sandhills NWR, Wildlife Biologist
Rick Kanaski, USFWS, Refuges, Regional Archaeologist
Mark Parker, USFWS, Carolina Sandhills NWR, Fire Management Officer
Lynn Quattro, SCDNR, Comprehensive Wildlife Strategy Coordinator
Charles McEntyre, Tennessee Valley Authority, Planner and Team Facilitator

This core planning team met on June 21, 2007, to develop the vision and goals for the refuge and to identify issues, concerns, and opportunities related to fish and wildlife protection, habitat restoration, recreation, and management of threatened and endangered species. In addition, the planning team considered federal and state mandates, as well as applicable local ordinances, regulations, and plans. The team also directed the process of obtaining additional input by compiling a mailing list of likely interested government agencies, non-governmental agencies, businesses, and individual citizens.

A notice of intent to prepare a comprehensive conservation plan for the refuge was published in the *Federal Register* on August 22, 2007. The Service also published news releases in local and regional newspapers, posted information on the refuge's web site, and mailed notices to a comprehensive mailing list, announcing that the Service would prepare a comprehensive conservation plan. Service personnel placed posters announcing a public scoping meeting to solicit issues about the refuge in local post offices, local government buildings, and stores.

The Service invited governmental agencies and officials to an intergovernmental scoping meeting on September 10, 2007, at the refuge headquarters. The Service also invited these agencies, plus other organizations, businesses, and citizens, to participate in a public scoping meeting held on September 10, 2007, in McBee, South Carolina. At the public scoping meeting, the team introduced the audience to the refuge and its planning process and asked attendees to identify their issues and concerns. The Service expanded the planning team's identified issues and concerns to include those generated by the agencies, organizations, businesses, and citizens from the local community. All public and advisory team comments were considered; however, some issues important to the public fall outside the scope of this planning process. The team considered all issues that were raised throughout the planning process, and developed a plan that attempts to balance competing opinions regarding important issues. The team identified those issues that, in the team's best professional judgment, are most significant to the refuge.

## SUMMARY OF ISSUES, CONCERNS, AND OPPORTUNITIES

The issues, concerns, and opportunities the team judged to be most significant fall into the five categories listed below.

- Internal: enhance longleaf pine/wiregrass habitat (e.g. increase growing season burns and accelerate transition to multi-age management) and enhance environmental education efforts.
- State: continue use of prescribed fire, especially into ecotones. Continue ban on pine straw raking to protect reptiles and amphibians; and enhance monitoring and research.
- Tribes: None
- Partners: continue partnerships with Sand Hills State Forest, Chesterfield County, and SCDNR; and increase interactions with land trusts.
- Public: increase economic benefit projects (e.g. pine straw raking and agricultural leases); enhance recreational fishing; and, add historical trails and interpretation.

### *FISH AND WILDLIFE POPULATION MANAGEMENT*

#### Conserve, Restore, and Enhance Threatened and Endangered Species

Protection and recovery of threatened and endangered plants and animals are important responsibilities delegated to the Service and its national wildlife refuges. Several state- and federal-listed threatened and endangered species are found on the refuge, including the red-cockaded woodpecker (RCW) and Pine Barrens tree frog. Carolina Sandhills NWR supports more RCWs than any other refuge and represents the best chance of recovering this species on Service-owned lands. The refuge follows recommendations and guidelines in the Red-cockaded Woodpecker Recovery Plan (2003) and has seen modest rates of population growth. Additional information on group size and composition may be beneficial in facilitating and achieving a higher rate of population growth. Instituting a population survey for Pine Barrens tree frogs, a state-threatened species, would be beneficial particularly because Carolina Sandhills NWR has been identified as one of the most critical locations for this species.

#### Surveys of Neotropical Migratory Birds, Marsh and Water Birds, Shorebirds, and Raptors

The refuge currently conducts a Breeding Bird Survey, participates in SCDNR annual bald eagle survey, conducts the Christmas bird count, and implemented a southeastern nightjar survey in 2006. Effects of habitat management efforts could be assessed by adding baseline population surveys of Bachman's Sparrows, Henslow's Sparrows, and other grassland birds; documenting rookery success of marsh and water birds; instituting shorebird surveys in moist-soil units; instituting a population survey of Swainson's Warblers in canebreak habitat; and, instituting citizen science surveys run by volunteers.

#### Status and Trends of Resident Wildlife Populations

The Service currently conducts deer-herd health checks every 5 years, quail-whistling cock surveys, mourning dove call counts, and annual mourning dove banding operations to help meet state goals. A covey count could be added.

The Service also currently conducts furbearer and fox squirrel sighting surveys. Building a GIS database of sightings/signs and developing a population study/index would enhance those efforts. Also, there is a need to annually monitor for wildlife disease or disease outbreaks on the refuge.

*HABITAT MANAGEMENT*

Restore, Maintain, and Enhance Longleaf Pine Habitat

The refuge uses commercial tree harvesting as a tool maintain, enhance, and restore the native longleaf pine/wiregrass ecosystem that covers approximately 35,000 acres of the refuge. Harvest methods use singletree selection systems, such as basal area thinning (operator select and mark and cut), and group selection harvests of less than 2 acres to improve stand vigor and habitat conditions. Clear-cutting of off-site species, such as slash pine and loblolly pine, may occur. Clear-cut areas are re-planted in native longleaf pine. Commercial tree harvests provide benefits to the longleaf/wiregrass ecosystem and associated species with special emphasis on the endangered red-cockaded woodpecker. Other wildlife populations (specifically Bachman's sparrow, Pine Barrens tree frog, and Sherman's fox squirrel) benefit from these habitat management activities.

A minor, yet vital component of the longleaf pine ecosystem includes wetland microhabitats. Refuge staff should manage, protect, enhance and/or restore the unique floristic communities found in seepage bogs and stream-head pocosins. In either case, the use, season, and intensity of prescribed fire will shape the ecosystem and determine the herbaceous plant communities.

As a land management demonstration refuge, refuge staff should aggressively address non-native vegetation with an emphasis on eradicating non-native grasses (e.g., love grass, bamboo, fescue) from fields, trails, and road edges and restoring areas to wiregrass, native warm season grasses, or native vegetation. In addition, as cooperative farming contracts expire, new agreements should emphasize native perennial establishment instead of exotic perennials such as bi-color lespedeza.

Forest management efforts should be continually re-evaluated to ensure they are consistent with the overall management goals of the refuge [e.g., prescribed burning program, smoke management policies, application of herbicide (hexazinone-Velpar), hydro-axe and roller chopping, salvage timber sales, direct/artificial seeding and planting efforts].

A Geographic Information System (GIS) data base coverage could be developed for all refuge habitats and their associated biological attributes. This database would include the Heritage Program to aide in the inventory and location of "rare" plant species on the refuge.

Provide Habitat for Migratory Birds

Carolina Sandhills NWR provides stop-over or nesting habitat for many species of neotropical migratory birds and resident songbirds, including the prairie warbler, Bachman’s sparrow, American redstart, and Kentucky warbler. When forest management decisions are made, bird surveys in stands could be established that will be subjected to management in the near-term, as well as stands that will not be managed in the near-term to track bird responses over time.

Several species of waterfowl may be found in the fall and winter, including mallards, black ducks, pintails, green-winged teal, American widgeon, ring-necked ducks, and hooded mergansers. Canada geese and wood ducks may be seen in the refuge pools year-round. Of the 28 ponds (pools) and lakes, four categories have been established to guide management: status quo, water management, fisheries management, and restoration. Periodic draw-downs of waterfowl management pools should be continued to achieve desired submerged aquatic vegetation, encourage moist-soil plant production, and control weedy submerged vegetation such as coon tail.

Demonstrate Sound Land Management Practices

The staff at Carolina Sandhills NWR uses a number of management techniques in support of its stated objectives. These include prescribed burning, hydro-axing, roller chopping, single-tree thinning, clear-cutting, salvage tree removal, and manipulating water levels. The staff could identify areas that demonstrate the beneficial effects of these treatments on ground layer cover and diversity and work with landowners and managers to employ these techniques on private lands within the Sandhills corridor.

*RESOURCE PROTECTION*

Land Acquisition

Acquisition of privately owned lands from willing sellers within the current refuge acquisition boundary would maximize ecosystem management objectives (longleaf, prescribed fire, trust species, and species with special designations) and opportunities for public use and education.

Along the Sandhills ecosystem corridor (US Highway 1), there are significant gaps in protected lands. The refuge should work cooperatively with neighboring public lands, the Service's Private Lands Program, partners, and land trusts to identify lands that could contribute to longleaf restoration efforts, recovery of listed and candidate species, and provide linkages and connectivity for wildlife species. A suite of programs should be used to protect and restore lands: Partners for Fish and Wildlife, Conservation Reserve Program (CP36), carbon sequestration, conservation easements, or acquisition by the appropriate partner.

Climate Change

Since 1957, the climate of South Carolina has been characterized by warmer and drier conditions. According to recent observations (1957-1991), the annual average temperature increased by nearly 1$^{o}$F when compared to the average. Precipitation decreased 6 percent or 3.2 inches primarily due to lower than average springtime rainfall (SCDNR 2009b). The refuge needs to determine how a warmer and drier climate may affect flora and fauna in an already xeric system. Specifically, the refuge should conduct research and modeling to determine and plan for the affects of climate change on grassland restoration, disease and pest vulnerability, forest and prescribed fire management, and water resources.

Water Resources

Although the refuge receives an average of 47 to 48 inches of precipitation a year, about 30 inches is returned to the atmosphere through evapotranspiration, leaving an average annual water yield of about 17 inches for runoff and groundwater infiltration (Cherry et. al. 2001). Carolina Sandhills NWR lies below the Fall Line and contains sand and clay beds of the Middendorf Formation, one of the region's most important sources of water supply. The majority of the Pee Dee region, including Chesterfield, Darlington, Florence, and Marlboro Counties relies heavily on the Middendorf for irrigation, public water supply, and industrial use (SCDHEC 2007b). A warmer and drier climate will result in reduced evapotranspiration and groundwater infiltration. As more users require water from the Middendorf aquifer, it is unknown how hydrological resources may be impacted, thus affecting terrestrial and aquatic systems.

Very little water quality information has been collected (or is available) for the surface waters (streams, ponds, etc.) of the refuge. Sand mining activities in the headwaters of both Black Creek and Lynches River present a threat to aquatic resources in the watersheds. Sand mining causes bank stability problems, loss of riparian area, and altered in-stream habitats. Also, increased bedloads, higher turbidity,

disturbed substrates and changing stream morphology result in decreasing reproduction and survival of fish and benthos (SCDNR 2005a). The Service should work with upstream landowners to ensure water quality and quantity under different withdrawal and use scenarios.

Air Quality

EPA reduced the PM 2.5, 24-hour standard from 65 ppm down to 35 ppm in September 2006 and in March, 2008 the 8-hour ozone (O3) standard was also revised downward from 0.085 ppm to 0.075 ppm. In response, the EPA proposed new non-attainment designations which affect all three air monitoring locations used by the refuge. As such, the refuge is projected to be in a non-attainment area for ozone by 2020 under the new 2008, 8-hour standard. Prescribed fire smoke is not currently believed to produce significant ozone directly, but does produce the precursors for ozone formation once in the presence of sunlight. Since prescribed fire is the primary tool used by the refuge to manage and shape the longleaf pine ecosystem, it is imperative that the Service become engaged in air quality discussions to ensure the continued ability to apply prescribed fire on the landscape.

*VISITOR SERVICES*

Provide Opportunities for Environmental Education

Environmental education programs are conducted throughout the year for school children, civic organizations, and the general public. Wildlife interpretive displays and literature may be found at the main entrance to the refuge, and at the Lake Bee area. Education opportunities could be enhanced through interpreting Wildlife Drive with wayside exhibits and demonstration signage. The website could be updated monthly and include an article on refuge happenings. Citizen science and volunteer opportunities could be increased. Examples are monitoring and maintaining blue bird boxes, documenting RCW group size, and monitoring wood duck boxes in impoundments.

Fishing

The quality of recreational fishing on the refuge could be enhanced by selecting five to six primary ponds and lakes (e.g., Martin's Lake, May's Lake, Lake Bee) to provide fishing opportunities and stock as needed with native fishes. Also, the refuge could implement the 2004 Fish Survey Report management recommendations.

Hunting

The refuge currently provides significant hunting opportunities, including deer (archery, muzzleloader, modern gun, and youth), quail, rabbit, raccoon, and turkey. The refuge could increase some hunting opportunities based on the proposed alternative.

*REFUGE ADMINISTRATION*

Facilities and Equipment

Current facilities could be enhanced by adding facilities recommended in the Visitor Services Review to expand recreational and educational programs and opportunities.

Equipment could be added to the fleet for producing and harvesting native warm season grass seed, and employing all methods of mechanical control including hydro-axing and roller chopping.

Staffing

Current staffing levels place significant constraints on biological monitoring, prescribed fire implementation, environmental education and interpretation activities, and law enforcement capability. To enhance these capabilities, refuge staff could be increased from 10 full-time employees, one shared full-time law enforcement officer, and one collateral duty officer to 17 full-time employees, one full-time law enforcement officer, two collateral duty officers, and a cadre of career seasonal, temporary, and student employees.

**Wilderness Review**

Refuge planning policy requires a wilderness review as part of the comprehensive conservation planning process. The results of the wilderness review are included in Appendix H.

# IV. Management Direction

## INTRODUCTION

The Service manages fish and wildlife habitats considering the needs of all resources in decision-making; however, fish and wildlife conservation assumes priority in refuge management. As a requirement of the Improvement Act, the Service will maintain ecological health, diversity, and integrity of refuges. Public uses are permitted when appropriate and compatible with wildlife and habitat conservation. The Service has identified six priority wildlife-dependent public uses: hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation.

Described below is the proposed comprehensive conservation plan for managing the refuge during the next 15 years. This proposed management direction contains the goals, objectives, and strategies that will be used to achieve the refuge vision.

Three alternatives for managing the refuge were considered:

- Continuing the current management focus or "No Action" alternative;
- Maximizing Native Wildlife and Habitat Diversity; and
- Optimizing Ecosystem Management with Enhanced Visitor Services

Each of these alternatives is described in the Alternatives section of the Environmental Assessment. The Service chose the alternative "Optimizing Ecosystem Management with Enhanced Visitor Services" as the proposed management direction.

Implementing the proposed alternative will result in a progressive shift toward uneven-aged forest management with few differences in the wildlife objectives. The most significant change would occur in the visitor services program. There would be an emphasis on building increased community knowledge and support for the refuge purposes and benefits with a focus on involving more youth in outdoor activities. By implementing this CCP, the refuge will progress towards the desired future condition as described below:

The Carolina Sandhills NWR landscape is dominated (75-80 percent of area) by expansive open, mature longleaf pine woodlands above a floristically diverse native grass-forb ground cover, only rarely broken by non-forested upland openings. Embedded throughout the extensive upland pine habitat matrix are small, legume-rich "bean-dip" depressions and small, scattered patches of regenerating longleaf pine seedlings and pole-sized stem "cohorts" and oaks. Upland fields and native warm-season grasslands occupy 1-3 percent of the upland landscape. Linear areas of canebrakes, Atlantic White Cedar, hillside herb bogs, and stream-head pocosin thread through upland forests, varying in width in the upper reaches of drainages and around small pond and lake margins (10-15 percent of area) and (hydric) bottomland forests (3-5 percent of area). Non-native plants such as weeping lovegrass, shrub lespedeza, or black bamboo are largely absent.

The refuge is a "working," actively managed landscape. Evidence of frequent, low intensity surface fire is commonly observed, and fire plays a primary role in shaping ecological communities throughout the rolling sandhills landscape. Hillside herb bogs and seepages are maintained with frequent, predominantly growing season fires which limit the woody shrub component. Fires burning in adjacent upland pine woodlands are not normally excluded from areas where canebrake, Atlantic white cedar, or stream-head pocosin occur, and therefore help maintain these important ecotones.

Also, evidence of recent tree harvesting (i.e., ecological or restoration forestry), along with generally small areas of agricultural activity may be observed, but are not visually dominant landscape features.

The largely fire-maintained ground layer on uplands is dominated by native bunch grasses, forbs, and dwarf shrubs, and often includes basal sprouts of oak species that vary with site conditions. Ground layer composition ranges from wiregrass-dominated uplands to diverse mixtures of grasses and forbs, especially legume species on more productive loamy soils. On most sites, the oak and other woody shrubs are confined to and maintained within the understory layer (< 2 meters tall), but there are some areas where oaks are entirely absent and others where oaks are larger in stature and obtain a position in the mid-story and even upper tree canopy. Wetland and seepage communities (including several insectivorous plants), occur in hydrologically appropriate locations, typically in narrow areas along drainages and pond margins, where occasionally prescribed fire visits and creates openings where Atlantic white cedar reproduction is sometimes seen. A number of uncommon but unique plants can be found across these different habitats including Well's Pyxie Moss, Sweet Pitcher-Plant, Pine Barrens Gentian, and White-Wicky. This diverse flora also supports a variety of native pollinators, especially bees, butterflies, and moths (lepidopteron).

The open, mature longleaf pine stands and associated native grass-forb ground cover supports a self-sustaining breeding population of at least 165 active RCW clusters, using primarily naturally excavated cavities. Other open pineland birds commonly observed include Bachman's sparrow, Chuck-wills-widow, Northern bobwhite, Brown-headed nuthatch, and Red-headed woodpecker, as well as Sherman's fox squirrel and bats. Southern hognose and pine (or gopher) snakes are also found on occasion. Along moister riverine forest Swainson's warbler, Acadian flycatchers, Kentucky warbler, Hooded warbler, Wood thrush, and the cavity-dependent prothonotary warbler and American wood duck can be observed. In streamhead pocosins, canebrakes, and hillside seepage areas, Swainson's warbler, Prairie warbler, American woodcock, Great-crested flycatchers and American wood duck can be observed along with the unique Pine Barrens tree frog. In forest openings and grasslands, American kestrel, Northern bobwhite, Loggerhead shrike, Grasshopper and Henslow's sparrows, Field sparrow, mourning dove, white-tailed deer, and eastern wild turkey are commonly seen. Snags, both pine and hardwood, dot the landscape in their respective ecosystems, providing refugia and breeding sites for cavity nesting species.

The Carolina Sandhills NWR consistently receives an appropriate level of funding to achieve and maintain these desired conditions utilizing full time, seasonal and temporary employees, refuge volunteers, and cooperative agreements with other agencies and partner organizations.

**VISION**

The call of the bobwhite quail beckons the visitor to explore the expansive, rolling longleaf pine landscape found on Carolina Sandhills National Wildlife Refuge. Lying between the Piedmont and the Coastal Plain, the refuge demonstrates sound forest and wildlife management that support a recovered red-cockaded woodpecker population, an abundance of migratory birds, and a diversity of plants and animals that flourish in this fire-shaped ecosystem. The sounds of solitude, contrasting hues and varied textures of native wildflowers, grasses, and trees awaken the senses and stir the soul. Refuge stewards, including staff, neighbors, partners, and volunteers, work collaboratively to understand, protect, and restore biological communities. Wildlife-compatible recreation and environmental education opportunities promote a strong conservation ethic and foster a greater understanding and appreciation of the longleaf pine ecosystem and mission of the National Wildlife Refuge System.

## GOALS, OBJECTIVES, AND STRATEGIES

The goals, objectives, and strategies presented in hierarchical format are the Service's response to the issues, concerns, and needs expressed by the planning team, the refuge staff, partners, and the public. Chapter V, Plan Implementation, identifies the projects associated with the various strategies. These goals, objectives, and strategies reflect the Service's commitment to achieve the mandates of the Improvement Act, the mission of the Refuge System, and the purposes and vision of Carolina Sandhills NWR. The Service intends to accomplish these goals, objectives, and strategies within the next 15 years.

*Note to reader:* parenthetical references appear following certain objectives to provide a crosswalk to specific recommendations and discussions found in the Forestry and Fire Program Review Report (USFWS 2007d).

*FISH AND WILDLIFE POPULATION MANAGEMENT*

**Goal**
Conserve, manage, and restore populations of native plant and animal species representative of the sandhills longleaf pine ecosystem, with special emphasis on migratory birds and threatened and endangered species.

**Target:** Endangered and Threatened Species, and State Special Concern Species

One federally listed threatened and endangered species is known to occur within the boundary of the refuge:

**Red-cockaded woodpecker (RCW) *(Picoides borealis)* - Endangered (E).** As of 2009, there are 165 clusters of which 151 clusters are active. The refuge Red-cockaded Woodpecker Management Plan was approved in February 2006. The recovery goal is 165 active clusters; current numbers represent 92 percent recovered. This recovery level was achieved by provisioning artificial cavities to develop new "recruitment" clusters and managing the surrounding pine forest with frequently applied low-intensity prescribed surface fires, and primarily even-aged forest management. Over the last 8 years, the refuge has seen an average increase of 4-5 clusters per year provided through recruitment stands or by budding from existing groups. At the current rate of increase, the refuge will achieve recovery within 4-6 years.

Sub-Goal 1A: Implement RCW management plans (USFWS 2003b, 2006a) to achieve a population goal of 165 active groups.

Objective 1: Obtain group composition data on active clusters on the refuge annually.

*Strategy:*

- Conduct group composition surveys on 50 percent of the population yearly. The number of birds seen and heard in each cluster will be documented. Color band combinations will be recorded if possible.

Objective 2: Monitor populations through cluster status, potential breeding groups, and nesting success annually.

*Strategies:*

- Evaluate each cluster during nesting season (March-July) to determine its activity status. This will be done for 100 percent of clusters yearly.

- Monitor at least 50 percent of potential breeding groups annually. Potential breeding group status can be determined through documented nesting or morning follows in active clusters in which no nesting is observed.

Objective 3: Continue to be a donor population for other RCW populations within the Southern Range Translocation Cooperative or as approved/identified by the RCW Recovery Coordinator.

*Strategies:*

- Attempt to band 100 percent of the nestlings each year using a unique color band combination. Band combinations and gender for each potential sub-adult bird roosted will be recorded and added to the candidate list for trapping and translocation.

- Establish volunteer coop to assist with group composition by observing adults and fledglings during the breeding season.

- In early fall, translocate subadult birds (less than 12 months in age) from their natal cluster, identified prior to trapping.

Objective 4: Work with SCDNR, Cheraw State Park, and Sandhills State Forest to manage RCWs as one recovery population.

*Strategy:*

- Participate in yearly coordination meetings to share information and strategies.

Objective 5: Provide outreach materials and education opportunities to interested public groups and media about RCW management and their habitat.

Objective 6: Maintain and improve habitat required for the RCW population through management practices such as prescribed burning, reforestation, thinning, removal of midstory vegetation, and installation of artificial cavities needed to maintain four suitable cavities in each cluster in 50 percent of the population annually.

Objective 7: Locate and catalog all existing cavity trees and integrate this information into a Geographical Information System (GIS) database.

*Strategies:*

- Obtain GPS points of all existing RCW cavity trees on the refuge.

- Integrate information into an RCW habitat analysis program.

**Southern Bald Eagle *(Haliaeetus leucocephalus)* - Listed - Taxon Recovered (L-TR)**. The bald eagle is primarily associated with coasts, rivers, and lakes, usually nesting near bodies of water where it feeds. There are no documented nests within in the refuge; however, a few migratory bald

eagles have been noted moving through the area during winter. Although the bald eagle was downlisted in 2007, it is still protected by the Migratory Bird Treaty Act and the Golden Eagle Protection Act. Bald eagle habitat is protected and states require monitoring.

**Pine Barrens Tree Frog** (*Hyla andersoni)* **- State Threatened (ST)**. The refuge supports numerous colonies of this species and is the second largest concentration of these frogs in the state. Prescribed fire is used on all known frog bogs to control plant succession, the greatest threat to the tree frog's existence.

**Carolina Pygmy Sunfish** (*Elassoma okatie*) **- State Threatened (ST)**. Carolina pygmy sunfish may be present in refuge waters. Waters suitable for this species include Black Creek, Ham Branch, and downstream from Lake Bee.

**Bachman's Sparrow** (*Aimophila aestivalis)* **- State Species of Concern (SC)**. Bachman's sparrows nest in the base of bunch grasses and are found in mature to old-growth southern pine forests that have been frequently burned. Burning during the growing season every 3-5 years has been shown to enhance the quality of Bachman's sparrow habitat.

**Southern Hognose Snake** *(Heterodon simus)* **- (SC).** Three Southern hognose snakes were spotted on the refuge in 2006. This was the first sighting on the refuge since 1975.

**Swainson's Warbler** (*Limnothlypis swainsonii)* **- (SC).** The Swainson's warbler uses mature, rich, damp, deciduous floodplain and swamp forests, where they normally occur in the shadiest parts of the forest. Forest structure consists of dense upper and lower canopy and shrubs (some suggest cane is important nesting habitat for this species), with little herbaceous cover. This warbler is of high conservation importance, because of its small breeding range, specialized habitat requirements, low overall densities, and even more restricted winter distribution. More important than the exact type of understory plants present is the presence of a thick understory with vine "tents" and tangles, and small shaded glades carpeted with leaf litter.

**Pine or Gopher Snake** (*Pituopis melanoleucus)* **- (SC).** Pine snakes are uncommon and patchily distributed in South Carolina and Georgia. This species is restricted to sandy habitats including abandoned old fields, scrub oaks, or pine forests. Soil texture may also be important because pine snakes are among the only snakes known to excavate their own hibernacula and summer dens.

**Well's Pyxie Moss** (*Pyxidanthera barbulata)* **- (SC).** Well's Pyxie moss is a diminutive, creeping evergreen sub-shrub that forms dense mats sprinkled with delicate white-pink flowers. Its prostrate growth form and crowded tiny leaves allow the plant to conserve water in the very xeric habitats in which it occurs. Its habitat includes the back-barrier dunes of southern Long Island, throughout the dwarf pine plains of New Jersey, among the last remaining longleaf pine stands of Virginia, to the sandhills of the Carolinas. Fire suppression leads to succession by woody vegetation that out-competes *Pyxidanthera* for light.

**Sweet Pitcher Plant** (*Sarracenia rubra)* **- (SC).** Sweet pitcher plant prefers savannahs and acidic seepage or sandy-gravelly bogs. It is also found on wet granite and near headwaters of small springs, and depends on frequent, low-intensity fires to maintain open habitat and reduce competition. This species' habitat is threatened by draining, logging, and woody encroachment due to fire suppression; it may hybridize with other *Sarracenia* spp.

**Sandhills Chub** (*Semotilus lumbee)* **- (SC).** Sandhills chubs were observed in 1999 on North Prong, a tributary to Swift Creek. Several of the Black Creek tributaries offer suitable habitat as well.

**Pine Barrens Gentian** (*Gentiana autumalis)* **- (SC).** Fires serve to maintain the unique plant community where this species is found by preventing the succession of the ecosystem to hardwood forest. Fire suppression, invasive weeds, and the altering of natural water flows all pose threats to populations of *Gentiana autumnalis.*

**White-Wicky** (*Kalmia cuneata)* **- (SC).** Found in the moist ecotones between longleaf pine communities and streamhead pocosins on the refuge. Frequent fire disturbance is important in maintaining the habitat that this species requires. Growing season burns every 3 to 5 years are recommended for populations of this species to maintain habitat.

Sub-Goal 1B: For federally listed species, provide habitat to help meet species recovery plan goals and for priority species (National Special Concern, State Special Concern and State Threatened) identified in the Comprehensive Wildlife Conservation Strategy (2005a).

Objective 1: Manage existing longleaf pine stands to provide for red-cockaded woodpecker foraging habitat following the guidelines in RCW recovery plans (USFWS 2003b, 2006a) and for overall health and diversity of a pine-dominated ecosystem.

Objective 2: Continue to provide for secure winter roosting sites for bald eagles.

*Strategy:*

- Implement the National Bald Eagle Management Guidelines around any newly established nest sites (USFWS 2007e).

Objective 3: Monitor populations of threatened and endangered species, and state special concern species sufficient to discern population trends and effects of habitat management.

*Strategy:*

- Implement population monitoring for Pine Barrens tree frog through coordination with the SCDNR and volunteers.

**Target:** Resident Wildlife

Sub-Goal 1C: Enhance existing managed open areas for grassland birds to assist the goals of the Northern Bobwhite Conservation Initiative (Dimmick et. al. 2002) and the Partners in Flight Bird Conservation Plan for the South Atlantic Coastal Plain (Hunter et. al. 2001).

Objective 1: Plant 5 acres of openings along wildlife drive in seed-producing annuals.

Objective 2: Restore native warm season grasses and forbs on larger openings; e.g., Martins Lake and Oxpen (upland soils, not seepage bog).

*Strategy:*

- Develop interpretive signs for Native Warm Season Grass establishment sites to promote Best Management Practices.

Sub-Goal 1D: Consider partnership opportunities with the Southeast Bat Diversity Network to achieve goals for bat species listed in the Comprehensive Wildlife Conservation Strategy (2005a).

**Target:** Wood Duck

Sub-Goal 1E: Enhance wood duck nesting/brood rearing habitats to assist habitat goals and objectives of North American Waterfowl Management Plan (NAWMP, Plan Committee 2004) and Atlantic Coast Joint Venture (2005).

Objective 1: Maintain a nest box program of 40-50 nest boxes.

*Strategy:*

Use refuge volunteers to conduct annual box checks and maintenance during the months of September-January.

Objective 2: Manage several ponds annually through drawdown to encourage growth of emergent and shrub vegetation.

*Strategies:*

- Maintain open water to vegetation ratio of (50-70 percent vegetation: 30-50 percent open water) in ponds to provide optimal brood habitat.

- Conduct drawdowns after July 1 to avoid the breeding and brood-rearing periods.

**Target:** Waterfowl

The Atlantic Coast Joint Venture (ACJV) planning region includes Carolina Sandhills NWR. Within the ACJV, 12 Focus Areas have been identified for South Carolina and have established waterfowl habitat and populations goals. Carolina Sandhills NWR falls outside these Focus Areas, but is adjacent to the Great Pee Dee-Lynches Rivers Focus Area that has the following established habitat and population goal: protect 10,000 acres to benefit priority waterfowl species.

The highest priority non-breeding waterfowl species identified in the ACJV are: Canada goose (Southern James Bay Population), Canada goose (Atlantic Population) and American black duck.

Of these species, Southern James Bay Canada geese (SJBG) occur on Carolina Sandhills NWR. The recent peak number for wintering SJBG on Carolina Sandhills NWR has been 200 geese. Based on the SJBG Management Plan 2000-2004, the population goal is to maintain a spring population of 150,000 and 50,000 breeding pairs. Specific to the wintering population, the objective is to increase the January population in North Carolina and South Carolina to 8,000 (based on 1985-89 or pre-decline averages).

Sub-Goal 1F: Provide wintering habitat for SJBG and other waterfowl and nesting/brooding rearing habitat for wood ducks to help meet NAWMP (2004) goals/objectives of the Atlantic Flyway Council.

Objective 1: Manage Martin's Lake and associated fields to provide the life cycle needs during winter and migrational staging periods to support 200-500 SJBG and 100-500 ducks annually.

*Strategies:*

- Provide 5-10 acres of green browse (e.g., winter wheat, clover, annual rye grass) adjacent to Martin's Lake annually.

- Keep Martin's Lake closed November 15 - March 1 to provide sanctuary for over-wintering SJBG and other migratory waterfowl.

Objective 2: Complete periodic (e.g., once every 2-3 years) submerged vegetation surveys for the larger ponds (e.g., Martins Lake, Holdover, Oxpen Lake, Honkers Lake, Pool J, and Lake 12) to evaluate management actions and determine timing for drawdowns to improve the production of desirable submerged aquatic plants for waterfowl.

*Strategy:*

- Conduct periodic submerged aquatic vegetation surveys. Contact the Columbia Migratory Bird field office for assistance with these surveys.

Objective 3: Manage select pools and lakes to provide seasonal waterfowl habitat annually (Pond (pools) and lakes - Martins, Pools D and J, Lake 12, and Holdover).

*Strategy:*

- Pools will be drawn down slowly beginning in April, pulling one board per week. Draw downs will gradually expose banks to sunlight while the main channel is maintained.

**Target:** Nongame Birds

Within longleaf pine stands, patches of oaks within grassy/herbaceous understory are desirable for prairie warblers (patchy fire or less frequent in some areas—depend upon stand age). In addition, some amount of scrub/shrub within longleaf pine stands provides good habitat for this species. Grass and herbaceous diversity in mature pine stands provide nesting, food, and cover for certain priority birds (e.g., Bachman's sparrow and northern bobwhite quail).

Sub-Goal 1G: In accordance with conservation plans for South Atlantic Coastal Plain by Partners in Flight (Hunter et. al 2001) and North American Landbird Conservation Plan (Rich et. al. 2004).

Objective 1: Attain population and habitat objectives for priority bird species on Carolina Sandhills NWR: Bachman's sparrow (5 pairs/100 acres); field sparrow, chuck-wills-widow; northern bobwhite (7 coveys/100 acres); prairie warble, brown-headed nuthatch (4.5 pairs/100 acres); red-headed woodpecker (2 pairs/100 acres).

*Strategy:*

- Implement a targeted mist netting survey to maintain population and survival trends for Bachman's sparrows.

Objective 2: Provide habitat conditions conducive to supporting priority stream-head pocosin associated species by 2010 (e.g., Swainson's warbler, Kentucky warbler, hooded warbler, wood thrush, American woodcock).

Objective 3: Erect 12 American kestrel boxes in the Oxpen and in mature pine areas with low basal area and an established grass-forb herbaceous layer.

*Strategy:*

- Use volunteers to conduct occupancy surveys once a month from May to July.

**Target:** Shorebirds, Wading Birds

In accordance with conservation plans for South Atlantic Coastal Plain by Partners in Flight, Southeastern U.S.-Caribbean Shorebird Conservation Plan, and Southeast U.S. Waterbird Conservation Plan attain population and habitat objectives for priority shorebird species on Carolina Sandhills NWR.

Sub-Goal 1H: Provide suitable foraging habitat annually for migrating shorebirds.

Objective 1: Manage selected pools and lakes to provide seasonal shorebird habitat annually [Pond (pools) and lakes - Martins, Pools D and H, Lake 12, and Holdover].

*Strategy:*

- Pools will be drawn down slowly beginning in April or July to create mudflat conditions during southward and northward migrations.

**Target:** Amphibians/Reptiles

Approximately 72 species of amphibians and reptiles are likely to occur on the refuge or within the refuge acquisition boundary.

Sub-Goal 1I: Increase the current knowledge of amphibian and reptiles that occur on the refuge.

Objective 1: Determine presence/absence of priority amphibian and reptile species on the refuge by 2012.

*Strategies:*

- Enlist volunteers and seek the assistance of SCDNR biologists to coordinate with staff on amphibian and reptile monitoring/research opportunities.

- Work with colleges/universities to develop inventory/research partnerships.

- Use volunteers to develop and conduct Calling Amphibian Survey routes for representative refuge habitats.

Objective 2: Participate in South Carolina Partners in Amphibian and Reptile Conservation (PARC)/SE PARC Initiatives as partnership opportunities arise, especially priority species monitoring/research.

*Strategy:*

- Consider habitat management recommendations for high-priority species contained within the SC PARC and SE PARC plans.

**Target:** Fisheries/Aquatic Resources

The refuge has a diverse assemblage of aquatic species, including imperiled species such as the sandhills chub and possibly the Carolina pygmy sunfish. The Lynches River and its tributaries, many of which initiate on the refuge, provide important habitat for several imperiled aquatic taxa.

Sub-Goal 1J: Conduct surveys to determine the presence and extent of priority species populations and habitats.

Objective 1: Monitor the condition of priority species and their habitats once detected.

Objective 2: Ensure water quality and quantity to support priority species and their habitats.

Objective 3. Develop partnerships with USGS, SCDNR, and others to support research and monitoring of priority aquatic species and their habitats.

**Target:** Migratory Bird Banding

Sub-Goal 1K: Assist with approved dove banding programs that support migratory bird population management in the Atlantic Flyway.

Objective 1: Conduct annual mourning dove banding operations to help meet annual statewide dove banding goal.

*Strategies:*

- Work with state dove banding coordinator to set up banding stations.

- Train volunteers/staff to conduct annual dove banding operations.

**Target:** Wildlife Disease

Sub-Goal 1L: Work with the National Health Laboratory to diagnose/detect disease outbreaks.

Objective 1: Annually monitor for wildlife disease or disease outbreaks on the refuge by incorporating into current and future wildlife population surveys.

Objective 2: Maintain deer herd density at appropriate level to ensure herd health and to maintain habitat quality for other wildlife species.

*Strategies:*

- Enlist the services of the Southeastern Cooperative Wildlife Disease Study Group to evaluate deer herd health once every 5 years or as appropriate, coordinating through the Regional Office, Division of Planning and Resource Management.

- Conduct annual herd health checks through collection of samples at check station and through analysis of harvest data.

**Target:** Inventorying/Surveying/Monitoring

Sub-Goal 1M: Provide monitoring information to evaluate the effectiveness of habitat management treatments and evaluate population trends using an adaptive management approach.

Objective 1: Implement species-specific monitoring protocols in order to track population trends for indicator or focal species.

*Strategies:*

- Continue conducting annual Breeding Bird Survey route.

- Erect permanent signage and establish GPS locations for the 50-point Breeding Bird Survey route.

- Continue conducting annual Christmas Bird Count to track winter bird trends and abundance in various habitats of the refuge. Volunteers will conduct the survey with coordination by the refuge biologist.

- Continue conducting bald eagle mid-winter survey.

- Conduct shorebird surveys using refuge volunteers during fall and spring migration using International Shorebird Survey protocol and store and manage data on the SAMBI website.

- Continue to conduct annual Southeastern Night jar survey.

- Continue to conduct furbearer survey.

- Continue to conduct quail call count routes.

- Continue to conduct dove call count routes.

Objective 2: Develop and implement habitat management response surveys to identify species response to treatments in longleaf pine and restoration in pocosin habitat sites.

*Strategies:*

- Monitor response to habitat treatments of pine-associated breeding birds (e.g., Bachman's sparrow and field sparrow) annually (Hamel et. al 1995).
- Monitor fox squirrels response to habitat treatments in both spring and fall for at least 3 years.
- Conduct fall quail counts at the same points (or a subset of points) during last week of September to second week of November.
- Maintain GIS database of habitat components (e.g., forest, pocosin), management activities (e.g., prescribed burning, thinning), and species data (e.g., presence/absence, breeding).

Objective 3: Conduct additional inventories to identify presence and abundance of certain wildlife populations not otherwise identified.

*Strategies:*

- Conduct a refuge wide herpetofauna and amphibian inventory.
- Conduct a refuge wide bat inventory.

**Target:** Nuisance/Exotic Plants and Animals

Sub-Goal 1N: Opportunistically remove nuisance/exotic plants and animals to help meet refuge habitat/population objectives for federal trust resources.

Objective 1: Complete a baseline inventory of invasive plants/animals on the refuge by 2012 and incorporate into GIS database.

Objective 2: Promote and record harvest/sightings of feral hogs/coyotes during deer/turkey hunts.

Objective 3: Immediately and aggressively control (via removal) feral hogs when observed on refuge.

Objective 4: Explore techniques to control fire ants on the refuge.

**Target:** Research Studies

Sub-Goal 1P: Explore opportunities to fund and/or support research studies to help refine habitat management techniques and evaluate wildlife responses to habitat management actions.

Objective 1: Ecology of stream-head pocosins.

Objective 2: Habitat relationship between Carolina Sandhills NWR Atlantic white cedar stands and eastern North Carolina and Florida Atlantic white cedar stands.

Objective 3: Ecology of fire, ground cover, and flowering plants in the longleaf/wire grass community and the relationship to pollinators (i.e., native bees).

Objective 4: Potential effects of fire ants on native wildlife populations at Carolina Sandhills NWR.

Objective 5: Effects of climate change on species composition, diversity, and abundance in the sandhills of South Carolina.

Objective 6: Carbon cycling in sandhills longleaf pine ecosystems.

Objective 7: Diversity of insect fauna in relationship to management activities.

*HABITAT MANAGEMENT*

**Goal 2.** Conserve, manage, and restore representative refuge habitats with emphasis on longleaf pine forests and associated native ground cover, sand hill streams and bogs, and grassland openings.

Sub-Goal 2A: Composition and structure of upland longleaf pine forests. The most abundant forest type at Carolina Sandhills NWR is the xeric longleaf pine/turkey oak woodlands. Across this type there are naturally regenerated forests as well as artificially established "plantations" of both slash pine and longleaf pine. Turkey oaks are abundant in the current upland forest, varying in height from ground layer (<1 meter) to 3 meters. On any given site, oak height is determined largely by time since burning. Further, the oak component is uniformly distributed and ubiquitous and the herbaceous ground layer is sparse, providing little fuel to carry frequent surface fires.

Objective 1: Compile stand inventory data into GIS database. Data should include basal area, age, stems per acre, and other attributes as identified in the RCW Recovery Plan (USFWS 2003b).

Objective 2 (DFC1): Adopt the (NatureServe-based) LANDFIRE National BPS classification system (MapZone 58) for the refuge CCP and ensuing plan period.

Objective 3 (DFC2): Soils strongly influence vegetation in the sand hills. Draft desired future conditions that span the biological variation occurring across soil types. Adopt a qualitative DFC summary for the Carolina Sandhills NWR landscape.

Objective 4 (DFC2b): Adopt a quantitative matrix to supplement the DFC for the Carolina Sandhills NWR to help guide future management actions. Measure vegetative structure and diversity and photograph benchmark sites.

NATURALLY REGENERATED CANOPY FORESTS

Objective 1 (FLORA10a): On pine uplands, use prescribed fire, mechanical, and chemical treatments to confine turkey oaks to the understory shrub stratum (oak height is <2m tall, and stems <2"dbh).

*Strategies:*

- Ensure that age distribution of stands cover all classes across the refuge to maintain long-term sustainability for the red-cockaded woodpecker. Allow natural regeneration to occur in older-aged stands to create uneven-aged stands.

- For cavity nesting species, retain snags over 15 inches that are not posing a safety hazard to personnel, fire, or visitors.

- Establish bird surveys in stands that will be subjected to forest management and in stands that will not be managed to track bird response over time.

Objective 2 (FLORA10b): Monitor post-treatment understory plant recovery (abundance and species composition) of both turkey oaks and native ground cover plants.

Objective 3 (FLORA11): Use a portion of the existing Research Natural Area (RNA) to study habitat treatment techniques and responses to minimize the effects from site differences on results, side-by-side with prescribed fire, and a fire-chemical combination demonstration.

*Strategies:*

- Use late-season, frequent fire to determine the feasibility of changing fire regime to enhance forest structure and ground layer diversity.
- Demonstrate chemical treatment to accomplish the desired structural change (oak density reduction).

Objective 4 (FLORA12): Consider using herbicides to facilitate restoration of a denser and more diverse ground layer, and ultimately more diverse and abundant resources for herbivores and RCWs.

Objective 5 (FLORA12): Identify demonstration areas to monitor the effects of oak removal on ground layer cover and diversity by creating oak-free patches, planting wiregrass, native forbs, and seed. This will address concerns about whether these natives can thrive when oaks are removed.

PINE PLANTATIONS

The refuge includes approximately 13,600 acres of longleaf pine plantations resulting from the conversion of slash pine plantations to even-aged longleaf pine.

Objective 1 (RCW1): Even-aged management will remain an important component of the RCW habitat management program during the 5-year life of the CCP. Using modified, irregular shelterwood (with clumps) may mitigate unsuitable RCW habitat conditions resulting from a dense pine sapling midstory throughout a stand.

Objective 2 (RCW2): Multi-aged management will gradually increase in importance during the 15-year life of the CCP. This shift toward multi-aged management will require several decades before roughly equal proportions of even-aged and multi-aged structure longleaf pine are achieved.

Objective 3 (RCW3): Retain hexazinone as a viable oak management tool for use within RCW clusters and areas where prescribed fire is not controlling oak understory.

Objective 4 (FLORA15): Use forest management techniques to accelerate the transition of some compartments from primarily even-aged pine woodlands toward multi-aged pine stand structure.

*Strategies:*

- Select areas that are reproductively active, and intermediate in site index for longleaf pine.
- Release patches of longleaf regeneration present in cone-bearing longleaf pine plantations while thinning areas between regeneration patches to variable residual stocking levels.

- Complete conversion of remaining slash pine (~300 aces) to longleaf during the 15-year life of the CCP.

- Work with Ecological Services to ensure any potential for “incidental take” is properly addressed, then proceed with harvesting the slash pine and re-planting longleaf pine as soon as possible.

- In areas with dense oak understory and/or midstory, consider using growing season burning. If growing season burns cannot be accomplished, more frequent and higher intensity dormant season burns should be conducted.

- Use mechanical treatments in stands where fire has not controlled oak growth or density due to unsuitable fuels, or interruptions in normal fire return intervals.

Sub-Goal 2B: Forest Management (SILV). Longleaf pines naturally regenerate and live and die under a number of disturbance regimes. Frequent fire is implicit in all of these scenarios and an essential longleaf pine ecosystem process. Tree canopy disturbances that commonly initiate tree regeneration and influence longleaf pine stand structure and composition occur along a gradient of spatial scales.

Objective 1 (SILV1): Begin conversion of some even-aged longleaf pine stands to multi-aged structure using Variable Retention Harvesting as appropriate over large (multi-compartment) areas, targeting sites with an intermediate site index (mesic, not xeric or hydric). Suggested gap size for releasing established longleaf pine regeneration to create multi-aged structure is 0.25-2 acres. Stand replacement regeneration patch sizes in RCW habitat must not exceed 10-25 acres.

Objective 2 (SILV2): Do not attempt to convert any existing, even-aged structure longleaf pine units to multi-aged until the majority of longleaf stems are reproductively ready (as above, >30 years, >10 in. dbh). Use Variable Density Thinning only in these situations.

Objective 3 (SILV3): Adopt the aggregate retention harvest approach to forest management compartments selected for emulating stand replacement disturbance that provide RCW cluster site or foraging habitat.

Objective 4 (SILV4): Consider whether or not each planned silvicultural activity will result in stand conditions that, in the event of an unwanted ignition, reduce the possibility of a wildfire that is large, or is intense and difficult to control. When either is true, report the planned and accomplished silvicultural activity Hazardous Fuel Reduction or Wildland Urban Interface benefits in appropriate databases.

Sub-Goal 2C: Prescribed Fire and Fire Regimes (RX). *Note:* The recommendations below are intended to both enhance fire management program capabilities and achieve desirable ecological conditions. They are made with an understanding that constraints are placed on any fire management program to assure safe operations, meet smoke management objectives, and maintain good neighbor relations.

Turkey oak densities in the majority of the upland pine/scrub oak systems exceed expected densities within the hypothetical historic “range of variability.” High turkey oak density appears to coincide with low herbaceous ground cover. There are three primary concerns with oak abundance: (1) Oak stems persisting in the understory may re-grow rapidly (taller and increase in stem diameter) if fire is excluded from a site for 1-2 burn cycles, and a much more intense fire is required to sufficiently damage living oak tissue for effective oak control; (2) oak stems persisting on the site may compete

with understory vegetation for meager resources (primarily moisture and nutrients); and, (3) abundant, tall oaks can also shade out the understory vegetation. A natural herb-forb understory is a more flammable fuel bed component than the oak litter that replaces it, and loss of this flammability, "cooler" fires, reduces the effectiveness of fires that do occur even further in controlling oaks.

Objective 1 (RX1): Develop and implement a GIS-based, fire management prioritization tool based on the mental model now used to prioritize prescribed fire needs and resources across the landscape.

*Strategies:*

- Use managers and researchers to identify and weight the key factors that determine treatment priority and placement.
- Develop the GIS/remote sensing data layers needed to directly or indirectly represent these key factors by their relative importance weights, and then score each factor as to how it should influence burning.
- Use the current qualitative body of knowledge and expertise at the refuge to iteratively modify the model.
- Test the underlying model assumptions with monitoring.

Objective 2: For upland pine/scrub oak systems, on sites with low stature oaks, fire may prove the most effective management tool.

*Strategies:*

- Continue shifting from dormant season to more growing season prescribed burns. Include fires later in the spring and early summer (mid-April – mid-June).
- Increase the fire frequency to 2-3 years, or as frequently as a fuel bed sufficient to sustain fire spread is available.
- Where an opportunity exists, conduct burns on the hot/dry end of the prescription window, provided weather conditions following the burn predict precipitation events.
- In areas with taller oaks, a combination of management techniques, including fire, mechanical treatments, and herbicide, may be employed to reduce oak stature and abundance, and increase the abundance of ground cover vegetation.
- Periodically utilize firing techniques that increase the residence time of fire around the base of the oaks.

Objective 3: On upland pine sites, use prescribed fire in spring and early summer (mid-April – mid-June) to achieve desired future conditions.

*Strategies:*

- When appropriate, conduct burns on the hot/dry end of the prescription window, provided weather conditions following the burn predict precipitation events.
- Accept range of outcomes based on fire frequency, weather conditions, and firing techniques that may result in localized (individual tree or small patch) pine mortality and snag production, leaving snags in place where appropriate. Pine mortality will lead to more patches available for regeneration and structural variability in the canopy.

Objective 4: On upland hardwood/pine sites, continue the existing strategy of allowing this system to burn when the adjacent pinelands burn. More intense mixed or replacement fires may occur infrequently during drought conditions.

Objective 5: In bottomland pine/titi type forests, increase fire frequency and severity along the edges of this system to reduce the upslope encroachment of woody shrubs and reestablish ecotones along the edges of drains farther downslope. This may restore seeps along the edges of the drains. Atlantic white cedar occurs in more protected areas, so it likely would not experience significant mortality if fire periodically encroaches into exterior portions of the drainages. Fire, along with artificial impoundment reclamation, may open up new areas for colonization by cedar, and allow it to move (as it historically did) around the landscape in response to available habitat.

Objective 6: On the seepage slope, conduct annual prescribed burns before vegetation greens up, on the hot and dry end of the prescription. This will reduce shrubs in the seep and stimulate desired responses from the herbaceous vegetation.

Objective 7: Fuel levels are typically low and are well managed within the refuge. This reduces the threat of naturally ignited fires developing into unmanageable wildfires that might threaten resources, property, or the safety of individuals. Continue using the full range of appropriate management response options to all natural (lightning) ignitions where and when conditions warrant.

Sub-Goal 2D: Alternative Fuels Treatments. Carolina Sandhills NWR uses a hydro-axe with a front-mounted rotary head to reduce undesirable scrub oaks throughout longleaf pine stands that cannot be controlled with prescribed fire. Formerly, single-pass roller “drum” chopping was relied upon to reduce taller midstory oak stems. Herbicide application (foliar spray using backpack sprayer and aerial spray) has also been used to control oak re-sprouting and larger midstory oak stems.

Objective 1: Continue mechanical treatment using the hydro-axe to create more open stands, conducive to RCW habitat management.

*Strategies:*

- Follow up with a direct foliage spray 1-2 growing seasons after the mechanical treatment.

- A direct stump application may be a less expensive alternative in mechanically treated areas. Herbicide application would have to closely follow the hydro-axe (on the same day, preferably within a few hours) to spray freshly cut stumps before they are “sealed.”

Objective 2: Carolina Sandhills NWR currently has a 200-acre "natural area" set aside in Compartment 5 near the Wildlife Drive and Oxpen Farm area which has not been actively managed for many years. The stand has a longleaf pine over-story with a very dense scrub oak mid-story. Design a demonstration project to control scrub oaks and restore herbaceous groundstory using various forest and habitat management techniques "side-by-side" to determine efficacy of treatments.

*Strategies:*

- This area could be made suitable as RCW habitat and/or as an easily accessed native ground cover restoration demonstration area with reduction of the mid-story on portions of the area.

- The scrub oaks on this site are large enough to interest a chipping operator to come in and remove these trees to cut costs and save Carolina Sandhills NWR from using refuge machinery.

Sub-Goal 2E: Native Plant Community Composition and Structure. The Carolina Sandhills NWR represents one of the largest contiguous pieces of the fall-line sandhills landscape. It is unique among sandhills public lands in that it represents the highest and driest remnant. The landscape is almost entirely forested, and forest and prescribed fire management practices are essential for maintaining the integrity of the system. Composition and structure beneath the canopy are affected directly by management practices, and indirectly by the management-determined canopy conditions that can affect light, soil moisture, decomposition rates, nutrient availability, etc. While the shrub and herb communities are of interest as components of the natural biological heritage, they are also important factors in the quality of habitat for wildlife species, both common and "special" species.

Objective 1: Solidify inventory of "rare" plant resources where possible. Consult with the South Carolina Heritage Program for known locations on the refuge and perhaps on the state forest to help focus any future inventory efforts. Initiate surveys of all potentially suitable sites on and around the refuge to obtain a more complete understanding of species' distributions and population status. Capture all known locations in a GIS system.

Objective 2: Establish old-field species (including blackberries) at the Oxpen Farm site. Consider the opportunity for restoring native plant species to the site (especially warm season grasses to facilitate burning); perhaps use the Oxpen Farm area to develop a reliable local seed source (seed orchard) for additional restoration.

Objective 3: Establish a native species seed orchard to support local restoration projects in a portion of the Oxpen Farm area. Coincidentally, establish a "visible" native ground cover restoration demonstration area (may be especially effective if located and interpreted along Highway 145). Identify partners who may collaborate in such an effort.

Objective 4: Initiate inventory of upland "bean dips" to support the comprehensive conservation planning process. Initiate surveys of all potentially suitable sites on the refuge to get a more complete understanding of the distribution and floristic composition of these areas within the refuge. All field-going personnel should be made aware of this resource and asked to look for and report such sites as they conduct other field work. Utilize GIS, aerial imagery, and ground surveys to document additional locations. Capture all known locations in a GIS system.

Sub-Goal 2F: Seepage Bog, Atlantic White Cedar, Hillside Herb Bog, and Streamhead Pocosins. Although the refuge landscape is dominated by upland, xeric pine woodlands, there are important, but less common, plant communities of management concern. None of these habitat types were

historically a major component on the refuge, and they are generally restricted to narrow drainages within the longleaf-dominated landscape. An appropriate use of prescribed fire has allowed these fire-dependent communities to persist on the refuge landscape.

HILLSIDE SEEPAGE BOGS

Objective 1: Search refuge records and the South Carolina Heritage Trust data base for results of any previous surveys or research for rare species or imperiled community occurrences.

*Strategies:*

- From this search, develop a GIS search model based on known locations, including locations on the neighboring state forest.
- Use this landscape model to target searches.
- Use GIS, aerial imagery, and ground surveys to document additional locations.
- Create a GIS layer or other documentation method to capture information when additional occurrences of rare communities or species are located.
- Designate a staff member to maintain a database and conduct and/or coordinate surveys for other occurrences on the refuge.

CANEBRAKES-STREAMHEAD POCOSIN-ATLANTIC WHITE CEDAR COMPLEXES.

Objective 1: Continue efforts to burn across the ecotone between uplands and seeps. Accept fire-induced mortality of some existing Atlantic white cedar stems/patches or other changes in vegetation that occur. Monitor selected Atlantic white cedar occurrences to gauge progress.

Objective 2: Continue the existing strategy of using fire to restore canebrakes along the upper reaches of drainages where appropriate. Increase fire frequency and severity along the edges of this system to reduce the encroachment of woody shrubs upslope and reestablish ecotones along the edges of drains. This may restore seeps along the edges of the drains.

Objective 3: Identify the least productive impoundments for de-watering and restoration to the original wetland hydrologic regime, and eventually substrate conditions.

*Strategies:*

- Begin selective restoration with low productivity impoundments in the upstream reaches of each drainage basin, and then work progressively downstream.

- As existing impoundment margins are reclaimed and restored, new patches of cane, pocosin shrubs, pond pine, and Atlantic white-cedar on sites with more appropriate hydrology should eventually replace stems and patches lost to fire mortality on the "drier" end of the gradient. Allow natural wetland vegetative succession to proceed following de-watering, although planting select species may be used to accelerate succession or adjust wetland plant species composition.

- Do not exclude fires from moving into these wetland restoration areas from the adjacent uplands.

Objective 4: Atlantic white cedar currently exists in "fire shadow" portions (often near the centers) of streamhead pocosins as long narrow stands in drainages. Utilize prescribed burns on a normal rotation for the upland pine stands, and allow fire to burn into the adjacent AWC areas. Over time, fire will reduce the encroachment of shrubs, expose the historic ecotone, and create conditions favorable for AWC reproduction. Occasional mortality or damage to residual AWC may occur, but at acceptable levels. If potential restoration areas are identified, document current conditions to allow success with AWC restoration to be tracked over time.

Sub-Goal 2G: Exotic Species

Objective 1: Eliminate weeping love grass (*Eragrostis curvula*) from the refuge.

*Strategies:*

- Control weeping lovegrass throughout the Oxpen site, especially adjacent to the seepage bog.

- Annually treat 25-50 acres of weeping love grass and replant areas to native warm season grasses or native shrubs.

- Foliar application of a glyphosate herbicide is effective in spring after the new foliage is in full growth but before blossom heads have formed.

- Thoroughly clean all equipment used in field management and fireline construction and maintenance as it moves between sites to reduce accidental spread and introduction of love grass.

Objective 2: Implement bamboo removal plan and follow-up with mechanical and/or herbicide treatments until eradication is achieved.

Objective 3: Phase out (10 acres/year) the acreage planted and maintained in shrub lespedeza and replace with native grasses (including warm season species).

Sub-Goal 2H: Managed wildlife openings. Carolina Sandhills NWR contains 1,202 acres of old fields and managed wildlife openings scattered throughout the refuge. These fields range in size from less than one acre to more than 100 acres and add to the diversity of habitat types on the refuge. Old fields and farming have changed drastically over the past three decades on the refuge. In 1970, approximately 90 percent of the "old fields" were cooperatively farmed. Today, less than 9 percent of the 1,202 acres of the "old fields" are cooperatively farmed. Under the current management practice for managed openings, approximately 100 acres are planted as food plots to mostly annual, seed-producing plant species (e.g., millet and wheat).

Objective 1: Encourage the use of native warm season grass establishment for all existing open field (i.e., food plots) areas to provide early successional native vegetation for wildlife.

*Strategies:*

- Convert 5-10 acres of open fields (i.e., food plots) to native warm season grass/forbs each year.
- Continue disking a minimum of 1/3 of small managed openings in November and February.
- Maintain existing acres with fire to promote a grassy/herbaceous growth with patches of scrub/shrub, using a combination of dormant and growing season burning in a 3-year cycle.

Objective 2: Continue management of dove fields (approximately 100 acres).

Objective 3: Use annual cool season crops to provide wildlife viewing opportunities along the Wildlife Drive and in refuge public use areas.

Sub-Goal 2I: Cooperative Farming. Historically, 1,900 acres were cooperatively farmed on Carolina Sandhills NWR. By 1970, approximately 1,200 acres were cooperatively farmed. During this time, most of the croplands were in a rotation of corn, soybeans, wheat, or rye. This required heavy applications of fertilizers, pesticides, and herbicides. At the end of 1975, the cooperative farmers indicated they could no longer make a profit. Today, approximately 105 acres are cooperatively farmed by two farmers. Fields are planted in shrub lespedeza (*Lespedeza bicolor*) and millet.

Objective 1: Ensure that the cooperative farm program contributes to the refuge's overall purposes and demonstrates an economically feasible crop utilizing native vegetation.

Objective 2: Gradually convert the acreage planted in lespedeza to native warm season grass beginning in 2009.

*Strategies:*

- Work with cooperative farmers to realize the economic feasibility of native warm season grasses.
- Work with cooperative farmers to obtain/pursue financial assistance and cost-share through the Natural Resources Conservation Service and the Service (cost-share and technical assistance, challenge cost-share; Partners program) to establish native warm season grasses.
- Attempt to harvest seed at other local locations; donation of seed for cooperative farmers. Work with partners (TNC, Native Plant Society, Jones Center, Clemson PD Center, Longleaf Alliance); model after other projects that are currently underway.
- Host one native warm season grass demonstration workshop annually at the refuge for local farmers, federal and state agency staffs, and non-governmental organizations.
- Enlist the help of the refuge friends group to co-host an annual native warm season grass workshop.

Sub-Goal 2J: Water (Ponds and Lakes). Of the 28 ponds (pools) and lakes, four categories have been established to guide management: status quo, water level management, fisheries management, and restoration. Management will be tailored to provide: public use, scenic, waterfowl, wood ducks, and sport fishing.

Objective 1: Status Quo: Pools may receive periodic attention to address vegetation concerns or maintenance needs; i.e., the water control structures will be maintained in good working order; periodic draw-downs will occur to manage submerged aquatic vegetation. It is important to maintain these ponds and lakes because many of their levees are roads, so they are essential to support the refuge infrastructure. Pond and lakes - Pools A, B, C, E, G, K, L; Oxpen 3; Lower Triple; McLeod's; Lakes 16 and 17; Twin Lakes; and Beaver Pond.

Objective 2: Water Level Management: Periodic draw-downs will occur to management submerged aquatic vegetation and/or encourage moist-soil plant production. Ponds and lakes – Martins; Pools D and H; Lake 12; and Holdover.

Objective 3: Fishery Management: Manage for recreational fishing; utilize fish stocking with native fishes. Pond and lakes - Pool J; Honkers; Martins; Mays; Lake Bee; and Oxpen 1.

Objective 4: Restoration: Restore historic water flows, carefully evaluate removal of existing structures; beaver control may be needed; some of the restoration areas will be for Atlantic white cedar (fire excluded), while others may be for seepage bogs, cane, or pond pine (fire maintained). Ponds and lakes - Pool F; Oxpen 2; Hamburg; Middle Triple; and Upper Triple.

*Strategy:*

- Conduct surveys to document existing vegetation and evaluate plant response to restoration.

Sub-Goal 2K: Wildlife and Habitat Management Capabilities. There are currently 10 full-time employees at the refuge, including two managers and an administrative officer, two in support of the biological program, three in the fire management program, one forester, and one maintenance employee.

Objective 1: Current fire-funded staffing levels and project allocations are limiting for prescribed burning accomplishment (especially in the growing season); and fire management is below its potential.

*Strategy:*

- Request funding for two career seasonal firefighters and three temporary seasonal firefighters instead of the five temporary seasonal firefighters. This would make extending the burn season possible, enhance wildfire control capability, and increase productivity at the refuge.

Objective 2: Prescribed burning is accomplished using aerial ignition, allowing refuge staff to take advantage of good burning conditions. Aerial ignition should continue to be a vital part of the prescribed burning program on the refuge.

*Strategy:*

- Increase prescribed fire project dollars by 100 percent to support 13,000 acres treated annually, optimizing use of aerial ignition. Current allocation of prescribed fire project dollars ($84,000) supports the treatment of less than 6,500 acres annually, well below the refuge's potential and ecological thresholds and needs.

Objective 3: Current staffing and funding levels for forest management inhibits the ability to provide habitat for trust resources or achieve desired future conditions.

*Strategies:*

- Restore junior forester position to plan and monitor harvest activities on1,500 acres annually, conduct mechanical and chemical improvements on at least 500 acres annually, and monitor forest health related to climate change.

- Restore forestry technician position to restore wiregrass and other native grass species to the landscape, complete annual forest stand inventory on approximately 10,000 acres, and mark and cruise timber.

- Establish forestry technician position to conduct field management and boundary maintenance. In addition, the incumbent could assist with wildlife surveys, timber cruising, duck and dove banding, impoundment management and other field labor tasks.

- Increase forest project dollars ($100,000) to support management of 2,000 acres to be treated annually. Current allocation of forest project dollars ($20,000) supports the treatment of less than 350 acres annually, well below ecological thresholds and what is necessary to support trust resource management and endangered species recovery.

Objective 4: Current biologist staffing is not sufficient to sustain adequate monitoring of RCW nesting or foraging, and leaves no available biologist time to conduct other wildlife management work.

*Strategies:*

- Establish a biological technician position to obtain group composition annually, identify and coordinate translocations to recipient populations, construct recruitment clusters and provision current clusters to maintain suitable cavity requirements, collect GPS data and condition assessments for all cavity trees and starts, and manage all data and mapping resources.

- Establish a biological technician position to quantify avian resources by establishing baseline information and conducting annual monitoring. In addition, this technician would be responsible for designing and conducting surveys for submerged aquatic vegetation, reptiles and amphibians, fox squirrels, bats, and evaluating wildlife response to habitat improvements.

Objective 5: Current biological and forestry staffing is not sufficient to support landscape objectives related to range-wide longleaf pine restoration and management.

*Strategies:*

- Establish a Geographic Information Specialist position to develop and manage a geographically referenced data system that will enable biologists and foresters to establish baseline information, monitor prescriptive treatments, and evaluate progress towards achieving ecological health and integrity of the longleaf pine system.

- Establish a Land Management Demonstration Biologist/Forest Ecologist position to initiate private lands restoration to increase longleaf pine across the landscape.

*RESOURCE PROTECTION*

**Goal 3.** Identify and conserve archaeological and natural resources and promote conservation through interagency and private landowner cooperation, partnerships, and land protection programs.

Sub-Goal 3A: Archaeological and Cultural Resources Management and Protection. The cultural resources and cultural history of the Carolina Sandhills NWR are valued and preserved, and connect refuge staff, visitors, and the community to the area's past.

Objective 1: Work with the Service's Regional Archaeologist and the State Historic Preservation Officer to protect archaeological and historical resources of the refuge.

Objective 2: Conduct "Level 1" survey as needed for projects.

Objective 3: Continue law enforcement patrol.

Objective 4: Partner with interested groups to protect historic assets (e.g., historical societies and cemetery groups).

Sub-Goal 3B: Land Protection.

Objective 1: Explore opportunities to acquire lands within the refuge acquisition boundary to meet refuge wildlife, habitat, and conservation goals.

*Strategies:*

- Develop partnerships with land trusts and non-governmental organizations to protect lands through acquisition or through conservation easements.

- Develop priority list for land acquisitions.

- Utilize the Land for Timber Exchange Program to help meet this objective.

- Target acquisitions that will maximize ecosystem management objectives (longleaf, prescribed fire, trust species, and species with special designations) and opportunities for public use and education.

Objective 2: Explore opportunities to place easements on lands near the refuge that will compliment refuge objectives.

Objective 3: Consider larger landscape conservation planning efforts (partnerships) to help guide acquisitions, easements, and habitat linkages.

*Strategies:*

- Locate and evaluate important gaps and corridors. Work with partners to protect important habitats and connections serving trust species and species with special designations.

- Continue involvement and leadership role with the "Range-wide Conservation Plan for Longleaf Pine" effort.

Objective 4: Work with refuge neighbors to promote wildlife and habitat goals and objectives on private lands.

*Strategies:*

- Annually coordinate with the Partners for Fish and Wildlife Program to identify opportunities to enter into cooperative wildlife management agreements with private landowners near the refuge.

- Explore opportunities to improve habitat management on neighboring lands through farm bill programs, forest stewardship program, and other conservation programs to manage lands in concert with ecosystem objectives.

- Work with district conservationists, Cooperative Extension Service, SCDNR technical guidance biologists, Service biologists, and others to prioritize lands surrounding the refuge suitable for restoration or enhancement for wildlife.

- Develop a Sandhills Conservation Partnership Working Group.

Sub-Goal 3C: Protecting Refuge Lands

Objective 1: Maintain 20 percent of refuge boundary annually by painting boundary and posting/replacing signs

Objective 2: Monitor Farm Service Agency easements to ensure compliance.

*Strategies:*

- Complete annual Farm Service Agency easement site visits and/or contact owners at least every 3 years.

- Replace boundary signs and boundary paint on two easements annually.

Sub-Goal 3D: Resource Threats

Objective 1: Contaminants - Cooperate with state and federal agencies to institute a structured monitoring program, determine sources, and investigate means to reduce impacts.

Objective 2: Water Quality - Assist U.S. Geological Survey and South Carolina Department of Natural Resources in water quantity study in Chesterfield County. Add additional wells and monitoring stations to key locations throughout the refuge to determine effects of water withdrawals on refuge resources.

Objective 3: Air and Water Quality - Assist the state with air quality monitoring and expand monitoring to include water quality study.

Objective 4: Climate Change - Work with U.S. Geological Survey to design and conduct research and modeling to determine and plan for the effects of climate change on grassland restoration, disease and pest vulnerability, forest and prescribed fire management, and water resources.

Objective 5: Climate Change and Water Resources - Work with U.S. Geological Survey to study longleaf pine transpiration rates under variable climate and water withdrawal scenarios and model potential effects on terrestrial and aquatic systems.

Objective 6: Water Quality and Quantity - Develop working group of representative upstream and downstream landowners to work collaboratively to protect water quality and quantity of refuge streams under different withdrawal and use scenarios.

Objective 7: Air Quality - The Service should participate in a working group to discuss air quality parameters related to predicted non-attainment areas to ensure the continued ability to apply prescribed fire on the landscape in fire-dependent ecosystems.

Sub-Goal 3E: Land Management Demonstration Area for Longleaf Pine. Use Carolina Sandhills NWR's designation as a Land Management Research and Demonstration Area to further investigation, innovation, and instruction in wildlife and habitat management.

Objective 1: Annually host a public lands and private landowner demonstration day to showcase the restoration and management practices on the range of subtypes of longleaf pine forest, from xeric sandhills to mesic flatwoods and hydric savannahs on Carolina Sandhills NWR.

*Strategy:*

Continue wildlife inventorying and habitat monitoring to serve as a repository of data and information about longleaf pine ecosystem management.

Sub-Goal 3F: State Partners/Coordination.

Objective 1: Foster positive relationships with local, state, and regional partners to further information and technology exchange to attain refuge goals.

*Strategies:*

- Attend annual Sandhills RCW cooperators meeting to share information and discuss the management of RCWs and the longleaf pine community.

- Participate and conduct surveys organized by other agencies. Share data and annual reports for surveying and monitoring results.

- Continue to foster statewide memorandum of understanding for fire (suppression) for refuges in the state; work to address issues of prescribed fire and suppression.

- Continue memorandum of understanding with SCDNR to share resources; renew every 5 years. Attend annual cooperators meeting between agencies.

- Continue memorandum of understanding with The Nature Conservancy; translocating RCWs and addressing the use of prescribed fire on a regional scale.

- Continue memorandum of understanding with Sand Hills State Forest, part of lease agreement for management services in return for land (5 years for prescribed fire, 25 years for slash conversion, and 50 years for wildfire initial attack and response).

- Continue memorandum of understanding with Parks, Recreation, and Tourism statewide to assist with prescribed burning for the parks.

- Continue memorandum of understanding with Sand Hills State Forest for law enforcement work.

- Explore partnerships with native plant society or Natural Resources Conservation Service for information exchange and cooperative project development for habitat restoration; exchange of expertise and technology (e.g., native warm season grass, bog, seepage).

*VISITOR SERVICES*

**Goal 4.** Provide quality environmental education and interpretation programs, outreach opportunities, and wildlife-compatible recreational activities that lead to enjoyment and a greater understanding of, and appreciation for, Carolina Sandhills NWR, wildlife, and habitats.

Sub-Goal 4A: Welcome and Orient Visitors. Provide visitors with clear information about what they can do, where they can go, and how to safely and ethically engage in recreational and educational activities.

Objective 1: Develop an up-to-date Visitor Services Plan that reflects current legislation, director's orders, initiatives, policy, and the mission of the refuge, the Refuge System and the Service. The plan should also address the current and future visitor services and recreation needs of refuge visitors.

Objective 2: Develop appropriate signage and brochures to orient and educate visitors.

*Strategies:*

- Place signs along the improved gravel road to keep visitors on route.

- Place directional signs at all decision points on the gravel roads and where trails cross (Tate Trail).

- Place sign on wildlife drive alerting visitors that the Longleaf Pine Trail and Woodland Pond Trail are just ahead.

- Place directional signs in McBee on Highway 151, directing traffic from 151 to the refuge.

- Place mile markers on wildlife drive and on improved gravel road.
- Replace routed signs with new ones at fields and pools.
- Name and mark all roads and water bodies in the brochures and on the landscape.
- Redesign reptile and amphibian brochure to Service graphic standards.
- Replace one-page trail guide with a tear sheet.
- Create mobility-impaired parking place at first pier at Mays Lake.
- Create mobility-impaired parking places at existing parking areas.
- Develop a plan to handle RVs and other large vehicles that come to the office and then need to get back on Hwy 1 (where do they turn around?). Explore the possibility of Federal Highway funds for this.
- Gravel roads to visitor facilities and ensure they are well maintained and passable for all vehicles.
- Replace the information panels at Quarters 212 Kiosk.
- Place a three-panel information kiosk at Mays Lake
- Routinely check all structures to ensure safety and integrity.

Sub Goal 4B: Provide Quality Hunting Opportunities. Hunting programs will be conducted in a safe and cost-effective manner, and to the extent practicable, carried out in accordance with State regulations.

Objective 1: Maintain the “no trapping” and “no coyote hunting” policies unless biological assessment determines they are needed for management purposes.

Objective 2: Consider placing dove hunt into the fee program to cover field preparation.

Sub Goal 4C: Provide Quality Fishing Opportunities. Fishing programs will be conducted in a safe and cost-effective manner, and to the extent practicable, carried out in accordance with State regulations.

Objective 1: Select 5-6 primary ponds (pools) and lakes (e.g., Martin’s Lake, May’s Lake, Lake Bee) to provide recreational fishing opportunities for the general public that utilize native fishes.

*Strategies:*

- Open Martin’s Lake to fishing from March 1 to November 1 to provide fishing opportunities.
- Manage Lake Bee, May’s Lake, Pool J, Honkers and Oxpen 1 to improve recreational fishing opportunities.

- Survey ponds every 5 years to determine stocking levels.
- Stock ponds (pools) and lakes with native fish as needed.
- Complete periodic fish creel surveys to document fishing effort and success.

Objective 2: Ensure mobility-impaired fishing areas also have accessible parking spaces.

Objective 3: Host annual youth fishing event.

Objective 4: Designate a youth-only fishing pond.

Sub Goal 4D: Provide Quality Wildlife Observation and Wildlife Photography Opportunities. Visitors of all ages and abilities will have an opportunity to observe and photograph key wildlife and habitat resources of the refuge. Viewing and photographing wildlife in natural or managed environments will foster a connection between visitors and natural resources.

Objective 1: Place spotting scopes on the observation towers.

Objective 2: Develop a demonstration area to illustrate the 3-year burn cycle. Include interpretive panels. (No-Burn, 1-Year, 2-Year, 3-Year)

Objective 3: Develop information panels along Tate's Trail.

Objective 4: Erect mobile seasonal viewing blind at RCW clusters along wildlife drive during nesting season to decrease disturbance and direct public access.

Sub Goal 4E: Develop and Implement a Quality Environmental Education Program. Through formal, curriculum-based environmental education tied to national and state education standards, the refuge will advance public awareness, understanding, appreciation, and knowledge of key fish, wildlife, plant, and resource issues. The refuge will support environmental education through the use of facilities, equipment, educational materials, teacher workshops, and study sites that are safe and conducive to learning.

Objective 1: Develop a set of programs that will be offered to the public.

Objective 2: Develop presentation about RCW, fire management, longleaf pine ecosystem, and the geology of the area and how it creates unique habitats.

Objective 3: Develop comprehensive environmental education program to be run by volunteers and funded by grants to invite a 3$^{rd}$, 4$^{th}$, or 5$^{th}$ grade from each elementary school in Chesterfield and Darlington Counties to visit the refuge annually to engage in onsite learning on curricula involving ecosystems, prescribed burning, weather, forestry, and wildlife management.

*Strategies:*

- Contract with a teacher or hire an intern to use these topics and develop programs that connect to the state standards. Options include: intern from Coker College, contract a teacher, or volunteer or friends groups.

- Identify appropriate area(s) to develop as outdoor learning area(s).

Objective 5: Work with friends group to have environmental education as one of its primary focuses.

Objective 6: Consider developing a discovery trunk about RCW/longleaf pine to loan to teachers.

Sub Goal 4F: Interpret Key Resources and Issues. The refuge will communicate the most important fish, wildlife, habitat, and other resource issues to visitors of all ages and abilities through effective interpretation. The refuge will tailor messages and delivery methods to specific audiences and present them in appropriate locations. Through heightened awareness, we will inspire visitors to take positive actions supporting refuge goals and the Refuge System mission.

Objective 1: Develop interpretive exhibits about endangered species management (specifically the RCW), longleaf pine habitat (fire), resource management activities (farming, food plots, forestry practices, water management), and the formation of unique habitats associated with the Fall Line separating the Piedmont Plateau from the Atlantic Coastal Plain. (Sandhills, unusual plants, etc).

Objective 2: Ensure all public use areas include interpretive signage.

Sub Goal 4G: Manage for Appropriate Recreational Opportunities. Compatible wildlife-dependent recreational uses are the priority public uses of the Refuge System (e.g., hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation) and will receive enhanced consideration over other general public uses. The refuge will only permit other uses when determined that they are legally mandated, provide benefits to the Service, occur due to special circumstances, or facilitate one of the priority wildlife-dependent recreational uses.

Objective 1: Evaluate all refuge uses, complete appropriate use determinations and compatibility determinations to ensure compliance with the Improvement Act (Appendices E and F).

Objective 2: Develop “Let’s Go Outside” brochure to highlight appropriate recreational uses, such as bike riding and picnicking, to encourage families to use the refuge and pursue outdoor recreational opportunities.

Sub Goal 4G: Communicate Key Issues with Off-site Audiences. Effective outreach depends on open and continuing communication between the refuge staff and the public. This communication involves determining and understanding the issues, identifying audiences, crafting messages, selecting the most effective delivery techniques, and evaluating effectiveness.

Objective 1: Pick the most appropriate community event(s) in the area to participate in and eliminate events that do not contribute to the refuge.

Objective 2: Continue to participate in the Palmetto Sportsmen Classic and the Pee Dee Deer Classic.

Objective 3: Participate in the Career Fair at Coker College.

Objective 4: Work with Friends Group to host two annual special events in spring and fall.

Objective 5: Develop personal relationship with specific reporters at the local papers.

*Strategies:*

- Issue press releases on seasonal topics such as burns, hunts, special event days, economic resources report, etc.
- Host an annual Media Day.
- Provide news articles to the local papers on a regular basis.

Objective 6: Provide outreach materials in a prepared, consistent format.

*Strategies:*

- Use the cable access channel to promote events and opportunities at the refuge.
- Explore opportunities to use local radio stations to provide refuge information to the community.
- Join one of the local chambers of commerce or other civic group.
- Develop a rack card to be placed in local hotels and businesses.

Objective 7: Schedule a congressional staff day/VIP tour.

Objective 8: Conduct talks at local community civic groups.

Sub Goal 4H: Build Volunteer Programs and Partnerships with Refuge Support Groups. Volunteers and refuge support groups fortify refuge staffs with their gift of time, skills, and energy. Refuge staff will initiate and nurture relationships with volunteers and refuge support groups, and will continually support, monitor, and evaluate these groups with the goal of fortifying important refuge activities. Whether through volunteers, refuge support groups, or other important partnerships in the community, refuge personnel will seek to make the refuge an integral part of the community.

Objective 1: Develop and manage a volunteer program.

*Strategies:*

- Designate a volunteer coordinator.
- Identify volunteer job opportunities, develop job descriptions, and recruit volunteers.
- Identify and recruit volunteers (potential sources of volunteers: Coker College (Biology and Education), scouts, work campers, school groups, and community civic groups.
- Expand recreational vehicle camper program.
- Hold annual volunteer recognition event.
- Develop an intern program to support environmental education.

Objective 2: Support a dynamic and thriving friends organization.

*Strategies:*

Develop a memorandum of agreement with friends group.

Participate in the Friends' mentoring program.

Assist friends group in applying for the $5,000 startup grant from NWRA.

*Strategies:*

Hold an annual Friends celebration/recognition program.

Work with friends group to involve them in the environmental education program.

Objective 3: Foster positive relationships with local, state, and regional partners to further information and technology exchange.

*Strategies:*

- Partner with SCDNR on the outdoor event, such as annual public lands and private landowner demonstration day to showcase restoration and management practices on Carolina Sandhills NWR.
- Partner with Wild Turkey Federation to host a youth turkey hunt.
- Develop a partnership with Coker College to support the environmental education program.
- Explore ways to expand the partnerships with McBee High School, Dutch Fork High School, and South Carolina Governors School for Math and Science.
- Partner with retailer for Kids Fishing event or outdoor event.

Sub Goal 4I: Natural Resource Management Capabilities (MCAP). There are currently 10 full-time employees at the refuge, including two managers and an administrative officer, two in support of the biological program, three in the fire management program, one forester, and one maintenance employee.

Objective 1: Establish a refuge operations specialist/facility manager to oversee the restoration of wiregrass and other native grass species to the landscape and to manage Service assets so that core personnel can implement actions for trust species.

Objective 2: Establish an engineering equipment operator to maintain refuge roads and facilities to improve visitor enjoyment of the refuge and to protect the Service's investment in these facilities by completing routine maintenance. In addition, the operator will assist the biological and forestry programs in sustaining biological communities through maintenance of impoundments, roads, dams, fire breaks, fields, and water control structures.

Objective 3: Establish a computer specialist position to assist with micro-computing needs, network relationships, GIS support, and web page maintenance to enable natural resource staff to concentrate on mission-dependent work.

Objective 4: Establish a park ranger position to plan and implement a "Connecting Kids with Nature" program to provide curriculum-based, on-refuge environmental education programs to fourth and fifth graders in Chesterfield and Darlington County schools and to address visitor services needs for 25,000 visitors annually.

Objective 5: Establish a full-time refuge law enforcement officer position to ensure visitor safety, address resource issues such as pine straw theft and historic structure vandalism, and provide protection and monitoring for Farm Service Agency easements to prevent resource degradation before it occurs.

# V. Plan Implementation

## INTRODUCTION

Refuge lands are managed as defined under the Improvement Act. Congress has distinguished a clear legislative mission of wildlife conservation for all national wildlife refuges. National wildlife refuges, unlike other public lands, are dedicated to the conservation of the nation's fish and wildlife resources and wildlife-dependent recreational uses. Priority projects emphasize the protection and enhancement of fish and wildlife species first and foremost, but considerable emphasis is placed on balancing the needs and demands for wildlife-dependent recreation and environmental education.

To accomplish the purpose, vision, goals, and objectives contained in this Draft CCP/EA for Carolina Sandhills NWR, this section identifies projects, funding and personnel needs, volunteers, partnerships opportunities, step-down management plans, a monitoring and adaptive management plan, and plan review and revision.

## PROPOSED PROJECTS

Listed below are the proposed project summaries and associated costs for fish and wildlife population management, habitat management, resource protection, visitor services, and refuge administration during the next 15 years. This proposed project list, categorized by goal, reflects the priority needs identified by the planning team, the public, and the refuge staff based upon available information. These projects were generated for the purpose of achieving the refuge's objectives and strategies. The primary linkages of these projects to those planning elements are identified in each summary. A complete listing of each proposed project in priority order can be found in Appendix J.

### *FISH AND WILDLIFE POPULATION MANAGEMENT*

Project 1: Conduct recovery actions to achieve recovery of refuge RCW population.

Carolina Sandhills NWR is home to the largest population of RCWs on Service-owned lands. It is also the majority contributor to the Sandhills Recovery Unit, which includes Carolina Sandhills NWR (165 groups) and Sand Hills State Forest (85 groups). [Cheraw State Park may contribute to the recovery effort, but any groups contributed would be above the 250 groups required to achieve recovery.] A biological technician is needed to implement recovery actions on the refuge. Duties will include obtaining group composition annually, identifying and coordinating translocations to recipient populations, constructing recruitment clusters and provisioning current clusters to maintain suitable cavity requirements, collecting GPS data and condition assessments for all cavity trees and starts, and managing all data and mapping resources. *(Linkages: Sub-Goals 1A, 2K)*

Project 2: Increase knowledge of biological species through surveys and monitoring.

Carolina Sandhills NWR is home to more than 190 species of birds. In recent years, regional information suggests that several of these species may be in decline, yet their abundance and distribution across the refuge landscape is unknown. This project would fund a biological technician to quantify avian resources by establishing baseline information and conducting annual monitoring. In addition, this technician would be responsible for designing and conducting surveys for submerged aquatic vegetation, Bachman's sparrow, field sparrow, chuck-wills-widow, prairie warbler, brown-headed nuthatch, red-headed woodpecker, Swainson's warbler, Kentucky warbler, hooded warbler,

wood thrush, American woodcock, American kestrel, reptiles and amphibians, fox squirrels, and bats. *(Linkages: Sub-Goals 1F, 1G, 1H, 1I, 1M, 2K)*

Project 3: Monitor invasive and nuisance plants and wildlife and implement control measures.

Several non-native plants have become problematic during the last 20 years, including weeping love grass, bamboo, serecia and bi-color lespedeza. In addition, in recent years, coyotes and feral hogs have become abundant, displacing native wildlife and damaging habitats. This project would contract a baseline survey of nuisance wildlife and plants. Phase two of the project would contract the control of coyotes April through June annually and feral hogs year-round with USDA Wildlife Services. *(Linkages: Sub-Goals 1L, 2G)*

*HABITAT MANAGEMENT*

Project 4: Enhance forest management capability.

Carolina Sandhills NWR contains one of the largest tracts of longleaf pine in its range. The refuge is also home to the largest population of the endangered RCW on Service lands. To restore the ecological integrity of the system and to create habitat conditions necessary for the recovery of the RCW, forest management is needed. At one time, the refuge had three forestry staff to manage habitat; however, severe budget cuts reduced forest management staff by two-thirds. This staffing level is insufficient to meet the annual objectives of the refuge. As the refuge is 72 square miles with almost 46,000 acres of forested habitat, a forester is needed to address the habitat management backlog. The forester will plan and monitor harvest activities on 1,500 acres annually, conduct mechanical and chemical improvements on at least 500 acres annually, and monitor forest health related to climate change. *(Linkages Sub-Goals 2A, 2B, 2D, 2K)*

Project 5: Optimize forest management capability and control invasive species.

In the 1940s and 50s, approximately 1,000 acres of grasslands were planted in non-native weeping love grass and bi-color lespedeza. Both of these species have begun invading longleaf pine habitat and displacing native wiregrass, which is essential to the ecological health and integrity of the longleaf pine system. A forestry technician is needed to restore wiregrass and other native grass species to the landscape. The restoration of native grasses will provide habitat for bird species of concern such as Bachman's and Henslow's sparrows, and ensure the ecological integrity of the longleaf system for the endangered red-cockaded woodpecker. In addition to treating invasive species, the forestry technician will complete annual forest stand inventory on approximately 10,000 acres; which result in prioritized forest conservation and restoration activities on 1,000 to 1,500 acres. A forestry technician is needed to mark and cruise timber. *(Linkages: Sub-Goals 1C, 2D, 2E, 2G, 2H, 2I, 2J, 2K)*

Project 6: Integrate refuge forestry, wildlife, and fire programs through spatial data development and management.

Carolina Sandhills NWR contains one of the largest tracts of longleaf pine in its range and provides habitat for the largest population of the RCW on Service lands. Staff manages habitat based on 1970s forest inventory data and mapping created with AutoCAD, an engineering system that is not spatially referenced. Forest and wildlife management programs will be enhanced and facilitated by implementing a geographically referenced data system that will enable biologists and foresters to establish baseline information, monitor prescriptive treatments, and evaluate progress towards achieving ecological health and integrity of the longleaf pine system. In addition, ecological changes as a result of climate change can be evaluated against baseline

conditions and monitored. A Geographic Information Specialist will develop and manage this system. *(Linkages: Sub-Goals 1A, 1I, 1M, 2A, 2C, 2E, 2F, 2K)*

Project 7: Demonstrate longleaf pine management and facilitate ecosystem restoration on private lands surrounding the refuge.

The forest fills important conservation roles for many species, some of which are threatened or endangered, yet the roles of this forest go far beyond local conservation. The refuge is contiguous with a state forest and park; collectively accounting for 100,000 acres of longleaf pine, a feature that is rare in today's landscape. Carolina Sandhills NWR is one of two national wildlife refuges in the Southeast Region chosen as a Land Management Demonstration Refuge for longleaf pine management. A Land Management Demonstration Biologist/Forest Ecologist will initiate private lands restoration to increase longleaf across the landscape. In addition, the biologist will oversee the management of forest and biological resources on the refuge. Private landowners and conservation partners in state agencies and private wildlife organizations will frequent the refuge to learn about best management practices for longleaf pine in sandhills soils. *(Linkages: Sub-Goals 2A, 2B, 2D, 2K)*

Project 8: Manage openings and assist with forest management activities.

Carolina Sandhills NWR has 1,200 acres of managed openings. These openings are mowed, disked, planted, and/or burned annually. In addition, the refuge has hundreds of miles of boundary to maintain. This project would add a forestry technician to conduct field management and boundary maintenance. In addition, the incumbent could assist with wildlife surveys, timber cruising, duck and dove banding, impoundment management and other field labor tasks. *(Linkages: Sub-Goals 1C, 1D, 1F, 1H, 1K, 2B, 2D, 2G, 2H, 2J, 2K)*

Project 9: Carbon Release and Sequestration Rates for Longleaf Pine on Marginal Sites.

Carolina Sandhills NWR has one of the largest prescribed fire programs in the Southeast Region of the Service. Concerns have been raised about carbon emissions from prescribed burns and their effects on air quality. The refuge currently has an EPA Air Quality Monitoring Station on site; however, the amount of carbon emitted from prescribed burns is unknown. The amount of carbon sequestered from the atmosphere by green biomass that is restored by prescribed burns is also unknown. One study of ponderosa pine in Arizona suggests that three times as much carbon is sequestered by herbaceous biomass that grows following a prescribed burn than in pine stands that have not been burned. This project would partner with a university to determine how much carbon the refuge is emitting through prescribed burning and how much carbon is sequestered in the year burned, or one, two and three years after burning and in unburned stands. *(Linkages: Sub-Goals 1P, 2A, 2B, 2D, 2K)*

Project 10: Restoration of longleaf pine through control of hardwood midstory.

Carolina Sandhills NWR contains one of the largest tracts of longleaf pine in its range, which has been reduced from 90 million acres to less than 2 million acres. Additionally, fire exclusion during the 1950s and 1960s encouraged scrub oaks to become dominant in the understory and ground layer of refuge forests. Due to vigorous root systems, prescribed fire typically top kills these scrub oaks. Vigorous re-sprouting occurs, further shading grasses, forbs, and legumes from developing. Applying Velpar ULW on 5,000 acres the first year and 2,000 acres each year for 10 years will, along with a strong prescribed fire initiative, restore the ecological balance in refuge pinelands. *(Linkages: Sub-Goals 1A, 1B, 1G, 1M, 2A, 2C, 2D, 2E, 2K)*

Project 11: Convert off-site pine to longleaf pine to restore ecosystem function.

Carolina Sandhills NWR contains one of the largest tracts of longleaf pine in its range, which has been reduced from 90 million acres to less than 2 million acres. The refuge is also home to the largest population of the endangered RCW on Service lands. To restore the ecological integrity of the system and to create habitat conditions necessary for the recovery of the RCW, forest management is needed. The refuge has several areas that were recently acquired or where longleaf pines have failed to naturally regenerate at sufficient densities. This project would plant longleaf pine on sites converted from off-site loblolly and slash pine and replant areas where natural regeneration has failed. Establishing these stands would support recovery initiatives for the RCW and ensure long-term habitat suitability for this species beyond current forest inventories. *(Linkages: Sub-Goals 2A, 2B, 2E, 2K)*

Project 12: Streamhead Pocosin Research.

Carolina Sandhills NWR is the southern extent of Atlantic white cedar. This species is not fire tolerant, yet it proliferates along the margins of an ecosystem dominated by fire. Research is needed to study the ecology of streamhead pocosins, the role of fire in management of pocosins, and the relationship between longleaf pine, pocosins, fire, and Atlantic white cedar. *(Linkages Sub-Goals 1P, 2E)*

Project 13: Ecology of fire, ground cover, and flowering plants in the longleaf pine/wiregrass community and the relationship to pollinators.

Carolina Sandhills NWR is home to more than 800 species of plants. Only in recent years have researchers begun to inventory insects found in the sandhills. One researcher has discovered more than 60 species of native solitary bees, more than 20 of which were state records for South Carolina. Additional inventory is needed and should be expanded to include all pollinating insects. The relationship between this diverse assemblage of plants and pollinators needs to be determined. *(Linkages: Sub-Goals 1P, 2E)*

Project 14: Establish longleaf/wiregrass restoration area at the Research Natural Area.

The Research Natural Area was proposed for inclusion into this national Research Natural Area system many years ago. It was never “officially” accepted into the program. These areas would be removed from any active management to let succession and other processes occur without the interference of management. As a result, this 200-acre area contains a longleaf pine canopy, a dense hardwood midstory, few shrubs, and a very sparse understory. As this area was not accepted into the program, there are no legal constraints prohibiting the restoration of a floristically diverse ground cover. Due to its size and similarity in site conditions, this area offers a unique opportunity to test different restoration regimes to determine the efficacy of restoring native ground cover and replicating the results on private lands, as well as refuge lands where midstory has not been effectively controlled. *(Linkages: Sub-Goals 2A, 2B, 2C, 2D, 2E)*

Project 15: Expand prescribed fire ability to treat 13,000 to 15,000 acres annually.

Prescribed burning is accomplished using aerial ignition, allowing refuge staff to optimize good burning conditions. Aerial ignition should continue to be a vital part of the prescribed burning program on the refuge. Current allocation of prescribed fire project dollars ($84,000) supports the treatment of less than 6,500 acres annually, well below the refuge’s potential and ecological thresholds and needs. This project will increase prescribed fire project dollars by 100 percent to support 13,000 acres treated annually, optimizing use of aerial ignition. *(Linkages: Sub-Goals 1A, 1B, 1G, 1P, 2A, 2B, 2C, 2D, 2E, 2F, 2K)*

*RESOURCE PROTECTION*

Project 16: Protect visitors and refuge resources with enhanced law enforcement capability.

Carolina Sandhills NWR contains 46,000 acres of forested habitat and provides wildlife-dependent recreation to thousands of visitors annually. Visitors participate in hunting from October through April, fishing from March through October, environmental education from September through May, and wildlife observation, photography and interpretation year-round. To ensure visitor safety, a full-time refuge law enforcement officer is needed. In addition to visitor safety, law enforcement presence will address resource issues such as pine straw theft and historic structure vandalism that have occurred in the absence of full-time law enforcement presence. Finally, the refuge has management responsibility for twelve Farm Service Agency easements in five counties. Having a full-time law enforcement officer will provide protection of these easements and prevent resource degradation. *(Linkages: Sub-Goals 3A, 3C, 3F, 4A, 4B, 4C, 4I)*

Project 17: Develop a Sandhills Longleaf Pine Conservation Partnership Working Group.

The Sandhills region of South Carolina offers a unique opportunity to form a Sandhills Longleaf Pine Conservation Partnership. Federal, state and private lands account for more than 100,000 acres of longleaf pine, an imperiled ecosystem in the Southeast Region of the Service. Through a working group, conservation partners can leverage grant and restoration dollars and target lands for restoration that will meet ecosystem objectives. *(Linkages: Sub-Goals 3B, 3E, 3F)*

Project 18: Research, model, and plan for climate change affects on refuge habitats, programs, and management.

Since 1957, the climate of South Carolina has been characterized by warmer and drier conditions. The refuge needs to determine how a warmer and drier climate may affect flora and fauna in an already xeric system. Specifically, the refuge, working with scientists in academia or agency (USGS, EPA, etc.), should conduct research and modeling to determine and plan for the effects of climate change on grassland restoration, disease and pest vulnerability, forest and prescribed fire management, and water resources. *(Linkages: Sub-Goals 2A, 2B, 2C, 2E, 2F, 2G, 2H, 3D, 3E)*

Project 19. Conduct research on longleaf pine evapotranspiration rates.

Although the refuge receives an average of 47 to 48 inches of precipitation a year, about 30 inches is returned to the atmosphere through evapotranspiration, leaving an average annual water yield of about 17 inches for runoff and groundwater infiltration (Cherry et. al. 2001). It is unknown how a warmer and drier climate may impact transpiration rates of longleaf pine. Additionally, as more users require water from the Middendorf aquifer, it is unknown how hydrological resources may be impacted, thus affecting terrestrial and aquatic systems. Working with hydrologists and hydrogeologists from the USGS, the refuge will conduct research on longleaf pine transpiration rates under variable climate and water withdrawal scenarios and model potential effects on terrestrial and aquatic systems. (Linkages: Sub Goals 2A, 2B, 3D, 3E)

Project 20. Develop a Watershed Conservation Working Group.

Tributaries of the Lynches River and Black Creek either initiate or flow through the refuge, supporting a diverse assemblage of upland and pocosin communities. The refuge will develop a stakeholders working group, representing upstream and downstream landowners who will work collaboratively to protect water quality and quantity throughout the watershed. Through this working group, conservation partners can

leverage grant and restoration dollars and target lands for conservation that will meet watershed objectives. *(Linkages: Sub-Goals 1B, 1D, 1G, 1I, 1J, 2E, 2F, 2J, 3B, 3C, 3D)*

*VISITOR SERVICES*

Project 21: Connect kids with nature through environmental education opportunities.

Technological advances in the last 10 years have caused a decrease in the number of students participating in outdoor activities. On average, a child spends 6 hours per day in front of a television or computer monitor. Health officials have documented an increase in childhood obesity and behavioral maladies. A refuge education specialist will plan and implement a "Connecting Kids with Nature" program that will provide curriculum-based, on-refuge environmental education programs to fourth and fifth graders in both Chesterfield and Darlington County schools. In addition to curriculum objectives, the program will focus on nature exploration and "getting outdoors" to enjoy public lands. Visitor services program needs will also be addressed, including creating a welcoming and informative experience for 25,000 visitors annually. *(Linkages: Sub-Goals 4A, 4E, 4F, 4H, 4I)*

*REFUGE ADMINISTRATION*

Project 22: Support Endangered Species Recovery and Ecosystem Restoration with a Computer Specialist.

Information technology changes at a rapid rate. As a rural field station and with regulations related to prohibitions of “civilians” working on government computers, it is imperative that a computer specialist be placed on site to assist with micro-computing needs, network relationships, GIS support, and web page maintenance. Providing this support will enable natural resource staff to concentrate on other mission-dependent work. *(Linkages: Goals 1, 2, 4)*

Project 23: Maintain refuge equipment and facilities.

Carolina Sandhills NWR has more than 150 miles of roads open year-round to public vehicle access. Along these roads, the refuge has numerous kiosks, interpretive wayside exhibits, boardwalks, observations towers, trails, and a photoblind. In the recent past, the refuge had four engineering equipment operators to maintain roads, facilities, and equipment. An equipment operator is needed to maintain refuge roads and facilities to improve visitor enjoyment of the refuge and to protect the Service's investment in these facilities by completing routine maintenance. In addition, the operator will assist the biological and forestry programs in sustaining biological communities through maintenance of impoundments, roads, dams, fire breaks, fields, and water control structures. *(Linkages: Goals 3, 4)*

Project 24: Manage Refuge Operations, Facilities and Invasive Species. In the 1940s and 50s, approximately 1,000 acres of grasslands were planted in non-native weeping love grass and bi-color lespedeza. Both of these species have begun invading longleaf pine habitat and displacing native wiregrass, which is essential to the ecological health and integrity of the longleaf pine system. In addition, the refuge has many buildings, support facilities, more than 150 miles of roads, and several other types of assets. A refuge operations specialist/facility manager is needed to restore wiregrass and other native grass species to the landscape and to manage Service assets (real property inventory and Service Asset Maintenance Management System projects, fleet, and energy) so that core personnel can implement actions for trust species. The restoration of native grasses will provide habitat for bird species of concern such as Bachman's and Henslow's sparrows, and ensure the

ecological integrity of the longleaf system for the endangered red-cockaded woodpecker. *(Linkages: Sub-Goals 1C, 2D, 2E, 2G, 2H, 2I, 2J, 4I)*

**Table 8. Proposed positions to achieve desired future conditions and optimally manage refuge natural, cultural, and administrative resources**

| Priority | Title | Project Number |
|---|---|---|
| 1 | Refuge Forester GS-0462-5/7/9 | Project 4 |
| 2 | Refuge Operations Specialist GS-0485-5/7/9 | Project 24 |
| 3 | GIS Specialist GS-0401-9/11 | Project 6 |
| 4 | Interpretive Park Ranger GS-0025-5/7/9 | Project 21 |
| 5 | Park Ranger (LE) GS-0025-7/9 | Project 16 |
| 6 | Equipment Operator WG-08 | Project 23 |
| 7 | Computer Support/IT Specialist GS-0334-9 | Project 22 |
| 8 | Biological Technician GS-0404-5/6/7 | Project 1 |
| 9 | Forestry Technician GS-0462-5/6/7 | Project 5 |
| 10 | Land Management Demonstration Biologist/ Forest Ecologist GS-0486/460-12 | Project 7 |
| 11 | Biological Technician GS-0404-4/5 | Project 2 |
| 12 | Forestry Technician GS-0462-4/5 | Project 8 |

**Figure 16. Proposed organizational chart—Carolina Sandhills NWR**

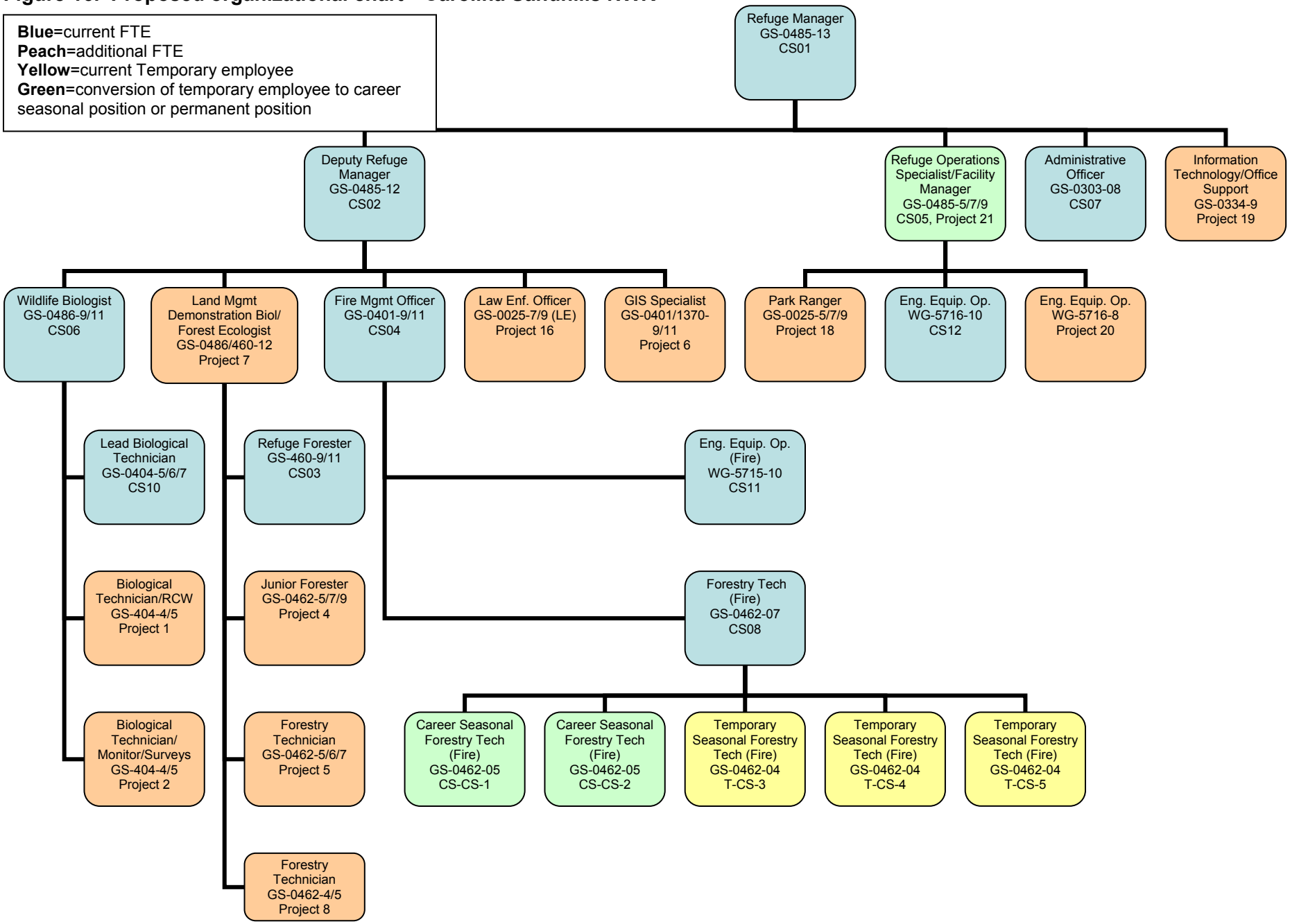


**Table 9. Summary of projects (not in priority order; organized by goal, e.g., wildlife, habitat, resource protection, and visitor services)**

| PROJECT NUMBER | PROJECT TITLE | FIRST YEAR COST ($1,000) | RECURRING ANNUAL COST ($1,000) | STAFF (FTE'S) |
|---|---|---|---|---|
| 1 | Conduct Recovery Actions to achieve recovery of refuge RCW population | 138 | 83 | 1.0 |
| 2 | Increase knowledge of biological species through surveys and monitoring | 113 | 58 | 1.0 |
| 3 | Monitor invasive and nuisance plants and wildlife and implement control measures | 140 | 40 | |
| 4 | Enhance forest management capability | 138 | 83 | 1.0 |
| 5 | Optimize forest management capability and control invasive species | 125 | 70 | 1.0 |
| 6 | Integrate refuge forestry, wildlife and fire programs through spatial data development and management | 153 | 98 | 1.0 |
| 7 | Demonstrate longleaf pine management and facilitate ecosystem restoration on private lands surrounding the refuge | 170 | 115 | 1.0 |
| 8 | Manage openings and assist with forest management activities | 113 | 58 | 1.0 |
| 9 | Carbon Release and Sequestration Rates for Longleaf Pine on Marginal Sites (5 year study) | 140 | 40 | |
| 10 | Restoration of longleaf pine through control of hardwood midstory (10 year project) | 100 | 100 | |
| 11 | Convert off-site pine to longleaf pine to restore ecosystem function | 50 | 50 | |
| 12 | Streamhead Pocosin Research (3 year study) | 100 | 50 | |
| 13 | Ecology of fire, ground cover, and flowering plants in the longleaf pine/wiregrass community and the relationship to pollinators (5 year study) | 140 | 40 | |
| 14 | Establish longleaf/wiregrass restoration area at the Research Natural Area (5 year study) | 50 | 50 | |
| 15 | Expand prescribed fire ability to treat 13,000 to 15,000 acres annually | 168 | 168 | |
| 16 | Protect visitors and refuge resources with enhanced law enforcement capability | 149 | 94 | 1.0 |
| 17 | Develop a Sandhills Longleaf Pine Conservation Partnership Working Group | 25 | 25 | |
| 18 | Research, model, and plan for climate change effects on refuge habitats, programs, and management (5-year study). | 150 | 50 | |
| 19 | Conduct research on longleaf pine evapotranspiration rates (2-year study) | 50 | 50 | |
| 20 | Develop a Watershed Conservation Working Group | 25 | 5 | |
| 21 | Connect kids with nature through environmental education opportunities | 153 | 98 | 1.0 |
| 22 | Support Endangered Species Recovery and Ecosystem Restoration with a Computer Specialist | 138 | 83 | 1.0 |
| 23 | Maintain refuge equipment and facilities | 123 | 68 | 1.0 |
| 24 | Manage Refuge Operations, Facilities and Invasive Species | 138 | 83 | 1.0 |

## PARTNERSHIP AND VOLUNTEER OPPORTUNITIES

A key element of this Draft CCP/EA is to establish partnerships with local volunteers, landowners, private organizations, and state and federal natural resource agencies. In the immediate vicinity of the refuge, opportunities exist to establish partnerships with Sand Hills State Forest, SCDNR, and Cheraw State Park. Additional partnership opportunities will be forged with the towns of McBee, Patrick, Chesterfield, Hartsville, and Cheraw. At regional and state levels, partnerships may be established or enhanced with organizations such as The Nature Conservancy, The Pee Dee Land Trust, The Black Creek Land Trust, The National Wild Turkey Federation, The South Carolina Wildlife Federation, and the South Carolina Prescribed Fire Council.

## STEP-DOWN MANAGEMENT PLANS

A CCP is a strategic plan that guides the direction of the refuge. A step-down management plan provides specific guidance on activities, such as habitat, fire, and visitor services. These plans (Table 9) are also developed in accordance with NEPA, which requires the identification and evaluation of alternatives and public review and involvement prior to their implementation.

**Table 10. Carolina Sandhills NWR step-down management plans related to the goals and objectives of the CCP**

| Step-down Plan | Completion Date |
|---|---|
| Forest Management Plan | 2010 |
| Wildlife Inventory Plan | 2011 |
| Exotic Plant Management Plan | 2011 |
| Fire Monitoring Plan-Habitat treatment effectiveness | 2012 |
| Field Management Plan | 2012 |
| Lake/Pond Management Plan | 2012 |
| Law Enforcement Plan | 2013 |
| Visitor Services Plan | 2013 |
| Fire Management Plan (Update) | 2014 |
| Archaeological Resources Protection Plan | 2015 |
| RCW Management Plan (Update) | 2016 |

## MONITORING AND ADAPTIVE MANAGEMENT

Adaptive management is a flexible approach to long-term management of biotic resources that is directed over time by the results of ongoing monitoring activities and other information. More specifically, adaptive management is a process by which projects are implemented within a framework of scientifically driven experiments to test the predictions and assumptions outlined within a plan.

To apply adaptive management, specific surveying, inventorying, and monitoring protocols will be adopted for the refuge. The habitat management strategies will be systematically evaluated to determine management effects on wildlife populations. This information will be used to refine approaches and determine how effectively the objectives are being accomplished. Evaluations will include ecosystem team and other appropriate partner participation. If monitoring and evaluation indicate undesirable effects for target and non-target species and/or communities, then alterations to the management projects will be made. Subsequently, the CCP will be revised. Specific monitoring and evaluation activities will be described in the step-down management plans.

## PLAN REVIEW AND REVISION

This CCP, when final, will be reviewed annually as the refuge's annual work plans and budgets are developed. It will also be reviewed to determine the need for revision, which will occur if and when conditions change or significant information becomes available, such as a change in ecological conditions or a major refuge expansion. The final CCP will be augmented by detailed step-down management plans to address the completion of specific strategies in support of the refuge's goals and objectives. Revisions to the CCP and the step-down management plans will be subject to public review and NEPA compliance.

## SECTION B. ENVIRONMENTAL ASSESSMENT

# *I. Background*

### INTRODUCTION

The Fish and Wildlife Service (Service) prepared this Environmental Assessment (EA) for Carolina Sandhills National Wildlife Refuge (NWR) in compliance with the National Environmental Policy Act (NEPA) and the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act). The Improvement Act requires the development of comprehensive conservation plans for all refuges. Following a public review and comment period on this Draft CCP/EA, a final decision will be made by the Service that will guide management actions and decisions on the refuge during the next 15 years, provide understanding about the refuge and management activities, and incorporate information and suggestions from the public and refuge partners.

This Draft CCP/EA proposes a management direction, which is described in detail through a set of goals, objectives, and strategies. This Draft CCP/EA addresses current management issues, provides long-term management direction and guidance for the refuge, and satisfies the legislative mandates of the Improvement Act. While this Draft CCP/EA provides general management direction, subsequent step-down plans will provide more detailed management direction and actions.

This EA process establishes and evaluates a range of reasonable management alternatives. The intent is to support informed decision-making regarding future management of the refuge. Each alternative presented in this EA was generated with the potential to be fully developed into a final CCP. The predicted biological, physical, social, and economical impacts of implementing each alternative are analyzed in this EA. This analysis assists the Service in determining if the alternatives represent no significant impacts, thus requiring the preparation of a Finding of No Significant Impact, or if the alternatives represent significant impacts, thus requiring more detailed analysis through an Environmental Impact Statement and a Record of Decision. Following public review and comment, the Service will select an alternative to be fully developed for this refuge.

### PURPOSE AND NEED FOR ACTION

This EA evaluates the effects the proposed actions may have on refuge resources, the surrounding community, and the refuge's ability to meet the purpose(s) and goals identified in the Draft CCP (for which we evaluate each alternative). The purpose is to ensure that Carolina Sandhills NWR (a) restores, maintains, and enhances longleaf pine habitat and associated plant and animal species; (b) conserves, restores, and enhances threatened or endangered species, with special emphasis on the red-cockaded woodpecker; (c) provides habitat for migratory birds; (d) provides opportunities for environmental education, interpretation, and wildlife-dependent recreation; and (e) demonstrates sound land management practices that enhance natural resource conservation and conserves and enhances the diminishing longleaf pine/wiregrass ecosystem.

The CCP is needed to address current management issues, provide long-term management direction for the refuge, and satisfy the legislative mandates of the Improvement Act, which requires the preparation of a CCP for all national wildlife refuges.

## DECISION FRAMEWORK

Based on the assessment described in this EA, the Service will select an alternative to implement the CCP for Carolina Sandhills NWR. The final CCP will include a Finding of No Significant Impact (FONSI), which is a statement explaining why the selected alternative will not have a significant effect on the quality of the human environment. This determination is based on an evaluation of the Service and Refuge System mission, the purpose(s) for which the refuge was established, and other legal mandates. Assuming no significant impact is found, implementation of the CCP will begin and will be monitored annually and revised as necessary.

## PLANNING STUDY AREA

The Carolina Sandhills NWR is located in a rural area in the northeastern region of South Carolina. (Figure 1). The refuge is comprised of 47,850 acres, including fee ownership of 45,348 acres, and nine conservation easements totaling 2,502 acres. The majority of the refuge lies in Chesterfield County, South Carolina and there is one fee title tract totaling 210 acres in Marlboro County. The refuge was established by Executive Order 8067, dated March 17, 1939, under the authority of the 1933 National Industrial Recovery Act and the Emergency Relief Appropriations Act of 1935 and is managed by the Service. This EA will identify management on refuge lands, as well as those lands proposed for acquisition by the Service.

## AUTHORITY, LEGAL COMPLIANCE, AND COMPATIBILITY

The Service developed this Draft CCP/EA in compliance with the Improvement Act and Part 602 of the Fish and Wildlife Service Manual (National Wildlife Refuge System Planning). The actions described within this Draft CCP/EA also meet the requirements of NEPA. The refuge staff achieved compliance with NEPA through the involvement of the public and the incorporation of this EA, with a description of the alternatives considered and an analysis of the environmental consequences of the alternatives (Chapters III and IV in this section). When fully implemented, the CCP will strive to achieve the vision and purposes of Carolina Sandhills NWR.

The Refuge System includes federal lands and waters managed primarily to provide habitat for a diversity of fish, wildlife and plants. National wildlife refuges are established under many different authorities and funding sources for a variety of purposes, which are established under specific legislation, through presidential orders, or in special agreements. Additional authorities delegated by Congress, federal regulations, executive orders, and several management plans guide the operation of the refuge. Appendix C lists the key laws, orders, and regulations that provide a framework for the proposed action.

The CCP's overriding consideration will be to fulfill the purposes for which the refuge was established. The laws that established the refuge and provided the funds for acquisition state the purposes. Fish and wildlife management is the first priority in refuge management, and the Service allows and encourages public use (wildlife-dependent recreation) that is compatible with, or does not detract from, the refuge's mission and purposes.

### *COMPATIBILITY*

The National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997, states that national wildlife refuges must be protected from incompatible or harmful human activities to ensure that Americans can enjoy Refuge System lands and waters. Before activities or uses are allowed on a national wildlife refuge, the uses must be

found to be compatible. A compatible use "...will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge." In addition, "wildlife-dependent recreational uses may be authorized on a refuge when they are compatible and not inconsistent with public safety."

Appropriate use forms and compatibility determinations were prepared for hunting (off-road vehicle use); fishing; wildlife observation and photography; environmental education and interpretation; recreational uses (hiking, walking, jogging, bicycling, mountain biking, and picnicking); horseback riding; commercial tree harvest; cooperative farming; public safety and military training; natural resource collecting (pine straw, firewood, and pine cones); camping; cemetery upkeep; and research and collecting. Please refer to Appendix E for findings of appropriate use and Appendix F for the compatibility determinations for those public uses approved for the refuge.

An interim compatibility determination is a document that assesses the compatibility of an activity during the period of time the Service first acquires a parcel of land to the time a formal, long-term management plan for that parcel is prepared and adopted. If additional properties are acquired for the refuge, interim compatibility determinations would provide for interim use of the properties until they are added to the refuge's management plans, at which time formal compatibility determinations would be prepared or the use(s) would be incorporated into existing compatibility determinations.

**PUBLIC INVOLVEMENT AND THE PLANNING PROCESS**

In accordance with Service guidelines and NEPA recommendations, public involvement has been a crucial factor throughout the development of the Draft CCP/EA for Carolina Sandhills NWR. This Draft CCP/EA has been written with input and assistance from interested citizens, conservation organizations, and employees of local and state agencies. The participation of these stakeholders and their ideas has been of great value in setting the management direction for Carolina Sandhills NWR. The Service, as a whole, and the refuge staff, in particular, are very grateful to each one who has contributed time, expertise, and ideas to the planning process. The staff remains impressed by the passion and commitment of so many individuals for the lands and waters administered by the refuge.

Public scoping was conducted through a formal Open House on the evening of September 10, 2007, at the Boy Scout Hut in McBee, South Carolina. Presenters provided programs on the CCP process and an overview of the refuge. Twelve people attended and there was an open period of questions and answers following the introductory presentations. There were also table-top exhibits focusing on the CCP process and refuge programs.

In addition to the public scoping activities, nine members of three South Carolina agencies participated in an Intergovernmental Scoping meeting on September 10, 2007. Comment forms were provided at the public forum, placed at local businesses throughout the community and at the refuge headquarters, and were provided to persons who made inquiries through the Internet, by mail, or in person.

Additional efforts to keep the community informed and to solicit input for the planning effort include: inviting press coverage of the public scoping meeting, providing information on the refuge's web page, and sending information to key contacts.

A complete summary of the issues and concerns is provided in Appendix D. For more detailed information about the planning process and the identification of specific issues, please refer to Section A, Chapter III.

# II. Affected Environment

For a description of the affected environment, see Section A, Chapter II, Refuge Overview.

# III. Description of Alternatives

## FORMULATION OF ALTERNATIVES

Alternatives are different approaches or combinations of management objectives and strategies designed to achieve the refuge's purpose and vision, and the goals identified in the Draft CCP; the priorities and goals of the Carolina Sandhills CCP Core Team; the goals of the Refuge System; and the mission of the Service. Alternatives are formulated to address the significant issues, concerns, and problems identified by the Service and the public during public scoping.

The three alternatives identified and evaluated for Carolina Sandhills NWR represent different approaches to provide permanent protection, restoration, and management of the refuge's fish, wildlife, plants, habitats, and other resources, while providing quality opportunities for appropriate and compatible wildlife-dependent recreation. Refuge staff assessed the biological conditions and analyzed the external relationships affecting the refuge. This information contributed to the development of refuge goals and, in turn, helped to formulate the alternatives. As a result, each alternative presents different sets of objectives for reaching refuge goals. Each alternative was evaluated based on its effectiveness in achieving the purposes, vision, and goals of the refuge and its ability to address priority issues related to wildlife and habitat management, resource protection, visitor services, and refuge administration. Please refer to Section A, Chapter III, for discussion of priority issues.

## FEATURES AND MANAGEMENT COMMON TO ALL ALTERNATIVES

Although the alternatives differ in many ways, there are similarities among them; several elements of refuge management are common to all alternatives. All management activities that could impact natural resources, including subsurface mineral reservations, utility lines and easements, soil, water, and air contaminants, and archaeological and historical resources would be managed to comply with all applicable laws, regulations, and policies. All alternatives are subject to all applicable future permit requirements. Individual projects may require additional consultation with the Service's Regional Archaeologist and the State of South Carolina Historic Preservation Office. Additional consultation, surveys, and clearance may be required where project development would be conducted on the refuge or when activities would affect properties eligible for the National Historic Register.

Other common features of the alternatives include:

- Wildlife First – Each was developed with the Service mandate to focus on the core needs of the fish and wildlife that the refuge was formed to protect and enhance.
- RCW Recovery – Each would provide for 100 percent monitoring of RCW clusters.

## DESCRIPTION OF ALTERNATIVES

Serving as a basis for each alternative, goals were developed to help achieve the refuge's purposes and vision and the mission of the Refuge System. Each alternative represents a different set of objectives. Objectives are desired conditions or outcomes that are grouped into sets and, for this planning effort, consolidated under three alternatives. These alternatives represent different management approaches for managing the refuge over a 15-year time frame while still meeting the refuge purposes and goals. Three alternatives were developed and analyzed, including the no action and proposed action alternatives. Alternative A continues current management similar to recent activities and levels on the refuge. Alternative B focuses refuge management actions on maintaining

and enhancing wildlife and habitat diversity. Alternative C, the proposed action, focuses management actions on optimizing ecosystem goals while enhancing visitor services. The three alternatives are described below. A comparison of each alternative follows the general description.

*ALTERNATIVE A - (CURRENT MANAGEMENT - NO ACTION) LONGLEAF PINE FOREST/WILDLIFE MANAGEMENT WITH RCW FOCUS AND VISITOR SERVICES*

This is the "status quo" alternative. Under this alternative, no new actions would be taken. The refuge would continue its management activities and programs at levels similar to those that have been taken during the recent past, as summarized below.

**Wildlife and Habitat Management**

Regarding threatened, endangered, and imperiled species, the Service would maintain its focus on RCW monitoring and recovery, while managing for a suite of species. The Service would continue to maintain and improve habitat required for RCWs by conducting even-aged silviculture on approximately 15,000 acres of pine plantations and by beginning to transition to multi-age management. The Service would increase growing season burning by prescribed burning 10,000-20,000 acres annually and continuing to use mechanical and chemical treatments to confine turkey oaks to understory stratum. Actions would include monitoring all RCW clusters and nests and raking all RCW trees in units planned for prescribed burning. Banding of chicks, group composition checks, and other surveys would be limited.

Regarding managing for a suite of species, the Service would continue to provide secure winter roosting sites for bald eagles, to manage grasslands for birds of conservation concern, and to opportunistically manage and restore seepage bogs, Atlantic white cedar, and cane bottoms.

The Service would continue to monitor eagles, waterfowl, neotropical migratory birds, game species, and other wildlife with the Christmas bird counts and other surveys; maintain a nest box program of 40-50 wood duck boxes, and manage several ponds annually through drawdown to encourage growth of emergent and shrub vegetation; conduct occasional later summer draw downs for fall migration of shorebirds, and manage and restore wetland communities using current programs of water level manipulation and prescribed burning.

The Service would continue to manage for native plants by documenting locations, maintaining plant lists, conducting sporadic Atlantic white cedar restoration, and removal of non-native plants; restore natural condition/composition of the Oxpen Farm Unit by utilizing prescribed fire, disking, and mowing to manage grasslands; continue to manage both native and non-native species on an "as needed" basis.

The Service would continue to manage non-native bamboo by establishing its current boundary with GPS units and periodically checking to ensure it remains confined; establish a native seed nursery for native warm season grass restoration and demonstration efforts; continue to grow non-native perennial legumes through cooperative farming agreements and provide wildlife openings, including 100 acres of dove fields, annual warm season crops, and annual cool season crops. There would be no actions focused on marsh and water birds, raptors, or Pine Barrens tree frogs.

**Visitor Services**

Visitor services would continue at levels similar to past management activities. Visitors would be welcomed and oriented with the current Visitor Center displays, a kiosk and brochure rack; the three kiosks throughout the refuge; and occasional interpretive wayside exhibits and brochure racks available at the Office, Visitor Drive, and Lake Bee. The Service would update its web site 3-4 times per year.

The Service would continue to provide current quality hunting and fishing opportunities. Hunting would continue to include deer, quail, rabbit, raccoon, and turkey. Deer hunting would include archery, muzzleloader, modern gun, and youth hunts. Coyote hunting would not be allowed. The Service would continue to allow fishing in most pools and some pools would be occasionally stocked. Martin's Lake would be seasonally open for fishing.

Wildlife observation and photography would continue to be supported with the current facilities, including 4 trails; 2 observation towers (1 interpreted); and 1 photo blind.

The Service would continue to provide quality environmental education programs to 3rd-5th grade classes and other groups as requested. Current numbers are about 200 students/year with few volunteers to assist. The Service would continue to interpret key resources and issues by providing information and programs as requested if time permits; and continue to provide opportunities for appropriate, compatible public uses as requested without advertising their availability.

The Service would continue to provide information and programs as requested if time permits and to work with volunteers, friends groups, and partners, such as SCDNR, South Carolina Forest Commission, Cheraw State Park, Cheraw Fish Hatchery, and The Nature Conservancy. The Service would continue to work with private landowners near the refuge to promote refuge goals and objectives.

**Resource Protection**

The Service would continue to maintain 20 percent of refuge boundary annually by painting boundary and posting/replacing signs and would inspect one-third of the 10 easements each year; consider purchase of inholdings (properties within the acquisition boundary) from willing sellers as they become available; continue to conduct "Level I" type information/activities as needed for projects to protect archaeological and historical resources on the refuge; continue to provide one shared full-time officer and one dual-function officer to patrol the refuge and provide visitor protection; and, continue to assist U.S. Geological Survey and SCDNR in water quantity study in Chesterfield County and to assist with air quality monitoring.

**Refuge Administration**

The Service would continue to maintain current facilities and equipment and to manage refuge programs with 10 full-time employees and a cadre of seasonal fire crew and student employees. This staffing level places significant constraints on enhancing multi-aged forest habitat, environmental education and interpretation activities, and law enforcement capability.

*ALTERNATIVE B - MAXIMIZING NATIVE WILDLIFE AND HABITAT DIVERSITY WHILE PROVIDING VISITOR SERVICES*

Alternative B would focus refuge management on maximizing native wildlife and habitat diversity while providing approximately the current level of visitor services. In general, Alternative B includes all the actions in Alternative A (no action), with additional actions to enhance wildlife and habitat. The following discussion will focus on the differences between Alternatives A and B.

**Wildlife and Habitat Management**

Regarding threatened, endangered, and imperiled species, the Service would continue its focus on RCW monitoring and recovery, while managing for a suite of species; enhance habitat required for RCWs by accelerating the transition to multi-aged forest management. After proper planning and peer review, the Service would begin using uneven management strategies throughout 38,000 acres of pinelands to improve forest structure and composition, focusing on diversifying plantation structure to create multiple-aged classes and densities of overstory pines while improving ground layer structure and composition; increase growing season burning; consider use of fall burning for hazardous fuel reduction and seed bed preparation in advance of cone crop drop.

The monitoring of RCW clusters and nests would be unchanged, but the banding of chicks and group comp checks would increase to 100 percent. The Service would work to increase partnership activities with SCDNR, Cheraw State Park, and Sandhills State Forest to manage RCW as one recovery population. The Service would upgrade its mapping system from Autocad to a geographic information system (GIS) and integrate forestry/biological (native plants, threatened and endangered species, etc.) and fire plans into that GIS.

The Service would enhance the management of the unique floristic communities on the refuge, including seepage bogs, Atlantic white cedar and cane bottoms, and old field species at Oxpen Farm. The Service would develop and implement habitat management response surveys to identify species response to treatments in longleaf pine and restoration in pocosin habitat sites.

Regarding managing for a suite of species, the Service would continue the current wildlife and habitat management activities, and would add the following actions: enhance management of the impoundments and wetlands on the refuge to better provide for wildlife and those habitats; manage remaining pools and lakes to provide seasonal waterfowl and shorebird habitat annually and to control undesirable submerged aquatic vegetation; implement moist-soil management at Martin's, 12, Holdover, D and H (other pools as needed for vegetation control) and restore natural stream drainage/function in F, Oxpen 2, Hamburg, Middle and Upper Triple; establish and expand rare and sensitive plant communities by surveying upland "bean dips" and other seepage areas and managing seepage slopes; conduct a baseline population survey of Pine Barrens tree frogs in appropriate habitat (seeps), coordinate with SCDNR, and conduct surveys to assess effects of habitat management; and, monitor populations of threatened and endangered species and state special concern species to discern population trends and effects of habitat management; and participate in SC PARC/SE PARC Initiatives.

The Service would manage 1,200 acres of grasslands for birds of conservation concern, conduct baseline population surveys of grassland birds, and survey to assess effects of habitat management. As part of the grassland management and restoration, the Service would restore longleaf-wiregrass and native grasslands, establish native warm season grasses demonstration areas, and eradicate non-native plants (fescue, love grass, and bamboo). The Service would also establish a native seed nursery/orchard for native warm season grasses and native ground

cover and would engage in native plant botanical research. The Service would phase out shrub lespedeza and replace with native warm season grasses; no annual row crops or cooperative farming of non-native species would occur.

**Visitor Services**

All visitor services activities, except for hunting and fishing, would be unchanged from Alternative A. In order to maximize native wildlife and habitat diversity, the Service would slightly reduce support for hunting and fishing activities. These changes would include:

- Reducing deer archery hunting from 3 weeks per year to 1 week per year
- Reducing deer modern gun hunting from 6 days per year to 4 days per year
- Eliminating quail season
- Reducing rabbit hunting from 3 days/week in January to 2 days/week
- Changing turkey hunts to mornings only on the same 6 days in April
- No stocking or pond management beyond water level management
- Not opening Martin's seasonally for fishing

**Resource Protection**

The Service would maintain the refuge boundaries as in Alternative A. The Service would target any land acquisitions to those that will maximize opportunities for management of trust species and species with special designations (threatened and endangered species, candidate, rare). The Service would also begin to locate and evaluate important gaps and corridors and work with partners to protect important habitats and connections serving trust species and species with special designations. The Service would increase easements inspections so that all would be inspected annually, and would develop management plans for each easement to meet wildlife diversity goals.

The Service would increase the protection of archaeological and historical resources on the refuge by conducting "Level II" investigations as needed.

The Service would increase refuge and visitor protection by dedicating the full-time officer to Carolina Sandhills NWR and by adding a second dual-function officer.

The Service would increase cooperation with state and federal agencies to institute a structured monitoring program, determine sources, and investigate means to reduce impacts from any contaminants. The Service would add additional wells and monitoring stations to key locations throughout the refuge to determine effects of water withdrawals on refuge resources and expand monitoring to include a water quality study.

**Refuge Administration**

The Service would continue to maintain current facilities and equipment as in Alternative A. However, the Service would minimize heavy equipment use to prevent soil disturbance and discontinue use of roller choppers. The Service would increase staff from 10 to 17 and utilize a cadre of career seasonal, temporary, and student employees.

*ALTERNATIVE C - (PROPOSED ALTERNATIVE) OPTIMIZING ECOSYSTEM MANAGEMENT WITH ENHANCED VISITOR SERVICES.*

Alternative C reflects optimizing refuge operations by balancing enhanced habitat and fish and wildlife population management and enhanced wildlife-dependent public use management. This adaptive management alternative includes implementation of selected actions from Alternative B, while enhancing visitor services to achieve greater benefits to the refuge and surrounding area. For example, the baseline biological information described under Alternative B would be useful in identifying opportunities to improve visitor experiences. As with the discussion for Alternative B, the following discussion will focus on the differences from the current operations, Alternative A.

**Wildlife and Habitat Management**

Regarding threatened, endangered, and imperiled species, the Service would continue its focus on RCW monitoring and recovery, while managing for a suite of species; enhance habitat required for RCWs by accelerating the transition to multi-aged management; after proper planning and peer review, employ uneven-aged management strategies throughout 38,000 acres of pinelands to improve forest structure and composition, focusing on diversifying plantation structure to create multiple-aged classes and densities of overstory pines, while improving ground layer structure and composition; use all available tools to control midstory: chemical, mechanical, and precommercial, which would be a combination of Alternatives A and B; increase growing season burning; consider use of fall burning for hazardous fuel reduction and seed bed preparation in advance of cone crop drop; protect active RCW trees by raking prior to prescribed fire operations and monitor all RCW trees and relic longleaf pine during prescribed fire operations, taking appropriate action if safe and feasible.

The monitoring of RCW clusters would be unchanged; however, nest monitoring (core population) would be reduced to 50 percent instead of 100 percent. The Service would increase partnership activities with SCDNR, Cheraw State Park, and Sandhills State Forest to manage RCWs as one recovery population. The Service would also be a donor population for populations within Georgia, South Carolina, and North Carolina and participate in the Southern Range Translocation Team. As needed, the Service would upgrade its mapping system from Autocad to a geographic information system (GIS) and integrate forestry/biological (native plants, threatened and endangered species, etc.) and fire plans into that GIS.

The Service would enhance the management of the unique floristic communities on the refuge including seepage bogs, Atlantic white cear and cane bottoms, and old field species at Oxpen Farm. The Service would develop and implement habitat management response surveys to identify species response to treatments in longleaf pine and restoration in pocosin habitat sites.

Regarding managing for a suite of species, the Service would continue the current wildlife and habitat management activities, such as using water-level manipulation to manage and restore wetland communities, as in Alternative A. The Service would add dedicated annual later summer draw downs in at least two ponds for shorebirds.

The Service would establish and expand rare and sensitive plant communities by surveying upland “bean dips” and other seepage areas and managing seepage slopes. The Service would conduct a baseline population survey of Pine Barrens tree frogs in appropriate habitat (seeps) and coordinate with SCDNR and conduct surveys to assess effects of habitat management. The Service would monitor populations of threatened and endangered species and state special concern species to discern population trends and effects of habitat management, and participate in SC PARC/SE PARC initiatives.

The Service would manage 1,200 acres of grasslands for birds of conservation concern, conduct baseline population surveys of grassland birds, and survey to assess effects of habitat management. As part of the grassland management and restoration, the Service would restore longleaf-wiregrass and native grasslands, establish native warm season grass demonstration areas, and eradicate non-native plants (fescue, love grass, and bamboo). The Service would also establish a native seed nursery/orchard for native warm season grass and native ground cover and engage in native plant botanical research.

The Service would continue to manage 100 acres as dove fields and allow annual cool season crops. The Service would also work with cooperative farmers to begin growing native warm season grass as a seed source or biofuel production.

**Visitor Services**

Most visitor services activities would be enhanced from Alternative A. The Service would add interpretation for the Wildlife Drive with wayside exhibits and demonstration signage and update website monthly. Hunting and fishing would be enhanced by:

- Establishing blinds in Oxpen for the deer youth hunt
- Adding days and locations as popularity of hunt increases
- Designating 2 days per week for quail during state season instead of current 1 day per week
- Adding 10 days in December to the current 10 days in February for raccoons
- Designating youth units in “closed area” along Wildlife Drive
- Allowing incidental take for coyotes with deer hunts instead of “none”
- Selecting 5 to 6 primary ponds and lakes (e.g., Martin’s Lake, May’s Lake, Lake Bee) to provide recreational fishing opportunities and stocking as needed with native fishes
- Evaluating whether to implement 2004 Fish Survey Report management recommendations

The Service would enhance wildlife observation and photography by providing two additional trails to the photo blind and the seep with better interpretation, adding interpretation to second observation tower, and adding a second photo blind. A seasonal viewing blind would be established in active RCW clusters along the wildlife drive during the nesting season.

The Service would enhance the environmental education program by development of a comprehensive program to be implemented by volunteers and funded by grants. This program would invite a 3rd, 4th, or 5th grade from each elementary school in Chesterfield and Darlington Counties to visit the refuge at least once to engage in on-site learning on curricula involving ecosystems, prescribed burning, weather, forestry, and wildlife management.

The Service would enhance its interpretation of key resources and issues by providing outreach and education materials in a prepared, consistent format and by providing opportunities to interested public groups and media about RCW management and habitat.

The Service would enhance its appropriate recreational uses (e.g., biking, picnicking) by developing a “Let’s Go Outside” brochure, highlighting appropriate recreational uses and encouraging families to use the refuge and pursue outdoor recreational opportunities.

The Service would enhance its communication about key issues with off-site audiences by hosting an annual public lands and private landowner demonstration day to showcase the restoration and management practices on Carolina Sandhills NWR.

The Service would enhance its volunteer program and partnerships with friends groups and other local, state, and regional partners to further information and technology exchange. The Service would search for opportunities to enter into cooperative wildlife management agreements with private landowners in PFW focus areas.

**Resource Protection**

The Service would maintain the refuge boundaries as in Alternative A. The Service would target any land acquisitions to those that would maximize ecosystem management objectives (e.g.; longleaf pine, prescribed fire, trust species, and species with special designations) and opportunities for public use and education. The Service would also begin to locate and evaluate important gaps and corridors and work with partners to protect important habitats and connections serving trust species and species with special designations. The Service would increase easements inspections so that all would be inspected annually and two easements annually would receive refreshed boundary signs and boundary paint.

The Service would increase the protection of archaeological and historical resources on the refuge by conducting “Level II” investigations as needed.

As in Alternative B, the Service would increase refuge and visitor protection by dedicating the full-time officer to Carolina Sandhills NWR and by adding a second dual function officer.

The Service would increase cooperation with state and federal agencies to institute a structured monitoring program, determine sources, and investigate means to reduce impacts from any contaminants. The Service would add additional wells and monitoring stations to key locations throughout the refuge to determine effects of water withdrawals on refuge resources and expand monitoring to include a water quality study.

**Refuge Administration**

The Service would add facilities recommended in the Visitor Services Review to enhance recreational and educational programs and opportunities. The Service would add equipment to the fleet for producing and harvesting native warm season grass seed; and employ all methods of mechanical control including hydro-axing and roller chopping. The Service would increase staff from 10 to 17 and utilize a cadre of career seasonal, temporary, and student employees.

## COMPARISON OF THE ALTERNATIVES BY ISSUE

Alternative A (No Action) and C (Proposed Action) are not greatly different (there are nuances that differentiate the two). The primary change would be a progressive shift to uneven-aged forest management and enhancements in the wildlife objectives. The other largest change would be enhanced visitor services to build increased community (local and far away) knowledge and experience of the refuge (purposes, benefits), with a focus on involving more youth in outdoor activities. Currently, hunting is 85 percent of visitor services, but the number of hunters has been declining. A summary of the three alternatives is provided in Table 11.

**Table 11. Comparison of alternatives by management issues for Carolina Sandhills NWR**

| **ISSUES** | **** Wildlife First is presumed for each alternative**** | **Alternative A (No Action)** (E) Longleaf Pine Forest/Wildlife Management with RCW Focus and Visitor Services | **Alternative B** (C) Maximize Native Wildlife and Habitat Diversity while providing Visitor Services | **Alternative C (Proposed Action)** (H) Optimize Ecosystem Management with Enhanced Visitor Services |
|---|---|---|---|---|
| **Biological** | **RCW Monitoring and Recovery** | 100% monitoring RCW clusters. | Same as Alt. A. | Same as Alt. A. |
| | | 100% nest monitoring. | Same as Alt. A. | 50% nest monitoring (core population). |
| | | 80+% banding of chicks. | 100% banding of core population. | Same as Alt. B. |
| | | 25% group comp checks. | 100% group comp of core population. | Same as Alt. B. |
| | | Be donor population for other RCW populations in Southern Range Translocation Coop. | Same as Alt. A. | Be a donor population for populations within GA, SC, and NC and participate in the Southern Range Translocation Team. |
| | | Limited cooperation with partners. | Work with SCDNR, Cheraw State Park and Sandhills State Forest to manage RCW as one recovery population. | Same as Alt. B. |
| | | Continue use of Autocad mapping program. | Locate and catalog all cavity trees and integrate into GIS. | Same as Alt. B. |
| | | Protect by raking 100% of all RCW trees (Act, IA, Dead) in units planned for prescribed burning. | Protect by raking 100% of all RCW trees and relic longleaf pine in all units planned for prescribed burning. | Protect active RCW trees by raking. Monitor all RCW trees and relic longleaf pine during prescribed fire operations, taking appropriate action when safe and feasible. |

| ISSUES | **** Wildlife First is presumed for each alternative**** | **Alternative A (No Action)** (E) Longleaf Pine Forest/Wildlife Management with RCW Focus and Visitor Services | **Alternative B** (C) Maximize Native Wildlife and Habitat Diversity while providing Visitor Services | **Alternative C (Proposed Action)** (H) Optimize Ecosystem Management with Enhanced Visitor Services |
|---|---|---|---|---|
| **Biological, Cont.** | | Survey 4 compartments annually to inventory RCW trees. | Same as Alt. A. | Survey 50% of clusters annually to inventory RCW trees and provide for 4 RCW trees/clusters. |
| | **Manage for suite of species** | | | |
| | Eagles | Midwinter survey. | Same as Alt. A. | Same as Alt. A. |
| | Waterfowl<br><br>- Wood Ducks | Wintering waterfowl population surveys<br>-maintain a nest box program of 40-50 wood duck boxes.<br>-manage several ponds annually through drawdown to encourage growth of emergent and shrub vegetation. | Same as Alt. A plus:<br>-manage Martin's Lake and associated open fields to support 200-500 SJBG and 100-500 ducks annually.<br>-complete periodic submerged vegetation. surveys for the larger ponds to evaluate management actions and timing of drawdowns.<br>-manage remaining pools and lakes to provide seasonal waterfowl habitat annually and to control undesirable. submerged aquatic vegetation.<br>-maintain open water to vegetation. Ratios: (50-70% vegetation, 30-50% open water) in ponds to provide optimal wood duck brood habitat. | Same as Alternative A and B but no surveys. |
| | Neotropical Migratory Birds | Breeding bird survey, Christmas bird count, Southeastern Nightjar survey. | Same as Alt. A, plus baseline population surveys of Bachman's Sparrow, Henslow's Sparrows, and | Same as Alt. B |

| ISSUES | **** Wildlife First is presumed for each alternative**** | **Alternative A (No Action)** (E) Longleaf Pine Forest/Wildlife Management with RCW Focus and Visitor Services | **Alternative B** (C) Maximize Native Wildlife and Habitat Diversity while providing Visitor Services | **Alternative C (Proposed Action)** (H) Optimize Ecosystem Management with Enhanced Visitor Services |
|---|---|---|---|---|
| **Biological, Cont.** | | | other grassland birds; conduct surveys to assess effects of habitat management | |
| | Marsh and Water Birds | None. | Survey Pool K annually, document rookery success. | Survey Pool K annually, document rookery success. |
| | Shorebirds | Occasional later summer draw downs for fall migration of shorebirds. | Institute shorebird surveys in moist-soil units; manage remaining pools and lakes to provide seasonal shorebird habitat annually. | Institute shorebird surveys in moist-soil units. Dedicated annual later summer draw downs in at least two ponds. |
| | Raptors | None. | Institute a Hawk Watch Program run by Volunteers. | Same as Alt. B. |
| | Game Species | Deer-herd health check every 5 years; quail-whistling cock survey; mourning dove call counts; conduct annual mourning dove banding operations to help meet state goal. | Same as Alt. A, plus: Covey count. | Same as Alt. B. |
| | Other wildlife | Furbearers-survey; fox squirrels-sighting survey. | Same as Alt. A, plus build GIS database of sightings/signs and develop population study/index (refer to CSNWR Trapping Plan, July 2000). -annually monitor for wildlife disease or disease outbreaks on the refuge. | Same as Alt. B. |
| | Pine Barrens tree frogs | None. | Baseline population survey in appropriate habitat (seeps); coordinate with SCDNR and conduct surveys to assess | Same as Alt. B. |

| ISSUES | **** Wildlife First is presumed for each alternative**** | **Alternative A (No Action)** (E) Longleaf Pine Forest/Wildlife Management with RCW Focus and Visitor Services | **Alternative B** (C) Maximize Native Wildlife and Habitat Diversity while providing Visitor Services | **Alternative C (Proposed Action)** (H) Optimize Ecosystem Management with Enhanced Visitor Services |
|---|---|---|---|---|
| | | | effects of habitat management. | |
| **Biological, Cont.** | Other Threatened and Endangered (T&E) | None. | Monitor population of T&E and State Special Concern species sufficient to discern population trends and effects of habitat management.<br>Participate in SC PARC/SE PARC Initiatives | Same as Alt. B. |
| | Native plants | Document locations, maintain plant list, sporadic Atlantic white cedar (AWC) restoration, systematic removal of offsite pine, sporadic removal of non-native plants. | Same as Alt. A, plus create GIS layer(s), engage in botanical research, AWC restoration plan, restoration of longleaf-wiregrass, systematic removal of love grass, restoration of native grasslands. | Same as Alt. B. |
| | Continue Management/Restoration of Ecosystem | Manage, protect, enhance, and or restore longleaf pine in uplands. Opportunistically manage and restore seepage bogs, AWC, and cane bottoms. | Manage, protect, enhance, and/or restore the unique floristic communities on the refuge including seepage bogs, AWC, and cane bottoms -establish old field species at Oxpen Farm. | Same as Alt. B. |
| **Habitat** | Achieve desired future conditions and essential biological legacies | Maintain and improve habitat required for RCW population. Continue to provide secure winter roosting sites for bald eagles. | Same as Alt. A, plus develop and implement habitat management. Conduct surveys to identify species response to treatments in longleaf pine and restoration in pocosin habitat sites. | Same as Alt. B. |

| ISSUES | **** Wildlife First is presumed for each alternative**** | **Alternative A (No Action)** (E) Longleaf Pine Forest/Wildlife Management with RCW Focus and Visitor Services | **Alternative B** (C) Maximize Native Wildlife and Habitat Diversity while providing Visitor Services | **Alternative C (Proposed Action)** (H) Optimize Ecosystem Management with Enhanced Visitor Services |
|---|---|---|---|---|
| **Habitat, Cont.** | Manage grasslands for birds of conservation concern. | Periodic plantings and management to control invasive woody vegetation and keep field in grass stage. | Manage 1,200 acres<br>-establish native warm season grass demonstration areas.<br>-evaluate current field (managed openings) program to incorporate appropriate native warm season grass restoration and management.<br>-eradicate non-native grasses (fescue and love grass) from fields, trails, and road edges, and restore to wiregrass, native warm season grass or native vegetation.<br>-establish a disking regime in November and February to promote growth of native grasses and legumes.<br>-restore native warm season grasses and forbs on larger openings; Martins Lake and Oxpen (upland soils, not seepage bog). | Same as Alt. B. |
| | Accelerate transition of even-aged management to multi-aged management to reduce overstocking of pine overstory and increase light to forest floor. | Conduct even-aged silviculture on approximately 15,000 acres of pine plantations to manage/restore longleaf pine ecosystem. | After proper planning and peer review, begin using uneven-aged management strategies throughout 38,000 acres of pinelands to improve forest structure and composition, concentrate in diversifying plantation structure to create multiple age classes and densities of overstory pines while improving ground layer | Same as Alt. B. |

| ISSUES | **** Wildlife First is presumed for each alternative**** | **Alternative A (No Action)** (E) Longleaf Pine Forest/Wildlife Management with RCW Focus and Visitor Services | **Alternative B** (C) Maximize Native Wildlife and Habitat Diversity while providing Visitor Services | **Alternative C (Proposed Action)** (H) Optimize Ecosystem Management with Enhanced Visitor Services |
|---|---|---|---|---|
| **Habitat, Cont.** | | | structure and composition, integrate Forestry/Biological and Fire GIS | |
| | Increase growing season burning. | Prescribed burn 10,000-20,000 acres annually. | Prescribe burn 10,000-20,000 acres annually, shifting to growing season more each year, burn grasslands and seeps annually.<br>Consider use of fall burning for hazardous fuel reduction and seed bed preparation in advance of cone crop drop. | Same as Alt. B. |
| | Use mechanical and chemical treatments to confine turkey oaks to understory stratum. | -Occasional use of herbicides to treat oak encroachment.<br>-Roller chopping and hydro-axing of midstory oaks. | -Precommercial thinnings to improve habitat structure<br>-Hydro-axing to remove midstory oaks | -Combination of Alt. A and B (use all available tools to control midstory: chemical, mechanical and pre-commercial) |
| | Restore natural condition/composition of Oxpen Farm Unit | -Use prescribed fire, disking, and mowing to manage grasslands with occasional outcroppings of mast producing trees;<br>-manage both native and non-native species on an “as needed” basis | -Use prescribed fire, disking, and mowing to manage grasslands with occasional outcroppings of mast producing trees<br>-Establish native species seed orchard<br>-establish native ground cover restoration demonstration<br>-control weeping love grass throughout at Oxpen Farm | Same as Alt. B |

| ISSUES | **** Wildlife First is presumed for each alternative**** | **Alternative A (No Action)** (E) Longleaf Pine Forest/Wildlife Management with RCW Focus and Visitor Services | **Alternative B** (C) Maximize Native Wildlife and Habitat Diversity while providing Visitor Services | **Alternative C (Proposed Action)** (H) Optimize Ecosystem Management with Enhanced Visitor Services |
|---|---|---|---|---|
| **Habitat, Cont.** | Manage non-native bamboo | GPS boundary and periodically check to ensure it remains confined. | Remove bamboo and develop follow-up treatments. | Same as Alt. B. |
| | Manage and restore wetland communities using water level manipulation | Moist-soil management of Martin's, 12, Holdover, D & H (other pools as needed for Vegetation control)<br>-Seeps management=burn 1-3 years<br>-Pools=status quo A, B, C, E, F, G, J, K, L, Twin Lakes, Triple Lakes, 16, 17, Oxpen 1, 2, 3, Honkers, Mays, Beaver, McLeod's, Lake Bee | Moist-soil management Martin's, 12, Holdover, D & H (other pools as needed for Vegetation control)<br>-Seeps management=burn annually<br>-Pools=status quo A, B, C, E, G, K, L, Lower Triple, 16, 17, Oxpen 3, Beaver, McLeod's<br>-restore natural stream drainage/function in F, Oxpen 2, Hamburg, Middle and Upper Triple. | Same as Alt. A. |
| | Establish and expand rare and sensitive plant communities. | Manage seepage slope. | Alternative A plus Inventory upland "bean dips" and other seepage areas that may occur on the refuge. | Same as Alt. B. |
| | Establish native seed nursery for native warm season grass restoration/demonstration | Non-native perennial legumes (cooperative farmer). | Phase out shrub lespedeza and replace with native warm season grasses and maintain through disking, burning, and mowing. No annual row crops or cooperative farming will occur. | Same as Alt. B, plus Biofuel (coop farmer) or native warm season grass as a seed source |
| | Wildlife Openings | -100 acres Dove fields<br>-Annual warm season crops<br>-Annual cool season crops | -Establish native warm season grass on 1,200 acres and maintain through disking, burning, and mowing.<br>-No annual row crops | -100 acres managed dove fields<br>-Perennial grasses/legumes<br>-Annual cool season crops |

| ISSUES | **** Wildlife First is presumed for each alternative**** | **Alternative A (No Action)** (E) Longleaf Pine Forest/Wildlife Management with RCW Focus and Visitor Services | **Alternative B** (C) Maximize Native Wildlife and Habitat Diversity while providing Visitor Services | **Alternative C (Proposed Action)** (H) Optimize Ecosystem Management with Enhanced Visitor Services |
|---|---|---|---|---|
| | | | | -Cooperative farming to include native warm season grass as a seed source or biofuel production. |
| **Visitor Services** | Welcome and Orient Visitors | Visitor Center Displays, Kiosk and brochure rack<br>-Three kiosks throughout refuge.<br>-Occasional interpretive wayside exhibits and brochure racks available at Office, Visitor Drive, and Lake Bee.<br>-Web Site updated 3-4 times annually. | Same as Alt. A | Same as Alt. A plus:<br>-Interpret Wildlife Drive with Wayside exhibits and demonstration signage.<br>-Update website monthly and include refuge happenings article. |
| | Quality Hunting and Fishing | Deer archery 3 – weeks<br>Deer muzzleloader=4 days<br>Deer modern gun=6 days<br>Deer youth=1 day<br><br>Quail=Wednesday and Friday of state season<br><br>Rabbit=Tuesday, Thursday, and Saturday in January<br><br>Raccoon=10 days in February<br><br>Turkey=6 days April | Deer archery – 1 week<br>Deer muzzleloader=4 days<br>Deer modern gun=4 days<br>Deer youth=1 day<br><br>Eliminate quail season<br><br>Rabbit – Tuesday/Thursday in January<br><br>Raccoon season – same | Deer archery – 3 weeks<br>Deer muzzleloader=4 days<br>Deer modern gun=6 days<br>Deer youth=1 day with established blinds in Oxpen; conduct draw hunt. Add additional days and locations as popularity of hunt increases<br><br>Quail= Fridays during state season<br><br>Rabbit=Tuesday, Thursday, and Saturday in January<br><br>Raccoon=10 days in December and February |

| ISSUES | **** Wildlife First is presumed for each alternative**** | **Alternative A (No Action)** (E) Longleaf Pine Forest/Wildlife Management with RCW Focus and Visitor Services | **Alternative B** (C) Maximize Native Wildlife and Habitat Diversity while providing Visitor Services | **Alternative C (Proposed Action)** (H) Optimize Ecosystem Management with Enhanced Visitor Services |
|---|---|---|---|---|
| **Visitor Services, Cont.** | | Youth turkey=1 day March<br><br>Coyote=none<br><br>Allow fishing in most pools, some occasionally stocked<br><br>Martin's seasonally open for fishing | Turkey – 6 days, mornings only<br>Youth turkey – 1 day<br><br>Coyote – none<br><br>Permit fishing; no stocking or pond management beyond water level management<br><br>Do not open Martin's seasonally for fishing | Turkey=6 days April<br>Youth turkey=1 day March; establish youth units in "closed area" along Wildlife Drive and conduct draw for youth hunt.<br><br>Coyote=incidental to deer<br><br>-Select 5-6 primary ponds and lakes (e.g., Martin's Lake, May's Lake, Lake Bee) to provide recreational fishing opportunities and stock as needed with native fishes.<br>-Consider implementing 2004 Fish Survey Report management. recommendations<br>-Martin's seasonally open to fishing |
| | Quality Wildlife Observation and Photography | 4 trails<br>2 observation towers (1 interpreted)<br>1 photo blind | Same as Alt. A | 5 trails, better interpretation (new trail and Seep)<br>2 observation towers (both interpreted)<br>2 photo blinds |
| | Quality Environmental Education Program | 3rd-5th grades and other groups as requested.<br>About 200 students/year, few volunteers. | Same as Alt. A. | Comprehensive Environmental Education Program run by volunteers and funded by grants to invite a 3rd, 4th, or 5th grade from each elementary |

| ISSUES | **** Wildlife First is presumed for each alternative**** | **Alternative A (No Action)** (E) Longleaf Pine Forest/Wildlife Management with RCW Focus and Visitor Services | **Alternative B** (C) Maximize Native Wildlife and Habitat Diversity while providing Visitor Services | **Alternative C (Proposed Action)** (H) Optimize Ecosystem Management with Enhanced Visitor Services |
|---|---|---|---|---|
| **Visitor Services, Cont.** | | | | school in Chesterfield and Darlington Counties to visit the refuge at least once during a 3-year period to engage in on-site learning on curricula involving ecosystems, prescribed burning, weather, forestry, and wildlife management. |
| | Interpret key resources andissues | Provide information and programs as requested if time permits. | Same as Alt. A. | Provide outreach and education materials in a prepared, consistent format.<br>Provide opportunities to interested public groups and media about RCW management and habitat. |
| | Appropriate Recreational Uses (i.e., biking, picnicking) | Provide opportunities for appropriate, compatible public uses. Opportunities are permitted as requested and not advertised as available. | Same as Alt. A. | Develop “Let’s Go Outside” brochure to highlight appropriate recreational uses, such as bike riding and picnicking, to encourage families to use the refuge and pursue outdoor recreational opportunities. |
| | Communicate Key Issues w/ off-site audiences | Provide information and programs as requested if time permits. | Same as Alt. A. | Host annual public lands and private landowner demonstration day to showcase the restoration and management practices on the refuge. |

| ISSUES | **** Wildlife First is presumed for each alternative**** | **Alternative A (No Action)** (E) Longleaf Pine Forest/Wildlife Management with RCW Focus and Visitor Services | **Alternative B** (C) Maximize Native Wildlife and Habitat Diversity while providing Visitor Services | **Alternative C (Proposed Action)** (H) Optimize Ecosystem Management with Enhanced Visitor Services |
|---|---|---|---|---|
| | Build Volunteer Program and Partnerships with Friends Groups | -SCDNR, SCFC, Cheraw State Park, Cheraw Fish Hatchery, TNC, Friends.<br>-Work with private landowners near the refuge to promote refuge goals and objectives. | Same as Alt. A. | Same as Alt. A, plus:<br>-foster positive relationships with local, state, and regional partners to further information and technology exchange<br>-other land trusts?<br>-identify opportunities to enter into cooperative wildlife management agreements with private landowners in PFW focus areas.<br>-monitor Farm Service Agency easements. |
| **Land Protection** | Refuge Boundary | Maintain 20% of refuge boundary annually by painting boundary and posting/replacing signs. | Same as Alt. A. | Same as Alt. A. |
| | Land Acquisition | Consider purchase of inholdings (properties within the acquisition boundary) from willing sellers as they become available. | Same as Alt. A plus: target acquisitions to those that will maximize opportunities for management of trust species and species with special designations (threatened and endangered, candidate, rare) | Same as Alt. A plus: target acquisitions to those that will maximize ecosystem management objectives (longleaf pine, prescribed fire, trust species, and species with special designations), and opportunities for public use and education. |
| | Gaps/Corridors | None. | Locate and evaluate important gaps and corridors. Work with partners to protect important habitats and connections serving trust species and | Same as Alt. B. |

| ISSUES | **** Wildlife First is presumed for each alternative**** | **Alternative A (No Action)** (E) Longleaf Pine Forest/Wildlife Management with RCW Focus and Visitor Services | **Alternative B** (C) Maximize Native Wildlife and Habitat Diversity while providing Visitor Services | **Alternative C (Proposed Action)** (H) Optimize Ecosystem Management with Enhanced Visitor Services |
|---|---|---|---|---|
| | | | species with special designations. | |
| | Easements | 10 easements; one-third inspected annually. | All easements inspected annually. Two easements annually receive refreshed boundary signs and boundary paint. Management plans for each easement are developed and implemented to meet wildlife diversity goals. | All easements inspected annually. Two easements annually receive refreshed boundary signs and boundary paint. |
| **Cultural Resources** | Archeological and Historical Resources | "Level I" type information/activity as needed for projects. | "Level II" investigation. | Same as Alt. A. |
| **Law Enforcement** | Visitor Protection | One shared full-time officer and one dual function officer patrol refuge | One full time officer dedicated to Carolina Sandhills NWR plus two dual function officers patrol refuge | Same as Alt. B |
| **Resource Threats** | Contaminants | None | Cooperate with state and federal agencies to institute a structured monitoring program, determine sources, and investigate means to reduce impacts. | Same as Alt. B. |
| | Water Quantity | Assist USGS/DNR in water quantity study in Chesterfield County. | Same as Alt. A plus: add additional wells and monitoring stations to key locations throughout the refuge to determine effects of water withdrawals on refuge resources. | Same as Alt. B. |

| ISSUES | **** Wildlife First is presumed for each alternative**** | **Alternative A (No Action)** (E) Longleaf Pine Forest/Wildlife Management with RCW Focus and Visitor Services | **Alternative B** (C) Maximize Native Wildlife and Habitat Diversity while providing Visitor Services | **Alternative C (Proposed Action)** (H) Optimize Ecosystem Management with Enhanced Visitor Services |
|---|---|---|---|---|
| | Air and Water Quality | Assist SC DHEC with air quality monitoring. | Same as Alt. A plus: expand monitoring to include water quality study. | Same as Alt. B. |
| **Refuge Admin.** | Facilities | Maintain current facilities. | Same as Alt. A. | Add facilities recommended in Visitor Services Review to enhance recreational and educational programs and opportunities. |
| **Refuge Admin., Cont.** | Equipment | Maintain current equipment. | Same as Alt. A, except minimize heavy equipment use to prevent soil disturbance. Discontinue use of roller chopper. | Same As Alt. A plus: add equipment to the fleet for producing and harvesting native warm season grass seed; employ all methods of mechanical control including hydro-axing and roller chopping. |
| | Staff | Manage refuge programs with 10 full-time employees and a cadre of seasonal fire crew and student employees. | Manage refuge programs with 17 full-time employees and a cadre of career seasonal, temporary, and student employees. | Same as Alt. B. |

## ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER ANALYSIS

The alternatives development process under NEPA and the Improvement Act is designed to allow consideration of the widest possible range of issues and potential management approaches. During the alternatives development process, many different solutions were considered. The following alternative components were considered but not selected for detailed study in this Draft CCP/EA because they are not compatible with the refuge purpose and mission. These included suggestions for increasing acreages in traditional agricultural crops, allowing commercial pine straw raking, and more emphasis on game species such as deer, turkey, and quail, instead of threatened and endangered species such as the RCW.

# IV. Environmental Consequences

## OVERVIEW

This section analyzes and discusses the potential environmental effects or consequences that can be reasonably expected by the implementation of each of the three alternatives described in Chapter III of this EA. For each alternative, the expected outcomes are portrayed through the 15-year life of the CCP.

## EFFECTS COMMON TO ALL ALTERNATIVES

A few potential effects will be the same under each alternative and are summarized under seven categories: environmental justice, climate change, other management, land acquisition, cultural resources, refuge revenue-sharing, and other effects.

### *ENVIRONMENTAL JUSTICE*

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Population and Low-Income Population" was signed by President Clinton on February 11, 1994, to focus federal attention on the environmental and human health conditions of minority and low-income populations, with the goal of achieving environmental protection for all communities. The order directed federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. The order is also intended to promote nondiscrimination in federal programs substantially affecting human health and the environment, and to provide minority and low-income communities with access to public information and opportunities for participation in matters relating to human health or the environment.

None of the management alternatives described in this EA will disproportionately place any adverse environmental, economic, social, or health impacts on minority and low-income populations. Implementation of any action alternative that includes public use and environmental education is anticipated to provide a benefit to the residents residing in the surrounding communities.

### *CLIMATE CHANGE*

The U.S. Department of the Interior issued an order in January 2001, requiring federal agencies under its direction that have land management responsibilities to consider potential climate change impacts as part of long-range planning endeavors.

The increase of carbon within the Earth's atmosphere has been linked to the gradual rise in surface temperatures commonly referred to as global warning. In relation to comprehensive planning for national wildlife refuges, carbon sequestration constitutes the primary climate-related impact to be considered in planning. The U.S. Department of Energy's *Carbon Sequestration Research and Development* (U.S. Department of Energy 1999) defines carbon sequestration as "...the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere."

The land is a tremendous force in carbon sequestration. Terrestrial biomes of all sorts—grasslands, forests, wetlands, tundra, perpetual ice, and desert—are effective both in preventing carbon emissions and in acting as a biological "scrubber" of atmospheric carbon monoxide. The conclusions of the Department of Energy's report noted that ecosystem protection is important to carbon sequestration and may reduce or prevent the loss of carbon currently stored in the terrestrial biosphere.

Conserving natural habitat for wildlife is the heart of any long-range plan for national wildlife refuges. The actions proposed in this Draft CCP/EA would conserve or restore land and water, and would thus enhance carbon sequestration. This, in turn, contributes positively to efforts to mitigate human-induced global climate changes.

*OTHER MANAGEMENT*

All management activities that could affect the refuge's natural resources, including subsurface mineral reservations, utility lines and easements, soils, water and air, and historical and archaeological resources, would be managed to comply with all laws and regulations. In particular, any existing and future oil and gas exploration, extraction, and transport operations on the refuge would be managed identically under each of the alternatives. Thus, the impacts would be the same.

*LAND ACQUISITION*

Funding for land acquisition from willing sellers within the approved acquisition boundary of Carolina Sandhills NWR would come from the Land and Water Conservation Fund, the Migratory Bird Conservation Fund, Corps of Engineers mitigation programs, or donations from conservation and private organizations. Conservation easements and leases can be used to obtain the minimum interests necessary to satisfy refuge objectives if the refuge staff can adequately manage uses of the areas for the benefit of wildlife. The Service can negotiate management agreements with local, state, and federal agencies, and accept conservation easements. Some tracts within the refuge acquisition boundary may be owned by other public or private conservation organizations. The Service would work with interested organizations to identify additional areas needing protection and provide technical assistance if needed. The acquisition of private lands is entirely contingent on the landowners and their willingness to participate.

*CULTURAL RESOURCES*

All alternatives afford additional land protection and low levels of development, thereby producing little negative effect on the refuge's cultural and historic resources. Potentially negative effects could include logging, construction of new trails or facilities, and development of water impoundments. In most cases, these management actions would require review by the Service's Regional Archaeologist in consultation with the State of South Carolina's Historic Preservation Office, as mandated by Section 106 of the National Historic Preservation Act. Therefore, the determination of whether a particular action within an alternative has the potential to affect cultural resources is an on-going process that would occur during the planning stages of every project.

Service land acquisition with known or potential archaeological or historical sites provides two major types of protection for these resources: protection from damage by federal activity and protection from vandalism or theft. The National Historic Preservation Act requires that any actions by a Federal agency which may affect archaeological or historical resources be reviewed by the State Historic Preservation Office, and that the identified effects must be avoided or mitigated. The Service's policy is to preserve these cultural, historic, and archaeological resources in the public trust, and avoid any adverse effects wherever possible.

Land acquisition, within the current acquisition boundary, by the Service would provide some degree of protection to significant cultural and historic resources. If acquisition of private lands does not occur and these lands remain under private ownership, the landowner would be responsible for protecting and preserving cultural resources. Development of off-refuge lands has the potential to destroy archaeological artifacts and other historical resources, thereby decreasing opportunities for cultural resource interpretation and research.

*REFUGE REVENUE-SHARING*

Annual refuge revenue-sharing payments to Chesterfield and Marlboro Counties would continue at similar rates under each alternative. If lands are acquired and added to the refuge, the payments would increase accordingly.

*OTHER EFFECTS*

Each of the alternatives would have similar effects or minimal to negligible effects on soils, water quality and quantity, noise, transportation, human health and safety, children, hazardous materials, waste management, aesthetics and visual resources, and utilities and public services.

**SUMMARY OF EFFECTS BY ALTERNATIVE**

The following section describes the environmental consequences of adopting each refuge management alternative. Table 12 summarizes and addresses the likely outcomes for the specific issues, and is organized by categories similar to those in the Alternatives Table 11. In Table 12, Alternative A, the “no change” alternative, is normally considered as the status quo or “neutral” option. This does not mean that the current actions do not have positive effects, but that this alternative is the baseline against which the other two alternatives are compared.

Alternative A – Current Management (No Action), Longleaf Pine Forest/Wildlife Management with RCW Focus and Visitor Services

Implementing Alternative A, the No Action Alternative, would maintain the status quo and would have neutral to mildly beneficial impacts on the human environment, wildlife populations, and wildlife habitat. Maintaining only current funding and staffing would limit the refuge’s ability to significantly address issues identified by the planning team.

Implementation of Alternative A is anticipated to result in net positive environmental benefits.

The management activities outlined under Alternative A are anticipated to have net neutral to positive impacts on soils, and would help to improve air quality. Minor, short-term negative air quality impacts could be experienced during controlled burns or wildfires; however, these impacts would be offset by high quality native habitats that result from these treatments.

The management activities outlined under Alternative A are anticipated to have net neutral impacts on hydrology and water quality, and positive impacts to biological resources. Habitat management activities would result in quality habitats supporting native wildlife and habitat diversity.

<u>Wildlife and Habitat Management</u>
The refuge would continue to focus primarily on RCW monitoring and recovery while managing for a suite of other species, including migratory birds and other species of the longleaf pine/wiregrass ecosystem. The transitions to uneven-aged forests and native warm season grasslands would be

delayed or not occur. Other opportunities for managing habitat to protect and enhance federal-listed threatened and endangered species and state-listed species would not be evaluated. Also, because no comprehensive GIS inventory of refuge flora and fauna would exist, the refuge would not be as informed about levels of biodiversity and keystone species of various refuge ecosystems. There would be no documentation of baseline biological resource conditions, and therefore opportunity for an adaptive management strategy for refuge resources would be limited.

Resource Protection

The refuge would pursue opportunities to purchase or exchange only priority tracts within the refuge acquisition boundary, rather than all lands within the boundary, therefore limiting the acreage under refuge management.

Visitor Services

Current hunting and fishing opportunities would be continued, but the quality of those activities would not be enhanced through active management. Current wildlife observation and photography opportunities would exist, but no additional trails, improvements to observation towers, or wildlife viewing through management of vegetation along refuge roads would occur. The refuge would continue environmental education and interpretation activities only as permitted by workload; not adding a park ranger to the staff would negatively impact the refuge's ability to conduct more of these types of activities. Current volunteer activities would continue, but the effectiveness of activities would be negatively impacted because no formal plan would exist to identify volunteer jobs and recruit to fill them. Finally, there would be no change or improvements in existing visitor facilities or programs—hence refuge accessibility and visitor information access would be limited under this alternative.

Refuge Administration

The refuge would continue current staffing levels, which include a refuge manager, deputy refuge manager, administrative officer, wildlife biologist, lead biological technician, refuge forester, fire management officer, engineering equipment operator (fire), forestry technician (fire), and an engineering equipment operator. Without additional staff, such as a land management demonstration biologist/forest ecologist, park ranger, and a second law enforcement officer, some refuge activities are limited, as discussed in the sections above, and especially in the areas of forest/habitat management, environmental education and outreach, law enforcement capability, and baseline inventories of refuge biota.

Alternative B – Maximizing Native Wildlife and Habitat Diversity, While Providing Visitor Services

Implementing Alternative B would result in enhanced management of habitat and fish and wildlife populations, with little or no additional emphasis on management for wildlife-dependent public uses; however, it is anticipated to result in net positive environmental benefits.

The management activities outlined under Alternative B are anticipated to have net neutral to positive impacts on soils through habitat restoration and management activities.

The management activities outlined under Alternative B would help to improve air quality. Minor, short-term negative air quality impacts could be experienced during controlled burns or wildfires; however, these impacts are offset by high-quality native habitats that result from these short duration treatments.

The management activities outlined under Alternative B are anticipated to have net positive impacts to water quality and hydrology, and positive impacts to biological resources. Habitat management activities would result in high-quality habitats supporting increased numbers of migratory birds and native wildlife and wildlife diversity.

Wildlife and Habitat Management
Increasing involvement with partners to manage the RCW as one recovery population and integrate RCW data into a GIS system would improve RCW habitat and recovery. Additional actions to manage some pools for seasonal waterfowl would enhance aquatic habitats. Conducting surveys of migratory birds, shore birds, game species, and threatened and endangered species would provide information needed to provide for better management for all these species.

Transitioning to uneven-aged forest management, enhancing native warm season grass areas, and eradicating non-native species would return habitats to more historic conditions and improve overall habitat conditions for the species of concern.

Resource Protection
Additional law enforcement and "Level II" archaeological investigations would better protect refuge resources. Expanding water quality and quantity monitoring activities would ensure early detection of any potential negative issues. The refuge would pursue opportunities to purchase or exchange for all lands within the refuge acquisition boundary, thus maximizing the acreage under refuge management.

Visitor Services
Most current visitor services opportunities would continue as in Alternative A, the no action alternative (see discussion in the Alternative A section, above). There would be minor reductions in support for hunting and fishing.

Refuge Administration
An additional seven staff members would be added to the current staff, which would allow the refuge to perform the enhanced wildlife and habitat management activities described in the above sections. These positions would include a land-management demonstration/forest ecologist, biological and forestry technicians, a full-time law enforcement officer, an additional dual function officer, a GIS specialist, and a park ranger. Further, the refuge would actively seek additional cooperative opportunities with other agencies, groups, and individuals as staff availability would permit.

Alternative C – Optimize Ecosystem Management with Enhanced Visitor Services (Proposed Action)

Implementing Alternative C would balance fish and wildlife population and habitat concerns with wildlife-dependent public use needs, by focusing on enhancements in areas where linkages among all the concerns would result in greater benefits to the refuge and surrounding area.

Implementation of Alternative C is anticipated to result in net positive environmental benefits.

The management activities outlined under Alternative C are anticipated to have net positive impacts on soils and soil formation processes, hydrology and water quality, and would help to improve air quality. Minor, short-term negative air quality impacts could be experienced during controlled burns or wildfires; however, these impacts are offset by high-quality native habitats that result from these short-duration treatments. Net positive impacts to biological resources are anticipated due to habitat management activities that would result in high-quality habitats supporting native wildlife and wildlife diversity.

Wildlife and Habitat Management
The wildlife and habitat management actions in Alternative C are essentially the same as described above in Alternative B. There are minor adjustments to balance Alternatives A and B, such as using all available methods to control understory oaks, continuing 100 acres of managed dove fields, and continuing some cool season crops.

Resource Protection

Most of the resource protection actions in Alternative C are similar to those described above in Alternative B. Additional law enforcement and “Level II” archaeological investigations would better protect refuge resources. Expanding water quality and quantity monitoring activities would ensure early detection of any potential negative issues. The refuge would pursue opportunities to purchase or exchange for all lands within the refuge acquisition boundary, thus maximizing the acreage under refuge management.

Visitor Services

The visitor services actions in Alternative C would be significantly enhanced from Alternative A. There would be additional interpretive signage, additional hunting and fishing opportunities, two additional trails, and an additional blind. There would also be additional environmental education and outreach activities, which would enhance communication with off-site audiences and partnerships. Any environmental impacts from these actions should be minor and temporary and would be offset by increased support for the refuge mission and purposes.

Refuge Administration

An additional seven staff members would be added to the current staff, which would allow the refuge to perform the enhanced wildlife and habitat management activities described in the above sections. These positions would include a land-management demonstration/forest ecologist, biological and forestry technicians, a full-time law enforcement officer, an additional collateral duty officer, a GIS specialist, and a park ranger. Further, the refuge would actively seek additional cooperative opportunities with other agencies, groups, and individuals as staff availability would permit.

**Table 12. Summary of environmental effects by alternative, Carolina Sandhills NWR**

| Issues | Alternative A (Current Management – No Action Alternative) | Alternative B | Alternative C (Proposed Alternative) |
|---|---|---|---|
| **Wildlife and Habitat Management** | | | |
| **Red-cockaded Woodpecker, Monitoring and Recovery** | No Change – Neutral | Positive<br>Increased monitoring and enhanced habitat | Same as Alt. B. |
| **Eagles** | No Change – Neutral | Same as Alt. A. | Same as Alt. A. |
| **Waterfowl** | No Change – Neutral | Positive<br>Manage lakes for waterfowl | Same as Alt. A. |
| **Neotropical Migratory Birds** | No Change – Neutral | Neutral to Positive<br>Surveys will increase knowledge and would improve management | Same as Alt. B. |
| **Marsh and Water Birds** | No Change – Negative to Neutral<br>No Management | Neutral to Positive<br>Surveys will increase knowledge and would improve management | Same as Alt. B. |
| **Shorebirds** | No Change - Neutral | Positive<br>Surveys will increase knowledge and water management would increase habitat | Same as Alt. B. |
| **Raptors** | No Change - Negative to Neutral<br>No Management | Neutral to Positive<br>Hawk Watch will increase knowledge and would improve management | Same as Alt. B. |
| **Game Species** | No Change - Neutral | Slight Positive<br>Covey Count adds knowledge | Same as Alt. B. |

| Issues | Alternative A (Current Management – No Action Alternative) | Alternative B | Alternative C (Proposed Alternative) |
|---|---|---|---|
| **Other Wildlife** | No Change - Neutral | Positive<br>Monitoring for disease would reduce severity of outbreaks. GIS system would enhance management | Same as Alt. B. |
| **Pine Barrens Tree Frogs** | No Change - Negative to Neutral<br>No Management | Neutral to Positive<br>Surveys will increase knowledge and would improve management | Same as Alt. B. |
| **Other Threatened and Endangered Species** | No Change - Negative to Neutral<br>No Management | Neutral to Positive<br>Surveys will increase knowledge and would improve management | Same as Alt. B. |
| **Native Plants** | No Change - Neutral | Positive<br>Removal of love grass and restoration of native grasses, GIS would enhance management | Same as Alt. B. |
| **Continue Management/Restoration of Ecosystem** | No Change - Neutral | Positive<br>Management of seepage bogs, AWC, and cane bottoms | Same as Alt. B. |
| **Achieve desired future conditions and essential biological legacies** | No Change - Neutral | Positive<br>Habitat response surveys would aid adaptive management | Same as Alt. B. |
| **Manage grasslands for birds of conservation concern** | No Change - Neutral | Strong Positive<br>Native warm season grass demonstrations and other actions | Same as Alt. B. |

| Issues | Alternative A (Current Management – No Action Alternative) | Alternative B | Alternative C (Proposed Alternative) |
|---|---|---|---|
| **Accelerate transition of even aged management to uneven-aged management to reduce overstocking of pine overstory and increase light to forest floor** | No Change - Neutral | Strong Positive<br>Uneven age forest management would diversify habitat, GIS would enhance management | Same as Alt. B. |
| **Increase growing season burning** | No Change - Neutral | Positive<br>Shift to growing season burns would enhance habitat | Same as Alt. B. |
| **Use mechanical and chemical treatments to confine turkey oaks to understory statum** | No Change - Neutral | Positive<br>Precommercial thinning would reduce midstory | Strong Positive<br>Use of all available tools would produce most reduction in midstory, any impacts from properly applied herbicides would be negligible and short-term |
| **Restore natural condition/composition to Oxpen Farm Unit** | No Change - Neutral | Positive<br>Native seed orchard and native ground covers would enhance habitat | Same as Alt. B. |
| **Manage non-native bamboo** | No Change - Neutral | Positive<br>Removal and follow-up would reduce presence | Same as Alt. B. |
| **Manage and restore wetland communities using water level manipulation** | No Change - Neutral | Positive<br>Additional water level and wetlands managements would enhance these habitats | Same as Alt. A. |

| Issues | Alternative A (Current Management – No Action Alternative) | Alternative B | Alternative C (Proposed Alternative) |
|---|---|---|---|
| **Establish and expand rare and sensitive plant communities** | No Change - Neutral | Neutral to Positive<br>Inventories will increase knowledge and would improve management | Same as Alt. B. |
| **Establish native seed nursery for native warm season grass restoration/demonstration** | No Change - Neutral | Positive<br>Replace shrub lespedeza and crops with native warm season grasses | Positive<br>Replace shrub lespedeza and crops with native warm season grasses<br>Addition of biofuel or native warm season grass as seed source |
| **Wildlife Openings** | No Change - Neutral | Positive<br>Replace crops with NWSG | Slight Positive<br>Addition of native warm season grass to cooperative farming |
| **Visitor Services** | | | |
| **Welcome and Orient Visitors** | No Change - Neutral | Same as Alt. A. | Positive<br>Interpret Wildlife Drive and update website more often to increase awareness and understanding of wildlife and habitat diversity |
| **Quality Hunting and Fishing** | No Change - Neutral | Slight negative<br>Minor reduction in hunting and fishing | Positive<br>Increased hunting and fishing opportunities |
| **Quality Wildlife Observation and Photography** | No Change - Neutral | Same as Alt. A. | Positive<br>Increased trails, blinds, interpretation |

| | | | |
|---|---|---|---|
| **Quality Environmental Education Program** | No Change - Neutral | Same as Alt. A. | Positive<br>Increased Environmental Education opportunities |
| **Issues** | **Alternative A (Current Management – No Action Alternative)** | **Alternative B** | **Alternative C (Proposed Alternative)** |
| **Interpret key resources and issues** | No Change - Neutral | Same as Alt. A. | Positive<br>Enhanced outreach and educational materials and opportunities |
| **Appropriate recreational uses (i.e., biking, picnicking, etc.)** | No Change - Neutral | Same as Alt. A. | Positive<br>Brochure to highlight appropriate recreational uses |
| **Communicate key issues with off-site audiences** | No Change - Neutral | Same as Alt. A. | Positive<br>Outreach would provide increased information to public |
| **Build volunteer program and partnerships with Friends groups** | No Change - Neutral | Same as Alt. A. | Positive<br>Additional partnerships and agreements would leverage additional resources |
| **Resource Protection** | | | |
| **Refuge Boundary** | No Change – Neutral | Same as Alt. A. | Same as Alt. A. |
| **Land Acquisition** | No Change - Neutral | Positive<br>Targeted acquisitions would maximize benefits for species | Positive<br>Targeted acquisitions would maximize benefits for ecosystem |
| **Gaps/Corridors** | No Change – Negative to Neutral<br>No management | Positive<br>Knowledge and partnerships would enhance important habitats and connections | Same as Alt. B. |

| Issues | Alternative A (Current Management – No Action Alternative) | Alternative B | Alternative C (Proposed Alternative) |
|---|---|---|---|
| **Easements** | No Change - Neutral | Positive<br>Increased maintenance would reduce violations, management plans would enhance wildlife diversity | Positive<br>Increased maintenance should reduce violations |
| **Archaeological and Historical Resources** | No Change - Neutral | Positive<br>More knowledge would result in improved management | Same as Alt. A. |
| **Visitor Protection** | No Change - Neutral | Positive<br>More officers would enhance safety | Same as Alt. B. |
| **Contaminants** | No Change – Negative to Neutral<br>No management | Positive<br>Additional monitoring would enhance water quality management | Same as Alt. B. |
| **Water Quantity** | No Change - Neutral | Positive<br>Additional monitoring would enhance water quantity management | Same as Alt. B. |
| **Air and Water Quality** | No Change - Neutral | Positive<br>Additional monitoring would enhance air and water quality management | Same as Alt. B. |
| **Refuge Administration** | | | |
| **Refuge Facilities** | No Change - Neutral | Same as Alt. A. | Positive<br>Additional facilities would enhance recreational and educational opportunities |

| Issues | Alternative A (Current Management – No Action Alternative) | Alternative B | Alternative C (Proposed Alternative) |
|---|---|---|---|
| **Refuge Equipment** | No Change - Neutral | Neutral to Positive<br>Would reduce soil disturbance | Positive<br>Additional equipment for native warm season grass |
| **Refuge Staff** | No Change - Neutral | Positive<br>Additional staff would allow increase resource management and protection and increased environmental education opportunities | Same as Alt. B. |

## UNAVOIDABLE IMPACTS AND MITIGATION MEASURES

Under Alternative A—the no-action alternative—there are numerous unavoidable impacts, including inadequate law enforcement for protecting significant visitor use; continued degradation of the biological functions of native plant communities and wildlife habitat due to the invasion of exotic plants and nuisance animals; and a continued decrease in biodiversity. Over time, if these issues are not addressed, they will continue to adversely impact refuge resources.

Alternative C, the proposed alternative, also has some unavoidable impacts. These impacts are expected to be minor and/or short-term in duration. However, the refuge will attempt to minimize those impacts whenever possible. The following sections describe the measures the refuge will employ to mitigate and minimize potential impacts that would result from implementation of the proposed alternative.

### *WATER QUALITY FROM SOIL DISTURBANCE AND USE OF HERBICIDES*

Soil disturbance and siltation due to water management activities; road and levee maintenance; and the construction of trails and blinds is expected to be minor and of short duration. To further reduce potential impacts, the refuge will use best management practices to minimize soil erosion and runoff into water bodies.

Foot traffic on new and extended foot trails is expected to have a negligible impact on soil erosion. To minimize the impacts from public use, the refuge will include informational signs that request trail users to remain on the trails, to avoid causing erosion problems.

Long-term herbicide use for exotic plant and oak encroachment control could result in a slight decrease in water quality in areas prone to exotic plant infestation and large areas of midstory oaks. Through the proper application of herbicides, however, this is expected to have a minor and temporary impact on the environment, with the benefit of reducing or eliminating exotic plant infestations and improving control of midstory oaks.

### *WILDLIFE DISTURBANCE*

Disturbance to wildlife is an unavoidable consequence of any public use program, regardless of the activity involved. While some activities, such as wildlife observation, may be less disturbing than others, all of the public use activities proposed under the proposed alternative will be planned to avoid unacceptable levels of impact.

The known and anticipated levels of disturbance from the proposed alternative are not considered to be significant. Nevertheless, the refuge will manage public use activities to reduce impacts. Providing access for fishing opportunities allows the use of a renewable natural resource without adversely impacting other resources. Hunting will also be managed with restrictions that ensure minimal impact. General wildlife observation will result in minimal disturbance to wildlife. If the refuge determines that impacts from the expected additional visitor uses are above the levels anticipated, those uses will be discontinued, restricted, or rerouted to other less sensitive areas to minimize impacts.

### *VEGETATION DISTURBANCE*

Negative impacts could result from the creation, extension, and maintenance of trails that require the clearing of non-sensitive vegetation along their length. These are expected to be minor short-term impacts.

Increased visitor use may increase the potential for the introduction of new exotic species into areas when visitors do not comply with boating regulations at the boat ramps and other access points, or with requests to stay on trails. The refuge will minimize this impact by enforcing the regulations for access to the refuge's water bodies, and by installing informational signs that request users to stay on the trails.

*USER GROUP CONFLICTS*

As public use increases, unanticipated conflicts between different user groups could occur. If this should happen, the refuge will adjust its programs, as needed, to eliminate or minimize any public use issues. The refuge will use methods that have proven to be effective in reducing or eliminating public use conflicts. These methods include establishing separate use areas, different use periods, and limits on the numbers of users in order to provide safe, quality, appropriate, and compatible wildlife-dependent recreational opportunities.

*EFFECTS ON ADJACENT LANDOWNERS*

Implementation of the proposed alternative is not expected to negatively affect the owners of private lands adjacent to the refuge. Positive impacts that would be expected include higher property values, less intrusion of invasive exotic plants, and increased opportunities for viewing more diverse wildlife; however, some negative impacts that may occur include a higher frequency of trespass onto adjacent private lands, and noise associated with increased traffic. To minimize these potential impacts, the refuge will provide informational signs that clearly mark refuge boundaries; maintain the refuge's existing parking facilities; use law enforcement; and provide increased educational efforts at the visitor center.

*LAND OWNERSHIP AND SITE DEVELOPMENT*

Land acquisition efforts by the Service could lead to changes in land use and recreational use patterns. However, most of the non-Service-owned lands within the refuge's approved acquisition boundary are currently undeveloped. If these lands are acquired as additions to the refuge, they would be maintained in a natural state, managed for native wildlife populations, and opened to wildlife-compatible public uses, where feasible.

Potential development of the refuge's buildings, trails, and other improvements could lead to minor short-term negative impacts on plants, soils, and some wildlife species. When building any structure, efforts would be made to use recycled products and environmentally sensitive treated lumber. All construction activities would comply with the requirements of Section 404 of the Clean Water Act; the National Historic Preservation Act; Executive Order 11988, Floodplain Management; and other applicable regulatory requirements.

**CUMULATIVE IMPACTS**

A cumulative impact is defined as an impact on the natural or human environment, which results from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions regardless of which agency (federal or non-federal) or person undertakes such other actions (40 Code of Federal Regulations, 1508.7).

Cumulative impacts are the overall, net effects on a resource that arise from multiple actions. Impacts can "accumulate" spatially, when different actions affect different areas of the same resource. They can also accumulate over the course of time, from actions in the past, present, and future. Occasionally, different actions counterbalance one another, partially canceling out each other's effect on a resource, but more typically, multiple effects add up, with each additional action contributing an incremental impact on

the resource. In addition, sometimes the overall effect is greater than merely the sum of the individual effects; e.g., when one more reduction in a population crosses a threshold of reproductive sustainability, and threatens to extinguish the population.

A thorough analysis of impacts always considers cumulative aspects; there are virtually always other actions that have affected a resource in some way in the past, or are affecting it in the present, or will affect it in the reasonably foreseeable future. So any assessment of a specific action's effects must in fact be made with consideration of what else has happened to that resource, what else is happening, or what else will likely happen to it.

The refuge is not aware of any past, present, or future planned actions that would result in a significant cumulative impact when added to the refuge's proposed actions, as outlined in the proposed alternative. Hunting, fishing, increased visitation, and prescribed burning would have negligible cumulative impacts.

Deer hunting would not have long-term or far-reaching effects on the regional deer population since the home ranges of deer limit them primarily to the refuge. Hunting seasons would not coincide with breeding and nesting seasons of migratory birds, so cumulative effects caused by hunting-induced disturbance would be minimal. There would be minimal negative effects to other wildlife, including listed species. Conflicts between hunters and other consumptive and non-consumptive users are not expected. Experience has proven that time and space zoning (e.g., separate use areas and use periods) is an effective tool in eliminating conflicts between user groups. Turkey hunting is unlikely to incur any negative cumulative impacts for the same reasons outlined above.

Fishing would not cause cumulative effects. State catch limits and periodic stocking would ensure that fish stocks on the refuge would not be depleted. Fishing would be limited to certain areas to minimize associated wildlife disturbance effects.

The cumulative impacts of increased visitation would be minimal. Although non-consumptive users can impact wildlife through disturbance, the seasonal closure of vulnerable areas (e.g., where wildlife are foraging or nesting) and use of natural "screens" (vegetation barriers) would minimize these adverse effects.

The cumulative effects of prescribed burning would be minimal. The use of relatively small, prescribed burns timed with favorable winds would maintain air pollution at acceptable levels. These managed burns would reduce fuel loads and help prevent or manage catastrophic wild fires that would have the potential to cause serious air quality problems.

## DIRECT AND INDIRECT EFFECTS OR IMPACTS

Direct effects are caused by an action and occur at the same time as the action. Indirect effects are caused by an action but are manifested later in time or further removed in distance, but still reasonably foreseeable.

The actions proposed for implementation under the proposed alternative include minor facility development, wildlife and population management, resource protection, public use, and administrative programs. These actions would result in both direct and indirect effects. The various programs proposed in this plan would likely lead to increased public use, a direct effect; and it, in turn, would lead to indirect effects such as increased littering, noise, and vehicular traffic.

Other indirect effects that may result from implementing the proposed alternative include minor impacts from siltation due to the disturbance of soils and vegetation while expanding or creating new foot trails and providing greater visitor access through improvements in Visitor Services.

## SHORT-TERM USES VERSUS LONG-TERM PRODUCTIVITY

The habitat protection and management actions proposed under the proposed alternative are dedicated to maintaining the long-term productivity of refuge habitats. The benefits of this plan for long-term productivity far outweigh any impacts from short-term actions, such as the construction of a blind or creation of new trails. While these activities would cause short-term negative impacts, the educational values and associated public support gained from the improved visitor experience would produce long-term benefits for the refuge's entire ecosystem.

The key to protecting and ensuring the refuge's long-term productivity is to find the threshold where public uses do not degrade or interfere with the refuge's natural resources. The plans proposed under the proposed alternative have been carefully conceived to achieve that threshold. Therefore, implementing the proposed alternative would lead to long-term benefits for wildlife protection and land conservation that far outweigh any short-term impacts.

# V. Consultation and Coordination

## OVERVIEW

This chapter summarizes the consultation and coordination that has occurred to date in identifying the issues, alternatives, and proposed alternative, which are presented in this Draft CCP/EA. The comprehensive planning process involved a wide variety of participants, including federal, state, and local governments; universities and researchers; private nonprofit organizations; the Friends of Carolina Sandhills NWR; local residents and businesses; and citizens from all over the country.

The planning process began in 2006 with various data-gathering sessions. As part of the process, the Service conducted several reviews: wildlife management (2006), visitor services (2006), wilderness (2007), and habitat (2007, forestry and fire). These reviews were conducted to determine the status, trends, and condition of the refuge's resources and facilities. The interdisciplinary teams possessed expertise in wildlife biology, nongame management, game management, migratory bird biology, private lands initiatives, forest management, fire and plant ecology and management, conservation biology, ecological research, environmental education, and visitor services. The information garnered from these reviews helped the planning team analyze and develop recommendations for this Draft CCP/EA. Others, with expertise and familiarity with refuge resources, reviewed various sections of this Draft CCP/EA. The following individuals served on one (or more) review teams or provided input and guidance in the development of this Draft CCP/EA:

**Academia**
Fred Edinger, PhD, Coker College, *Professor of Geology*
Sharon Hermann, PhD, Auburn University, *Ecologist*

**Federal Agencies**
Charles Babb, USDA NRCS, Chesterfield County, *District Conservationist*
Bruce Campbell, USGS, *Hydrologist*
Julie Hovis, U.S. Air Force, Shaw AFB, *Endangered Species/Wildlife Biologist*
Ron Morton, USDA NRCS, *Resource Soil Scientist*
Joan Walker, PhD, USDA, Forest Service Southern Research Station, *Botanist*

**South Carolina Department of Environment, Health and Control**
Scott Reynolds, Division of Air Quality Analysis, *Director*

**South Carolina Department of Natural Resources**
Judy Barnes, Small Game Project, *Wildlife Biologist*
Laurel Barnhill, *Bird Conservation Coordinator*
Elizabeth Osier, SCDNR, *Fisheries Biologist*
Lynn Quattro, SC Department of Natural Resources, *Comprehensive Wildlife Strategy Coordinator*
Cindy Sanders, SCDNR, *Fisheries Biologist*
Johnny Stowe, *Wildlife Biologist and Forester*

**South Carolina Forestry Commission**
Brian Davis, Sand Hills State Forest, *Forester and Director*
Darryl Jones, Forest Protection, *Director*

**The Nature Conservancy**
Keith Fisher, Florida Chapter, *Ecologist*

**US Fish and Wildlife Service**
*Carolina Sandhills NWR*
Allyne Askins, *Refuge Manager*
Don Cockman, *Deputy Refuge Manager*
Jack Culpepper, *Forester*
Nancy Jordan, *Wildlife Biologist*
Mark Parker, *Fire Management Officer*

*Division of Ecological Services*
Jason Ayers, Charleston Field Office, *Fish and Wildlife Biologist*
Joe Cockrell, Charleston Field Office, *Fish and Wildlife Biologist*

*Division of Migratory Birds*
John Stanton, Columbia Migratory Bird Field Office, *Wildlife Biologist*

*Division of Refuges*
Dave Brownlie, Tallahassee, FL, *Regional Fire Ecologist*
Shawn Gillette, Okefenokee NWR, *Refuge Ranger*
Laura Housh, Division of Planning and Resource Management, *Planner*
Mike Housh, Okefenokee NWR, *Fire Management Officer*
Chuck Hunter, Division of Planning and Resource Management, *Chief*
Rick Kanaski, Division of Planning and Resource Management, *Regional Archeologist*
Ray Paterra, Cape Romain NWR, *Refuge Ranger*
Carl Schmidt, Piedmont NWR, *Forester*
Garry Tucker, Visitor Services and Outreach, *Chief*

In addition, the Service established a Core Planning Team that obtained input from the public and governmental and nongovernmental partners. This team was the primary decision-making team for this Draft CCP/EA. The key tasks of this group involved defining and refining the vision; identifying, reviewing, and filtering the issues; defining the goals; outlining the alternatives; and providing a conceptual framework for the plan (objectives and strategies to accomplish the vision). The following individuals served on the Core Planning Team:

**Core Planning Team**
Allyne Askins, USFWS, Carolina Sandhills NWR, *Refuge Manager*
Jason Ayers, USFWS, Ecological Services, *Wildlife Biologist*
Don Cockman, USFWS, Carolina Sandhills NWR, *Deputy Refuge Manager*
Jack Culpepper, USFWS, Carolina Sandhills NWR, *Forester*
Brian Davis, SC Forestry Commission, Sand Hills State Forest, *Forester and Director*
Nancy Jordan, USFWS, Carolina Sandhills NWR, *Wildlife Biologist*
Mark Parker, USFWS, Carolina Sandhills NWR, *Fire Management Officer*
Lynn Quattro, SC Department of Natural Resources, *Comprehensive Wildlife Strategy Coordinator*
Charles McEntyre, Tennessee Valley Authority, *Planner and Team Facilitator*

SECTION C. APPENDICES

# Appendix A. Glossary

**Adaptive Management:** Refers to a process in which policy decisions are implemented within a framework of scientifically driven experiments to test predictions and assumptions inherent in a management plan. Analysis of results helps managers determine whether current management should continue as is or whether it should be modified to achieve desired conditions.

**Alluvial:** Sediment transported and deposited in a delta or riverbed by flowing water.

**Alternative:** 1. A reasonable way to fix the identified problem or satisfy the stated need (40 CFR 1500.2). 2. Alternatives are different sets of objectives and strategies or means of achieving refuge purposes and goals, helping fulfill the Refuge System mission, and resolving issues (Service Manual 602 FW 1.6B).

**Anadromous:** Migratory fishes that spend most of their lives in the sea and migrate to fresh water to breed.

**Biological Diversity:** The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur (Service Manual 052 FW 1. 12B). The System's focus is on indigenous species, biotic communities, and ecological processes. Also referred to as biodiversity.

**Carrying Capacity:** The maximum population of a species able to be supported by a habitat or area.

**Categorical Exclusion:** A category of actions that does not individually or cumulatively have a significant effect on the human environment and have been found to have no such effect in procedures adopted by a federal agency pursuant to the National Environmental Policy Act (40 CFR 1508.4).

**CFR:** Code of Federal Regulations.

**Compatible Use:** A proposed or existing wildlife-dependent recreational use or any other use of a national wildlife refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purpose(s) of the national wildlife refuge [50 CFR 25.12 (a)]. A compatibility determination supports the selection of compatible uses and identifies stipulations or limits necessary to ensure compatibility.

| | |
|---|---|
| **Comprehensive Conservation Plan:** | A document that describes the desired future conditions of a refuge or planning unit and provides long-range guidance and management direction to achieve the purposes of the refuge; helps fulfill the mission of the Refuge System; maintains and, where appropriate, restores the ecological integrity of each refuge and the Refuge System; helps achieve the goals of the National Wilderness Preservation System; and meets other mandates (Service Manual 602 FW 1.6 E). |
| **Concern:** | See Issue |
| **Cover Type:** | The present vegetation of an area. |
| **Cultural Resource Inventory:** | A professionally conducted study designed to locate and evaluate evidence of cultural resources present within a defined geographic area. Inventories may involve various levels, including background literature search, comprehensive field examination to identify all exposed physical manifestations of cultural resources, or sample inventory to project site distribution and density over a larger area. Evaluation of identified cultural resources to determine eligibility for the National Register follows the criteria found in 36 CFR 60.4 (Service Manual 614 FW 1.7). |
| **Cultural Resource Overview:** | A comprehensive document prepared for a field office that discusses, among other things, its prehistory and cultural history, the nature and extent of known cultural resources, previous research, management objectives, resource management conflicts or issues, and a general statement on how program objectives should be met and conflicts resolved. An overview should reference or incorporate information from a field office's background or literature search described in Section VIII of the Cultural Resource Management Handbook (Service Manual 614 FW 1.7). |
| **Cultural Resources:** | The remains of sites, structures, or objects used by people in the past. |
| **Designated Wilderness Area:** | An area designated by the U.S. Congress to be managed as part of the National Wilderness Preservation System (Draft Service Manual 610 FW 1.5). |
| **Disturbance:** | Significant alteration of habitat structure or composition. May be natural (e.g., fire) or human-caused events (e.g., aircraft overflight). |
| **Ecosystem:** | A dynamic and interrelating complex of plant and animal communities and their associated non-living environment. |
| **Ecosystem Management:** | Management of natural resources using system-wide concepts to ensure that all plants and animals in ecosystems are maintained at viable levels in native habitats and basic ecosystem processes are perpetuated indefinitely. |

| | |
|---|---|
| **Endangered Species (Federal):** | A plant or animal species listed under the Endangered Species Act that is in danger of extinction throughout all or a significant portion of its range. |
| **Endangered Species (State):** | A plant or animal species in danger of becoming extinct or extirpated in the state within the near future if factors contributing to its decline continue. Populations of these species are at critically low levels or their habitats have been degraded or depleted to a significant degree. |
| **Environmental Assessment (EA):** | A concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action, alternatives to such action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9). |
| **Environmental Impact Statement (EIS):** | A detailed written statement required by section 102(2)(C) of the National Environmental Policy Act, analyzing the environmental impacts of a proposed action, adverse effects of the project that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources (40 CFR 1508.11). |
| **Estuary:** | The wide lower course of a river into which the tides flow. The area where the tide meets a river current. |
| **Finding of No Significant Impact (FONSI):** | A document prepared in compliance with the National Environmental Policy Act, supported by an environmental assessment, that briefly presents why a federal action will have no significant effect on the human environment and for which an environmental impact statement, therefore, will not be prepared (40 CFR 1508.13). |
| **Goal:** | Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units (Service Manual 620 FW 1.6J). |
| **Habitat:** | Suite of existing environmental conditions required by an organism for survival and reproduction. The place where an organism typically lives. |
| **Habitat Restoration:** | Management emphasis designed to move ecosystems to desired conditions and processes, and/or to healthy ecosystems. |
| **Habitat Type:** | See Vegetation Type. |
| **Improvement Act:** | The National Wildlife Refuge System Improvement Act of 1997. |
| **Informed Consent:** | The grudging willingness of opponents to “go along” with a course of action that they actually oppose (Bleiker). |

| | |
|---|---|
| **Issue:** | Any unsettled matter that requires a management decision [e.g., an initiative, opportunity, resource management problem, threat to the resources of the unit, conflict in uses, public concern, or other presence of an undesirable resource condition (Service Manual 602 FW 1.6K)]. |
| **Management Alternative:** | See Alternative |
| **Management Concern:** | See Issue |
| **Management Opportunity:** | See Issue |
| **Migration:** | The seasonal movement from one area to another and back. |
| **Mission Statement:** | Succinct statement of the unit's purpose and reason for being. |
| **Monitoring:** | The process of collecting information to track changes of selected parameters over time. |
| **National Environmental Policy Act of 1969 (NEPA):** | Requires all agencies, including the Service, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decision-making (40 CFR 1500). |
| **National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57):** | Under the Refuge Improvement Act, the Fish and Wildlife Service is required to develop 15-year comprehensive conservation plans for all national wildlife refuges outside Alaska. The Act also describes the six public uses given priority status within the Refuge System (i.e., hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation). |
| **National Wildlife Refuge System Mission:** | The mission is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans. |
| **National Wildlife Refuge System:** | Various categories of areas administered by the Secretary of the Interior for the conservation of fish and wildlife, including species threatened with extinction; all lands, waters, and interests therein administered by the Secretary as wildlife refuges; areas for the protection and conservation of fish and wildlife that are threatened with extinction; wildlife ranges; game ranges; wildlife management areas; or waterfowl production areas. |

| | |
|---|---|
| **National Wildlife Refuge:** | A designated area of land, water, or an interest in land or water within the Refuge System. |
| **Native Species:** | Species that normally live and thrive in a particular ecosystem. |
| **Noxious Weed:** | A plant species designated by federal or state law as generally possessing one or more of the following characteristics: aggressive or difficult to manage; parasitic; a carrier or host of serious insect or disease; or non-native, new, or not common to the United States. According to the Federal Noxious Weed Act (P.L. 93-639), a noxious weed is one that causes disease or had adverse effects on man or his environment and therefore is detrimental to the agriculture and commerce of the Untied States and to the public health. |
| **Objective:** | A concise statement of what we want to achieve, how much we want to achieve, when and where we want to achieve it, and who is responsible for the work. Objectives derive from goals and provide the basis for determining strategies, monitoring refuge accomplishments, and evaluating the success of strategies. Making objectives attainable, time-specific, and measurable (Service Manual 602 FW 1.6N). |
| **Plant Association:** | A classification of plant communities based on the similarity in dominants of all layers of vascular species in a climax community. |
| **Plant Community:** | An assemblage of plant species unique in its composition; occurs in particular locations under particular influences; a reflection or integration of the environmental influences on the site such as soils, temperature, elevation, solar radiation, slope, aspect, and rainfall; denotes a general kind of climax plant community. |
| **Preferred Alternative:** | This is the alternative determined (by the decision-maker) to best achieve the refuge purpose, vision, and goals; contributes to the Refuge System mission, addresses the significant issues; and is consistent with principles of sound fish and wildlife management. |
| **Prescribed Fire:** | The application of fire to wildland fuels to achieve identified land use objectives (Service Manual 621 FW 1.7). May occur from natural ignition or intentional ignition. |
| **Priority Species:** | Fish and wildlife species that require protective measures and/or management guidelines to ensure their perpetuation. Priority species include the following: (1) State-listed and candidate species; (2) species or groups of animals susceptible to significant population declines within a specific area or statewide by virtue of their inclination to aggregate (e.g., seabird colonies); and (3) species of recreation, commercial, and/or tribal importance. |
| **Public Involvement Plan:** | Broad long-term guidance for involving the public in the comprehensive conservation planning process. |

| | |
|---|---|
| **Public Involvement:** | A process that offers impacted and interested individuals and organizations an opportunity to become informed about, and to express their opinions on Service actions and policies. In the process, these views are studied thoroughly and thoughtful consideration of public views is given in shaping decisions for refuge management. |
| **Public:** | Individuals, organizations, and groups; officials of federal, state, and local government agencies; Indian tribes; and foreign nations. It may include anyone outside the core planning team. It includes those who may or may not have indicated an interest in service issues and those who do or do not realize that Service decisions may affect them. |
| **Purposes of the Refuge:** | "The purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge sub-unit." For refuges that encompass congressionally designated wilderness, the purposes of the Wilderness Act are additional purposes of the refuge (Service Manual 602 FW 106 S). |
| **Recommended Wilderness:** | Areas studied and found suitable for wilderness designation by both the Director of the Fish and Wildlife Service and the Secretary of the Department of the Interior, and recommended for designation by the President to Congress. These areas await only legislative action by Congress in order to become part of the Wilderness System. Such areas are also referred to as "pending in Congress" (Draft Service Manual 610 FW 1.5). |
| **Record of Decision (ROD):** | A concise public record of decision prepared by the federal agency, pursuant to NEPA, that contains a statement of the decision, identification of all alternatives considered, identification of the environmentally preferable alternative, a statement as to whether all practical means to avoid or minimize environmental harm from the alternative selected have been adopted (and if not, why they were not), and a summary of monitoring and enforcement where applicable for any mitigation (40 CFR 1505.2). |
| **Refuge Goal:** | See Goal |
| **Refuge Purposes:** | See Purposes of the Refuge |
| **Songbirds:** (Also Passerines) | A category of birds that is medium to small, perching landbirds. Most are territorial singers and migratory. |
| **Step-down Management Plan:** | A plan that provides specific guidance on management subjects (e.g., habitat, public use, fire, and safety) or groups of related subjects. It describes strategies and implementation schedules for meeting CCP goals and objectives (Service Manual 602 FW 1.6 U). |

| | |
|---|---|
| **Strategy:** | A specific action, tool, technique, or combination of actions, tools, and techniques used to meet unit objectives (Service Manual 602 FW 1.6 U). |
| **Study Area:** | The area reviewed in detail for wildlife, habitat, and public use potential. For purposes of this CCP, the study area includes the lands within the currently approved refuge boundary and potential refuge expansion areas. |
| **Threatened Species (Federal):** | Species listed under the Endangered Species Act that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range. |
| **Threatened Species (State):** | A plant or animal species likely to become endangered in the state within the near future if factors contributing to population decline or habitat degradation or loss continue. |
| **Tiering:** | The coverage of general matters in broader environmental impact statements with subsequent narrower statements of environmental analysis, incorporating by reference, the general discussions and concentrating on specific issues (40 CFR 1508.28). |
| **U.S. Fish and Wildlife Service Mission:** | The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people. |
| **Unit Objective:** | See Objective |
| **Vegetation Type, Habitat Type, Forest Cover Type:** | A land classification system based upon the concept of distinct plant associations. |
| **Vision Statement:** | A concise statement of what the planning unit should be, or what we hope to do, based primarily upon the Refuge System mission and specific refuge purposes, and other mandates. We will tie the vision statement for the refuge to the mission of the Refuge System; the purpose(s) of the refuge; the maintenance or restoration of the ecological integrity of each refuge and the Refuge System; and other mandates (Service Manual 602 FW 1.6 Z). |

**Wilderness Study Areas:** Lands and waters identified through inventory as meeting the definition of wilderness and undergoing evaluation for recommendation for inclusion in the Wilderness System. A study area must meet the following criteria:

- Generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;
- Has outstanding opportunities for solitude or a primitive and unconfined type of recreation; and
- Has at least 5,000 contiguous roadless acres or is sufficient in size as to make practicable its preservation and use in an unimpaired condition (Draft Service Manual 610 FW 1.5).

**Wilderness:** See Designated Wilderness

**Wildfire:** A free-burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands (Service Manual 621 FW 1.7).

**Wildland Fire:** Every wildland fire is either a wildfire or a prescribed fire (Service Manual 621 FW 1.3

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ACJV | Atlantic Coast Joint Venture |
| AFT | Alternative Fuels Treatments |
| AMR | Appropriate Management Response |
| AQI | Air Quality Index |
| A-VRH | Aggregate Variable Retention Harvest |
| BAQ | [SCDHEC] Bureau of Air Quality |
| BCC | Birds of Conservation Concern |
| BCR | Bird Conservation Regions |
| BRT | Biological Review Team |
| CAA | Clean Air Act |
| CCC | Civilian Conservation Corps |
| CCP | Comprehensive Conservation Plan |
| CFR | Code of Federal Regulations |
| cfs | cubic feet per second |
| DENR | North Carolina Department of Environment and Natural Resources |
| DFC | Desired Future Condition |
| DOI | Department of the Interior |
| DU | Ducks Unlimited |
| EA | Environmental Assessment |
| EE | environmental education |
| EIS | Environmental Impact Statement |
| EPA | U.S. Environmental Protection Agency |
| ESA | Endangered Species Act |
| FONSI | Finding of No Significant Impact |
| FR | Federal Register |
| FTE | full-time equivalent |
| FWS | U.S. Fish and Wildlife Service (also Service) |
| FY | Fiscal Year |
| GIS | Global Information System |
| LE | Law Enforcement |
| LMRD | Land Management Demonstration Refuge |
| MCAP | Management Capabilities |
| NAAQS | National Ambient Air Quality Standards |
| NABCI | North American Bird Conservation Initiative |
| NAMS | National Ambient Air Monitoring Stations |
| NAWMP | North American Waterfowl Management Plan |
| NEPA | National Environmental Policy Act |
| NRCS | Natural Resources Conservation Service |
| NRHP | National Register of Historic Places |
| NWR | National Wildlife Refuge |
| NWRS | National Wildlife Refuge System |
| NWSG | Native Warm Season Grass |
| ONRW | Outstanding National Resource Waters |
| ORW | Outstanding Resource Waters |
| PARC | Partners in Amphibian and Reptile Conservation |
| PFT | Permanent Full Time |
| PFW | Partners for Fish and Wildlife |
| PUNA | Public Use Natural Area |
| RCW | Red-cockaded Woodpecker |

| | |
|---|---|
| RM | Refuge Manual |
| RNA | Research Natural Area |
| ROD | Record of Decision |
| RONS | Refuge Operating Needs System |
| RRP | Refuge Roads Program |
| SAMMS | Service Asset Maintenance Management System |
| SCDNR | South Carolina Department of Natural Resources |
| SCDHEC | South Carolina Department of Health and Environmental Control |
| SCFC | South Carolina Forestry Commission |
| SCPRT | South Carolina Parks, Recreation and Tourism |
| SJBG | Southern James Bay Geese |
| SLAMS | State and Local Air Monitoring Stations |
| SR | State Route |
| SUP | Special Use Permit |
| T&E | Threatened and Endangered |
| TFT | Temporary Full Time |
| TNC | The Nature Conservancy |
| USC | United States Code |
| USDA | United States Department of Agriculture |
| USGS | United States Geological Survey |
| VDT | Variable Density Thinning |
| VRH | Variable Retention Harvesting |
| WMA | Wildlife Management Area(s) |

# *Appendix B. References and Literature Citations*


Atlantic Coast Joint Venture. 2005. www.acjv.org

Badr, A.W., A. Wachob, and J.A. Gellici. 2004. South Carolina Water Plan. S.C. Department of Natural Resources. Columbia, SC. 120pp.

Bailey, R.G. 1978. Descriptions of the Ecoregions of the United States. U.S. Department of Agricultural Forest Service, Misc. Publ. #1391, Washington, D.C.

Caudill, J. and A. Laughland. 2002. Banking on Nature 2002. U.S. Fish and Wildlife Service, Division of Economics, Washington, DC. 118 pp.

Caudill, J., and E. Henderson. September 2005. Banking on Nature 2004: The Economic Benefits to Local Communities of National Wildlife Visitation. U.S. Fish and Wildlife Service, Division of Economics, Washington, DC.

Cherry, R., A. Badr, and A. Wachob. 2001. General Hydrology of South Carolina. South Carolina Department of Natural Resources, Columbia, S.C. http://www.dnr.sc.gov/water/hydro/HydroPubs/Map%202%20letter%20size.pdf

City-Data.com. 2008. Chesterfield County, S.C. http://www.city-data.com/county/Chesterfield_County-SC.html

Dimmick, R.W., M.J. Gudlin, and D.F. McKenzie. 2002. The Northern Bobwhite Conservation Initiative. Miscellaneous Publication of the Southeastern Association of Fish and Wildlife Agencies, South Carolina. 96 pp. http://seqsg.qu.org/seqsg/nbci/nbci.cfm

Dupree, A. Hunter. 1957. Science in the Federal Government: A History of Policies and Activities to 1940. Harvard University Press, Cambridge, Massachusetts. 460 pp.

Environmental Impact (RC&D), Inc. 2001. Increasing Wildlife on Public Lands in the Sandhills of North Carolina, A Guide to Management and Restoration. Aberdeen, NC. 16 pp.

Gabrielson, Ira N. 1943. Wildlife Conservation. The Macmillan Company, New York, New York. 250 pp.

Griffeth, J.A., S.V Stehman, and T. R. Loveland. 2003. Landscape Trends in Mid-Atlantic and Southeastern United States Ecoregions. Environmental Management, Vol. 32, No. 5, pp.572-588. http://edc2.usgs.gov/LT/regions/eco65.php

Griffith, G.E., Omernik, J.M., Comstock, J.A., Schafale, M.P., McNab, W.H., Lenat, D.R., MacPherson, T.F., Glover, J.B., and Shelburne, V.B. 2002. Ecoregions of North Carolina and South Carolina, (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,500,000). http://www.epa.gov/wed/pages/ecoregions/ncsc_eco.htm

Hamel, P. B., W. P. Smith, D. J. Twedt, J. R. Woehr, E. Morris, R. B. Hamilton, and R. J. Cooper. 1995. A land manager's guide to point counts of birds in the southeast. U. S. Department of Agriculture, Forest Service, Southern Research Station, General Technical Report, SO-120, New Orleans, LA. 39 pp.

Hunter, W.C., L.H. Peoples, and J.A. Collazo. 2001. Partners in Flight Bird Conservation Plan for the South Atlantic Coastal Plain (Physiographic Area 03). Atlanta, GA. 166pp.

Hunter, W.C., W. Golder, S. Melvin, and J. Wheeler. 2006. Southeast United States Regional Waterbird Conservation Plan. Atlanta, GA, and Arlington, VA: U.S. Fish and Wildlife Service; and Wilmington, NC: North Carolina Audubon Society. http://www.waterbirdconservation.org/pdfs/regional/seusplanfinal906.pdf http://www.waterbirdconservation.org/southeast_us.html

James, F. C. 1991. Signs of trouble in the largest remaining population of red-cockaded woodpeckers. Auk 108:419-423.

James, F. C., C. A. Hess, and D. Kufrin. 1997. Species-centered environmental analysis: indirect effects of fire history on red-cockaded woodpeckers. Ecological Applications 7:118-129.

Krabill, W., W. Abdalati, E. Frederick, S. Manizade, C. Martin, J. Sonntag, R. Swift, R. Thomas, W. Wright, and J. Yungel. 2000. Greenland Ice Sheet: High-elevation Balance and Peripheral Thinning. *In* Science July 21, 2000: pp. 428-430.

Kuchler, A. W. 1964. Manual to accompany the map of potential vegetation of the conterminous United States. Special Publication No. 36. New York: American Geographical Society. 77 pp. http://www.fs.fed.us/database/feis/kuchlers/k114/all.html

Kush, J. S., compiler. 2003. Longleaf Pine: A Southern Legacy Rising from the Ashes, Proceedings of the Fourth Longleaf Alliance Regional Conference; 2002 November 17-20; Southern Pines, NC. Longleaf Alliance Report No. 6.

Kushlan, J.A., M.J. Steinkamp, K.C. Parsons, J. Capp, M. Acosta Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R.M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J.E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas, Washington, DC, U.S.A. 78pp. http://www.waterbirdconservation.org/nawcp.html

Laycock, George. 1965. The Sign of the Flying Goose: A Guide to the National Wildlife Refuges. The Natural History Press, Garden City, New York. 299 pp.

Leigh, D.S. 1998. Evaluating Artifact Burial by Eolian versus Bioturbation Processes, South Carolina Sandhills, USA. *In* Geoarcheology, December 1998, Vol. 13, No. 3: pp. 309-330. http://www3.interscience.wiley.com/cgi-bin/abstract/36033/ABSTRACT

Loveland, T. R. and W. Acevedo. 2008. Land Cover Change in the Eastern United States-Land Cover Trends. U. S. Geological Survey, Center for Earth Observations and Science, Sioux Falls, SD. 13pp. http://edc2.usgs.gov/LT/LCCEUS.php

Madden, K., R. Sharitz, S. Harper, D. Imm and B. Collins. 2003. Tree Composition and Soil Characteristics of Fall Line Sandhill Communities. Savannah River Ecology Laboratory, Aiken, SC; and USDA-FS Savannah River, New Ellenton, SC. http://www.uga.edu/srel/ESSite/Tree_composition_soil_characteristics.pdf

Matthews, S., R. O'Connor, L.R. Iverson, and A.M. Prasad. 2004: *Atlas of Climate Change Effects in 150 Bird Species of the Eastern United States*. General Technical Report NE-GTR-318.

National Wilderness Preservation System. 2004. Wilderness Legislation: The Wilderness Act of 1964. http://www.wilderness.net/index.cfm?fuse=NWPS&sec=legisAct

Newcome, Roy Jr. 2004. Ground-Water Resources of Chesterfield County, SC. South Carolina, Department of Natural Resources, Land, Water and Conservation Division, Water Resources Report 36. http://www.dnr.state.sc.us

North American Bird Conservation Initiative. 2002. Integrated Bird Conservation in the U.S. www.nabci-us.org/plans.html

North American Waterfowl Management Plan, Plan Committee. 2004. Strategic Guidance: Strengthening the Biological Foundation. Canadian Wildlife Service, U.S. Fish and Wildlife Service, Secretaria de Medio Ambiente y Recursos Naturales. 22pp. http://www.fws.gov/birdhabitat/NAWMP/index.shtm

North Carolina Department of Environment and Natural Resources, Division of Air Quality. 2009. Air Monitoring Program. http://daq.state.nc.us/monitor/

Rich, T. D., C. J. Beardmore, H. Berlanga, P. J. Blancher, M. S. W. Bradstreet, G. S. Butcher, D. W. Demarest, E. H. Dunn, W. C. Hunter, E. E. Iñigo-Elias, J. A. Kennedy, A. M. Martell, A. O. Panjabi, D. N. Pashley, K. V. Rosenberg, C. M. Rustay, J. S. Wendt, T. C. Will. 2004. Partners in Flight North American Landbird Conservation Plan. Cornell Lab of Ornithology. Ithaca, NY. Partners in Flight website. http://www.partnersinflight.org/cont_plan/

Ruth, J.M. 2006. Partners in Flight-U.S. Website. Served by the U.S. Geological Survey Paxtuxent Wildlife Research Center, Laurel, MD. http://www.partnersinflight.org and http://www.blm.gov/wildlife/pifplans.htm

South Carolina Department of Health and Environmental Control. 1997. 208 Water Quality Management Plan: Update for non-designated Area of South Carolina. Bureau of Water, Columbia, SC. http://www.scdhec.net/environment/water/docs/208plan.pdf

South Carolina Department of Health and Environmental Control. 2000. Watershed Water Quality Assessment: Pee Dee River Basin, Technical Report # 015-00, 2nd edition. Bureau of Water, Columbia, SC. http://www.scdhec.net/environment/water/docs/peedee2k1.pdf

South Carolina Department of Health and Environmental Control. 2004. Water Classifications and Standards Regulation 61-68. Bureau of Water, Columbia, SC. http://www.scdhec.gov/environment/water/regs/r61-68.pdf#xml=http://www.scdhec.net/cgi-bin/texis.exe/Webinator/search/xml.txt?query=outstanding+resource+waters&pr=www&prox=page&rorder=750&rprox=750&rdfreq=250&rwfreq=500&rlead=1000&sufs=1&order=r&cq=&id=46daacea7

South Carolina Department of Health and Environmental Control. 2006. South Carolina Air Program. Bureau of Air Quality (BAQ), Columbia, SC. http://www.scdhec.com/administration/library/CR-003800.pdf

South Carolina Department of Health and Environmental Control. 2007a. Black Creek/Lake Robinson (Watershed 03040201-100) -- Pee Dee River Basin. Bureau of Water, Columbia, SC. http://www.scdhec.net/environment/Water/shed/peedee.htm

South Carolina Department of Health and Environmental Control, 2007b. South Carolina Water Use Report, 2006 Summary. Technical Document # 004-07. Bureau of Water, Columbia, SC. http://www.scdhec.net/environment/water/docs/wtruse2006.pdf

South Carolina Department of Health and Environmental Control. 2007c. Watershed Water Quality Assessment: Pee Dee River Basin. Technical Report No.005-07. Bureau of Water, Columbia, S.C.

South Carolina Department of Natural Resources. 1997. General Soil Map of South Carolina. Land Resources and Conservation Districts Division, Columbia, SC. http://www.ces.clemson.edu/scmaps/cartography/SoilsMap.html

South Carolina Department of Natural Resources. 2000. SC Maps Teaching Manual-Sandhills/Midlands Region, 4th ed. SCDNR Education Programs, Columbia, SC. http://www.ces.clemson.edu/scmaps/manual/wordmanual

South Carolina Department of Natural Resources. 2002. Ground-Water Resources of Kershaw County, South Carolina. WR Report #24, Columbia, SC. http://www.dnr.sc.gov/lwc/pubs/pdfs/kershawreport.pdf

South Carolina Department of Natural Resources, 2004. South Carolina Water Plan, 2nd Edition. Land, Water, and Conservation Division, Columbia, SC. http://www.keoweefolks.org/reference/scwaterplan.pdf

South Carolina Department of Natural Resources. 2005a. Comprehensive Wildlife Conservation Strategy (CWCS). Columbia, SC.
http://www.dnr.sc.gov/cwcs/
http://www.dnr.sc.gov/cwcs/pdf/habitat/SandhillsHabitat.pdf
http://www.dnr.sc.gov/cwcs/pdf/habitat/SoutheasternAquatic.pdf

South Carolina Department of Natural Resources and South Carolina Geological Survey. 2005b. Geology of South Carolina, Generalized Geologic Map of South Carolina. Columbia, SC. http://www.dnr.state.sc.us/geology/geology.htm

South Carolina Department of Natural Resources. 2007. Cheraw Fish Hatchery. Columbia, SC. http://hatcheries.dnr.sc.gov/cheraw/index.html

South Carolina Department of Natural Resources. 2008. Chesterfield County. State Climate Office, Columbia, SC. http://www.dnr.sc.gov/cgi-bin/sco/hsums/cliMAINnew.pl?sc6616
http://www.dnr.sc.gov/climate/sco/ClimateData/countyData/county_chesterfield.php

South Carolina Department of Natural Resources. 2009a. Designated Scenic Rivers. Columbia, SC. http://www.dnr.sc.gov/water/envaff/river/desig_rivers.html

South Carolina Department of Natural Resources. 2009b. The Impact of Climate Change on South Carolina. SC State Climatology Office, Columbia, SC. http://www.dnr.sc.gov/climate/sco/Publications/climate_change_impacts.php

South Carolina Employment Security Commission. 2008. Spotlight on Chesterfield County. Labor Market Information, Columbia, S.C. http://www.sces.org/lmi/Spotlights/Chesterfield.pdf

South Carolina Forestry Commission. 2004. Sand Hills State Forest. Columbia, SC. http://www.state.sc.us/forest/refshill.htm

South Carolina Information Highway. 2007. http://www.sciway.net/data/county-population/chesterfield.html

South Carolina Library. 2006. Chesterfield County History. Columbia, SC. http://www.statelibrary.sc.gov/chesterfield-county.html

South Carolina Department of Parks, Recreation and Tourism. 2009a. Cheraw State Park. Columbia, SC. http://www.southcarolinaparks.com/park-finder/state-park/1554.aspx

South Carolina Department of Parks, Recreation and Tourism. 2009b. H. Cooper Black Jr. Memorial Field Trial and Recreation Area. http://www.southcarolinaparks.com/park-finder/state-park/26716.aspx

South Carolina Department of Parks, Recreation and Tourism. 2009c. South Carolina's Climate. Columbia, SC. http://www.scprt.com/facts-figures/geographyclimateeconomy.aspx

U.S. Department of Agriculture, Natural Resources Conservation Service. Date unknown. Climate Reports (Narratives and Tables) for Soil Survey Regions of the U.S. National Water and Climate Center. http://www.wcc.nrcs.usda.gov/cgibin/soil-nar-state.pl?state=sc http://ftp.wcc.nrcs.usda.gov/support/climate/wetlands/sc/45025.txt

U.S. Department of Agriculture, Natural Resources Conservation Service. 2008a. Soil Series Classification Database. Soil Survey Staff, Lincoln, NE. http://soils.usda.gov/technical/classification/scfile/index.html

U.S. Department of Agriculture, Natural Resources Conservation Service. 2008b. Taxonomic Classification of the Soils-Chesterfield County, South Carolina. National Cooperative Soil Survey. Web Soil Survey 2.0. http://websoilsurvey.nrcs.usda.gov/app/

U.S. Department of Commerce, U.S. Census Bureau. 2003. Census 2000. http://www.census.gov/main/www/cen2000.html

U.S. Department of the Interior, Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau. 2001. National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

U.S. Environmental Protection Agency. 2003. Air Quality Index (AQI) - A Guide to Air Quality and Your Health." *In* AirNow. http://airnow.gov/index.cfm?action=static.aqi

U.S. Environmental Protection Agency. 2009a. Air Quality Index Report - Chesterfield County, South Carolina. http://www.epa.gov/air/data/monaqi.html?co~45025~Chesterfield%20Co%2C%20South%20Carolina

U.S. Environmental Protection Agency. 2009b. Climate Change. http://www.epa.gov/climatechange/

U.S. Environmental Protection Agency. 2009c. County Air Quality Map - Criteria Air Pollutants-South Carolina. http://www.epa.gov/cgi-bin/broker?_service=airdata&_program=progs.webprogs.msummary.scl&_debug=2&geotype=st&geocode=SC&geoname=South+Carolina&mpol=aqi_days&myear=2005&exc=&mapsize=zsc&reqtype=viewmap

U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. 2009d. National Ambient Air Quality Standards (NAAQS). http://www.epa.gov/air/criteria/html

U.S. Fish & Wildlife Service. 2003a. Carolina Sandhills National Wildlife Refuge Brochure. McBee, SC. 16pp. http://library.fws.gov/Refuges/carolina_sandhills02.pdf

U.S. Fish & Wildlife Service. 2003b. Recovery Plan for the Red-cockaded Woodpecker (*Picoides borealis*)," Second Revision. Atlanta, GA. 316pp. http://www.fws.gov/rcwrecovery/recovery_plan.html

U.S. Fish and Wildlife Service. 2004. Carolina Sandhills National Wildlife Refuge – Fish Survey Report of Selected Impoundments in September 2004. Edenton, NC.

U.S. Fish and Wildlife Service. 2006a. Red-Cockaded Woodpecker Management Plan for Carolina Sandhills National Wildlife Refuge. McBee, SC. 80pp.

U.S. Fish and Wildlife Service. 2006b. Visitor Services Review Report for Carolina Sandhills National Wildlife Refuge. Atlanta, GA. 22pp.

U.S. Fish and Wildlife Service. 2007a. Annual Narrative Report 2005. Carolina Sandhills National Wildlife Refuge, McBee, SC. 62 pp.

U.S. Fish and Wildlife Service. 2007b. Carolina Sandhills National Wildlife Refuge – Biological Review Report. Columbia Migratory Bird Field Office, Columbia, NC.

U.S. Fish and Wildlife Service. 2007c. Carolina Sandhills National Wildlife Refuge Fact Sheet. McBee, SC. http://www.fws.gov/southeast/pubs/facts/crlcon.pdf

U.S. Fish and Wildlife Service. 2007d. Forestry and Fire Program Review Report to Carolina Sandhills National Wildlife Refuge. Tallahassee, FL. 51pp.

U.S. Fish and Wildlife Service. 2007e. National Bald Eagle Management Guidelines. Washington, D.C. 25 pp.

U.S. Fish and Wildlife Service. 2008. Carolina Sandhills National Wildlife Refuge Bird List. McBee, SC. 12pp. http://www.fws.gov/carolinasandhills/Assets/PDF/birdlist.pdf

U.S. Fish and Wildlife Service. 2009a. Carolina Sandhills National Wildlife Refuge Web Pages. McBee, SC
http://www.fws.gov/carolinasandhills/birdwatching.html
http://www.fws.gov/carolinasandhills/staffing.html#Staffing,
http://www.fws.gov/carolinasandhills/staffing.html#financial
http://www.fws.gov/carolinasnadhills/burning.html
http://www.fws.gov/carolinasandhills/fishing.html
http://www.fws.gov/carolinasandhills/florafauna.html
http://www.fws.gov/carolinasandhills/hiking_walking.html
http://www.fws.gov/carolinasandhills/history.html
http://www.fws.gov/carolinasandhills/hunting.html
http://www.fws.gov/carolinasandhills/objectives.html
http://www.fws.gov/carolinasandhills/longleaf.html
http://www.fws.gov/carolinasandhills/Assets/PDF/plantlist.pdf
http://www.fws.gov/carolinasandhills/florafauna.html

U.S. Fish and Wildlife Service. 2009b. Ecosystem Units. http://www.fws.gov/offices/ecounits.html

U.S. Fish and Wildlife Service, Southeast Region, Planning Division.
http://www.fws.gov/southeast/planning/index.htm

U.S. Geological Survey. 2008. USGS Water Resources of South Carolina. Water Resources Discipline, Columbia, SC.
http://sc.water.usgs.gov/water-data.html

U.S. Global Climate Change Research Program. 2006. A Report by the Climate Change Science Program (CCSP) and the Subcommittee on Global Change Research, A Supplement to the President's Fiscal Year 2006 Budget. Newtown Square, PA, 340 pp.
http://www.usgcrp.gov/usgcrp/Library/ocp2006/ocp2006-hi-eco.htm

U.S. North American Bird Conservation Initiative. 2009. Integrated Bird Conservation in the United States, NABCI-Bird Conservation, Region 27, Southeastern Coastal Plain, and NABCI-Bird Conservation, Region 29, Piedmont. Charleston, SC. .
http://www.nabci-us.org/
http://www.nabci-us.org/bcr27.html
http://www.nabci-us.org/bcr29.html

Watson, C. and K. Malloy. 2006. South Atlantic Migratory Bird Initiative Implementation Plan – An Integrated Approach to Management of All Birds Across All Habitats. Atlantic Coast Joint Venture.Charleston, SC. 91pp.
http://www.acjv.org/documents/sambi_plan.pdf

Wright, Newell O. 1978. Carolina Sandhills National Wildlife Refuge: A Cultural Resources Survey. Archaeological Research Associates, Valdosta, GA. 106 pp.

# Appendix C. Relevant Legal Mandates and Executive Orders

| STATUE | DESCRIPTION |
|---|---|
| Administrative Procedures Act (1946) | Outlines administrative procedures to be followed by federal agencies with respect to identification of information to be made public; publication of material in the Federal Register; maintenance of records; attendance and notification requirements for specific meetings and hearings; issuance of licenses; and review of agency actions. |
| American Antiquities Act of 1906 | Provides penalties for unauthorized collection, excavation, or destruction of historic or prehistoric ruins, monuments, or objects of antiquity on lands owned or controlled by the United States. The Act authorizes the President to designate as national monuments objects or areas of historic or scientific interest on lands owned or controlled by the Unites States. |
| American Indian Religious Freedom Act of 1978 | Protects the inherent right of Native Americans to believe, express, and exercise their traditional religions, including access to important sites, use and possession of sacred objects, and the freedom to worship through ceremonial and traditional rites. |
| Americans With Disabilities Act of 1990 | Intended to prevent discrimination of and make American society more accessible to people with disabilities. The Act requires reasonable accommodations to be made in employment, public services, public accommodations, and telecommunications for persons with disabilities. |
| Anadromous Fish Conservation Act of 1965, as amended | Authorizes the Secretaries of Interior and Commerce to enter into cooperative agreements with states and other non-federal interests for conservation, development, and enhancement of anadromous fish and contribute up to 50 percent as the federal share of the cost of carrying out such agreements. Reclamation construction programs for water resource projects needed solely for such fish are also authorized. |
| Archaeological Resources Protection Act of 1979, as amended. | This Act strengthens and expands the protective provisions of the Antiquities Act of 1906 regarding archaeological resources. It also revised the permitting process for archaeological research. |
| Architectural Barriers Act of 1968 | Requires that buildings and facilities designed, constructed, or altered with federal funds, or leased by a federal agency, must comply with standards for physical accessibility. |
| Bald and Golden Eagle Protection Act of 1940, as amended | Prohibits the possession, sale or transport of any bald or golden eagle, alive or dead, or part, nest, or egg except as permitted by the Secretary of the Interior for scientific or exhibition purposes, or for the religious purposes of Indians. |

| STATUE | DESCRIPTION |
|---|---|
| Bankhead-Jones Farm Tenant Act of 1937 | Directs the Secretary of Agriculture to develop a program of land conservation and utilization in order to correct maladjustments in land use and thus assist in such things as control of soil erosion, reforestation, conservation of natural resources and protection of fish and wildlife. Some early refuges and hatcheries were established under authority of this Act. |
| Cave Resources Protection Act of 1988 | Established requirements for the management and protection of caves and their resources on federal lands, including allowing the land managing agencies to withhold the location of caves from the public, and requiring permits for any removal or collecting activities in caves on federal lands. |
| Clean Air Act of 1970 | Regulates air emissions from area, stationary, and mobile sources. This Act and its amendments charge federal land managers with direct responsibility to protect the "air quality and related values" of land under their control. These values include fish, wildlife, and their habitats. |
| Clean Water Act of 1974, as amended | This Act and its amendments have as its objective the restoration and maintenance of the chemical, physical, and biological integrity of the Nation's waters. Section 401 of the Act requires that federally permitted activities comply with the Clean Water Act standards, state water quality laws, and any other appropriate state laws. Section 404 charges the U.S. Army Corps of Engineers with regulating discharge of dredge or fill materials into waters of the United States, including wetlands. |
| Coastal Barrier Resources Act of 1982 (CBRA) | Identifies undeveloped coastal barriers along the Atlantic and Gulf Coasts and included them in the John H. Chafee Coastal Barrier Resources System (CBRS). The objectives of the act are to minimize loss of human life, reduce wasteful federal expenditures, and minimize the damage to natural resources by restricting most federal expenditures that encourage development within the CBRS. |
| Coastal Barrier Improvement Act of 1990 | Reauthorized the Coastal Barrier Resources Act (CBRA), expanded the CBRS to include undeveloped coastal barriers along the Great Lakes and in the Caribbean, and established "Otherwise Protected Areas (OPAs)." The Service is responsible for maintaining official maps, consulting with federal agencies that propose spending federal funds within the CBRS and OPAs, and making recommendations to Congress about proposed boundary revisions. |
| Coastal Wetlands Planning, Protection, and Restoration (1990) | Authorizes the Director of the Fish and Wildlife Service to participate in the development of a Louisiana coastal wetlands restoration program, participate in the development and oversight of a coastal wetlands conservation program, and lead in the implementation and administration of a national coastal wetlands grant program. |

| STATUE | DESCRIPTION |
|---|---|
| Coastal Zone Management Act of 1972, as amended | Established a voluntary national program within the Department of Commerce to encourage coastal states to develop and implement coastal zone management plans and requires that “any federal activity within or outside of the coastal zone that affects any land or water use or natural resource of the coastal zone” shall be “consistent to the maximum extent practicable with the enforceable policies” of a state’s coastal zone management plan. The law includes an Enhancement Grants Program for protecting, restoring, or enhancing existing coastal wetlands or creating new coastal wetlands. It also established the National Estuarine Research Reserve System, guidelines for estuarine research, and financial assistance for land acquisition. |
| Emergency Wetlands Resources Act of 1986 | This Act authorized the purchase of wetlands from Land and Water Conservation Fund moneys, removing a prior prohibition on such acquisitions. The Act requires the Secretary to establish a National Wetlands Priority Conservation Plan, required the states to include wetlands in their Comprehensive Outdoor Recreation Plans, and transfers to the Migratory Bird Conservation Fund amounts equal to import duties on arms and ammunition. It also established entrance fees at national wildlife refuges. |
| Endangered Species Act of 1973, as amended | Provides for the conservation of threatened and endangered species of fish, wildlife, and plants by federal action and by encouraging the establishment of state programs. It provides for the determination and listing of threatened and endangered species and the designation of critical habitats. Section 7 requires refuge managers to perform internal consultation before initiating projects that affect or may affect endangered species. |
| Environmental Education Act of 1990 | This Act established the Office of Environmental Education within the U.S. Environmental Protection Agency to develop and administer a federal environmental education program in consultation with other federal natural resource management agencies, including the Fish and Wildlife Service. |
| Estuary Protection Act of 1968 | Authorized the Secretary of the Interior, in cooperation with other federal agencies and the states, to study and inventory estuaries of the United States, including land and water of the Great Lakes, and to determine whether such areas should be acquired for protection. The Secretary is also required to encourage state and local governments to consider the importance of estuaries in their planning activities relative to federal natural resource grants. In approving any state grants for acquisition of estuaries, the Secretary was required to establish conditions to ensure the permanent protection of estuaries. |

| STATUE | DESCRIPTION |
|---|---|
| Estuaries and Clean Waters Act of 2000 | This law creates a federal interagency council that includes the Director of the Fish and Wildlife Service, the Secretary of the Army for Civil Works, the Secretary of Agriculture, the Administrator of the Environmental Protection Agency and the Administrator for the National Oceanic and Atmospheric Administration. The council is charged with developing a national estuary habitat restoration strategy and providing grants to entities to restore and protect estuary habitat to promote the strategy. |
| Food Security Act of 1985, as amended (Farm Bill) | The Act contains several provisions that contribute to wetland conservation. The Swampbuster provisions state that farmers who convert wetlands for the purpose of planting after enactment of the law are ineligible for most farmer program subsidies. It also established the Wetland Reserve Program to restore and protect wetlands through easements and restoration of the functions and values of wetlands on such easement areas. |
| Farmland Protection Policy Act of 1981, as amended | The purpose of this law is to minimize the extent to which federal programs contribute to the unnecessary conversion of farmland to nonagricultural uses. Federal programs include construction projects and the management of federal lands. |
| Federal Advisory Committee Act (1972), as amended | Governs the establishment of and procedures for committees that provide advice to the federal government. Advisory committees may be established only if they will serve a necessary, nonduplicative function. Committees must be strictly advisory unless otherwise specified and meetings must be open to the public. |
| Federal Coal Leasing Amendment Act of 1976 | Provided that nothing in the Mining Act, the Mineral Leasing Act, or the Mineral Leasing Act for Acquired Lands authorized mining coal on refuges. |
| Federal-Aid Highways Act of 1968 | Established requirements for approval of federal highways through national wildlife refuges and other designated areas to preserve the natural beauty of such areas. The Secretary of Transportation is directed to consult with the Secretary of the Interior and other federal agencies before approving any program or project requiring the use of land under their jurisdiction. |
| Federal Noxious Weed Act of 1990, as amended | The Secretary of Agriculture was given the authority to designate plants as noxious weeds and to cooperate with other federal, State and local agencies, farmers' associations, and private individuals in measures to control, eradicate, prevent, or retard the spread of such weeds. The Act requires each Federal land-managing agency, including the Fish and Wildlife Service, to designate an office or person to coordinate a program to control such plants on the agency's land and implement cooperative agreements with the states, including integrated management systems to control undesirable plants. |

| STATUE | DESCRIPTION |
|---|---|
| Fish and Wildlife Act of 1956 | Establishes a comprehensive national fish, shellfish, and wildlife resources policy with emphasis on the commercial fishing industry but also includes the inherent right of every citizen and resident to fish for pleasure, enjoyment, and betterment and to maintain and increase public opportunities for recreational use of fish and wildlife resources. Among other things, it authorizes the Secretary of the Interior to take such steps as may be required for the development, advancement, management, conservation, and protection of fish and wildlife resources including, but not limited to, research, development of existing facilities, and acquisition by purchase or exchange of land and water or interests therein. |
| Fish and Wildlife Conservation Act of 1980, as amended | Requires the Service to monitor non-gamebird species, identify species of management concern, and implement conservation measures to preclude the need for listing under the Endangered Species Act. |
| Fish and Wildlife Coordination Act of 1958 | Promotes equal consideration and coordination of wildlife conservation with other water resource development programs by requiring consultation with the Fish and Wildlife Service and the state fish and wildlife agencies where the "waters of a stream or other body of water are proposed or authorized, permitted or licensed to be impounded, diverted…or otherwise controlled or modified" by any agency under federal permit or license. |
| Improvement Act of 1978 | This act was passed to improve 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 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 volunteer programs. |
| Fishery (Magnuson) Conservation and Management Act of 1976 | Established Regional Fishery Management Councils comprised of federal and state officials, including the Fish and Wildlife Service. It provides for regulation of foreign fishing and vessel fishing permits. |
| Freedom of Information Act, 1966 | Requires all federal agencies to make available to the public for inspection and copying administrative staff manuals and staff instructions; official, published and unpublished policy statements; final orders deciding case adjudication; and other documents. Special exemptions have been reserved for nine categories of privileged material. The Act requires the party seeking the information to pay reasonable search and duplication costs. |
| Geothermal Steam Act of 1970, as amended | Authorizes and governs the lease of geothermal steam and related resources on public lands. Section 15 c of the Act prohibits issuing geothermal leases on virtually all Service-administrative lands. |

| STATUE | DESCRIPTION |
|---|---|
| Lacey Act of 1900, as amended | Originally designed to help states protect their native game animals and to safeguard U.S. crop production from harmful foreign species, this Act prohibits interstate and international transport and commerce of fish, wildlife or plants taken in violation of domestic or foreign laws. It regulates the introduction to America of foreign species. |
| Land and Water Conservation Fund Act of 1948 | This Act provides funding through receipts from the sale of surplus federal land, appropriations from oil and gas receipts from the outer continental shelf, and other sources for land acquisition under several authorities. Appropriations from the fund may be used for matching grants to states for outdoor recreation projects and for land acquisition by various federal agencies, including the Fish and Wildlife Service. |
| Marine Mammal Protection Act of 1972, as amended | The 1972 Marine Mammal Protection Act established a federal responsibility to conserve marine mammals with management vested in the Department of the Interior for sea otter, walrus, polar bear, dugong, and manatee. The Department of Commerce is responsible for cetaceans and pinnipeds, other than the walrus. With certain specified exceptions, the Act establishes a moratorium on the taking and importation of marine mammals, as well as products taken from them. |
| Migratory Bird Conservation Act of 1929 | Established a Migratory Bird Conservation Commission to approve areas recommended by the Secretary of the Interior for acquisition with Migratory Bird Conservation Funds. The role of the commission was expanded by the North American Wetland Conservation Act to include approving wetlands acquisition, restoration, and enhancement proposals recommended by the North American Wetlands Conservation Council. |
| Migratory Bird Hunting and Conservation Stamp Act of 1934 | Also commonly referred to as the “Duck Stamp Act,” requires waterfowl hunters 16 years of age or older to possess a valid federal hunting stamp. Receipts from the sale of the stamp are deposited into the Migratory Bird Conservation Fund for the acquisition of migratory bird refuges. |
| Migratory Bird Treaty Act of 1918, as amended | This Act implements various treaties and conventions between the United States and Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. Except as allowed by special regulations, this Act makes it unlawful to pursue, hunt, kill, capture, possess, buy, sell, purchase, barter, export or import any migratory bird, part, nest, egg, or product. |
| Mineral Leasing Act for Acquired Lands (1947), as amended | Authorizes and governs mineral leasing on acquired public lands. |

| STATUE | DESCRIPTION |
|---|---|
| Minerals Leasing Act of 1920, as amended | Authorizes and governs leasing of public lands for development of deposits of coal, oil, gas, and other hydrocarbons; sulphur; phosphate; potassium; and sodium. Section 185 of this title contains provisions relating to granting rights-of-way over federal lands for pipelines. |
| Mining Act of 1872, as amended | Authorizes and governs prospecting and mining for the so-called "hardrock" minerals (i.e., gold and silver) on public lands. |
| National and Community Service Act of 1990 | Authorizes several programs to engage citizens of the U.S. in full- and/or part-time projects designed to combat illiteracy and poverty, provide job skills, enhance educational skills, and fulfill environmental needs. Among other things, this law establishes the American Conservation and Youth Service Corps to engage young adults in approved human and natural resource projects, which will benefit the public or are carried out on federal or Indian lands. |
| National Environmental Policy Act of 1969 | Requires analysis, public comment, and reporting for environmental impacts of federal actions. It stipulates the factors to be considered in environmental impact statements, and requires that federal agencies employ an interdisciplinary approach in related decision-making and develop means to ensure that unqualified environmental values are given appropriate consideration, along with economic and technical considerations. |
| National Historic Preservation Act of 1966, as amended | It establishes a National Register of Historic Places and a program of matching grants for preservation of significant historical features. Federal agencies are directed to take into account the effects of their actions on items or sites listed or eligible for listing in the National Register. |
| National Trails System Act (1968), as amended | Established the National Trails System to protect the recreational, scenic, and historic values of some important trails. National recreation trails may be established by the Secretaries of Interior or Agriculture on land wholly or partly within their jurisdiction, with the consent of the involved state(s), and other land managing agencies, if any. National scenic and national historic trails may only be designated by Congress. Several national trails cross units of the National Wildlife Refuge System. |
| National Wildlife Refuge System Administration Act of 1966 | Prior to 1966, there was no single federal law that governed the administration of the various national wildlife refuges that had been established. This Act defines the National Wildlife Refuge System and authorizes the Secretary of the Interior to permit any use of a refuge provided such use is compatible with the major purposes(s) for which the refuge was established. |

| STATUE | DESCRIPTION |
|---|---|
| National Wildlife Refuge System Improvement Act of 1997 | This Act amends the National Wildlife Refuge System Administration Act of 1966. This Act defines the mission of the National Wildlife Refuge System, establishes the legitimacy and appropriateness of six priority wildlife-dependent public uses, establishes a formal process for determining compatible uses of Refuge System lands, identifies the Secretary of the Interior as responsible for managing and protecting the Refuge System, and requires the development of a comprehensive conservation plan for all refuges outside of Alaska. |
| Native American Graves Protection and Repatriation Act of 1990 | Requires federal agencies and museums to inventory, determine ownership of, and repatriate certain cultural items and human remains under their control or possession. The Act also addresses the repatriation of cultural items inadvertently discovered by construction activities on lands managed by the agency. |
| Neotropical Migratory Bird Conservation Act of 2000 | Establishes a matching grant program to fund projects that promote the conservation of neotropical migratory birds in the united States, Latin America, and the Caribbean. |
| North American Wetlands Conservation Act of 1989 | Provides funding and administrative direction for implementation of the North American Waterfowl Management Plan and the Tripartite Agreement on wetlands between Canada, the United States, and Mexico. The North American Wetlands Conservation Council was created to recommend projects to be funded under the Act to the Migratory Bird Conservation Commission. Available funds may be expended for up to 50 percent of the United States' share cost of wetlands conservation projects in Canada, Mexico, or the United States (or 100 percent of the cost of projects on federal lands). |
| Refuge Recreation Act of 1962, as amended | This Act authorizes the Secretary of the Interior to administer refuges, hatcheries, and other conservation areas for recreational use, when such uses do not interfere with the area's primary purposes. It authorizes construction and maintenance of recreational facilities and the acquisition of land for incidental fish and wildlife-oriented recreational development or protection of natural resources. It also authorizes the charging of fees for public uses. |
| Partnerships for Wildlife Act of 1992 | Establishes a Wildlife Conservation and Appreciation Fund to receive appropriated funds and donations from the National Fish and Wildlife Foundation and other private sources to assist the state fish and game agencies in carrying out their responsibilities for conservation of non-game species. The funding formula is no more that 1/3 federal funds, at least 1/3 foundation funds, and at least 1/3 state funds. |

| STATUE | DESCRIPTION |
|---|---|
| Refuge Revenue Sharing Act of 1935, as amended | Provided for payments to counties in lieu of taxes from areas administered by the Fish and Wildlife Service. Counties are required to pass payments along to other units of local government within the county, which suffer losses in tax revenues due to the establishment of Service areas. |
| Rehabilitation Act of 1973 | Requires nondiscrimination in the employment practices of federal agencies of the executive branch and contractors. It also requires all federally assisted programs, services, and activities to be available to people with disabilities. |
| Rivers and Harbors Appropriations Act of 1899, as amended | 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. The Fish and Wildlife Coordination Act provides authority for the Service to review and comment on the effects on fish and wildlife activities proposed to be undertaken or permitted by the Corps of Engineers. Service concerns include contaminated sediments associated with dredge or fill projects in navigable waters. |
| Sikes Act (1960), as amended | Provides for the cooperation by the Departments of Interior and Defense with state agencies in planning, development, and maintenance of fish and wildlife resources and outdoor recreation facilities on military reservations throughout the United States. It requires the Secretary of each military department to use trained professionals to manage the wildlife and fishery resource under his jurisdiction, and requires that federal and state fish and wildlife agencies be given priority in management of fish and wildlife activities on military reservations. |
| Transfer of Certain Real Property for Wildlife Conservation Purposes Act of 1948 | This Act provides that upon 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. |
| Transportation Equity Act for the 21st Century (1998) | Established the Refuge Roads Program, requires transportation planning that includes public involvement, and provides funding for approved public use roads and trails and associated parking lots, comfort stations, and bicycle/pedestrian facilities. |
| 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. |

| STATUE | DESCRIPTION |
|---|---|
| Water Resources Planning Act of 1965 | Established Water Resources Council to be composed of Cabinet representatives including the Secretary of the Interior. The Council reviews river basin plans with respect to agricultural, urban, energy, industrial, recreational and fish and wildlife needs. The act also established a grant program to assist States in participating in the development of related comprehensive water and land use plans. |
| Wild and Scenic Rivers Act of 1968, as amended | This Act selects certain rivers of the nation possessing remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values; preserves them in a free-flowing condition; and protects their local environments. |
| Wilderness Act of 1964, as amended | This Act directs the Secretary of the Interior to review every roadless area of 5,000 acres or more and every roadless island regardless of size within the National Wildlife Refuge System and to recommend suitability of each such area. The Act permits certain activities within designated wilderness areas that do not alter natural processes. Wilderness values are preserved through a “minimum tool” management approach, which requires refuge managers to use the least intrusive methods, equipment, and facilities necessary for administering the areas. |
| Youth Conservation Corps Act of 1970 | Established a permanent Youth Conservation Corps (YCC) program within the Departments of Interior and Agriculture. Within the Service, YCC participants perform many tasks on refuges, fish hatcheries, and research stations. |

| EXECUTIVE ORDERS | DESCRIPTIONS |
|---|---|
| EO 11593, Protection and Enhancement of the Cultural Environment (1971) | States that if the Service proposes any development activities that may affect the archaeological or historic sites, the Service will consult with Federal and State Historic Preservation Officers to comply with Section 106 of the National Historic Preservation Act of 1966, as amended. |
| EO 11644, Use of Off-road Vehicles on Public Land (1972) | Established policies and procedures to ensure that the use of off-road vehicles on public lands will be controlled and directed so as to protect the resources of those lands, to promote the safety of all users of those lands, and to minimize conflicts among the various uses of those lands. |
| EO 11988, Floodplain Management (1977) | The purpose of this Executive Order is to prevent federal agencies from contributing to the "adverse impacts associated with occupancy and modification of floodplains" and the "direct or indirect support of floodplain development." In the course of fulfilling their respective authorities, federal agencies "shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains." |
| EO 11989 (1977), Amends Section 2 of EO 11644 | Directs agencies to close areas negatively impacted by off-road vehicles. |
| EO 11990, Protection of Wetlands (1977) | Federal agencies are directed to provide leadership and take action to minimize the destruction, loss of degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. |
| EO 12372, Intergovernmental Review of Federal Programs (1982) | Seeks to foster intergovernmental partnerships by requiring federal agencies to use the state process to determine and address concerns of state and local elected officials with proposed federal assistance and development programs. |
| EO 12898, Environmental Justice (1994) | Requires federal agencies to identify and address disproportionately high and adverse effects of its programs, policies, and activities on minority and low-income populations. |

| EXECUTIVE ORDERS | DESCRIPTIONS |
|---|---|
| EO 12906, Coordinating Geographical Data Acquisition and Access (1994), Amended by EO 13286 (2003). Amendment of EOs and other actions in connection with transfer of certain functions to Secretary of DHS. | Recommended that the executive branch develop, in cooperation with state, local, and tribal governments, and the private sector, a coordinated National Spatial Data Infrastructure to support public and private sector applications of geospatial data. Of particular importance to comprehensive conservation planning is the National Vegetation Classification System (NVCS), which is the adopted standard for vegetation mapping. Using NVCS facilitates the compilation of regional and national summaries, which in turn, can provide an ecosystem context for individual refuges. |
| EO 12962, Recreational Fisheries (1995) | Federal agencies are directed to improve the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing opportunities in cooperation with states and tribes. |
| EO 13007, Native American Religious Practices (1996) | Provides for access to, and ceremonial use of, Indian sacred sites on federal lands used by Indian religious practitioners and direction to avoid adversely affecting the physical integrity of such sites. |
| EO 13061, Federal Support of Community Efforts Along American Heritage Rivers (1997) | Established the American Heritage Rivers initiative for the purpose of natural resource and environmental protection, economic revitalization, and historic and cultural preservation. The Act directs Federal agencies to preserve, protect, and restore rivers and their associated resources important to our history, culture, and natural heritage. |
| EO 13084, Consultation and Coordination With Indian Tribal Governments (2000) | Provides a mechanism for establishing regular and meaningful consultation and collaboration with tribal officials in the development of federal policies that have tribal implications. |
| EO 13112, Invasive Species (1999) | Federal agencies are directed to prevent the introduction of invasive species, detect and respond rapidly to and control populations of such species in a cost effective and environmentally sound manner, accurately monitor invasive species, provide for restoration of native species and habitat conditions, conduct research to prevent introductions and to control invasive species, and promote public education on invasive species and the means to address them. This EO replaces and rescinds EO 11987, Exotic Organisms (1977). |

| EXECUTIVE ORDERS | DESCRIPTIONS |
|---|---|
| EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds. (2001) | Instructs federal agencies to conserve migratory birds by several means, including the incorporation of strategies and recommendations found in Partners in Flight Bird Conservation plans, the North American Waterfowl Plan, the North American Waterbird Conservation Plan, and the United States Shorebird Conservation Plan, into agency management plans and guidance documents. |

# *Appendix D. Public Involvement*

## SUMMARY OF PUBLIC SCOPING COMMENTS

### Carolina Sandhills NWR, Intergovernmental Meeting, Sept. 10, 2007, 1-3 pm, Refuge HQ

**Attendees**

Jason Ayers, Biologist, USFWS, 176 Croghan Spur Rd, Ste. 200, Charleston, SC 29407, jason-ayers@fws.gov, 843-727-4707, ext. 219
Steve Bennett, Herpetologist, SCDNR, P.O. Box 167, Columbia, SC 29202, BennettS@dnr.sc.gov, 803-734-3930
Janet Clarke, Environmental Health Manager., SCDHEC, EQC, 2600 Bull St., Columbia, SC 29201, ClarkeJR@dhec.sc.gov, 803-896-8954
Molly Ellwood, SCPRT, 100 State Park Rd, Cheraw, SC 29520, mellwood@scprt.com, 843-537-9656
Elizabeth Osier, SCDNR, 2007 Pisgah Rd, Florence, SC 29501, osiere@dnr.sc.gov, 843-661-4767
Lynn Quattro, CWCS Coordinator, SCDNR, P.O. Box 167, Columbia, SC 29202, QuattroL@dnr.sc.gov, 803-734-9094
Scott Reynolds, SCDHEC, Div. Air Quality Analyses, 8231 Parklane Rd, Columbia, SC 29223, reynolds@dhec.sc.gov, 803-896-0902
Cynthia Sanders, SCDNR, 2007 Pisgah Rd, Florence, SC 29501, sandersc@dnr.sc.gov, 843-661-4767
Richard Smith, Park Manager, SCPRT, Cheraw State Park, 100 State Park Rd, Cheraw, SC 29520, rsmith@scprt.com, 843-537-9656
Sam Stokes, Wildlife Coordinator, SCDNR, 2007 Pisgah Rd, Florence, SC 29501, stokess@DNR.SC.gov, 843-661-4761

**Refuge Staff**

Lyne Askins, Project Leader, USFWS, Carolina Sandhills NWR, 23734 U.S. Highway 1, McBee, SC 29101, Allyne_Askins@fws.gov, 843-335-6023
Don Cockman, Deputy Project Leader, USFWS, Carolina Sandhills NWR, 23734 U.S. Highway 1, McBee, SC 29101, Don_Cockman@fws.gov, 843-335-8401
Jack Culpepper, Forester, USFWS, Carolina Sandhills NWR, 23734 U.S. Highway 1, McBee, SC 29101, jack_culpepper@fws.gov, 843-335-8401

Charles McEntyre, Planner, Facilitator, U.S. Tennessee Valley Authority (TVA), 1101 Market Street, Chattanooga, TN 37402, clmcentyre@tva.gov, 423-751-4123

Agenda
CCP Overview – Lyne Askins
Refuge Overview – Don Cockman
Hand out draft vision and goals – Charles McEntyre
Discussion
Determining priority issues and alternatives (product was draft Table 10 in EA Chapter III)

## Comments

Wildlife

Do you have cougars on your property? No actual sightings in years (DC)
How do you sample fish – electroshocking and seining, gill netting. We only manage a handful of ponds due to acidic waters, low productivity. Example: Mays lake stocking. Not ready to be re-opened this year as planned.
DNR has a sampling site – high diversity, low numbers.
Has there been a sandhills chub captured – yes. Believe so and we can provide you the reports.
Have another site up the road, characteristic sandhills soils. Same findings.
Do you plan major change from what you are doing? Game seasons? Native warm season grasses?
Monitoring (Sammy)? Grassland birds?
Reptiles and amphibians – unique and special place (Steve). Endangered and threatened
Spotted turtle, s. hog nose – species in need of mgmt - threatened
Tiger Salamander, Pine snake
Pine barrens tree frog (PBTF) – create more habitat by opening up habitat – most important place in SC, need to monitor
Pine snake – fossorial, seldom above ground – stump holes – leave them
Refuge as lab for University research, etc.
Pbtf – Oxpen – seeps – growing season burns, burning into the ecotones
Species of conservation need (future T&E species) – species on the edge (LQ)
Does the DNR feel comfortable with the amount of public use that we have (DC)?
We don't hunt squirrels or waterfowl.
Pine straw and litter matrix – critically important to small vertebrates, moisture control is extremely important, continue ban on pine straw raking

Habitat

Growing season burns
Continue to burn into the heads, don't disk out the wetlands
Water, Air – no industry in the middle of a wildlife refuge
Is most of the land around the refuge in private ownership? Yes (DC)
National air toxics trends site at Ruby, ambient air quality
Would like to be there for a while to provide context for what's going in the cities.
Rainfall data, rain chemistries not done at this point, could add if is interest in this.
Ethanol plants, selling water to NC, permits web site
I-73 – putting smoke on the interstate
Are you working with land trusts to identify lands needing conservation? Need to work with LT to identify these lands and promote management.
What are long-range plans for inholdings? Acquire as possible.
LE – partners w/ SHSF, Chesterfield Co, DNR, pine straw raking, is it a problem?
DHEC – criminal division for illegal dumping (construction), solid waster violation

Cultural resources

Partnerships and public relations
Existing Environmental Education. Is as requested; partner with local schools, YMCA, applied for grant for all 4th-5th grades in Darlington County; last year over 200 students, trying to recruit volunteers
Recreation – environmental education association of SC, might be able to volunteering, grants, local hunting and fishing clubs
What kind of fishing opportunities do you provide -- do you need technical assistance?

Comments from the public:

1. At one time, refuge was of interest to the community, it had an agricultural basis…it grew watermelons, corn, grains. This is no longer done. There is less community interest in the refuge. Agriculture and wildlife are compatible uses and the speaker does not understand why the refuge does not focus more on agriculture as it did in the past. The speaker appreciated the presentations, but is more interested in how the community can benefit from the refuge.

   The speaker also expressed concern about water resources, particularly groundwater and its relationship to the fishing area on the refuge. He stated that the area is a growing retirement community and people want to come for the open space and recreation possibilities (e.g., fishing). The fishing is not good now. The refuge is interested in RCWs but the public could "care less" because it offers no benefit to the community. He stated that people want to identify with the refuge where humans can get something from it.

   The speaker stated that he was concerned about burning when perfectly good pine straw was going up in flames. The pine straw could be raked and sold and the funds could be used to benefit the refuge…it could be used to manage/restock the lakes with fish. He also stated that people want to use the refuge to hunt quail and turkey and that they do not care about migratory birds (note: the way he stated this lead me to believe he may have been referring to ducks as the "migratory birds.")

2. The refuge is ¼ of Chesterfield County. At one time the lakes were good, but the refuge is not filling the ponds anymore. He believes the reason for this is fear of sand coming in and washing out the dams. Lake Bee used to be a huge recreation area, now it is seldom used. People used to come and enjoy the refuge but no one comes anymore. The camping area is not being used. Why doesn't the refuge allow more water in the ponds? A lot of land is blocked off from public use (roads) and people cannot get in. The refuge is a big part of the county. Residents could get more out of the refuge if it was more accessible, particularly Lake Bee.

3. The speaker suggested that the refuge put in a hiking trail to access the beautiful natural areas along an old tram way. This would let people get a glimpse of history. Include signs and interpretation of historical information, plant information, etc.

4. The speaker reiterated that pine straw is worth more now and should be raked and sold to finance refuge operations (different speaker than #1). It is a great source of income. Wondered why raking would not do the same thing as fire to protect against wildfires.

# *Appendix E. Appropriate Use Determinations*

**Carolina Sandhills National Wildlife Refuge Appropriate Use Determinations**

An appropriate use determination is the initial decision process a refuge manager follows when first considering whether or not to allow a proposed use on a refuge. The refuge manager must find that a use is appropriate before undertaking a compatibility review of the use. This process clarifies and expands on the compatibility determination process by describing when refuge managers should deny a proposed use without determining compatibility. If a proposed use is not appropriate, it will not be allowed and a compatibility determination will not be undertaken.

Except for the uses noted below, the refuge manager must decide if a new or existing use is an appropriate refuge use. If an existing use is not appropriate, the refuge manager will eliminate or modify the use as expeditiously as practicable. If a new use is not appropriate, the refuge manager will deny the use without determining compatibility. Uses that have been administratively determined to be appropriate are:

- Six wildlife-dependent recreational uses - As defined by the National Wildlife Refuge System Improvement Act of 1997, the six wildlife-dependent recreational uses (hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation) are determined to be appropriate. However, the refuge manager must still determine if these uses are compatible.

- Take of fish and wildlife under state regulations - States have regulations concerning take of wildlife that includes hunting, fishing, and trapping. The Service considers take of wildlife under such regulations appropriate. However, the refuge manager must determine if the activity is compatible before allowing it on a refuge.

**Statutory Authorities for this policy:**

**National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997, 16 U.S.C. 668dd-668ee.** This law provides the authority for establishing policies and regulations governing refuge uses, including the authority to prohibit certain harmful activities. The Act does not authorize any particular use, but rather authorizes the Secretary of the Interior to allow uses only when they are compatible and "under such regulations as he may prescribe." This law specifically identifies certain public uses that, when compatible, are legitimate and appropriate uses within the Refuge System. The law states ". . . it is the policy of the United States that . . .compatible wildlife-dependent recreation is a legitimate and appropriate general public use of the System . . .compatible wildlife-dependent recreational uses are the priority general public uses of the System and shall receive priority consideration in refuge planning and management; and . . . when the Secretary determines that a proposed wildlife-dependent recreational use is a compatible use within a refuge, that activity should be facilitated . . . the Secretary shall . . . ensure that priority general public uses of the System receive enhanced consideration over other general public uses in planning and management within the System . . . ." The law also states "in administering the System, the Secretary is authorized to take the following actions: . . . issue regulations to carry out this Act." This policy implements the standards set in the Act by providing enhanced consideration of priority general public uses and ensuring other public uses do not interfere with our ability to provide quality, wildlife-dependent recreational uses.

**Refuge Recreation Act of 1962, 16 U.S.C. 460k.** The Act authorizes the Secretary of the Interior to administer refuges, hatcheries, and other conservation areas for recreational use, when such uses do not interfere with the area's primary purposes. It authorizes construction and maintenance of recreational facilities and the acquisition of land for incidental fish and wildlife oriented recreational development or protection of natural resources. It also authorizes the charging of fees for public uses.

**Other Statutes that Establish Refuges, including the Alaska National Interest Lands Conservation Act of 1980 (ANILCA) (16 U.S.C. 410hh - 410hh-5, 460 mm - 460mm-4, 539-539e, and 3101 - 3233; 43 U.S.C. 1631 et seq.).**

**Executive Orders.** The Service must comply with Executive Order 11644 when allowing use of off-highway vehicles on refuges. This order requires the Service to designate areas as open or closed to off-highway vehicles in order to protect refuge resources, promote safety, and minimize conflict among the various refuge users; monitor the effects of these uses once they are allowed; and amend or rescind any area designation as necessary based on the information gathered. Furthermore, Executive Order 11989 requires the Service to close areas to off-highway vehicles when it is determined that the use causes or will cause considerable adverse effects on the soil, vegetation, wildlife, habitat, or cultural or historic resources. Statutes, such as ANILCA, take precedence over executive orders.

**Definitions:**

*Appropriate Use*
A proposed or existing use on a refuge that meets at least one of the following four conditions.

1) The use is a wildlife-dependent recreational use as identified in the Improvement Act.
2) The use contributes to fulfilling the refuge purpose(s), the Refuge System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997, the date the Improvement Act was signed into law.
3) The use involves the take of fish and wildlife under state regulations.
4) The use has been found to be appropriate as specified in section 1.11.

*Native American***.** American Indians in the conterminous United States and Alaska Natives (including Aleuts, Eskimos, and Indians) who are members of federally recognized tribes.

*Priority General Public Use*. A compatible wildlife-dependent recreational use of a refuge involving hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation.

*Quality*. The criteria used to determine a quality recreational experience include:

- Promotes safety of participants, other visitors, and facilities.
- Promotes compliance with applicable laws and regulations and responsible behavior.
- Minimizes or eliminates conflicts with fish and wildlife population or habitat goals or objectives in a plan approved after 1997.
- Minimizes or eliminates conflicts with other compatible wildlife-dependent recreation.
- Minimizes conflicts with neighboring landowners.
- Promotes accessibility and availability to a broad spectrum of the American people.
- Promotes resource stewardship and conservation.

- Promotes public understanding and increases public appreciation of America's natural resources and the Service's role in managing and protecting these resources.
- Provides reliable/reasonable opportunities to experience wildlife.
- Uses facilities that are accessible and blend into the natural setting.
- Uses visitor satisfaction to help define and evaluate programs.

*Wildlife-Dependent Recreational Use*. As defined by the Improvement Act, a use of a refuge involving hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation.

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: __Carolina Sandhills NWR_____

Use: __Cooperative Farming_____

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or Step-down plan approved after October 9, 1997.

| Decision Criteria | Yes | No |
|---|---|---|
| (a) Do we have jurisdiction over the use? | X | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, local) | X | |
| (c) Is the use consistent with applicable Executive Orders and Department and Service policies? | X | |
| (d) Is the use consistent with public safety? | X | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | X | |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | X | |
| (g) Is the use manageable within available budget and staff? | X | |
| (h) Will this manageable in the future within existing resources? | X | |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | X | |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | X | |

Where we do not have jurisdiction of the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with exiting policy, or unsafe ("no" to (b), (c), or (d) may not be found appropriate. If the answer is no to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted the State fish and wildlife agencies. **Yes____** **No _X**
When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on the overall assessment of these factors, my summary conclusion is that the proposed use is

**Not Appropriate____** **Appropriate _X**

Refuge Manager_____ Date_____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside of the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor _____ Date _____

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: ____Carolina Sandhills NWR_____

Use: __Commercial Timber Harvest for Wildlife Habitat Improvement _____

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or Step-down plan approved after October 9, 1997.

| Decision Criteria | Yes | No |
|---|---|---|
| (a) Do we have jurisdiction over the use? | X | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, local) | X | |
| (c) Is the use consistent with applicable Executive Orders and Department and Service policies? | X | |
| (d) Is the use consistent with public safety? | X | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | X | |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | X | |
| (g) Is the use manageable within available budget and staff? | X | |
| (h) Will this manageable in the future within existing resources? | X | |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | X | |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | X | |

Where we do not have jurisdiction of the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with exiting policy, or unsafe ("no" to (b), (c), or (d) may not be found appropriate. If the answer is no to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted the State fish and wildlife agencies. **Yes_X___ No_____**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on the overall assessment of these factors, my summary conclusion is that the proposed use is

**Not Appropriate____ Appropriate _X__**

Refuge Manager_____ Date_____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside of the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor _____ Date _____

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: ___Carolina Sandhills NWR_____

Use: __Boating (electric motors and non-motorized)_____

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or Step-down plan approved after October 9, 1997.

| Decision Criteria | Yes | No |
|---|---|---|
| (a) Do we have jurisdiction over the use? | X | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, local) | X | |
| (c) Is the use consistent with applicable Executive Orders and Department and Service policies? | X | |
| (d) Is the use consistent with public safety? | X | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | X | |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | X | |
| (g) Is the use manageable within available budget and staff? | X | |
| (h) Will this manageable in the future within existing resources? | X | |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | X | |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | X | |

Where we do not have jurisdiction of the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with exiting policy, or unsafe ("no" to (b), (c), or (d) may not be found appropriate. If the answer is no to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted the State fish and wildlife agencies. **Yes_____ No__X__**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on the overall assessment of these factors, my summary conclusion is that the proposed use is

**Not Appropriate_____ Appropriate__X__**

Refuge Manager_____ Date_____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside of the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor _____ Date _____

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: ___Carolina Sandhills NWR_____

Use: ___Public Safety Training and Military Ground and Air Exercises_____

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or Step-down plan approved after October 9, 1997.

| Decision Criteria | Yes | No |
|---|---|---|
| (a) Do we have jurisdiction over the use? | X | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, local) | X | |
| (c) Is the use consistent with applicable Executive Orders and Department and Service policies? | X | |
| (d) Is the use consistent with public safety? | X | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | X | |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | X | |
| (g) Is the use manageable within available budget and staff? | X | |
| (h) Will this manageable in the future within existing resources? | X | |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | | X |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | X | |

Where we do not have jurisdiction of the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with exiting policy, or unsafe ("no" to (b), (c), or (d) may not be found appropriate. If the answer is no to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted the State fish and wildlife agencies. **Yes_____ No__X__**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on the overall assessment of these factors, my summary conclusion is that the proposed use is

**Not Appropriate_____ Appropriate__X___**

Refuge Manager_____ Date_____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside of the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor _____ Date _____

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: ___Carolina Sandhills NWR_____

Use: _Natural Resource Collection (personal use firewood cutting and collection, pine cone collecting and pine straw raking)_ _____

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or Step-down plan approved after October 9, 1997.

| Decision Criteria | Yes | No |
|---|---|---|
| (a) Do we have jurisdiction over the use? | X | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, local) | X | |
| (c) Is the use consistent with applicable Executive Orders and Department and Service policies? | X | |
| (d) Is the use consistent with public safety? | X | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | X | |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | X | |
| (g) Is the use manageable within available budget and staff? | X | |
| (h) Will this manageable in the future within existing resources? | X | |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | X | |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | X | |

Where we do not have jurisdiction of the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with exiting policy, or unsafe ("no" to (b), (c), or (d) may not be found appropriate. If the answer is no to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted the State fish and wildlife agencies. **Yes_____ No__X__**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on the overall assessment of these factors, my summary conclusion is that the proposed use is

**Not Appropriate_____ Appropriate__X__**

Refuge Manager_____ Date_____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside of the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor _____ Date _____

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: ___Carolina Sandhills NWR_____

Use: ____Cemetery Upkeep_____

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or Step-down plan approved after October 9, 1997.

| Decision Criteria | Yes | No |
|---|---|---|
| (a) Do we have jurisdiction over the use? | X | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, local) | X | |
| (c) Is the use consistent with applicable Executive Orders and Department and Service policies? | X | |
| (d) Is the use consistent with public safety? | X | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | X | |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | X | |
| (g) Is the use manageable within available budget and staff? | X | |
| (h) Will this manageable in the future within existing resources? | X | |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | X | |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | X | |

Where we do not have jurisdiction of the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with exiting policy, or unsafe ("no" to (b), (c), or (d) may not be found appropriate. If the answer is no to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted the State fish and wildlife agencies. **Yes_____ No__X__**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on the overall assessment of these factors, my summary conclusion is that the proposed use is

**Not Appropriate_____ Appropriate_X___**

Refuge Manager_____ Date_____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside of the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor _____ Date _____

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: ___Carolina Sandhills NWR_____

Use: __Scientific Research and Collections_____

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or Step-down plan approved after October 9, 1997.

| Decision Criteria | Yes | No |
|---|---|---|
| (a) Do we have jurisdiction over the use? | X | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, local) | X | |
| (c) Is the use consistent with applicable Executive Orders and Department and Service policies? | X | |
| (d) Is the use consistent with public safety? | X | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | X | |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | X | |
| (g) Is the use manageable within available budget and staff? | X | |
| (h) Will this manageable in the future within existing resources? | X | |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | X | |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | X | |

Where we do not have jurisdiction of the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with exiting policy, or unsafe ("no" to (b), (c), or (d) may not be found appropriate. If the answer is no to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted the State fish and wildlife agencies. **Yes_____ No__X__**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on the overall assessment of these factors, my summary conclusion is that the proposed use is

**Not Appropriate_____ Appropriate__X__**

Refuge Manager_____ Date_____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside of the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor _____ Date _____

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: __Carolina Sandhills NWR_____

Use: ___Off-road Vehicles in Support of Mobility Impaired Hunters_____

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or Step-down plan approved after October 9, 1997.

| Decision Criteria | Yes | No |
|---|---|---|
| (a) Do we have jurisdiction over the use? | X | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, local) | X | |
| (c) Is the use consistent with applicable Executive Orders and Department and Service policies? | X | |
| (d) Is the use consistent with public safety? | X | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | X | |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | X | |
| (g) Is the use manageable within available budget and staff? | X | |
| (h) Will this manageable in the future within existing resources? | X | |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | X | |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | X | |

Where we do not have jurisdiction of the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with exiting policy, or unsafe ("no" to (b), (c), or (d) may not be found appropriate. If the answer is no to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted the State fish and wildlife agencies. **Yes_____ No_X___**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on the overall assessment of these factors, my summary conclusion is that the proposed use is

**Not Appropriate_____ Appropriate__X__**

Refuge Manager_____ Date_____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside of the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor _____ Date _____

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: ____Carolina Sandhills NWR_____

Use: Outdoor Recreation (Bicycling, Hiking, Jogging, Walking, Mountain Biking, Picnicking)

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or Step-down plan approved after October 9, 1997.

| Decision Criteria | Yes | No |
|---|---|---|
| (a) Do we have jurisdiction over the use? | X | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, local) | X | |
| (c) Is the use consistent with applicable Executive Orders and Department and Service policies? | X | |
| (d) Is the use consistent with public safety? | X | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | X | |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | X | |
| (g) Is the use manageable within available budget and staff? | X | |
| (h) Will this manageable in the future within existing resources? | X | |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | X | |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | X | |

Where we do not have jurisdiction of the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with exiting policy, or unsafe ("no" to (b), (c), or (d) may not be found appropriate. If the answer is no to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted the State fish and wildlife agencies. **Yes_____ No__X__**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on the overall assessment of these factors, my summary conclusion is that the proposed use is

**Not Appropriate_____ Appropriate__X___**

Refuge Manager_____ Date_____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside of the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor _____ Date _____

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: __Carolina Sandhills NWR_____

Use: __Camping_____

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or Step-down plan approved after October 9, 1997.

| Decision Criteria | Yes | No |
|---|---|---|
| (a) Do we have jurisdiction over the use? | X | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, local) | X | |
| (c) Is the use consistent with applicable Executive Orders and Department and Service policies? | X | |
| (d) Is the use consistent with public safety? | X | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | X | |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | X | |
| (g) Is the use manageable within available budget and staff? | X | |
| (h) Will this manageable in the future within existing resources? | X | |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | X | |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | X | |

Where we do not have jurisdiction of the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with exiting policy, or unsafe ("no" to (b), (c), or (d) may not be found appropriate. If the answer is no to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted the State fish and wildlife agencies. **Yes_____ No__X__**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on the overall assessment of these factors, my summary conclusion is that the proposed use is

**Not Appropriate_____ Appropriate__X__**

Refuge Manager_____ Date_____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside of the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor _____ Date _____

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: ___Carolina Sandhills NWR_____

Use: ___Horseback Riding_____

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or Step-down plan approved after October 9, 1997.

| Decision Criteria | Yes | No |
|---|---|---|
| (a) Do we have jurisdiction over the use? | X | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, local) | X | |
| (c) Is the use consistent with applicable Executive Orders and Department and Service policies? | X | |
| (d) Is the use consistent with public safety? | X | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | X | |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | X | |
| (g) Is the use manageable within available budget and staff? | X | |
| (h) Will this manageable in the future within existing resources? | X | |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | X | |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | X | |

Where we do not have jurisdiction of the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with exiting policy, or unsafe ("no" to (b), (c), or (d) may not be found appropriate. If the answer is no to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted the State fish and wildlife agencies. **Yes_____ No__X__**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on the overall assessment of these factors, my summary conclusion is that the proposed use is

**Not Appropriate_____ Appropriate__X__**

Refuge Manager_____ Date_____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside of the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor _____ Date _____

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: ___Carolina Sandhills NWR_____

Use: ___Dog Training and Field Trials_____

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or Step-down plan approved after October 9, 1997.

| Decision Criteria | Yes | No |
|---|---|---|
| (a) Do we have jurisdiction over the use? | X | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, local) | X | |
| (c) Is the use consistent with applicable Executive Orders and Department and Service policies? | X | |
| (d) Is the use consistent with public safety? | X | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | X | |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | X | |
| (g) Is the use manageable within available budget and staff? | | X |
| (h) Will this manageable in the future within existing resources? | | X |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | | X |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | | X |

Where we do not have jurisdiction of the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with exiting policy, or unsafe ("no" to (b), (c), or (d) may not be found appropriate. If the answer is no to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted the State fish and wildlife agencies. **Yes_____ No_X___**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on the overall assessment of these factors, my summary conclusion is that the proposed use is

**Not Appropriate__X__ Appropriate_____**

Refuge Manager_____ Date_____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside of the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor _____ Date _____

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: __Carolina Sandhills NWR_____

Use: __Organized Sporting Competitions_____

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or Step-down plan approved after October 9, 1997.

| Decision Criteria | Yes | No |
|---|---|---|
| (a) Do we have jurisdiction over the use? | X | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, local) | | X |
| (c) Is the use consistent with applicable Executive Orders and Department and Service policies? | X | |
| (d) Is the use consistent with public safety? | X | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | | X |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | X | |
| (g) Is the use manageable within available budget and staff? | | X |
| (h) Will this manageable in the future within existing resources? | | X |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | | X |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | | X |

Where we do not have jurisdiction of the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with exiting policy, or unsafe ("no" to (b), (c), or (d) may not be found appropriate. If the answer is no to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted the State fish and wildlife agencies. **Yes_____ No_X___**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on the overall assessment of these factors, my summary conclusion is that the proposed use is

**Not Appropriate__X__ Appropriate_____**

Refuge Manager_____ Date_____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside of the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor _____ Date _____

**A compatibility determination is required before the use may be allowed.**

**FINDING OF APPROPRIATENESS OF A REFUGE USE**

Refuge Name: __Carolina Sandhills NWR_____

Use: __Commercial Collection of Pine Straw_____

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or Step-down plan approved after October 9, 1997.

| Decision Criteria | Yes | No |
|---|---|---|
| (a) Do we have jurisdiction over the use? | X | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, local) | | X |
| (c) Is the use consistent with applicable Executive Orders and Department and Service policies? | | X |
| (d) Is the use consistent with public safety? | X | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | | X |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | | X |
| (g) Is the use manageable within available budget and staff? | | X |
| (h) Will this manageable in the future within existing resources? | | X |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | | X |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | | X |

Where we do not have jurisdiction of the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with exiting policy, or unsafe ("no" to (b), (c), or (d) may not be found appropriate. If the answer is no to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted the State fish and wildlife agencies. **Yes_X____ No_____**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on the overall assessment of these factors, my summary conclusion is that the proposed use is

**Not Appropriate__X__ Appropriate_____**

Refuge Manager_____ Date_____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside of the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor _____ Date _____

**A compatibility determination is required before the use may be allowed.**

# *Appendix F. Compatibility Determinations*

**Carolina Sandhills National Wildlife Refuge Compatibility Determinations**

**Uses:** The following uses were found to be appropriate and evaluated to determine their compatibility with the mission of the Refuge System and the purposes of the refuge.

(1) Hunting; (2) Fishing; (3) Wildlife Observation and Photography; (4) Environmental Education and Interpretation; (5) Cooperative Farming; (6) Commercial Tree Harvest for Wildlife Habitat Improvement; (7) Boating; (8) Public Safety Training and Military Exercises; (9) Natural Resource Collection for Personal Use; (10) Cemetery Upkeep; (11) Scientific Research and Collections; (12) Off-road Vehicles in Support of Mobility Impaired Hunters; (13) Outdoor Recreation; (14) Camping; and (15) Horseback Riding.

**Refuge Name:** Carolina Sandhills National Wildlife Refuge

**Establishing and Acquisition Authorities:**

The Carolina Sandhills National Wildlife Refuge is located in Chesterfield County, South Carolina and was established by Executive Order on March 17, 1939. Additional lands were added to the refuge under the Migratory Bird Conservation Act and the Fish and Wildlife Act of 1956.

**Refuge Purposes:** For lands acquired under the Executive Order 8067, dated March 17, 1939, the purpose of the acquisition is “as a refuge and breeding ground for migratory birds and other wildlife.”

For lands acquired under the Migratory Bird Conservation Act, 16 USC, Subpart 715-715Y, as amended, the purpose of the acquisition is “for use as an inviolate sanctuary, or for any other management purpose, for migratory birds.” 16 USC, Subpart 715d (Migratory Bird Conservation Act).

For lands acquired under the Fish and Wildlife Act of 1956, 16 USC, Subpart 742 (a) - 754, as amended, the purpose of the acquisition is for the development, advancement, management, conservation, and protection of fish and wildlife resources, 16 USC, Subpart 742 (a) (4), for the benefits of the U.S. Fish and Wildlife Service in performing its activities and services. Such acceptance may be subject to the terms of any restrictive of affirmative covenant or condition of servitude...,” 16 USC, Subpart 742f (b) (1) (Fish and Wildlife Act of 1956).

In addition to the aforementioned establishment criteria designated for Carolina Sandhills National Wildlife Refuge, the Refuge has identified the following five major objectives:

1) To restore, maintain, and enhance longleaf pine habitat and associated plant and animal species;

2) To preserve, restore, and enhance endangered or threatened species, with special emphasis on the red cockaded woodpecker;

3) To provide habitat for migratory birds;

4) To provide opportunities for environmental education, interpretation, and wildlife oriented recreation; and

5) To demonstrate sound land management practices which enhance natural resource conservation;

**National Wildlife Refuge System Mission:**

“The Mission of the National Wildlife Refuge System is to administer a national network of lands and water 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.”

**Goals of the National Wildlife Refuge System:**

(1) To preserve, restore, and enhance in their natural ecosystems (when practicable) all species of animals and plants that are endangered or threatened with becoming endangered; (2) to perpetuate the migratory bird resource; (3) to preserve a natural diversity and abundance of fauna and flora on refuge lands; (4) to provide an understanding and appreciation of fish and wildlife ecology and man's role in his environment; and (5) to provide refuge visitors with high quality, safe, wholesome, and enjoyable recreational experiences oriented toward wildlife to the extent these activities are compatible with the purposes for which the refuge was established.

**Other Applicable Laws, Regulations and Policy:**
National Wildlife Refuge System Improvement Act of 1997
National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee)
Refuge Recreation Act of 1962 (16 U.S.C. 460k-460k-4)
Title 50 of the Code of Federal Regulations, Subchapters B and C)
The Refuge Manual
The Service Manual
Endangered Species Act of 1973 (16 U.S.C. 1531-1543)
Migratory Bird Conservation Act of 1929 (16 U.S.C. 715-715d)
Migratory Bird Hunting and Conservation Stamp Act (I 6 U. S.C. 718-718h)
Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-712)
National Environmental Policy Act of 1969 (P.L. 91-190, 42 U.S.C. 4321-4347)
Bald Eagle Protection Act of 1940 (16 U.S.C. 668-668d)

Compatibility determinations for each description listed were considered separately. Although the proceeding sections from Uses through Other Applicable Laws, Regulations, and Policies are only written once within the plan, they are part of each descriptive use and become part of that compatibility determination if considered apart from the comprehensive conservation plan.

**Description of Use:** Hunting (Big Game, Other Migratory Bird, Small Game, and Exotic Animal Take Incidental to Legally Harvested Game). Hunting will be permitted for white-tailed deer, rabbit, opossum, raccoon, quail, dove, woodcock, feral hogs, and turkey.

**Availability of Resources:** Carolina Sandhills NWR has been open to hunting since 1963. As a result, access trails, refuge roads, open fields, signage, check stations, and other facilities have been developed in support of this activity. Law enforcement staff patrols, enforces laws and regulations, and ensures public safety. Administrative, managerial, and biological staff allocate a portion of their time to administering this program. Maintenance of support facilities and infrastructure is a cost absorbed by the refuge's operation and maintenance budgets. Based on a review of the refuge's budget and allocation for this activity, there are enough funds, equipment, and resources to administer this use at its current level. Additional funding may be required if the level of this use changes.

**Anticipated Impacts of the Use:** Sport hunting provides recreational opportunities and can be used to assist in the management of certain game species. Carefully managed hunting maintains populations at a level compatible with the environment and permits the use of valuable renewable resources. The harvest of feral hogs is beneficial to native wildlife since hogs compete for mast, destroy native plant populations, and prey upon nests, small vertebrates, and invertebrates. Deer hunting keeps the herd at healthy population levels commensurate with available habitat. There may be some limited disturbance to non-targeted species of wildlife and some trampling of vegetation; however, this should be short-lived, relatively minor, and not expected to negatively impact the habitats on the refuge. Problems associated with littering and violations of game laws will be controlled through effective law enforcement. The projected level of hunting is considered compatible with the purposes of the proposed refuge.

**Public Review and Comment:** The public review and comment period coincided with the review of the Draft Comprehensive Conservation Plan and Environmental Assessment for Carolina Sandhills NWR.

**Determination (check one below):**

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

**Stipulations Necessary to Ensure Compatibility:** Hunting will be in accordance with state regulations and the refuge's Hunt Plan. Law enforcement patrols will ensure hunter compliance with laws and regulations governing this activity. Vehicles are restricted to existing roads. All hunts are designed to provide quality user opportunities based on estimated population levels and biological parameters. Numbers of hunters, hunting days, areas, and bag limits will be adjusted as needed to minimize over-harvest, resource damage, or conflicts with other priority public uses, regardless of impacts to user opportunities.

No waterfowl or squirrel hunting will be permitted. Waterfowl are not in significant concentrations to support their harvest. Martin's Lake is the main area that waterfowl concentrate and as such, will be closed to all types of public hunting to minimize potential disturbance. Since fox squirrels are declining throughout their range, no squirrel hunting will be permitted to reduce the chance of harvest of fox squirrel during a gray squirrel season. The harvest of feral hogs will be permitted incidental to deer during established gun seasons.

**Justification:** Under the National Wildlife Refuge System Improvement Act of 1997, hunting is a priority public use. Public hunting on Carolina Sandhills NWR is an acceptable form of wildlife-dependent recreation and compatible with the purposes for which the refuge was established. One of the management objectives of the refuge is to provide quality wildlife-dependent recreation. This use supports this objective. Hunting is a viable management tool on the refuge for controlling the deer population. Hunting of feral hogs is beneficial to native plant and animal communities and populations. Hunting of other species is not known to negatively impact populations of these animals.

**NEPA Compliance for Refuge Use Description:** *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 15-year Re-evaluation Date:**

**Description of Use:** Fishing, including recreational fishing, fishing derbies, and clinics. Recreational freshwater fishing is permitted on refuge pools, ponds, and lakes and along Black Creek and Lynches River. Visitors fish from banks, platforms, piers, or by boat.

**Availability of Resources:** Carolina Sandhills NWR has been open to fishing since 1939. As a result, access trails, parking areas, signage, water control structures, fishing structures, and other facilities have been developed to support this wildlife-dependent priority public use. These facilities will be maintained to meet the needs of the visiting public and to provide wetland habitat for the natural diversity of wildlife species. The Service provides mobility-impaired access to several impoundments. This use requires management, law enforcement, and administrative expenditures. Several of the larger impoundments and lakes have boat launches. Fish are occasionally provided by the nearby Cheraw State Fish Hatchery and Orangeburg National Fish Hatchery. Refuge cooperators may conduct fishing clinics and derbies in support of recreational fishing and connecting people to nature initiatives.

**Anticipated Impacts of the Use:** Recreational fishing, fishing derbies, and clinics will not have any significant effects on refuge fish populations, wildlife species, or habitat. Facilities developed to support this use may also be used by visitors participating in wildlife observation and photography. Management of ponds, including the periodic drawdown of water and exposure of mudflats, supports migratory bird objectives. The primary impacts may be disturbance to and take of non-target species, vandalism, littering, pollution, and habitat disturbance.

**Public Review and Comment:** The public review and comment period coincided with the review of the Draft Comprehensive Conservation Plan and Environmental Assessment for Carolina Sandhills NWR.

**Determination (check one below):**

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

**Stipulations Necessary to Ensure Compatibility:** Adherence to state fishing laws and regulations will maintain healthy fish populations at a sustainable level. Numbers of people fishing, fishing seasons, and catch limits will be modified as needed to prevent over-harvest of fish species or resource damage. Law enforcement patrols will ensure compliance with state and refuge regulations. Disturbance to non-target species and pollution are minimized by implementing an electric trolling motor restriction for refuge pools, ponds, and lakes. Fishing is restricted to daylight hours. The Martins Lake area, an important wintering waterfowl area, will be closed to public entry and fishing from October 1 through March 1. Cooperators will work closely with refuge staff in planning fishing clinics and derbies and will be required to obtain a special use permit for events not sponsored by the refuge.

**Justification:** Recreational fishing is a priority public use identified in the National Wildlife Refuge System Improvement Act of 1997. At Carolina Sandhills NWR, fishing is an acceptable form of wildlife-dependent recreation and compatible with the purposes for which the refuge was established. One of the management objectives of the refuge is to provide quality wildlife-dependent recreation. This use supports this objective. Recreational fishing will not have adverse impacts of fish populations or plant and wildlife species.

**NEPA Compliance for Refuge Use Description:** *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 15-year Re-evaluation Date:**

**Description of Use:** Wildlife Observation and Photography (including means of access). Allow general public access on refuge lands for the purpose of observing or photographing wildlife and plants. All areas will be opened unless specifically closed by the manager. Access is obtained by walking, hiking, and using motorized vehicles, boats, bicycles, or horses. Foot travel is permitted throughout the refuge and on trails unless the area is marked as closed. Motor vehicles are permitted on refuge roads, although seasonal closure may occur. Boats powered by electric motor or by man are permitted in refuge ponds, polls, and lakes. Bicycles are permitted on refuge roads. Horses are permitted by special use permit in designated locations. These secondary uses (boats, bicycles and horses) are addressed in a separate compatibility determinations.

**Availability of Resources:** The refuge has four trails, ranging in length from 1/10 of a mile to 3 miles, which provide access to wildlife viewing areas. Other supporting facilities include a photography blind, several observation towers and platforms, a 9-mile paved auto-tour route, a 9-mile improved gravel road, more than 100 miles of primitive roads, and 30 ponds. Current staffing and funding are sufficient to support the existing level of use. If the level of use changes, additional funds and staff may be needed to continue to provide a quality experience for visitors engaging in these uses.

**Anticipated Impacts of the Use:** Wildlife observation/photography activities might result in some disturbance to wildlife. Other impacts may include collecting, poaching, littering, plant removal, and vandalism. Some animals that cross refuge-paved roads may be injured or killed by motorists. These impacts, when properly managed, are expected to be minimal and to have an insignificant

effect on refuge resources, including wildlife and their habitats. Therefore, the anticipated levels of wildlife observation/photography activities are considered compatible with the purposes for which the refuge would be established.

**Public Review and Comment:** The public review and comment period coincided with the review of the Draft Comprehensive Conservation Plan and Environmental Assessment for Carolina Sandhills NWR.

**Determination (check one below):**

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

**Stipulations Necessary to Ensure Compatibility:** All activities will be daylight use only. Areas may be closed to public entry during refuge management operations, such as prescribed burning or during big game hunting seasons, to ensure public safety. Law enforcement patrol of public use areas will minimize violations and ensure public safety.

**Justification:** Wildlife observation and photography are priority, wildlife-dependent recreational uses of the refuge as defined by the National Wildlife Refuge Improvement Act of 1997. One of the management objectives of the refuge is to provide quality wildlife-dependent recreational opportunities. Facilitating these uses leads to a greater understanding of and appreciation for wildlife, habitats, ad wildlife refuges.

**NEPA Compliance for Refuge Use Description:** *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 15-year Re-evaluation Date:**

**Description of Use:** Environmental Education and Interpretation. The purpose of the refuge's environmental education and interpretation programs is to increase the public's knowledge, understanding, and appreciation of wildlife, habitats, and conservation programs. Activities include traditional on-site programs (either led by staff, trained volunteers, or teachers), off-site programs in classrooms, nature study, workshops, and interpretive literature, displays, and support facilities such as trails, displays, signs, auto tour routes, and visitor contact stations.

**Availability of Resources:** Facilities such as visitor contact station, trails, and shelters, require funding to build and staff to maintain them. However, this expense facilitates the Service in carrying out its mission. The management of a volunteer program is important to implement an effective environmental education program. Funding in support of this program is nonexistent and refuge staff absorb time and materials costs from refuge operating dollars to conduct programs.

**Anticipated Impacts of the Use:** The use of on-site, hands-on activities by school groups, scout groups, and groups of adults may impose a low-level impact on sites where these activities occur. These impacts may include trampling of vegetation and temporary disturbance to wildlife in the immediate vicinity during the activity. However, it is not anticipated that such impacts would be permanent or significant. Off-site programs would not create any impacts to on-site refuge resources.

**Public Review and Comment:** The public review and comment period coincided with the review of the Draft Comprehensive Conservation Plan and Environmental Assessment for Carolina Sandhills NWR.

**Determination (check one below):**

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

**Stipulations Necessary to Ensure Compatibility:** Activities will be scheduled and conducted in previously developed areas with support facilities. Lake Bee and the Triple Lakes shelter have facilities to support large groups and accommodate their needs. Periodic evaluation of sites and programs offered should occur to determine if objectives are being met and to determine impacts to refuge resources. Regulations to ensure safety for all the participants should be issued in writing to all group leaders and teachers responsible for group participation prior to arrival.

**Justification:** Carolina Sandhills NWR uses environmental education and interpretation to educate visitors and to foster understanding and appreciation of refuge resources. Environmental education and interpretation are priority wildlife dependent recreational uses of the refuge as defined by the National Wildlife Refuge System Improvement Act of 1997. One of the management objectives of the refuge is to provide quality wildlife-dependent recreational opportunities.

**NEPA Compliance for Refuge Use Description:** *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 15-year Re-evaluation Date:**

**Description of Use:** Cooperative Farming. Cooperative farming is utilized on the refuge to maintain approximately 100 acres of field habitat in perennial legumes or grasses or annual row crops (milo, millet, sorghum, sunflowers, or wheat) to support the refuge's designation as a Land Management Demonstration Refuge (LMDR). This use is a refuge economic management activity. The refuge has two cooperative farmers who enter into agreements on a 3-year cycle. The contracts provide that the farmer keeps 75 percent of the seeds harvested while the refuge's share is 25 percent of the crop, which can be in the form of seeds harvested, plants left standing, or in-kind services valued at 25 percent of total crop harvest. At present time, the refuge does not have the staffing or funding necessary to establish perennial crops without the assistance of these cooperative farmers. The refuge's share of seeds is used to establish perennial plant cover on other fields that the refuge farms

through force account operations. Cooperative farming operations will continue, and may expand, under carefully regulated conditions.

The cooperative farming program occurs from early spring through late fall. Fields are prepared in early spring and planted in late spring. Seeds are harvested in the fall. Wheat is planted in September to provide green browse through the winter months. All work is performed during daylight hours. An Integrated Pest Management Plan (IPMP) directs the use of pesticides and identifies best management practices to deal with various pest species that may impact agricultural crops. The IPMP ensures that adjacent or surrounding lands are not impacted by cooperative farming activities.

Cooperative farmers will provide all equipment to prepare fields and plant and harvest crops. Cooperative farmers will perform soil tests to determine nutrient needs (fertilizer and lime), and all applications must be approved by the assistant refuge manager. Application of pesticides must follow IPMP and be approved through a pesticide use proposal and proper authorities. The assistant refuge manager will be responsible for administering the cooperative farming program, including preparing contracts, meeting with farmers, verifying crops and pest problems, and negotiating refuge shares in the fall.

**Availability of Resources:** The station has adequate resources to manage this activity. Administering this program takes between 8 and 10 staff days annually. No refuge equipment is used to administer this use. Additionally, fields in the cooperative farming program are located along paved roads, one of which is a U.S. highway, so the refuge does not have to create or maintain access for these farmers. Force account farming additional acres would require expenditure of refuge funds, staff, and equipment. While there are no offsetting revenues returned to the station, the refuge does receive 25 percent of the crop share for wildlife enhancements.

**Anticipated Impacts of the Use:** Cooperative farming results in some degree of soil erosion due to spring disking and planting operations. However, there are no wetlands or water resources adjacent or nearby cooperatively farmed fields. Cooperative farmers are permitted to use approved pesticides under a closely monitored pesticide use proposal program. Refuge-approved pesticides have low toxicity and fast biodegradation rates compared to other commonly used agricultural pesticides. Under approved label application rates and methods, approved pesticides should have minimal effect on the biological environment. However, the potential exists for misapplication or accidental spills of approved pesticides. During the past 10 years, there have been no known pesticide accidents or pesticide-related wildlife mortality reported on the refuge. Careful monitoring of pesticide use by cooperative farmers should reduce potential impacts.

**Public Review and Comment:** The public review and comment period coincided with the review of the Draft Comprehensive Conservation Plan and Environmental Assessment for Carolina Sandhills NWR.

**Determination (check one below):**

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

**Stipulations Necessary to Ensure Compatibility:** The cooperative farming program is regulated through cooperative farming agreements, which are either annually reviewed for annual crops or every 3 years if perennial crops are grown. Cooperative farmers must abide by all conditions established in the cooperative farming agreement and addendums. Cooperative farmers must apply

best management practices and integrated pest management techniques as recommended by refuge staff. All proposed chemicals must be submitted and approved by the refuge manager and Integrated Pest Management Coordinator, Regional Office, and/or Washington Office. Under these monitored conditions, the cooperative farming program has been and is expected to be compatible with the refuge's purposes.

**Justification:** The cooperative farming actions set forth in the cooperative farming agreement(s) are in accordance with Service guidelines for the protection, management, and enhancement of habitats for wildlife populations on the refuge. In addition, establishing demonstration areas for the production of native perennial grasses and plants will fulfill the refuge's objective of serving as a Land Management Demonstration Refuge.

**NEPA Compliance for Refuge Use Description:** *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-year Re-evaluation Date:**

**Description of Use: Use:** Commercial Tree Harvest for Wildlife Habitat Improvement. This use is a tool for maintaining, enhancing, or restoring the native longleaf pine/wiregrass ecosystem and associated species, with special emphasis on the endangered red-cockaded woodpecker. Harvest methods use singletree selection systems, such as basal area thinning (operator select and mark and cut), and group selection harvests of up to 2 acres to improve stand vigor and habitat conditions. Clear-cutting of off-site species, such as slash pine and loblolly pine, will occur. Clear-cut areas will be planted in native longleaf pine. Most product sales are by sealed bids and closely monitored by refuge staff.

**Availability of Resources:** The refuge forester at Carolina Sandhills NWR will make silvicultural prescriptions and administer all forest-related activities on the refuge. While some activities may be accomplished utilizing refuge staff and equipment, most large-scale operations will involve contract labor or timber sales to forest products companies that provide or contract professional logging crews.

**Anticipated Impacts of the Use:** Minimal disturbance to soil and vegetation on Service lands may occur during logging operations. Severe erosion is not typical in soils of such high sand content. However, refuge personnel will continuously monitor the conditions of haul trails and adjust operations if needed. The overall impacts of the disturbances on wildlife from logging operations is expected to be of short duration and negligible. Long-term improvements will result from conducting prescribed forest treatments. For example, by thinning the forest canopy, more sunlight will reach the forest floor, enhancing conditions for grasses, forbs, vines, and other ground vegetation. The development of a floristically diverse ground layer will provide beneficial habitat for ground nesting birds and many species of insects. Research has shown a positive correlation between the amount of ground cover, specifically wiregrass, and RCW fitness (James et. al. 1991; James et. al. 1997).

**Public Review and Comment:** The public review and comment period coincided with the review of the Draft Comprehensive Conservation Plan and Environmental Assessment for Carolina Sandhills NWR.

**Determination (check one below):**

_____Use is Not Compatible

___X___Use is Compatible with the Following Stipulations

**Stipulations Necessary to Ensure Compatibility:** A special use permit will be issued to all contractors and subcontractors who harvest timber from Carolina Sandhills NWR. The "Special Conditions Applicable to Timber Harvest," which is made part of the special use permit will help to ensure compatibility. Logging activities will be monitored by the refuge forester to ensure compliance with the special conditions. No trees or parts of those trees containing red-cockaded woodpecker cavities will be injured or disturbed. These trees are conspicuously identified by a white band completely encircling the trunk of the tree. Due to the recognized value of maintaining snags to provide nesting and foraging for a variety of wildlife species, salvage operations will be utilized only in situations where safety is compromised (public use areas, roadsides, etc.) or where overall forest health may be at risk.

All timber treatment projects are stepped-down from the Forest Management Plan to a compartment-level stand prescription. These annual prescriptions are peer-reviewed by two refuge foresters, a regional natural resource chief, and an endangered species biologist in the Charleston Ecological Services office (through a Section 7 consultation) prior to being approved by the refuge manager and the Service's Regional Office.

The refuge forester will determine the best location for logging decks and ensure that placement will not disturb known archaeological sites or significant biological or hydrological areas. Further, decks and skid trails will meet the following stipulations when applicable: harvest activities are prohibited within a standard 50-100 feet streamside buffer zone; existing gravel roads, old earthen logging roads, and ATVs trails will be used to minimize disturbance to relatively undisturbed areas; and where appropriate, pre-existing log decks will be re-used. Decks will be placed to provide adequate skid trails for logging equipment so that potential damage to residual (leave) trees is minimized. Measures will be taken to ensure disturbances are minimized and temporary in nature. Vegetation will gradually return to its natural condition in disturbed sites within the cutting areas after logging operations are complete. Existing ground cover and operational techniques, such as the placement of logging slash to reduce erosion/disturbance, will provide protection from any significant soil erosion.

**Justification:** Longleaf pine (*P. palustris*), with its extensive tap root and ability to tolerate frequent fire, is the naturally occurring and dominant species on the deep, sandy soils characteristic of the sandhills. The refuge contains one of the largest remaining tracts of longleaf pine in its range. At one time, there was more than 92 million acres of longleaf pine from southern Virginia south to Florida and west to eastern Texas. Today, longleaf pine occurs on approximately 2 million acres, less than 2 percent of its former range (Environmental Impact [RC&D], Inc., 2001). The Service, the Longleaf Alliance, and other conservation organizations are working cooperatively to restore longleaf pine across its range.

Forest management activities, such as commercial tree harvesting, are used to restore and manage longleaf pine. Additionally, commercial tree harvesting is necessary to maintain forest health and improve wildlife habitat on the refuge. Commercial tree harvesting for wildlife management has been utilized on the refuge for almost 70 years. Since the 1970s, the emphasis has shifted to ecosystem restoration and management specifically related to the longleaf pine ecosystem. One of the management objectives for the refuge is to create, maintain, and enhance habitat for all species of wildlife, with special emphasis on threatened and endangered species, such as the red-cockaded

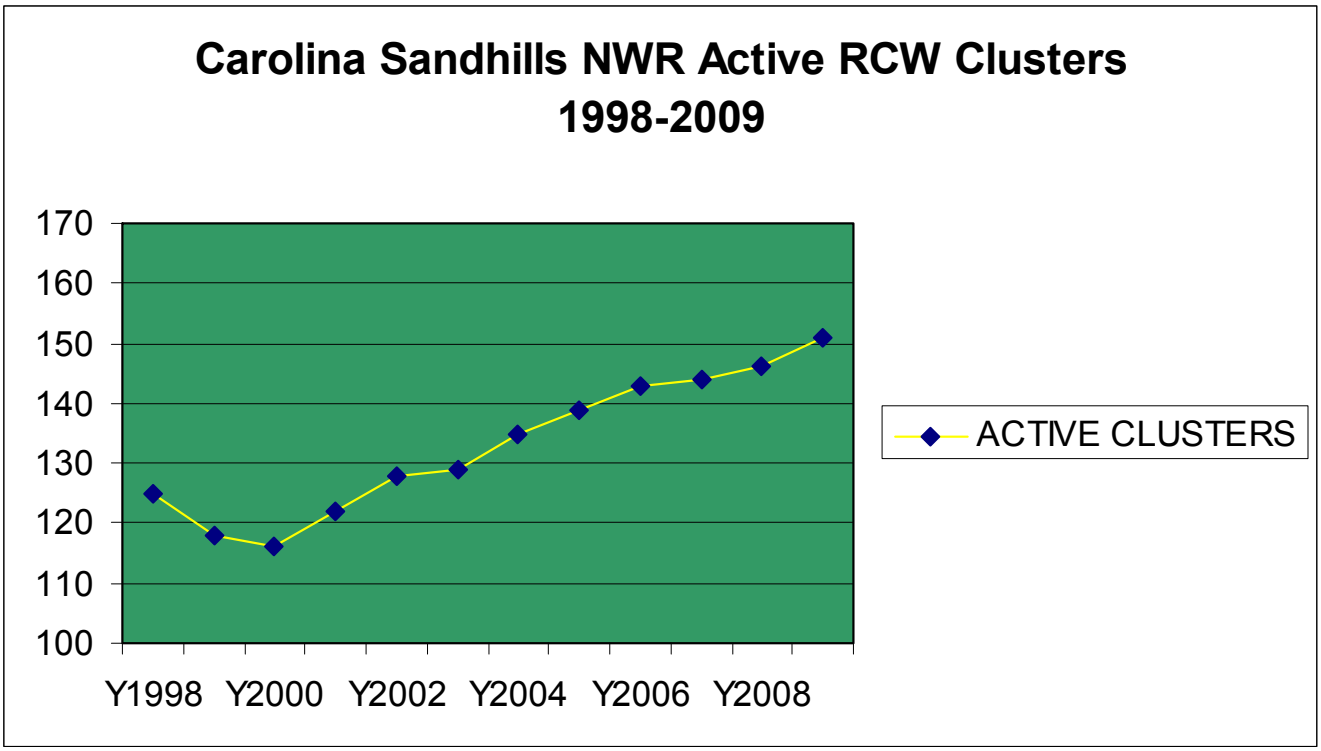
woodpecker (RCW). The forest management operations conducted are beneficial to wildlife by providing a more open canopy, which will encourage growth of native ground cover, which improves RCW fitness and provides enhanced foraging opportunities for deer, turkey, quail, fox squirrel, and numerous other species. Converting slash pine to native longleaf pine is necessary to restore the forest and provide long-term foraging and nesting habitat for the RCW. Harvest activities are beneficial to forest health by reducing inter-specific competition, which will help protect against pest and disease outbreaks.

Of significant management interest is the ability to use forest management operations to demonstrate longleaf pine restoration and management. The Carolina Sandhills NWR is one of only two refuges in the Southeast Region designated as a demonstration refuge for longleaf pine restoration and management. Restoring off-site loblolly and slash pine plantations to native longleaf pine habitat and associated ground cover will provide a unique opportunity to show private landowners how to accomplish this task. Commercial tree harvesting used on the refuge demonstrates sound forest management that can be replicated on private lands.

The refuge has an approved Forest Management Plan (1995). Timber treatments, including precommercial thinning, basal area and operator select thinnings, shelter wood cuts, seed tree cuts and clear cutting, are routinely prescribed activities to enhance wildlife habitat on the heavily forested refuge and in particular, in plantation pines (approximately 14,000 acres). Product classes identified for removal include second-entry pulpwood harvest, chip-n-saw, poles, and sawtimber. Stands targeted for improvement currently have basal areas in excess of 70 square feet per acre or are forested in off-site pine species such as slash and loblolly pine. Thinning treatments will reduce basal area to 40 to 50 square feet per acre, when appropriate, as recommended in the Red-cockaded Woodpecker Recovery Plan (USFWS 2003). Group selection harvest, removal of all product classes in up to 2-acre blocks, may be used as recommended in the recovery plan (2003) to create additional age classes in otherwise even-aged plantation stands. Several stands (10 to 40 acres in size) of off-site slash pine and loblolly pine may be clear-cut and converted to longleaf.

For administrative reasons, refuge timber sales are typically small sales valued at $50,000 to $150,000. This makes it easier for the forester to administer and encourages more bidders. As the size of the units offered increases, the number of bidders on the sale decreases. To obtain the best value for the products offered, sales are managed by location, product class, size, age, and /or harvest method. The forester merchandises, markets, and administers all timber sales through special use permits. Timber contractors submit receipts and accompanying scale tickets to the refuge on a weekly basis.

Wildlife species have responded favorably to forest and habitat management improvements. As shown in the graph below, the refuge's population of RCWs is increasing (n=148 active groups in 2008; n=118 active groups in 1999; see graph) at a higher rate than required by the recovery plan (2003). The refuge's recovery goal for RCW is 165 groups. This growth will continue as the relatively young refuge forest matures and additional habitat becomes suitable, as defined by the recovery plan. The proposed activity facilitates the refuge's ability to provide habitat for this species as it expands across the landscape.




**National Environmental Policy Act (NEPA) Compliance:** Allowing the projected levels of commercial tree harvest evaluated in this compatibility determination will have a beneficial impact on refuge resources. Permitting this use should not be controversial since this activity is a prescribed management tool for improving wildlife habitat and conditions for an endangered species and supports the local economy.

**NEPA Compliance for Refuge Use Description:** *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-year Re-evaluation Date:**

**Description of Use:** Boating (motorized and human-powered). The refuge has 30 pools, lakes, and ponds impounding approximately 300 acres of water. Seasonal fishing or wildlife viewing from motorboats with restricted motor sizes and non-motorized boats may occur. Freshwater fishing, wildlife observation, and photography are companion activities that may occur.

**Availability of Resources:** There are 30 constructed ponds, some of which have boat ramps. Current staffing and funding are sufficient to support the existing level of use. If the level of use changes, additional funds and staff may be needed to continue to provide a quality experience for visitors engaging in these uses.

**Anticipated Impacts of the Use:** The restricted use of motorized and human-powered boats in refuge pools, lakes and ponds will not adversely impact refuge purposes or objectives. Impacts may include wildlife disturbance, littering, vandalism, water pollution from outboard motors, and vegetation disturbance.

**Public Review and Comment:** The public review and comment period coincided with the review of the Draft Comprehensive Conservation Plan and Environmental Assessment for Carolina Sandhills NWR.

**Determination (check one below):**

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

**Stipulations Necessary to Ensure Compatibility:** Daylight use only. Anglers may fish and boat year-round in most refuge pools, lakes, and ponds. Public entry is prohibited in Martin's Lake from October 1 through the end of February annually to reduce disturbance to wintering waterfowl. Airboats, personal watercraft, and hovercraft are prohibited. Outboard motors are prohibited; electric motors permitted. In pools and lakes without designated boat ramps, boats will not be dragged up and down the dams and levees.

**Justification:** Limited motorized (electric) and human-powered boating for fishing, wildlife observation, and wildlife photography are low impact activities. Boating provides access to fishing, a priority public use. Since fish and wildlife observation is an integral part of the boating experience, this is a compatible secondary use which leads to the enjoyment of fish, wildlife, and habitats found on the refuge.

**NEPA Compliance for Refuge Use Description:** *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-year Re-evaluation Date:**

**Description of Use:** Public Safety Training and Military Exercises. Limited portions of the refuge would be made available to facilitate public safety and military training operations. All operations would be managed under a special use permit. Operations would be restricted to a few times a year to minimize impacts with users participating in priority public uses or supporting secondary uses. The use will be conducted for training purposes. This use is not a priority public use.

The use will be conducted by the South Carolina National Guard or the Chesterfield County Sheriff's Department. Officials will inform the refuge manager of all training operations in writing, including date(s), duration, proposed location(s), and planned activity(ies) prior to scheduling such training. Refuge staff will coordinate this activity and ensure that the agency/military takes all necessary precautions to safeguard trust species before, during, and after exercises. Officials will also be responsible for coordinating with local, state, and federal agencies, if applicable.

**Availability of Resources:** The station has adequate resources to administer and manage this activity. Administration of this activity will consist of less than four staff days per year. Management of this activity will consist of the refuge manager meeting with the lead training officer to ensure that the proposed activity will not occur in any sensitive areas or during sensitive times of the year.

**Anticipated Impacts of the Use:** Noise from military vehicles or aircraft may occur on a temporary basis. We do not anticipate any long-term impacts from these training exercises. We do not anticipate any direct or indirect cumulative impacts from these proposed training exercises.

**Public Review and Comment:** The public review and comment period coincided with the review of the Draft Comprehensive Conservation Plan and Environmental Assessment for Carolina Sandhills NWR.

**Determination (check one below):**

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

**Stipulations Necessary to Ensure Compatibility:** All Training/Exercises

- Prior approval and coordination with refuge mManager on date, location and details of exercise.
- Training prohibited from April 15 through June 15.
- Training prohibited on Saturdays during October, November, December, January, and in March and April when big game hunts are scheduled (typically last Saturday in March and first two Saturdays in April).
- No fixed activity of greater than 2 hours duration within 200 feet of RCW trees.
- No overnight activities.
- Special use permit required for each exercise.

Stipulations for Military Training/Exercises:

- Training prohibited on week days.
- No tracked vehicles.
- No refueling exercises.
- No digging for fox holes, equipment defilade, obstacles, etc.

Stipulations for Law Enforcement Training:

- Dogs must be leashed and/or under voice control of the handling officer.

**Justification:** Conducting law enforcement or military training exercises is compatible if the stipulations outlined are followed. This use will not materially interfere with the refuge's purposes or management objectives. This use will be restricted during sensitive times of the year (RCW nesting season) and during scheduled priority public use activities.

**NEPA Compliance for Refuge Use Description:** *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-year Re-evaluation Date:**

**Description of Use:** Natural Resource Collection for Personal Use. This use involves pine cones, pine straw, and scrub oaks. The refuge permits individuals to rake pine straw or collect pine cones from administrative areas surrounding refuge houses, maintenance shops, headquarters, and mowed areas adjacent to these facilities. The refuge permits individuals to cut firewood in designated areas consisting of scrub oaks (e.g., turkey oak, blue jack, and black jack) for personal use. No collecting of natural resources is permitted for commercial application or sale.

**Availability of Resources:** The refuge receives approximately 10 requests (combined) annually to conduct these activities. The station has adequate resources to administer and manage this activity. Administration of this activity will consist of less than 5 staff days per year.

**Anticipated Impacts of the Use:** We do not anticipate any long-term impacts from these activities. We do not anticipate any direct or indirect cumulative impacts from these activities.

**Public Review and Comment:** The public review and comment period coincided with the review of the Draft Comprehensive Conservation Plan and Environmental Assessment for Carolina Sandhills NWR.

**Determination (check one below):**

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

**Stipulations Necessary to Ensure Compatibility:** Removal of pine straw and pine cones for personal use will be limited to administrative areas near the headquarters, maintenance compound, residences, and shelters at Lake Bee. Firewood cutting will be permitted in areas chosen by the refuge forester and will consist only of scrub oaks. No firewood cutting will be permitted near wetlands. Individuals may request a special use permit to conduct these activities.

**Justification:** Removing pine straw and pine cones from areas that are mowed will be beneficial and help the refuge keep these administrative areas attractive. Removing scrub oaks from areas that have a midstory problem will benefit the endangered red-cockaded woodpecker and improve habitat conditions.

**NEPA Compliance for Refuge Use Description:** *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-year Re-evaluation Date:**

**Description of Use:** Cemetery Upkeep. The refuge has several abandoned cemeteries of cultural significance including a Confederate soldiers' cemetery, old homestead cemetery, and an African-American slave cemetery. A group has requested to periodically clean these cemetery sites by removing overgrown vegetation, limbs, and other plant debris.

**Availability of Resources:** The station has adequate resources to administer and manage this activity. Administration of this activity will consist of 1 staff day per year.

**Anticipated Impacts of the Use:** We do not anticipate any long-term impacts from this activity. We do not anticipate any direct or indirect cumulative impacts from this proposed activity.

**Public Review and Comment:** The public review and comment period coincided with the review of the Draft Comprehensive Conservation Plan and Environmental Assessment for Carolina Sandhills NWR.

**Determination (check one below):**

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

**Stipulations Necessary to Ensure Compatibility:** The individual(s) must obtain a special use permit annually. The permittee(s) must notify the refuge manager prior to entering the cemeteries. Only hand tools and small power tools may be used; motorized earthmoving equipment and ATVs are prohibited. At the end of each calendar year, the permittee(s) should report their activities to the refuge manager.

**Justification:** Keeping the cemetery site free from debris will ensure its protection during prescribed fire and forest management activities. This use facilitates the ability for the refuge to protect significant cultural areas under our jurisdiction. This use is compatible and will not materially interfere or detract from refuge purposes or management objectives.

**NEPA Compliance for Refuge Use Description:** *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-year Re-evaluation Date:**

**Description of Use:** Scientific Research and Collections. This includes scientific researching, inventorying, monitoring, or scientific collecting conducted by non-refuge personnel on refuge lands. The refuge is often used for biological research, for example by Clemson University, North Carolina State University, South Carolina Department of Natural Resources, and other agency or university interests.

**Availability of Resources:** The cost of most field studies is borne by the researchers or institution sponsoring the research, with the exception of staff time to review proposals, issue the special use permit, and monitor the project. These are considered routine duties of refuge managers and staff.

**Anticipated Impacts of the Use:** The collecting or monitoring of field data during a research project may cause mortality to some target species. Minor habitat and temporary wildlife disturbance may also occur. The impacts of research projects are minimized by strict monitoring and coordination with refuge staff.

**Public Review and Comment:** The public review and comment period coincided with the review of the Draft Comprehensive Conservation Plan and Environmental Assessment for Carolina Sandhills NWR.

**Determination (check one below):**

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

**Stipulations Necessary to Ensure Compatibility:** All research proposals are reviewed by refuge staff before approval is given. If collecting is proposed, all applicable state and federal permits must be acquired before approval. A special use permit is prepared for each project, which specifies the purpose, duration, and location of the project and any special conditions that the permittee must follow. Refuge personnel routinely monitor progress and permittees are required to submit an annual progress report, final report at the conclusion of the research, and copies of any resulting publications. Scientific researching and collecting will only be permitted by individuals sponsored by academic institutions or by natural resource agencies.

**Justification:** Wildlife and plant research is critical to filling in baseline information and information gaps that exist. Research provides information that will help the Service manage longleaf pine and constituent species appropriately. Species identifying, resource inventorying, and monitoring provide valuable data for refuge operations. Access to applied research can aid management decisions. The refuge usually works as a minor partner in the project, yet receives tremendous benefit with the information collected. Some research is of regional and national significance and can provide information to other refuges and natural resources organizations.

**NEPA Compliance for Refuge Use Description:** *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-year Re-evaluation Date:**

**Description of Use:** Off-road Vehicles in Support of Mobility Impaired Hunters. Use of 4-wheeled all-terrain vehicles (ATVs) by hunters with mobility impairments is important to providing adequate hunting opportunities for these individuals. The terrain makes use of ATVs, the most cost-effective method of providing access to hunters with mobility impairments.

Access to hunters with mobility impairments is permitted by possessing a South Carolina Department of Natural Resources Disability License and requesting a special use permit. The hunters are responsible for providing all equipment and associated assistance during the hunts. The permit grants no other access by ATV to any other refuge areas or facilities.

**Availability of Resources:** The refuge manager will review and issue special use permits. The refuge receives less than five requests per year. The staff is able to manage this use within the existing budget.

**Anticipated Impacts of the Use:** Impacts to wildlife, plants, and habitat by off-road vehicles (ORVs) and ATVs are well-documented and some disturbance to wildlife, plants, and their habitats is expected to occur. The impact is minimized by restricting use to an area that is not environmentally sensitive. No long-term or cumulative impacts are anticipated with this use.

**Public Review and Comment:** The public review and comment period coincided with the review of the Draft Comprehensive Conservation Plan and Environmental Assessment for Carolina Sandhills NWR.

**Determination (check one below):**

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

**Stipulations Necessary to Ensure Compatibility:** Hunters must apply annually and possess a South Carolina Department of Natural Resources Disability License. Use is restricted to transportation to and from hunting locations within an area designated for mobility impairments during established hunting seasons. Use of ATVs is restricted to the permittee and his/her gear and game. Carrying another person or their game is prohibited. The permittee must comply with other refuge and state hunter regulations.

**Justification:** A primary objective for the refuge is to provide quality, wildlife-dependent recreational opportunities. Having mobility impairment should not exclude hunters from participating in a refuge hunt. By providing access to hunters with mobility impairments, we are complying with the National Wildlife Refuge System Improvement Act of 1997 and the American's with Disabilities Act. Providing this activity is compatible with refuge purposes, objectives, and Service regulations.

**NEPA Compliance for Refuge Use Description:** *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-year Re-evaluation Date:**

**Description of Use:** Outdoor Recreation. This use involves bicycling, hiking, jogging, walking, mountain biking, and picnicking). More than 150 miles of refuge roads, levees, and designated trails are used by visitors for walking, hiking, and jogging. Many visitors enjoy road biking on the refuge's paved Wildlife Drive. Other visitors enjoy mountain biking on the more than 140 miles of gravel and sand roads.

During the 1960s, a picnic area was developed near Lake Bee. This area has become a favorite spot to fish, picnic, bird watch, or spend a lazy afternoon. There are three picnic shelters, one of which is National Historic Register Eligible as it was constructed by the Civilian Conservation Corps in the early 1940s. Restrooms are available.

**Availability of Resources:** The roads and levees are maintained for refuge purposes. Refuge staff and volunteers maintain three hiking trails. The Lake Bee Recreation Area is maintained by refuge staff and volunteers.

**Anticipated Impacts of the Use:** Impacts from these uses could include littering, vegetation trampling, and wildlife disturbance. Refuge law enforcement officers patrol regularly. Refuge volunteers pick up litter. No significant impacts are expected from picnicking. Some littering, vandalism, plant removal, and perhaps feeding/disturbance of wildlife may occur. Violations are infrequent. Trash receptacles are provided and are used (and not abused by locals dumping trash).

**Public Review and Comment:** The public review and comment period coincided with the review of the Draft Comprehensive Conservation Plan and Environmental Assessment for Carolina Sandhills NWR.

**Determination (check one below):**

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

**Stipulations Necessary to Ensure Compatibility:** Hiking, jogging, walking, road biking, mountain biking, and picnicking are restricted to daylight hours. Pets must be leashed at all times. Bicycling is restricted to refuge roads and levees; trails are designed for pedestrian traffic only.

**Justification:** These activities are low-impact and provide opportunities for visitors to connect with nature while participating in a secondary use. Picnicking gives refuge visitors the opportunities to rest and observe wildlife. Providing these activities is compatible with refuge purposes, objectives, and Service regulations.

**NEPA Compliance for Refuge Use Description:** *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-year Re-evaluation Date:**

**Description of Use:** Camping. The refuge has a designated scout/student camping area. The area is primarily used by Boy Scouts from the Columbia, Florence, and Hartsville, South Carolina, areas and troops within a 2-hour drive in North Carolina. The area is behind a locked gate and not visible to refuge visitors. Use of the camping area is by special use permit and restricted to youth organizations.

**Availability of Resources:** The Triple Lakes Camping area has public water, picnic tables, and a shelter with a concrete pad. Restrooms are available by walking one-third of a mile to the check station. Refuge staff routinely mow the access road and camping area as part of prescribed refuge maintenance. Refuge staff and volunteers maintain the restrooms. The refuge receives 5 to 10 requests annually to use the site. The station has adequate resources to administer and manage this activity, which will consist of no more than 5 staff days per year.

**Anticipated Impacts of the Use:** Some impacts such as littering, vegetation trampling, and wildlife disturbance may occur, but are not expected to be significant. The potential for accidental wildfire exists. The use of the Triple Lakes camping area by approved groups will not negatively impact refuge resources. This use is at a low level and not expected to increase. Service projects completed by past groups include: trail maintenance, RCW tree raking, bluebird and wood duck box construction, boardwalk and resting bench construction, kiosk kit installation, tree and wiregrass planting, invasive weed pulling, and litter removal.

**Public Review and Comment:** The public review and comment period coincided with the review of the Draft Comprehensive Conservation Plan and Environmental Assessment for Carolina Sandhills NWR.

**Determination (check one below):**

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

**Stipulations Necessary to Ensure Compatibility:** This use is restricted to youth organizations involved in outdoor skills development or learning. A special use permit is required. Each group/organization will complete a service project determined by the refuge manager or provide a copy of research results/species list if the organization is a class group. A fire ring is provided; however, if the refuge is under fire danger/drought conditions, open fires will be prohibited.

**Justification:** Occasional primitive camping in the Triple Lakes camping area is a low-impact and low-cost activity. Providing this opportunity to youth organizations fosters a land ethic and exposes a new generation to the wonders of wildlife refuges. This activity provides an opportunity for visitors to connect with nature and provide valuable service to the refuge. Providing this activity is compatible with refuge purposes, objectives and Service regulations.

**NEPA Compliance for Refuge Use Description:** *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-year Re-evaluation Date:**

**Description of Use:** Horseback Riding. Horseback riding is an occasional use on the refuge; however, since the neighboring Sand Hills State Forest, H. Cooper Black Field Trial and Equestrian Center, and Cheraw State Park allow horseback riding, this use on the refuge has declined. Although there are more than 150 miles of roads on the refuge, most are improved with crush and run gravel, which is hard on the horses and riders. There are no designated trailer parking areas or support facilities for feeding or watering horses. Groups of more than five riders are required to obtain a special use permit.

**Availability of Resources:** Based on the existing level of use by horseback riders, the refuge has adequate resources to manage this use. Refuge roads are maintained to support refuge operations. The refuge receives two to three requests annually for group rides.

**Anticipated Impacts of the Use:** The potential for horseback riding to disturb wildlife, plants, habitat, and cultural resources exists. The level of disturbance depends on frequency, duration, season, and time of day. Horseback riding has both direct and indirect effects on plants and habitat. Trampling causes direct mortality. Grazing reduces vegetation. Indirect effects can be soil compaction and erosion. There is a potential for exotic plants to be spread by fecal droppings. Any trail or earthen road can become a conduit for the introduction of exotic plants, since exposed soil and abundant sunlight provide favorable conditions for establishment. Horse manure is not harmful to human health, although it can cause conflicts with other user groups since it is odorous, unaesthetic, and a nuisance.

**Public Review and Comment:** The public review and comment period coincided with the review of the Draft Comprehensive Conservation Plan and Environmental Assessment for Carolina Sandhills NWR.

**Determination (check one below):**

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

**Stipulations Necessary to Ensure Compatibility:** Horseback riding to facilitate a priority public use such as wildlife observation is only compatible on unimproved (earthen) refuge roads open to vehicle traffic. Horses are not allowed on the Wildlife Drive, improved (gravel, crush and run) refuge roads, foot trails, or woods roads closed to vehicle traffic. Camping and overnight parking are prohibited. Group size is limited to a maximum five riders unless authorized through a special use permit. Horseback riding is prohibited during refuge big game gun hunts. No corralling, tethering, or hitching along refuge roads is permitted.

**Justification:** While not a primary, wildlife-dependent public use, horseback riding is compatible under the stipulations outlined. Reasons for this determination include: wildlife observation can be an element of horseback riding; horseback riding allows the refuge to reach an audience that it would not otherwise reach; horseback riders are potential partners and supporters for the refuge; and impacts associated with horseback riding do not exceed impacts caused by other public uses. At the current level of use, horseback riding is compatible on the refuge. This use is not expected to increase since other nearby public lands cater to this use and provide facilities to support this use.

**NEPA Compliance for Refuge Use Description:** *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-year Re-evaluation Date:**

**Literature Cited:**

Environmental Impact (RC&D), Inc. 2001. Increasing Wildlife on Public Lands in the Sandhills of North Carolina, A Guide to Management and Restoration. Aberdeen, NC 16 pp.

James, F. C. 1991. Signs of trouble in the largest remaining population of red-cockaded woodpeckers. Auk 108:419-423.

James, F. C., C. A. Hess, and D. Kufrin. 1997. Species-centered environmental analysis: indirect effects of fire history on red-cockaded woodpeckers. Ecological Applications 7:118-129.

U.S. Fish and Wildlife Service. 2003. Recovery plan for the red-cockaded woodpecker (*Picoides borealis*): second revision. U.S. Fish and Wildlife Service, Atlanta, GA. 296 pp.

**Approval of Compatibility Determinations**

The signature of approval is for all compatibility determinations considered within the Comprehensive Conservation Plan for Carolina Sandhills National Wildlife Refuge. If one of the descriptive uses is considered for compatibility outside of the comprehensive conservation plan, the approval signature becomes part of that determination.

Refuge Manager: _____
(Signature/Date)

Regional Compatibility Coordinator: _____
(Signature/Date)

Refuge Supervisor: _____
(Signature/Date)

Regional Chief, National Wildlife Refuge System, Southeast Region: _____
(Signature/Date)

# *Appendix G. Intra-Service Section 7 Biological Evaluation*

**Originating Person:** Allyne Askins
**Telephone Number:** 843-335-6023
**E-Mail:** allyne_askins@fws.gov
**Date:** 18 February 2009

**PROJECT NAME (Grant Title/Number):** Comprehensive Conservation Plan for the Carolina Sandhills NWR.

**I. Service Program:**
**___ Ecological Services**
**___ Federal Aid**
**___ Clean Vessel Act**
**___ Coastal Wetlands**
**___ Endangered Species Section 6**
**___ Partners for Fish and Wildlife**
**___ Sport Fish Restoration**
**___ Wildlife Restoration**
**___ Fisheries**
**_X_ Refuges/Wildlife**

**II. State/Agency:** U.S. Fish and Wildlife Service

**III. Station Name:** Carolina Sandhills National Wildlife Refuge

**IV. Description of Proposed Action (attach additional pages as needed):**

See attached Draft Comprehensive Conservation Plan and Environmental Assessment for the Carolina Sandhills National Wildlife Refuge, Chesterfield and Marlboro Counties, South Carolina, which describes management actions to achieve desired future conditions as described below:

The Carolina Sandhills NWR landscape is dominated (75-80 percent of area) by expansive open, mature longleaf pine stands above a floristically diverse native grass-forb ground cover, only rarely broken by non-forested upland openings. Embedded throughout the extensive upland pine habitat matrix are small, legume-rich “bean-dip” depressions and small patches of oaks and regenerating longleaf pine seedling “cohorts,” along with upland fields and native warm-season grasslands (1-3 percent of area). Narrow areas of canebrakes, Atlantic White Cedar, hillside herb bogs, and stream-head pocosin in upper reaches of drainages and around the margins of small (artificial) ponds and lakes (10-15 percent of area) and (hydric) bottomland forests (3-5 percent of area) thread through upland forests. Non-native plants such as Weeping lovegrass, shrub Lespedeza or black bamboo are largely absent.

The refuge is a “working,” actively managed landscape. Evidence of frequent, low intensity surface fire is commonly observed and is a primary force in shaping the ecological communities throughout the rolling landscape. Hillside herb bogs and seepages are maintained with frequent, predominantly growing season fire, which limits the woody shrub component. Fires burning in adjacent upland pine

stands are not normally excluded from areas where canebrake, Atlantic white cedar or stream-head pocosin occur, in order to maintain these important ecotones. Also, evidence of recent tree harvesting along with generally small areas of agricultural activity may be observed, but are not dominant features of the landscape.

The largely fire-maintained ground layer on uplands is dominated by native bunch grasses, forbs, and dwarf shrubs, and often includes basal sprouts of oak species that vary with site conditions. Ground layer composition ranges from wiregrass-dominated uplands to diverse mixtures of grasses and forbs, especially legume species, on more productive loamy soils. On most sites the oak and other woody shrubs are confined to and maintained within the understory layer (< 2 meters tall), but there are also some areas where oaks are larger in stature and obtain a position in the mid-story and even upper tree canopy. Wetland and seepage communities (including several insectivorous plants), occur in hydrologically appropriate locations, typically in narrow areas along drainages and around ponds, where occasional prescribed fire intrusions create openings where Atlantic white cedar reproduction from seed can be seen. A number of uncommon but unique plants can be found across these different habitats including Well's Pyxie Moss, Sweet Pitcher-Plant, Pine Barrens Gentian, and White-Wicky. This diverse flora also supports a variety of native pollinators, especially bees, butterflies and moths.

The open, mature longleaf pine stands and associated native grass-forb ground cover support a self-sustaining breeding population of at least 165 active RCW clusters, using primarily naturally excavated cavities. Other open pineland birds commonly observed include Bachman's Sparrow, Chuck-wills-widow, Northern Bobwhite, Brown-headed Nuthatch, and Red-headed Woodpecker, as well as Sherman's fox squirrel and bats. The Southern Hognose and the Pine (or Gopher) Snakes are also found on occasion. Along riverine, streamhead pocosin, and hillside seepage areas Swainson's warbler, Prairie Warbler, prothonotary warbler, Acadian and Great-crested flycatchers, Kentucky Warbler, Hooded Warbler, Wood Thrush, Field Sparrow, American Woodcock, and American wood duck can be observed along with the unique pine barrens treefrog. In forest openings and grasslands American Kestrel, Northern Bobwhite, Loggerhead shrike, Grasshopper and Henslow's sparrows, mourning dove, white-tailed deer, and eastern wild turkey are commonly seen.

The Carolina Sandhills NWR consistently receives an appropriate level of funding to achieve and maintain these desired conditions utilizing full time, seasonal, and temporary employees, refuge volunteers, and cooperative agreements with other agencies and partner organizations.

## V. Pertinent Species and Habitat:

**Red-cockaded woodpecker (*Picoides borealis*) - Endangered.** The red-cockaded woodpecker was listed in 1970. It received federal protection under the Endangered Species Act of 1973. Carolina Sandhills NWR presently supports a large concentration of red-cockaded woodpecker (RCW). The Service has developed a recovery strategy for the RCW that includes participation with other federal and state agencies and private landowners. A refuge-wide survey conducted in 1984 indicated a population of 122 clusters (status unknown). Presently the refuge supports 144 active clusters, making it the largest RCW population on Service lands. The recovery goal for the refuge is 165 active clusters. The refuge's Red-cockaded woodpecker Management Plan was signed February 2006.

**Eastern pumas (*Puma concolor couguar*) - Endangered**. Pumas are reddish brown-tan in color. They have white fur on the belly and under the chin. Black markings are apparent behind the ears, on the face, and on the tip of the tail. On average, they weigh between 65 to 130 pounds and grow to be 6 feet in length. Their western counterparts can grow up to 170

pounds because of availability of larger prey. Many eastern pumas have an upward turn or kink at the end of the tail and a swirl or cow lick in the middle of the back. Puma cubs are pale with spots and have rings around the tail. They lose their spots and rings at approximately six months of age. No evidence of these large cats inhabiting the refuge exists and one has not been seen in over a decade.

**A. Include species/habitat occurrence map:** Red-cockaded woodpecker scattered throughout refuge. No documented eastern cougar sightings in over 10 years.

**B. Complete the following table:**

| SPECIES/CRITICAL HABITAT | STATUS[1] |
|---|---|
| RCW | E |
| Eastern cougar | E |

*[1]STATUS: E=endangered, T=threatened, PE=proposed endangered, PT=proposed threatened, CH=critical habitat, PCH=proposed critical habitat, C=candidate species*

**VI. Location:**

**A. Ecoregion Number and Name:**
Savannah-Santee-Pee Dee Ecosystem
Area II

**B. County and State:**
Chesterfield, South Carolina

**C. Section, township, and range (or latitude and longitude):**
Lat 34° 31'-35'
Longitude 80° 12'-18'

**D. Distance (miles) and direction to nearest town:**
4 miles west to McBee, SC

**E. Species/habitat occurrence:**
Red-cockaded woodpecker/38,000 acres upland pine
Eastern Cougar/43,000 woodland habitat

## VII. Determination of Effects:

**A. Explanation of effects of the action on species and critical habitats in item V.**
**B. (attach additional pages as needed):**

| SPECIES/ CRITICAL HABITAT | IMPACTS TO SPECIES/CRITICAL HABITAT |
|---|---|
| RCW | Management of upland pine habitat will enhance nesting and foraging habitat in accordance with the RCW Recovery Plan. |
| Eastern cougar | Active management is prescribed for upland areas. Wooded wetlands will not be actively managed; therefore, no impact on cougar habitat is expected. |

**C. Explanation of actions to be implemented to reduce adverse effects:**

| SPECIES/ CRITICAL HABITAT | ACTIONS TO MITIGATE/MINIMIZE IMPACTS |
|---|---|
| RCW | Management activities that occur in upland pine, with the exception of prescribed fire, will not be conducted during RCW nesting season (April-June). |
| Eastern cougar | No impact to this species' habitat. |

## VIII. Effect Determination and Response Requested:

| SPECIES/ CRITICAL HABITAT | DETERMINATION[1] | | | RESPONSE[1] REQUESTED |
|---|---|---|---|---|
| | NE | NA | AA | |
| RCW | | X | | |
| Eastern cougar | | X | | |

[1]*DETERMINATION/RESPONSE REQUESTED:*

*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. Response Requested is optional but a "Concurrence" is recommended for a complete Administrative Record.*

*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. Response Requested is a "Concurrence."*

*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. Response Requested for listed species is "Formal Consultation." Response Requested for proposed or candidate species is "Conference."*

Signature (originating station) Date 6/19/09

Project Leader
Title

**IX. Reviewing Ecological Services Office Evaluation:**

A. Concurrence ✓ Nonconcurrence _____

B. Formal consultation required _____

C. Conference required _____

D. Informal conference required _____

E. Remarks (attach additional pages as needed):

Signature date 7/20/09

for Timothy N. Hall

Title Field Supervisor office Charleston ES

# Appendix H. Wilderness Review

The Wilderness Act of 1964 defines a wilderness area as an area of federal land that retains its primeval character and influence, without permanent improvements or human inhabitation, and is managed so as to preserve its natural conditions and which:

1. generally appears to have been influenced primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;

2. has outstanding opportunities for solitude or primitive and unconfined types of recreation;

3. has at least 5,000 contiguous roadless acres or is of sufficient size to make practicable its preservation and use in an unimpeded condition; or is a roadless island, regardless of size;

4. does not substantially exhibit the effects of logging, farming, grazing, or other extensive development or alteration of the landscape, or its wilderness character could be restored through appropriate management at the time of review; and

5. may contain ecological, geological, or other features of scientific, educational, scenic, or historic value.

*SUMMARY OF REFUGE WILDERNESS REVIEW*

The determination to recommend (or not recommend) a Wilderness Study Area to Congress for wilderness designation will be made through the comprehensive conservation plan decision-making process.

The Planning Team, consisting of the Refuge Manager, Assistant Refuge Manager, Refuge Forester, Refuge Wildlife Biologist, Ecological Services Biologist, South Carolina Department of Natural Resources Planning Biologist, and South Carolina Forestry Commission Forest Protection Forester inventoried refuge lands within the planning area and found no areas that meet the eligibility criteria for a Wilderness Study Area as defined by the Wilderness Act. Therefore, the suitability of refuge lands for wilderness designation is not analyzed further in this plan.

# Appendix I. Refuge Biota

Table I-1. Commonly observed reptiles and amphibians of Carolina Sandhills NWR

| | |
|---|---|
| ***Toads*** | ***Turtles*** |
| Eastern Spadefoot Toad | Snapping Turtle |
| Southern Toad | Eastern Musk Turtle |
| Fowler's Toad | Eastern Mud Turtle |
| Oak Toad | Spotted Turtle |
| Eastern Narrowmouth Toad | Eastern Box Turtle |
| | Yellow-belly Slider |
| ***"True" Frogs*** | Florida Cooter |
| Bullfrog | |
| Carpenter Frog | ***Lizards*** |
| Green Frog | Eastern Anole |
| Southern Leapord Frog | Eastern Fence Lizard |
| | Six-lined Racerunner |
| ***Treefrogs*** | Ground Skink |
| Southern Cricket Frog | Broadhead Skink |
| Spring Pepper | Southeastern Five-lined Skink |
| Upland Chorus Frog | Five-lined Skink |
| Pine Barrens Treefrog | Eastern Glass Lizard |
| Green Treefrog | |
| Barking Treefrog | ***Non-Venomous Snakes*** |
| Pine Woods Treefrog | Brown Water Snake |
| Squirrel Treefrog | Redbelly Water Snake |
| Gray Treefrog | Northern Water Snake |
| | Banded Water Snake |
| ***Salamanders*** | Black Swamp Snake |
| Two-toed Amphiuma | Glossy Crayfish Snake |
| Lesser Siren | Queen Snake |
| Dwarf Mudpuppy | Brown Snake |
| Eastern Newt | Redbelly Snake |
| Northern Dusky Salamander | Eastern Garter Snake |
| Slimy Salamander | Rough Earth Snake |
| Mud Salamander | Eastern Hognose Snake |
| Red Salamander | Southern Hognose Snake |
| Northern Two-lined Salamander | Mud Snake |
| Dwarf Salamander | Black Racer |
| Tiger Salamander | Eastern Coachwhip |
| | Rough Green Snake |
| ***Venomous Snakes*** | Corn Snake |
| Copperhead | Black Rat Snake |
| Cottonmouth | Pine Snake |
| Canebrake Rattlesnake | Eastern Kingsnake |
| Pigmy Rattlesnake | Scarlet Kingsnake |
| | Mole Kingsnake |
| | Scarlet Snake |
| | Southeastern Crowned Snake |

Table I-2. Conspicuous flowering plants at Carolina Sandhills NWR

| **Common Name** | ***Scientific Name*** |
|---|---|
| Trailing Arbutus | *Epigaea repens* |
| Butterwort | *Pinguicula caerulea* |
| Golden Club | *Orontium aquaticum* |
| Heartleaf | *Hexastylis minor, H. Arifolia* |
| Dogwood | *Cornus florida* |
| Yellow Pitcher Plant | *Sarracenia flava* |
| Pixie Moss | *Pyxidanthera barbulata* |
| Sundew | *Drosera intermedia* |
| Yellow Jessamine | *Gelsemium sempervirens* |
| Wild Lupine | *Lupinus diffusus* |
| Phlox | *Phlox nivalis, P. drummondii* |
| Toadflax | *Linaria canadensis* |
| Birdfoot Violet | *Viola pedata* |
| Primrose-leaved Violet | *Viola primulifolia* |
| Dwarf Huckleberry | *Gaylussacia dumosa* |
| Sheperd's Purse | *Capsella bursa-pastoris* |
| Yucca; Beargrass | *Yucca filamentosa* |
| Spurge Nettle | *Cnidoscolus stimulosus* |
| Pitcher Plant (Purple) | *Sarracenia purpurea* |
| Dwarf Iris | *Iris verna* |
| Dangleberry | *Gaylussacia frondosa* |
| Hawthorn | *Crataegus marshallii* |
| Staggerbush | *Lyonia mariana* |
| Dwarf Locust | *Robinia nana* |
| Crab Apple | *Malus angustifolia* |
| Black Cherry | *Prunus serotina* |
| Sweet Pitcher Plant | *Sarracenia rubra* |
| Swarf Dandelion | *Krigia virginica* |
| Fetterbush | *Lyonia lucida* |
| Daisy Fleabane | *Erigeron philadelphicus* |
| Venus' Looking Glass | *Specularia perfoliata* |
| Japanese Honeysuckle | *Lonicera japonica* |
| Sandwort | *Arenaria caroliniana* |
| Tulip Poplar | *Liriodendron tulipfera* |
| Storax | *Styrax americana* |
| Cinquefoil; five-finger | *Pontentilla candensis* |
| Prickley Pear | *Opuntia compressa* |
| Yellow Milkwort | *Polygala lutea* |
| Inkberry | *Ilex glabra* |

| **Common Name** | ***Scientific Name*** |
|---|---|
| Sandhill Milkweed | *Asclepias humistrata* |
| False Wild Indigo | *Baptisia cinerea* |
| Goat's Rue | *Tephrosia virginiana* |
| Spiny Locust | *Robinia hispida* |
| Purple Thistle | *Carduus sp.* |
| Pink Spiderwort | *Tradescantia rosea* |
| Cyrilla | *Cyrilla racemiflora* |
| Colic-root | *Aletris farinosa* |
| Spotted Wintergreen | *Chimaphila maculata* |
| Butterfly Weed | *Asclepias tuberosa* |
| Meadow Beauty | *Rhexia alifanus* |
| Hairy False-foxglove | *Aureolaria pectinata* |
| Bladderwort | *Utricularia fibrosa* |
| Bitterweed | *Helenium amarum* |
| Dayflower | *Commelina erecta* |
| Sweet Pepperbush | *Clethra alnifolia* |
| Sourwood | *Oxydendrum arboreum* |
| Sundew | *Drosera rotndifolia* |
| Sensitive Brier | *Schrankia microphylla* |
| White Water Lily | *Nymphaea odorata* |
| Water-Shield | *Brasenia schreberi* |
| St. Peter's Wort | *Hypericum stans* |
| Arrowhead | *Sagittaria longirostra* |
| Pipewort; Hatpin | *Eriocaulon compressum* |
| Indian-plantain | *Cacalia lanceolata* |
| Rattlebox | *Crotalaria mucronata* |
| Goldenrod | *Solidago sp.* |
| Cardinal Flower | *Lobelia cardinalis* |
| Rabbit Tobacco | *Graphalium obtusifolium* |
| Lobelia | *Lobelia elongata* |
| Blazing Star | *Liatris spicata* |
| Narrow-leaved sunflower | *Helianthus angustifolius* |
| Camphorweed | *Heterotea subaxillaris* |
| Dog-fennel | *Eupatarium compositifolium* |
| Gerardia | *Agalinus setacea* |
| Sea Myrtle | *Baccharis halimifolia* |
| Aster | *Aster curtisii* |
| Duckweed | *Lemna perpusilla* |

Table I-3. Carolina Sandhills NWR bird list

*Loons*
Common Loon

*Grebes*
Pied-billed Grebe
Horned Grebe

*Pelicans and their Allies*
Double-crested Cormorant
Anhinga

*Herons, Egrets and Allies*
American Bittern
Least Bittern
Great Blue Heron
Great Egret
Snowy Egret
Little Blue Heron
Cattle Egret
Green Heron
Black-crowned Night-Heron

*Ibises, Spoonbill, and Stork*
White Ibis

*Vultures*
*Black Vulture
*Turkey Vulture

*Waterfowl*
Greater White-fronted Goose
Snow Goose
*Canada Goose
*Wood Duck
Gadwall
American Wigeon
American Black Duck
Mallard
Blue-winged Teal
Northern Shoveler
Northern Pintail
Green-winged Teal
Canvasback
Redhead
Ring-necked Duck
Lesser Scaup
Bufflehead
Common Goldeneye
Hooded Merganser
Ruddy Duck

*Hawks and Allies*
Osprey
Bald Eagle
Northern Harrier
Sharp-shinned Hawk
Cooper's Hawk
*Red-shouldered Hawk
Broad-winged Hawk
*Red-tailed Hawk
Golden Eagle
*American Kestrel

*Gallinaceous Birds (Quail, Turkey and Allies*
*Wild Turkey
*Northern Bobwhite

*Rails, Gallinules, Coots and Cranes*
King Rail
Virginia Rail
American Coot

*Shorebirds*
*Killdeer
Greater Yellowlegs
Lesser Yellowlegs
Solitary Sandpiper
Spotted Sandpiper
Upland Sandpiper
Least Sandpiper
Pectoral Sandpiper
Common Snipe
*American Woodcock
Ring-billed Gull
Herring Gull

*Pigeons, Doves*
*Mourning Dove
*Common Ground Dove

*Cuckoos*
Black-billed Cuckoo
*Yellow-billed Cuckoo

Table I-3. (continued) Carolina Sandhills NWR bird list

*Owls*
*Barn Owl
*Eastern Screech Owl
*Great Horned Owl
*Barred Owl
Long-eared Owl
Short-eared Owl

*Nightjars*
*Common Nighthawk
*Chuck-will's-widow
*Whip-poor-will

*Swifts, Hummingbirds*
*Chimney Swift
*Ruby-throated Hummingbirdcc

*Kingfishers*
*Belted Kingfisher

*Woodpeckers*
*Red-headed Woodpeckercc
*Red-bellied Woodpeckercc
*Yellow-bellied Sapsucker
Downy Woodpecker
*Hairy Woodpecker
*Red-cockaded Woodpecker
*Northern Flicker
*Pileated Woodpecker

*Flycatchers*
*Eastern Wood-Pewee
*Acadian Flycatcher
Eastern Phoebe
*Great Crested Flycatcher
*Eastern Kingbird

*Shrike*
*Loggerhead Shrike

*Vireos*
*White-eyed Vireo
Blue-headed Vireo
*Yellow-throated Vireo
*Red-eyed Vireo

*Jays and Crows*
*Blue Jay
*American Crow
*Fish Crow

*Martins and Swallows*
*Purple Martin
Tree Swallow
*Northern Rough-winged Swallowcc
*Barn Swallow

*Chickadees and Titmice*
*Carolina Chickadee
*Tufted Titmouse

*Nuthatches*
Red-breasted Nuthatch
*White-breasted Nuthatch
*Brown-headed Nuthatch

*Creepers*
Brown Creeper

*Wrens*
*Carolina Wren
House Wren
Winter Wren
Sedge Wren
Marsh Wren

*Kinglets and Gnatcatchers*
Golden-crowned Kinglet
Ruby-crowned Kinglet
*Blue-gray Gnatcatcher

*Bluebirds, Thrushes and Robin*
*Eastern Bluebird
Veery
Gray-cheeked Thrush
Swainson's Thrush
Hermit Thrush
*Wood Thrush
*American Robin

*Thrashers*
*Gray Catbird
*Northern Mockingbird
*Brown Thrasher

Table I-3. (continued) Carolina Sandhills NWR bird list

*Starlings*
*European Starling

*Pipits*
American Pipit

*Waxwings*
Cedar Waxwing

*Warblers*
Blue-winged Warbler
Golden-winged Warbler
Tennessee Warbler
Orange-crowned Warbler
*Northern Parula
Yellow Warbler
Magnolia Warbler
Cape May Warbler
Black-throated Blue Warbler
Yellow-rumped Warbler
Black-throated Green Warblero
Blackburnian Warbler
*Yellow-throated Warbler
*Pine Warbler
*Prairie Warbler
Palm Warbler
Blackpoll Warbler
Black-and-white Warbler
American Redstart
*Prothonotary Warbler
Swainson's Warbler
Ovenbird
Northern Waterthrush
Louisiana Waterthrush
Kentucky Warbler
*Common Yellowthroat
*Hooded Warbler
Canada Warbler
*Yellow-breasted Chat

*Tanagers*
*Summer Tanager
Scarlet Tanager

*Sparrows*
*Eastern Towhee
*Bachman's Sparrow
*Chipping Sparrow
*Field Sparrow
Vesper Sparrow
Savannah Sparrow
Fox Sparrow
Song Sparrow

*Sparrows (Cont.)*
Swamp Sparrow
White-throated Sparrow
White-crowned Sparrow
Dark-eyed Junco
*House Sparrow (introduced, non-native species)

*Cardinals, Grosbeaks, and Buntings*
*Northern Cardinal
*Blue Grosbeak
*Indigo Bunting

*Blackbirds, Grackles, Cowbirds and Orioles*
Bobolink
*Red-winged Blackbird
*Eastern Meadowlark
Rusty Blackbird
*Common Grackle
Brown-headed Cowbird
*Orchard Oriole
Baltimore Oriole

*Finches*
Purple Finch
House Finch
Pine Siskin
American Goldfinch
Evening Grosbeak

*Accidental Visitors*
Tundra Swan
Barnacle Goose
Oldsquaw
Common Merganser
Red-breasted Merganser
Tri-colored Heron
Merlin
Short-billed Dowitcher
Common Moorhen
American Golden Plover
Semipalmated Sandpiper
Black Tern
Peregrine Falcon
Sora
Horned Lark
Rose-breasted Grosbeak
Bonaparte's Gull
Rough-legged Hawk

Table I-4. Species of special concern and state threatened that occur on Carolina Sandhills NWR

| **Species of Special Concern** | **State Threatened** |
|---|---|
| Bachman's Sparrow (*Aimophila aestivalis*) | Carolina Pygmy Sunfish (*Elassoma boehlkei*) |
| Southern Hognose Snake (*Heterodon simus*) | Pine Barrens Tree Frog (*Hyla andersonii*) |
| Swainson's Warbler (*Limnothlypis swainsonii*) | |
| Pine/Gopher Snake *(Pituophis melanoleucus)* | |
| Well's Pyxie Moss (*Var barbulata*) | |
| Sweet Pitcher-Plant (*Sarracenia rubra*) | |
| Sandhills Chub (*Semotilus Lumbee*) | |
| Pine Barrens Gentian (*Gentiana autumnalis*) | |
| White-Wicky (*Kalmia cuneata*) | |

Table I-5. Priority aquatic species of the Southeastern Plains Ecobasin
(Pee Dee Watershed portion only)

**Common Name *Scientific Name***

Highest Priority

**Fishes**

"Thinlip" chub *Cyprinella sp. (c.f. zanema)*
Sandhills chub *Semotilus lumbee*
Robust redhorse *Moxostoma robustum*
Carolina pygmy sunfish *Elassoma boehlkei*
"Broadtail" madtom *Noturus spp. (c.f. insignis)*

**Mussels**

Yellow lampmussel *Lampsilis cariosa*
Brook floater *Alasmidonta varicosa*
Barrel floater *Anodonta couperiana*

**Snails**

Ridged Lioplax *Lioplax subcarinata*

High Priority

**Fishes**

Blackbanded sunfish *Enneacanthus chaetodon*
Pinewoods darter *Etheostoma mariae*
Piedmont darter *Percina crassa*

**Mussels**

Roanoke slabshell *Elliptio roanokensis*

**Crayfish**

Sandhills crayfish *Procambarus pearsei*
Pee Dee lotic crayfish *Procambarus lepidodactylus*

**Common Name *Scientific Name***

Moderate Priority

**Fishes**

Satinfin shiner *Cyprinella analostana*
Greenfin shiner *Cyprinella chloristia*
Fieryblack shiner *Cyprinella pyrrhomelas*
Highback chub *Hybopsis hypsinotus*
Comely shiner *Notropis amoenus*
Redlip shiner *Notropis chiliticus*
Lowland shiner *Pteronotropis stonei*
Notchlip redhorse *Moxostoma collapsum*
Snail bullhead *Ameiurus abrunneus*
White catfish *Ameiurus catus*
Flat bullhead *Ameiurus platycephalus*
Striped bass *Morone saxatilis*
Mud sunfish *Acantharchus pomotis*

**Mussels**

Carolina lance *Elliptio angustata*
Carolina slabshell *Elliptio congarea*
Eastern elliptio *Elliptio complanata* complex
Variable spike *Elliptio icterina* complex
Pod lance *Elliptio folliculata*
Atlantic spike *Elliptio producta*
Eastern creekshell *Villosa delumbis*

**Crayfish**

Edisto crayfish *Procambarus ancylus*
Santee crayfish *Procambarus blandingii*
A crayfish *Procambarus hirsutus**

[* because of difficulty in obtaining information on this species, the level of priority is undetermined]

# Appendix J. Budget Requests

Table J-1. Refuge Operating Needs System (Rons) projects identified in the CCP (Note: This is a closed database. Projects without a RONS Project Number will be added to the RONS database during the next open period.)

| PRIORITY | RONS NUMBER | PROJECT NUMBER | PROJECT TITLE | FIRST YEAR COST ($1,000) | RECURRING ANNUAL COST ($1,000) | STAFF (FTE'S) |
|---|---|---|---|---|---|---|
| 1 | FY08-2769 | 4 | Enhance forest management capability | 138 | 83 | 1.0 |
| 2 | FY08-4562 | 10 | Restoration of longleaf pine through control of hardwood midstory (10-year project) | 100 | 100 | |
| 3 | FY08-2786 | 24 | Manage Refuge Operations, Facilities and Invasive Species | 138 | 83 | 1.0 |
| 4 | | 15 | Expand prescribed fire ability to treat 13,000 to 15,000 acres annually | 168 | 168 | |
| 5 | FY08-2788 | 6 | Integrate refuge forestry, wildlife, and fire programs through spatial data development and management | 153 | 98 | 1.0 |
| 6 | | 19 | Conduct research on longleaf pine transpiration rates (2-year study) | 50 | 50 | |
| 7 | FY08-2811 | 21 | Connect kids with nature through environmental education opportunities | 153 | 98 | 1.0 |
| 8 | FY08-4536 | 18 | Research, model, and plan for climate change affects on refuge habitats, programs, and management (5-year study) | 150 | 50 | |
| 9 | FY08-2849 | 16 | Protect visitors and refuge resources with enhanced law enforcement capability | 149 | 94 | 1.0 |
| 10 | FY08-4565 | 11 | Convert off-site pine to longleaf pine to restore ecosystem function | 50 | 50 | |
| 11 | FY08-2855 | 23 | Maintain refuge equipment and facilities | 123 | 68 | 1.0 |
| 12 | | 20 | Develop a Watershed Conservation Working Group | 25 | 5 | |
| 13 | | 22 | Support Endangered Species Recovery and Ecosystem Restoration with a Computer Specialist | 138 | 83 | 1.0 |
| 14 | | 17 | Develop a Sandhills Longleaf Pine Conservation Partnership Working Group | 25 | 25 | |
| 15 | | 1 | Conduct Recovery Actions to achieve recovery for refuge RCW population | 138 | 83 | 1.0 |

| PRIORITY | RONS NUMBER | PROJECT NUMBER | PROJECT TITLE | FIRST YEAR COST ($1,000) | RECURRING ANNUAL COST ($1,000) | STAFF (FTE'S) |
|---|---|---|---|---|---|---|
| 16 | FY08-4538 | 3 | Monitor invasive and nuisance plants and wildlife and implement control measures | 140 | 40 | |
| 17 | FY08-2921 | 5 | Optimize forest management capability and control invasive species | 125 | 70 | 1.0 |
| 18 | | 14 | Establish longleaf/wiregrass restoration area at the Research Natural Area (5 year study) | 50 | 50 | |
| 19 | FY08-2864 | 7 | Demonstrate longleaf pine management and facilitate ecosystem restoration on private lands surrounding the refuge | 170 | 115 | 1.0 |
| 20 | | 9 | Carbon Release and Sequestration Rates for Longleaf Pine on Marginal Sites (5 year study) | 140 | 40 | |
| 21 | FY08-2917 | 2 | Increase knowledge of biological species through surveys and monitoring | 113 | 58 | 1.0 |
| 22 | | 13 | Ecology of fire, ground cover, and flower plants in the longleaf pine/wiregrass community and the relationship to pollinators (5 year study) | 140 | 40 | |
| 23 | FY08-4532 | 8 | Manage openings and assist with forest management activities | 113 | 58 | 1.0 |
| 24 | | 12 | Streamhead Pocosin Research (3 year study) | 100 | 50 | |

Table J-2. Priority Service Asset Maintenance Management System (Samms) projects that address deferred maintenance (DM) and capital improvement (CI) projects identified during the CCP planning process or expected during the CCP implementation timeframe (Note: Projects without a SAMMS Project Number will be added to the database as needed during annual updates of the 15-year plan.)

| PRIORITY | SAMMS PROJECT NUMBER | PROJECT TITLE |
|---|---|---|
| ***Years 1-5*** | | |
| 1 | 2008795244 | Replace Rusted and Malfunctioning Pipe Gates |
| 2 | 2006542711 | Rehabilitate Wire Road |
| 3 | | Replace 1980 Motor Grader |
| 4 | | Rehabilitate RT 4 |
| 5 | | Rehabilitate Lake Bee Dam and Water Control Structure |
| 6 | | Rehabilitate RT 9a |
| 7 | | Replace Pole Shed at Helicopter Area |
| 8 | 2006542739 | Rehabilitate RT 6 |
| 9 | | Demolish Pool F Corroded Structure and Repair RT9 |
| 10 | 2007701793 | Rehabilitate RT 2b |
| 11 | 2007733481 | Rehabilitate Ruby Tower (Radio Communications) |
| 12 | 2006542725 | Rehabilitate Lake 16 Access Road |
| 13 | 00102911 | Replace Martin's Lake Observation Tower |
| 14 | 2007701813 | Rehabilitate RT 5 |
| 15 | 2007735345 | Replace Kiosk Structure and Panels (Q212) |
| 16 | 2006542723 | Rehabilitate RT 2 |
| 17 | | Relocate Helispot |
| 18 | 2007701792 | Rehabilitate RT 2a |
| 19 | | Expand Office Area at Fire Maintenance Shop |
| 20 | 2007701806 | Rehabilitate Loop Road |
| 21 | | Demolish Corn Crib |
| ***Years 6-10*** | | |
| | 2009970969 | Rehabilitate RT 11 |
| | 2007701810 | Rehabilitate RT 12 |
| | 2007701804 | Rehabilitate RT 7a |

| PRIORITY | SAMMS PROJECT NUMBER | PROJECT TITLE |
|---|---|---|
| | 2007701802 | Rehabilitate RT 2e |
| | 2007701794 | Rehabilitate Rte 118 |
| | 2007701778 | Rehabilitate RT 6c |
| | 2006542708 | Rehabilitate RT 10a |
| | | Rehabilitate Gravel in Maintenance Yard |
| | | Replace Terex Articulating Front End Loader |
| | | Replace JD 450 Bulldozer |
| | | Replace Caterpillar 416 Front End Loader/Backhoe |
| | | Replace Prowler Travel Trailer Used as Quarters 2 |
| | | Replace Lake Bee Fishing Pier |
| | | Rehabilitate Lake 12 Dam |
| | | Rehabilitate Lake 16 Dam |
| | | Rehabilitate Lake 17 Dam |
| | | Rehabilitate Pool K Dam |
| | | Rehabilitate Pool L Dam |
| | | Rehabilitate Pool D Dam |
| ***Years 11-15*** | | |
| | | Rehabilitate Pool J Dam |
| | | Rehabilitate Honkers Lake Dam |
| | | Rehabilitate Martins Lake Dam |
| | | Rehabilitate Mays Lake Dam |
| | | Rehabilitate Oxpen Lake Dam |
| | | Resurface Paved Wildlife Drive |
| | | Replace Bunkhouse |
| | | Rehabilitate Pool H Dam |
| | | Replace Tool Shed and Smoke House |

# *Appendix K. List of Preparers*

## Preparers

Allyne Askins, USFWS, Carolina Sandhills NWR, *Refuge Manager*
Evelyn Nelson, USFWS, Division of Planning, *Editor*
Charles McEntyre, Tennessee Valley Authority, *Planner and Team Facilitator*
Randy Musgraves, USFWS, Division of Planning, *Graphics Editor*
Tammy Springston, Tennessee Valley Authority, *Technical Editor*

## Contributors

Jason Ayers, USFWS, Charleston Field Office, Ecological Services, *Fish and Wildlife Biologist*
Charles Babb, USDA NRCS Chesterfield County, *District Conservationist*
Judy Barnes, SCDNR, *Wildlife Biologist, Small Game Project*
Laurel Barnhill, SCDNR, *Bird Conservation Coordinator*
Dave Brownlie, USFWS, *Regional Fire Ecologist*
Bruce Campbell, USGS, *Hydrologist*
Don Cockman, USFWS, Carolina Sandhills NWR, *Deputy Refuge Manager*
Joe Cockrell, USFWS, Charleston Field Office, Ecological Services, *Fish and Wildlife Biologist*
Jack Culpepper, USFWS, Carolina Sandhills NWR, *Forester*
Brian Davis, SC Forestry Commission, Sand Hills State Forest, *Forester and Director*
Fred Edinger, PhD, Coker College, *Professor of Geology*
Keith Fisher, The Nature Conservancy – Florida Chapter, *Ecologist*
Shawn Gillette, USFWS, Okefenokee NWR, *Refuge Ranger*
Sharon Hermann, PhD, Auburn University, *Ecologist*
Laura Housh, USFWS, Division of Planning, *Planner*
Mike Housh, USFWS, Okefenokee NWR, *Fire Management Officer*
Julie Hovis, U.S. Air Force, Shaw AFB, *Endangered Species/Wildlife Biologist*
Chuck Hunter, USFWS, Division of Planning and Resource Management, *Chief*
Darryl Jones, SC Forestry Commission, Forest Protection, *Director*
Nancy Jordan, USFWS, Carolina Sandhills NWR, *Wildlife Biologist*
Rick Kanaski, USFWS, Division of Refuges, *Regional Archeologist*
Ron Morton, USDA NRCS, *Resource Soil Scientist*
Elizabeth Osier, SCDNR, *Fisheries Biologist*
Mark Parker, USFWS, Carolina Sandhills NWR, *Fire Management Officer*
Ray Paterra, USFWS, Cape Romain NWR, *Refuge Ranger*
Lynn Quattro, SC Department of Natural Resources, *Comprehensive Wildlife Strategy Coordinator*
Scott Reynolds, SCDEHC, Division of Air Quality Analysis, *Director*
Cindy Sanders, SCDNR, *Fisheries Biologist*
Carl Schmidt, USFWS, Piedmont NWR, *Forester*
John Stanton, USFWS, Columbia Migratory Bird Field Office, *Wildlife Biologist*
Johnny Stowe, SCDNR, *Wildlife Biologist and Forester*
Garry Tucker, USFWS, Visitor Services and Outreach, *Chief*
Joan Walker, PhD, USDA, Forest Service Southern Research Station, *Botanist*