

HABITAT MANAGEMENT PLAN FOR **CAROLINA SANDHILLS NATIONAL WILDLIFE REFUGE**

Chesterfield County, South Carolina

Southeast Region



Carolina Sandhills National Wildlife Refuge

Habitat Management Plan



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Table of Contents

HABITAT MANAGEMENT PLAN

Chapter I. Introduction.....	9
Scope and Rationale	9
Legal Mandates.....	10
Relationship to Other Plans.....	11
Special Designations	13
Chapter II. Background, Inventory and Description Of Habitat	14
Location.....	14
Physical or Geographic Setting.....	15
Climate	16
Geology and topography.....	16
Soils.....	16
Hydrology.....	18
Habitat Conditions – Historic to Current.....	19
Historic Habitat Conditions.....	19
Current Habitat Conditions.....	23
Forest Stand Classification	28
Terrestrial and Aquatic Habitats Discussion	31
Management Unit Descriptions.....	32
Changes Associated with Global Climate Change	38
Chapter III. Resources Of Concern	40
Longleaf pine/wiregrass ecosystem and embedded wetlands: pocosins, seepage bogs, Atlantic white cedar and canebrakes	40
Red-cockaded woodpecker.....	41
Migratory Birds.....	42
Northern Bobwhite Quail.....	42
Bachman's sparrow	43
Pine Barrens treefrog.....	43
Habitat Requirements for Resources of Concern.....	43
Longleaf pine/wiregrass ecosystem (including embedded wetlands, Pocosins, Seepage bogs, Atlantic white cedar, and Canebrakes)	44
Red-cockaded woodpecker.....	45
Migratory Birds.....	47

Northern Bobwhite Quail	47
Bachman's sparrow	49
Pine Barrens treefrog.....	49
Reconciling Conflicting Needs	49
Chapter IV. Habitat Goals and Objectives	50
Longleaf Pine Ecological Integrity.....	52
Embedded Wetlands	58
Red-cockaded Woodpecker	58
Chapter V. Habitat Management Strategies.....	60
Longleaf Pine Ecosystem	61
Potential Management Strategies	61
<i>Prescribed (Rx) Fire</i>	62
<i>Silvicultural Practices</i>	67
Prioritizing Management Actions.....	68
Selected Management Strategies to achieve Longleaf Pine Objectives	69
Embedded Wetlands	81
Red-Cockaded Woodpecker.....	82
Habitat Management for Other Resources	83
Quality Public-Use Opportunities	83
Wetland Impoundments	84
Grassland and Forest Openings	84
Habitat Management Strategies for Other Resources.....	85
Wetland Impoundment Management	85
Grassland and Forest Openings Management.....	88
Management Strategy Common to All Refuge Habitat Objectives	90
Invasive Species	90
Management Unit Prescriptions.....	91
Monitoring Needs to Inform Refuge Management Decisions	92
Management Strategy Documents	93
Necessary Resources	93
Documentation of Special Uses	95
Documentation of Compliance	95
Chapter VI. Literature Citations	98
APPENDICES.....	109

Appendix A. Red-Cockaded Woodpecker Population Goal Analysis.....	111
Appendix B. Soils	123
Appendix C. Management Units.....	127
Appendix D. Forest Management Documentation	129
D.1 SAMPLE ANNUAL PRESCRIPTION	129
D.2 SAMPLE INTRA-SERVICE SECTION 7 BIOLOGICAL EVALUATION FORM	137
D.3 SAMPLE TIMBER BID INVITATION	148
D.4 SAMPLE TIMBER BID FORM.....	150
D.5 CONDITIONS APPLICABLE TO TIMBER HARVESTING PERMITS	151
D.6 SOUTHEASTERN REGION GUIDANCE CONCERNING COMMERCIAL FOREST MANAGEMENT PAYMENT PRACTICES	153
D.7 DELEGATION OF AUTHORITY TO CONDUCT TIMBER SALES	164
D.8 COMMERCIAL ACTIVITIES SPECIAL USE PERMIT	165
Appendix E. Appropriate Use And Compatibility Documents List	169
Appendix F. HMP And CCP Goals And Objectives Crosswalk	171
Appendix G. Environmental Action Statement	173
Preferred Alternative.....	173
Categorical Exclusion(s).....	176
Permits/Approvals.	177
Public Involvement/Interagency Coordination.....	177
Supporting Documents.....	178

LIST OF FIGURES

Figure 1. Location of Carolina Sandhills NWR and surrounding conservation lands.....	14
Figure 2. Physiographic provinces of South Carolina and location of Carolina Sandhills NWR	15
Figure 3. Soils of Chesterfield County, South Carolina.....	17
Figure 4. Annual precipitation, evapotranspiration, and water yield within South Carolina.....	18
Figure 5. Annual acreage of prescribed and wild fire at Carolina Sandhills NWR from 1939-2011.....	23
Figure 6. Historical forest management compartments at Carolina Sandhills NWR.....	34
Figure 7. Forest Management Units at Carolina Sandhills NWR	35
Figure 8. Detail Showing Forest Stand Boundaries within a Management Unit	36
Figure 9. Location of Fields and Impoundments at Carolina Sandhills NWR.	37
Figure 10. Pine Plantations within Carolina Sandhills NWR	48
Figure 11. Habitat Objectives of Carolina Sandhills NWR	51
Figure 12. Longleaf Pine Objective Hierarchy for Carolina Sandhills NWR	53
Figure 13. Utility Functions for Attributes of Longleaf Pine Community at Carolina Sandhills NWR.....	54
Figure 14. Example of Ecological Integrity Continuum Showing Existing and Potential Integrity of a Site.....	62
Figure 15. Average Number of Available Burn Days per Month at Carolina Sandhills NWR.....	65
Figure 16. Factors that Influence Decisions when Prioritizing Management Units to Receive Prescribed Burns at Carolina Sandhills NWR.....	66
Figure 17. Factors that Influence Decisions to Conduct a Growing Season Burn Within a Management Unit at Carolina Sandhills NWR	67
Figure 18. Potential Cost: Benefit of Management Actions.....	68
Figure 19. Actions to Under-Plant Longleaf Pine.....	71
Figure 20. Decision Process for Ground Cover Restoration at Carolina Sandhills NWR.....	72
Figure 21. Desired Future Distribution of Longleaf Pine Age Classes at Carolina Sandhills NWR	73
Figure 22. Silvicultural Thinning Processes at Carolina Sandhills NWR	74
Figure 23. Decision Process to Convert Slash/Loblolly Pine to Longleaf Pine at Carolina Sandhills NWR.....	76
Figure 24. Process for Planting of Longleaf Pine Seedlings at Carolina Sandhills NWR	77
Figure 25. Conditions that Warrant Use of Herbicides to Control Scrub Oak at Carolina Sandhills NWR.....	79
Figure 26. Criteria to Evaluate Use of Mechanical Thinning of Scrub Oak at Carolina Sandhills NWR.....	80
Figure 27. Red-cockaded Woodpecker Management Strategies.....	83
Figure 28. Impoundment Management Strategies at Carolina Sandhills NWR	87
Figure 29. Impoundment Water Regime to Provide Habitat for Shorebirds and Waterfowl During the Annual Cycle at Carolina Sandhills NWR	87
Figure 30. Management of Early Successional Communities at Carolina Sandhills NWR	89
Figure 31. Herbicide Control of Selected Invasive Plants within Grasslands at Carolina Sandhills NWR.....	91

LIST OF TABLES

Table 1. Acreage of major cover-types found at Carolina Sandhills NWR	28
Table 2. Categorization of forest stands within Carolina Sandhills NWR	29
Table 3. Crosswalk of cover-type classification systems at Carolina Sandhills NWR.....	30
Table 4. Example Longleaf Pine Ecological Integrity Score for a Forest Stand at Carolina Sandhills NWR.....	55
Table 5. Example of Aggregate Longleaf Pine Ecological Integrity Score for a Forest Management Unit at Carolina Sandhills NWR.....	56
Table 6. Suggested Seasons for Prescribed Burning of Longleaf Pine to Achieve Stand Objectives. (Reprinted from Roth and Frankin. Undated. Clemson University Forestry Leaflet 32.)	64
Table 7. Habitat Management Staffing Needs at Carolina Sandhills NWR.	93
Table 8. Habitat Management Project Funding Needs at Carolina Sandhills NWR.....	94

CHAPTER I. INTRODUCTION

SCOPE AND RATIONALE

In August 2010, the U.S. Fish and Wildlife Service (FWS or Service) published the Final Comprehensive Conservation Plan (CCP) for Carolina Sandhills National Wildlife Refuge (USFWS 2010). As part of the planning and National Environmental Policy Act (NEPA), the FWS evaluated the effects of implementing a broad range of fish, wildlife, plant, and habitat management programs and techniques to achieve Carolina Sandhills NWR purposes, goals, and objectives; address FWS trust resource responsibilities; maintain and, where appropriate, restore biological integrity, diversity, and environmental health; and support achievement of the National Wildlife Refuge System (NWRS) mission to:

Administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

In addition to the NWRS mission, the refuge identified the following vision statement to identify the future desired condition of the refuge:

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 supports a recovered red-cockaded woodpecker (RCW) 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 manage, 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.

Whereas the CCP identifies overall goals and objectives for Carolina Sandhills NWR, the Habitat Management Plan (HMP) outlines how vegetative communities on the refuge will be managed to achieve those goals and objectives. This plan incorporates all habitat management strategies to be applied on the refuge for the next 15 years. The HMP will clarify Carolina Sandhills NWR's role in contributing toward conservation at the local, regional, and ecosystem scales while preserving the biological integrity, diversity, and environmental health (ecological integrity) of the sandhills longleaf (*Pinus palustris*) pine ecosystem.

Habitat is defined as simply "the physical and biological surroundings of an organism" (Bolen and Robinson 1995). It includes all of the natural components of an ecosystem that are essential for survival including food, cover, water and space. Each organism has specific habitat requirements, thus no two species use exactly the same habitat. For example, a longleaf pine community is not a habitat unto itself; however, each organism found within a longleaf pine community will use different components of the longleaf pine community to meet their habitat requirements. Thus managing for a healthy, high quality longleaf pine ecosystem, will allow many species that are associated with longleaf pine to find their specific habitat requirements within the community.

HMPs are dynamic, working documents that provide refuge staff a decision making process; guidance for the management of refuge vegetative communities, and in some cases, specific habitat requirements of some species; and long-term vision, continuity, and consistency for habitat management on refuge lands. Each plan incorporates the role of the refuge in international, national, regional, tribal, State, ecosystem, and refuge goals and objectives; guides analysis and selection of specific habitat management strategies to achieve those goals and objectives; and uses key data, scientific literature, expert opinion, and staff expertise.

LEGAL MANDATES

President 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 FWS. The purposes of the refuge are to provide habitat for migratory birds, to demonstrate sound management practices that would enhance natural resource conservation, and to provide wildlife-dependent recreation opportunities.

In addition to the specific purposes that were established for each refuge, Congress passed the National Wildlife Refuge System Improvement Act of 1997. This legislation provides clear guidance for the mission of the Refuge System and prioritizes wildlife-dependent public uses. The Act states that each refuge will:

- Fulfill the mission of the National Wildlife Refuge System;
- Fulfill the individual purposes of each refuge;
- Consider the needs of wildlife first;
- Fulfill requirements of comprehensive conservation plans that are prepared for each unit of the Refuge System;
- Maintain the biological integrity, diversity, and environmental health (ecological integrity) 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 use; and allow refuge managers to determine compatible public uses.

Over time, active management has restored the refuge's once-damaged and in some areas, barren lands to a healthy, rich habitat for plants and animals. The responsibilities of the FWS have expanded to include restoration and enhancement of the longleaf pine community for the intrinsic value of the community itself, as well as, for the benefit of the red-cockaded woodpecker (*Picoides borealis*), designated as an endangered species in 1970. 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.

The statutory authority for conducting habitat management planning on National Wildlife Refuges is derived from the National Wildlife Refuge System Administration Act of 1966 (Refuge Administration Act), as amended by the National Wildlife Refuge Improvement Act of 1997 (Refuge Improvement Act), 16 U.S.C. 668dd – 668ee. Section 4(a) (3) of the

Refuge Improvement Act states: "With respect to the System, it is the policy of the United States that each refuge shall be managed to fulfill the mission of the System, as well as the specific purposes for which that refuge was established . . ." and Section 4(a) (4) states: "In administering the System, the Secretary shall monitor the status and trends of fish, wildlife, and plants in each refuge." The Refuge Improvement Act provides the Service the authority to establish policies, regulations, and guidelines governing habitat management planning within the System (Service Manual 620 FW 1).

HMPs comply with all applicable laws, regulations and policies governing the management of the National Wildlife Refuge System. The lifespan of an HMP is 15 years and parallels that of refuge CCPs. HMPs are reviewed every five years utilizing peer review recommendations, as appropriate, in the HMP revision process or when initiating CCPs. Annual Habitat Work Plans, or as they are referred to at Carolina Sandhills NWR, Annual Prescriptions will identify specific management actions to be conducted during a calendar year.

RELATIONSHIP TO OTHER PLANS

Multiple partnerships have been developed among government and private entities to address management considerations affecting species or guilds of species. There is a large amount of conservation and protection information that identifies the potential role of the refuge at the local, ecosystem, national, and international scales to assist in managing for these species. 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 the HMP.

Range-Wide Conservation Plan for Longleaf Pine (*Pinus palustris*), March 2009.

As a result of unsustainable harvest, conversion to other vegetation communities, and exclusion of frequent fire, longleaf pine communities of the southeast have declined from nearly 90 million acres to approximately 3.4 million acres today. To address this significant reduction of longleaf pine communities, a group of experts were convened in 2005 to develop a conservation plan for the management of longleaf pine. This plan provides guidance to national, state and private organizations for the enhancement and management of longleaf pine. A goal of increasing the longleaf pine community from the current 3.4 million acres to 8 million acres during the next 15 years was established. Carolina Sandhills NWR will play a significant role in longleaf pine management, with the ability to enhance the quality and quantity of longleaf pine stands on the refuge and demonstrate sound habitat management practices. When combined with the adjoining 46,000 acres of Sand Hills State Forest administered by the state of South Carolina, a significant amount of quality longleaf pine will be managed to help meet objectives of the Longleaf Pine Conservation Plan.

Due to both the intrinsic value of longleaf pine communities, and the fact that most of the resources of concern identified within the refuge's CCP have their habitat requirements met within quality longleaf pine communities, management of longleaf pine will be the dominant action within this HMP.

Red-cockaded Woodpecker (RCW) Recovery Plan (2003) and Refuge RCW Management Plan (2006). Carolina Sandhills NWR has the largest population of RCWs on Service-owned lands. Priority actions identified in the recovery plan were incorporated into goals, objectives, and strategies of the refuge CCP. The recovery plan identified Carolina Sandhills NWR and Sand Hills State Forest (SHSF) as the Sandhills (SC) Recovery Unit, a secondary core population capable of supporting 250 Potential Breeding Groups (PBGs). The recovery plan further estimated a population goal for the refuge as 193 active clusters¹. In 2006, after a review of the refuge's spatial data and available habitat, the approved population goal for the refuge was revised to 165 PBGs² and a refuge-specific RCW Management Plan was written and approved. As this HMP will replace the 2006 Refuge RCW Management Plan, new spatial analysis technology and current refuge data was used to re-evaluate the RCW population goal. Results of the analysis are in Appendix A.^{1,2}

Additional national and regional plans were reviewed to provide direction for the refuge's HMP. For a full description of relevant plans, please see pages 25-27 in the refuge's CCP (2010).

NABCI - North American Bird Conservation Initiative: Carolina Sandhills NWR is included in Bird Conservation Region 27, Southeastern Coastal Plain.

Bird Conservation Plan for the South Atlantic Coastal Plain: Carolina Sandhills NWR lies within Physiographic Area 03, the South Atlantic Coastal Plain and has the largest population of the endangered red-cockaded woodpeckers on refuge lands, a priority species in the plan.

ACJV – The Atlantic Coast Joint Venture: Carolina Sandhills NWR is included in the Atlantic Coast Joint Venture (2005) although it is not tasked with contributing to population goals identified in the plan due to the upland longleaf pine forest which comprises the majority of the habitat (ACJV 2005).

SAMBI – The South Atlantic Migratory Bird Initiative: 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).

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). The plan's building blocks are the Bird Conservation Regions (BCRs) developed for and utilized by the NABCI.

CWCS – South Carolina's Comprehensive Wildlife Conservation Strategy: Carolina Sandhills NWR is identified as a significant public land holding in the Sandhills Ecoregion. In addition, the refuge is home to several Priority Conservation Species identified in the

¹ Refuge pine acreage divided by 200.

² Previously, the refuge's entire pine acreage was considered RCW habitat. However, several habitat classifications and their spatial arrangement are not suitable for RCW: fields, ponds, lakes, stream corridors, bottomland hardwoods, and upland hardwoods. In addition, since RCW do not share nesting areas, the habitat needed to be partitioned to provide for this exclusivity. This population estimate partitioned the suitable habitat.

CWCS, including eastern fox squirrel, Pine Barrens treefrog, Bachman's sparrow, northern bobwhite, and red-cockaded woodpecker.

The CWCS identifies that fire suppression contributes to habitat loss for bird species that require an understory with a diverse herbaceous plant layer that is maintained by routine burning. However, in recent years, use of adequate fire management has decreased in the state, which has resulted in successional changes that render the habitat unsuitable for some animal species.

The CWCS Conservation Actions applicable to Carolina Sandhills NWR include:

Restore and enhance impaired habitat, where feasible and cost-effective. Habitat enhancements include:

- Encourage nest/roost site retention/restoration
- Employ prescribed burning
- Restore natural stream courses and flows
- Eliminate or reduce invasive and non-native species from habitats
- Replant native plants
- Restore wetlands

This HMP also incorporates the recommendations of other approved station plans including the Fire Management Plan (USFWS 2009), the Biological Review (USFWS 2007b), and the Forestry and Fire Review (USFWS 2008). Prescribed fire strategies detailed in this plan dovetail with the Fire Management Plan.

SPECIAL DESIGNATIONS

Carolina Sandhills NWR is one of 14 Land Management Research and Demonstration (LMRD) Areas managed by the FWS. 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 research, wildlife inventorying and monitoring, the sites will become a repository of data and information about featured habitats or management issues (USFWS 2007b).

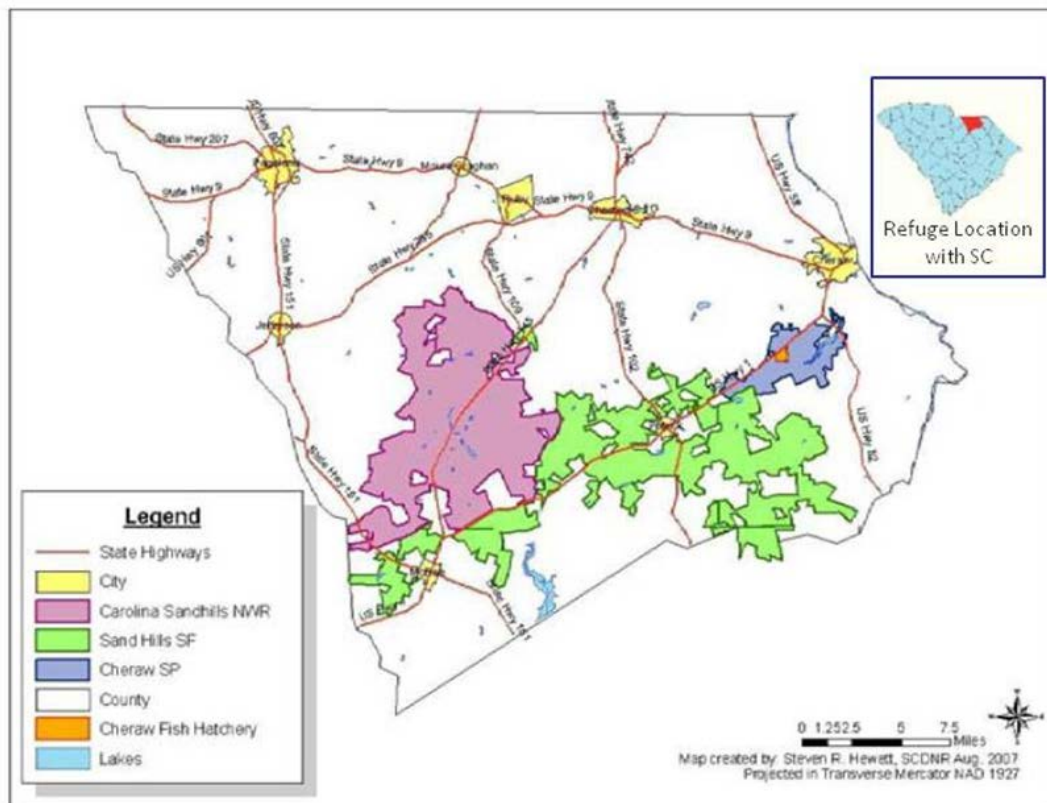
Carolina Sandhills NWR is recognized as a Globally Important Bird Area by the Audubon Society because of its red-cockaded woodpecker population and breeding population of Bachman's sparrow.

CHAPTER II. BACKGROUND, INVENTORY AND DESCRIPTION OF HABITAT

LOCATION

The Carolina Sandhills NWR is in a rural area in the northeastern region of South Carolina. The refuge contains 48,428 acres, including fee ownership of 45,926 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. Figure 1 illustrates the refuge location, acquisition boundary and nearby acquired lands. Conservation easements are not illustrated and are managed in caretaker status due to budget and staffing constraints.

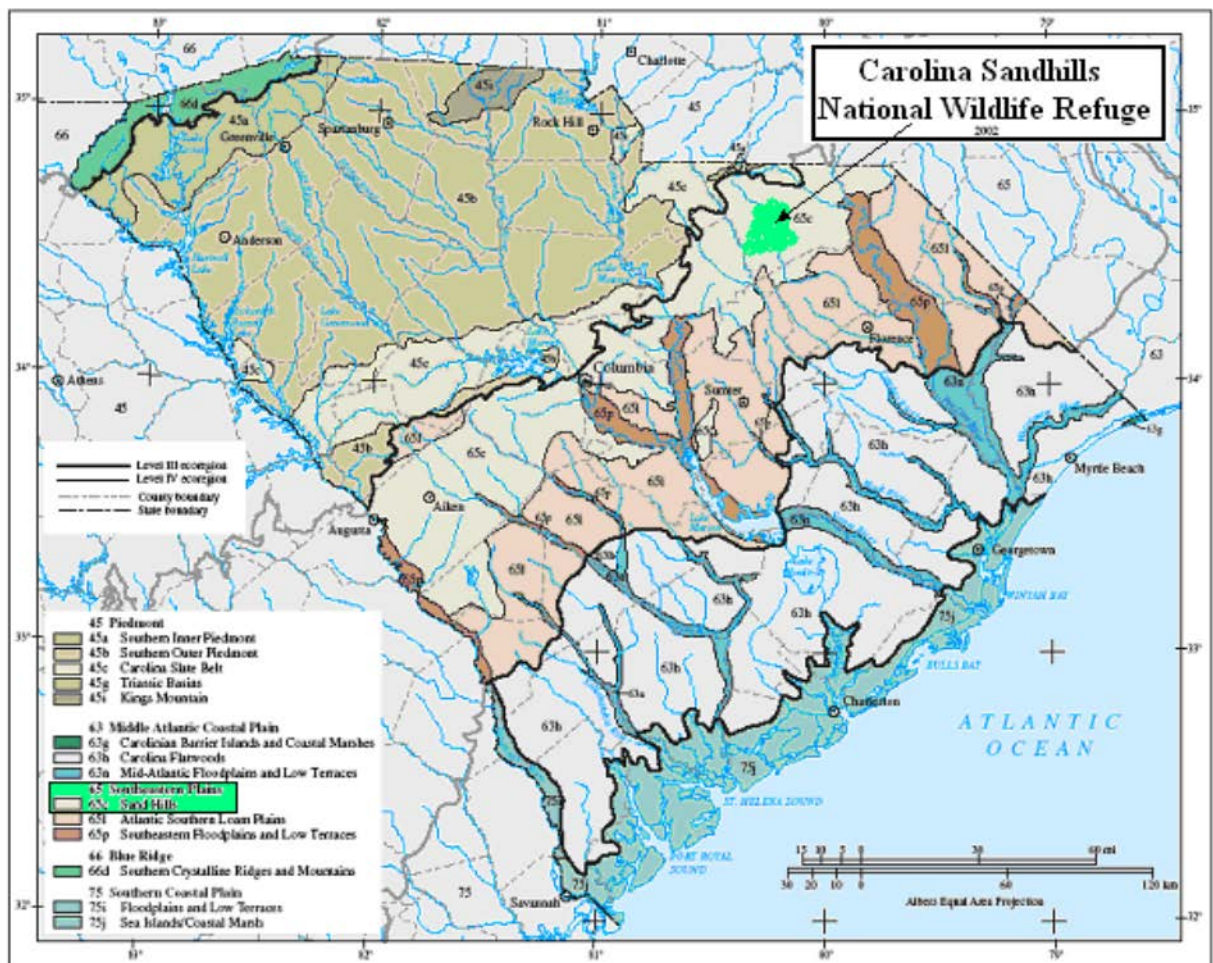
Figure 1. Location of Carolina Sandhills NWR and surrounding conservation lands



PHYSICAL OR GEOGRAPHIC SETTING

South Carolina is composed primarily of four physiographic provinces (Atlantic Coastal Plain/Coastal Zone, Sandhills, Piedmont Plateau, and Blue Ridge Mountains) (Figure 2). Carolina Sandhills NWR is located in the Sandhills region of South Carolina and overlies a portion of the fall line that forms the transition zone between the Atlantic Coastal Plain and the Piedmont physiographic provinces. This unique band of sandy hills and seepage bogs are found in a 10 to 30 mile wide strip which stretches from southwest Georgia to North Carolina. Topography characterized by gently rolling hills capped by deep coarse sands dominates the region. These sandy hills are bisected by numerous intermittent and perennial streams which form riparian pocosins characterized by dense, nearly impenetrable vegetation growth. Stream sediment deposits over thousands of years have created the hilly topography visible today. These coarse sands are extremely porous and infertile.

Figure 2. Physiographic provinces of South Carolina and location of Carolina Sandhills NWR



CLIMATE

The Carolina Sandhills NWR experiences a humid subtropical climate, with long, hot, sultry summers and short, mild winters. The average temperature in Chesterfield County is about 61°F, with average daily temperatures ranging from 30°-55°F in January and from 70°-91°F 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. 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 2009).

The average relative humidity is high (51-87%), skies are generally clear (58-66%) and winds are generally low (means <8mph) and from the southwest most of the year, but from the northwest in September and October.

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) 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), with elevations on the refuge ranging from 250 to 500 ' above MSL. Maximum elevations in the immediate area of the Carolina Sandhills NWR are 513' above MSL on Sugarloaf Mountain and 520' above 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 (SCDNR 2005a).

SOILS

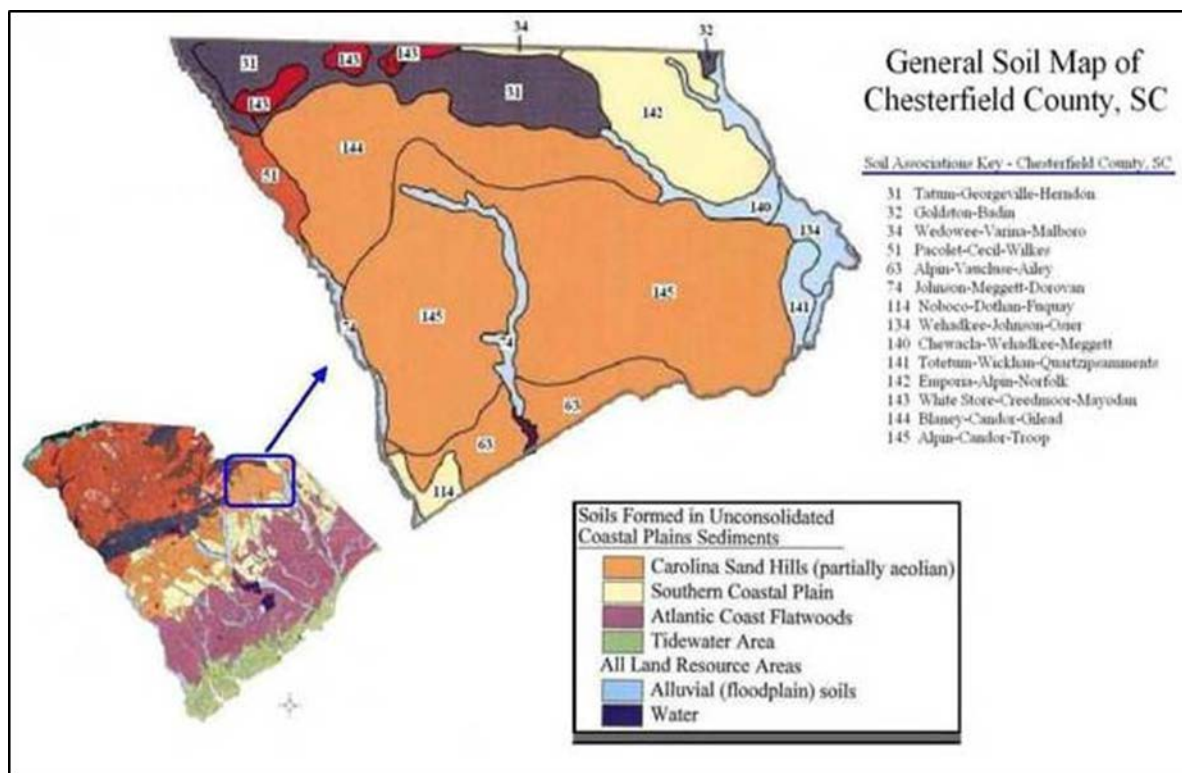
The Sandhills consist primarily of Cretaceous and Tertiary marine, fluvial, and eolian sediments, the majority of which is unconsolidated marine sediment (Leigh 1998). The soils of the Carolina Sandhills are among the oldest in the Coastal Plain of South Carolina and are generally low in fertility, very well drained, and strongly acidic. It is not uncommon to find clay lenses or horizons in Sandhills soils. Some of these clay lenses may form a barrier to root growth and water movement (SCDNR 2000), while lenses in different locations prove more beneficial by increasing water retention and nutrient exchange.

Deep sandy soils with occasional outcroppings of red and kaolin clays are found on the Carolina Sandhills NWR (USFWS 2007b). 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. Quartzipsamments 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 amounts of clay to form 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). See Appendix B for a complete description of soils found on the refuge. Figure 3 illustrates the general soil associations of Chesterfield County, which completely encompasses the refuge (USDA NRCS 2008b).

As indicated, these soils have high percentages of sand (greater than 85 percent), low soil moisture, and low soil nutrient content, <1% organic matter (Madden et. al. 2003). Thus the low fertility soils greatly influence the vegetative communities that occur on the refuge. The dominate community of longleaf pine is well adapted to these soils, however growth rates of longleaf pine at Carolina Sandhills NWR are well below those that occur at other geographic locations. Additionally, the many rare plants that occur on the refuge are specifically adapted to these very infertile conditions.

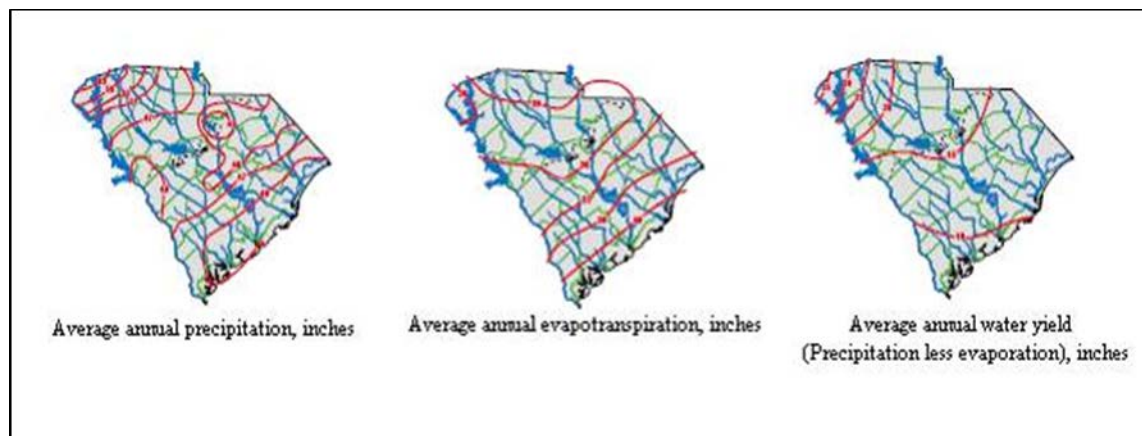
Figure 3. Soils of Chesterfield County, South Carolina



HYDROLOGY

The hydrologic resources of South Carolina and the Carolina Sandhills NWR are abundant. 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 4 (Cherry et. al. 2001).

Figure 4. Annual precipitation, evapotranspiration, and water yield within South Carolina



Ground Water

Chesterfield County has two markedly different sources of ground water, with about 20 percent in crystalline rocks beneath a thin weathered zone containing ground water only in fractures providing low yields, while the remainder of the county, including the Carolina Sandhills NWR, lies below the Fall Line and contains sand and clay beds of the high yielding Middendorf Formation. The majority of the Pee Dee region relies heavily on the Middendorf for irrigation, public supply, and industrial use (Newcome, Jr., R. 2004, SCDHEC 2007b). Deep sand aquifers of the Middendorf allow surface water to sink rapidly into the soil.

Surface Water

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 of evergreen shrubs border these streams, producing some unique vegetation communities. 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] 2008). (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 2002).

HABITAT CONDITIONS – HISTORIC TO CURRENT

HISTORIC HABITAT CONDITIONS

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. 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). Chesterfield County was formed in 1785.

Vast longleaf pine forests dominated the landscape of the sandhills during man's first settlement in the area in the mid-1700's. These longleaf pine forests supported major lumber and naval store industries during the late 1800's. By the early 1900's, these forests had been largely depleted and destroyed. Most of the woodlands had been severely cutover and wildfires burned unchecked throughout the area. Farming became the predominant lifestyle in the region. Deep, infertile, sandy soils and poor farming practices caused most agricultural attempts to fail. The federal government began obtaining this depleted and eroded land from 1936 to 1939 by purchases and other civil actions under the authority of the National Industrial Recovery Act and the Emergency Appropriation Act of 1935. Land acquired under this project became known as the Sandhills Project (LA-SC-4). Rehabilitation of the land was begun by the Works Progress Administration and the Civilian Conservation Corps.

A lease and a cooperative agreement (A-SC-454) between the Bureau of Biological Survey and the South Carolina Forestry Commission (SCFC) were signed on April 29, 1939. Conditions of this agreement divided the Sandhills Project (92,000 acres) into two areas. One-half of the area was designated as the Sand Hills State Forest (SHSF) while the other half of the area was designated as the Carolina Sandhills NWR. Title to the entire project was retained by the United States Department of the Interior. The refuge was established as a breeding ground for wildlife and as a demonstration site for game management techniques. The SHSF was established as a demonstration conservation area embodying the principals and objectives of planned multiple land use.

The refuge was established from approximately 122 individual tracts of land ranging in size from one acre to 10,000 acres. The FWS began planting trees, building waterfowl impoundments and green tree reservoirs, planting wildlife food plots, and restocking fish and wildlife. During the first few years following establishment, wildfire control became essential since they had previously raged unchecked over these lands prior to federal acquisition. A system of truck trails and firebreaks was constructed to provide access and protection for wildfire control. An organized fire protection system was set up providing detection and suppression crews year round. A program of fire prevention education was also initiated.

After reducing the occurrence and size of wildfires, reforestation of abandoned agricultural fields and understocked pine lands with heavy scrub-oak components became the main

management goal. A method of converting understocked, scrub-oak communities to productive pine was initiated in the late 1940's. This program was given a tremendous boost in the early 1960's by the passage of an act referred to as the "scrub-oak eradication project" permitting the use of receipts from timber products to be used for site preparation and reforestation. Over 13,000 acres of old abandoned fields and site prepared land were planted to pines during the period. Approximately 11,000 acres of longleaf pine and 2,000 acres of slash pine (*P. elliotii*) were planted. Site prepared lands were pushed in windrows and heavily disced, followed by machine-planted pines in the year following site preparation.

In 1969, a devastating ice storm occurred in the sandhills belt of South Carolina, resulting in serious timber damage and loss. The total commercial timber volume was reduced by one-third due to the damage, resulting in the need for extensive salvage operations. The ice storm took its greatest toll on younger stands, which were most vulnerable to ice damage. Due to the heavy damage and resulting understocked conditions, many stands had to be regenerated short of their normal rotation.

Under the aforementioned cooperative agreement, the (SCFC) was responsible for forest management on the refuge from 1939 to 1984. During this time, timber management plans were prepared jointly for the SHSF and the refuge. In 1972 and 1979, continuous forest inventory (CFI) plots were established and measured to ascertain timber volumes. Optimum rotation ages for timber volume production for longleaf and loblolly (*P. taeda*) pine were calculated based on available data for the soil types present, which, in most cases, were determined to be extremely low in fertility.

Over time, it became apparent that management of these timber stands for optimum volume production usually resulted in less than optimal habitat conditions for many wildlife species. This was due to short rotations, poor interspersed and juxtaposition of regeneration areas, and dense tree spacing. Until 1982, average rotation ages on the refuge were 80 years for longleaf pine, 60 years for loblolly pine, 50 years for pond pine (*P. serotina*), and 25-45 years for slash pine. Slash pine plantations were typically planted at a 6' x 8' spacing (908 trees per acre) and longleaf seedlings were planted between 800 to 1,000 seedlings per acre. Both slash pine and longleaf pine seedlings were planted at such heavy densities to allow for high mortality, which frequently occurred in the first year after planting on these poor soils. It is important to note that these planting rates although dense are probably lower than natural seeding rates which typically result in 1200 or more seedlings per acre. However, these relatively short rotation ages and densely stocked stands were clearly undesirable from a wildlife management standpoint, particularly for the wildlife species which require late successional stage woodlands with open understories, such as the endangered RCW, eastern wild turkey, and fox squirrel.

The passage of the Endangered Species Act of 1973 brought about changes in the timber management program on the refuge. Guidelines were prepared for the management of RCW and published in the *Red-cockaded Woodpecker Recovery Plan* (USFWS 1979). In 1981, the *Five Year (1982-87) Forest Management Plan for Sand Hills State Forest and Carolina Sandhills National Wildlife Refuge* was prepared by the S.C. Forestry Commission. This plan sought to better coordinate the management of timber with the wildlife objectives on the refuge. Rotation ages for longleaf and loblolly pine were increased to 100 years and 80 years, respectively, as stipulated in the RCW recovery plan to better meet the requirements of the woodpecker. All residual (100+ years old) longleaf pine trees were required to be left in addition to all nesting and roosting cavity trees. These local guidelines were eventually replaced by the recommendations in the *Revised Red-cockaded*

Woodpecker Recovery Plan (USFWS 1985) and have been updated following revisions to the recovery plan, most recently in 2003 (USFWS 2003).

Between 1974 and 1984, refuge timber management activities, except salvage, were based on annual compartment prescriptions prepared by the SCFC and approved by the refuge forester and refuge manager. Management activities included pulpwood and sawtimber thinning to enhance the stands for many wildlife species with emphasis on the endangered RCW. In 1984, a two-year moratorium was enacted, which restricted the SCFC from conducting any timber sales activities on the refuge while the Regional Solicitor determined how timber receipts from the refuge could be used. No timber management activities except for a salvage sale due to tornado damage were conducted during the moratorium.

In 1986, the Cooperative Agreement was officially terminated and the FWS assumed responsibility for timber management on the refuge. In December 1990, Congress passed legislation authorizing the FWS to transfer ownership of the SHSF to the SCFC. Refuge forestry staff continued to operate under the existing forest management plan and prepared annual compartment prescriptions for management activities. Such activities included thinning longleaf pine plantations due to heavy stocking and crowded stand conditions. This thinning was accomplished through the marking of each individual tree that was to be harvested.

In 1991, the FWS prepared a *Forest Habitat Management Plan* for the refuge. Under this management plan, the refuge forests have been managed under a system of “all-aged management in even-aged units.” The main priority was given to thinning pine plantations. In 1992, the refuge began using operator select thinning, where the operator (logger) selects the trees to be removed under the guidelines specified in the pulpwood bid. These guidelines stipulated diameter limits and the removal of suppressed and diseased trees with a residual basal area of 60-70 square feet per acre.

In 1992, a management prescription was prepared and approved to convert 1,953 acres of slash pine plantations to native longleaf pine over a period of 25 years. Under a Memorandum of Understanding between the FWS and the SCFC, the Commission was responsible for restoring longleaf pine on the slash pine plantation sites as the refuge had these sites cleared. Slash pine plantations had originally showed good early growth on many sites, but stagnated at an early age, especially in overstocked stands. Many slash pine plantations on the refuge were stagnant and understocked as a result of ice damage, tornados and Hurricane Hugo. Wildlife value of these stands was poor and scrub-oaks thrived in the sparse canopy conditions. Additionally, Annosus root rot (*Heterobasidion annosum*) began to appear in many slash pine plantations. These factors resulted in numerous slash pine stands with poor long-term potential to provide suitable RCW habitat.

During the first two years of slash pine conversion (1994 and 1995), stands were clearcut, disced, and allowed to lay dormant for one year. A tractor-mounted V-blade was used to prepare beds for planting seedlings. Longleaf pine seedlings were then mechanically planted in rows at an 8 x 10 foot spacing (544 trees/acre). If survival rates were poor on any sites, the area would be replanted. In 1996, this system of site prep was changed due to erosion problems, which occurred after planting due to sparse levels of residual live vegetation and leaf litter or woody debris for ground cover after clearing. Under the current system of site prep, no disking or V-blading is used. When the slash pine is harvested, the logging debris is scattered across the site. One year after clearing, the areas are hand-planted with containerized longleaf pine seedlings, which have much greater survival rates

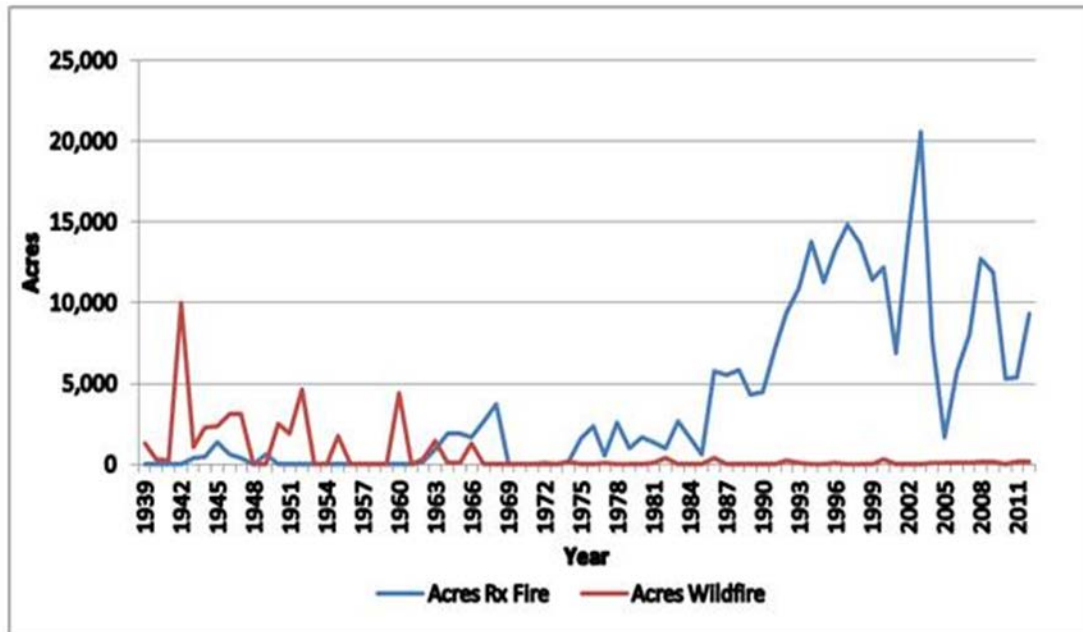
in the dry, sandy soil than bare-root stock. This method reduces soil erosion and plant disturbance by keeping ground cover in place. The size of the longleaf restoration sites has also been reduced to stagger the age distribution on the refuge as much as possible and provide greater diversity of wildlife habitat. The size and location of the selected slash conversion sites depend upon proximity to RCW cluster sites and the amount of foraging habitat within cluster partitions. The RCW recovery plan (USFWS 2003) provides guidelines for implementing offsite pine conversions to longleaf pine related to RCW nesting and foraging.

Prescribed fire has played a major ecological role at Carolina Sandhills NWR since the early years of its establishment. The first recorded prescribed burning on the refuge occurred between 1941 and 1945, when approximately 2,300 acres of fields and woodlands were burned. Prescribed burning was done on a very small scale on the refuge in the following 20 years (Figure 5). A severe ice storm in 1969 resulted in a cessation of burning due to heavy fuel loads until 1974. The lack of fire had visible negative effects on the longleaf pine ecosystem. Turkey oaks increased in abundance in the upland areas, creating a dense understory/midstory beneath the longleaf pine overstory. Several RCW cluster sites were reported abandoned as the midstory scrub-oaks encroached on cavity trees. Longleaf pine natural regeneration was reportedly reduced and the fire-dependent native ground cover suffered due to the lack of fire and the dense sub-canopy of scrub-oaks that reduced the amount of sunlight reaching the ground.

A key event that elevated the priority of prescribed burning on the refuge was the passage of the Endangered Species Act (ESA) of 1973. Although the RCW was listed as endangered in 1970, it was not protected by law until the ESA was passed. The ESA and its implementing regulations prohibit any activities that would significantly modify or degrade habitat or that interfere with essential biological functions such as feeding, breeding or sheltering of listed species. As previously noted and as supported by research throughout the species' range, RCW abandon cluster sites when hardwood midstory develops. Prescribed fire is an effective tool in controlling hardwood midstory development.

Prescribed burning was reinitiated on the refuge in 1975, with 1,577 acres burned that year. The refuge started burning on a five-year rotation with backing fires to reduce the heavy fuel buildups. By 1982, these heavy fuel accumulations were reduced enough to utilize strip head fires and gridded spot fires. The objectives of the prescribed burning program were: (1) wildlife habitat improvement, especially to provide open forest conditions favored by the RCW, (2) wildfire suppression through hazardous fuel reduction, and (3) hardwood control. Another key occurrence during 1982 was the first use of aerial ignition to conduct prescribed burns. The use of aerial ignition was the single most important factor in accomplishing prescribed burning of large acreages during a given year. With limited personnel and suitable burning days available, aerial ignition allowed 1,500 to 2,000 more acres to be burned per day than hand burning.

Figure 5. Annual acreage of prescribed and wild fire at Carolina Sandhills NWR from 1939-2011



Between 1990 and 1995, an average of 10,000 acres was burned per year. Early growing season burns were initiated during 1992 and have increased to more than 3,000 acres per year. Better hardwood control, habitat conditions favoring grass and forb understory communities, and woody fuel reductions occur with growing season burns. These growing season fires more naturally mimic historic fire occurrence and result in better control of hardwoods, increased wiregrass (*Aristida stricta*) seed production and viability, and enhanced native understory vegetation in general.

Although the importance of fire in maintaining the sandhills longleaf pine ecosystem is accepted widely today, fire management on the refuge has spanned the spectrum from primarily wildfire suppression to aggressive prescribed burning used to achieve a variety of management objectives. While a progressive prescribed burning program on the refuge has not prohibited wildfire occurrence, it certainly has resulted in fewer and smaller fires that are easier to contain (Figure 5). Prescribed burning on a three-year burning rotation during the past decade has greatly reduced hazardous fuel loads and has provided a mosaic of habitats across the refuge, benefitting an array of open pine and grassland species.

CURRENT HABITAT CONDITIONS

The Carolina Sandhills NWR landscape is covered by longleaf pine in primarily two condition classes. Approximately thirty-three percent of the refuge is characterized by open, mature longleaf pine woodlands above a native grass-forb ground cover. Acreage of major forest cover types is depicted in Table 1. Scattered old-growth and relic turpentine longleaf pine trees left uncut by early logging operations are present throughout the refuge. Many of the old growth longleaf pine trees were left unharvested because they were either poorly formed, difficult to access, or contained defects (cavities, turpentine scars) making them undesirable from an industry perspective, but highly valuable from wildlife and ecosystem

perspectives. Scrub oaks, collectively including turkey oak (*Quercus laevis*), blackjack oak (*Q. marilandica*), bluejack oak (*Q. incana*), and sand post oak (*Q. margaretiae*), are common in the understory. On many 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. On the better sites where clay outcroppings occur, longleaf pine is occasionally mixed with loblolly pine.

The second class of longleaf pine occupies approximately thirty-one percent of the landscape and is characterized by second and third growth timber stands planted since refuge establishment. The earliest refuge records date to 1937 when 171 acres of longleaf pine were planted. Other plantations have been established since 1951 to present, initially on sites that were dominated by scrub-oaks with understocked pine canopies (1950s and 1960s) and subsequently, on sites that had been planted in off-site pine species that fared poorly in the xeric site conditions of the sandhills. To illustrate the extremely poor site conditions that occur in the sandhills, at 40 years old, longleaf pine have an average diameter of only 8 inches and an average height of less than 50 feet. Due to growth stagnation and damage from frequent ice storms, many slash and loblolly pine plantations have been converted to longleaf pine.

Approximately sixty-five percent of the plantation longleaf pine is greater than 40 years old and was previously thinned to an average basal area of 70ft²/ac. These stands are characterized by a relatively closed canopy and sparse to no understory except pine needles. In these older plantation stands, the next prescribed silvicultural action is too thin to an average 50ft²/ac., which will reduce canopy cover, promote more favorable conditions for groundcover restoration, and retain enough trees per acre to ensure foraging and future nesting habitat for the RCW. Low-grade basal area thinning, where the smallest diameter trees and diseased trees are removed while the most healthy and vigorous trees are retained at a desired basal area, is the preferred method for improving conditions within these stands. Silvicultural thinning, thermal thinning, [either from natural ignitions (lightning) or pockets of higher intensity prescribed fire], tipovers of single trees or windthrows of groups of trees will transform these plantation sites to more natural conditions over time.

Embedded throughout the extensive upland forest of natural and planted longleaf pines are small, legume-rich “bean-dip” depressions and small, scattered patches of regenerating longleaf pine seedlings, pole-sized stem “cohorts” of pine and oaks. Linear areas of canebrakes (*Arundinaria gigantea*, ssp. *Tecta*), Atlantic white cedar (*Chamaecyparis thyoides*), hillside herb bogs, and stream-head pocosins thread through upland forests, varying in width in the upper reaches of drainages (narrow) and around small pond and lake margins (approximately fifteen percent of the refuge) and (hydric) bottomland forests (three percent of area). At lower elevations, these pocosins are broad, bowl-like depressions.

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 in density 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. Wetland and seepage communities (including several insectivorous plants), occur in hydrologically appropriate locations. These include narrow areas along drainages and pond margins, where occasionally prescribed fire visits and creates openings for Atlantic white cedar reproduction. A number of uncommon but unique plants can be found across these different habitats including Well's pyxie moss (*Pyxidanthra barbulata brevifolia*), sweet

pitcher-plant (*Sarracenia rubra*), pine barrens gentian (*Gentiana autumnalis*), and white-wicky (*Kalmia cuneata*). This diverse flora also supports a variety of native pollinators, especially bees, butterflies, and moths (lepidopteron).

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. Also, evidence of recent tree harvesting, along with generally small areas of agricultural activity are observed. Upland fields and native warm-season grasslands occupy less than one percent of the upland landscape. 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., sericea and bi-color lespedeza) were planted to enrich the infertile soil. Weeping love grass (*Eragrostis curvula*) 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. An 8-acre patch of black bamboo (*Phyllostachys nigra*), escaped from a former nursery operation on the lands prior to refuge acquisition) exists adjacent to SC Highway 145 in the drain surrounding Rogers Branch

The open, mature longleaf pine stands and associated native grass-forb ground cover supports a population of RCWs, using naturally excavated and artificially provisioned cavities. Other open pineland birds commonly observed include Bachman's sparrow (*Peucaea aestivalis*), chuck-wills-widow (*Antrostomus carolinensis*), northern bobwhite (*Colinus virginianus*), brown-headed nuthatch (*Sitta pusilla*), and red-headed woodpecker (*Melanerpes erythrocephalus*), as well as fox squirrel (*Sciurus niger*). Southern hognose (*Heterodon simus*) and pine (or gopher, *Pituophis melanoleucus*) snakes are also found on occasion. Along moister riverine forest Swainson's warbler (*Limnothlypis swainsonii*), Acadian flycatchers (*Empidonax virescens*), Kentucky warbler (*Oporornis formosus*), hooded warbler (*Wilsonia citrine*), wood thrush (*Hylocichla mustelina*), and the cavity-dependent prothonotary warbler (*Protonotaria citrea*) and wood duck (*Aix sponsa*) can be observed. In streamhead pocosins, canebrakes, and hillside seepage areas, Swainson's warbler, prairie warbler (*Dendroica discolor*), American woodcock (*Scolopax minor*), great-crested flycatchers (*Myiarchus crinitus*) and American wood duck can be observed along with the unique pine barrens treefrog (*Hyla andersonii*). In forest openings and grasslands, American kestrel (*Falco sparverius*), northern bobwhite, loggerhead shrike (*Lanius ludovicianus*), grasshopper (*Ammodramus savannarum*) and Henslow's (*A. henslowii*) sparrows, field sparrow (*Spizella pusilla*), mourning dove (*Zenaida macroura*), white-tailed deer (*Odocoileus virginianus*), and eastern wild turkey (*Meleagris gallopavo*) are commonly seen. Snags, both pine and hardwood, dot the landscape in their respective ecosystems, providing refugia and breeding sites for cavity nesting species. Following are detailed descriptions of each major vegetation community found on Carolina Sandhills NWR:

Upland Pine/Scrub Oak Habitat Type

Pine - (SAF Type 70, Longleaf Pine, ~35,000 acres) - This habitat type is comprised of natural longleaf pine. On the better sites, longleaf pine is replaced with loblolly pine (SAF Type 81) and occasionally shortleaf pine (*P. echinata*). Occurring mostly on dry sites, the most common associate species is turkey oak. Other associates found less abundantly are persimmon (*Diospyros virginiana*), sassafras (*Sassafras albidum*), and bluejack, blackjack and sand post oaks.

Pine - (SAF Type 81, Loblolly Pine) - This type is comprised of natural loblolly pine found on the more productive pine areas, which often are old abandoned agriculture sites. Common

associates include sweetgum (*Liquidambar styraciflua*), blackjack oak, bluejack oak, post oak (*Q. stellata*) and shortleaf pine.

Pine Plantation - This type was created by clearing land stocked with scrub-oaks or old fields and planting with longleaf, loblolly or slash pine. This land was originally stocked with insufficient volumes of merchantable timber to be economically operable or consisted of worn out agricultural land. Originally, 700-1,000 pine seedlings/acre were planted, but such areas are now planted at 435 trees/acre. Currently, converted slash and loblolly pine plantations are artificially regenerated to ensure successful conversion to site-appropriate longleaf pine.

Pine/Scrub Oak - (SAF Type 71, Longleaf Pine-Scrub-oak) - This type occupies dry sand ridges and upper slopes and rather large areas of well-drained coarse sands. This type often replaces longleaf pine after cutting and repeated fires. The overstory is comprised of scattered longleaf pine with the understory containing medium to heavy densities of turkey oak and, on occasion, blackjack oak.

Southern Scrub Oak - (SAF Type 72) - This type is composed of a mixture of scrub-oaks with persimmon, sassafras, and assorted hickories (*Carya* spp.) as minor associates. This type is found on dry sand ridges formerly occupied by longleaf pine or longleaf pine /scrub oak types. Scrub oaks were historically present under longleaf pine and gradually took over when the pine was clearcut or died out.

Upland Hardwood/Pine Habitat Type

Pine-Hardwood - (SAF Type 82, Loblolly Pine-Hardwood, ~ 1,800 acres) - Loblolly pine is not predominant, but it is the key tree species making up at least 25 percent of the stand, where it is associated with a wide variety of moist and wet site hardwoods such as sweetgum, sweetbay (*Magnolia virginiana*), and redbay (*Persea borbonia*). On drier sites associates are southern red oak (*Q. falcata*), post oak, hickory, dogwood (*Cornus florida*), and persimmon. This type occupies the moist but well drained and relatively fertile slopes that occur adjacent to streams. It is probably a transition or tension zone type with succession towards hardwoods.

Upland Hardwood - Located on the moist but well drained and relatively fertile slopes that occur adjacent to the creeks and branches, this type is identical to the pine-hardwood type with the absence of pine. Common tree and plant species growing on these sites include southern red oak, black oak, dogwood, hickory, blackjack oak, sand post oak, sassafras, wild grape (*Vitis* spp.), greenbrier (*Smilax* spp.), huckleberry (*Gaylussacia* spp.), and sparkleberry (*Vaccinium arboreum*).

Bottomland Pine/Titi Habitat Type

Pine Bottomland - (SAF Type 98, Pond Pine, ~ 5,000 acres) - This lowland pocosin pine type occupies the higher, better drained portions of swamps and is located along numerous drains and branches which bisect the refuge. The dominant overstory is pond pine. Minor associates are yellow poplar, sweetbay, red bay, Atlantic white cedar, red maple (*Acer rubrum*), titi (*Cyrilla racemiflora*), and swamp tupelo (*Nyssa sylvatica* var. *biflora*). The understory is an often impenetrable lush green tangle of many shrubs and vines, including gallberry (*Ilex coriacea*), inkberry (*I. glabra*), fetterbush (*Leucothoe racemosa*), greenbrier, sumac (*Rhus* spp.), sweet pepperbush (*Clethra alnifolia*), canebrakes, and tag alder (*Alnus serrulata*).

Bottomland Hardwood Habitat Type

Bottomland Hardwood - (SAF Type 104, Sweetbay-Swamp Tupelo-Red Bay, ~ 1,800 acres)
- This coastal plain hardwood type is located along Black Creek and Big Black Creek.

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 and red maple. On broader sites, bald cypress (*Taxodium distichum*) can become an important canopy species. Tulip poplar (*Liriodendron tulipifera*), sweet gum, pond pine, loblolly pine 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. The soil is normally saturated or at least moist throughout the growing season. Surface flooding occurs occasionally but does not persist through the growing season.

Bottomland Hardwood - (SAF Type 91, Swamp Chestnut Oak-Cherrybark Oak; SAF Type 93, Sugarberry-American Elm-Green Ash; and SAF Type 94, Sycamore-Sweetgum-American Elm) - This floodplain community is typical of river bottoms found in the Piedmont physiographic region, such as along Lynches River. 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*). Sugarberry (*Celtis laevigata*) is often replaced by hackberry (*C. occidentalis*). American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), white oak (*Q. alba*), sycamore (*Platanus occidentalis*), red maple, box elder (*Acer negundo*), mockernut hickory (*Carya tomentosa*), American beech (*Fagus grandifolia*), and eastern cottonwood (*Populus deltoides*) are other species encountered. Frequent flooding occurs during spring and summer. 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 contains oxbow lakes and pools. Dominant trees are bald cypress and water tupelo (*Nyssa aquatica*), swamp tupelo, water elm (*Planera aquatica*) and red maple.

Grassland and Early Successional Habitat Type

This cover-type consists of approximately 1,200 acres. Grasslands or early successional fields consist of grasses, herbs, shrubs and few, if any, trees. Also included are managed open areas such as meadows, pastures, with or without damp depressions and seeps. Typically, these seeps have 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.

Ponds and Depressions

A variety of permanently and semi-permanently flooded isolated freshwater wetlands (~ 300 acres), 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 seeps with canopy cover. Vegetation is variable, depending on position on the slope, the amount of peat accumulation and fire history. Pond pine shrubland is representative, intergrading with fire-maintained hillside herb bogs on wetter seeps. Steeper slopes support a mixture of pine

species and a characteristic shrub layer of titi, canebrake, sand myrtle (*Leiophyllum buxifolium*), mountain laurel (*Kalmia latifolia*) and inkberry.

Table 1. Acreage of major cover-types found at Carolina Sandhills NWR

Forest Type	Symbol	Acreage
Planted Pine	PL	14038
Natural Pine	P	15031
Pine – Scrub Oak	PS	6288
Scrub Oak	S	314
Pine Hardwood	PH	1329
Upland Hardwood	UH	448
Pine Bottomland	PB	4975
Bottomland Hardwood	BH	1855
Forest Openings/Fields		1214
Water/Impoundments		287
Total		45779

FOREST STAND CLASSIFICATION

Forest stands are categorized according to timber type, which is derived by dominant species present and size class (Table 2). Age classes for pine species have been determined for each type. The age of a stand is determined by obtaining the age of the dominant trees in the stand. If a stand contains two age classes, the dominant age class is recorded. In artificially regenerated stands, the age is determined by the year planted. Stand type classifications have been mapped in each forest management compartment. A complete refuge covertime map within this document would not show sufficient detail as to be informative; however a detailed covertime map is available for reference within the refuge's GIS system.

Table 2. Categorization of forest stands within Carolina Sandhills NWR

SAF Cover / Timber Type Symbols*	Site Index+
<p>P Natural Pine {SAF Types 70 (Longleaf) and 81 (Loblolly)}</p> <p>PL Pine Plantation (Planted)</p> <p>PS Pine Scrub-oak (SAF Type 71)</p> <p>S Scrub-oak (SAF Type 72)</p> <p>PB Pine Bottomland (SAF Type 98)</p> <p>PH Pine Hardwood (SAF Type 82)</p> <p>UH Upland Hardwood</p> <p>BH Bottomland Hardwood (SAF Types 93 and 104)</p>	<p>Site index 80, 15% of refuge Found along small streams, terraces, seepage areas and broad, low flats. Located primarily in the PB (pine-bottomland) and BH (bottomland hardwood) timber types</p> <p>Site index 70, 4% of refuge Found on broad toe slopes and low running ridges as well as concave side-slopes. Located primarily in the PH (pine-hardwood) and UH (upland hardwood) timber types.</p> <p>Site index 60, 15% of refuge Found on broad, rolling upland flats and side slopes at higher elevations. Located primarily in P (pine) timber type.</p> <p>Continued.</p>
Forest Size Classes^	
<p>Class 1 – Sawtimber (Pine - >12 inches DBH, Hardwood - \geq12 inches DBH)</p> <p>Class 2 - Mixed Pulpwood, Sawtimber, and Chip and Saw (Pine 10-12 inches)</p> <p>Class 3 – Pulpwood (Pine - 4-9 inches DBH, Hardwood - 6-11 inches DBH)</p> <p>Class 4 – Sapling (Pre-Commercial, Pine – 1-3 inches DBH, Hardwood - 1- 5 inches DBH)</p> <p>Class 5 - Seedling (Regeneration, < 1 inch DBH)</p>	<p>Site index 50, 66% of refuge Found on broad, rolling upland flats and side slopes at higher elevations. Located primarily in P (pine) and PS (pine/scrub-oak) timber types.</p>

*Symbols are used to describe forest stands based on the general dominant species present; also included are Society of American Foresters (SAF) Cover Types.

^Forest Size Classes often refer, in general, to commercial applications; they are also used as stand descriptors for habitat management purposes on the refuge. For example, RCW cavity trees and nesting habitat are almost exclusively found in P1 or P2 habitat. These stands are typically naturally regenerated longleaf pine with dominant trees at least 70 years old. Until forest stands have been inventoried and evaluated from an ecological context, these size class categories are used to describe the size of timber on a stand scale.

+Due to the wide variation in site quality in the sandhills as influenced by poor sandy soils, age generalizations only represent an average and are not extremely reliable indicators of size class. In general, pines are at least 35 years old before reaching sawtimber size. Site indices (relative measure of forest site quality based on the height [in feet] of dominant trees at 50 years that helps estimate land productivity for timber and wildlife values) range from 50 to 80 feet on the refuge.

Table 3 from Forestry and Fire Program Review Final Report (2007) identifies both the LANDFIRE Biophysical Setting (BPS) and Natureserv Community Ecological System community codes for each of the above SAF forest types (Rollins and Frame 2006, Comer et al. 2003). Refuge staff will be converting SAF based forest type maps to the LANDFIRE system during the time-frame of this plan. However, neither LANDFIRE or the NatureServ vegetation classification systems provide detailed information about timber size class, potential growth rates, or site indices, thus this additional information will remain as a refuge forest management information need.

Table 3. Crosswalk of cover-type classification systems at Carolina Sandhills NWR

LANDFIRE/Nature Serve Name	LAND FIRE BPS#	Nature Serve CES#	Class Name	SAF Type	SAF Name	Other Names
Atlantic Coastal Plain Fall-line Sandhills Longleaf Pine Woodland	BPS 551346	CES20 3.254	Upland Pine-Scruboak Habitat (34,700 acres)	70 71 72 81	Longleaf Pine Longleaf Pine-Scrub Oak Southern Scrub Oak Loblolly Pine	Pine Plantation Pine Scrub Oak [Old] Field Pine
Atlantic Coastal Plain Upland Longleaf Pine Woodland	BPS 551347	CES20 3.281	Upland Pine Habitat(included with above acreage)	70	Longleaf Pine	
Atlantic Coastal Plain Dry and Dry-Mesic Oak Forest	BPS 551335	CES20 3.241	Upland hardwood/Pine Habitat (1869 acres)	82	Loblolly Pine-Hardwood	Pine Hardwood Upland Hardwood
Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin, and Baygall (see also portions describing sandhills situations for: Atlantic Coastal Plain Canebrake-Pocosin and; Atlantic White Cedar Forest)	BPS 551468 BPS 581452 BPS581 480.2	CES20 3.252 CES20 3.267 CES20 3.636	Bottomland Pine/Titi Habitat (4928 acres) Canebrake Atlantic white cedar	98 N/A 97	Pond Pine N/A Atlantic white-cedar	Pine Bottomland
Atlantic Coastal Plain Sandhill Seep	Was not modeled separately	CES20 3.253	Seepage Slope Habitat (acres included elsewhere)	N/A	N/A	Seepage Slope
Gulf and Atlantic Coastal Plain Small Stream Riparian Systems	BPS 551470	CES20 3.630	Bottomland Hardwood Habitat (1663 acres)	104 93 91 94 N/A	Sweetbay-Swamp Tupelo-Red Bay Sugarberry-American Elm-Green Ash Swamp Chestnut Oak-Cherrybark Oak Sycamore-Sweetgum-American Elm (as listed above for bottomland hardwood)	Bottomland Hardwood – Black Cr and Big Black Cr Bottomland Hardwood – Lynches R Interior Hardwoods – major tributaries to Black Cr. And Lynches R.

TERRESTRIAL AND AQUATIC HABITATS DISCUSSION

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 pond-like 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. 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, red maple, gallberry, titi, redbay, and sweetbay magnolia as the predominant species. 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 provide habitat for a number of unique species that use the refuge.

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.

Although the refuge landscape is dominated by upland, xeric pine woodlands, there are important, but less common plant communities of management concern. Embedded within the forest communities are hillside seepage bogs, canebrakes, streamhead pocosin and Atlantic White Cedar communities. 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 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 treefrogs.

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. When a natural fire regime occurs, 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.

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, Pine Barrens treefrog, white-wicky, and several species of pitcher plants and sundews – to name just a few (Kuchler 1964, USFWS 2007b).

MANAGEMENT UNIT DESCRIPTIONS

The SCFC, which had management responsibility for refuge forests until 1984, divided the refuge into 10 management units of approximately 4,500 acres each. Geographic features such as streams and roads were used to delineate each compartment. In 1974, the Service and SCFC agreed to an annual planning prescription to delineate where and what work would occur with a goal of working in two compartments per year. The compartments were eventually divided into smaller management units to facilitate planning and balance field and administrative work in compartments based on annual work plans. The refuge was thus divided into 21 forest management compartments utilizing existing roads and natural barriers as compartment boundaries (Figure 6). These compartments ranged in size from 1,269 acres to 3,405 acres. The compartments included: forest stands, prescribed burn units, impoundments, and fields.

The size and boundaries of the 21 compartments were primarily located to meet administrative needs and did not effectively align with or represent the scale of wildlife habitat, forest or fire management actions. To remedy this situation, this plan identifies 180 prescribed fire burn units as Forest Management Units (Figure 7). The units range in size from 3.5 to 1347 acres with an average size of 247 acres (Appendix C). These new unit boundaries are more closely aligned with actual management actions on the ground, especially prescribed fire. The new forest management units will normally contain several discrete forest stands (Figure 8). The smaller size of management units will greatly facilitate management planning and evaluation of management actions at achieving resource objectives. Past compartment management actions records will be maintained for future analysis and comparison to changing forest conditions.

Prescribed burn units

Refuge forest management units and prescribed burn units overlap (Figure 7). This allows for efficient planning and evaluation of results of various prescribed fire regimes, and interaction with various forest management actions.

Impoundments

There are 28 man-made impoundments (Figure 9) on the refuge that have been divided into four management categories: status quo (pools receive periodic attention to address vegetation concerns or maintenance needs); water level management (periodic drawdowns occur to manage submerged aquatic vegetation and/or encourage moist-soil plant production); fishery management (managed for recreational fishing); and restoration (restore historic water flows).

Managed Wildlife Openings

The refuge contains 1,200 acres of old fields and managed wildlife openings scattered throughout the refuge (Figure 9). There are three major field complexes: Oxpen Farm Unit (314 acres), Dove Field A (113 acres), and Martin's Lake fields (71 acres). The remaining 64 fields range in size from 0.5 to 57 acres. Two fields are planted by refuge staff in millet, sorghum, and/or sunflowers for annual dove hunts. The remaining fields have been periodically mowed, disked, burned, planted in other wildlife foods such as winter wheat or otherwise managed to maintain field conditions. Currently, approximately 70 acres are cooperatively farmed and planted in browntop millet.

Figure 6. Historical forest management compartments at Carolina Sandhills NWR

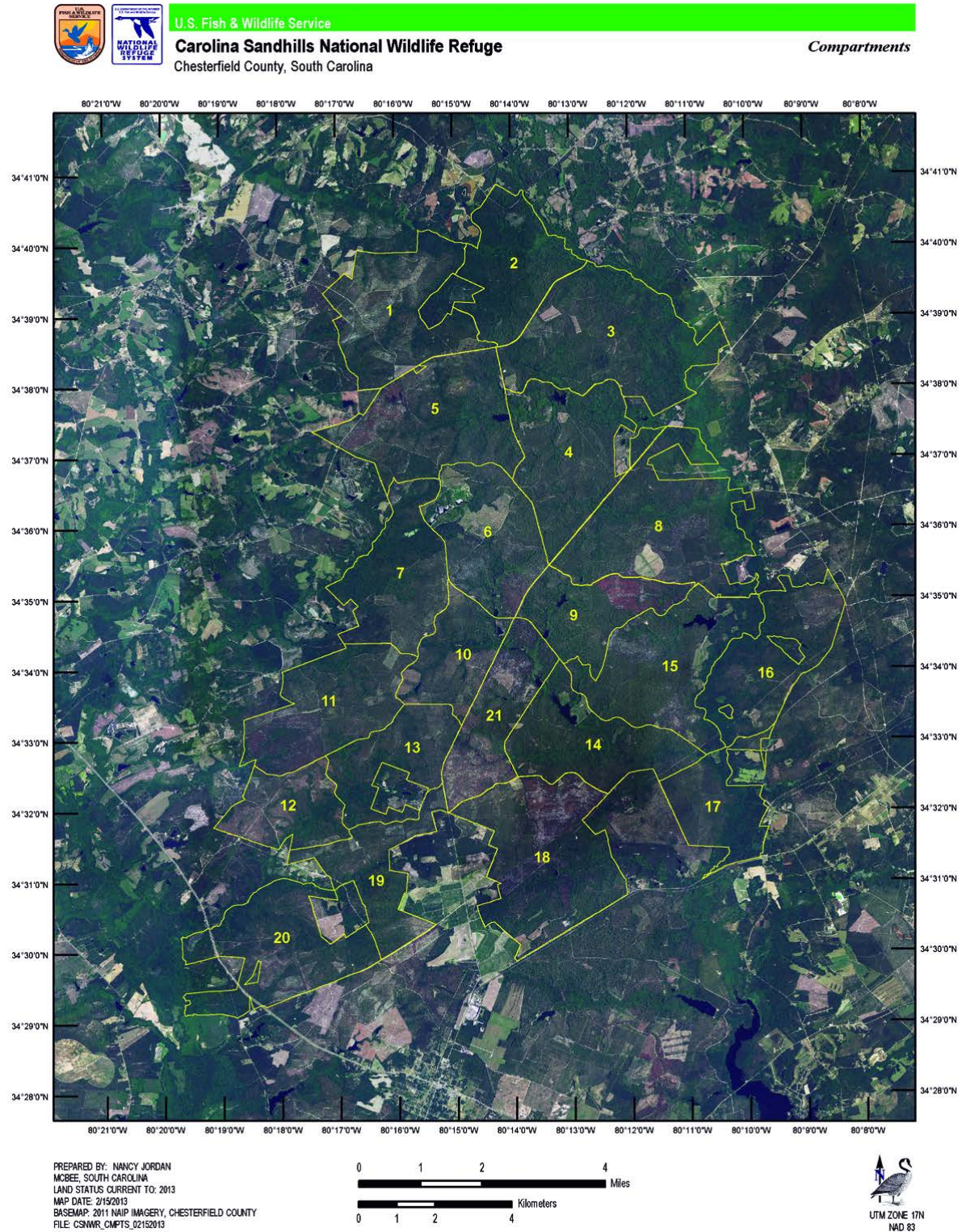


Figure 7. Forest Management Units at Carolina Sandhills NWR

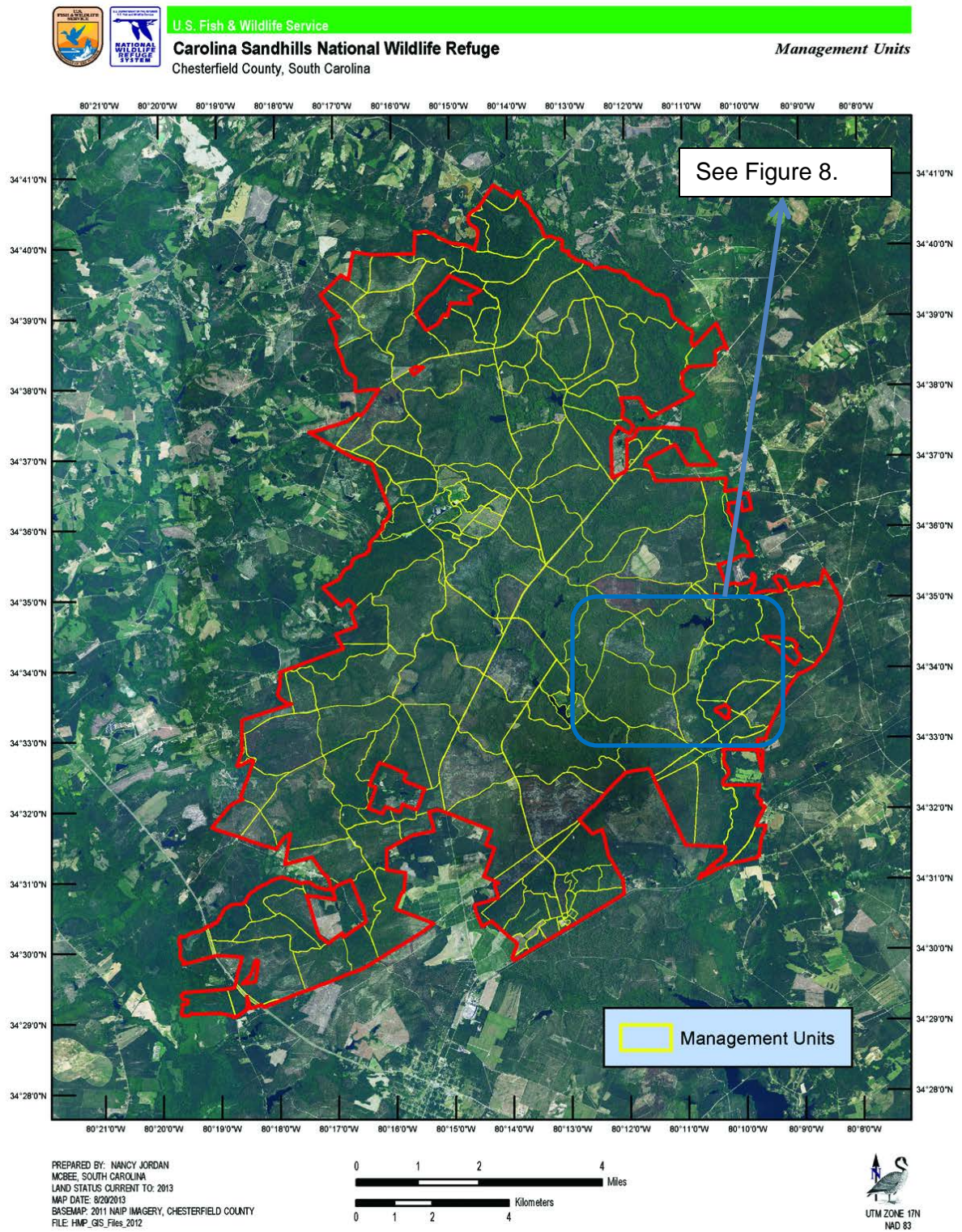


Figure 8. Detail Showing Forest Stand Boundaries within a Management Unit

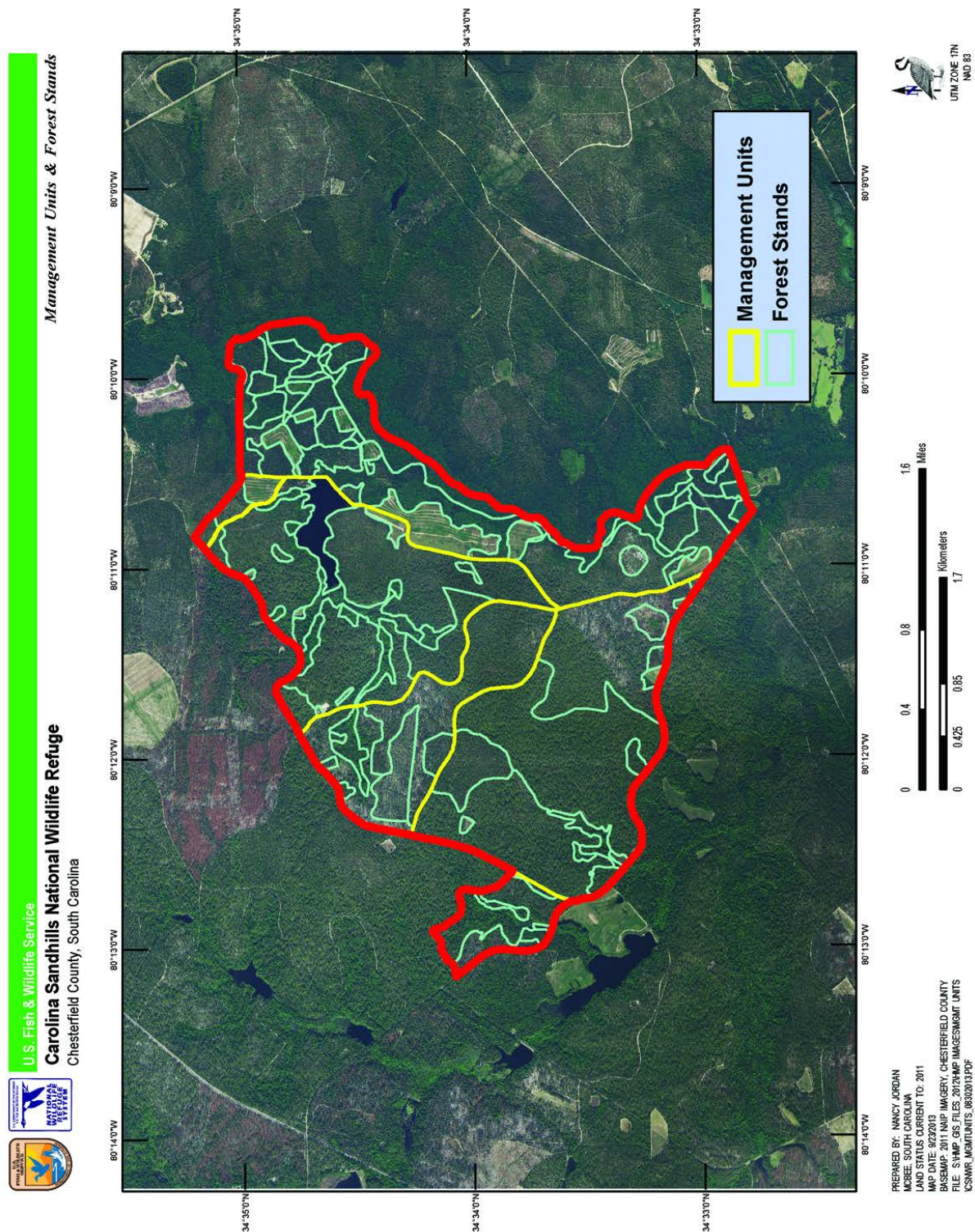
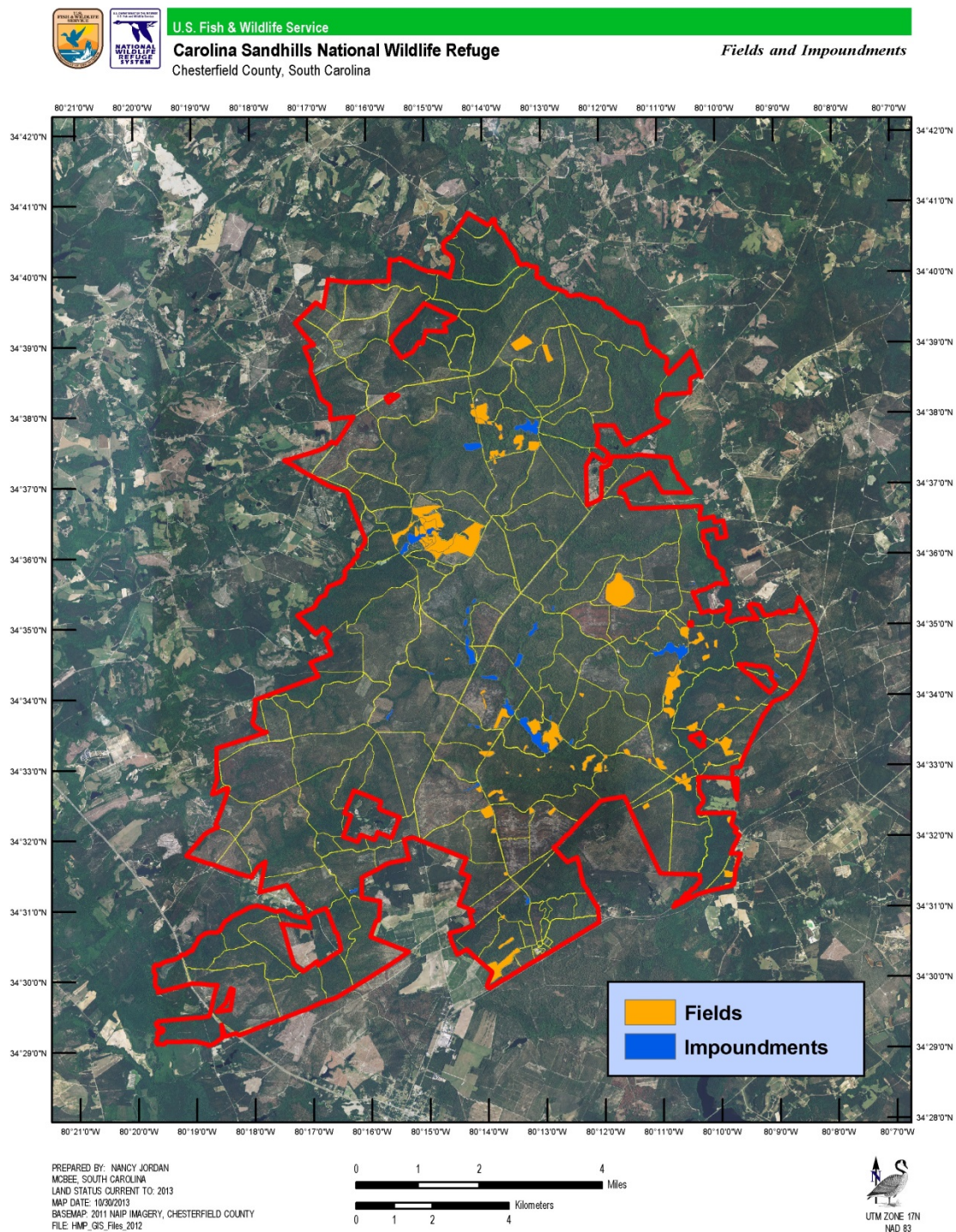


Figure 9. Location of Fields and Impoundments at Carolina Sandhills NWR.



CHANGES ASSOCIATED WITH GLOBAL CLIMATE CHANGE

Climate change for the southeastern United States and the Carolina Sandhills NWR geographic area may include extreme precipitation events; greater likelihood of warmer and dryer summers and wetter and milder winters; and, alterations of ecosystems and habitats – to name but a few possibilities.

The South Carolina Department of Natural Resources, Office of State Climatology, details some of the changes the state might expect related to natural resources management at Carolina Sandhills NWR (SCDNR 2009):

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.

Forestry – Studies indicate climate change could cause significant changes in South Carolina's forests. Forest dieback in 30 to 80 years; Southern hardwoods (e.g., black gum, laurel oak, and elm) might replace loblolly pines as the dominant species; conversion of forest to grasslands; and increased vulnerability to pests and disease.

Water Resources – 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. Drier scenarios create oxygen-starved lakes and streams and wet scenarios increase the threat of pollution from runoff degrading water quality. The capacity of the current drainage system to handle an increase in the frequency of large amounts of precipitation could be exceeded.

The source of these impacts (*shifts in migration patterns, invasive species proliferation*) are difficult to isolate as caused either in part or in full by global climate change, but are anticipated nevertheless. This plan addresses these short-term anticipated impacts of invasive species and community shifts through habitat management objectives. Impacts including increased drought, fire severity, and storm intensity cannot be influenced by the scope of this plan.

As climate change slowly occurs, an important consideration in management of National Wildlife Refuges is to avoid attempts to maintain the status of biotic communities as they are presently found. Attempts to maintain the status quo of biotic communities in the face of uncontrollable site condition factors (climate change), can and often is done, but is always a very costly endeavor. A much more prudent direction is to allow biotic communities to evolve and adapt to changing conditions. Fortunately, some of the predicted impacts of drier climate and increased fire severity will benefit the dominate longleaf pine community that occurs at Carolina Sandhills NWR. Over the next 100 year timeframe, predicted climate change impacts to eastern tree species identify that longleaf pine will benefit from climate change, whereas other southern yellow pines will experience a range contraction (Prasad et al 2007). This projected enhancement of longleaf pine communities should benefit the many species that are strongly associated with longleaf pine. For example, Bachman's sparrow is projected to have a similar range expansion and improved habitat conditions in

association with longleaf pine (Matthews et al 2007). 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).

CHAPTER III. RESOURCES OF CONCERN

Resources of concern include species or species groups that support refuge purposes as well as FWS trust resource responsibilities (including threatened and endangered species and migratory birds). Resources of concern may also be natural, functional communities such as those found under historic conditions that are to be maintained and where appropriate, restored on the refuge (601 FW 3.10B[1]).



Resources of concern for Carolina Sandhills NWR were identified within the refuge's CCP after considering conservation needs identified within international, national, regional, or ecosystem goals/plans; state fish and wildlife conservation plans; recovery plans for threatened and endangered species; and previously approved refuge resource management plans. Selected resources of concern are those species or communities for which the refuge may make a significant conservation contribution, through individual refuge actions, or working in concert with other organizations or government agencies.

Identification and Status of Refuge Resources of Concern

- Longleaf pine/wiregrass ecosystem and embedded wetlands: Pocosins, Seepage bogs, Atlantic white cedar and Canebrakes
- Red-cockaded woodpecker
- Migratory Birds
- Northern bobwhite quail
- Bachman's sparrow
- Pine Barrens treefrog

LONGLEAF PINE/WIREGRASS ECOSYSTEM AND EMBEDDED WETLANDS: POCOSINS, SEEPAGE BOGS, ATLANTIC WHITE CEDAR AND CANEBRAKES

The longleaf pine community is a refuge resource of concern due to the intrinsic value of this ecosystem. Carolina Sandhills NWR currently contains approximately 35,000 acres of forest dominated by longleaf pine. When associated communities (hardwoods, pocosins, fields, etc.) are included, the refuge provides more than 45,000 acres of the longleaf pine ecosystem, thus making a significant contribution toward the restoration and management of this rare forest community. From a landscape perspective, when combined with the adjoining Sand Hills State Forest, Cheraw Fish Hatchery, Cheraw State Park, SCDNR Wildlife Management Areas, and adjacent private lands in longleaf pine, the contribution is even greater (more than 119,000 acres). Additionally, Carolina Sandhills NWR serves as a Land Management Research Demonstration area for longleaf pine, influencing land management actions on lands surrounding the refuge (and other public lands) through voluntary programs and opportunities for private landowners.

Carolina Sandhills NWR is located within the historic longleaf pine range. The longleaf pine community provides critical habitat for numerous rare and unique species such as: red-cockaded woodpecker, Bachman's sparrow, Pine Barrens treefrog (Engstrom 1993, Guyer and Bailey 1993), and many unique plants that are associated with longleaf pine forests.

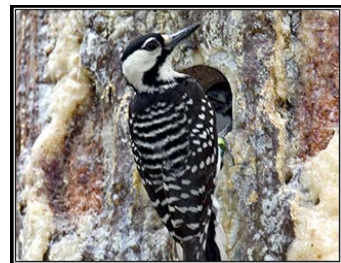
The longleaf pine/wiregrass ecosystem once ranged from the coastal plains of southeastern Virginia to the West Gulf Coastal Plain of Texas (Frost 1993). Within that broad area, longleaf pine forests are diverse, from pine barrens to coastal flatwoods to xeric sandhills (Peet and Allard 1993). While longleaf pine serves as the main structural component, biodiversity is contained in the upland herbaceous groundcover and in the nonalluvial depressional wetlands, such as pocosins and herbaceous shrub bogs, embedded within the mosaic of the longleaf pine forest. At Carolina Sandhills NWR, wiregrass is the main groundcover component, but over 800 species of plants have been documented. Many species associated with open longleaf pine/wiregrass woodlands inhabit Carolina Sandhills NWR, including the largest population of the endangered red-cockaded woodpecker on FWS lands and several high priority species such as a breeding population of Bachman's sparrows (Seaman and Krementz 2000), Pine Barrens treefrogs (Garton and Sill 1979, Cely and Sorrow 1986), red-headed woodpeckers, chuck-will's-widow, brown-headed nuthatch, eastern fox squirrel, southern hognose snake, pine snake, and five species of bats. Well's pyxie moss and pine Barrens gentian, uncommon but unique plants, are also found in the longleaf pine uplands.

Ninety-seven percent of the historic longleaf pine range has been destroyed or altered (Ware et al. 1993, Frost 1993) such that this forest type has been identified as one of the most important native ecosystems for conservation (Watson and Malloy 2006). Therefore, Carolina Sandhills NWR is an important contributor to its conservation, serving as a Land Management and Research Demonstration site for longleaf pine as well as playing a major role in range-wide efforts such as the Longleaf Alliance and America's Longleaf Restoration Initiative, in addition to being one of the priority habitats within the newly formed South Atlantic Coast Landscape Conservation Cooperative (SALCC).

Wetlands embedded within the xeric longleaf pine landscape include pocosins, seepage bogs, canebrakes, and Atlantic white cedar (Richardson 2003, Kirkman et al. 1998). Canebrakes and Atlantic white cedar (two successional extremes within pocosin situations) have been reduced to one percent of their original pre-settlement occurrence (Frost 1995). Hillside seepage bogs, canebrakes, streamhead pocosins and Atlantic white cedar border Carolina Sandhills NWR streams which provides habitat for many unique species found on the refuge. These wetlands are integrated into the landscape and support diverse vegetation species (Walker 1993), amphibians (Means et al. 2004, Means 2006), and migratory birds (Hunter et al. 2001) within the longleaf pine/wiregrass ecosystem. The moister riverine forest areas provide habitat for Acadian flycatchers, Kentucky warbler, hooded warbler, wood thrush, prothonotary warblers and wood ducks. Areas of streamhead pocosins, canebrakes, and hillside seepage areas provide habitat for Swainson's warblers, prairie warbler, and American woodcock. Unique plants found in these hydric areas are sweet pitcher plants and white-wicky.

RED-COCKADED WOODPECKER

Carolina Sandhills NWR has the largest population of the federally endangered RCW on Service lands. They were chosen as a species of concern because of their conservation and trust species status. RCWs are unique woodpeckers in that they rely on live southern pines for foraging and for nest cavity excavation (Conner et al. 2001). RCWs received protection under the Endangered Species Act in 1973 due to extreme reduction of its



primary habitat, the longleaf pine ecosystem. Since that time, many advances and successes in RCW management have led to population increases, including four major populations recently achieving their recovery goals as outlined in the *RCW Recovery Plan* (USFWS 2003). The recovery plan identified the refuge and neighboring SHSF as the Sandhills (SC) Recovery Unit, a secondary core population capable of supporting 250 Potential Breeding Groups (PBGs). As of 2012, the refuge currently supports 139 PBGs, 151 active clusters, and 166 managed territories.

MIGRATORY BIRDS

One of the establishing purposes for Carolina Sandhills NWR is to provide habitat for migratory birds. Habitats for migratory birds at Carolina Sandhills NWR include the upland longleaf pine/wiregrass forest, pocosins, Atlantic white cedar and canebrakes. Current refuge information on migratory birds comes from annual Christmas Bird Counts, Breeding Bird Surveys, and Southeastern Nightjar surveys. Over sixty species of migratory birds have been documented on the refuge through these surveys including several Birds of Conservation Concern (USFWS 2008): American kestrel, chuck-will's-widow, whip-poor-will (*Caprimulgus vociferous*), common nighthawk (*Chordeiles minor*), red-headed woodpecker, loggerhead shrike, brown-headed nuthatch, white-breasted nuthatch (*Sitta carolinensis*), Swainson's warbler, sedge wren (*Cistothorus platensis*), prairie warbler, and prothonotary warbler. According to Breeding Bird Survey trend analysis, abundance of approximately 20 neotropical species in the Southeast Region has declined between 1966 and 2007 (Sauer et al. 2008). Because populations of many of the above migratory birds are in decline (BirdLife International 2000) or rely heavily upon longleaf pine forest to meet their habitat requirements, they are a resource of concern on the refuge.

NORTHERN BOBWHITE QUAIL

The refuge has approximately 1,200 acres of managed openings, ie. open fields and clearings, representing less than one percent of total land cover. In addition to managed openings, open pine woodlands with a basal area of less than 50ft²/ac and a grassy, herbaceous groundcover also support grassland dependent species. Northern bobwhites, and most species of grassland birds, are declining over much of their range (Sauer et al. 2011), mainly due to either a loss of or degradation of habitat. Northern bobwhites are a resource of concern because there has been focused planning efforts, including a rangewide recovery plan, the National Bobwhite Conservation Initiative (NBCI) and because all declining grassland bird species are expected to respond to habitat restoration efforts targeting northern bobwhites. Northern bobwhites were designated a priority species in South Carolina's Comprehensive Wildlife Conservation Strategy and the refuge has been named a "significant public land holding" within the South Carolina NBCI Pee Dee Focal Region (SCDNR 2013).

Other grassland bird species that have been documented on the refuge and would benefit from northern bobwhite habitat management are eastern meadowlark (*Sturnella magna*), chipping sparrow (*Spizella passerine*), fox sparrow (*Passerella iliaca*), Lincoln's sparrow (*Melospiza lincolni*), savannah sparrow (*Passerculus sandwichensis*), song sparrow (*M. melodia*), vesper sparrow (*Pooecetes gramineus*), white-crowned sparrow (*Zonotrichia leucophrys*), white-throated sparrow (*Z. albicollis*), loggerhead shrike, American kestrel, northern bobwhite, sedge wren, and northern harrier (*Circus cyaneus*). Three are listed in the USFWS Birds of Conservation Concern (2008): loggerhead shrike, sedge wren (non-breeding) and American kestrel (*paulus* ssp.).

BACHMAN'S SPARROW

Bachman's sparrow (*Aimophila aestivalis*) is a Species of Concern in the Southeast Region mainly due to land use changes in the last century (Haggerty 1988). It is classified as threatened or endangered in several states (Dunning 2006) and in 2002 it was red-listed (i.e., one of the most at risk species) by the National Audubon Society on its Watch List (see <http://birds.audubon.org/species/bacspa>). It is a Partners in Flight Priority as a species of continental and regional importance (Panjabi et al. 2005, <http://www.rmbo.org/pif/pifdb.html>). It is also a priority species in the Bird Conservation Plan for the South Atlantic Coastal Plain (Hunter et al. 2001), as well as a species of concern of the highest priority for the state of South Carolina (SCDNR 2005a). Due to species occurrence and the abundance of potential habitat at Carolina Sandhills NWR, it was identified as a resource of concern.

PINE BARRENS TREEFROG

The Pine Barrens treefrog is endemic to the longleaf pine/wiregrass ecosystem and occurs in three disjunct populations: the pine barrens of New Jersey, the Fall Line Sandhills of North Carolina and South Carolina, and the Florida panhandle and adjacent south Alabama (NatureServe 2010). This amphibian occurs in the acidic pocosins and herb shrub bogs



embedded within the longleaf pine uplands in the southeast (Cely and Sorrow 1983, Means and Longden 1976). Though apparently secure within the protected lands where it occurs, relative scarcity and specialized habitat requirements justify continued monitoring and protection. Plant succession due to fire suppression appears to be a significant threat in South Carolina (Cely and Sorrow 1986).

First documented on the refuge in 1977, Garton and Sill (1979) found Pine Barrens treefrogs at 18 locations on Carolina Sandhills NWR. During a partial survey in the summer of 2010, calling males were heard at 9 locations on Carolina Sandhills NWR. Eight of the locations were similar to sites in Garton and Sill (1979) with one new location found. An acoustical survey done by SCDNR in 2012 found six sites with Pine Barrens Treefrogs present out of thirteen sampled. In South Carolina, the Pine Barrens treefrog is classified as State Threatened and of the highest priorities for management (SCDNR 2005a). The Pine Barrens treefrog is a resource of concern due to its highly specialized habitat requirements and because it has a significant population on the refuge (SCDNR 2005b).

HABITAT REQUIREMENTS FOR RESOURCES OF CONCERN

This section describes the components that are attributed to good quality habitat for the resources of concern. Management strategies and practices to achieve these conditions are discussed in Chapter 5 Habitat Management Strategies.

LONGLEAF PINE/WIREGRASS ECOSYSTEM (INCLUDING EMBEDDED WETLANDS, POCOSINS, SEEPAGE BOGS, ATLANTIC WHITE CEDAR, AND CANEBRAKES)

The longleaf pine/wiregrass ecosystem is comprised of upland longleaf pine forests and the wetland habitats (pocosins, seepage bogs, Atlantic white cedar, and canebrakes) that surround the creeks, streams, and seepage slopes embedded in its topography. Habitat requirements, in terms of habitat management, are similar for both. Therefore, this section will describe the habitat requirements for the entire longleaf pine/wiregrass ecosystem on the refuge.

Site characteristics that allow longleaf pine to outcompete other species are generally infertile soils and frequent fire. Evidence of frequent, low intensity surface fire is commonly observed and fire plays a primary role in shaping the 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 excluded from areas where canebrake, Atlantic white cedar or stream-head pocosin occur as fire helps to maintain these important ecotones.

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. 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 so Atlantic white cedar reproduction is sometimes seen.

Threats to the longleaf pine/wiregrass ecosystem include invasive species (weeping lovegrass, black bamboo, and shrub lespedeza) absence of timber management (thinning pine plantations and re-planting longleaf pine), and most importantly, lack of fire. Weeping lovegrass and shrub lespedeza were planted on the edges of roads and in managed fields for wildlife and soil stability. Weeping lovegrass has the potential to creep into the uplands and can disrupt fire regimes by increasing fine fuel loads and burning with greater intensity than native vegetation (Platt and Gottschalk 2001, J. Walker, unpublished data). Black bamboo occurs in one 8-acre patch on the refuge and its high stem density is changing the streambank vegetation by shading out other plants.

Lack of timber management, i.e., low-grade thinnings and artificial regeneration of longleaf pine on sites that were planted with offsite pines, can also degrade the longleaf pine/wiregrass ecosystem. Currently throughout the range of longleaf pine, there is approximately 3,000,000 acres with an overstory of longleaf pine (Outcalt and Sheffield 1996); however, only an estimated 1.2 to 2 million acres of these lands have intact native understories (Noss 1989). Longleaf pine plantations that have not undergone their first thinning typically do not have native groundcover due to the closed canopy reducing sunlight to the forest floor. Reducing or eliminating thinning threatens the restoration of ground cover (Harrington and Edwards 1999).

Slash pine was planted in the past due to its reputation as a fast grower and the lack of success with establishing longleaf pine and its slow growth rate (Landers et al. 1995).

Slash pine is not native to the xeric sandhills and grows poorly on these dry and infertile sites. Additionally there was extensive damage to these plantations on the refuge due to frequent ice storms. Currently, there are approximately 567 acres of slash pine plantations scheduled for conversion to longleaf. In addition, since 2000, the refuge has acquired 574 acres, almost entirely forested in loblolly pine. While loblolly pine can be appropriate for certain sites in the sandhills, its fire intolerance and shorter life span make it less desirable in xeric upland sites.

However, the greatest threat to the longleaf pine/wiregrass ecosystem, especially on public lands where there has been restoration progress in the last twenty years, is lack of fire (Frost 2006). It has been well documented that the longleaf pine/wiregrass ecosystem is a fire-dependent, disturbance-shaped community (Engstrom et al. 2001, Ware et al. 1993, Brockway and Lewis 1997). The benefits of periodic fire include (1) maintaining the integrity of longleaf pine bunchgrass ecosystems by excluding invasive plants that are poorly adapted to fire, (2) preparing a seedbed favorable for the regeneration of longleaf pine seedlings, (3) reducing the density of understory vegetation and thus providing microsites for a variety of herbaceous plants, (4) stimulating increased seed production by native grasses, (5) releasing nutrients immobilized in accumulated plant biomass for recycling to the infertile soil and subsequently more rapid uptake by plants, (6) enhancing wildlife habitat, (7) controlling harmful insects and pathogens, and (8) reducing fuel levels and the wildfire hazard (Brennan and Hermann 1994, Haywood et al. 2001, Landers and Boyer 1999, Lemon 1949, McKee 1982, Outcalt 1994, Wade and Lundsford 1990).

Furthermore, fire has shaped the wetland areas embedded in the longleaf pine/wiregrass forest matrix, such as seepage bogs, canebrakes, Atlantic white cedar, and pocosins. Frequent fires prune back woody shrubs and maintain herbaceous bog communities along the ecotone from uplands to depressional wetlands (Noss and Harris 1990, Means 1996, Drewa et al. 2002, Kirkman 1995). Exclusion of fire has resulted in a loss of these wetland habitats; for example, approximately 98% of canebrake habitat in the southeast has been lost in the past century due to increased canopy closure and decreased light to the forest floor (Noss et al. 1995). The prescribed burning program on the refuge has increased the amount of acreage burned annually and has included more growing season burns since 1976. The observed effect has been an increase in canebrake areas along streamheads and improved habitat by reducing woody vegetation in pocosins for rare plant species such as white wicky (*Kalmia cuneata*) and sweet pitcher plant (*Sarracenia rubra*) (Ingram and Robinson 1998). The range of Atlantic white cedar occurs in a narrow belt along the Atlantic and Gulf coasts from southern Maine to northern Florida westward to southern Mississippi (Little and Garrett 1990). It is uncommon in South Carolina but is typically found along perennial streams of the Fall Line sandhills ecoregion. These streams are typified by clear, flowing water with sandy bottoms, characteristic of streams originating from seeps or springs (Sheridan et al. 1999). Atlantic white cedar will not be harvested on the refuge; however, management considerations include allowing periodic fires, allowing natural flows of perennial streams, and preventing the establishment of competing vegetation (Tanglely 1984, Zampella 1987).

RED-COCKADED WOODPECKER

Red-cockaded woodpeckers are endemic to the southeastern pine forests and they require open pine woodlands with large old pines maintained by frequent fire for nesting and roosting habitat (Jackson 1971). They are unique among North American woodpeckers in that they require mature live pines for foraging and to excavate their cavities (Hooper and

Lennartz 1981, Hardesty et al. 1997, Engstrom and Sanders 1997, Zwicker and Walters 1999). Their diet mainly consists of arthropods, especially ants, while nestlings have a more varied diet than adults (Hess and James 1998). Woodpeckers forage on pine trees by flaking and/or prying plates of bark from the tree to gain access to arthropods underneath, in addition to drilling on the bole and branches (Ligon 1970). Prescribed burning and herbaceous groundcover appear to increase arthropod availability for RCWs, although the path through the food chain has yet to be studied (New and Hanula 1998, James et al. 1997). RCWs increased their foraging in stands with less hardwood mid-story and canopy hardwoods (Walters et al. 2000, Walters et al. 2002, Jones and Hunt 1996, Bradshaw 1995).

Their cooperative breeding social system of living in family groups contributes to population persistence, as there is typically a cohort of helpers ready to fill in breeding vacancies (Walters 1988, Walters 1991, Walters et al. 1992). The family group occupies a cluster which is defined as “the aggregation of cavity trees previously and currently used and defended by a group of woodpeckers” (USFWS 2003). Territorial and resident year-round, their territories are relatively large, from 75 to 370 acres, depending on habitat quality (DeLotelle et al. 1987, Hooper et al. 1982, Porter and Labiskey 1986, USFWS 1985, Walters 1991, Engstrom and Sanders 1997, USFWS 2003). Habitat quality is associated with larger group size and higher reproductive fitness (Conner et al. 1999, Walters et al. 2002, James et al. 2001). Habitat fragmentation negatively affects RCWs (Conner and Rudolph 1991, Rudolph and Conner 1994, Conner and Dickson 1997).

Based on the above cited research, good quality red-cockaded woodpecker foraging habitat is defined in the Recovery Plan (USFWS 2003) as follows:

- a. There are 18 or more stems/ac of pines that are ≥ 60 years in age and ≥ 14 in. dbh with a minimum basal area of 20 ft²/ac
- b. Basal area of pines 10-14 in. dbh is between 0 and 40 ft²/ac
- c. Basal area of pines < 10 in dbh is below 10 ft²/ac and below 20 stems/ac
- d. Basal area of all pines ≥ 10 in. dbh is at least 40 ft²/ac
- e. Groundcover of native bunchgrass and/or other native, fire-tolerant, fire-dependent herbs total 40 percent or more of ground and midstory plants and are dense enough to carry growing season fire at least once every 5 years.
- f. No hardwood midstory exists, or if a hardwood midstory is present it is sparse and less than 7 ft. in height.
- g. Canopy hardwoods are absent or less than 10 percent of the number of canopy trees in longleaf forests. Xeric and sub-xeric oak inclusions that are naturally existing and likely to have been present prior to fire suppression may be retained but are not counted in the total area dedicated to foraging habitat.
- h. Above conditions are within 0.5 mi of the center of the cluster, and preferably, 50 percent or more is within 0.25 mi of the cluster center.
- i. Foraging habitat is not separated by more than 200 ft. of non-foraging areas. Non-foraging areas include (1) any predominantly hardwood forest, (2) pine stands less than 30 years in age, (3) cleared lands such as agricultural lands or recently clear-cut areas, (4) paved roadways, (5) utility rights of way, and (6) bodies of water.

The refuge landscape is approximately 91% pine (mainly longleaf pine), including natural pine, pine hardwood, pine bottomlands, and pine plantations, providing RCW breeding and foraging territories throughout much of the refuge. Attainment of the refuge-specific

population goal may depend on the maturation of more than 13,000 acres of longleaf pine plantations (Figure 10) Red-cockaded woodpeckers begin using these pine plantations when the stand attains approximately 30 years of age. RCWs will form new groups by budding from existing groups or pioneering when the quality of habitat is high. Red-cockaded woodpecker territories (partitions) average 200 acres in size (USFWS 2003); however, territory size is relative to habitat quality. Partitions on the refuge range from 62 acres to 442 acres.

The refuge's contribution toward recovery of this species is considerable. The refuge's forest management practices and its influence on forest management practices on private lands surrounding the refuge, further increases the contribution toward recovery. There is no conflict between management for quality longleaf pine communities and provisioning habitat for RCWs, as optimum habitat for the woodpecker consists of mature, open longleaf pine forest with a diverse grass-forb groundcover.

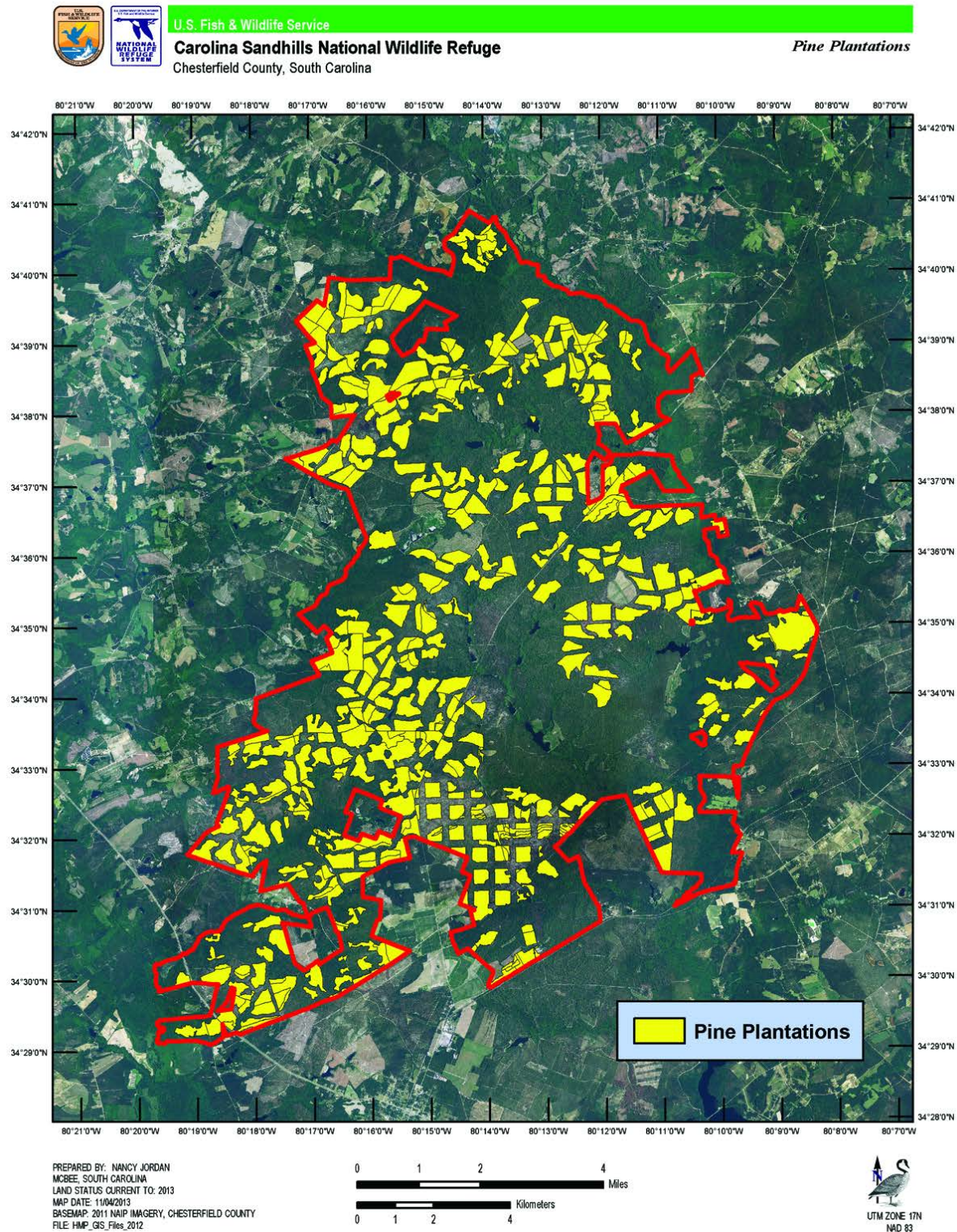
MIGRATORY BIRDS

Habitat requirements for migratory birds include: a varied habitat structure, such as canopy trees, midstory vegetation, vines, and woody and herbaceous groundcover to provide nesting, foraging, perching, and roosting sites (Rich et al. 2004). Not all previously listed migratory birds breed on the refuge, though some use the refuge as stopover habitat during migration (Moore et al. 1995). Contiguous habitat with few edges appears to decrease probability of nest depredation and brown cowbird parasitism (Brittingham and Temple 1983). Forest fragmentation often adversely influences use of a site by these birds, thus the large contiguous tracts of forest at Carolina Sandhills NWR will provide excellent habitat for many of these species. In addition, allowing fire to creep into the embedded wetlands provides transitional ecotones that offers diverse habitats beneficial to migratory birds, from species that use the more hydric areas to species that utilize the pine dominated uplands.

NORTHERN BOBWHITE QUAIL

Habitat requirements for bobwhite quail, as well as other grassland birds that utilize the mature pine woods, include little to no hardwood midstory and spacing between trees to allow grasses, especially wiregrass, to respond to the increased sunlight (Wood et al. 2004). Management of fields and openings for bobwhites and other grassland birds include maintaining grasses and forbs with a few small trees and/or shrubs (Askins 2007). Bobwhite nests typically consists of dead plant material (grasses, stems and pine needles) constructed in a slight depression in the soil. In general, bobwhites like a diversity of cover types including forests, managed fields and openings (Yarrow 2009). Most of the grassland habitat on the refuge is herbaceous, grassy groundcover dominated by wiregrass and other bunch grasses, including five species of bluestem (*Andropogon sp.*), mainly broomsedge, beneath a sparse longleaf pine canopy. There are also three large grassland units (Oxpen, Dove Field A and Martin's Lake fields) which provide habitat for bobwhite quail. For other grassland species, these fields and open forest provide vital habitat during winter. Open pinelands and fields are maintained by disturbance, including prescribed fire, thinning, disking, and mowing.

Figure 10. Pine Plantations within Carolina Sandhills NWR



BACHMAN'S SPARROW

Bachman's sparrow is a grassland bird whose habitat is solely located in the southeastern United States and is endemic to southern pinelands. This enigmatic sparrow requires open pine woodlands with a dense groundcover of grasses and forbs as well as a few shrubs they can use for perching and territorial singing (Dunning and Watts 1990). Nesting habits of this bird are very sensitive to hardwood encroachment as they typically build their nests in the base of clump grasses, such as wiregrass and bluestem (Haggerty 1988). Bachman's sparrows are endemic to an ecosystem that is frequently disturbed and with a high fire return rate. Bachman's sparrows are found to have higher nesting success and overwinter survival when their habitat is prescribed burned on a regular basis (Cox and Jones 2009). Sparrow abundance decreases as time since burning increases (Dunning 2006) and breeding season conditions are best maintained using regular (≤ 3 years) prescribed fire (Tucker et al. 2004). Bachman's sparrows are sensitive to pinewoods habitat structure as they positively respond to percentage of grass and bare ground in their territories (Cox and Jones 2007).

Management for RCWs appears to benefit Bachman's sparrows and other grassland and neotropical migratory species as thinning and prescribed burning creates diverse habitat structure within the longleaf pine forest mosaic (Plentovich et al. 1998, Conner et al. 2002). Research on movements and survival of Bachman's sparrows following prescribed summer burns was conducted on Carolina Sandhills NWR in 1997 (Seaman and Krementz 2000). Status of the population is currently unknown though Bachman's sparrows have been documented during the annual Breeding Bird Survey. In addition, surveys completed in 2012 showed Bachman's sparrows at 28% of random points within longleaf pine habitats on the refuge (Jordan, unpubl. data). Their presence was best indicated by fire frequency (number of burns since 2001) and pine basal area between 40 and 70ft²/ac.

PINE BARRENS TREEFROG

Typical habitat for the Pine Barrens treefrog in the southeast is distinguished by topography, soils, and vegetation of the Carolina Sandhills, with pocosin or evergreen shrub-herb bogs embedded within longleaf pine-wiregrass-turkey oak forest providing quality treefrog habitat (Means and Moler 1979, Tardell et al. 1981). Requirements for breeding habitat are low vegetation with dense growth of sphagnum mosses (Garton and Sill 1979) and dispersal typically requires drainages of hillside seepage bogs within dry upland pine forests (Cely and Sorrow 1983, Means and Longden 1976).

RECONCILING CONFLICTING NEEDS

Managing the longleaf pine ecosystem in a holistic manner meets the habitat requirements of each identified resource of concern. Variation in topography, soils, and moisture regimes within the longleaf pine community creates the natural variation of habitats that are required by species dependent upon longleaf pine ecosystems. Allowing these natural variations to occur at both the appropriate spatial and temporal time scale throughout the refuge will increase the ecological integrity of the refuge as a whole. Thus, management of the longleaf pine ecosystem in a holistic manner, that allows ROCs to occur at their natural densities and interspersions throughout the system, presents no conflicts in management among the various resources of concern.

CHAPTER IV. HABITAT GOALS AND OBJECTIVES

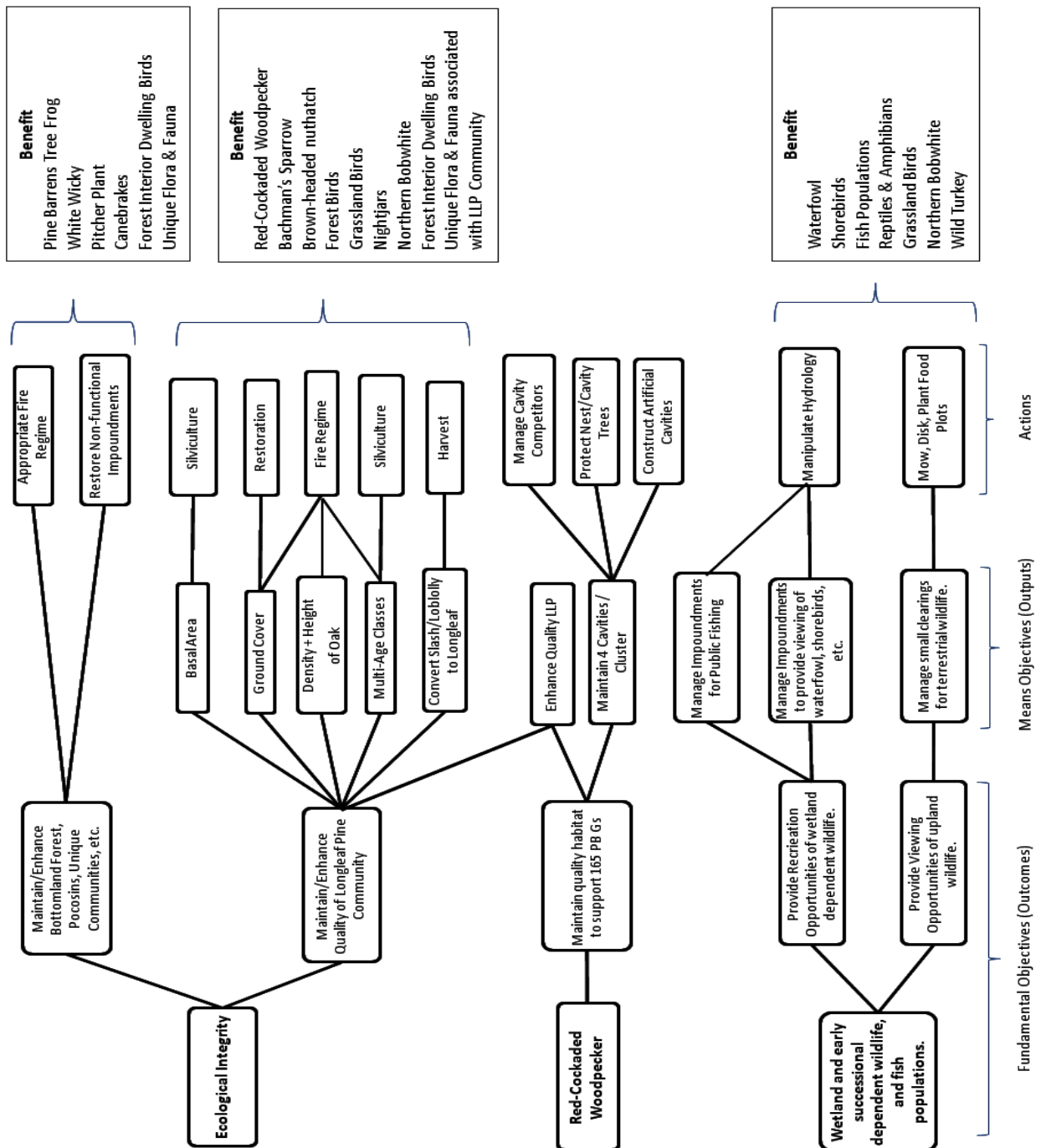
Refuge goals and objectives were developed in the CCP. This plan focuses on those goals and objectives that can be achieved through active habitat management actions (Appendix F). Goals and objectives pertain to resources of concern identified in Chapter 3.

The desired future conditions for the refuge landscape is one dominated (75-80% of area) by expansive open, mature longleaf pine woodlands above a floristically diverse native grass-forb ground cover. 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 are established in native warm-season grasslands and non-native plants such as weeping lovegrass, shrub lespedeza, or black bamboo are largely absent. 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 and (hydric) bottomland forests.

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.

Habitat objectives for the refuge are graphically depicted in Figure 11. There are 2 primary objectives that will be achieved through active habitat management at the refuge, these being 1) maintain and improve ecological integrity of the longleaf pine community and 2) management of red-cockaded woodpeckers.

Figure 11. Habitat Objectives of Carolina Sandhills NWR



Goal³: 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.

LONGLEAF PINE ECOLOGICAL INTEGRITY

Objective 1: *During the 15- year time span of the HMP, improve the overall quality of 35,093 acre longleaf pine community found on the refuge. Quality of the longleaf pine community will be measured through the use of a constructed longleaf pine integrity index that takes into consideration important components of natural historically occurring longleaf pine communities (See Means Objectives Figure 12). Management actions during the 15 year HMP cycle will be targeted toward improving overall refuge-wide integrity scores by 5-10%.*

Resources of Concern: Longleaf pine-wiregrass ecosystem and associated embedded wetlands, red-cockaded woodpeckers, migratory birds, northern bobwhite quail, Bachman's sparrow, Pine Barrens Treefrog.

Rationale: Maintaining and improving the longleaf pine community on the refuge provides critical habitat for numerous rare and unique species such as: red-cockaded woodpecker, Bachman's sparrow, Pine Barrens Treefrog, and many unique plants that are associated with longleaf pine forests. Ninety-seven percent of the historic longleaf pine range has been destroyed or altered such that this forest type has been identified as one of the most important native ecosystems for conservation.

An objective hierarchy (Figure 12) was developed to identify the fundamental objective (Outcomes), for management of the longleaf pine community, along with means objectives (Outputs), the attributes that constitute a quality longleaf pine forest. In addition to the fundamental and means objectives, factors that influence the objectives were also identified, along with management actions that are targeted toward attaining each means objective.

To create the longleaf pine integrity index, utility functions were developed for each means objective (Figure 13). The utility functions identifies the measurement scale of each attribute, as well as, how desirable the range of values for an attribute is in meeting the objective (a utility value of 1 is completely desirable, while a value of 0 is undesirable). Monitoring will be directed toward measuring each of the means objectives within longleaf pine stands, and combining all the utility function values into an aggregate integrity score for the forest stand and eventually the overall management unit (Tables 4 and 5). These integrity score values will be used to identify which aspect of a forest stand needs improvement, help to prioritize management actions among stands, and evaluate overall success of longleaf pine management at the refuge and achievement of the refuge longleaf pine objective.

³ All goals, objectives and strategies identified within this HNP are stepped down from the goals, sub-goals, and objectives found in Carolina Sandhills NWR Comprehensive Conservation Plan (2010). For a crosswalk table to align management objectives described here and following, please see Appendix F.

Figure 12. Longleaf Pine Objective Hierarchy for Carolina Sandhills NWR

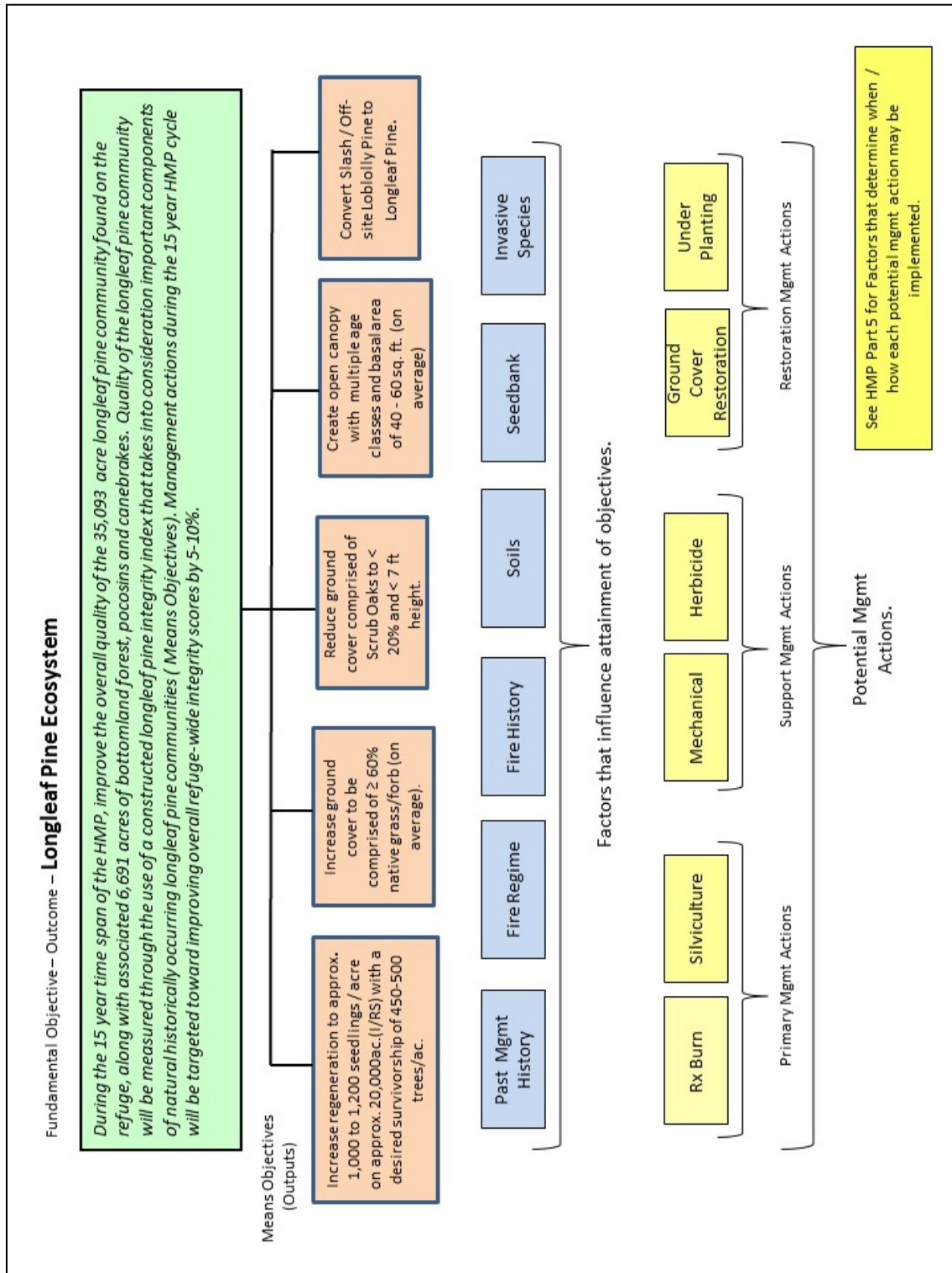
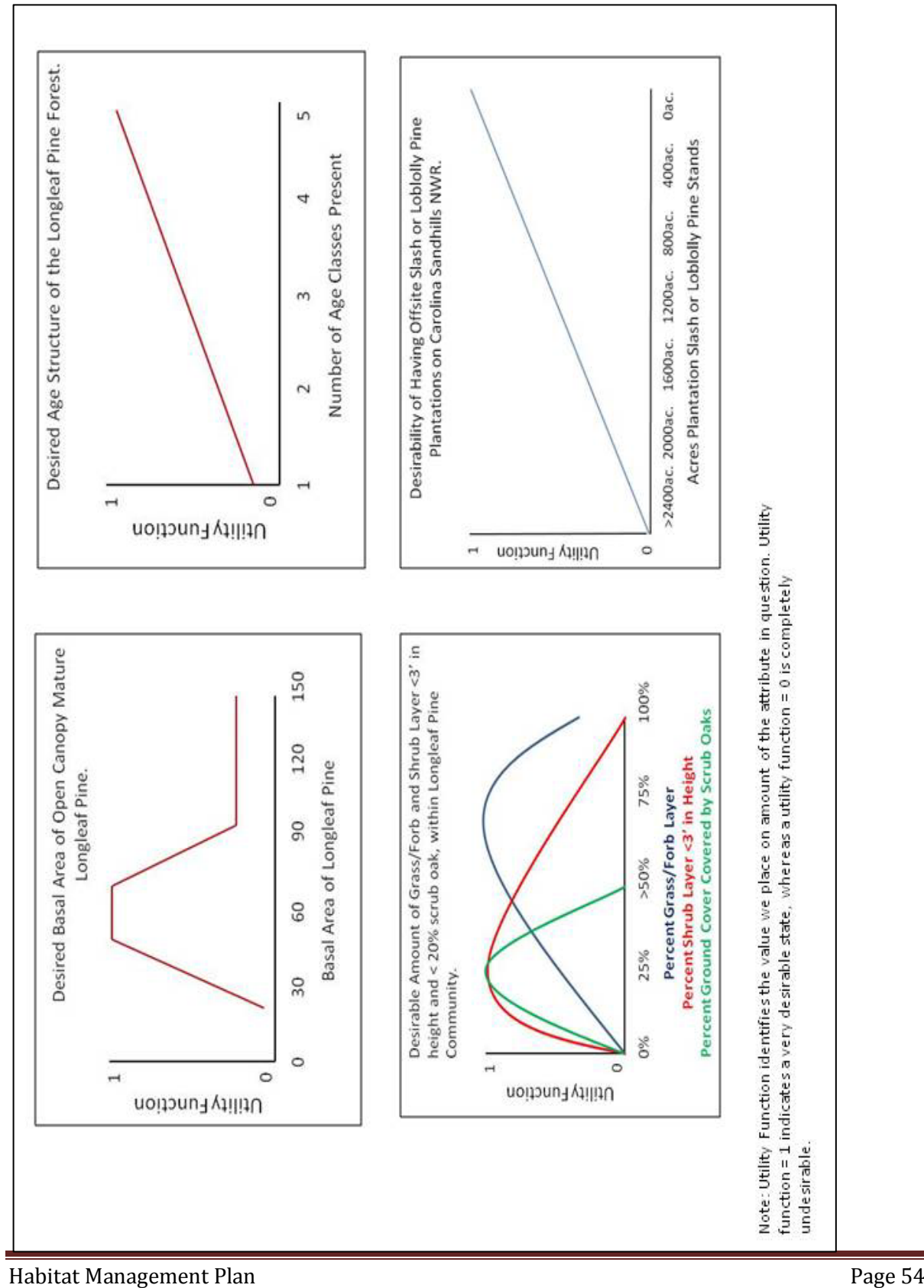


Figure 13. Utility Functions for Attributes of Longleaf Pine Community at Carolina Sandhills NWR



Spatial Scale of the Longleaf Pine Integrity Index:

Monitoring the quality of longleaf pine communities using the integrity index will be carried out at both the forest stand and management unit level. However due to wide natural variation within ecological communities, the spatial scale at which a community is measured will greatly influence results of the monitoring. Thus, the larger spatial scale of refuge forest management units will be used to monitor progress at improving the refuge's longleaf pine community over time.

Integrity scores will be measured for individual forest stand to measure the integrity pre and post management treatments. To obtain the integrity score for the entire management unit, individual stand scores will be weighted by their percent area of the entire management unit, and then combined to determine an overall score (Table 5). To obtain an overall refuge-wide longleaf pine integrity score, all management unit scores can be weighted by their percent area of the entire refuge-wide longleaf pine community, and combined to identify a refuge-wide longleaf pine integrity score.

Table 4. Example Longleaf Pine Ecological Integrity Score for a Forest Stand at Carolina Sandhills NWR.

Example: Possible scores (for 1 Forest Stand) of different metrics to measure quality of LLP Communities. (Scores are taken from Utility Function Graphs)						
Attribute	Integrity Score					Max Score
LLP Basal Area	< 20 = 0	20-30 = 0.5	31-80 = 1	81-90 = 0.5	> 90 = 0.3	1
% Spatial Area Scrub Oak	0-10 = 0.6	11-20 = 1	21-50 = 0.5	51-75 = 0.3	>75 = 0	1
% Grass/Forb	0-10 = 0.3	11-25 = 0.5	26-35 = 0.75	>36 = 1		1
% woody ground layer < 3' in Height.	0-5 = 0.4	6-20 = 0.75	21-40 = 1.0	41-75 = 0.5	> 75 = 0.3	1
Mixed Age Classes ^A	1 age class=0.2	2 age classes=0.4	3 age classes=0.6	4 age classes=0.8	≥ 5 age classes=1	1
% Unit planted Slash or Loblolly Pine	>25%=0	20-24%=.2	15-19%=.4	10-11%=.6	0-9%=1.0	1
Total Possible Score						6
^A Age classes = seedling, sapling; intermediate (30-60 y.o.); mature (3 age potentials....60-125y.o.; 125-199y.o. and 200+y.o.). Age class score is dependent upon spatial scale. Scale used is at the Management Unit scale of approximately 1500 acres.						

Table 5. Example of Aggregate Longleaf Pine Ecological Integrity Score for a Forest Management Unit at Carolina Sandhills NWR

Example: Calculation to combine Forest Stand Integrity Scores into a Composite Forest Management Unit Integrity Score.				
Forest Stand	Stand Acreage	% Stand Area of Unit (Stand Acreage/Unit Acreage)	Stand Integrity Score	Stand Contribution toward Unit Integrity Score (% Stand Area * Stand Integrity Score)
Stand A	100	0.1	5.2	0.52
Stand B	400	0.4	4.6	1.84
Stand C	200	0.2	3.1	0.62
Stand D	300	0.3	5.1	1.53
Total Mgmt Unit Acreage of LLP	1000	Total Mgmt Unit Integrity Score		4.51

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
<ul style="list-style-type: none">• Longleaf pine basal area• Percent spatial area of stand covered by scrub oak• Percent coverage by grasses and forbs• Percent area of woody ground cover < 3' height• Mixed age classes of longleaf pine• Percent of stand planted in slash or loblolly pine.	<ul style="list-style-type: none">• Forest Habitat Inventory
Primary Wildlife Response Variables	Probable Assessment Methods
<ul style="list-style-type: none">• Red-cockaded woodpecker population growth and reproductive fitness• Bachman's sparrow occupancy• Northern bobwhite occupancy	<ul style="list-style-type: none">• Annual RCW population status and reproductive fitness monitoring• Bi-annual targeted playback survey for Bachman's sparrow and Northern Bobwhite• Annual Quail Whistling Call Count Census Survey (with SCDNR)• Christmas Bird Count

EMBEDDED WETLANDS

Objective 2: *During the 15 year time frame of the HMP, maintain and protect 6,691 acres of embedded wetlands including bottomland forest and associated unique communities such as: canebrakes, pocosin wetlands, Atlantic-white cedar and bogs, that are interspersed within the overarching longleaf pine community.*

Resources of Concern: Pine Barrens Treefrog, migratory birds, white wicky, pitcher plant, canebrakes, unique flora & fauna

Rationale: Bottomland forests and their associated unique plant communities are an integral component of the longleaf pine forest. Many unique and rare plants occur within these bottomland forests.

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
<ul style="list-style-type: none">• Maintain transition zone between pine-dominated uplands and hardwood-dominated wetlands with variable habitat structure• Maintain and enhance populations of unique flora including pitcher plants, canebrakes, and white wicky	<ul style="list-style-type: none">• Forest Habitat Inventory• GIS unique flora populations• Periodic inventory of unique flora populations
Primary Wildlife Response Variables	Probable Assessment Methods
<ul style="list-style-type: none">• Pine Barrens Treefrog occupancy• Migratory bird occupancy trends	<ul style="list-style-type: none">• Acoustic frog surveys• Breeding Bird Survey

RED-COCKADED WOODPECKER

Objective 3: *Carolina Sandhills NWR will manage at least 35,000 acres of longleaf pine vegetation communities during the 15 year time frame of the HMP to progress toward achieving 177 Red-Cockaded Woodpecker clusters that support at least 157 potential breeding groups.*

Resources of Concern: Red-cockaded woodpecker

Rationale: As previously discussed, the RCW recovery plan identified the refuge and neighboring SHSF as the Sandhills (SC) Recovery Unit, a secondary core population capable of supporting 250 Potential Breeding Groups (PBGs). The recovery plan further estimated a population goal for the refuge as 193 active clusters, which was further refined in 2006. The refuge recovery goal was predicted to be 165 PBGs. However, neither of the estimated population figures evaluated the relationship of total available clusters (Active, Inactive) to those occupied by PBGs and by solitary birds.

During development of the HMP, all habitats were re-evaluated and re-partitioned to establish a RCW population goal for the refuge. Consideration included removal of non-foraging habitat, site index, proximity to existing clusters, as well as habitat configuration (type, age, size, quality, juxtaposition) within partitions. In addition to foraging habitat, the population goal also includes population dynamics data such as ratio of PBGs to Active Clusters (ACs) and Total Clusters available (TC). The population goal should reflect dynamics that occur within typical RCW populations (PBGs, solitary birds, floater birds, and inactive clusters). Appendix A provides a discussion of the criteria used to define and evaluate habitat and the data to analyze population dynamics. As a secondary core recovery population, the number of PBGs in the population (refuge and SHSF) will not change to reach recovery; however, the number of PBGs/TCs supported by refuge lands may change as property-specific criteria are applied.

As of 2012, there are 166 potential clusters, with 151 clusters currently active, supporting 139 PBGs. While attainment of the refuge-specific population goal may depend on the maturation of more than 13,000 acres of longleaf pine plantations, RCWs will form new groups by budding from existing groups or pioneering when the quality of habitat is high. Achievement of the RCW objective is entirely dependent upon maintaining and enhancing the longleaf pine community on the refuge. Thus, all management strategies for longleaf pine constitute management for RCWs.

Adaptive Management Monitoring Elements:

Primary Habitat Response Variables	Probable Assessment Methods
<ul style="list-style-type: none"> • Longleaf pine basal area • Percent spatial area of stand covered by scrub oak • Percent coverage by grasses and forbs • Percent area of woody ground cover < 3' height • Mixed age classes of longleaf pine 	<ul style="list-style-type: none"> • Forest Habitat Inventory
Primary Wildlife Response Variables	Probable Assessment Methods
<ul style="list-style-type: none"> • Red-cockaded woodpecker population growth and reproductive fitness 	<ul style="list-style-type: none"> • Annual RCW population status and reproduction fitness monitoring

CHAPTER V. HABITAT MANAGEMENT STRATEGIES

This chapter outlines a broad suite of management options to address goals and objectives described in Chapter 4. Management options identified within this HMP provide guidance to refuge staff to determine what actions are necessary to move a management unit from its current habitat state toward a future desired state. Specific locations and associated management actions to achieve refuge habitat objectives within a management unit are not provided within this plan. Selection of management units and strategies are dependent upon site-specific conditions, as determined by monitoring information or staff expertise. This flexibility is necessary due to the extensive number of forest stands, the status of each in regards to regeneration, age, stand density, composition, structure, invasives, etc. All these factors must be taken into consideration to develop specific management actions to achieve objectives. In many situations, unique suites of management strategies may be needed within any given forest stand or groups of stands, which may include combinations of chemical, fire, mechanical, or other management techniques. Site-specific conditions will also change over time, thus necessitating new or different management strategies within forest stands throughout the 15-year time-span of the HMP.

Each year, refuge staff will prepare Annual Prescriptions (APs) that identify the details of when, where, what, intensity, and frequency of management actions to be undertaken during the planning year to achieve objectives (See Appendix D.1 (Exhibit 2 of the HMP Policy 620 FW1)).

When developing APs, a number of factors beyond habitat conditions must be taken into consideration as to what can actually be accomplished during any given year. Many of these factors are obvious and can be planned for, such as: budgets, staffing, regulatory or policy constraints, and equipment needs. However, other factors are often uncontrollable, such as: staff turnover, weather constraints and/or opportunities, equipment breakdowns, or changing FWS priorities on short notice. Thus, with the appropriate justification and approvals, the refuge staff needs latitude to alter planned management actions to achieve objectives under changing conditions.

When conducting habitat management strategies, it must be recognized that many management actions do not result in instantaneous desired conditions to achieve wildlife or habitat objectives. This is especially true of forest management where it takes many years, well beyond the 15-year cycle of a CCP or HMP to achieve desired conditions. Many of the refuge's forest management actions are directed at "speeding-up" forest succession to achieve mature longleaf pine forest conditions. However, it must be remembered that it will still take approximately 200 years to achieve a mature 200 year old forest stand structure. Thus, it is critical that future planning initiatives and Service directives take these time frames into account. Alternatively, some habitat management strategies may achieve desired conditions within an annual cycle. Strategies directed toward manipulation of early successional habitats such as: forest openings, planting of annual crops or water level manipulations may achieve objectives within a one or two year time span.

LONGLEAF PINE ECOSYSTEM

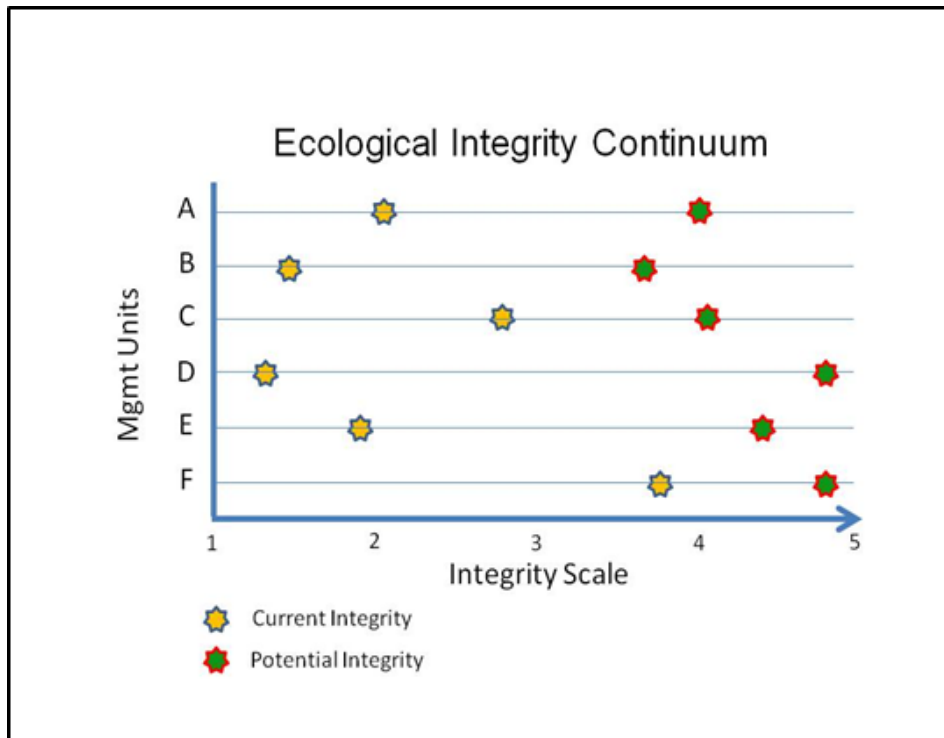
POTENTIAL MANAGEMENT STRATEGIES

Management strategies within longleaf pine will be undertaken to move management units incrementally from their current condition toward a desired future state that mimics historic natural conditions (Figure 14). Condition of each management unit will be measured using an ecological integrity index as identified in Table 5. Due to the complexity, and lengthy time period required to achieve desired conditions in a mature longleaf pine forest, no single management action will achieve the desired state. Rather a collection of management strategies through time will be necessary to achieve, and eventually maintain the desired condition of a management unit. Additionally, when evaluating success, it must be taken into account that sites do not have the same potential for high quality longleaf pine. Thus, site index, climate, past perturbations, invasives, or fragmentation caused by man, may all influence the potential of a site to achieve historic longleaf pine conditions.

Carolina Sandhills NWR is a Land Management Research Demonstration (LMRD) site for restoration of the longleaf pine ecosystem. As such, the refuge is expected to:

- Manage, enhance, and maintain a high quality longleaf pine ecosystem.
- Conduct research to develop methods that effectively and efficiently restore longleaf pine communities.
- Monitor results of management and publish scientific papers.
- Become a leader in longleaf management practices and work to provide management information to the public, forest managers, and other agencies and organizations.

Figure 14. Example of Ecological Integrity Continuum Showing Existing and Potential Integrity of a Site



To fulfill the role as a LMRD refuge, the refuge must not be constrained to the following longleaf pine management strategies, but rather must develop research proposals and management prescriptions that will test and evaluate new methods for restoring the longleaf pine ecosystem.

Prescribed (Rx) Fire

The element that connects all components, both aquatic and terrestrial, of the longleaf pine/wiregrass ecosystem, is fire. Fire has shaped the vegetative components of the southeast historically (Frost 1998) and fire suppression, along with land use changes, has changed the southeastern landscape in the last century (Pyne 1982). Water typically stands in the depressional wetlands, but drying allows fire to enter from adjacent upland plant communities (Kirkman et al. 1998). The interaction of fire with topography, soil types, and hydrologic regimes produces the incredible biodiversity of the longleaf pine/wiregrass ecosystem across the southeast (Peet and Allard 1993, Walker 1993). In the absence of fire, there would be no longleaf pine/wiregrass ecosystem (Van Lear et al. 2005).

Frequent fire reduces the prevalence of invading scrub oak species or other hardwoods, maintains an open park like forest, enhances a highly diverse ground cover community, and provides an appropriate seedbed for regeneration of longleaf pine and associated herbaceous layer. Frequent fire also protects stands from devastating wildfires by reducing fuel load buildup thus lowering the intensity of wildfires when they occur.

Prescribed fire mimics natural processes. Prescribed or controlled burning is completed under a “prescription” that establishes limits for various factors under which a fire may be initiated in relation to burn plan objectives and safety considerations. Weather factors such as temperature, wind speed and direction, relative humidity, and smoke lift are considered. Other factors include vegetative conditions, resource objectives, topography, availability of personnel, and equipment.

Prescribed fire is an effective tool when applied at the proper time, which depends on the objectives to be achieved, vegetative conditions, and safety. Dormant season fires are often used to reduce fuel loads and are often safer to conduct than fires during warmer times of the year. Growing season fires result in greater mortality of encroaching woody vegetation that is not fire adapted. However, even the time of year when a growing season fire is conducted may yield very different results. Fires conducted during hot summer months with high ambient temperatures may result in mortality of even fire-adapted species such as longleaf pine. Summer fires are also increasingly subject to variable weather such as thunderstorms, which may greatly increase safety concerns. Roth and Franklin (Undated) performed a literature review and developed a suggested guide to the timing of fire to achieve specified objectives within longleaf pine communities (Table 6).

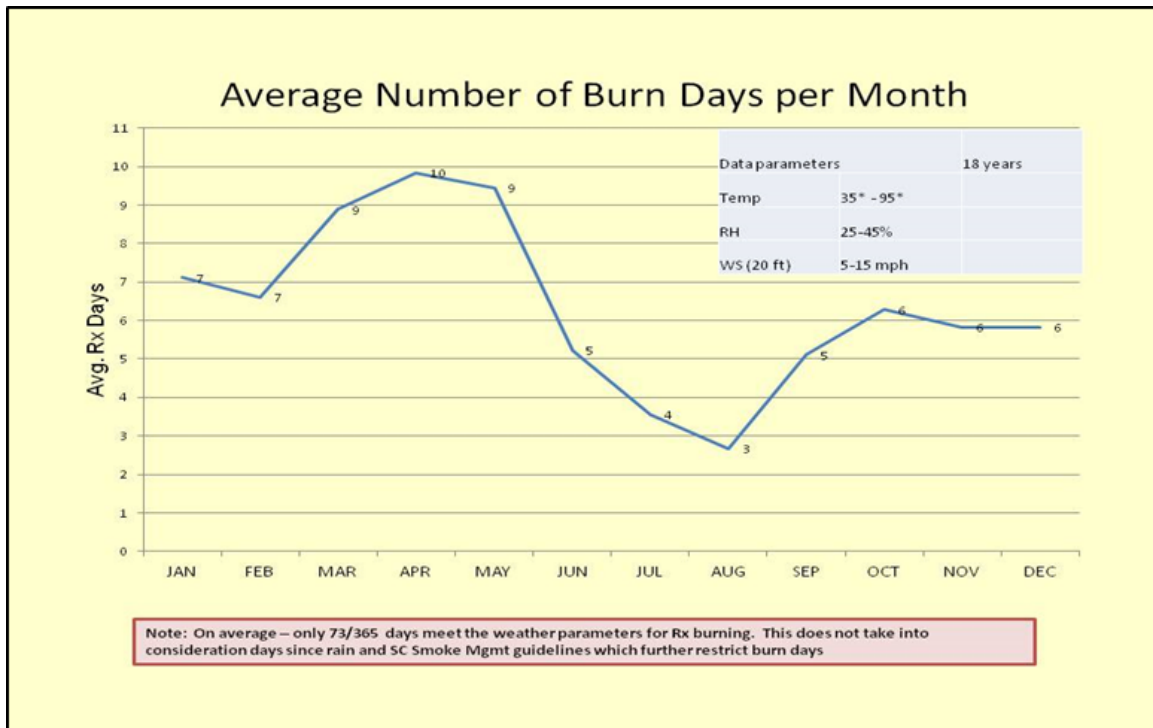
Significant influences to planning the timing of a prescribed fire is consideration of safety, weather, and Clean Air Act regulations promulgated through SC Smoke Management Guidelines, all of which dictate whether the fire may actually be conducted (SCFC 2006). Each of these considerations is inter-related. Safety concerns must be met relative to the number of available qualified personnel and equipment for the specified fire. However, weather conditions may be such that conducting a fire, regardless of available personnel, may still be unsafe. Air quality regulations also dictate whether a burn may be performed. When certain weather conditions are present, smoke management and other considerations of air quality will prevent refuge staff from conducting the burn. Conversely, even when all safety and air quality guidelines are met, weather alone may preclude conducting a burn, when humidity or fuel moisture is too low, such that fire behavior, intensity, and severity produce undesirable results.

Through analysis of 18 years of weather data, refuge staff determined the average number of days per month when a burn may be possible to conduct (Figure 15). It was calculated that weather would allow for 73 burn days per year. This number of potential burn days will be taken into consideration when planning burns, as well as, placing constraints on number of acres that can be burned at appropriate times to meet objectives each year. Additional constraints of fuel moisture and air quality considerations may further reduce the available number of burn days. Fortunately, the largest number of available burn days is found during the early growing season months of March through May when the majority of burns are conducted to control hardwood encroachment into longleaf pine stands.

Table 6. Suggested Seasons for Prescribed Burning of Longleaf Pine to Achieve Stand Objectives. (Reprinted from Roth and Franklin. Undated. Clemson University Forestry Leaflet 32.)

Stratum or Community Element	Common Objectives in Burning	Effective Burning Seasons
Deciduous Hardwoods	<ul style="list-style-type: none"> --Reduce size, presence and understory sprouting to advance ground-layer vegetation and lessen potential of hardwoods capturing the overstory. --Reduce hazardous fuels to prevent fires in dense, overgrown hardwood understories from causing needle scorch above or crowning via "fuel ladders" to the pine canopy 	<ul style="list-style-type: none"> --Several years of annual burning in the early growing season unless fuel accumulations are excessive. --Several years of cool winter burning before continuing with growing-season burns
Longleaf Pines	<ul style="list-style-type: none"> --Protect early regeneration -- Control brown-spot fungus on grass stage -- Increase seedling height growth --Arrest hardwood incursion --Remove hazardous fuels --Prepare seedbed for pine regeneration 	<ul style="list-style-type: none"> --No burning for 2 years --Early growing season (Mar) --Early growing season (Mar) --Growing season, with prior sequence of winter burns if excess fuels are present --Sequence of burns in winter prior to any summer burning --Summer just prior to the autumn seed fall
Native Perennial Bunchgrasses	<ul style="list-style-type: none"> -- Provide continuity of fine fuels to sustain future prescribed burning --Perpetuate or restore native grass diversity --Stimulate reproduction of native grasses 	<ul style="list-style-type: none"> --Frequent burning, summer or winter --Vary season of burning, but include growing season burns --Generally early growing season, but varies with species
Native Forbs (Herbaceous Flowering Plants)	<ul style="list-style-type: none"> --Perpetuate or restore native forb diversity --Stimulate reproduction of native forbs 	<ul style="list-style-type: none"> --Frequent burning, varying the season --Vary the season, including growing season burning
Native Fauna	<ul style="list-style-type: none"> --Retain or restore habitat characteristics to sustain key species and native diversity 	<ul style="list-style-type: none"> --Varies with species, but growing season burns are often helpful as long as any excess fuels have been eliminated; protect key species by staggering burn rotations for adjacent management units.
Hazardous fuel accumulations in fire-suppressed stands	<ul style="list-style-type: none"> --Reduce excess litter safely to avoid damage to pine roots and stem issues from fires smoldering in thick duff layers; reduce heavily developed hardwood "rough" 	<ul style="list-style-type: none"> --Series of cool winter burns; no growing-season burning until fuels are normalized

Figure 15. Average Number of Available Burn Days per Month at Carolina Sandhills NWR



A variety of firing techniques (backing, flanking, and head fire) are used depending on objectives for conducting the burn. A combination of these firing techniques is typically used during prescribed fire treatments. The type of prescribed fire may depend on weather conditions, personnel, physical site conditions, and the desired temperature and intensity of the fire to achieve desired results.

Backing fire (burning into the wind) provides low to moderate fire intensity depending on the vegetation, the lowest rates of fire spread, and the longest residence time. This firing technique is used to slowly burn through the vegetation and provides effective litter consumption.

Flanking fire (burning parallel to the wind direction) creates moderate fire intensity and moderate rates of fire spread. In a flanking fire, the leading edge of fire backs through the vegetation. Along the heel side of the fire (flank), short bursts of head fire (burning with the wind) burn back toward the previously burned area (black). This technique is typically used to expand fire control lines.

The most intense fire behavior with rapid rates of spread and shorter residence time occurs during a head fire, when the fire is ignited and burns with the wind. This firing technique creates very intense heat and flames that quickly burn through the vegetation. Litter consumption ranges from light to complete depending on vegetation. When the burn unit control lines have been established, a head fire is used to consume the remaining vegetation.

In preparation of Annual Prescriptions, refuge staff must evaluate conditions within burn units and prioritize which units will be burned and under what conditions the burns will be conducted. On average, it is desired to burn each unit on approximately a 3-year rotation. Figure 16 depicts the factors that must be taken into consideration when prioritizing burn units. Once a unit is identified, an additional decision must be made as to whether resource objectives will be more effectively achieved by conducting a growing season burn. Figure 17 identifies the decision process and associated factors that determine if a growing season burn is warranted and/or feasible.

Figure 16. Factors that Influence Decisions when Prioritizing Management Units to Receive Prescribed Burns at Carolina Sandhills NWR

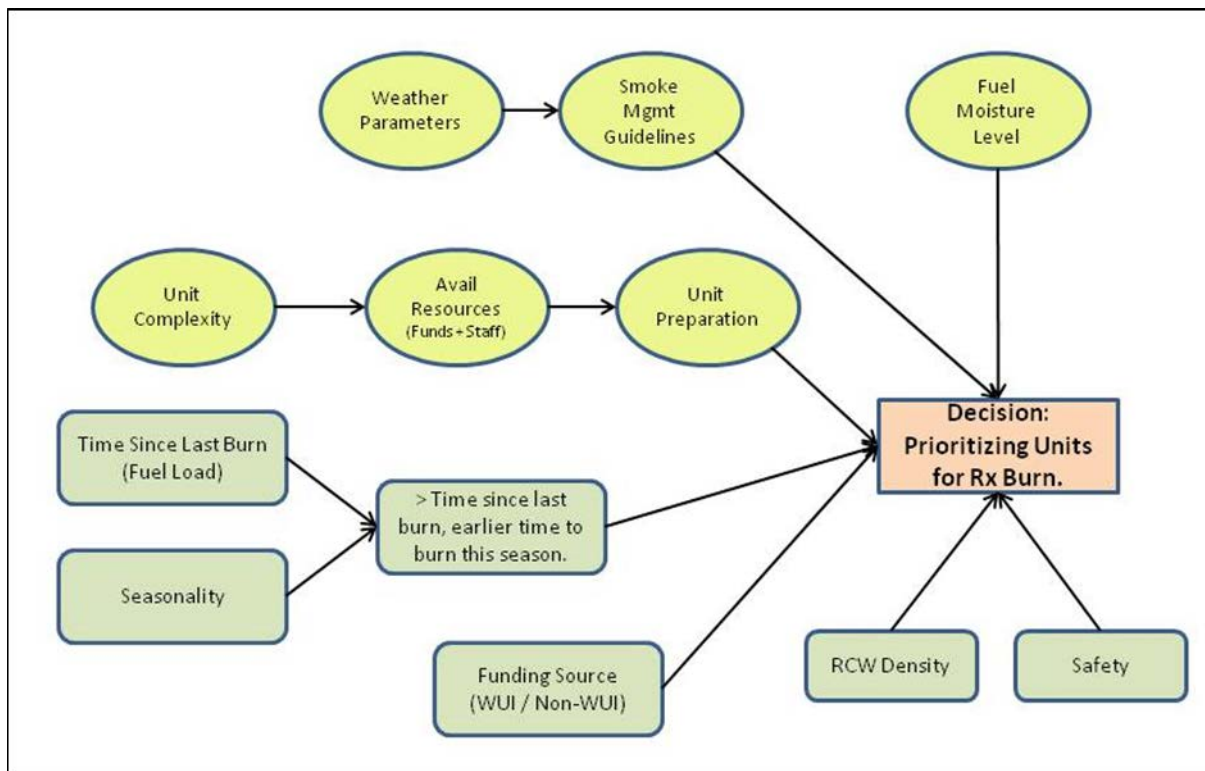
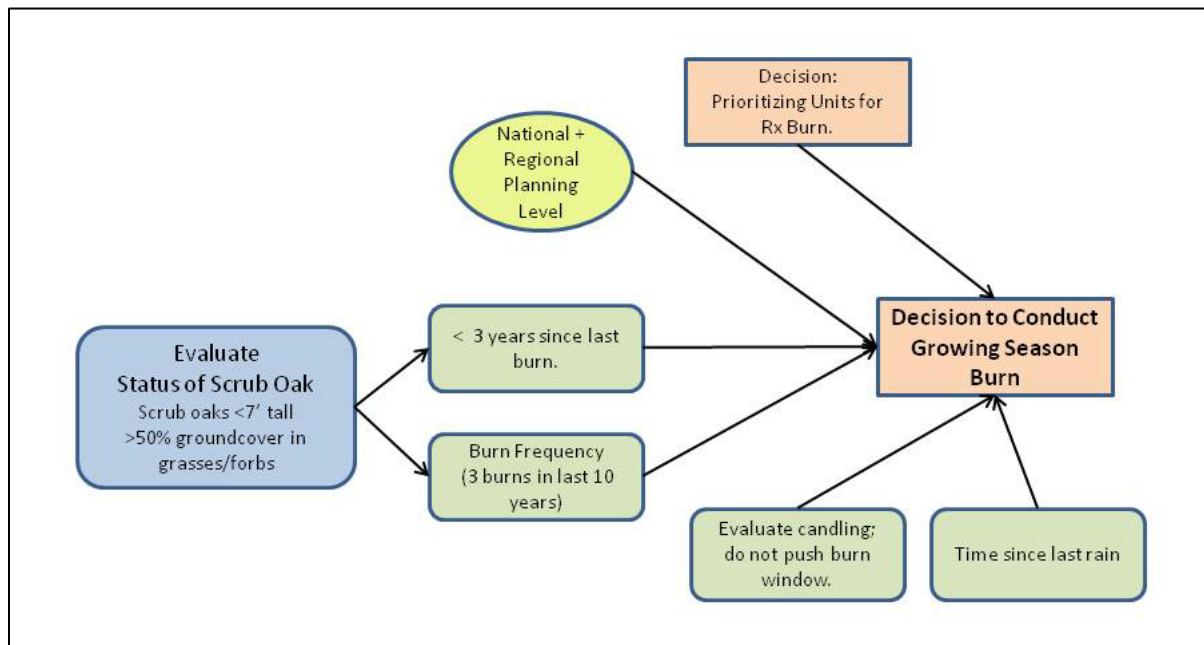


Figure 17. Factors that Influence Decisions to Conduct a Growing Season Burn Within a Management Unit at Carolina Sandhills NWR



Silvicultural Practices

Silvicultural practices have evolved beyond traditional objectives of economic timber harvest. Today, many agencies, landowners, and private organizations have identified forest objectives that include aesthetics, wildlife habitat, biological diversity, or other objectives (Guldin and Graham 2007). At Carolina Sandhills NWR, silvicultural practices are targeted toward restoring high quality longleaf pine communities for the intrinsic value of the community itself, enhancing biological diversity, and maintaining/enhancing habitat for unique wildlife that are dependent upon longleaf pine such as red-cockaded woodpeckers. These forest objectives present significant management challenges in the application, modification, or development of novel silvicultural practices. The goal of silvicultural actions at the refuge is to move incrementally forest stands from their current condition to the desired state that will achieve refuge objectives.

Carolina Sandhills NWR practices ecological forestry in managing the longleaf pine forest. This type of forestry values all components of the forest and focuses on ecological processes that result from natural disturbance. Stand termination harvesting is not conducted except where non-native and/or offsite species may require removal to reestablish natural conditions; therefore, native forests are managed to persist through time. Natural events including lightning strikes, endemic occurrences of pests and disease, weather events and fire result in mortality of single trees or groups of trees that provide desired ecological outcomes whenever such events result in small-scale disturbances dispersed throughout the forest and thereby provide foraging and nesting structure for many forest species.

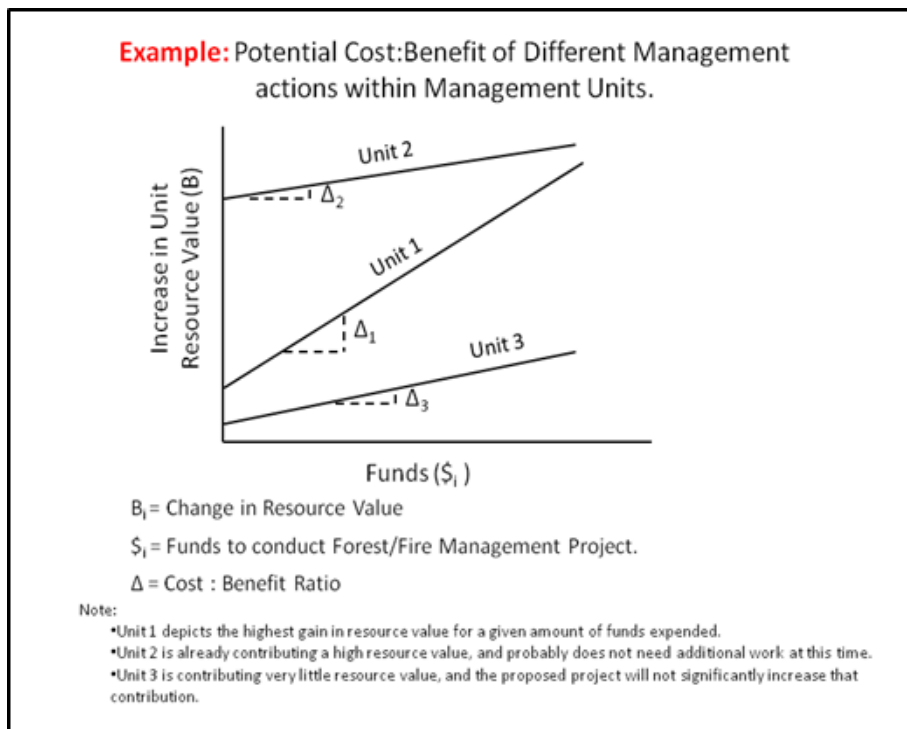
Overstory and groundcover restoration are considered in the timing and sequence of management actions to allow recovery processes that move forest systems towards desired conditions. Retention of biological legacies is a key factor in ecological forestry. Examples of biological legacies include very old and/or large trees, snags, blow-downs, tip-up mounds, and fallen logs.

PRIORITIZING MANAGEMENT ACTIONS

On an annual basis, forest management units that contain red-cockaded woodpecker clusters are evaluated relative to wildlife habitat, silvicultural, or fire management needs. A separate GIS layer map is then prepared identifying the location of all proposed wildlife, forest or fire management actions. In identifying proposed actions, consideration is given to refuge management capabilities to complete the proposed management actions; relative to budgets, staffing, equipment needs, or fire management constraints. The separate GIS layers are over-laid to identify location of all proposed actions and determine where any overlap of proposed work may occur. Inevitably several management actions may be proposed within the same management unit that may conflict with each other.

To resolve these conflicts, the appropriate refuge staff will meet to discuss each conflicting action and determine which shall take precedence. The overriding philosophy in resolving conflicts is the potential resource contribution of each proposed management action (Figure 18). Resolution of these conflicts will take into consideration; potential benefits to wildlife resources or the longleaf pine community, consequences of postponing the action, likelihood of completing the action given weather, equipment, or staff needs, and administrative costs and time-frames to plan the action.

Figure 18. Potential Cost: Benefit of Management Actions



During resolution of these potential management conflicts, the cost of not implementing the action must also be considered. Figure 18 identifies potential resource benefits when an action is implemented, however, in the same regard the slope of the lines may be negative if an action is not undertaken. Thus, the same cost: benefit must be taken into consideration if a management unit will have its resource value decreased by not performing a management action.

There are some management units within the refuge that do not contain red-cockaded woodpecker clusters and are thus visited much more infrequently than units that do contain clusters. These management units will be evaluated on a 5 year rotational basis to identify any habitat, forestry, or fire management actions that may be necessary within the unit. When evaluating these management units, basal area, stand composition, and extent of scrub oak will be the most important criteria evaluated to determine necessary management actions. A record of the year of evaluation within these units will be maintained, along with identification of the next year (5 years subsequent) when another evaluation will occur.

SELECTED MANAGEMENT STRATEGIES TO ACHIEVE LONGLEAF PINE OBJECTIVES

Figure 11 identifies five means objectives that will enhance the ecological integrity of the longleaf pine ecosystem. Accomplishment of each will further the refuge's efforts toward creating a longleaf pine ecosystem closely aligned with natural historical conditions of this landscape.

Strategy 1: Provide for natural regeneration and recruitment throughout the longleaf pine forest

Presently, pine plantations comprise roughly a third of the longleaf pine stands at Carolina Sandhills. Many of these plantations were planted during the 1930's through the 1970's as part of a reforestation effort. Thus, a large portion of the refuge's forests are currently in even-aged management. A refuge forest management review (2007) recommendation is to increase forest regeneration and convert much of the forest into uneven-aged forest stands. Conversion of these pine plantations into uneven aged stands will be a slow process over time, as the stands mature both biologically and structurally. Appropriate stocking levels must be maintained within the stands to allow structural maturity to occur. As these stands age and mature, stocking levels may then be manipulated in such a manner that allows for natural regeneration of longleaf pine.

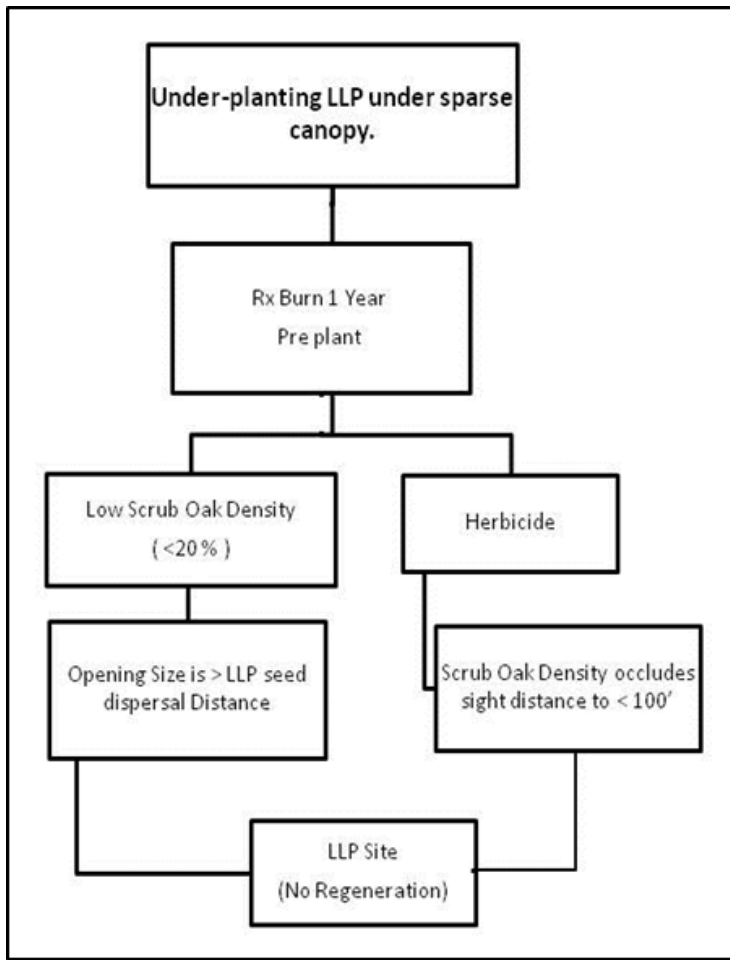
Longleaf pine seedbed conditions of bare mineral soil often result from forest management actions, forest fire (Rx burns), or natural disturbance regimes. Thus, where mature cone bearing trees occur, natural regeneration will most often be sufficient to meet refuge objectives and allow for conversion into uneven aged forest stands. In some situations, due to the poor seed dispersal abilities of longleaf pine under-planting may be necessary. This will most often occur in stands where very large forest opening are found, that are wider than tree heights around the perimeter of the opening.

Strategies to increase longleaf pine regeneration and survival:

- Delay Rx Burns for 2-4 years at sites where seedlings have not yet reached the fire resistant grass stage.

- Release patches (singletree selection /small gap management) of longleaf regeneration present in structurally mature cone-bearing longleaf pine plantations while thinning areas between regeneration patches to variable residual stocking levels.
- Within mature cone bearing longleaf pine, use group selection harvest to create small forest gaps to promote longleaf regeneration, subsequent to an Rx burn prior to seed fall. Gaps should be of a size that allows approximately 60% of forest floor within the gap to be exposed to sunlight and within the RCW Recovery Plan parameters of 25 to 40 acres.
- Where sparse longleaf pine canopy exists, with little or no regeneration, under-plant longleaf pine seedlings, after a pre-plant Rx Burn, and if necessary, control of scrub oak competition using herbicides (See Figure 19).
- Plant containerized longleaf pine seedlings at a stocking rate of 450-500 seedlings / acre at sites where slash or loblolly pine is harvested.
- When necessary, use Rx Burns in early growing season to control Fusiform rust (*Cronartium quercuum* F. sp. *Fusiforme*) on longleaf pine seedlings to increase survival.

Figure 19. Actions to Under-Plant Longleaf Pine



Strategy 2: Increase/Maintain ground cover within longleaf pine

Native ground cover under a longleaf pine canopy is comprised of a highly diverse community that is fire adapted and is the backbone of biological diversity within the longleaf pine ecosystem. As stated within the "Range-wide Conservation Plan for Longleaf Pine.

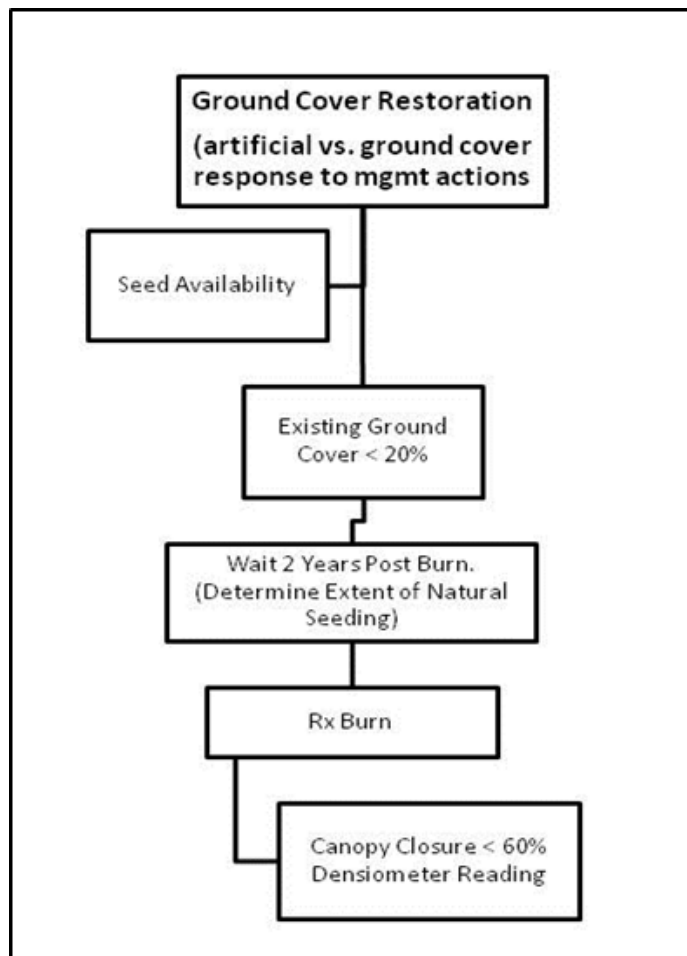
Still, today's remnants of the longleaf pine forests are some of the most biologically diverse ecosystems outside of the tropics. More than 140 species of vascular plants can be found in a 1,000 m2 area, with as many as 40 to 50 different plant species in one square meter. Nearly 900 endemic plant species—species found nowhere else — are found in these systems across the Southeast U.S.

The ground cover community is also an important contributor of light fuel needed to carry frequent fire through the longleaf pine community. Refuge management strategies will be directed toward maintaining and enhancing the ground cover community for its intrinsic biological diversity, rare and unique plants, habitat for numerous wildlife species and as an important component for fire as a natural process to shape the ecosystem. Dependent upon

site specific conditions of the ground cover itself, forest understory and overstory, the following management strategies may be implemented:

- Thinning of forest overstory (> 70% canopy closure) of longleaf pine to allow sufficient light penetration to the forest floor for optimum ground cover growth.
- Utilize Rx Fire at a return interval of 1-3 years, and at varying times of year to mimic natural fire regimes.
- Monitor and if appropriate control invasive and exotic species that may dominate the ground cover community, thereby influencing biological diversity, or rare and unique plants that occur there. Emphasize chemical control as mechanical control may enhance the spread of the invasive plant. If ground cover at a stand is sparse, evaluate the site for potential restoration by planting of native ground cover species (See Figure 20).

Figure 20. Decision Process for Ground Cover Restoration at Carolina Sandhills NWR

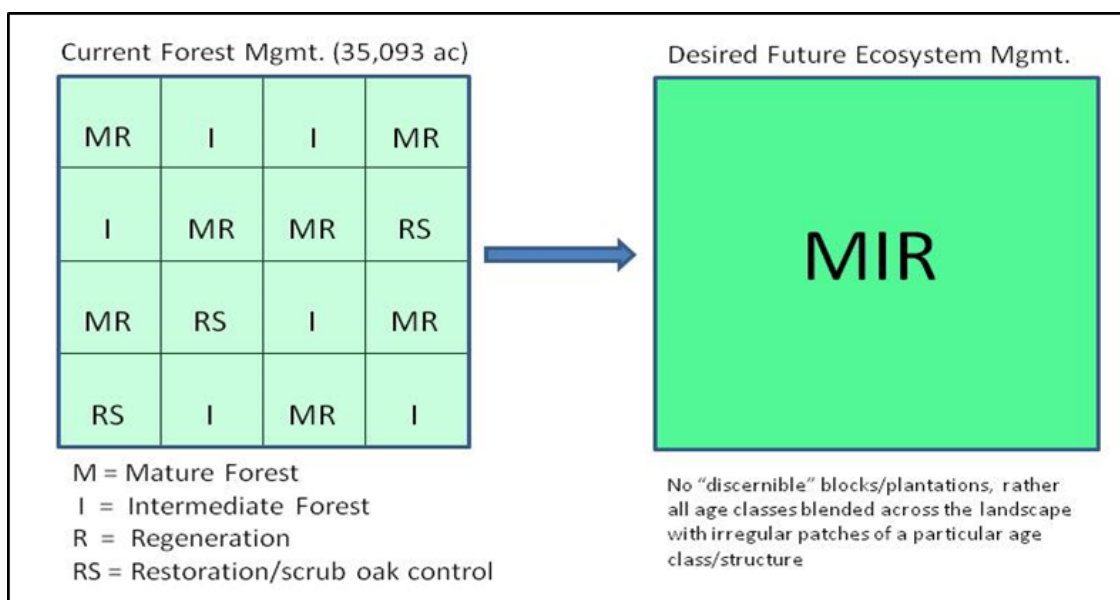


Strategy 3: Create open longleaf pine canopy with multiple age classes

Management for multiple age classes within a forest and all the values each age class provides to the ecology of the system is a dominant factor when applying ecological forestry. At Carolina Sandhills NWR, longleaf pine forest comprised of five or more age classes is desired (Table 5). This objective will take many years of silvicultural actions to achieve. Currently, the refuge consists of discrete patches of longleaf pine plantations, mature and intermediate forest, and scrub oak dominated stands. The desired future condition is to have all age classes blended across the landscape with small irregular patches of any particular age/class structure (Figure 21). Management strategies that may be implemented to create uneven-aged class forest stands include:

- Utilize group selection harvest system, to promote regeneration within small forest gaps.
- Protect/maintain legacy trees.
- Conduct thinning to release regeneration and clusters of intermediate longleaf pines.
- Implement management strategies to increase regeneration where needed

Figure 21. Desired Future Distribution of Longleaf Pine Age Classes at Carolina Sandhills NWR



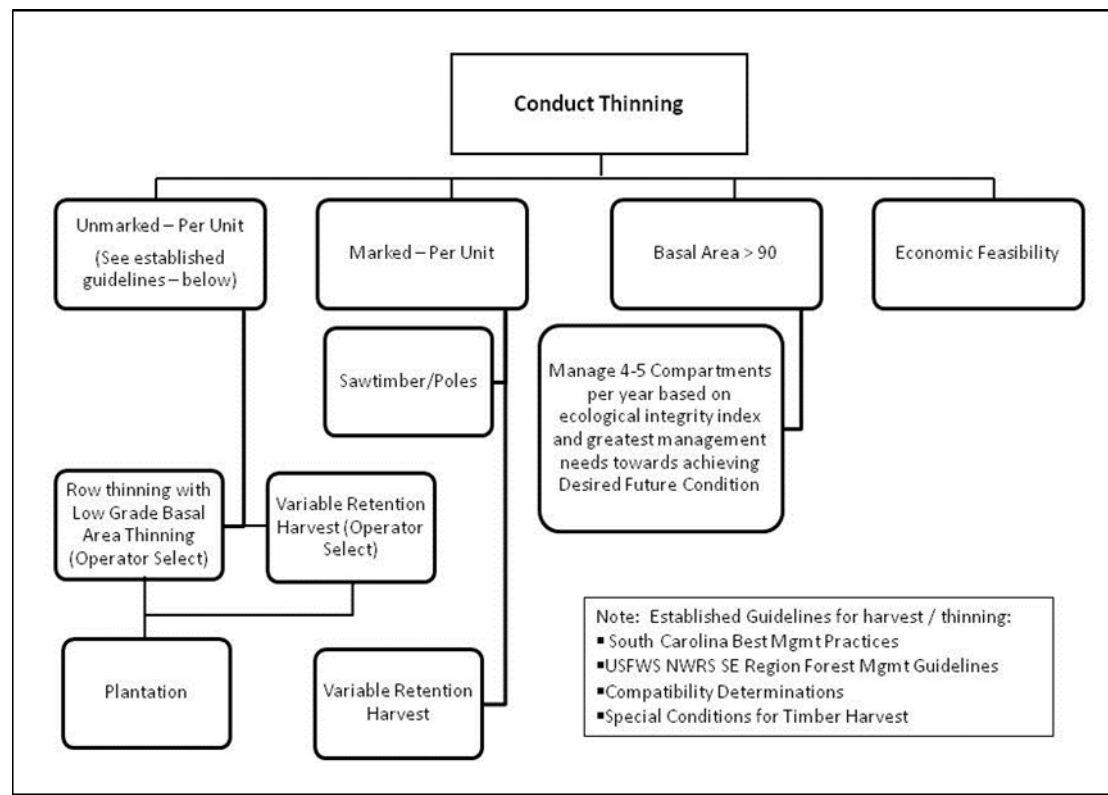
Strategy 4: Maintain Longleaf pine basal area of 40 – 60 sq. ft. /ac

Because of lightning strikes, wind-throw, and frequent natural and anthropomorphic fires, longleaf pine forests have typically grown into a grassland-type community with many age classes contributing to a multi-aged stand. Spacing between trees will optimally be sufficient to allow abundant needle fall to carry ground fire, and allow sufficient sunlight to penetrate to the forest floor to allow for development of a diverse ground cover community that also aids to carry frequent fire. Additionally, optimum tree spacing is important to longleaf regeneration since seeds seldom disperse more than a tree height from the parent

tree. Thus, basal area and tree spacing are very important criteria to promote historic longleaf pine conditions. Spatial management guidelines will be applied based on stand age (i.e., younger stands will have a higher BA and as stands mature, BA will be on the lower end of the range).

- Maintain sufficient canopy closure to ensure adequate needle-fall and to promote the establishment of grasses as fine fuel for Rx burns.
- Maintain sufficient tree spacing to allow for optimum longleaf pine seed dispersal.
- Maintain sufficient tree density to ensure spatial and temporal continuity of pines as required for RCW foraging and nesting habitat in perpetuity.
- Maintain tree spacing that allows sunlight to penetrate to the forest floor for development of a biological diverse ground cover community.
- Conduct forest thinning and/or harvest operations to promote or maintain the above conditions, maintaining basal area within an appropriate range for the size class of the stand, being generally 40-60 sq.ft./acre (Figure 22).

Figure 22. Silvicultural Thinning Processes at Carolina Sandhills NWR



Strategy 5: Convert Slash / Off-site Loblolly Pine to Longleaf Pine

Approximately 15% of planted pines at Carolina Sandhills NWR are offsite loblolly (1%) and slash (14%) pine plantations that were established in earlier reforestation efforts (the 1960s and early 1970s) to reclaim former agricultural lands or to “improve” stands with poor pine stocking. Unfortunately, due to faster growth of loblolly and slash pines, many acres of the longleaf pine forests have been converted in the southeastern U.S. to these species. In the Sandhills, these offsite species often stagnate and do not adapt to the poor site conditions (soils that are xeric, have low productivity and mineral content, and are excessively drained).

An important refuge objective is to restore these sights to high quality longleaf pine communities. A specific silvicultural action is the removal of slash pine (*Pinus elliotti*) and restoration to longleaf pine (Figure 23). RCW foraging habitat requirements are carefully considered when planning these forest conversions. To date, approximately 1,500 acres of offsite slash pine has been converted to longleaf pine. The remaining 500 acres will be evaluated, removed, and restored to longleaf during the first five years of the HMP’s implementation. As the RCW population is stable to increasing, and many longleaf pine plantations have reached 40 years of growth to provide needed foraging habitat, removing the remaining slash needs to be a priority for a variety of reasons. First, the slash has stagnated and in some sites is hybridizing with longleaf pine, potentially affecting the integrity and long-term quality of these sites. Secondly, slash pine is a prolific seeder and is dominating sites, precluding successful longleaf pine recruitment and development of desired groundcover conditions. Thirdly, as conversions are delayed, reaching desired future conditions are also delayed. As part of the habitat improvement prescription for these remaining stands, foraging habitat analyses will be completed for affected RCW clusters. If foraging habitat falls below the Minimum Stability Standard as recommended in the *RCW Recovery Plan*, staff will request a biological opinion concerning affected clusters from the Service’s Ecological Services branch. All actions will be in consultation with the Service’s RCW Recovery Coordinator and Ecological Services Division.

Management strategies to restore longleaf pine on sites occupied by offsite species include:

- All RCW cavity trees will be retained.
- Conduct clearcuts of slash/loblolly pine. In mixed stands, selectively remove slash and hybridized slash, retaining longleaf and promoting longleaf regeneration where feasible.
- Allow natural longleaf pine regeneration where tree removal is within seed dispersal distance of existing mature longleaf pine stand.
- Where natural longleaf pine regeneration is not feasible or is unsuccessful, control scrub oaks as needed and plant containerized longleaf pine seedlings at densities determined by site conditions (Figure 24).

Figure 23. Decision Process to Convert Slash/Loblolly Pine to Longleaf Pine at Carolina Sandhills NWR

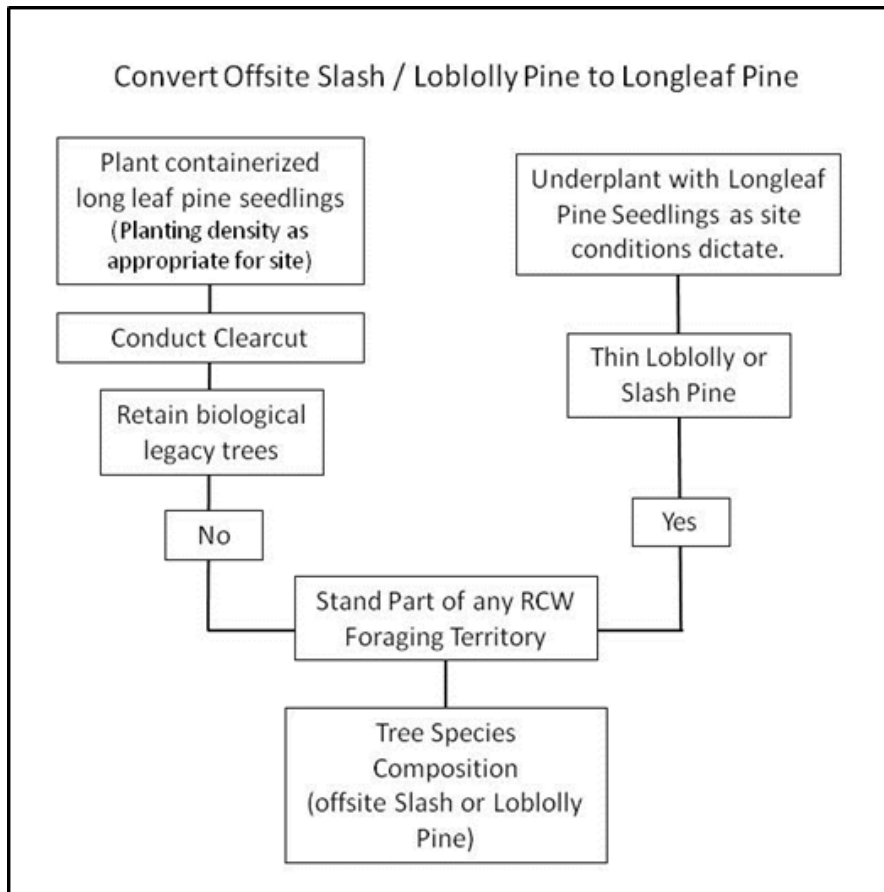
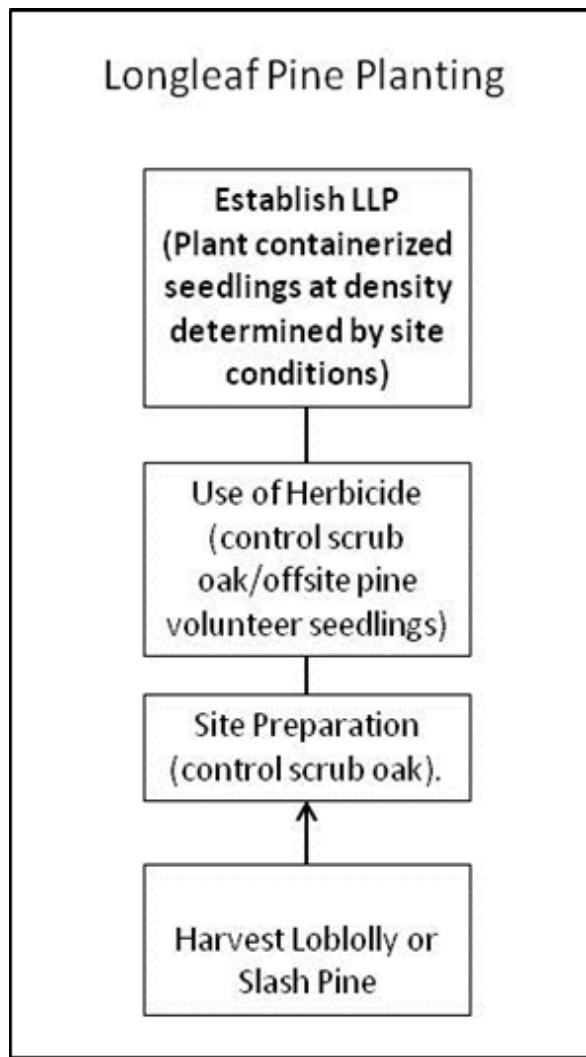


Figure 24. Process for Planting of Longleaf Pine Seedlings at Carolina Sandhills NWR



Strategy 6: Reduce Scrub Oaks Midstory

Scrub oak is a natural component of the longleaf pine ecosystem. Under normal historic conditions with frequent fire, it would be a minor component of the longleaf pine ecosystem with a patchy distribution and generally limited to the understory. However, absent fire for long periods, scrub oak may become a major component of the forest and diminish many of the values of a longleaf pine ecosystem.

Many sites have a common history of pine harvesting followed by fire reduction or exclusion. These conditions have promoted the only significant non-pine midstory species on many sites at Carolina Sandhills NWR: the turkey oak (*Quercus laevis*). In addition to fire, chemical treatments can be effective in minimizing turkey oak dominance where the absence of pine-fuels and fire has created conditions that suppress the herbaceous ground cover. Absent the longleaf pine and its associated ground cover, many sites are effectively fire-proofed since there is little fuel to carry a fire. Although the extent of turkey oak barrens are much greater today than was possible within a fire-maintained ecosystem, the areas represent a disturbance response that has always been an element in the longleaf pine sandhills

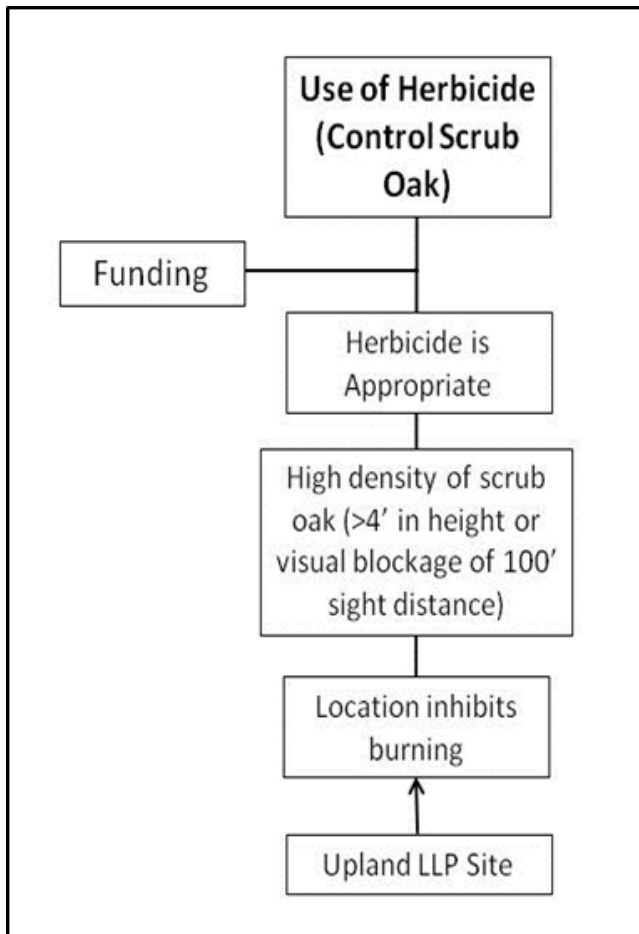
ecosystem. Within these barrens, as longleaf pine again becomes established, pine fuels modify the site's fire behavior and enhance herbaceous recovery. However, once the turkey oak is well established, the associated herbaceous plants are subject to heavy competition for moisture, nutrients and sunlight, and many herbaceous species become scattered or non-existent.

In addition to direct resource competition, turkey oak may also compete with herbaceous vegetation through smothering actions of leaf accumulations that may occur because of the leaf's physical characteristics coupled with the effects of wind. Few herbaceous plants are capable of reestablishment in those areas even where adequate seed sources exist. Numerous factors may affect this condition, including low moisture that precludes germination, as well as direct and reflected solar energy that may desiccate most young plants. One of the few species that can reestablish in these barrens is the longleaf pine itself. As it slowly becomes reestablished, the physical characteristics of the pine needles may begin to prevent the ground movement of turkey oak leaves and thereby may begin to reverse the described effects by slowly enhancing the site's ability to carry fire and reduce turkey oak dominance. Whether by prescribed fire, mechanical, or chemical treatment, herbaceous recovery is a primary management objective.

Following are management strategies to reduce the scrub oak component with longleaf pine stands:

- Conduct growing season Rx burns at a fire return interval between 1-3 years.
- Maintain longleaf pine basal area to allow sufficient needle fall and ground cover community for fine fuels that allow frequent fire to occur.
- Where fire is not practical (safety, absence of fuel, wildland urban interface concerns, dbh of oaks > 3in., etc.), utilize herbicide and/or a combination of mechanical/herbicide to control scrub oaks (Figure 25).

Figure 25. Conditions that Warrant Use of Herbicides to Control Scrub Oak at Carolina Sandhills NWR

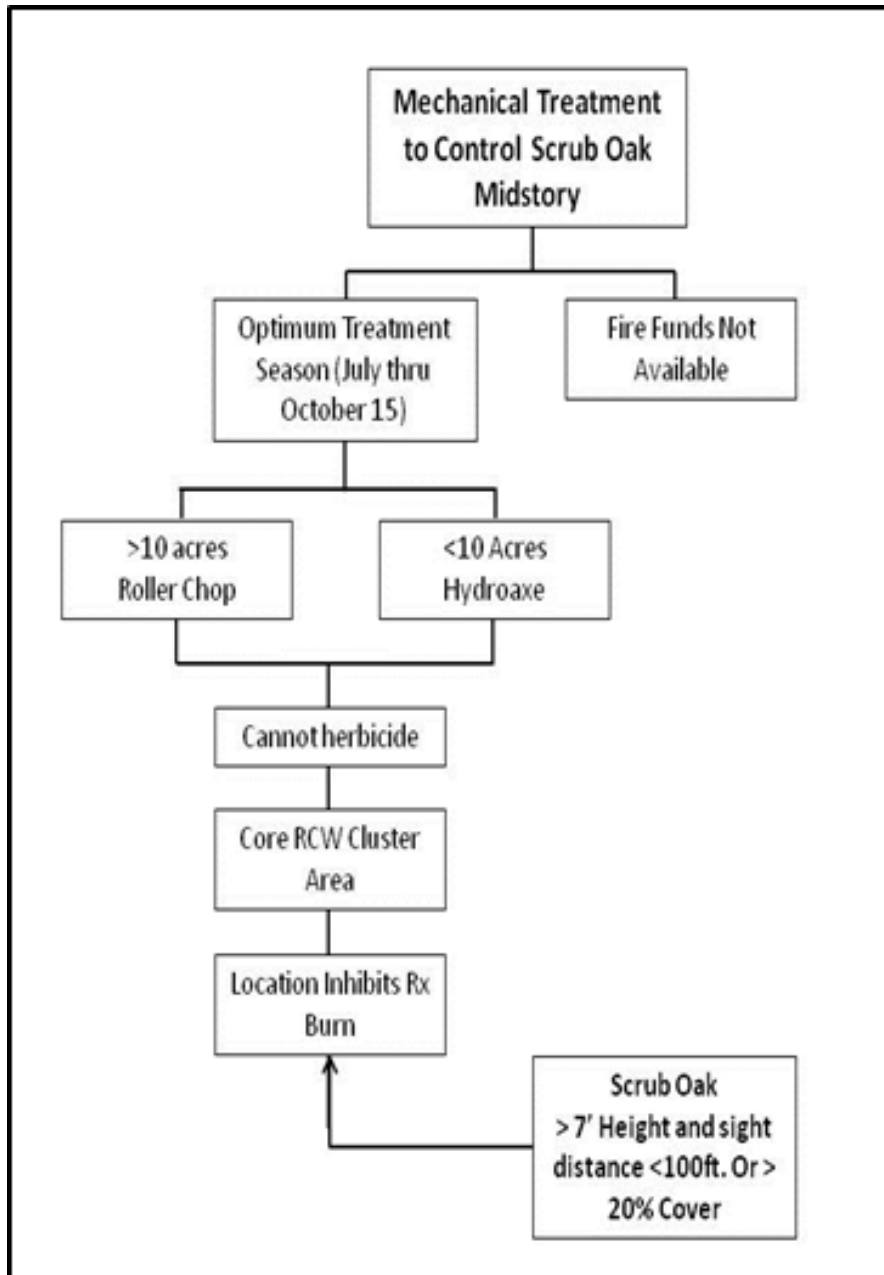


Herbicide selection should conform to the following conditions:

- Herbicides will be applied according to label directions after approval of Pesticide Use Proposals (PUPs) and appropriate Section 7 consultation.
- Selected herbicide is target-specific, with little impact to longleaf pine.
- Herbicide poses no threat to aquatic organisms, reptiles or amphibians.
- Where either Rx Fire or Herbicide control of scrub oak is not practical or feasible, evaluate the use of mechanical control (Figure 26).
- Important to note that mechanical controls are a “stopgap” measure that often significantly deteriorates a site’s fire response and thereby adversely affect native ground flora expansion over the longer view as vigorous re-sprouting and ground fuel modifications often do not enhance fire behavior. Additionally roller chopping can disperse clump grasses which can lead to positive ground cover outcomes provided the invasive lovegrass is not part of the replanting

outcomes, thus each site must be individually evaluated to determine the appropriate treatment.

Figure 26. Criteria to Evaluate Use of Mechanical Thinning of Scrub Oak at Carolina Sandhills NWR



EMBEDDED WETLANDS

Mesic forests and their associated unique plant communities are an integral component of the longleaf pine ecosystem. Many unique and rare plants occur within these hydric/mesic forests. Because fire has shaped the wetland areas embedded in the longleaf pine/wiregrass forest matrix, such as seepage bogs, canebrakes, Atlantic white cedar, and pocosins, it is the main management strategy for embedded wetlands. Frequent fires prune back woody shrubs and maintain herbaceous bog communities along the ecotone from uplands to depressional wetlands (Noss and Harris 1990, Means 1996, Drewa et al. 2002, Kirkman 1995).

Strategy 7: Evaluate wetland impoundments for restoration potential back to mesic forest or pocosins.

Where appropriate, open water control structures to allow free-flow of water for several years to determine vegetation response. If desirable response is achieved, remove dikes and water control structures. Evaluation criteria:

- Perimeter to Area ratio. Impoundments with a very high perimeter to area ratio are generally a narrow linear shape having less value to birds.
- Degree of Isolation. Isolated wetlands are utilized by fewer species than are wetland complexes.
- Area. Wetlands of greater size will have more value to wetland dependent birds.
- Bathymetry. Wetlands with water depths that persist throughout the year will have greater value to fisheries.
- Accessibility for Public-Use.

The below impoundments meet the above criteria. As funding and opportunities arise, restore the following impoundments back to a pocosin wetland community.

- Pool F (2.33 ac.)
- Oxpen 2 (0.87 ac.)
- Hamburg (0.62 ac.)
- Upper Triple (3.62 ac.)
- Middle Triple (1.88 ac.)

Strategy 8: Utilize periodic fire to manage embedded wetlands.

From Forest and Fire Review (2007):

“Wetland associated species appear to have encroached upslope from lower-lying refugia. Continue using fire to “push” (re-establish) this wetland-upland ecotone back down the moisture-slope gradient from which they spread. Increase fire frequency and severity along these edges. 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. 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. 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 re-establish ecotones along the edges of drains. This may restore seeps along the edges of the drains.”

Unique Seepage Bog Community

The ecologically unique Oxpen seepage bog is potentially threatened from adjacent exotic (non-native) plants, especially *Eragrostis curvula* (weeping lovegrass) that may expand and invade the bog site and/or generate extreme fire behavior such that future ability to continue managing with fire is jeopardized. Control weeping lovegrass throughout the Oxpen site, especially adjacent to the seepage bog using appropriate herbicides. An important wildlife species using the bog is the Pine Barrens Treefrog. This species requires small woody vegetation for calling posts. Thus, an important management consideration is to maintain a small woody vegetation component within the bog, but also not allow woody vegetation to overtake and dominate the bog. Thus, a prescribed burning program with a fire return interval of 2-4 years is needed to control, and allow for a small woody component within the bog.

- Monitor bog herb and shrub response and recovery following burning. Thereafter, continue regular, short interval (1-2 year) prescribed burning, preferably at different times during the growing season to control shrub encroachment.

RED-COCKADED WOODPECKER

Red-cockaded woodpeckers are integrally tied to the savannah-like conditions provided within a high quality longleaf pine ecosystem. Longleaf pine provides nesting, foraging, and roosting habitat for red-cockaded woodpeckers. Thus, managing for a quality longleaf pine ecosystem is also management for red-cockaded woodpeckers. Much like the longleaf pine/wiregrass ecosystem, there would be no RCWs if there is no fire, either natural or prescribed burning. Lack of fire in this system promotes hardwood midstory encroachment (Barrett and Downs 1943, Harcombe et al. 1993), which causes RCWs to abandon clusters (Loeb et al. 1992, Masters et al. 1995) and degrades foraging habitat (James et al. 1997, Walters et al. 2000, 2002). Management strategies for RCWs are thus focused on longleaf pine management and ensuring adequate nest cavity availability (Figure 27).

Management Strategies:

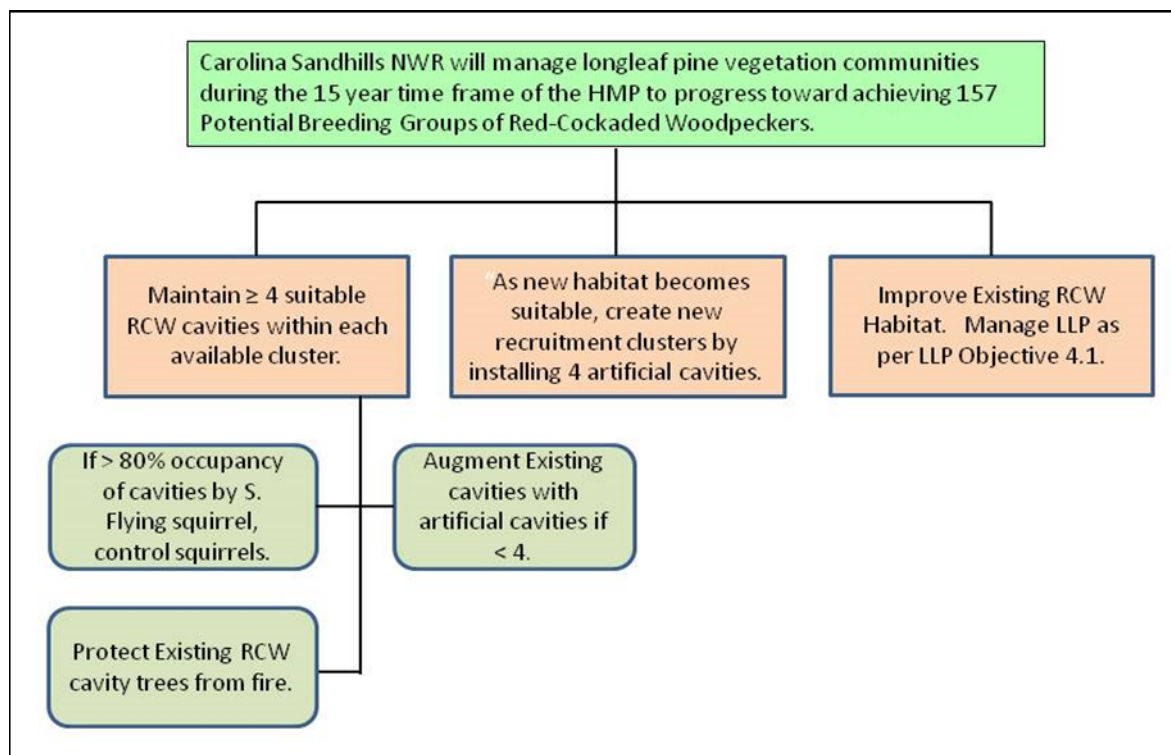
Manage longleaf pine (Strategies 1-6) to mimic historic natural conditions throughout the refuge, providing sufficient RCW habitat to meet the needs of 177 clusters that support 157 potential breeding groups.

Strategy 9: Cluster and cavity tree maintenance.

- Follow Red-Cockaded Woodpecker Recovery Plan for guidelines on management of clusters and cavity trees. Maintain a minimum of 4 suitable cavities within each RCW cluster.
- If suitable cavities within a cluster decline to less than 4, augment cavities by installation of artificial cavities.

- If cavity competitors utilize > 80% of available cavities within a cluster, control competitors.
- Maintain snags as alternative sites for cavity competitors.
- Protect cavity trees from fire through use of winter burns to reduce heavy fuel loads, and raking fuel (5' – 15') from around cavity trees.
- Use roller chopping and hydro-axing (large-scale mulching) to remove scrub oak encroachment within and around red-cockaded woodpecker cluster sites where prescribed fire and chemical control is not feasible.

Figure 27. Red-cockaded Woodpecker Management Strategies



Strategy 10: Population growth.

As opportunities arise and plantations mature, install recruitment clusters with 4 suitable nesting cavities to achieve the goal of 177 clusters.

HABITAT MANAGEMENT FOR OTHER RESOURCES

QUALITY PUBLIC-USE OPPORTUNITIES

While providing Quality Public-Use Opportunities is not a resource of concern for the refuge, managing habitats to provide quality wildlife-dependent recreational opportunities to the visiting public helps the refuge meet one of its establishing purposes. Refuge visitors often expect to observe a variety of wildlife at a NWR, and/or are permitted to partake in consumptive recreational activities such as hunting and fishing. To provide wildlife diversity for the visiting public to view, the refuge has maintained several small wetland

impoundments and early successional openings. These areas attract waterfowl, shorebirds, wild turkeys and other wildlife that refuge visitors expect to observe on the refuge. Additionally, wetlands that are conducive to maintaining fish populations allow for public fishing opportunities, while small early successional openings are used by hunters. Impoundments and field openings comprise less than 1% of the refuge. The refuge does not make any significant contribution toward populations of shorebirds, waterfowl, or other species that use these areas of the refuge. Thus, there is little conflict with the resources of concern identified in this HMP for providing compatible wildlife-dependent recreation using habitat management techniques such as water-level manipulation, planting, mowing, or discing, provided habitat fragmentation of the longleaf pine ecosystem is avoided.

WETLAND IMPOUNDMENTS

Objective 4: *During the 15 year time span of the HMP, continue to provide the "Big 6" recreational opportunities for refuge visitors to both view wetland dependent wildlife, and provide fishing opportunities within appropriate wetland impoundments, by maintaining quality habitat for both wetland wildlife and fish populations within impoundments conducive to each.*

Rationale: The refuge currently maintains 28 wetland impoundments where water levels can be actively managed. Differences in physical features of these impoundments allow some to be more conducive to management for different resources of concern. Thus some impoundments are capable of providing good fishing opportunities, while other impoundments may support greater numbers of migrating/wintering waterfowl, shorebirds, wading birds, and other guilds of wildlife. The majority of these impoundments are accessible to refuge visitors who have come to anticipate increased wildlife viewing opportunities near the impoundments, and/or fishing opportunities. Thus, the majority of these impoundments will be managed for the purpose of providing quality recreational opportunities to refuge visitors. However, there are several impoundments that are not conducive to public-use and also do not provide significant benefits toward wildlife resources of concern, thus criteria will be established to clearly identify these impoundments and then restore them to natural wetland communities.

GRASSLAND AND FOREST OPENINGS

Objective 5: *During the 15 year time span of the HMP, continue to provide "Big 6" recreational opportunities for refuge visitors to both view upland wildlife dependent upon grassland and small forest openings, as well as, enhance refuge upland game hunting experience, by maintaining small forest openings, grassland/seepage bog community, and 240 acres of planted food crops..*

Rationale: Similar to wetland impoundments, the refuge manages 1,200 acres of grasslands and small wildlife clearings ranging in size from 1 acre to approximately 100 acres. These openings attract a diversity of wildlife species that are available for viewing by the visiting public, who have come to expect to see different wildlife species at these locations. In addition, these fields combined with the pine uplands provide public hunting opportunities.

HABITAT MANAGEMENT STRATEGIES FOR OTHER RESOURCES

WETLAND IMPOUNDMENT MANAGEMENT

Refuge wetland impoundments will be evaluated and ranked for their potential contribution toward wetland wildlife, using criteria identified in Strategies for objective 5 above. Additional criteria of reliability of water supply, water depth, and ability to provide appropriate hydrology to meet life history requirements of selected fish species, will be used to determine which impoundments are best suited for fishery management (Figure 28). This evaluation process will result in impoundments being inserted into 1 of 3 categories:

- Impoundments maintained and managed for wetland wildlife.
- Impoundments managed for fish populations and recreational fishing.
- Impoundments to be restored to hydric/mesic forest or pocosin communities.

Management Strategies for wetland dependent wildlife:

The dynamic nature of water levels within a wetland provides habitat for a variety of wildlife during the annual wetland cycle. Shorebirds will use mudflats and shallow water areas during periods of drying and receding water levels at certain times of the year, coinciding with shorebird migration chronology. As water levels in a wetland are receding, invertebrate, fish and amphibian resources are often concentrated within small remnant pools within a wetland, thus providing high quality feeding habitat for wading birds. Additionally, as wetland bottoms are exposed to air, emergent wetland vegetation will germinate and mature during the growing season. When reflooded near the end of the growing season, emergent plant communities will provide quality food resources for migrating and wintering waterfowl. Furthermore, as wetland bottoms are exposed to air during the summer, oxidation and decomposition of organic matter will occur, thus returning nutrients to the soil resulting in increased productivity within the wetland.

Strategy 11: Shorebirds

- Evaluate bathymetry within impoundments for those units that have very gradually sloped bottoms and are greater than approximately 5 acres in size, as impoundments that can contribute to migrating shorebird habitat.
- At selected impoundments, gradually drawdown the impoundments beginning approximately 4-5 weeks prior to peak fall shorebird migration. Attempt to maintain shallow depths (<10cm), and a wet mud to water interface (Figure 29) during the duration of the drawdown.

Strategy 12: Migrating and Wintering Waterfowl

- Conduct slow drawdowns within impoundments during early, mid, or late growing season dependent upon desired moist soil vegetation response. Different moist soil vegetation species will germinate at different times, depending upon soil temperature and soil moisture content.
- Impoundments that are targeted for fall migrating shorebird use, may also be managed for spring migrating waterfowl by conducting a partial drawdown to optimize feeding depths at that time of year (Figure 29)

- Monitor impoundments for encroachment of any invasive species.
- Begin reflooding impoundments to coincide with arrival of targeted waterfowl species. Reflood some units to coincide with arrival of blue-winged teal, while other impoundments may be reflooded later in fall.
- All impoundments that have been subjected to a drawdown should be reflooded prior to date of first frost, allowing reptiles and amphibians sufficient time to locate winter refugia. Additionally, a number of important invertebrates that support wetland food chains must lay eggs on the water surface prior to first frost.

Strategy 13: Wood Ducks

- Manage for optimum brood rearing and roosting habitat for wood ducks within impoundments that provide water depths >12" with overhead emergent cover. Examples of wetland vegetation species that provide quality wood duck cover include arrow arum (*Peltandra virginica*) and buttonbush (*Cephalanthus occidentalis*) or flooded timber areas with a shrub layer.
- If managing buttonbush swamps for wood ducks, the buttonbush should periodically be subjected to a couple year droughts in order to rejuvenate the stand. If subjected to many years of constant flooding, a buttonbush stand will begin to experience high mortality without any regeneration, as regeneration occurs during drought cycles.
- If conducive, entire impoundments may be managed to provide wood duck brood habitat or fall roosting habitat. Alternatively, the upper portions of some impoundments may be managed for wood ducks, while the lower portions are managed for shorebirds or migrating/wintering waterfowl.
- Maintain approximately 12" or more water depths within brood habitat until time of fledging, while fall roost habitat should be reflooded in late August or September when wood ducks begin congregating at roost sites.
- Impoundments that are steep sided, > 5acres, and have a permanent water source to maintain water levels year around will be conducive for fisheries management and public fishing.
- If non-native species are dominant within an impoundment, the fishery will need to be reclaimed using an approved pesticide.
- Stocking of native fish with appropriate ratios of forage and predatory fish may be necessary, dependent upon current fish populations that are present.
- Dependent upon species of native fish present, water levels may need to be maintained during critical spawning period, so as not to expose spawning beds.
- Public access and facilities will be maintained for recreational fishing.

Figure 28. Impoundment Management Strategies at Carolina Sandhills NWR

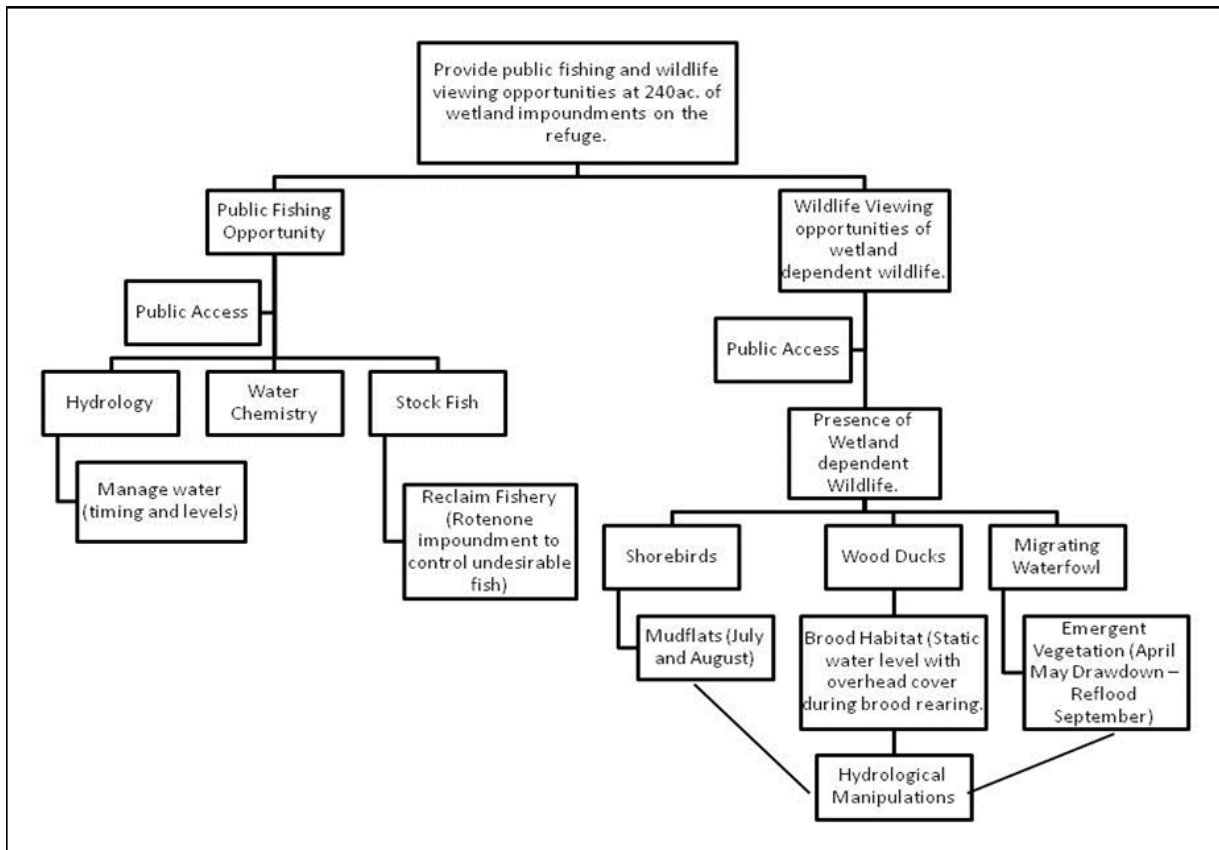
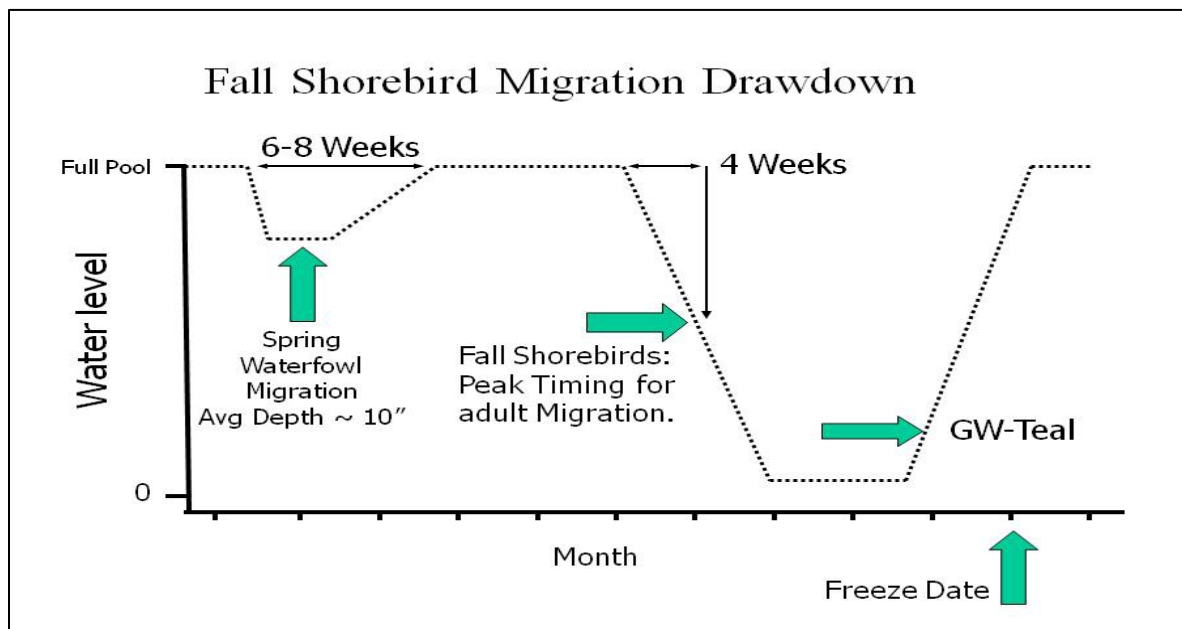


Figure 29. Impoundment Water Regime to Provide Habitat for Shorebirds and Waterfowl During the Annual Cycle at Carolina Sandhills NWR



GRASSLAND AND FOREST OPENINGS MANAGEMENT

Refuge visitors anticipate the opportunity to view many species of wildlife, rare or unique plant communities, and have a high quality hunting experiences when they visit Carolina Sandhills NWR. To promote a quality visitor experience, the refuge restores and/or maintains a number of small wildlife openings, planted food plots, and unique plant communities.

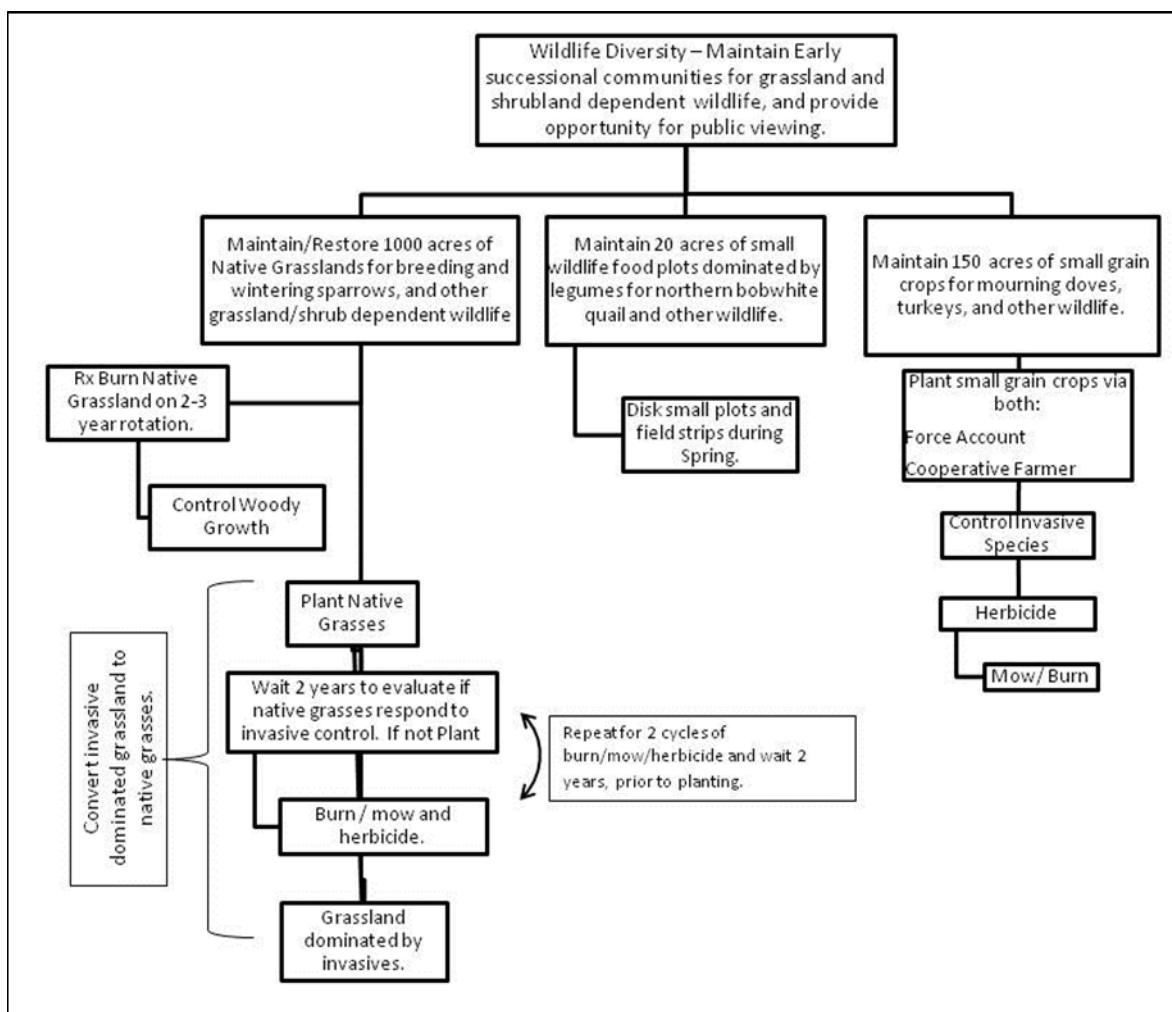
Management Strategies:

Strategy 14: Native Grasslands and Small Forest Openings

- Control invasive plants within grasslands prior to planting of native grasses or other manipulations.
- Restore and maintain native warm season grasslands and on existing non-forested sites on the refuge as appropriate.
- Careful preparation of the opening is necessary before attempting to plant native seed. This preparation includes prescribed burning, mowing, and use of herbicides during the growing season (Figure 30).
- The dormant seedbed at some sites could be sufficient to populate the opening if non-native species are reduced and/or eliminated to decrease competition. Another consideration is the source of native seed. At present, native seed from east of the Mississippi River, and more specifically, South Carolina, is either too expensive, non-existent and/or is not suited for our soils. The refuge is a partner in the South Carolina Partners for the Restoration of Native Plant Communities, coordinated by Clemson University Extension and the U. S. Forest Service. Currently, the refuge has collected and donated seed from native species such as little bluestem (*Schizachyrium scoparium*), goat's rue (*Tephrosia virginiana*), and blazing star (*Liatris graminifolia*) for the project's common garden experiments to determine the most efficient and economical way to harvest seeds and establish plugs for restoration.
- Use Rx burning with a return interval of 2-4 years, to control woody vegetation encroachment into grasslands.
- Where Rx burning is not feasible, use late growing season mowing to control small woody vegetation.
- Set back succession within small wildlife openings by disking openings on a 3 year rotation.
- Control invasive plants within small wildlife openings, using either mechanical or chemical treatments as appropriate.
- Plant approximately 50 acres of sunflowers and/or browntop millet in the dove fields on an annual basis.

- Maintain approximately 20 acres in wildlife food plots dominated by legumes.
- Utilize cooperative farming or force account to plant annually approximately 150 acres of browntop millet or other wildlife food crop as appropriate. If the opportunity occurs, transition cooperative farm fields into native warm season grasses (NWSG).
- If during the timeframe of the HMP the cooperative farmer wishes to terminate participation in the program, the refuge will evaluate options to continue plantings using force account, or to restore the acreage to forested habitat.

Figure 30. Management of Early Successional Communities at Carolina Sandhills NWR



MANAGEMENT STRATEGY COMMON TO ALL REFUGE HABITAT OBJECTIVES

INVASIVE SPECIES

The presence of invasive, non-native and nuisance plant species can alter the function of ecosystems due to the loss of wildlife habitat, displacement of native species, change in carrying capacity from reducing native forage production, lower plant diversity, increased soil erosion, and changes in fuel loads that affect fire intensity. These negative effects decrease the biological integrity, diversity, and environmental health of the refuge. Therefore, they require a management strategy that will control, and if possible, eradicate the exotic species.

Seven invasive species have the potential to affect significantly the biological integrity of the refuge: weeping lovegrass, shrub lespedeza, black bamboo, Johnsongrass, tall fescue, bahiagrass, and tree of heaven.

The refuge began planting weeping lovegrass in 1942, mainly for erosion control and forage. Many of the managed wildlife openings have at least some weeping lovegrass and there are some openings where weeping lovegrass is dominant. In a few of these openings, weeping lovegrass has begun to invade the surrounding forest stands. It has also become established in some of the firebreaks. As it creeps into the stands, it competes with native plants and alters fire intensity. Shrub (bicolor) lespedeza was introduced to the United States in the 1800s and began being promoted for wildlife food and erosion control in the 1900s. This species typically occurs in roadside ditches and managed openings on the refuge. Other non-native grass species such as Johnsongrass, tall fescue, and bahiagrass, are the remnants of old agricultural lands converted into wildlife openings. The black bamboo patch along the northern bank of Rogers Branch Creek drainage where it intersects with SC Highway 145 is the remnants from an old homestead and nursery. While weeping lovegrass, shrub lespedeza, tall fescue, bahiagrass, and Johnsongrass are in several locations on the refuge, mainly in the managed wildlife openings, the black bamboo patch is restricted to the streamside zone in only one location; the patch has grown from six acres in 2002 to eight acres in 2010. Tree of heaven is a fast-growing tree and prolific seeder, replacing native plants and creating dense thickets.

Management Strategies

Chemical herbicides will be used primarily to supplement, rather than as a substitute for, practical damage control measures, such as thorough cleaning of equipment before moving to a new location. Whenever a chemical is needed, the most narrowly specific herbicide available for the target organism in question should be chosen along with the most effective and safest way of applying it, unless consideration of persistence or other hazards would preclude that choice (7 RM 14). All chemicals will be approved through the Pesticide Use Proposal process and will follow Integrated Pest Management Policy (569 FW 1).

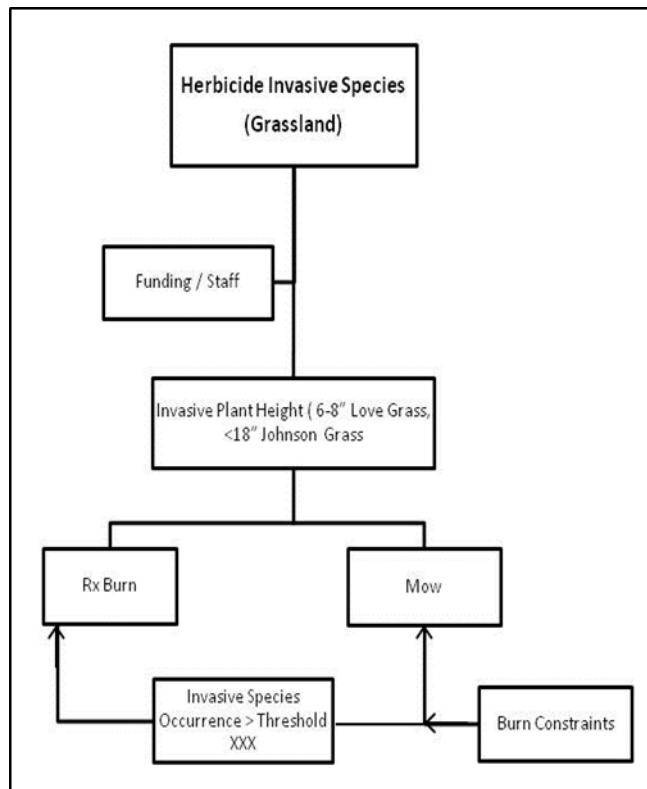
Strategy 15: GPS all areas of infestation by invasives; update annually.

Strategy 16: Burning, Mowing, and Bushhogging/Hydroaxing then Herbicides.

- After burning or mowing, treat with appropriate herbicides weeping lovegrass, shrub lespedeza, tall fescue, bahiagrass, and Johnsongrass when new growth is approximately 6" in length (Figure 31).

- Treat tree of heaven with appropriate herbicides using basal sprays where it is found on the refuge.
- Use repeated bush hogging/hydroaxing to eliminate the black bamboo patch along Highway 145; explore the use of complementary herbicides in conjunction with bush hogging/hydroaxing.

Figure 31. Herbicide Control of Selected Invasive Plants within Grasslands at Carolina Sandhills NWR



Strategy 17: Cleaning equipment.

- Clean all refuge heavy equipment before moving to a new site.
- Clean all contractor heavy equipment before and after working on the refuge.

MANAGEMENT UNIT PRESCRIPTIONS

As stated earlier, specific locations and associated management actions to achieve refuge habitat objectives within a management unit are not provided within this plan. Management of each unit is dependent on information gathered through monitoring and staff expertise and is prescribed on an annual basis. Therefore, providing specific prescriptions by unit extending into the 15 year life of this HMP is not useful. Provided in Appendix D.1 is a sample of the Annual Prescription utilized at Carolina Sandhills NWR. Annual Prescriptions will incorporate the appropriate management strategies discussed throughout this HMP.

MONITORING NEEDS TO INFORM REFUGE MANAGEMENT DECISIONS

An effective inventory and monitoring (I&M) program is critical to the success of habitat management actions to achieve station objectives. Existing conditions at each site are the result of a varying set of disturbance histories that must be considered to determine appropriate management / restoration actions. Due to the often uncertain response of complex ecological systems to management, the variety of silvicultural actions that may be implemented to alter a forest stand, and uncertain wildlife response to management, monitoring system response to treatments is critical to the learning process and a major component of the longleaf pine LMRD initiative at the refuge. The refuge's I&M Program will serve the following functions:

- Identify status of important attributes of refuge objectives. Results of these monitoring efforts will be compared to threshold values of the same attributes (identified within means objectives) to determine when/if a management strategy should be implemented.
- This comparison to determine when a management action should be conducted also allows refuge management decisions to be transparent. Thus, stakeholders will understand how and why refuge management decisions are made, which often reduces controversy.
- Evaluate the status of refuge habitat and wildlife objectives to determine the extent that refuge objectives have been achieved.
- Evaluate the response of vegetation communities and wildlife to refuge management strategies, for the purpose of improving the efficiency, effectiveness, or identification of new or modified strategies.
- Monitor the status of important components of refuge ecosystems over time to identify any changes that may require a refuge management response.

A refuge Inventory and Monitoring Plan will be developed to address the above monitoring needs. Sample designs and survey protocols within the plan must be efficient, allow for fast and easy data collection, and most importantly, survey results must represent the true population parameter within specified limits identified by the refuge. In general, sample designs should be developed to answer management questions at the scale of a forest stand or management unit. As an example, "How does percent cover of scrub oak respond to fire at intervals of 2 years, versus a return interval of 4 years?", or "Does red-cockaded woodpecker reproductive fitness increase following a reduction of scrub oak height to less than xx ft?"

Refuge staff does not have sufficient time to monitor everything on the refuge that they may like to. It is therefore necessary to prioritize monitoring needs, with an emphasis on collecting information that is used to inform management decisions and evaluate the effectiveness and efficiency of refuge management actions at achieving stated objectives.

MANAGEMENT STRATEGY DOCUMENTS

NECESSARY RESOURCES

Implementation of this HMP will necessitate adequate staffing, equipment and supplies at the station. Full staffing and funding will allow the refuge to improve the longleaf pine ecosystem and habitat for those wildlife species associated with longleaf pine.

Consequences of inadequate staffing and funding will result in sub-optimal quality of the refuge's longleaf pine ecosystem, along with declines in the unique biological diversity that occurs in this ecosystem. Wildlife species that depend upon fire-maintained longleaf pine forest for their habitat, such as red-cockaded woodpecker, Bachman's sparrow, nightjars, and others would also be expected to decline.

Table 7. Habitat Management Staffing Needs at Carolina Sandhills NWR.

Position	Grade	Current Staff	Additional Staff
Project Leader	GS-485-13	1	
Deputy Project Leader	GS-0485-12	1	
Wildlife Biologist	GS-486-11	1	1
LMRD Biologist	GS-401-11		1
Forester	GS-460-11	1	1
Forestry Technicians	GS-462-4/5/6/7	1(Fire)	2
Fire Management Officer	GS-401-11	1	
Wildlife Refuge Specialist	GS-485-9	1	
Biological Technicians	GS-0404-4/5/6/7	1 (v)	1
GIS/Information Technology	GS-0401-9/11		1

Table 8. Habitat Management Project Funding Needs at Carolina Sandhills NWR

PROJECT NUMBER	PROJECT TITLE	FIRST YEAR COST (\$1,000)	RECURRING ANNUAL COST (\$1,000)	STAFF (Additional FTE'S)
1	Conduct Recovery Actions to achieve recovery for 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 flower 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	

DOCUMENTATION OF SPECIAL USES

SUP Cooperative Farming

- Each year when cooperative farming takes place on the refuge, a cooperative farming agreement, special use permit, PUP, Section 7, and other environmental compliance documents will be prepared. These documents will outline the farming activity, crops to be planted, acreage, fertilizer, pesticides, planting and harvest dates, etc.

Timber Harvest / Thinning

- Timber Harvests (including commercial thinning and salvage cuts) will be performed under approved Regional timber harvest guidelines, "Southeast Region Guidance – Forest Management Payment Processing and Exchanges on National Wildlife Refuges." (Appendix D.6)
- Upon awarding of bids to a commercial operator, a Special Use Permit will be prepared to outline payment schedule, any special conditions, or restraints pertaining to the harvest action (Appendix D.8).

Research

- Scientific research and collecting including researching, inventorying, monitoring, or scientific collecting by non-refuge personnel sponsored by academic institutions of natural resource agencies is permitted. All research proposals are reviewed and evaluated for nexus to refuge objectives before approval is given. If collecting is proposed, all applicable state and federal permits must be acquired before approval is granted, as well as animal welfare regulations by the sponsoring institution. 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. Special care is taken related to publicizing locations of rare or desirable species that poachers or collectors may illegally obtain for trade or profit. Refuge personnel routinely monitor progress and the permittee is required to submit an annual report, as well as a final report and copies of any resulting publications.

DOCUMENTATION OF COMPLIANCE

NEPA

- The Comprehensive Conservation Plan (CCP) for Carolina Sandhills NWR was approved in August 2010. The National Environmental Policy Act (NEPA) was followed and implemented during preparation of the CCP. During this process, the public had input into the CCP, and provided comment on the various alternatives identified and selected as the Preferred Alternative. All habitat management objectives and management strategies identified within this HMP were identified within NEPA documents for the refuge's CCP. This HMP simply identifies the details of how objectives within the CCP will be achieved, thus this HMP is in compliance with NEPA.

PUPS

- According to Service policy, any pesticide use on a NWR is subject to proper approval. The approval process requires the preparation of a Pesticide Use Proposal (PUP). Thus, during preparation of Annual Prescriptions as part of habitat management actions on the refuge, any actions that require the use of a pesticide will have a PUP submitted to the proper official for approval prior to application. This includes both the refuge's and cooperative farmer's use of pesticides.

Section 7

- The Endangered Species Act requires that when any action is undertaken that may impact a threatened or endangered species, a Intra-Service Section 7 Biological Consultation be completed and submitted to the Endangered Species Program for review and approval prior to implementation of the action (Appendix D.2 provides an example).

Clean Air and Water Acts

- The refuge is required to comply with the Federal Clean Air and Water Acts. The habitat management action that is most likely to be influenced by this Act is that of prescribed fire. During preparation of annual fire prescriptions, the refuge will identify under what conditions a prescribed fire will be permitted in order to comply with the Act.

Hazardous Fuels Management Prescriptions

- Service policy requires that a Hazardous Fuels Management Prescription be submitted and approved prior to conducting prescribed burns. The purpose of fire prescriptions are to identify under what conditions the burn is to be conducted, purpose of the burn, and to ensure that adequate staff and safety considerations are followed in conducting the burn.

Compatibility Determinations

- Service policy requires that a Compatibility Determination be completed for any proposed action on a refuge that may influence accomplishment of the purpose of the refuge itself. Refuge management actions themselves are exempt from having compatibility determination completed. Thus, the vast majority of habitat management actions identified within this HMP are exempt from that policy. However, economic actions are not exempt. Thus, both Cooperative Farming and any commercial timber operations as identified within this HMP must also have a compatibility determination completed and approved. The refuge CCP included compatibility determinations for these proposed activities. The re-evaluation date for these is 2020, within the period of the HMP. Appendix E provides a list of compatibility documents for designated uses at Carolina Sandhills NWR.

Cultural Resources

- To ensure the protection of cultural resources, the refuge shall review existing archaeological records for any proposed new ground disturbance area and conduct an on-the-ground evaluation. The refuge will consult with the Regional Archaeologist on all proposed new ground-disturbing projects.

CHAPTER VI. LITERATURE CITATIONS

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APPENDICES

APPENDIX A. RED-COCKADED WOODPECKER POPULATION GOAL ANALYSIS

SOUTHEAST REGION INTRA-SERVICE SECTION 7 BIOLOGICAL EVALUATION FORM

[Federally endangered, threatened, and candidate species]

[Note: This form provides the outline of information needed for intra-Service consultation. If additional space is needed, attach additional sheets, or set up this form to accommodate your responses.]

Originating Person: Allyne H. Askins, Refuge Manager
Telephone Number: 843/335-6023 **E-Mail:** allyne_askins@fws.gov
Date: 27 September 2013

PROJECT NAME (Grant Title/Number): Red-cockaded Woodpecker Population Goal Analysis in Conjunction with Habitat Management Planning at Carolina Sandhills National Wildlife Refuge

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
- ☒ Refuges/Wildlife

II. State/Agency: South Carolina / Division of Refuges

III. Station Name: Carolina Sandhills National Wildlife Refuge

IV. Description of Proposed Action (attach additional pages as needed):

Introduction: The Red-cockaded Woodpecker (RCW) population goal for Carolina Sandhills NWR was first published in the *RCW Recovery Plan Second Revision* (USFWS 2003). This goal was based on the highest number of active clusters that refuge lands could support. Ideally, the population goal is derived from three parameters: number of active clusters, proportion of solitary male groups, and proportion of captured clusters to calculate potential breeding groups (PBG). Because the refuge did not have sampling in place to provide data for these parameters, the total pine acreage (38,600) was divided by 200 (the standard territory size for each group of RCW). Thus, it was estimated that Carolina Sandhills NWR could support 193 active clusters. This method did not take into account transition zones from pine uplands to pine bottomlands, edge effects, and most importantly, habitat fragmentation.

In 2006, the refuge published a RCW Management Plan in accordance with the 2005 Ecological Services Memorandum “Implementation Procedures for Use of Foraging Habitat Guidelines and Analysis of Project Impacts under the Red-cockaded Woodpecker (*Picoides borealis*) Recovery Plan: *Second Revision*.” The refuge used geographically-based information (GIS) to partition territories based on habitat suitability and RCW occupancy. At that time, the refuge contained 156 total clusters with an average size of 193.9 acres. Analysis revealed that unoccupied habitats could support only an additional nine clusters, thus the refuge population goal was reduced from 193 to 165 potential clusters. While this goal was based on refuge-specific spatial data, it, too, only calculated the highest number of active clusters that the refuge could support.

During the planning process for the Habitat Management Plan (HMP), refuge staff calculated a refuge RCW recovery goal based on both biological and spatial parameters. We used reproductive and group status data from 2009-2012 to determine the number of PBGs that would likely occupy the total number of clusters the landscape could support. As with other populations where similar analyses were conducted, the number of active clusters is 1.1 times the number of PBGs. In addition, a more explicit approach was used in habitat partitioning as detailed below. The new goal identifies 177 total potential clusters capable of supporting 157 PBGs.

Partitioning Methodology

The following steps were used to identify and partition habitat:

1. We used GIS basemap NAIP Imagery for Chesterfield County, UTM Zone 17N NAD 83 with starting acreage of 45,926 (Figure A1).
2. Unsuitable habitat (fields, water bodies, private inholdings, facilities areas [office, helipad, maintenance areas, quarters, etc.], bottomland hardwood, upland hardwood, and scrub oak) was deleted.
3. Perennial streams were buffered 300 feet from center line as they are dominated by hardwoods and are not considered suitable RCW habitat. This distance was verified by overlaying the RCW cavity tree layer. Only one tree of 1,368 was located within this buffer zone.
4. Major roads and refuge trails intersecting the refuge were buffered and deleted in the following manner:
 - State Highway 145 and Angelus Road (two lane roads): 12’ lanes (two lanes) + 12’ shoulders (two shoulders) = 48’ width deleted where they transect the refuge.
 - State Highway 151 (four lanes with median): 10’ outside shoulder (two) + 4’ inside shoulder (two) + 12’ lanes (four) + 36’ median = 112’ width deleted where it transects the refuge.
 - Refuge trails (one and ½ lanes): 18’ (main lane) + 8’ shoulders (two) = 34’
5. Based on the guidelines on placement of recruitment clusters (USFWS 2003), forest stands of existing and/or potential foraging habitat were deleted if they:
 - Were separated by more than 200 feet from other existing and/or potential habitat
 - Were too small (< 200 acres) to support a cluster

- Were determined to be extremely difficult to manage due to location. (An example is the 16 stands totaling 328 acres that occur west of Highway 151 and adjacent to Lynches River. These stands are disconnected from other refuge lands).
6. The remaining habitat suitable for RCW nesting and foraging is 34,293 acres (Figure A2).

Partition Size and Placement

Site index, the relative measure of forest site quality based on the height (in feet) of the dominant trees at a specific age (typically 50 years), is used to determine the size for potential recruitment clusters (USFWS 2003). A forest with medium to high productivity (site index of 60 or more for dominant pine species) could provide each group of woodpeckers 120 acres of habitat. Conversely, a forest with low site productivity (site index below 60 for dominant pine species) would need more acreage for each group of woodpeckers (between 200-300 acres). Three data sources were used to determine site indices of potential recruitment clusters: Carolina Sandhills NWR Forest Management Plan (FMP, 1991), U.S. Geological Survey LiDar elevation data, and timber cruise data (2010-2012) for 2,000 acres of upland pine plantations.

The FMP determined site indices for Pine Bottomland (site index 80), Pine Hardwood (site index 70), and Pine Scrub oak (site index 50). The FMP described elevation as a determining factor for site index in pine stands, i.e., a site index of 50 at higher elevations and a site index of 60 at lower elevations. LiDar terrain data portrayed elevations ranged from 52 to 652 feet above sea level. The refuge forest stand data was overlaid on LiDar elevation data with a benchmark of 351 feet used to assess the site index of suitable stands. Pine stands were given a site index of 50 if the stand polygon was 75% located \geq 351 feet. Pine stands were given a site index of 60 if the stand polygon was over 25% located $<$ 351 feet (Figure A3). Finally, timber cruise data show that, on average, the trees are 50 feet tall at 50 years of age, indicating a site index of 50 for pine plantations. Based on these analyses, potential recruitment clusters should have at least 200 acres to support a PBG. This partition size is further supported by data from the 2012 breeding season where the average cluster acreage was 223 acres.

To assess where RCW recruitment clusters could be placed, existing cluster centers were calculated from triangulating all the RCW cavity trees assigned to a RCW group, including currently active, inactive, and historic trees (USFWS 2003). Cluster partitions are calculated by buffering the center point by a half-mile radius, then halving the overlap between clusters, if needed. In 2012, there were 166 cluster partitions (Figure A4). A full half-mile radius partition circle with no overlapping would equal approximately 500 acres. The following guidelines (USFWS 2003) were followed to identify potential recruitment clusters for the refuge:

- Cluster centers are located in longleaf stands at least 10 acres in size
- Cluster centers are between 0.25 and 1 mile from existing cluster centers
- Cluster partitions contain at least 200 acres of suitable and/or potentially suitable RCW habitat

- Cluster partitions do not reduce adjacent existing partition acreage below 200 acres unless that existing partition is already below 200 acres. In that case, the existing partition retains the original amount of acreage after the new partitions are created.

By applying these criteria and ground-truthing potential recruitment clusters, it was determined that the refuge could support 11 additional clusters for a total of 177 cluster areas (see Figure A5)

Population Data Analyses

Because of their cooperative breeding social system and their reliance on older, mature trees for nesting cavities, RCW populations are dynamic in terms of stable groups, captured clusters, new clusters budding from existing ones, single bird clusters, floater birds (birds that are maintaining a cavity but are not part of a group and do not defend any territory), and inactive (no RCWs are roosting in the cavity trees). Death of breeders, breeder females moving to breed in other clusters, clear-cutting on private land adjacent to protected public land, cavity competition, novel disturbances, and increased hardwood midstory can all cause fluctuations in RCW occupancy, including abandonment.

Group status data from 2009-2012 show these types of fluctuations including: PBGs ranging from 132 to 139; active clusters ranging from 150 to 153; inactive clusters ranging from 12 to 16; captured clusters ranging from 5 to 11; single bird clusters ranging from 1 to 2; and 4 floater clusters. The active cluster to PBG ratio averaged over the last four years equals 1.11, which is also the standard ratio identified within the *RCW Recovery Plan* (USFWS 2003). Multiplying the number of total clusters by this ratio will give the total number of PBGs the refuge will be able to sustain in consideration of population dynamics.

The equation is:

$$\begin{aligned} 177 \text{ clusters} \times 1.11 &= 196.47 \text{ (rounded off to twenty)} \\ 177 \text{ clusters} - 20 &= 157 \text{ PBGs} \end{aligned}$$

Carolina Sandhills NWR's RCW population goal is 157 PBGs managed in 177 cluster areas. This analysis increases the amount of clusters the refuge will manage from the previous goal of 165. It is important to note that this is a planning exercise and will guide habitat management decisions and prioritization during the lifespan of the HMP. However, when working with wild populations, species may establish new territories and groups that differ from those planned by biologists. Therefore, the population goal will be reviewed every five years to monitor actual growth as compared with predicted growth. Habitat partitions will be re-calculated every fifteen years during the HMP revision in response to changes in habitat and population dynamics.

Figure A1. Carolina Sandhills NWR Boundary Includes 45,926 Acres.

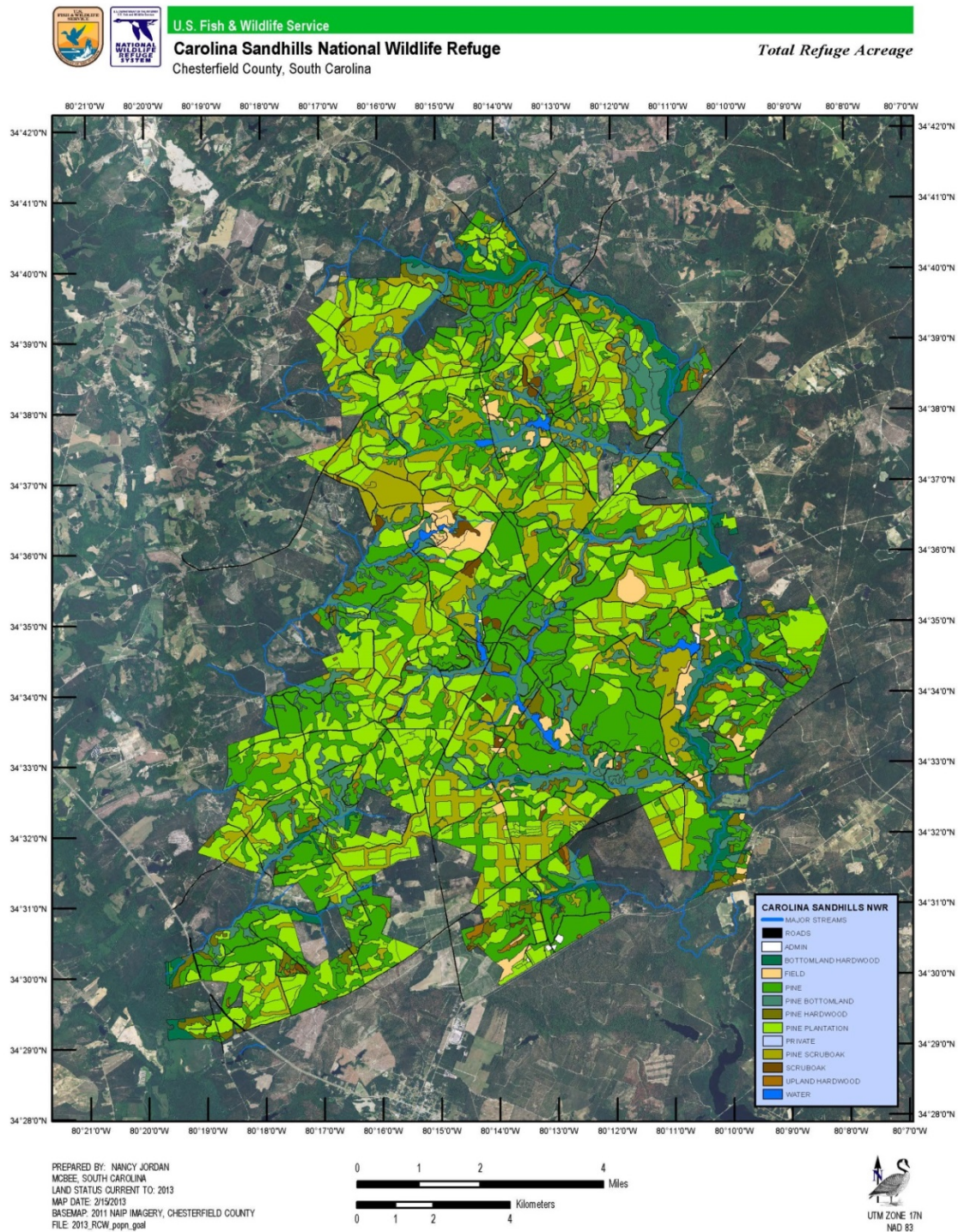


Figure A2. Carolina Sandhills NWR Suitable Habitat for RCW Nesting and Foraging include 34,293 Acres.

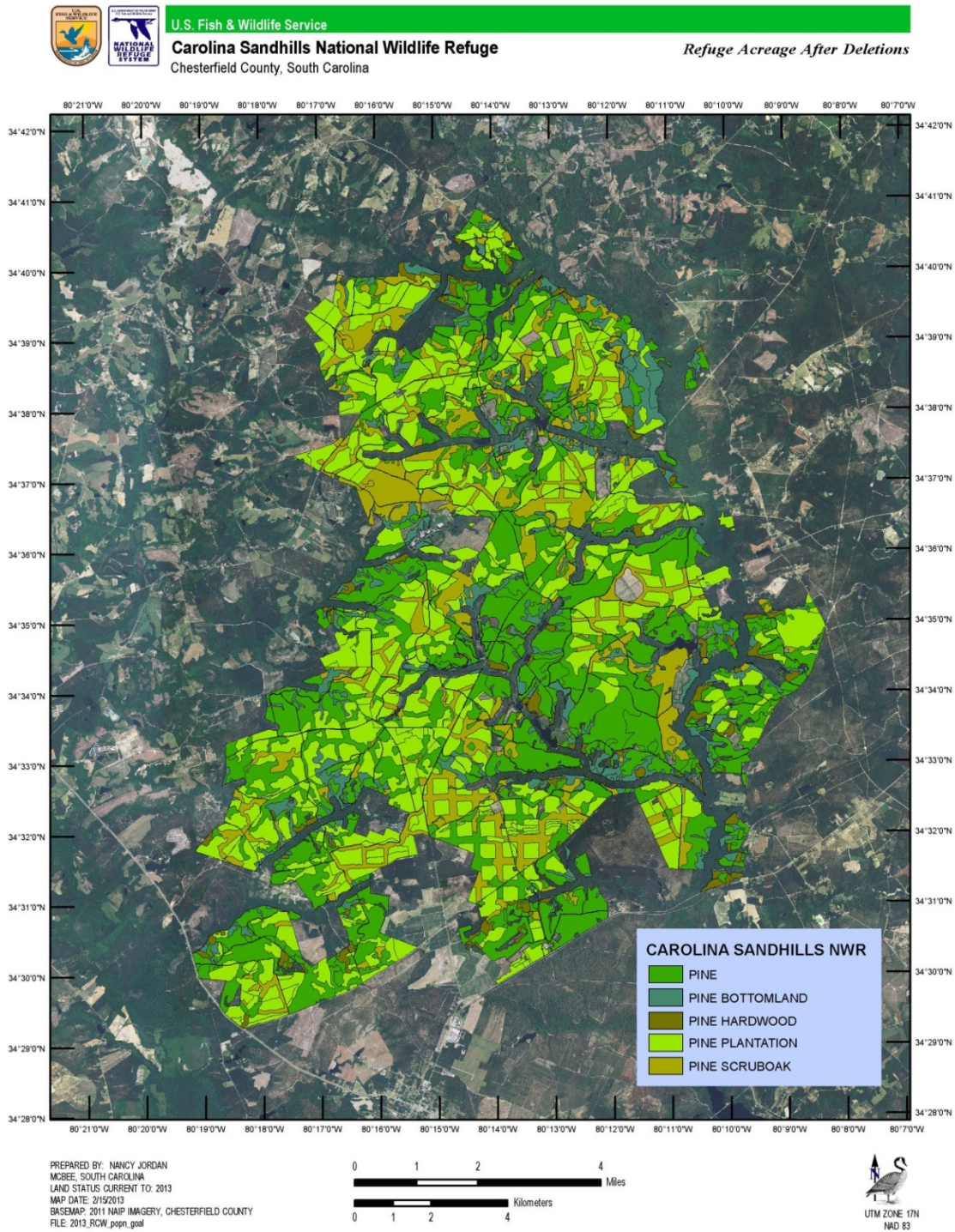


Figure A3. Carolina Sandhills NWR Site Index Analysis.

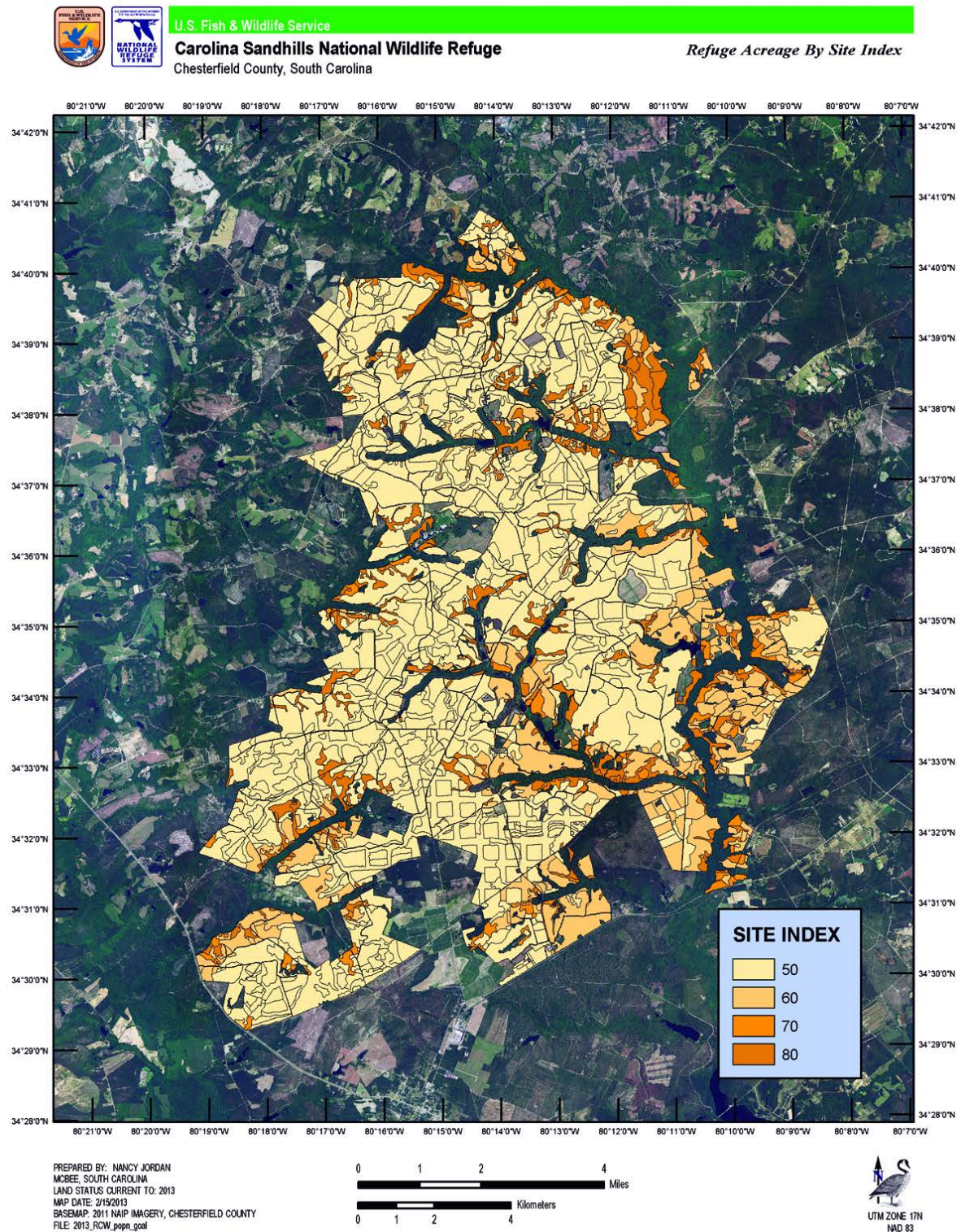


Figure A4. Existing RCW Cluster Partitions (2012) on Carolina Sandhills NWR.

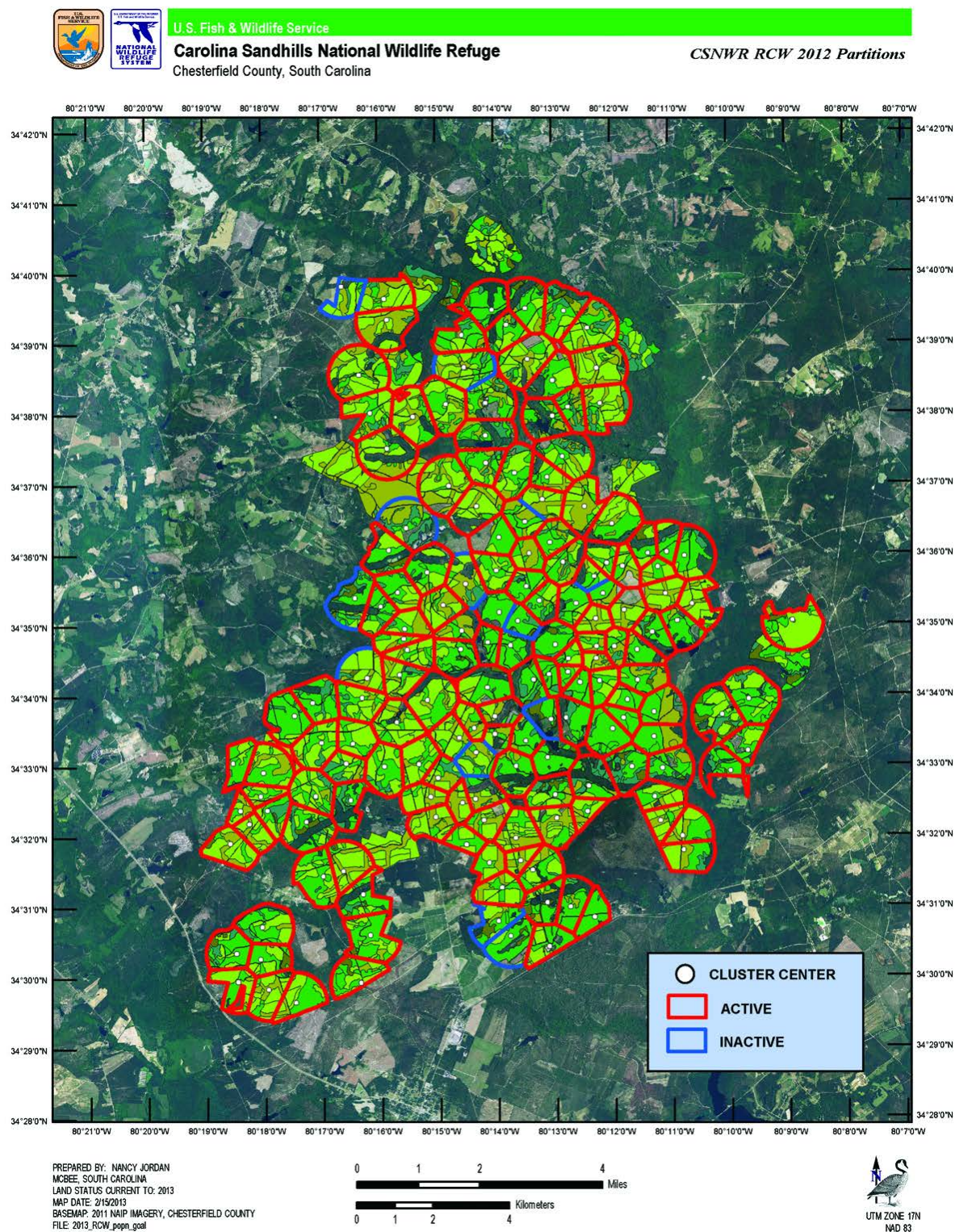
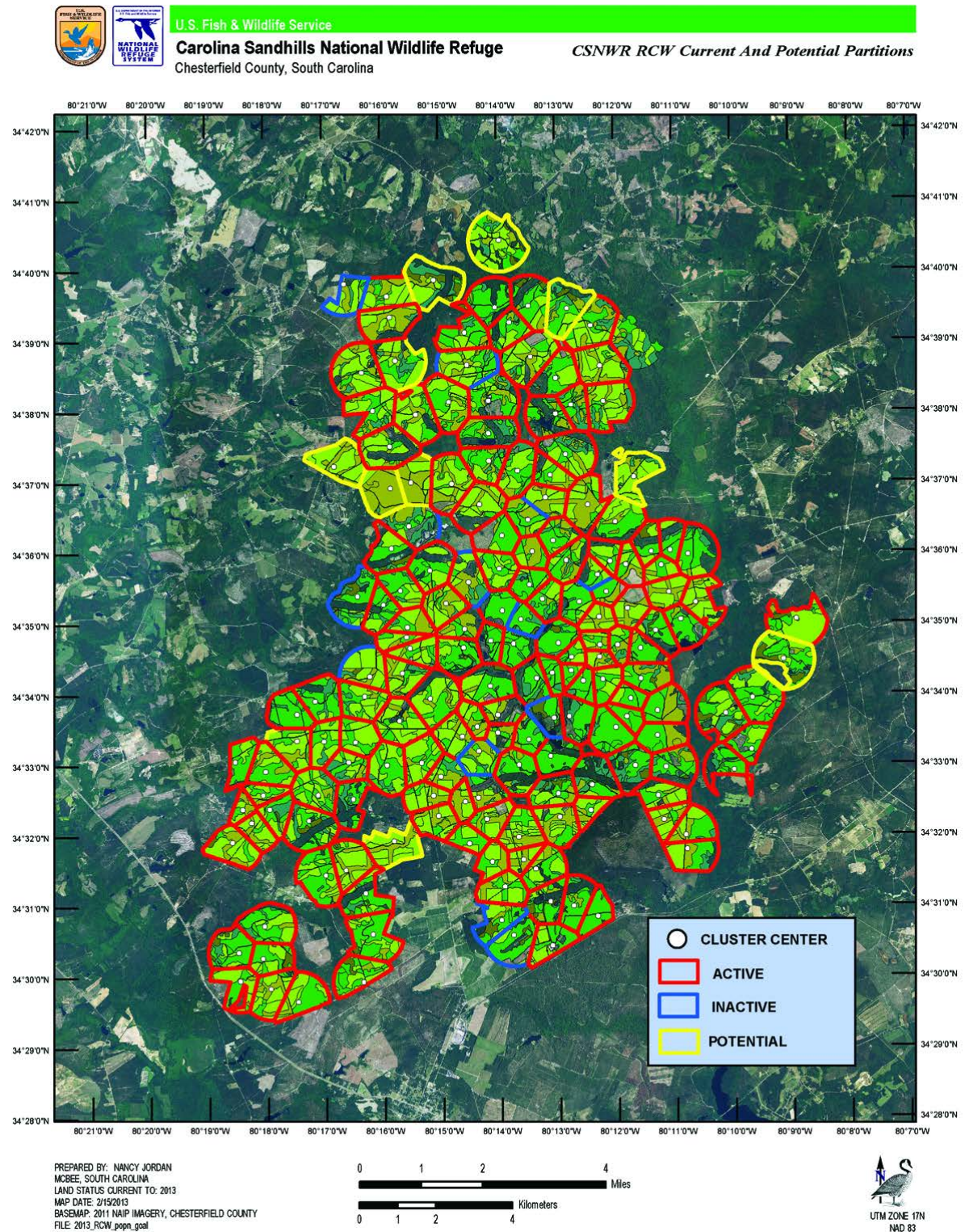


Figure A5. Final Spatial Configuration of Population Goal and Habitat Partitioning at Carolina Sandhills NWR.



V. Pertinent Species and Habitat:

A. Include species/habitat occurrence map (Figure A4)

B. Complete the following table:

Table 1. Listed/proposed species/critical habitat that occur or may occur within the project area:

SPECIES/CRITICAL HABITAT	STATUS¹
Red-cockaded Woodpecker (RCW)	Endangered

¹STATUS: E=endangered, T=threatened, PE=proposed endangered, PT=proposed threatened, CH=critical habitat, PCH=proposed critical habitat, C=candidate species

VI. Location (attach map):

- A. **Ecoregion Number and Name: Southeastern Plains (65c Sandhills), Savannah-Santee-Pee Dee River Watershed Ecosystem**
- B. **County and State: Chesterfield, SC**
- C. **Section, township, and range (or latitude and longitude): Latitude 34°31'-35' Longitude 80°12'-18'**
- D. **Distance (miles) and direction to nearest town: 4 miles east of McBee, SC**
- C. **Species/habitat occurrence:**
Red-cockaded Woodpecker; 34,293acres

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):**

Table 2. Project impacts to listed/proposed species/critical habitat.

SPECIES/ CRITICAL HABITAT	IMPACTS TO SPECIES/CRITICAL HABITAT
RCW	none

- B. **Explanation of actions to be implemented to reduce adverse effects:**

Table 3. Conservation measures proposed to minimize or eliminate adverse impacts to proposed/listed species, critical habitat.

SPECIES/ CRITICAL HABITAT	ACTIONS TO MINIMIZE IMPACTS
RCW	The population goal will be reviewed every five years to monitor actual growth as compared with predicted growth. Habitat partitions will be re-calculated every fifteen years during the HMP revision in response to changes in habitat and population dynamics.

VIII. Effect Determination and Response Requested:

Table 4. The effect determination and response requested for impacts to each proposed/listed species/critical habitat.

SPECIES/ CRITICAL HABITAT	DETERMINATION ¹			RESPONSE ¹ REQUESTED
	NE	NA	AA	
RCW	X			Concurrence

¹DETERMINATION/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".

March, 2005

/s/ Allyne H. Askins 9/27/13
Signature (originating station) date

Refuge Manager
Title

If the project description changes or incidental take exceeds that which has been exempted under section 9 of the Act, then the Ecological Services Field Office must be contacted.

IX. Reviewing Ecological Services Office Evaluation:

A. Concurrence X Non-concurrence _____

B. Formal consultation required _____

C. Conference required _____

D. Informal conference required _____

E. Remarks (attach additional pages as needed):

Thomas D. McCoy 09/30/2013
Signature date
Deputy Field Supervisor SCFO
Title office

APPENDIX B. SOILS

A detailed soil survey of Chesterfield County, South Carolina, including Carolina Sandhills National Wildlife Refuge, was completed by the Natural Resource Conservation Service (NRCS), U.S. Department of Agriculture, in 1989. Figure XX shows the location and percentage of soil types on the refuge. The following is a list and description of each soil series:

Ailey Series (0 to 6 percent slopes) consists of well drained soils that have thick sandy surface layers over a dense subsoil. These soils occur on rolling uplands. In a representative profile, the surface layer is dark grayish brown loamy sand. The subsoil is yellowish brown sandy clay loam. These gently sloping, well drained soils with a moderate thick sandy surface layer are slowly permeable and have a layer that inhibits root development. Water holding capacity is low. Native vegetation consists of longleaf pine, blackjack oak, bluejack oak, southern red oak, dogwood, and other hardwood associates. These better longleaf sites are nearly always located adjacent to streams.

Alpin Sand Series (0 to 6 percent slope) consists of excessively drained nearly level to strongly sloping soils. Typically, they have a thin dark gray fine sand surface layer and thin layers of light-yellowish-brown and pale brown fine sand to a depth of 54 inches. Between depths of 54 to 142 inches are layers of very pale brown and white fine sand containing lamella of yellowish-brown loamy fine sand. These sloping and strongly sloping, well drained soils have a moderately thick, sandy surface layer. Permeability is moderate to slow and water holding capacity is low. Soils are extremely droughty. Natural vegetation is longleaf pine and turkey oak with other common associates such as wiregrass, blackjack oak, bluejack oak and sand post oak. Over half of the Refuge land base is made up of the Alpin soil series.

Candor Sand Series (0 to 6 percent slopes) consists of nearly level to moderately steep, somewhat excessively drained soils on uplands. Typically these deep sandy soils have a grayish brown layer of sand ten inches thick over light yellowish brown sand to 21 inches. Yellowish-brown loamy sand from 21 to 34 inches is underlain by 22 inches of brownish yellow or very pale brown sand. From 56 to 80 inches is brownish yellow, strong brown and light red sandy loam and sandy clay loam with red and gray matters. These soils are droughty and rapidly permeable in the upper three feet. Native vegetation consists of longleaf pine and turkey oak with occasional loblolly pine.

Chewacla Silt Loam (0 to 2 percent slopes) are frequently flooded and consist of somewhat poorly drained soils on nearly level floodplains. Typically, they have brown loam surface layers about 8 inches thick with a subsoil 50 inches thick. Undrained, they are subject to frequent flooding during the winter and spring. Natural vegetation includes American sycamore, loblolly pine, sweetgum, yellow poplar (*Liriodendron tulipifera*), eastern cottonwood, green ash, and water oak.

Chewacla - Chastain Complex (0 to 2 percent slope) consists of somewhat poorly drained soils on nearly level flood plains which are frequently flooded. The Chastain Series (slopes less than 2 percent) consists of poorly drained, slowly permeable soils on flood plains of rivers in the coastal plain. These soils are undrained and are subject to frequent flooding. The water table is within 0.5 feet of the surface. Natural vegetation in the Chewacla Series

includes American sycamore, loblolly pine, sweetgum, red maple, and yellow poplar. Natural vegetation in the Chastain Series includes sweetgum and water oak. Emporia Loamy Sand (0 to 50 percent slopes) consists of very deep, well drained soils and are formed in loamy and clayey sediments. Typically, these soils have a pale brown loamy fine sand and fine sandy loam surface 15 inches thick. The subsoil from 15 to 57 inches is mottled yellowish-brown sandy clay loam and clay loam. Permeability is moderate or moderately rapid and water holding capacity is medium to high. Erosion hazard is low to high depending on the steepness of slope. Vegetation consists of longleaf pine, which is often replaced by loblolly pine, sweetgum, and southern red oak on less steep soils.

Bonneau Sand (1 to 6 percent slopes) consists of well drained or moderately well drained soils on nearly level to gently sloping uplands. These soils have a thick sandy A horizons over brownish yellow and yellowish brown sandy loam BT horizons. Soils are moderately droughty to extremely droughty. Natural vegetation is longleaf pine, loblolly pine, assorted hickories, and sand post oak.

Pelion Loamy Sand (10 to 15 percent slopes) consists of moderately well drained, slowly permeable soils. In a representative profile, the surface layer is grayish brown loamy sand about 5 inches thick. The subsurface is pale brown loamy sand about 5 inches thick. The upper 12 inches of the subsoil is reddish yellow sandy clay loam. These sloping, eroded soils that have loamy or clayey subsoils are a severe erosion hazard. Natural vegetation is loblolly pine, southern red oak, dogwood, and other associated hardwoods.

Kenansville Sand (0 to 2 percent slopes) consists of nearly level and gently sloping well drained soils on stream terraces and uplands. The surface layer is grayish brown loamy sand about 8 inches thick. The subsurface layer is light yellowish brown loamy sand about 16 inches thick. Soils are moderately droughty to extremely droughty. Natural vegetation is longleaf pine and loblolly pine.

Ogeechee Sandy Loam (0 to 2 percent slopes) consists of poorly drained nearly level soils in slight depressions. The surface layer is very dark gray loamy fine sand about 8 inches thick. The subsoil is mostly sandy clay loam and sandy clay to a depth of 60 inches. Permeability is moderate or moderately slow. Seasonally has a very high water table and/or occasional flooding during the winter and spring. Natural vegetation includes pond pine, loblolly pine, and sweetgum with understory vegetation consisting of pocosin species (gallberry, fetterbush, sweetbay, etc.).

Johnston Sandy Loam (0 to 2 percent slopes) consists of very poorly drained soils on nearly level flood plains. Black mucky loam or loam surface layers, 30 inches thick, and gray fine sandy loam underlying layers. Soils are frequently flooded and have a water table which covers the surface most of the time. The native vegetation consists of pond pine, swamp tupelo, blackgum (*Nyssa sylvatica*), sweetbay, red bay, yellow poplar, red maple, and greenbrier with understory of gallberry, fetterbush, and titi.

Troup Sand (0 to 10 percent slopes) are well drained sandy soils on level to hilly uplands. Surface layers are grayish brown sand or loamy sand. The subsurface is strong brown to reddish yellow loamy sand. Available water capacity is low. Soils are moderately droughty to extremely droughty. Natural vegetation includes longleaf pine, loblolly pine, and upland hardwood species such as dogwood, southern red oak, black oak, and blackjack oak.

Vaucluse Sand (2 to 10 percent slopes) consists of well drained soils with a moderately slow to slowly permeable, partly brittle horizon. These soils are on irregular slope breaks of 2 to 25 percent. Typically these soils have a loamy sand surface layer and a mottled red sandy clay loam subsoil. These soils are slowly permeable and have a layer that inhibits root development. Water holding capacity is low. Natural vegetation is comprised of longleaf pine, loblolly pine, blackjack oak, and bluejack oak.

Wehadkee Silky Clay Loam (0 to 2 percent slopes) consists of poorly drained nearly level soils on floodplains. The surface layer is grayish brown fine sandy loam about 8 inches thick. The subsoil extends to a depth of 40 inches. The underlying layer to a depth of 50 inches is gray sandy loam. These soils are poorly and very poorly drained soils that flood during winter and spring and have a water table within 0 - 5 feet from the surface. Well suited for water tolerant hardwoods. Natural vegetation includes water oak, willow oak, cherrybark oak (*Q. pagoda*), red maple, sweetgum, hackberry, and loblolly pine.

APPENDIX C. MANAGEMENT UNITS

MANAGEMENT UNITS	ACRES	MANAGEMENT UNITS	ACRES	MANAGEMENT UNITS	ACRES
0101	204.14	0409	7.99	0807	402.73
0102	261.47	0410	50.65	0808	82.65
0103	185.65	0411	25.31	0809	49.52
0104	178.35	0501	90.70	0810	52.21
0105	332.46	0502	336.32	0811	180.11
0106	250.29	0503	208.66	0901	680.00
0107	99.69	0504	413.13	0902	437.65
0108	413.06	0505	1347.39	0903	437.01
0109	19.22	0506	73.45	1001	590.46
0110	110.38	0507	70.92	1002	15.87
0111	352.80	0601	181.80	1003	746.33
0201	432.16	0602	87.55	1101	207.59
0202	331.69	0603	163.51	1102	150.81
0203	116.83	0604	50.60	1103	662.65
0204	626.33	0605	118.72	1104	455.10
0205	56.66	0606	130.57	1105	622.56
0206	71.82	0607	63.36	1106	83.74
0207	123.63	0608	229.36	1107	43.87
0208	74.14	0609	721.80	1108	19.10
0301	171.21	0610	154.91	1201	171.76
0302	355.98	0611	5.51	1202	170.86
0303	439.83	0612	58.19	1203	855.65
0304	260.11	0613	31.76	1204	121.40
0305	390.49	0614	60.45	1301	325.72
0306	449.77	0615	32.08	1302	391.48
0307	798.04	0616	51.28	1303	194.60
0308	128.94	0701	122.96	1304	72.18
0309	114.03	0702	153.86	1305	389.69
0310	10.02	0703	673.00	1306	63.55
0311	149.44	0704	730.40	1307	47.40
0401	400.68	0705	73.47	1401	109.19
0402	325.73	0706	30.21	1402	143.11
0403	310.21	0707	275.17	1403	1001.36
0404	289.46	0802	92.91	1404	177.46
0405	240.15	0803	1037.35	1405	56.19
0406	438.56	0804	181.30	1406	419.71
0407	346.30	0805	289.19	1407	72.04
0408	46.72	0806	692.27	1408	46.38

MANAGEMENT UNITS	ACRES	MANAGEMENT UNITS	ACRES		
1501	116.97	1819	3.54		
1502	801.13	1820	177.07		
1503	351.32	1821	78.84		
1504	683.99	1822	21.27		
1505	402.43	1901	279.48		
1506	363.85	1902	444.21		
1507	32.99	1903	344.31		
1508	48.77	1904	173.94		
1601	384.99	1905	89.16		
1602	403.89	1906	100.88		
1603	680.50	2001	322.18		
1604	158.44	2002	252.25		
1605	113.26	2003	172.18		
1606	119.00	2004	650.22		
1607	183.48	2005	234.07		
1608	20.81	2009	46.52		
1701	344.70	2010	178.36		
1702	498.23	2011	176.60		
1703	77.98	2012	8.32		
1704	318.11	2013	6.90		
1705	83.52	2014	58.95		
1706	7.96	2015	184.57		
1801	158.91	2016	136.34		
1802	98.80	2101	601.56		
1803	338.90	2102	474.13		
1804	641.02	2103	574.07		
1805	703.08	Nat Area	234.63		
1806	139.04				
1807	45.50				
1808	65.65				
1809	68.90				
1810	143.73				
1811	192.35				
1812	11.96				
1813	47.52				
1814	36.16				
1815	12.55				
1816	54.21				
1817	11.09				
1818	9.80				

APPENDIX D. FOREST MANAGEMENT DOCUMENTATION

D.1 SAMPLE ANNUAL PRESCRIPTION

Carolina Sandhills National Wildlife Refuge
2012 Management Prescription for Forest Harvest Operations
Compartments 11, 18, 19 & 21

Prepared By:

Forester CSNWR

Date

Station Review:

Wildlife Biologist, CSNWR

Date

Fire Management Officer, CSNWR

Date

Assistant Refuge Manager, CSNWR

Date

Peer Review:

Assistant Regional Forester

Date

Submitted by:

Refuge Manager, CSNWR

Date

Recommended by:

Region 4, Regional Forester

Date

Archaeological Review:

Region 4, Archaeologist

Date

Approved by:

Refuge Supervisor, Area III

Date

Section 1: Management Prescription for Forest Operations
(graphs and figures removed from sample)

I.	Carolina Sandhills NWR Overview	7
II.	Forest Habitat Types	7
III.	Forest Management and Restoration Techniques	8
IV.	2012 Forest Prescription Recommendations	10
A.	Harvest Objectives	11
B.	Methods	11
	<i>Graph 1 - Trees per Acre</i>	12
	<i>Graph 2 - Basal Area</i>	12
	<i>Graph 3 - DBH</i>	13
	<i>Graph 4 - Timber Height</i>	13
	Volume Table	14
	Compartment 11	15
	Compartment 18	16
	Compartment 19	17
	Compartment 21	18
C.	Harvest Planning and Preparations	19
D.	Protection of Archaeological Resources	20
	Appendix 1: Stand by Stand Metrics	21

Section 2: Intra-Service Section 7 Biological Evaluation

I. Carolina Sandhills National Wildlife Refuge Overview

Carolina Sandhills National Wildlife Refuge (CSNWR) was established in 1939 and comprises 45,779 acres of forested longleaf pine woodlands and associated habitats including freshwater impoundments, open fields and stream-pocosins. These habitats support nearly 200 species of birds, 42 species of mammals, 41 species of reptiles, 25 species of amphibians, and more than 750 plant species. Refuge habitats support the National Wildlife Refuge System's largest population of endangered red-cockaded woodpeckers (RCW). Along with the neighboring Sand Hills State Forest, the refuge is designated as a secondary core recovery population for this species. CSNWR forest management activities focus on conserving and restoring the longleaf pine ecosystem while enhancing habitat for the RCW. Forest treatments are designed to meet guidelines for achieving recovery as designated in the *Red-cockaded Woodpecker (Picoides borealis) Recovery Plan* (USFWS 2003).

II. Forest Habitat Types

Approximately 35,000 acres of pine uplands occur at CSNWR including approximately 15,000 acres of natural longleaf pine (*Pinus palustris*), 13,000 acres of pine plantations and 6,000 acres of pine scrub-oak habitat (Table 1). Plantation stands are primarily represented by longleaf pine; yet do include slash (*Pinus elliottii*) and a lesser component of loblolly (*Pinus taeda*). Slash pine is non-native and was established at CSNWR in the 1960's when the refuge forest management was conducted by the South Carolina Forestry Commission. Non-native slash pine stands are being converted to longleaf as RCW foraging guidelines allow. Loblolly pine is occasionally mixed with longleaf on CSNWR uplands; however its seedlings are intolerant of fire prior to reaching diameters of approximately two inches. Therefore, mesic areas having longer fire return intervals, and which promote more rapid seedling growth, favor their recruitment. Harvest planning includes the consideration of ecosystem appropriate removal, or reduction, of both slash pine and loblolly pine.

Table 1. Cover types and acreages at CSNWR.

Cover Type	Acreage
Bottomland Hardwood	1,855
Field	1,214
Pine	15,031
Pine Bottomland	4,975
Pine Hardwood	1,329
Pine Plantation	14,038
Pine Scrub Oak	6,288
Scrub Oak	314
Upland Hardwood	448
Water	287
Total	45,779

In contrast, shortleaf pine (*Pinus echinata*) is sparse across the CSNWR landscape, yet wide ranging. All shortleaf are retained and surrounding pine density reduced to favor shortleaf regeneration and recruitment. Established shortleaf seedlings resprout following fire, and its adaptability to grow on a wide range of sites place it within the upland longleaf pine matrix as well as a component of upland pine-hardwoods mix. Pond pine (*Pinus serotina*) is native and requires fire to melt the waxy coating on its cones and thereby release seed. Its seedlings, like shortleaf pine, resprout following fire. Despite the common name, pond pine is found throughout CSNWR, from the stream drains where it may reach diameters of two to three feet, to the driest ridges where it exhibits poor form and growth.

III. Forest Management and Restoration Techniques

In accordance with the *Forest Management Plan for the Carolina Sandhills NWR (1995)*, forestry staff review forest health and habitat needs within four or five of CSNWR's twenty one compartments for each prescription. Aerial photography is evaluated to assist in selecting stands that may require treatments; these stands are then examined on the ground to determine specific management needs such as planting and restoration, midstory treatments, and thinning. Staff are currently drafting a Habitat Management Plan, stepped

down from the *Carolina Sandhills National Wildlife Refuge Comprehensive Conservation Plan* (USFWS 2010) that will replace the Forest Management Plan.

Prescribed Burning

Frequent fire is the single most important factor for restoring and maintaining the longleaf pine ecosystem. Prescribed fire is applied to as much as one third of the refuge per year. Both dormant and growing season prescribed burns are used on two to five year rotation to improve wildlife habitat and promote open stand conditions that are representative of the longleaf pine ecosystem. Although accomplished on a separate schedule from that noted above, prescribed fire and silvicultural activities are closely coordinated to ensure all actions are compatible.

Mechanical Hardwood Midstory Removal

Roller chopping and hydro-axing (large-scale mulching) are used to remove scruboak encroachment within and around RCW cluster sites. This activity assists in maintaining open stand conditions beneficial to the RCW and other open pine/grassland species. A combination of mechanical removal followed by prescribed fire application is used to control hardwood midstory. With repeated prescribed fire applications, the herbaceous ground cover becomes better established.

Chemical Hardwood Control

Scruboak hardwood midstories have become well established in many areas of CSNWR due to misguided management practices in the 1950s and 1960s, including the absence of fire. Even though fire has been reintroduced in recent decades, some areas have poor fuel continuity and an inability to carry fire. Herbicide (hexazinone) can be very effective in restoring herbaceous conditions within such areas. The herbicide is applied in April or May at a target rate of 1.75 pounds per acre. Although aerial application is preferred and results in excellent control of the target hardwoods, ground application is also effective. In recent years, the average cost associated with this treatment has been approximately \$50/acre (aerial) and \$90/acre (ground). At present time, the company that manufactures the ultra-lightweight (ULW) granules has ceased production thereby requiring the use of ground application until an aerial product becomes available.

Risk Management Harvesting and other Timber Salvage Operations

Tree harvesting operations may be associated with forest health risks such as pine beetle infestations or public use risks where safety is compromised. These harvesting operations are normally small in scale and conducted as needed to mitigate risks while providing a cost-effective method for timber removals that generate revenue rather than costs. Timber salvage may find application in other situations; for example, where tornado damage has occurred, or where the installation of roads, buildings or fire breaks may be required. Wherever timber is limited in volume or value to the extent that its removal could generate costs to the Department, timber salvage operations provide a useful option.

Due to the longleaf pine's vigor, outbreaks of pine beetle infestations are typically localized and generally occur following lightning strikes, which often kill/weaken multiple stems in a single strike. Those dead or weakened trees provide the opportunity for small endemic pine beetle populations to multiply, and where the populations reach adequate size, the outbreak may spread to adjacent healthy timber. These conditions may also result from other climatic or disease stressors; e.g., root fungus (*Leptographium* sp.). Insect and/or disease controls occur whenever major outbreaks threaten to destroy valuable wildlife habitat or when there

is a high potential to spread to adjacent forestlands, or RCW clusters. When necessary, dead and/or dying timber will be removed. However, in areas where disease or insect outbreaks appear to be localized or affecting few trees, dead or dying trees will be left to provide snags for cavity nesting species; thereby reducing nest cavity parasitism and enhancing RCW management.

Timber Harvesting

Harvest operations are used to enhance wildlife habitat for many by reducing within-stand competition for moisture, nutrients and sunlight and promoting herbaceous species in the understory. Removal of smaller diameter timber promotes growth of the most vigorous stems and enhances the foraging conditions for the RCW while also ensuring that diameters needed for nest cavity provisioning are achieved throughout the stand at the earliest possible date. All harvest operations are designed to advance forest stands toward the recovery standard for foraging habitat as set forth in the *Red-cockaded Woodpecker Recovery Plan* (USFWS 2003, p.188).

IV. 2012 Forest Prescription Recommendations

Four management compartments (11, 18, 19 and 21) are addressed under this proposal for selective timber harvesting. Compartment 20 contains nearly 250 acres of slash pine that will be addressed under a separate prescription. Collectively, 35 upland pine plantations, with an average age of 49 years old, are recommended for treatment to enhance ecosystem restoration and improve foraging habitat for RCW and other species dependent on open pine/grassland conditions. The total area recommended for treatment is 1,293 acres.

A. Harvest Objectives

This prescription is limited to basal area reduction within 34 longleaf plantation stands established in the 1960s or 1970s. One 13-acre slash pine stand is recommended for clearcut. Otherwise the low-grade operator-select thinnings per the reverse-diameter limit are recommended for each stand. The smaller and less vigorous timber will be removed to enhance the growth of the larger timber. This prescription promotes a variety of habitat management objectives including:

- Improves RCW foraging habitat by providing open conditions and retaining larger diameter trees;
- Promotes RCW nest recruitment potential by retaining the largest and healthiest trees which provide opportunity for nest cavity inserts at the earliest possible dates;
- Improves tree vigor by reducing competition for resources;
- Enhances forest stand vigor through removal of stressed, diseased and damaged stems as determined necessary to maintain overall stand health; while also broadly considering ecosystem diversity which may include retention of some stressed, diseased and damage stems that are representative of endemic ecological conditions;
- Promotes herbaceous growth and vigor by providing adequate opening to reduce competition for moisture, light and nutrients and allow the dormant herbaceous seed bank to release;
- Removes offsite slash pine;
- Reduces the prevalence of loblolly pine within upland areas;
- Maintains and promotes existing shortleaf pine;

- Minimizes midstory establishment through post-harvest herbicide application and thereby promotes herbaceous release which enhances prescribed fire applications.

B. Methods

The average basal area (BA) for treatment areas is 77ft²/ac with a target BA post-harvest of 48ft²/ac, which correlates to an average tree reduction per acre of 181 to 90 (Graphs 1 through 4). The majority of the stands will be harvested via “operator select” per a reverse diameter limit (RDL) whereby the smallest diameter timber will be removed to accelerate growth of the residual trees. This will enhance overall forest health while also moving forest structure toward defined recovery standards for quality foraging habitat (*RCW Recovery Plan* p.188). The average RDL is 8 inches diameter at breast height (DBH). Some larger diameter timber will be removed due to placement of log decks and skid rows and offsite loblolly and diseased timber where not marked for ecological retention purposes.

Harvest volume estimates exceed 30,000 tons, which approximates one third of the standing volume of these plantations (Table 3). Harvest operations in these plantations will result in approximately 80% pulpwood, 15% chip-n-saw (CNS) and 5% sawtimber. However, the slow growth of longleaf pine in the sandhills results in a premium quality timber that provides for enhanced marketing potential of pulpwood-sized product into CNS markets. Given effective merchandizing and marketing, the potential exist for a higher percentage of the harvested product to be sold as CNS. Outcomes are dependent upon a variety of factors including bidding competition and market conditions at time of harvest.

Table 3. Harvest Volume and Timber Product Summary by Stand (See Appendix 1 for Stand by Stand Metrics; *truncated for brevity*)

Stand Number	Standing Volume Tons	Leave Volume Tons	Harvest Volume Tons	Pulpwood Tons	Chip-N-Saw Tons	Sawlogs Tons
Subtotal Comp 11	44,958	30,139	14,819	11,855	2,222	741
Subtotal Compt 18	18,020	11,667	6,353	5,083	953	318
Subtotal Compt 19	24,165	14,888	9,277	7,421	1,394	466
Totals	89,415	59,081	30,334	24,267	4,550	1,517

In Compartment 11, 16 longleaf plantation stands encompassing 664 acres are proposed for treatment by operator-select thinning per the reverse-diameter limit (Figure 2). A portion of Stands 16 and 17 will be further reviewed due to sampling variation. If determined necessary, areas within those stands may be marked to assist operator selection.

In Compartment 18, 6 stands totaling 242 acres are proposed for treatment (Figure 3). Stands 14, 17, 56 and 118 are recommended for operator-select thinning per the reverse-diameter limit. Stands 55 and 58 contain a mixture of longleaf, loblolly and slash pines, therefore, “take” timber will be marked to ensure offsite loblolly and slash pines are removed and longleaf pines retained.

In Compartment 19, 12 upland pine stands encompassing 355 acres are proposed for operator-select thinning per the reverse-diameter limit (Figure 4). Stands 9 and 20 may require interior marking to assist operator selection and will be conducted as necessary. Stand 8 (13 acres) is an offsite slash pine stand and will be clearcut and replanted in longleaf pine under an existing Memorandum of Understanding with the SC Forestry Commission.

Due to its proximity to other harvest areas, one stand in Compartment 21 totaling 32 acres is proposed for operator-select thinning per the reverse-diameter limit (Figure 5).

A percentage of the timber revenue will be used for herbicide treatment of each stand post-harvest to reduce midstory hardwood competition. Most of the plantations were extensively site prepared via root rake, heavy disking, and planting of watermelons before bare root seedlings were planted. These disturbances altered the native groundcover. This coupled with fire suppression from the 1950s through the early 1970s promoted a groundcover dominated by scruboaks. Increased scruboak midstory competition is an expected outcome of the proposed harvest actions, which will open up canopy conditions. Herbicide treatments will suppress scruboak midstory development and release the herbaceous groundcover seed bank, thereby increasing ecological diversity and improving stand structure.

The increased ecosystem health and function that follows herbaceous release provides increased invertebrate and vertebrate diversity. Further, the enhanced herbaceous layer provides fine-fuel continuity that then broadens the window for applying prescribed fire and increases the effectiveness of fire applications in achieving desired habitat structure for a variety open pine/grassland species. The harvest actions and subsequent herbicide treatments serve to move artificial plantation stand conditions to more natural ecological structure and function.

C. Harvest Planning and Preparations

Field work conducted in support of this prescription included data collection by a team of foresters, technicians, and forestry interns. Those data were analyzed using T-Cruise software to provide the stand metrics summarized in Appendix 1. Harvest stand boundaries are marked by yellow-retention marking paint on both faces of boundary trees. Additional “take” timber may be marked in blue marking paint (at dbh and on the stump) along the periphery of the stand to provide connectivity of the thinned stands to adjacent RCW clusters. Wherever shortleaf and pond pine trees exist within the harvest areas, these species are recommended for retention.

Logging routes, log decks and primary skidder routes will be established on a stand by stand basis in consultation with the wood buyer and/or logger. South Carolina's *Best Management Practices for Forestry* will be followed to protect water quality and site productivity and to improve the composition and quality of the future forest. Harvest operations are permitted from July 1 through April 1 and will be coordinated with biology staff to ensure the protection of RCW nesting areas. No mechanical activity will occur within 60 feet of active trees.

D. Protection of Archaeological Resources

To ensure the protection of cultural resources, the Refuge forester shall review existing archaeological records for the harvest area and conduct an on-the-ground evaluation. No known cultural records or resources are known to exist within the harvest area.

The Regional Archaeologist shall be contacted if issues/concerns arise. All loggers will be required to follow *South Carolina Forestry Best Management Practices* and shall limit site disturbance by using existing roads and log decks wherever possible. As a condition of harvest, the following clauses shall be included in the sale, or as a condition of the Special Use Permit:

1. Should previously unrecorded cultural resources or human remains be found on Service land, thinning activities will be halted and the Regional Archaeologist and Refuge Manager contacted immediately.
2. Should human remains be encountered in an unmarked grave, Refuge Law Enforcement will be contacted immediately. The Regional Archaeologist, Refuge Manager, County's Sherriff Office, and the Department of Archives and History shall also be contacted. Should human remains be identified as Native American, consultation with the Catawba Indian Nation will be initiated per the Native American Grave Protection and Repatriation Act.
3. If, during the course of the thinning operation, the permittee notes illegal excavation or archaeological resource removal, this information shall be immediately provided to the Refuge Manager.
4. If, during the course of the thinning, the permittee deliberately damages a recorded site, the permittee is responsible for the resultant site damage assessment and mitigation. The mitigation may include, but is not limited to, site restoration and data recovery.

D.2 SAMPLE INTRA-SERVICE SECTION 7 BIOLOGICAL EVALUATION FORM

Originating Person: Allyne H. Askins

Telephone Number: 843-335-6023

E-Mail: allyne_askins@fws.gov

Date: February 22, 2013

PROJECT NAME (Grant Title/Number):

Carolina Sandhills National Wildlife Refuge, 2012 Forest Management Prescription,
Compartments 11, 18, 19 & 21

I Service Program:

- ☐ Ecological Service
- ☐ 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):

A. Overview

Pine plantation thinning needs were evaluated within Compartments 11, 18, 19 & 21. This includes forest harvesting operations in 35 stands encompassing 1,293 acres. Stand locations are illustrated in Section 1, Figures 2-5. In accordance with the *Red-cockaded Woodpecker Recovery Plan* (2003) and objectives identified in the *Carolina Sandhills National Wildlife Refuge (CSNWR) Comprehensive Conservation Plan* (2010) and *Forest Habitat Management Plan* (1995), the purpose of these harvests are twofold: 1) to use forest management techniques to accelerate artificially regenerated stands (plantations) from homogenous age and structure to more natural conditions; and 2) to improve stand structure and function to meet red-cockaded woodpecker (RCW) habitat needs. The results of these harvest treatments will move 1,280 acres of pine plantation stands towards desired conditions for RCW habitat while also more broadly enhancing longleaf ecosystem objectives to benefit multiple floral and faunal species. When combined with refuge prescribed fire objectives and other restoration activities, these efforts serve to accelerate natural ecological succession stages in CSNWR's longleaf pine forests. In addition, one 13 acre slash pine plantation will be clearcut and replanted in longleaf pine.

B. Objectives

This prescription is limited to basal areas reduction within 34 longleaf plantation stands established in the 1960s or 1970s. One 13 acre slash pine stand is recommended for clearcut. Otherwise the low-grade operator-select thinnings per the reverse-diameter limit are recommended for each stand. The smaller and less vigorous timber will be removed to enhance the growth of the larger timber. This prescription promotes a variety of habitat management objectives including:

- Improves RCW foraging habitat by providing open conditions and retaining larger diameter trees;
- Promotes RCW nest recruitment potential by retaining the largest and healthiest trees which provide opportunity for nest cavity inserts at the earliest possible dates;
- Improves tree vigor by reducing competition for resources;
- Enhances forest stand vigor through removal of stressed, diseased and damaged stems as determined necessary to maintain overall stand health; while also broadly considering ecosystem diversity which may include retention of some stressed, diseased and damage stems that are representative of endemic ecological conditions;
- Promotes herbaceous growth and vigor by providing adequate opening to reduce competition for moisture, light and nutrients and allow the dormant herbaceous seed bank to release;
- Removes offsite slash pine;
- Reduces the prevalence of loblolly pine within upland areas;
- Maintains and promotes existing shortleaf pine;
- Minimizes midstory establishment through post-harvest herbicide application and thereby promotes herbaceous release which enhances prescribed fire applications.

C. Methods

The average basal area (BA) for treatment areas is 77ft²/ac with a target BA post-harvest of 48ft²/ac, which correlates to an average tree reduction per acre of 181 to 90 (Table 1). The majority of the stands will be harvested via “operator select” per a reverse diameter limit (RDL) whereby the smallest diameter timber will be removed to accelerate growth of the residual trees. Additionally, trees with specific wildlife values may be flagged for retention. This will enhance overall forest health while also moving forest structure toward defined recovery standards for quality foraging habitat (*RCW Recovery Plan* p.188). The average RDL is 8 inches diameter at breast height (DBH). Some larger diameter timber will be removed due to placement of log decks and skid rows, offsite loblolly and diseased timber where not marked for ecological retention purposes.

The outcome of these treatments will be the retention of 48ft²/ac of the healthiest and most vigorous trees. Diameter limits do not emphasize even-spacing, and instead often result in significant forest structure variation which is desirable for ecosystem diversity. The resources available to herbaceous plants within larger gaps further leads to herbaceous seed development within the stand, and thereby promotes herbaceous species recovery throughout. A related and important outcome of enhanced ground cover is the associated increase in invertebrate populations, which are beneficial to a variety of species including the RCW.

D. 2013 Harvest Area Descriptions

In Compartment 11, 16 longleaf plantation stands encompassing 664 acres are proposed for treatment by operator-select thinning per the RDL. A portion of Stands 16, 17 and 18 will be further reviewed due to sampling variation. If determined necessary, areas within those stands may be marked to assist operator selection.

In Compartment 18, 6 stands totaling 242 acres are proposed for treatment. Stands 14, 17, 56 and 118 are recommended for operator-select thinning per the RDL. Stands 55 and 58 contain a mixture of longleaf, loblolly and slash pines, therefore, "take" timber will be marked to ensure offsite loblolly and slash pines are removed and longleaf pines retained.

In Compartment 19, 12 upland pine stands encompassing 355 acres are proposed for operator-select thinning per the RDL. Stands 9 and 20 may require interior marking to assist operator selection and will be conducted as necessary. Stand 8 (13 acres) is an offsite slash pine stand and will be clearcut and replanted in longleaf pine under an existing Memorandum of Understanding with the SC Forestry Commission.

Due to its proximity to other harvest areas, one stand in Compartment 21 totaling 32 acres is proposed for operator-select thinning per the RDL. All planned harvest operations are in accordance with the management and foraging habitat guidelines set forth in the *RCW Recovery Plan (2003)*. These treatments will move habitat dedicated to specific clusters toward the desired structure identified in the recovery standard (*RCW Recovery Plan* p. 197).

Foraging guidelines place greater emphasis on larger (> 14 inch dbh) and older trees (> 60 years) and restrict BA of trees less than 10 inches dbh. All stands addressed herein fail to meet minimum foraging habitat requirements as defined in the *RCW Recovery Plan (2003)*; however, the proposed treatments will assist in attaining desired conditions at the earliest date (Table 2). Proper management of these plantations is crucial to providing the quality foraging habitat defined in the revised recovery plan. Regeneration areas of less than 40 acres are permitted where populations contain 100 potential breeding groups (PBG) or more. CSNWR had 139 PBG in the 2012 nesting season. In addition, the affected cluster (19-03) has 234 acres of foraging habitat within the partition, well above the minimum 120 acres of foraging habitat required by the recovery standard (*RCW Recovery Plan* p. 188).

Table 1. Stand data pre and post-harvest (*truncated*).

Stand Number	Species	Year Planted	Acres	Basal Area	Residual BA	Tree s/Ac	Residual Trees/Ac	Standing Volume Tons	Leave Volume Tons	Harvest Volume Tons
Subtotal Comp 11			664	75	48	165	89	44,958	30,139	14,819
Subtotal Comp 18			244	79	48	189	91	18,020	11,667	6,353
Subtotal Comp 19			342	79	46	201	91	23,790	14,888	9,082
21028	Longleaf	1967	32	77	52	157	81	2,272	1,568	704
Totals		1964	1,282	77	49	178	88	89,220	58,262	30,958

Table 2. Stand characteristics in relation to the recovery standard for foraging habitat requirements (*truncated*).

Trees per Acre (TPA) by DBH Category					Basal Area per Acre by DBH Category		
< 10 inch	10-14 in.	> 14 in.	< 10 inch		10-14 in.	> 14 in	
< 50 TPA		Min 18/ac	< 10 ft²		< 40 ft²	Min 20ft²/ac	
Compartment 11 - Timber-Enhancement Thinning Recommended to Promote RCW Habitat within 16 Upland-Pine Stands Encompassing 664 Acres							
Stand 9, Longleaf, 17 Acres, Planted 1963							
Pre	61	70	0		23	49	0
Post	11	70	0		3	49	0
Stand 11, Longleaf, 21 Acres, Planted 1963							
Pre	89	53	1		38	33	1
Post	22	53	1		15	33	1
Stand 12, Longleaf, 47 Acres, Planted 1963							
Pre	87	65	1		30	43	2
Post	14	65	1		4	43	2
Stand 14, Longleaf, 45 Acres, Planted 1963							
Pre	134	43	1		42	29	1
Post	62	43	1		15	29	1
Stand 16, Longleaf, 22 Acres, Planted 1963							
Pre	66	70	2		23	48	3
Post	12	70	2		3	48	3
Etc.							

V. Pertinent Species and Habitat:

A. Include species/habitat occurrence map:

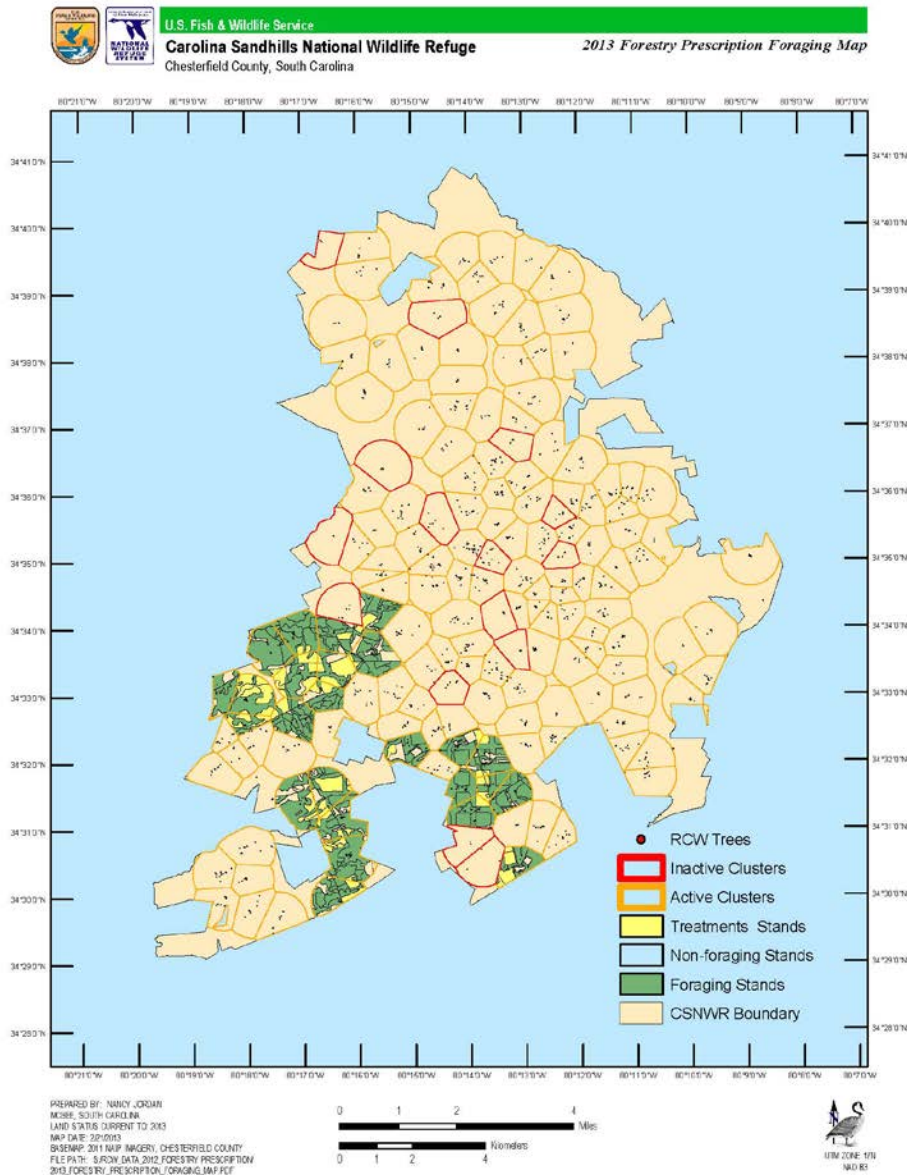
Complete the following table:

SPECIES/CRITICAL HABITAT	STATUS ¹
Red-cockaded Woodpecker/Upland pine	E

¹STATUS: E=endangered, T=threatened, PE=proposed endangered, PT=proposed threatened, CH=critical habitat, PCH=proposed critical habitat, C=candidate species

The refuge is part of the Sandhills (SC) Recovery Unit, a secondary core population (*RCW Recovery Plan* 2003). The population goal for recovery is 250 PBG of which the refuge will provide habitat to support 165 PBG and the adjacent Sand Hills State Forest will support 143 PBG. The refuge currently manages 166 clusters of which 151 are active. In 2012, there were 139 PBG and 128 nest initiations (Figure 1).

VI. **Location (attach map):**



- 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', 32', 33', 34' & 35'
 Long. 80° 12', 13', 14', 15', 16', 17' & 18'
- D. **Distance (miles) and direction to nearest town:** 4 miles East of McBee, SC
- E. **Species/habitat occurrence:**
 Red-cockaded Woodpecker / 40,000 acres upland pine habitat

Tables 3-27 (4-27 *deleted in sample*) provide cluster-level analysis of foraging habitat partitions for active clusters that contain treatment areas (**RED INDICATES TREATMENT STAND**). Thinning plantation stands will improve habitat in 28 RCW foraging partitions. Of these, 25 clusters are active and three clusters are inactive, thus no foraging habitat analysis (FHA) is required (Figures 2-8). Due to the saturation of the refuge's RCW population in available suitable habitat and the limited availability of suitable habitat due to the presence of nearly 14,000 of pine plantations, affected foraging partitions range in size from 107 acres to 293 acres. Of the 25 active clusters, 23 contained PBG and two consisted of floater adults. Twenty-one of the affected clusters nested in 2012. Two clusters with PBG did not nest, yet contained partitions with 196 acres of foraging habitat and 267 acres of foraging habitat. Stand metrics such as BA and size class are available for pine plantations. Metrics for natural pine stands include size class and age (>70 years old). Due to limited data available for conducting FHA for each cluster, foraging habitat is defined as size class 1 and 2 (sawtimber > 70 years old) and plantations at least 30 years old (as these stands have been thinned at least once). Any stand where the size class or age is unknown was automatically classified as non-foraging.

Table 3. Cluster-level Analysis of Foraging Habitat Partitions for Active Clusters

CLUSTER 10-03

ACTIVE PBG NESTED IN 2012

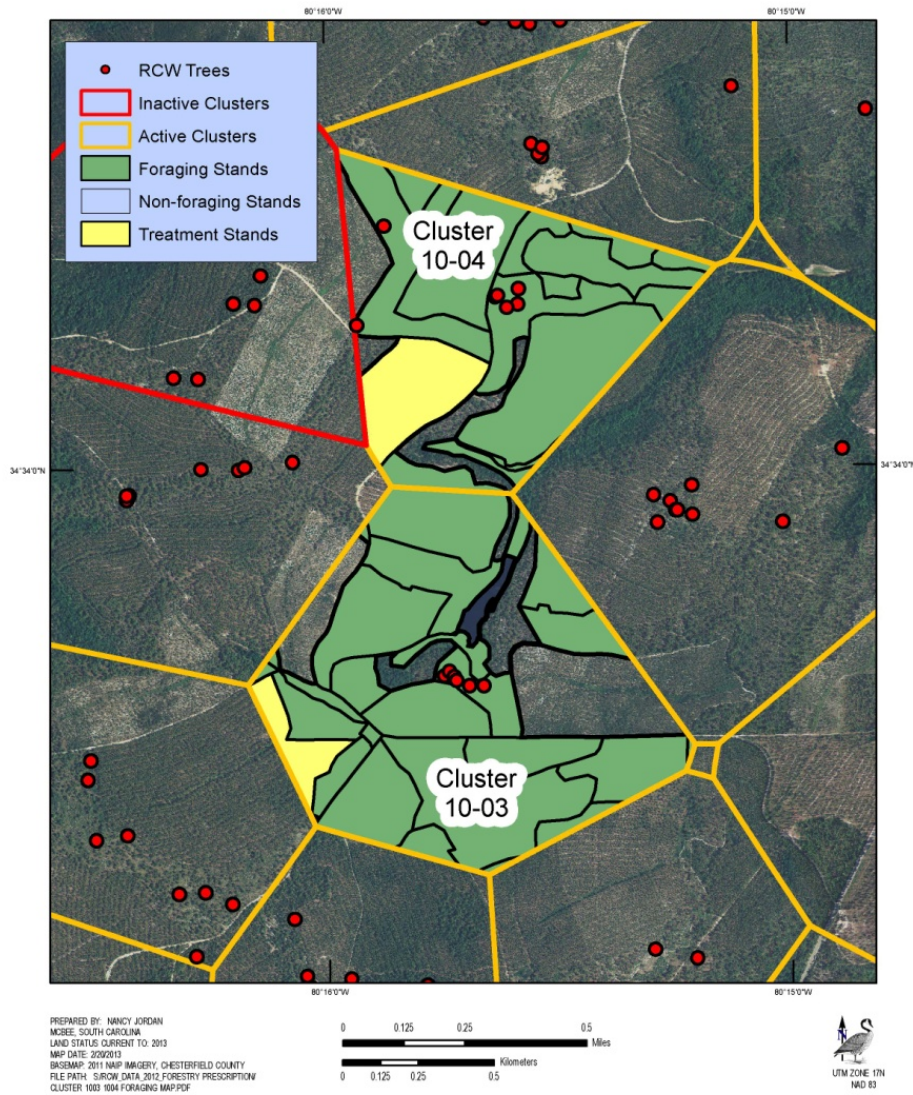
FORAGING

STAND	TYPE	SPECIES	SIZE_CLASS	PLANTED	TIMB_CLASS	timb_cla_1	Acreage
10000	PB	MIXED	2	9000		MISSING	5.84
10001	P	XX	2	9000	PINE	PINE	5.92
10004	PL	LL	123	1965	PINE	PINE	14.81
10005	P	XX	2	9000	PINE	PINE	9.13
10013	P	XX	2	9000	PINE	PINE	8.99
10014	PL	LL	123	1965	PINE	PINE	8.04
10046	PL	LL	123	1965	PINE	PINE	22.18
10047	PS	MIXED	2	9000	MIXED	MIXED	15.12
10048	PL	LL	123	1965	PINE	PINE	22.13
11000	P	LL	2	9000	MERGE	MISSING	3.39
11034	PL	LL	123	1963	PINE	PINE	10.70
11035	PL	LL	1	1937	PINE	PINE	8.12
11037	P	XX	2	9000	PINE	PINE	4.90
11040	P	XX	2	9000	PINE	PINE	0.36
11045	PL	LL	1	1937	PINE	PINE	0.44
11054	P	XX	2	9000	PINE	PINE	0.66
13024	PL	LL	123	1972	PINE	PINE	0.37
13025	PL	LL	123	1960	PINE	PINE	15.33
13026	PL	LL	123	1972	PINE	PINE	13.31
13027	P	XX	2	9000			17.39
13028	PL	LL	1	1937	PINE	PINE	37.45
13030	PL	LL	123	1963	PINE	PINE	7.97

TOTAL 232.55

NON-FORAGING

STAND	TYPE	SPECIES	SIZE_CLASS	PLANTED	TIMB_CLASS	timb_cla_1	Acreage
10002	UH	HWD	2	9000	HARDWOOD	HARDWOOD	5.86
10000	WATER	W	99	9000	LAKE 17	MISSING	4.15
10006	PL	LL	4	1997	PINE	PINE	33.36
11039	PL	LL	4	2000	PINE	PINE	11.68
10003	PS	MIXED	99	9000	MIXED	MIXED	10.91
10045	PS	MIXED	99	9000	MIXED	MIXED	1.81
11036	PS	MIXED	99	9000	MIXED	MIXED	0.12



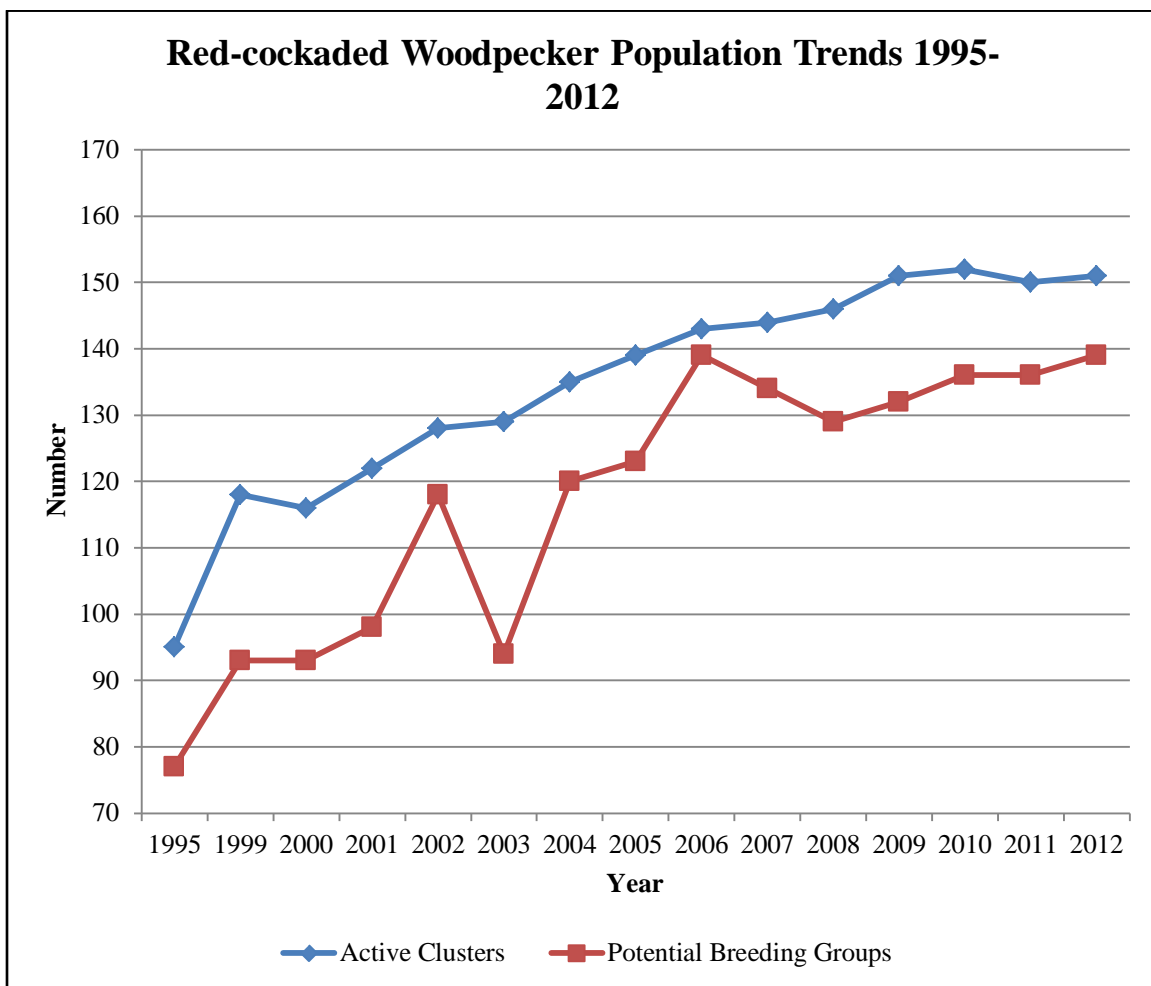
VII. Determination of Effects

A. Explanation of effects of the action on species and critical habitats:

While prescribed fire is an essential tool used to create habitat conditions that the RCW favors, it is even more effective when used in combination with a suite of tools to enhance habitat structure, including mechanical, chemical and silvicultural. Management actions are designed to restore the longleaf pine ecosystem and facilitate recovery of the RCW. Converting off-site slash pine to native longleaf is necessary to restore the forest and provide long term foraging and nesting habitat for the RCW.

The RCW has responded favorably to past silvicultural treatments (Figure 9). The refuge's population is increasing and the growth rate is limited only by the presence of 14,000 acres of planted pines that are two to 58 years old. This population growth will continue as the relatively young refuge forest matures and plantations are thinned and managed to become more suitable RCW habitat. The proposed treatments facilitate the refuge's ability to provide habitat for this species as it expands across the landscape.

Figure 9. RCW population trends 1995-2012 at Carolina Sandhills NWR.



SPECIES/CRITICAL HABITAT	IMPACTS TO SPECIES/CRITICAL HABITAT
Red-cockaded woodpecker	The thinning project will result in the removal of smaller and less vigorous timber to enhance the growth of residual larger timber. This operation will improve the RCW foraging habitat and move it toward the conditions identified in <i>the Red-cockaded Woodpecker Recovery Plan (USFWS 2003)</i> . The purpose of these harvests are twofold: 1) to use forest management techniques to accelerate artificially regenerated stands (plantations) from homogenous age and structure to more natural conditions; and 2) to improve stand structure and function to meet red-cockaded woodpecker (RCW) habitat needs. The results of these harvest treatments will move 1,280 acres of pine plantation stands towards desired conditions for RCW habitat while also more broadly enhancing longleaf ecosystem objectives to benefit multiple floral and faunal species.

A. Explanation of action to be implemented to reduce adverse effects:

SPECIES/CRITICAL HABITAT	ACTIONS TO MITIGATE/MINIMIZE IMPACTS
Red-cockaded woodpecker	Operations will be timed and conducted to minimize disturbance to RCW clusters. Logging in the stands nearest RCW trees will be prohibited during nesting season (April-June). Existing snags will be left in place to provide RCW foraging and potential nesting sites for competing cavity dwellers.

VIII. Effect Determination and Response Requested

SPECIES/CRITICAL HABITAT	DETERMINATION ¹			RESPONSE ¹ REQUESTED
	NE	NA	AA	
Red-cockaded Woodpecker		X		

¹DETERMINATION/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

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

Title

Office

D.3 SAMPLE TIMBER BID INVITATION

Timber Bid Invitation Compartment 11 - 300 Acres

August 8, 2013

Sealed bids for a timber sale will be received at the office of the Carolina Sandhills National Wildlife Refuge, McBee, SC until 1:00 pm, Thursday August 22, 2013 and opened at that time. The timber sale area will be shown by appointment to prospective bidders. For further information, or to set up an appointment, contact the Refuge Forester, Jack Culpepper at 843-335-6383 or 843-307-0960. The stumpage offered in this invitation is being sold on a per-ton basis for 1) pulpwood, 2) chip-n-saw and 3) sawtimber.

Length of Contract: The harvest period will be in effect from Monday August 26, 2013 through Friday March 28, 2014. See exclusion dates noted at the end of this document.

Performance Deposit: The sealed bid must include a performance bond of \$5,000 in the form of a bank draft or certified check made payable to the U.S. Fish and Wildlife Service. The bond submitted by the successful bidder will be retained by the Government for the duration of the contract to cover damages or claims that violate conditions of the permit. The balance will be returned to the permittee upon satisfactory completion of harvest operations.

Location and Description of Stands to be Thinned: 300 acres located in CSNWR's Management Compartment 11 to include seven longleaf pine plantation stands established in the 1960's; and an adjacent clearing of two miles of refuge road (RT-11) right-of way. See table below for harvest volume estimates and attached maps for harvest area locations.

Product	Estimated Harvest Tons
Pulp	5457
Chip-N-Saw	1154
Sawtimber	585

Special Use Permit (SUP) and Conditions Applicable to Timber Harvesting:

The successful bidder will be issued a SUP for signature prior to initiating harvest operations. The assigned Logging Supervisor shall review and sign the "*Conditions Applicable to Timber Harvesting*" (enclosed), attach to the SUP, and maintain onsite for reference.

Harvest Operations Overview:

Following consultation with the Refuge Forester, logging will begin within marked stands where "take" timber is marked in blue. Stand boundary trees are marked in yellow and shall remain. Upon completion, the Wood Buyer and/or Logging Supervisor will review stand-harvest results with the Refuge Forester prior to moving to a subsequent stand. Operator-select harvesting may be employed after satisfactory results are achieved in marked stands.

With the exception of two small slash pine stands (totaling 15 acres) all stands will be thinned to a target basal area of 50 with retention of the highest quality timber. This is a low-grade removal consisting primarily of the harvesting of small diameter timbers of 8-inch dbh

and below. Timber that is marked for removal includes the smallest diameter timbers, malformed or damaged timber, and timber infected with fusiform prior to removing healthy timber necessary to achieve target BA. The same approach will be applied for “operator-select” harvesting. It is highly recommended that all bidders and contract loggers have experience with selective-harvesting operations.

All timber to be harvested in the right-of-way clearing is marked in blue; all trees to be retained in the right-of-way are marked in yellow and include survey reference-trees.

Haul Routes: Will be determined in consultation with the successful bidder: options are illustrated on the attached maps. Once established, only designated haul routes will be used and shall be monitored for all timber-hauling operations.

Weekly Load Booklets: Weekly Load Booklets will be provided by the Refuge Forester, and shall be accurately maintained at all times by the Logging Supervisor or designee, made available upon request and returned to the Refuge Forester weekly.

Payment: will be made on a weekly basis beginning the second week of operations, accompanied by an owner settlement detailing the prior week’s harvest actions to include scale tickets summaries, organized for each product and maintained on a stand-by-stand basis.

Operational Exclusion Periods:

- 2013 Deer Season Gun-Hunts Exclusion dates: 12 days in total including 3 Saturdays: i.e., October 21-26, October 31-November 2, and November 14-16.
- Endangered-Species Exclusion Period: In any given year, timber harvest operations are not conducted during the endangered Red-cockaded Woodpecker’s nesting season: April 1 through July 31.

Given the exclusion periods, 137 days (Monday through Friday) are available to complete harvest operations. Weekend and holiday work must be approved on a case-by-case basis.

Bidding: Complete the attached *Timber Bid Form* in full for consideration. Return in the envelope marked *Timber Bid, 300 Acres, Compartment 11*. The Government reserves the right to reject any and all bids received.

D.4 SAMPLE TIMBER BID FORM

Timber Bid Form
(Complete in full)

_____ hereby submits the following bid prices for the timber offered for sale in CSNWR's Compartment 11 (300 acres).

If awarded the timber sale, you the undersigned, agree to submit payment on a weekly basis beginning the second week of operations. Payments will be accompanied by the owner's settlement and scale tickets which will be organized by product and referenced to the forest stand number from which the product was harvested.

<u>Product</u>	<u>Bid Price per Ton</u>	<u>Volume Estimate</u>	<u>Bid Totals by Product</u>
Pine Pulpwood	_____	_____ tons	_____
Pine Chip-N-Saw	_____	_____ tons	_____
Pine Sawtimber	_____	_____ tons	_____
**Estimated 7185 tons			

**Prospective bidders are strongly encouraged to make their own assessments and volume estimates; volume is not guaranteed

Bid Total _____
(Sum of all products bids)

Date Submitted: _____

Company Name: _____

Contact Person: _____

Address: _____

Phone Number: _____

Name of Bidder _____

Signature of Bidder _____

D.5 CONDITIONS APPLICABLE TO TIMBER HARVESTING PERMITS

CAROLINA SANDHILLS NATIONAL WILDLIFE REFUGE *Conditions Applicable to Timber Harvesting Permits*

The permittee shall attach this list of 1) *Conditions Applicable to Timber Harvesting Permits* to the 2) *Special Use Permit*, and maintain both documents on site. These documents, and the 3) *Weekly Load Booklet* shall be made available to CSNWR staff upon request.

1. The Refuge Manager or agent must be contacted prior to moving equipment onsite.
2. Logging operations will not be conducted during the endangered Red-cockaded Woodpecker nesting season of April 1 through July 31.
3. All refuge wildlife is protected. No type of wildlife will be harmed or harassed.
4. Littering in any manner on the refuge is a violation of Federal Regulations. The entire work area shall be kept free of all forms of litter at all times. Specific attention shall be given to proper storage, maintenance and clean-up of petroleum based products.
5. All logging operations shall be conducted during daylight hours Monday through Friday. Permission may be granted on a case-by-case basis for conducting harvesting operations on holidays or weekends.
6. Vehicles and other equipment will be operated in a safe manner. Signage will be established and maintained for points of entry onto refuge roads (as needed) and required for entry onto all public transportation routes.
7. Coordination with the Refuge Forester shall occur on a stand by stand basis as harvest operations progress to ensure appropriate placement of log decks, skid trails, haul routes and harvest results.
8. Harvest damage to the site will be minimized to the extent possible. Damage to the crowns and stems of residual timber shall not exceed 5%. Timber damaged unnecessarily, as determined by the Refuge Manager or agent, shall be paid for at three times the stumpage rate.
9. Trees shall be cut so as to leave a minimal stump, not to exceed 6 inches height for pulp and CNS, and 12 inches height for sawtimber.
10. To provide wildlife benefits, dead trees shall be left standing except where their presence is a safety hazard; e.g., adjacent to logging decks and refuge or public roads.
11. Trees and tops shall not be left hanging or supported by any living or dead tree, or brush, and shall be pulled down immediately after felling.
12. Tops and logging debris shall be pulled back 50 feet from highways, county roads and refuge roads, and logging debris scattered throughout the remainder of the

harvest area to limit accumulation and erosion while also distributing nutrients across the site upon decay.

13. The permittee and employees will take all precautions to prevent forest fires.

14. *South Carolina's Best Management Practices for Forestry* will be followed as mandatory practices. Failure to follow BMP's is grounds to terminate the *Special Use Permit*. Pay special attention to the following:

Skid Trails:

- Logging slash will be spread on skid trails and used to drive over.
- Skid trails will be retired with water bars and turnouts where needed.
- Streamside management zones will be avoided.

Log Decks:

- The Refuge Forester will determine placement of log decks in consultation with the Wood Buyer and/or Logging Supervisor.

Hauling:

- Hauling and/or logging operations will not be permitted when the ground is wet and subject to rutting or severe soil compaction.
- Only designated haul routes will be utilized.

15. The Refuge Manager shall have authority to temporarily close all or part of the operation during inclement weather, a period of high fire danger, refuge hunts, safety reasons or any other reason deemed necessary. Additional time, equal to the closing period, will be granted the permittee.

16. All merchantable portions of timber harvested must be removed from the refuge.

17. All logging equipment will be removed from refuge property within 72 hours of completing harvest operations.

Logging Supervisor's signature and date: _____

D.6 SOUTHEASTERN REGION GUIDANCE CONCERNING COMMERCIAL FOREST MANAGEMENT PAYMENT PRACTICES

Southeast Region Guidance

Forest Management Payment Processing and Exchanges on National Wildlife Refuges

Prepared by:

Jeff Denman	Supervisory Forester	White River NWR
Carl Schmidt	Supervisory Forester	Piedmont NWR
John Simpson	Administrative Forester	Bayou Cocodrie NWR
Greg Corace	Forester (Ecologist)	Seney NWR
Steve Seibert Office	Supervisory Wildlife Refuge Specialist	Southeast Regional

Executive Summary

The purpose of this document is to provide regional guidance concerning business practices related to processing payments and to identify the appropriate types of goods and services associated with forest management on refuges. This document is not intended to address silvicultural practices or other broad forestry issues.

Issue: Over the years, refuges within the Southeast Region have adopted different methodologies to process payments generated from forest management practices and have included a wide range of expenses, goods and services that are related to the sale. Additional clarity is needed to process payments correctly and consistently and to determine what expenses associated with a timber sale are appropriate.

Scope: The guidance applies to FWS lands (fee-title) and may not necessarily apply to overlays (leased lands).

Objective: To provide guidance and clarification, and establish appropriate standards for:

- 1) *Processing payments;*
- 2) *Defining appropriate expenses;*
- 3) *Documentation procedures.*

Background: Many Refuges in the Southeast Region have forests requiring active management to restore, conserve or enhance ecosystem functions and habitat conditions for trust resources. After conducting a forest habitat evaluation to determine what type of habitat management, if any, is needed to meet refuge objectives, a timber harvest may be prescribed by the refuge because it often provides the most suitable and cost-efficient means to mimic natural disturbances and/or promote ecological succession for restoration and conservation purposes. Once a timber harvest is prescribed, the forest products to be harvested are marked or designated, and then sold into the local timber market. The value is most commonly determined by competitive bids or appraisal. A Special Use Permit

(Permit) (5 RM 17.B and 603 FW 1-2) is then issued to the selected timber buyer (usually the highest bidder although operator skills and abilities and past performance may also be considered along with the bid amount). Terms of the Permit state the conditions of the sale, including access or site modifications to support the management action. Compliance inspections are conducted by Refuge staff to assure adherence to the terms. Once a bid is accepted, local logging companies harvest the designated trees, thus providing the desired ecological disturbance while also benefitting local economies through the employment of forest and logging companies and the sale of merchantable forest products.

This type of economic use may be authorized when it contributes to the achievement of the Refuge purpose(s) (50 CFR 29.1). The value of the Permit is to be commensurate with fees for similar products made by private land owners in the vicinity and can be a monetary exchange or a share in kind of the resources (50 CFR 29.5).

Field stations can authorize Special-Use permits and collect fees for timber sales provided they have a current approved Timber Sales Authorization (details are available from the Regional Forester). An approved Timber Sales Authorization is the delegation of authority to the refuge manager that allows for timber sales up to \$500,000. Timber Sales Approval Authorizations require renewal every 5 years. A Special-use permit governing sales exceeding \$500,000 requires approval from the Regional Chief of Refuges.

Net receipts are revenue from sales remaining after deduction of appropriate expenses incurred in producing the income (50 CFR 34.3(e)), and are deposited in the Revenue Sharing Fund (50 CFR 34.3(d)) through Denver Finance Center using collection transmittal #5 (refuge revenue sharing). Performance bonds to ensure compliance with Permit terms use collection transmittal #4 (suspense). Also, products of public land may be exchanged to acquire lands (16 USC dd (b) (3) (B)).

Expenses incurred in producing the income include staff time and operating expenses for planning timber sales, designating trees to be sold, and inspecting operations for compliance with terms of the Permit. Salaries, benefits, travel expenses, fuel, etc. are considered expenses of the sale. Other expenses include tools, specialized equipment, and supplies used primarily for sales, such as paint sprayers and paint, safety boots, etc. Obtaining and maintaining access to the sale has also been recognized as an expense of the sale. The intent is to limit expenses to those incurred in producing the income. A number of Refuges receive an Expense for Sales (6860 funding) allocation that has been used for these items. Some refuges have no allocation or insufficient amounts for those sale expenses. The remedy has been for those expenses to be deducted from the sale income prior to deposit into the Revenue Sharing Fund. Additionally, a refuge may receive an in-kind share of the resource or product which could be a portion of the timber harvested or lumber sawn from the timber. Exchanges of Timber for Land have been coordinated through the Division of Realty to acquire parcels within approved acquisition boundaries. Some exchanges have added acres to one Refuge with timber from another Refuge.

FWS regulation (50 CFR 25.12) and policy (603 FW 2(N)) indicate the exchange of timber for goods or services is possible but the legislative foundation for this is unclear. Therefore, the region limits the exchange of timber for goods and services to expenses clearly related to the approved silvicultural prescription and timber sale. Examples may include the planting of specific trees, control of designated plants, and/or expertise and labor to assist with the timber harvest and sale within the specified prescription area.

Processing Payments: Methods of payment for timber vary depending on how the sale is structured. Below is a list of payment methods being utilized, all of which meet the terms and spirit of the regulations. The economic viability of each sale in each locality will influence which method is thought to best meet the refuge purposes. As markets fluctuate, flexibility is needed to adapt additional methods to meet the terms and spirit of the regulations. A performance bond or guarantee is often a standard component of timber sale administration. This bond is to assure payments are made for the timber, and all tasks are completed in accordance with the terms of the Permit.

1) Lump Sum as Performance Bond with Refunding for Designated Expenses –The total value of the Permit to harvest trees is received from the Permittee and deposited into the Suspense Account of the Denver Finance Center as a Performance Bond to complete all the terms in the Permit. Permit terms include specific goods and services required to implement the prescribed treatment. When goods or services in the Permit are provided, the documented actual expense of those goods and services are refunded to the Permittee from the performance bond. When all required goods and services have been provided and expenses refunded, the balance of the performance bond becomes net receipts and is transferred from the Suspense Account to the Revenue Sharing Account. When both parties sign the Permit, the timber becomes the property of the permittee, who would then bear the burden of unforeseen loss; e.g. insects, fire, wind damage, etc. One example of appropriate language in the bid and Permit is:

“The Permittee will provide, conduct, or pay a contractor for goods or services needed to meet the stated goals and objectives, as determined by the Refuge Manager. These may include As designated goods or services are provided, the actual, documented costs of same will be refunded to the permittee.”

2) Per Unit Sale (also called pay as cut, pay by scale, scale sale, or per ton sale) with Deductions from Partial Payments –The value of the timber is based upon volume or weight and product class (sawlogs, pulpwood, etc.) as removed. In some cases (particularly in low value timber stands), it may be appropriate to accept a blended price for multiple products (e.g. pine chip-n-saw and pine pulpwood) to reduce merchandizing concerns. Weekly or bi-weekly payments are made by Permittee to the refuge based upon the scale and product of the timber removed, then deposited into the Revenue Sharing Account of the Denver Finance Center. When goods or services in the Permit are provided, the documented actual expense of those goods and services is deducted by the Permittee from the following payment(s) until satisfied. When all required goods and services have been provided and expenses deducted, all subsequent payments are net receipts and deposited at the Denver Finance Center into the Refuge Revenue Sharing Account. Timber remains the property of the refuge which retains the burden of unforeseen loss; e.g. flood, tornado damage, etc. until cut by the Permittee. One example of appropriate language in the bid and Permit is:

“The Permittee will provide, conduct, or pay a contractor for goods or services needed to meet the stated goals and objectives, as determined by the Refuge Manager. These may include As designated goods and services are provided, the actual, documented costs of same will be deducted from following payment(s) for the timber until balanced.”

3) Deducted from Lump Sum Bids –Bid and permit terms include a set amount for specific goods and services required to implement the prescribed treatment. The net value of the Permit to harvest trees (total value less set amount for goods and services) is received from the Permittee and deposited into the Revenue Sharing Account of Denver Finance Center. For example, it is determined that \$15,000 of road work would be required to complete a timber sale. If the gross value of the permit is \$100,000, the net value would then be \$85,000. One example of appropriate language in the bid and Permit is:

“To prepare and maintain Refuge roads for logging operations, the Permittee will either conduct or pay a contractor to in locations specified by the Refuge Manager. This is expected to cost for This value is to be deducted from the gross value, resulting in the net value of this Permit with Permittee being required to furnish or pay the expected cost out of pocket.”

A variation of this method includes stating a quantity of resources (e.g. gravel) in the bid and Permit that will be needed to complete the timber operation, such as:

“Prior to logging, the successful bidder must purchase and put on account with a vendor 1,000 tons of GD-8 crushed limestone rock for maintenance of a graveled portion of the logging access route; please bid accordingly.”

4) Potential Costs Bids - A variation of Example 3 is to not specify the amount of the required goods and services, but simply have the bidder take into account the *potential costs* of the requirements explicitly in the request for bids and have the permittee adjust their bid accordingly. Examples of appropriate phrases in the conditions of the permit would be:

“The Permittee will either conduct or pay a contractor at the Permittee’s expense to in locations specified by the Refuge Manager.”

“Roads within the Sale Area: The location of loading decks and logging roads will be mutually agreed to by the Permittee (or his representative) and the Refuge Forester prior to their placement. All primary haul roads used by the Permittee will be left in good condition or blocked after operations are completed by placing logging slash and/or dirt mounds across all entrance points as directed by the Refuge Forester. Those roads to be left open will be maintained and repaired so that the road will not hold standing water any more than the adjacent area. This will require the use of equipment such as a bulldozer and/or grader. Refuge roads will be maintained in pre-entry condition or better by the Permittee. Deteriorating roadbeds will be supplemented with B-stone, or SB-2, as directed by the Refuge Manager; “borrowing” dirt will not be allowed”

“Existing refuge roads used as haul roads will be maintained and repaired by the Permittee from wear caused by logging traffic; this requires a grader. Although the refuge roads are well graveled and dry, the Permittee will be responsible for supplementing with SB2 gravel if the road deteriorates due to logging traffic from this sale.”

Some of the advantages and disadvantages of each Permit Payment Process are identified in the following table:

Permit Payment Processing:		
Method	Advantages	Disadvantages
Lump Sum as Performance Bond with Refunding for Designated Expenses	<ul style="list-style-type: none"> • Actual expenses of sale are covered by sale. • Eliminates risk of refuge having to bear large expenses for sales. • Eliminates risk of Permittee having to bear unknown costs for goods and services. • Transfers risk for damage from insects, fire, wind, etc. to Permittee 	<ul style="list-style-type: none"> • Requires documentation of cost of goods and services for refunding. • Requires requesting Denver Finance Center to transfer funds.
Per Unit Sale with Deductions from Partial Payments	<ul style="list-style-type: none"> • Actual expenses of sale are covered by sale. • Eliminates risk of refuge having to bear large expenses for sales. • Eliminates risk of permittee having to bear unknown costs for goods and services. • Reduces transfer of funds at Denver Finance Center. 	<ul style="list-style-type: none"> • Requires documentation of goods and services for deductions. • The potential for timber theft and fraud by not reporting all loads of timber is greater than lump sum sales. • Refuge retains risk for damage from insects, fire, wind, etc.
Deducted from Lump Sum Bids	<ul style="list-style-type: none"> • Fixed amount provides security for bidders, limits their costs. • Minimizes transfer of funds with Denver Finance Center. • Eliminates risk of potential buyers having to bear unknown costs for goods and services. • Transfers risk for damage from insects, fire, wind, etc. to Permittee 	<ul style="list-style-type: none"> • Necessitates detailed and long-range planning of goods and services that will be required prior to conducting the sale. • Inability to accurately predict costs based on future weather conditions, material prices, and energy costs may result in high or low expense predictions. • If too low, refuge has to make road repairs from their budget. • If too high, excess materials wasted or misapplied.
Potential Costs Bids	<ul style="list-style-type: none"> • Requires less planning by Refuge staff. • Minimizes transfer of funds and associated documentation with Denver Finance Center. • Eliminates risk of refuge having to bear large expenses for sales. 	<ul style="list-style-type: none"> • Potential for high unknown costs to be shouldered by Permittee, results in low bids to offset for high risks, and may also result in fewer bidders (i.e. less competition due to risks and complexities).

Defining Appropriate Expenses: There are expenses for various tasks that are essential to many forest management operations. *To determine whether a particular task and expense is appropriate, a “but for” check can be performed. But for the sale of timber this expense would not have been incurred and but for the expense, the sale would not be consistent with the refuge’s habitat or forest management plan. When both conditions are met, the expense is appropriate.* If either condition is not met, the expense should not be deducted or refunded from the sale. Though not possible to list all potentially appropriate expenses, the examples below include expenses, goods and services that generally meet the “but for” check and could be appropriate to include as a condition of the sale:

- 1) **Providing access to sale areas – Road Management:** Road management is typically the largest expense related to a timber sale. It is essential in most cases to create and maintain or improve haul roads to support truck traffic associated with commercial timber harvest. This is a costly effort which is directly linked to conducting the harvest. These roads may be extraneous to the needs of the refuge after completion of the sale, in which case they must be rehabilitated to return to original condition. In cases in which the refuge chooses to keep the roads for future use, gating or replanting roads may be an acceptable option and would similarly be a requirement of the sale. State Best Management Practices (BMPs) are to be implemented in all these activities.

Examples of Appropriate Expenses:

- a. Road Materials (gravel, aggregate base, culverts, stone, mats, bridges, etc. for crossing drainages/ditches)
- b. Road Construction (bulldozing, road grading, installation of erosion control structures, etc.)
- c. Road Maintenance (smoothing, seeding road sides, gates or other closure structures such as dirt mounds to prevent access, leveling to restore to previous conditions, etc.)

- 2) **Supplies used for the sale:** Supplies are commonly required to conduct a timber sale. These supplies are direct costs of conducting the sale and it is appropriate to deduct expenses from the income.

Examples of Appropriate Expenses:

- a. Tree marking paint
- b. Flagging
- c. Paint guns
- d. Fuel associated with planning, implementing and monitoring the sale
- e. Safety Equipment (ex. snake leggings)

- 3) **Integrated forest management actions:** Actions on the project sale area that include the management of plants, treat impacts of the management action, and serve to meet the habitat objective for which the management action was taken. Care should be used to assure the actions meet the above mentioned “but for” check.

Examples of Appropriate Expenses:

- a. Control of designated plants by cutting, girdling, and/or spraying invasive or other undesirable plants.

- b. Plant seedlings of native species for site restoration after cutting, control of designated plants.
- c. Control of insect outbreak and rehabilitation on areas to be designated as the outbreak expands, such as for Southern Pine Beetle control.

There are as many types of acceptable forest management actions as there are wildlife objectives across the Southeast Region. It is impossible to enumerate all acceptable actions; such a list would by omission improperly designate an acceptable practice as disallowed. Instead, the refuge planning process that leads to a silvicultural prescription should address the management actions needed for a specific project.

- 4) **Providing supplemental expertise:** Many refuges lack sufficient expertise and/or personnel to get started or fully implement approved plans. By obtaining assistance from forestry contractors, local experts and/or Service experts from other refuges, these refuge forests could be managed in accordance with Comprehensive Conservation Plans and Habitat Management Plans with the benefit of additional net receipts deposited into the Revenue Sharing Account.

Examples of Appropriate Expenses:

- a. Preparing implementation plans for the Refuge Manager using approved management plans for guidance, that detail tree marking, logging operations, monitoring, etc.
- b. Marking trees in accordance with approved prescriptions and plans, using independent tree markers to designate the trees to be cut.
- c. Preparing and distributing bid invitations to potential buyers,
- d. Conducting bid openings and providing recommendations,
- e. Inspecting logging for compliance with BMPs and/or Permit terms, etc.
- f. Assessing and/or monitoring of vegetation or wildlife affected by the timber sale.

In all these tasks, as with all contractors, due care should be taken for independence of the contractor, quality assurance during the task, and completion of the task prior to payment for the expense. Tasks and material provided by the permittee as a condition of the Permit are not a federal acquisition, thus Federal Acquisition Regulations do not apply. There are numerous acceptable procedures and a few examples include:

- 1. Permittee will provide specialists to assist with tree marking. A list of approved, independent markers will be provided by the Refuge. These markers will supplement the marking crew and work alongside Refuge tree markers, who will provide guidance, oversight, and accounting of the independent markers.
- 2. Permittee will provide an independent inspector while logging proceeds. A list of approved inspectors will be provided by the Refuge. The inspector is to note various items and issues concerning the logging and report only to the Refuge. The Refuge will assess reports from the inspector, conduct follow-up examinations when deemed prudent, and administer the terms of the Permit, including any appropriate penalty judgment.

Documentation Procedures: The first part of documentation is the planning process. Comprehensive Conservation Plans, Habitat Management Plans, Forest Prescriptions, and Annual Work Plans should address more than harvesting trees. All aspects of habitat

management should be covered through the planning process, including exotic plant control, hazardous fuel reduction, wildlife habitat issues other than those related to merchantable trees, access needs, etc. – all applicable topics should be addressed in the prescription that lays out the implementation plans for a project area. The approval process for the silvicultural prescription accepts or rejects proposed actions that may be conducted as part of the sale of merchantable timber.

The second part of documentation comes during project implementation. Files must include detailed documentation of all the tasks related to the sale, track all refunds or value exchanges, and assurance that expenses are commensurate with those of similar tasks for local private landowners.

Just as refuges have flexibility in determining the appropriate method of timber sale, they also have some flexibility in determining the desired methods to track harvest revenue and expense. Some areas use a load logging report, others a load ticket tracking system while others add electronic monitoring (trail cameras) for monitoring and documentation purposes. Two examples of local-use forms are shown below. The first form (Refund Request) is intended for use with the Permit Payment Processing method 1) Lump Sum with Contractor Refunding for Qualifying Expenses. The second form (Per Unit Revenue and Expense Report) is for use with method 2) Per Unit Sale with Deductions from Partial Payments. The third sample form is a Logging Load Report and could be useful for Per Unit Sales. This report can assist in accounting for each load that leaves a logging deck before scale tickets are turned in a few weeks later, thus reducing the risk of timber theft and fraud from non-reported loads. Regardless of the methods chosen, it is incumbent upon the refuge to account for revenue and expenses and maintain appropriate documentation for each timber harvest.

Summary

Forest management continues to be a critical tool for meeting wildlife habitat objectives on FWS lands. This guidance is provided to help insure refuges remain within the intent of laws, policy and regulations associated with the sale of timber from FWS lands. For further information, please contact the regional forest management program.

Refund Request

Date:		Submitted By:	
Amount of Reimbursement:		Permittee:	
Special Use Permit #:		Worksite:	
Description of Expense: Attach or sketch map			
Signature of Requestor:			
Amount Approved:			
Approved By:		Date:	
Concurrence Signature:		Date:	
Request Submitted:		Date:	
Additional Comments: <div style="text-align: right;">WHR NWR 2009, CW</div>			

Per Unit Revenue and Expense Report

PERMITEE: _____			PERMIT: _____		
DATE: _____			PRODUCT: _____		
COMPARTMENT: _____			PDT. PRICE: _____		
PDM WHR 2009, CS					
DATE	CONTROL #	VOLUME	TOTAL VOL.	VALUE	TOTAL VALUE
TOTALS					

TIMBERSALE SERVICES

DATE	SERVICES			VALUE	TOTAL VALUE
TOTALS					

Logging Load Report

Tract: _____ Permit #: _____ Exp. Date _____ Permittee: _____ Logger: _____

Date	Load # (start over each day)	Time Load Left Landing	Truck name or #	Destination	Species Pine Hdwd		Product √ S/T Poles CNS P/W				Scale Ticket #	Scale mbf or tons	Initials
		am											
		pm											
		am											
		pm											
		am											
		pm											
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Note: Must fill out Report within 10 minutes of a loaded truck pulling away from the landing. Keep Report on loading site at all times so that it can be reviewed during routine logging inspections. Turn report in with scale tickets weekly.

WHR NW
2010, JB

D.7 DELEGATION OF AUTHORITY TO CONDUCT TIMBER SALES



UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Carolina Sandhills National Wildlife Refuge
23734 US Hwy 1
McBee, South Carolina 29101



United States Government Memorandum

To: Chief of Refuges, Southeast Region, Atlanta, GA

Through: Refuge Supervisor, Area 3, Atlanta, GA
Regional Forester, Southeast Region, Atlanta, GA

From: Project Leader, Carolina Sandhills NWR, McBee, SC

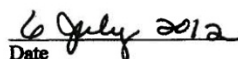
Subject: Timber Sales Approval Authorization

Date: July 6, 2012


In accordance with 5 RM 17.11B (2), I request the authority to issue Special Use Permits (SUP) for timber sales with values not in excess of \$500,000. The authority allows for the collection and processing of timber sale receipts immediately upon issuance of a SUP by the Project Leader or Refuge Manager. The approval will be valid for five years from the date of the final signature or until a change in management occurs. The delegation will streamline the collection and deposit process and will substantially reduce administrative burdens on Regional staff. For timber sales that exceed the delegated amount, the Chief of Refuges will issue and approve the SUP.

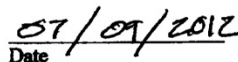
Requested By:


Allyne H. Askins, Project Leader

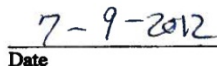

Date

Reviewed By:


Pete Jerome, Area Supervisor, Area 3

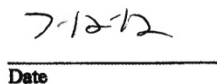

Date


Henry Sansing, Regional Forester


Date

Approved By:


David Viker, Chief of Refuges


Date

TAKE PRIDE
IN AMERICA 

D.8 COMMERCIAL ACTIVITIES SPECIAL USE PERMIT

**United States Department of the Interior
U.S. Fish and Wildlife Service
National Wildlife Refuge System
Commercial Activities Special Use
Application and Permit**

OMB Control Number 1018-0102
Expiration Date: 06/30/2014

Name of Refuge _____

Address _____

Attn: (Refuge Official) _____

Phone # _____ E-mail _____

Application

(To be filled out by applicant. Note: Not all information is required for each use. See instructions at the end of the notice.)

1) ☐ New ☐ Renewal ☐ Modification ☐ Other _____

Applicant Information

2) Full Name: _____ 7) Business Phone #: _____

3) Title: _____ 8) Business Fax #: _____

4) Business Name: _____ 9) E-mail: _____

5) Address: _____ 10) Business Tax ID #: _____

6) City/State/Zip: _____

11a) Within the past 5 years, has the company (entity) or any of the owners of the business been convicted, pled nolo contendere, forfeited collateral, or are currently under charges for any violations of any State, Federal, or local law, or regulations related to fish and wildlife or permit activities? ☐ Yes ☐ No

11b) If you answered "YES" to question #11a, provide: a) individual's name, b) date of charge, c) charge(s), d) location of incident, e) court, and f) action taken for each violation.

12) Assistants/subcontractors/subpermittees: (List full names, addresses and phone #'s and specifically describe services provided if subcontractors are used.)

Activity Information

(Depending on the activity for which you are requesting a permit, we may ask you for the following activity information. Please contact the specific refuge where the activity is being conducted to determine what information is required.)

13) Activity type: ☐ Guiding hunters ☐ Guiding anglers ☐ Guiding other outdoor users
☐ Commercial filming ☐ Agriculture ☐ Cabins ☐ Other _____

14a) State, Federal or tribal licenses required for activity: ☐ Yes ☐ No

14b) License type: _____ Number: _____ Date: _____

FWS Form 3-1383-C
03/11

15) Describe activity: (Specifically identify timing, frequency, and how the activity is expected to proceed.)

16) Location: (Specifically identify location; GPS location preferred.)

17a) Is map of location(s) required?

☐ Yes ☐ No ☐ N/A

17b) Is map of location(s) attached?

☐ Yes ☐ No

18) Estimated number of clients: Per Day _____ Per Season _____

19) Activity/site occupancy timeline: (Specifically identify beginning and ending dates, site occupation timeline, hours, clean-up and other major events.)

20a) Is Plan of Operation required?

☐ Yes ☐ No ☐ N/A

20b) Is Plan of Operation attached?

☐ Yes ☐ No

21a) Is trip schedule required?

☐ Yes ☐ No ☐ N/A

21b) Is trip schedule attached?

☐ Yes ☐ No

Insurance Coverage/Certifications/Permits

22a) Is grounding/flight insurance required?

☐ Yes ☐ No ☐ N/A

Carrier type: _____ Policy #: _____

22b) Is contaminants insurance required?

☐ Yes ☐ No ☐ N/A

Carrier type: _____ Policy #: _____

22c) Is medical evacuation insurance required?

☐ Yes ☐ No ☐ N/A

Carrier type: _____ Policy #: _____

23a) Is rat free certification required?

☐ Yes ☐ No ☐ N/A

Copy of certification provided:

☐ Yes ☐ No

23b) Is hull inspection certification required?

☐ Yes ☐ No ☐ N/A

Copy of certification provided:

☐ Yes ☐ No

23c) Is EMT/first aid certification required?

☐ Yes ☐ No ☐ N/A

Copy of certification provided:

☐ Yes ☐ No

23d) Are other certifications required?

☐ Yes ☐ No ☐ N/A

Copy of certification provided:

☐ Yes ☐ No

24a) Are State permits required?

☐ Yes ☐ No ☐ N/A

Copy of permits provided:

☐ Yes ☐ No

24b) Are Federal permits required?

☐ Yes ☐ No ☐ N/A

Copy of permits provided:

☐ Yes ☐ No

24c) Are tribal permits required?

☐ Yes ☐ No ☐ N/A

Copy of permits provided:

☐ Yes ☐ No

24d) Are other permits required?

☐ Yes ☐ No ☐ N/A

Copy of permits provided:

☐ Yes ☐ No

Logistics and Transportation

25a) Does activity require personnel to stay overnight onsite?

☐ Yes ☐ No

25b) Personnel involved:

26) Specifically describe all equipment/gear and materials used:

27a) Transportation description(s) and license number(s) to access refuge(s): (Provide description of and specific auto license/boat/plane registration number(s).)

27b) Specifically describe ship-to-shore transportation:

27c) Specifically describe intersite transportation:

27d) Specifically describe onsite transportation:

28a) Is fuel cache needed?

☐ Yes ☐ No ☐ N/A

28b) Specific location(s) of fuel caches: (GPS Coordinates preferred)

29a) Is Safety Plan required?

☐ Yes ☐ No ☐ N/A

29b) Is Safety Plan attached?

☐ Yes ☐ No

Work and Living Accommodations

30) Specifically describe onsite work and/or living accommodations, including spike camps:

31) Specifically describe on or offsite hazardous material storage or other on or offsite material storage space: (Including on and offsite fuel caches.)

32) Signature of Applicant _____ Date of Application: _____

Sign, date, and print this form and return it to the refuge for processing.
Do not fill out information below this page.

PRINT FORM

FWS Form 3-1383-C
03/11

For Official Use Only (This section to be filled out by refuge personnel only.)

Special Use Permit

Permit #: _____

1) Date: _____ 2) ☐ Permit Approved ☐ Permit Denied 3) Station #: _____

4) Additional special conditions required: (Special conditions may include activity reports, before and after photographs, and other conditions.)

☐ Yes ☐ No ☐ N/A

Additional sheets attached:

☐ Yes ☐ No

5) Received details on any Conviction(s) and/or Notice of Violation(s): ☐ Yes ☐ No ☐ N/A

6) Other licenses/permits required:

☐ Yes ☐ No ☐ N/A

Verification of other licenses/permits, type:

7) Insurance/certifications required:

☐ Yes ☐ No ☐ N/A

Verification of insurance/certification, type:

8) Minimum requirements analysis has been conducted:

☐ Yes ☐ No ☐ N/A

Assessment attached:

☐ Yes ☐ No

9) Record of Payments: ☐ Exempt ☐ Partial ☐ N/Full

10) Bond Paid: ☐ Yes ☐ No ☐ N/A

Amount of payment: _____ Record of partial payment: _____

This permit is issued by the U.S. Fish and Wildlife Service and accepted by the applicant signed below, subject to the terms, covenants, obligations, and reservations, expressed or implied herein, and to the notice, conditions, and requirements included or attached. A copy of this permit should be kept on-hand so that it may be shown at any time to any refuge staff.

Permit approved and issued by (Signature and title):

_____ Date: _____

Permit accepted by (Signature of applicant):

_____ Date: _____

**APPENDIX E. APPROPRIATE USE AND COMPATIBILITY
DOCUMENTS LIST**

Activity	Document/Location	Date/Expiration
Boating	Compatibility Determination/Comprehensive Conservation Plan (CCP)	5/25/2010; 2020
Camping	Appropriate Use Determination/FILE	6/28/2013
Cemetery Upkeep	Compatibility Determination/CCP	5/25/2010; 2020
Commercial Timber Harvest for Wildlife Habitat Improvement	Compatibility Determination/CCP	5/25/2010; 2020
Cooperative Farming	Compatibility Determination/CCP	5/25/2010; 2020
Dog Training and Field Trials	Appropriate Use Determination/CCP	4/9/2010
Environmental Education and Interpretation	Compatibility Determination/CCP	5/25/2010; 2025
Fishing	Compatibility Determination/CCP	5/25/2010; 2025
Horseback Riding	Compatibility Determination/CCP	5/25/2010; 2020
Hunting	Compatibility Determination/CCP	5/25/2010; 2025
Natural Resource Collection – Pine Straw (Commercial)	Appropriate Use Determination/CCP	4/9/2010
Natural Resources Collection – Personal Use	Compatibility Determination/CCP	5/25/2010; 2020

Odd-road Vehicles in support of Mobility-Impaired Recreation	Compatibility Determination/CCP	5/25/2010; 2020
Organized Sporting Competitions	Appropriate Use Determination/CCP	4/9/2010
Outdoor Recreation, e.g., hiking, biking, picnicking, etc.	Compatibility Determination/CCP	5/25/2010; 2020
Public Safety Training	Compatibility Determination/CCP	5/25/2010; 2020
Scientific Research and Collections	Compatibility determination/CCP	5/25/2010; 2020
Wildlife Observation & Photography	Compatibility Determination/CCP	5/25/2010; 2025
Youth Camping	Compatibility determination/CCP	5/25/2010; 2020

APPENDIX F. HMP AND CCP GOALS AND OBJECTIVES CROSSWALK

The objectives and strategies within the Habitat Management Plan are stepped down from Sub-goals and Objectives found in the Carolina Sandhills NWR Comprehensive Conservation Plan (2010). This Appendix provides a crosswalk to understand the relationship between these two documents.

HMP OBJECTIVES	HMP STRATEGIES	CCP SUB-GOALS AND OBJECTIVES
Objective 1: Improve and maintain overall quality of 35,093 ac of longleaf pine ecosystem	Strategies 1, 2, 3, 4, 5, 6, 14, 15, 16	Sub-Goal 1N – Objective 1, 3; Sub-Goal 2A – Objectives 1, 2, 3, 4; Naturally Regenerated Canopy Forests – Objectives 1, 2, 3, 4, 5; Plantations – Objectives 1, 2, 3, 4; Sub-Goal 1N – Objective 1; Sub-Goal 2B – Objectives 1, 2, 3, 4; Sub-goal 2C – Objectives 2, 3, 4, 7; Sub-Goal 2D – Objective 1, 2; Sub-Goal 2E – Objectives 1, 2, 3, 4; Sub-Goal 2G – Objective 1, 2
Objective 2: Maintain and protect 6,691 ac of embedded wetlands	Strategies 7, 8, 14, 16	Sub-Goal 1G – Objective 2; Sub-Goal 2C – Objective 5, 6; Sub-Goal 2F – Objectives 1, 2, 3, 4; Sub-Goal 2G – Objective 2; Sub-Goal 2J – Objective 4
Objective 3: Manage RCW towards recovery	Strategies 1, 2, 3, 4, 5, 6, 9, 10, 14, 15, 16	Sub-Goal 1A – Objective 6; Sub-Goal 1B – Objective 1; All Sub-Goals and Objectives pertaining to HMP Objective 1
Objective 4: Provide quality Big 6 through habitat enhancements in impoundments	Strategies 7, 11, 12, 13, 14, 16	Sub –Goal 1F – Objectives 1, 2, 3; Sub-Goal 1H – Objective 1; Sub-Goal 1N – Objective 1; Sub-Goal 2G – Objective 2; Sub-Goal 2J – Objectives 1, 2, 3, 4; Sub-Goal 4C – Objectives 1, 2, 3, 4; Sub-Goal 4D – Objectives 1,
Objective 5: Provide quality Big 6 through habitat enhancements in grasslands and fields	Strategies 2, 6, 13, 14, 15, 16	Sub-Goal 1C – Objectives 1, 2; Sub-Goal 2E – Objectives 1, 2, 3; Sub-Goal 2G – Objectives 1, 2, 3; Sub-Goal 2H – Objectives 1, 2, 3; Sub-Goal 2I – Objectives 1, 2; Sub-Goal 4B – Objectives 1, 2; Sub-Goal 4D – Objectives 1, 2, 3, 4, 5

APPENDIX G. ENVIRONMENTAL ACTION STATEMENT

U. S. FISH AND WILDLIFE SERVICE

ENVIRONMENTAL ACTION STATEMENT FOR CATEGORICAL EXCLUSION

Within the spirit and intent of the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA), and other statutes, orders, and policies that protect fish and wildlife resources, I have established the following administrative record and determined that the following proposed action is categorically excluded from NEPA documentation requirements consistent with 40 CFR 1508.4, 43 CFR 46.205, 43 CFR 46.210, 43 CFR 46.215, and 516 DM 8.

PREFERRED ALTERNATIVE.

The preferred alternative is the approval and implementation of the Habitat Management Plan (HMP) for Carolina Sandhills National Wildlife Refuge (NWR). This plan is a step-down management plan providing the refuge manager with specific guidance for implementing goals, objectives, and strategies identified in the Carolina Sandhills NWR Comprehensive Conservation Plan (CCP (2010)).

The Environmental Assessment of the CCP (Draft CCP and EA (2009) considered three alternatives and selected Alternative C for the preferred alternative (Final CCP (2010)). The CCP was to optimize refuge operations by balancing enhanced habitat and fish and wildlife population management and wildlife-dependent public uses. 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; 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; increase growing season burning; and, consider use of fall burning for hazardous fuel reduction and seed bed preparation in advance of cone crop drop.

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 the South Carolina Department of Natural Resources (SCDNR), Cheraw State Park, and Sandhills State Forest to manage RCWs as one recovery population. 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.

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 Treefrogs 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 South Carolina Partners in Amphibian and Reptile Conservation (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.

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 youth deer hunt
- Adding 10 days in December to the current 10 days in February for raccoons
- Designating youth units in “closed area” along Wildlife Drive
- Selecting 5 to 6 primary ponds and lakes to provide recreational fishing opportunities and stocking as needed with native fishes.

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.

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. 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 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. (CSNWR CCP 2010).

The CCP has defined goals, objectives and strategies to achieve the stated action. The actions further detailed in the HMP have been identified, addressed, and authorized by the Carolina Sandhills NWR CCP and accompanying Environmental Assessment (2010). These include:

Goal: 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.

Objective 1: *During the 15- year time span of the HMP, improve the overall quality of 35,093 acre longleaf pine community found on the refuge, along with associated 6,691 acres of bottomland forest, pocosins and canebrakes. Quality of the longleaf pine community will be measured through the use of a constructed longleaf pine integrity index that takes into consideration important components of natural historically occurring longleaf pine communities. Management actions during the 15 year HMP cycle will be targeted toward improving overall refuge-wide integrity scores by 5-10%. (CSNWR CCP: Sub-Goal 1N – Objective 1, 3; Sub-Goal 2A – Objectives 1, 2, 3, 4; Naturally Regenerated Canopy Forests – Objectives 1, 2, 3, 4, 5; Plantations – Objectives 1, 2, 3, 4; Sub-Goal 1N – Objective 1; Sub-Goal 2B – Objectives 1, 2, 3, 4; Sub-goal 2C – Objectives 2, 3, 4, 7; Sub-Goal 2D – Objective 1, 2; Sub-Goal 2E – Objectives 1, 2, 3, 4; Sub-Goal 2G – Objective 1, 2, pp. 81-105).*

Objective 2: *During the 15 year time frame of the HMP, maintain and protect 6,691 acres of embedded wetlands including bottomland forest and associated unique communities such as: canebrakes, pocosin wetlands, Atlantic-white cedar and bogs, that are interspersed within the overarching longleaf pine community. (CSNWR CCP: Sub-Goal 1G – Objective 2; Sub-Goal 2C – Objective 5, 6; Sub-Goal 2F – Objectives 1, 2, 3, 4; Sub-Goal 2G – Objective 2; Sub-Goal 2J – Objective 4, pp 81-105).*

Objective 3: *Carolina Sandhills NWR will manage at least 35,000 acres of longleaf pine vegetation communities during the 15 year time frame of the HMP to progress toward achieving 177 Red-Cockaded Woodpecker clusters that support at least 157 potential breeding groups. (CSNWR CCP: Sub-Goal 1A – Objective 6; Sub-Goal 1B – Objective 1; All Sub-Goals and Objectives pertaining to HMP Objective 1, pp. 81-105).*

Objective 4: *During the 15 year time span of the HMP, continue to provide the "Big 6" recreational opportunities for refuge visitors to both view wetland dependent wildlife, and provide fishing opportunities within appropriate wetland impoundments, by maintaining quality habitat for both wetland wildlife and fish populations within impoundments conducive*

to each. (CSNWR CCP: Sub-Goal 1F – Objectives 1,2 , 3; Sub-Goal 1H – Objective 1; Sub-Goal 1N – Objective 1; Sub-Goal 2G – Objective 2; Sub-Goal 2J – Objectives 1, 2, 3, 4; Sub-Goal 4C – Objectives 1, 2, 3, 4; Sub-Goal 4D – Objectives 1, pp. 81-105).

Objective 5: *During the 15 year time span of the HMP, continue to provide “Big 6” recreational opportunities for refuge visitors to both view upland wildlife dependent upon grassland and small forest openings, as well as, enhance refuge upland game hunting experience, by maintaining small forest openings, grassland/seepage bog community, and 240 acres of planted food crops. (CSNWR CCP: Sub-Goal 1C – Objectives 1, 2; Sub-Goal 2E – Objectives 1, 2, 3; Sub-Goal 2G – Objectives 1, 2, 3; Sub-Goal 2H – Objectives 1, 2, 3; Sub-Goal 2I – Objectives 1, 2; Sub-Goal 4B – Objectives 1, 2; Sub-Goal 4D – Objectives 1, 2, 3, 4, 5, pp. 81-105).*

CATEGORICAL EXCLUSION(S).

Categorical Exclusion Department Manual 516 DM 6, Appendix 1 Section 1.4 B (10), which states “the issuance of new or revised site, unit, or activity-specific management plans for public use, land use, or other management activities when only minor changes are planned. Examples could include an amended public use plan or fire management plan.”, is applicable to implementation to the proposed action.

Consistent with Categorical Exclusion (516 DM 6, Appendix 1 Section 1.4 B (10)) the HMP is a step-down management plan which provides guidance for implementation of the general goals, objectives, and strategies established in the CCP, serving to further refine those components of the CPP specific to habitat management. This HMP does not trigger an Exception to the Categorical Exclusions listed in 516 DM 2 Appendix 2.

Minor changes or refinements to the CCP in this activity-specific management plan include:

- Habitat management objectives are further refined by providing numerical parameter values that more clearly define the originating objective statement.
- Habitat management objectives are restated so as to combine appropriate objectives or split complicated objectives to provide improved clarity in the context of the HMP.
- Specific habitat management guidance, strategies, and implementation schedules to meet the CCP goals and objectives are included (e.g. location, timing, frequency, and intensity of application).
- All details are consistent with the CCP and serve to provide the further detail necessary to guide the refuge in application of the intended strategies for the purpose of meeting the habitat objectives.

PERMITS/APPROVALS.

Endangered Species Act, Intra-Service Section 7 Consultation was conducted during the CCP process. The determination was a concurrence that the CCP will not likely adversely affect the red-cockaded woodpecker, Eastern pumas (cougar) or any other federally listed endangered or threatened species, their formally designated critical habitat, or species currently proposed for Federal listing under the Endangered Species Act, as amended (signed June 19, 2009, pg. 205-209 of CSNWR, CCP).

Other Items to include that should be listed and can be found in the EA accompanying the final CCP:

Appropriate Use Determinations and Compatibility Determinations for the following uses:

- Hunting;
- Fishing;
- Wildlife Observation and Photography;
- Environmental Education and Interpretation;
- Cooperative Farming;
- Commercial Tree Harvest for Wildlife Habitat Improvement;
- Boating;
- Public Safety Training and Military Exercises;
- Natural Resource for Personal Use;
- Cemetery Upkeep;
- Scientific Research and Collections;
- Off-road vehicles in Support of Mobility Impaired Hunters;
- Outdoor Recreation;
- Youth Camping; and
- Horseback Riding.

PUBLIC INVOLVEMENT/INTERAGENCY COORDINATION.

The proposed HMP is a step-down of the approved CCP for CSNWR. The development and approval of the CCP included appropriate NEPA documentation and public involvement. An Environmental Assessment was conducted (Draft CCP and EA 2010) which proposed and addressed management alternatives and environmental consequences.

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 information garnered from these reviews helped the planning team analyze and develop recommendations for the CCP.

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 CCP. 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 (i.e., objectives and strategies to accomplish the vision).

A notice of intent to prepare a CCP 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 CCP. 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.

The Draft CCP/EA was available for public comment from January 22, 2010 through February 23, 2010. In addition, refuge staff presented information at civic clubs and community organizations (Friends of Carolina Sandhills NWR, Kiwanis, Rotary, etc.), about the CCP process along with information about becoming involved. In accordance with Service guidelines and National Environmental Policy Act recommendations, public involvement was crucial throughout the development of the CCP. The plan was written with input and assistance from the public, conservation partners, and others.

Refer to CCP for specific comments and Service response.

SUPPORTING DOCUMENTS.

Supporting documents for this determination include relevant office file material and the following key references (i.e. cropland management plan, impoundment management plan, fire management plan, forest management plan, revised or new CDs, etc...).

- U.S. Fish and Wildlife Service. 1995. Forest Management Plan for Carolina Sandhills National Wildlife Refuge. McBee, SC.
- U.S. Fish and Wildlife Service. 2008. Forestry and Fire Review for the Carolina Sandhills National Wildlife Refuge. McBee, SC. 51 pp.
- U.S. Fish and Wildlife Service. 2009. Fire Management Plan for Carolina Sandhills National Wildlife Refuge. McBee, SC.

- 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. 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. 2007b. Carolina Sandhills National Wildlife Refuge – Biological Review Report. Columbia Migratory Bird Field Office, Columbia, NC.
- 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. 2010. Carolina Sandhills National Wildlife Refuge, Comprehensive Conservation Plan.
- U.S. Fish and Wildlife Service. 2010. Carolina Sandhills National Wildlife Refuge, draft Comprehensive Conservation Plan and Environmental Assessment.


Project Leader

4-17-14
Date


Regional Refuge NEPA Coordinator

4/29/2014
Date