
**DRAFT COMPREHENSIVE CONSERVATION PLAN
AND ENVIRONMENTAL ASSESSMENT**

CURRITUCK NATIONAL WILDLIFE REFUGE
Currituck County, North Carolina

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

The U.S. Fish and Wildlife Service has prepared this Draft Comprehensive Conservation Plan and Environmental Assessment to guide the management of Currituck National Wildlife Refuge in Currituck County, North Carolina. The plan outlines programs and corresponding resource needs for the next 15 years, as mandated by the National Wildlife Refuge Improvement Act of 1997.

Before the Service began planning, it conducted a biological review of the refuge's wildlife and habitat management program and conducted public scoping meetings to solicit public opinion of the issues the plan should address. The biological review team was composed of biologists from federal and state agencies and nongovernmental organizations that have an interest in the refuge. The refuge staff held the public scoping meetings at four locations on four evenings. The staff also held another round of public meetings to solicit public reaction to the proposed alternatives.

The Service developed and analyzed three alternatives. Alternative 1 was a proposal to maintain the status quo. The refuge currently manages its impoundments by managing water levels and vegetation to create 50% good vegetation for migrating waterfowl, but does not manage for mudflats for shorebirds. It also manages marshes with prescribed fire. The staff surveys waterfowl on a routine basis. The refuge allows the six priority public use activities: hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation. The staff conducts environmental education and interpretation on an as-requested basis only. The refuge currently has seven staff members, all of whom are stationed at Mackay Island National Wildlife Refuge. They spend 2.85 full-time equivalent (FTE) staff years at Currituck National Wildlife Refuge and 4.15 FTE staff years on Mackay Island.

Alternative 2 proposed moderate program increases. The refuge would develop a habitat management plan and manage all habitats on the refuge. The refuge would manage its impoundments by managing water levels and vegetation to create 60% good vegetation for migrating waterfowl and 20% mudflats in the spring for shorebirds when feasible. The staff would monitor vegetation in the marshes before and after prescribed burns and inventory vegetation in the maritime swamp forest. They would survey a wide range of wildlife on the refuge. The refuge would continue to allow the six priority public use activities, but would have the capacity to increase the number of opportunities. The staff would conduct regularly scheduled environmental education and interpretation programs. The Service would partner with the North Carolina Wildlife Resources Commission to use the environmental education center being built by the Commission in Corolla. There would be fifteen staff members, four of whom would be stationed at Currituck and eleven of whom would be stationed at Mackay Island. They would spend 7.2 FTE staff years at Currituck and 7.8 FTE staff years at Mackay Island. The staff would include a biologist, public use specialist, refuge operations specialist, and law enforcement officer.

Alternative 3 proposed substantial program increases. The refuge would develop a habitat management plan and manage all habitats on the refuge. The refuge would manage its impoundments by managing water levels and vegetation to create 70% good vegetation for migrating waterfowl and 20% mudflats in the spring and 10% in the fall for shorebirds. The staff would survey invertebrates in the mudflats to determine the effect of management. The staff would monitor vegetation in the marshes before and after prescribed burns, adapt the burn plan to the monitoring results, and inventory vegetation in the maritime swamp forest. They would survey all wildlife on the refuge. The refuge would increase further the number of public use opportunities. The Service would use the environmental education center being built by the North Carolina Wildlife Resources Commission. There would be twenty-four staff members, seven of whom would be stationed at

Currituck and seventeen of whom would be stationed at Mackay Island. They would spend 12.75 FTE staff years at Currituck and 11.25 FTE staff years at Mackay Island. The staff would include separate law enforcement officers and public use specialists for each refuge.

The staff selected Alternative 2 as its preferred alternative. It advances the refuge program considerably, and is more realistic than Alternative 3 in terms of expected staffing levels to conduct the proposed program.

SECTION A. DRAFT COMPREHENSIVE CONSERVATION PLAN

I. Background

INTRODUCTION

The U.S. Fish and Wildlife Service (Service) has developed this Draft Comprehensive Conservation Plan to provide a foundation for the management and use of Currituck National Wildlife Refuge in Currituck County, North Carolina. The plan will serve as a guide for the refuge's management programs and actions over the next 15 years.

The Service developed this plan in compliance with the National Wildlife Refuge System Improvement Act of 1997 and Part 602 (National Wildlife Refuge System Planning) of the Fish and Wildlife Service Manual. The actions described within this plan also meet the requirements of the National Environmental Policy Act of 1969. The Service achieved compliance with this Act through the involvement of the public and the incorporation of an Environmental Assessment in this document, which describes the alternatives considered and an analysis of the environmental consequences of the alternatives. When fully implemented, this plan will strive to achieve the vision and purposes of Currituck National Wildlife Refuge.

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

A planning team prepared the plan. The planning team consisted of representatives from various Service programs, including the divisions of Refuges, Fisheries, Ecological Services, Realty, and Migratory Birds. In developing this plan, the planning team and the refuge staff incorporated the input of local citizens and the general public through a series of stakeholder and public scoping meetings. A description of this public involvement and the planning process itself are provided in Chapter III, Plan Development.

The plan represents the Service's proposed alternative and is being put forward after considering two other alternatives, as described in the accompanying Draft Environmental Assessment (Section B). After reviewing a wide range of public comments and management needs, the planning team developed these alternatives in an attempt to determine how to best meet the goals and objectives of Currituck National Wildlife Refuge. The proposed alternative is the Service's recommended course of action for the future management of the refuge, and forms the basis for this comprehensive conservation plan.

PURPOSE AND NEED FOR THE PLAN

The purpose of this comprehensive conservation plan is to identify the role that Currituck National Wildlife Refuge will play in support of the mission of the National Wildlife Refuge System, and to provide long-term guidance to the refuge's management programs and activities for the next 15 years. The plan is needed to

- provide a clear statement of direction for the future management of the refuge;

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

Perhaps the greatest need of the Service is to communicate with the public and include public participation in its efforts to carry out the mission of the National Wildlife Refuge System. Many agencies, organizations, institutions, businesses, and private citizens have developed relationships with the Service to advance the goals of the Refuge System. This Draft Comprehensive Conservation Plan supports the Partners in Flight Initiative; South Atlantic Coastal Plain Migratory Bird Conservation Plan; North American Waterfowl Management Plan; Western Hemisphere Shorebird Reserve Network; and National Wetlands Priority Conservation Plan.

U.S. FISH AND WILDLIFE SERVICE

The U.S. Fish and Wildlife Service is the primary federal agency responsible for the conservation, protection, and enhancement of the Nation's fish and wildlife populations and their habitats. Although the Service shares some conservation responsibilities with other federal, state, tribal, local, and private entities, it has specific trustee obligations for migratory birds, threatened and endangered species, anadromous fish, and certain marine mammals. In addition, the Service administers a national network of lands and waters for the management and protection of these resources.

As part of its mission, the Service manages more than 540 national wildlife refuges covering a total of more than 93 million acres. These areas comprise the National Wildlife Refuge System, the world's largest collection of lands and waters specifically managed for fish and wildlife. The majority of these lands, 77 million acres, lie in Alaska. The remaining 16 million acres are spread across the other 49 states and several island territories.

NATIONAL WILDLIFE REFUGE SYSTEM

The mission of the System, as defined by the National Wildlife Refuge System Improvement Act of 1997, is:

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

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

- fulfill the mission of the Refuge System;

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

Following passage of the Act in 1997, the Service immediately began efforts to carry out the direction of the new legislation, including the preparation of comprehensive conservation plans for all refuges. The development of these plans is now ongoing nationally. Consistent with the Act, The Service is preparing all refuge comprehensive conservation plans in conjunction with public involvement, and each refuge is completing its own plan within a 15-year schedule.

Approximately 37.5 million people visited the country's national wildlife refuges in 1998, mostly to observe wildlife in their natural habitats. As this visitation continues to grow, substantial economic benefits are being generated to the local communities that surround the refuges. Economists have reported that national wildlife refuge visitors contribute more than \$400 million annually to the local economies. In addition, the National Survey of Fishing, Hunting, and Wildlife-associated Recreation reports that nearly 40 percent of the country's adults spent \$108 billion on wildlife-related recreational pursuits in 2001 (U.S. Fish and Wildlife Service 2001).

Volunteerism continues to be a major contributor to the successes of the Refuge System. In 1998, volunteers contributed more than 1.5 million person-hours on the refuges nationwide, a service valued at more than \$20.6 million.

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

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

REFUGES OF THE ECOSYSTEM

Currituck National Wildlife Refuge is one of the ten national wildlife refuges in eastern North Carolina. Those ten national wildlife refuges—Alligator River, Cedar Island, Currituck, Great Dismal Swamp, Mackay Island, Mattamuskeet, Pea Island, Pocosin Lakes, Swanquarter, Roanoke River, and the Back Bay National Wildlife Refuge in Virginia—are all located in the watersheds of the Roanoke, Tar, Neuse, and Cape Fear rivers, which has been classified as Ecosystem Unit #34 by the U.S. Fish and Wildlife Service.

LEGAL POLICY CONTEXT

A variety of international treaties, federal laws, federal regulations, department and Service policies, and presidential executive orders guide the administration of Currituck National Wildlife Refuge. The documents and acts listed in Appendix III contain management options under the refuge's establishing authority; the National Wildlife Refuge Administration Act of 1966; and the National Wildlife Refuge System Improvement Act of 1997, the legal and policy guidance for the operation of national wildlife refuges.

NATIONAL CONSERVATION PLANS AND INITIATIVES

Along with the Service's legal mandates and initiatives, other planning activities directly influence the development of the comprehensive conservation plan. Various groups and agencies develop and coordinate planning initiatives involving federal, state, and local agencies; local communities; nongovernmental organizations; and private individuals to help restore habitats for fish and wildlife on and off public lands.

The Service is initiating cooperative partnerships in an effort to reduce the declining trend in biological diversity. Biological planning for species groups targeted in this plan reflects the North American Waterfowl Management Plan. The North American Waterfowl Management Plan of 1986 brings together international teams of biologists from private and government organizations from Canada and the United States. The partnerships, called joint ventures, are working to restore waterfowl and other migratory bird populations to the levels of the early 1970s by protecting about 6 million acres of priority wetland habitats from the Gulf of Mexico to the Canadian Arctic.

The United States Shorebird Conservation Plan and the Waterbirds for the Americas outline approaches to conserving those species groups. Restoration of migratory songbird populations is a high priority of the Partners in Flight Plan. It also provides strategies for conserving and managing wintering, breeding, and migration habitat for midcontinental wood duck and colonial bird populations.

The Partners in Flight Plan emphasizes landbird species as a priority for conservation. Habitat loss, population trends, and the vulnerability of species and habitats to threats are all factors used in the priority ranking of species. Further, biologists have identified focal species for each habitat type from which they will determine population and habitat objectives and conservation actions. This list of focal species, objectives, and conservation actions will aid migratory bird management on the refuge.

The Farm Bill programs administered by the U.S. Department of Agriculture provide cost-share funding and technical assistance to private landowners to install and manage conservation practices on working farms and forests and to restore cropland to natural habitats. The programs provide opportunities for landowners in the vicinity of national wildlife refuges to better manage their land as wildlife habitat or protect it with easements.

RELATIONSHIP TO STATE PARTNERS

A provision of the National Wildlife Refuge System Improvement Act of 1997, and subsequent agency policy, is that the Service shall ensure timely and effective cooperation and collaboration with other federal agencies and state fish and wildlife agencies during the course of acquiring and managing refuges. This cooperation is essential in providing the foundation for the protection and management of fish and wildlife throughout the United States.

The North Carolina Wildlife Resources Commission is a state-partnering agency with the Service charged with enforcement responsibilities for migratory birds and endangered species, as well as managing the state's natural resources. It also manages approximately 1.8 million acres of game lands in North Carolina.

The Commission coordinates the state's wildlife conservation program and provides public recreation opportunities, including an extensive hunting and fishing program, on several game lands and from several boat ramps located near Currituck National Wildlife Refuge. The Commission's participation and contribution throughout this comprehensive conservation planning process has been valuable. It is continuing its work with the Service to provide ongoing opportunities for an open dialogue with the public to improve the condition of fish and wildlife populations in North Carolina. Not only has the Commission participated in biological reviews, stakeholder meetings, and field reviews as part of the comprehensive planning process, it also is an active partner in the planning and coordination of annual hunting seasons and various wildlife and habitat surveys. Currituck National Wildlife Refuge provides hunting opportunities for waterfowl in cooperation with the Commission. A key part of the comprehensive planning process is the integration of common mission objectives between the Service and the Commission, where appropriate.

II. Refuge Overview

INTRODUCTION

LOCATION AND SIZE

Currituck National Wildlife Refuge is located in Currituck County in the northeastern corner of North Carolina. The refuge is named for the county where it is located. The refuge's approved acquisition boundary lies entirely in Currituck County (population 18,190).

The city of Virginia Beach, Virginia (population 425,257) is about 27 miles north of the refuge. Other nearby cities include Chesapeake, Virginia (population 199,184), 27 miles northwest; and Norfolk, Virginia (population 234,403), about 31 miles northwest (Figure 1).

The refuge covers a total of 4,570 acres in fee title ownership and 3,931 acres in conservation easements. It is bounded by Currituck Sound on the west; the Atlantic Ocean on the east; the city of Virginia Beach on the north; and Dare County, North Carolina, on the south. This region is part of a physiographic area known as the South Atlantic Coastal Plain. The area is also part of the Fish and Wildlife Service's administrative ecosystem known as the Roanoke–Tar–Neuse–Cape Fear Ecosystem.

ESTABLISHMENT

The refuge was established on August 2, 1983, by the Migratory Bird Conservation Commission through the authority of the Migratory Bird Conservation Act of 1929. The Service established the refuge's approved acquisition boundary of 18,015 acres in 1981.

REFUGE HISTORY AND PURPOSES

ACQUISITION HISTORY

The Service acquired 1,770 acres in 1985 by fee simple purchase and 166 acres by conservation easement. Since 1985, the refuge has acquired 2,800 additional acres in fee simple purchase for a total of 4,570 acres. It has added 3,931 acres of conservation easements (Table 1).

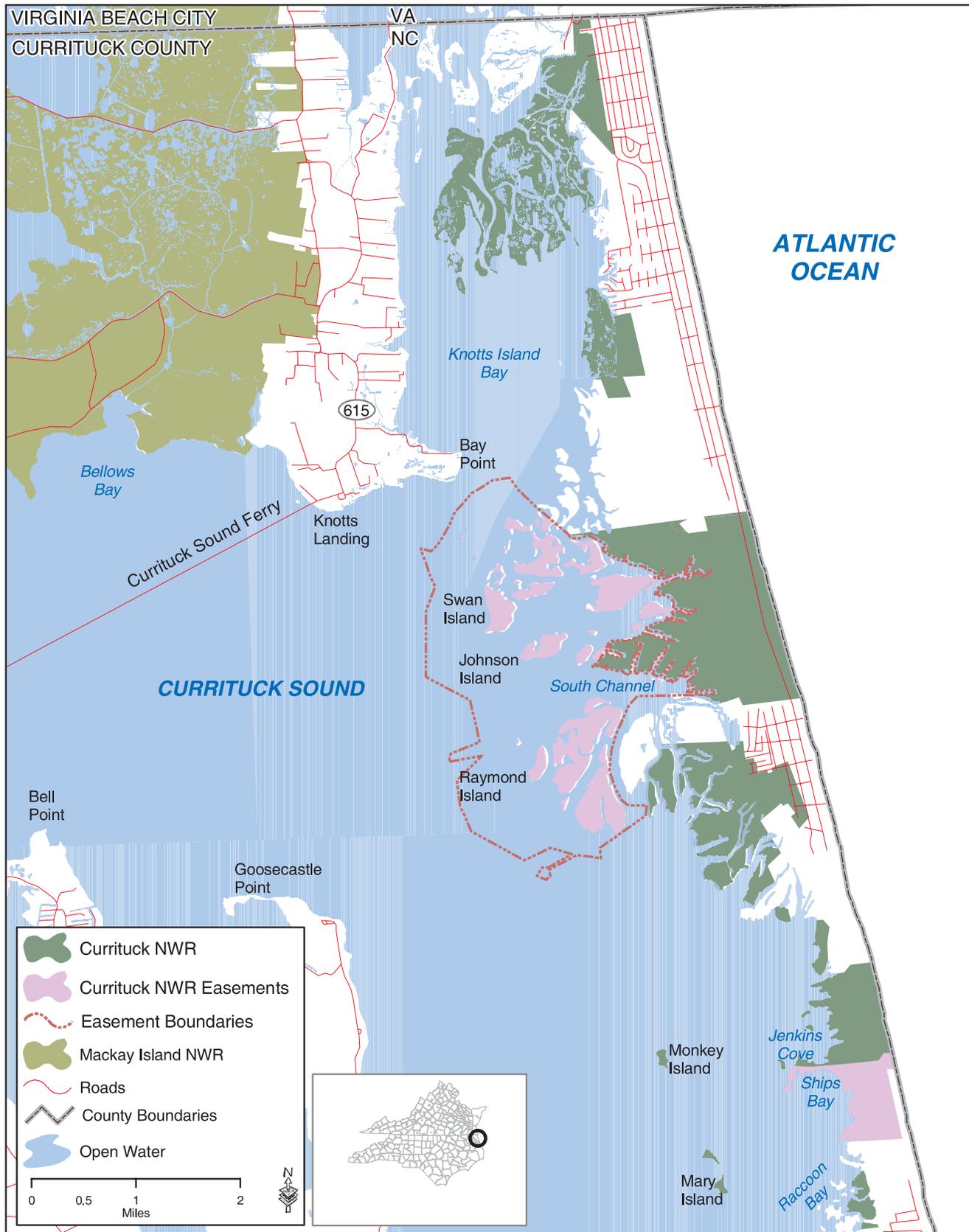
PURPOSES

The purpose of Currituck National Wildlife Refuge, as reflected in the legislation under which Congress authorized the refuge and the Service has acquired land, is to protect and conserve migratory birds and other wildlife resources through the protection of wetlands, in accordance with the following laws:

...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds... 16 U.S.C. Sec. 664 (Migratory Bird Conservation Act of 1929)

...for (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species... 16 U.S.C. Sec 460k-1 (Refuge Recreation Act of 1962)

Figure 1. Location of Currituck National Wildlife Refuge, Currituck County, North Carolina



The North American Waterfowl Management Plan's Atlantic Coast Joint Venture office, working through a collaborative effort with private, state, and federal agencies, has established certain habitat objectives for the physiographic area.

Table 1. Acquisition history of Currituck National Wildlife Refuge

FEE SIMPLE ACQUISITIONS						
YEAR	TRACTS	ACRES	COST	COST ACRE	TOTAL ACRES	TOTAL COST
1984	1	17.97	\$380,000	\$21,146	17.97	\$380,000
1985	1	1,747.78	\$3,430,000	\$1,962	1,765.75	\$3,810,000
1988	1	54.21	\$0	\$0	1,819.96	\$3,810,000
1997	3	1,576.28	\$1,285,200	\$815	3,396.24	\$5,095,200
1998	2	889.64	\$1,600,848	\$1,799	4,285.88	\$6,696,048
2003	1	284.00	\$2,327,336	\$8,195	4,569.88	\$9,023,384
TOTAL	9	4,569.88	\$9,023,384	\$1,974		
EASEMENT ACQUISITIONS						
YEAR	TRACTS	ACRES	COST	COST ACRE	TOTAL ACRES	TOTAL COST
1985	2	225.76	\$120,000	\$531	225.76	\$120,000
1996	1	3,705.00	\$0	\$0	3,930.76	0
TOTAL	3	3,930.76	\$120,000	\$31		\$120,000

Table 2. The Nature Conservancy ranking of vegetative communities of Currituck National Wildlife Refuge

Vegetative Community	State Rank	Global Rank
Maritime Evergreen Forest	S1	G2
Maritime Swamp Forest	S2	G2
Maritime Dry Grassland	S2	G3
Tidal Freshwater Marsh	S2	G4
Maritime Shrub	S3	G4
S1 = Critically imperiled in North Carolina because of extreme rarity or otherwise very vulnerable to extirpation in the state.		
S2 = Imperiled in North Carolina because of rarity or otherwise very vulnerable to extirpation in the state.		
S3 = Rare or uncommon in North Carolina.		
G1 = Critically imperiled globally because of extreme rarity or otherwise very vulnerable to extinction throughout its range.		
G2 = Imperiled globally because of rarity or otherwise very vulnerable to extinction throughout its range.		
G3 = Either very rare or local throughout its range, or found locally in a restricted area.		

SPECIAL DESIGNATIONS

The North Carolina Natural Heritage Program has designated most of the refuge, with the exception of the moist soil management area, as a Significant Natural Heritage Area. The Nature Conservancy ranks certain vegetative communities as imperiled or rare (Table 2).

The North Carolina Division of Water Quality has designated several water bodies in the vicinity of Currituck National Wildlife Refuge as outstanding resource waters or high quality waters.

The North Carolina Division of Marine Fisheries has designated several streams and water bodies within and off the borders of the refuge as anadromous fish spawning habitats.

ECOSYSTEM CONTEXT

Currituck National Wildlife Refuge lies within the South Atlantic Coastal Plain physiographic region (Figure 2). The South Atlantic Coastal Plain was once a 25 million-hectare complex of forested wetlands and uplands, dunes, and marshes that extended from Florida to North Carolina. Historically, the extent and duration of seasonal flooding along the ecosystem's rivers has fluctuated annually, recharging the South Atlantic Coastal Plain's aquatic systems and creating a rich diversity of dynamic habitats that supported a vast array of fish and wildlife resources.

REGIONAL CONSERVATION PLANS AND INITIATIVES

Along with the Service's legal mandates and initiatives, other planning activities directly influence the development of the comprehensive conservation plan. Various groups and agencies develop and coordinate planning initiatives involving regional, state, and local agencies; local communities; nongovernmental organizations; and private individuals to help restore habitats for fish and wildlife on and off public lands.

The Service is initiating cooperative partnerships in an effort to reduce the declining trend in biological diversity. Biological planning for species groups targeted in this plan reflect the North American Waterfowl Management Plan, which includes the Atlantic Coast Joint Venture; the joint venture between the North Carolina Wildlife Resources Commission and Fish and Wildlife Service; the Partners in Flight Plan; and the South Atlantic Migratory Bird Initiative.

The Atlantic Coast Joint Venture focus is that of the middle and upper Atlantic coast. Within the Atlantic Coast Joint Venture was the joint venture formed between the North Carolina Wildlife Resources Commission, Fish and Wildlife Service, and private conservation organizations.

The South Atlantic Coastal Plain serves as a primary migration habitat for migratory songbirds returning from Central and South America. It also provides wintering, breeding, and migration habitat for mid-continental wood duck and colonial bird populations. Restoration of migratory songbird populations is a high priority of the Partners in Flight Plan for the South Atlantic Physiographic Region.

The Partners in Flight Plan emphasizes land bird species as a priority for conservation. Habitat loss, population trends, and the vulnerability of species and habitats to threats are all factors used in the priority ranking of species. Further, biologists from local offices of the Service, the North Carolina Wildlife Resources Commission, and conservation organizations such as the Audubon Society and The Nature Conservancy have identified focal species for each habitat type from which they will determine population and habitat objectives

Figure 2. Currituck National Wildlife Refuge in the South Atlantic Coastal Plain physiographic area



and conservation actions. This list of focal species, objectives, and conservation actions will aid migratory bird management on the refuge.

The Farm Bill programs administered by the U.S. Department of Agriculture each have state-level plans and priority ranking systems in which the Service has input. The Service also utilizes those programs to assist private landowners in the vicinity of national wildlife refuges manage habitat for wildlife or protect their land with easements.

The North Carolina Wildlife Resources Commission has its own Comprehensive Wildlife Conservation Strategy to help direct the state's allocation of funds from the federally funded State Working Grants Program. The Service has provided input to the development and execution of the strategy.

ECOLOGICAL THREATS AND PROBLEMS

HABITAT LOSS AND FRAGMENTATION

The South Atlantic Coastal Plain has changed markedly over the last 100 years as civilization spread throughout the area. An estimated 40 percent of the coastal plain's natural vegetation has been lost to land conversion. The greatest changes to the landscape have been in the form of land clearing for agriculture and urban development (Hunter et al. 2001).

Although these changes have allowed people to settle and earn a living in the area, they have had a tremendous effect on biological diversity, biological integrity, and environmental health of the South Atlantic Coastal Plain. Vast areas of bottomland hardwood forests have been reduced to forest fragments ranging in size from very small tracts of limited functional value to a few large areas that have maintained many of the original functions and values of forested values. Severe fragmentation has resulted in a substantial decline in biological diversity and integrity. Species endemic to the South Atlantic Coastal Plain that have become extinct, endangered, or threatened include the red wolf and red-cockaded woodpecker (Table 3).

Breeding bird surveys show continuing declines in species and species populations. The avian species most adversely affected by fragmentation include those that are area-sensitive (dependent on large continuous blocks of hardwood forest); those that depend on forest interiors; those that depend on special habitat requirements such as mature forests or a particular food source; and/or those that depend on good water quality. Nest parasitism is also common in fragmented forests.

More than 300 species of breeding migratory songbirds are found in the region. Some of these, including the Swainson's warbler, prothonotary warbler, swallow-tailed kite, wood thrush, and cerulean warbler, have declined substantially and need the benefits of large forested blocks to recover and sustain their existence.

Table 3. Federally listed threatened and endangered animal species in the Coastal Plain of North Carolina

Region	Status	Common name	Scientific Name
Coastal Plain	Endangered	Manatee, West Indian	Trichechus manatus
Coastal Plain	Endangered	Sea Turtle, Hawksbill	Eretmochelys imbricata
Coastal Plain	Endangered	Sea Turtle, Kemp's Ridley	Lepidochelys kempii
Coastal Plain	Endangered	Sea Turtle, Leatherback	Dermochelys coriacea
Coastal Plain	Endangered	Stork, Wood	Mycteria americana
Coastal Plain	Endangered	Sturgeon, Shortnose	Acipenser brevirostrum
Coastal Plain	Endangered	Tern, Roseate	Sterna dougallii
Coastal Plain	Endangered	Whale, Finback	Balaenoptera physalus
Coastal Plain	Endangered	Whale, Humpback	Megaptera novaeangliae
Coastal Plain	Endangered	Whale, Right	Balaena glacialis
Coastal Plain	Endangered	Whale, Sea	Balaenoptera borealis
Coastal Plain	Endangered	Whale, Sperm	Physeter catodon
Coastal Plain	Endangered	Wolf, Red	Canis rufus
Coastal Plain	Endangered	Woodpecker, Red-cockaded	Picoides borealis
Coastal Plain	Threatened	Alligator, American	Alligator mississippiensis
Coastal Plain	Threatened	Eagle, Bald	Haliaeetus leucocephalus
Coastal Plain	Threatened	Plover, Piping	Charadrius melodus
Coastal Plain	Threatened	Sea Turtle, Green	Chelonia mydas
Coastal Plain	Threatened	Sea Turtle, Loggerhead	Caretta caretta
Coastal Plain	Threatened	Silverside, Waccamaw	Menidia extensa

Fragmentation has also brought the forest edge and brown-headed cowbird (a seed-eating bird common in agricultural areas) closer to the natural nesting sites of many forest interior-nesting birds. The brown-headed cowbird is a parasitic nester that lays eggs in the nests of other birds, rather than building a nest of its own. Nestling cowbirds are typically bigger and more aggressive, and out-compete the young of the species building the nest. This results in poor reproductive success and declining populations of forest interior-nesting species that are forced to nest near forest edges.

Fragmentation of bottomland hardwood forests has left many of the remaining forested tracts surrounded by a sea of agricultural lands. Intensive agriculture has removed most of the forested corridors along sloughs that formerly connected the forest patches. The loss of connectivity between the remaining forested tracts hinders the movement of wildlife between tracts and reduces the functional values of many remaining smaller forest tracts. The lost connections also result in a loss of gene flow. Restoring the connections to allow gene flow and reestablish travel corridors is particularly important for some wide-ranging species such as the black bear.

ALTERATIONS TO HYDROLOGY

In addition to the loss of vast acreages of bottomland forested wetlands, substantial alterations have occurred in the region's hydrology due to managed stream flows from flood control and hydroelectric power generation reservoirs; drainage ditches; river channel modifications; flood control levees; deforestation; and degradation to aquatic systems from excessive sedimentation, contaminants, and urban development.

The natural hydrology of a region is directly responsible for the connectedness of forested wetlands and indirectly responsible for the complexity and diversity of habitats through its effects on topography and soils. Natural resource managers recognize the importance of dynamic hydrology to forested wetlands and waterfowl-habitat relationships (Fredrickson and Heitmeyer 1988).

Instead of natural hydrology, large-scale, man-made hydrological alterations have changed the spatial and temporal patterns of flooding throughout the entire South Atlantic Coastal Plain. In addition, these alterations have modified both the extent and duration of annual seasonal flooding. The alteration of this annual flooding regime has had a tremendous effect on the forested wetlands and their associated wetland-dependent species. Specifically, the combination of managed stream flows and drainage ditches in bottomland forests exposes the forests to more frequent flooding than occurs naturally, drains the back swamps through natural levees, and floods the back swamps at low flows through the ditches.

In view of the hydrologic changes, it is very difficult, if not impossible, to fully emulate and reconstruct the structure and functions of a natural wetland. According to Mitsch and Gosselink (1993), restoration of wetland functions is especially difficult because wetlands depend on a dynamic interface of hydrologic regimes to maintain water, vegetation, and animal complexes and processes.

SILTATION OF AQUATIC ECOSYSTEMS

Aquatic systems, including lakes, rivers, sloughs and bayous, have been degraded as a result of deforestation and hydrologic alteration. Clearing of bottomland hardwood forests has led to an accelerated accumulation of sediments and contaminants in all aquatic systems. Many water bodies are now filled with sediments, greatly reducing their surface area and depth. Concurrently, the non-point source runoff of excess nutrients and contaminants is threatening the area's remaining aquatic resources. Turbidity caused by sediment limits light penetration into the water and consequently the growth of submerged aquatic vegetation. The federal threatened and endangered species list for the coastal plain of North Carolina includes four species of aquatic organisms that are listed as threatened and 10 species that are listed as endangered.

Hydrologic alterations have basically eliminated the geomorphologic processes that created oxbow lakes, sloughs, and river meander scars. Consequently, the protection, conservation, and restoration of these aquatic resources take on an added importance in light of the alterations associated with flood control and navigation.

PROLIFERATION OF INVASIVE AQUATIC PLANTS

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

CONSERVATION PRIORITIES

The declines in the South Atlantic Coastal Plain's dune, marsh, shrub, and forest communities and their associated fish and wildlife resources have prompted the Service to designate the Currituck Banks an area of special concern. A collaborative effort involving private, state, and federal conservation partners is now underway to implement a variety of tools to restore the functions and values of wetlands and other coastal habitats in the South Atlantic Coastal Plain. The goal is to prioritize and manage areas to most effectively maintain and possibly restore the biological diversity in the South Atlantic Coastal Plain. Some areas are prioritized as focus areas for intensive management, others for reforestation, and still others for preservation.

Conservation agencies and organizations have initiated several coordinated efforts to set priorities and establish focus areas to overcome the impacts of hydrologic changes and forest fragmentation. Conservationists established a cooperative private–state–federal partnership, known as the North American Waterfowl Management Plan, Atlantic Coast Joint Venture, in 1986 to help provide sufficient wintering waterfowl habitat throughout the Atlantic Coastal Plain.

The initial Atlantic Coast Joint Venture effort for waterfowl has expanded to also establish breeding bird objectives for shorebirds and neotropical migratory forest-nesting birds. The Atlantic Coast Joint Venture is working with the U.S. Shorebird Conservation Working Group to establish step-down objectives for shorebird foraging habitat for the fall migration period throughout the South Atlantic Coastal Plain.

Partners in Flight has developed bird conservation plans to focus a number of private, state, and federal restoration programs into specific areas in an effort to provide maximum program benefits for neotropical migratory songbirds. The goal of this collaborative restoration effort is to provide islands or blocks of habitat, especially forested habitat, in an otherwise highly fragmented landscape. The targeted block sizes range from 10,000 to 100,000 acres. Such areas are large enough to support viable populations of various suites of neotropical migratory songbirds. Of course, these areas would also support other species that depend on large forested blocks. Existing or proposed state wildlife management areas or national wildlife refuges are the anchors of the plans. These public lands serve as centers of biodiversity that landowners and managers enhance and support by the expansion of forested blocks, either through public or private management.

One of the biggest challenges to the management and restoration efforts underway in the South Atlantic Coastal Plain, and one that affects refuges in particular, is the need to meet long-term management objectives that address comprehensive ecosystem needs, including those of wintering migratory waterfowl, neotropical migratory birds, shorebirds, large mammals, and other wide-ranging species. Often management for one species or species group conflicts with the management objectives for another species or species group. The tendency is to pursue short-term priorities that frequently change as scientific knowledge expands and interests in special resources shift. Agencies and organizations must exercise caution to prevent the start-up of management and restoration actions that are difficult to reverse and fail to meet the long-term, comprehensive management needs of the ecosystem or a specific area within the ecosystem. An example might be a tendency to suppress large areas of shrubs in an effort to provide habitat for species of neotropical migratory songbirds that require a marsh habitat, such as the sharp-tailed sparrow and seaside sparrow. Such an approach may overlook the critical habitat needs of other songbirds that prefer a scrub/shrub habitat, such as the painted bunting.

The habitat goals of the Atlantic Coast Joint Venture can only be met through active management of croplands, moist soil areas, and forested wetlands on both public and private lands (Reinecke and Baxter 1996). Active management (i.e., vegetation manipulation and hydrology restoration) is required to compensate for the spatial and temporal habitat changes that have been caused by deforestation and hydrologic alterations throughout the South Atlantic Coastal Plain. When properly managed, Currituck National Wildlife Refuge would make a substantial contribution to meeting the objectives of the Atlantic Coast Joint Venture. Setting habitat and species objectives from the perspective of the South Atlantic Coastal Plain is advantageous because it looks at the big picture and enables managers to plan and provide habitat for a diversity of species throughout their range.

Although the management of marshes, shrub/scrub areas, and forest stands is probably the best solution for restoring the vast forests that have been altered, it must be remembered that hydrology (flooding) drives the ecological system in the South Atlantic Coastal Plain. The plant and animal community throughout the South Atlantic Coastal Plain is dependent upon the hydrologic cycle. It is incumbent upon land managers to manage hydrology in an effort to restore the ecological diversity that once characterized the South Atlantic Coastal Plain. Refuges can install impoundments and structures to control and manage water in an effort to mimic historic flood cycles and to meet wildlife habitat objectives.

CHALLENGES

In order for Currituck National Wildlife Refuge to meet its multiple objectives of national, regional, and local scope—ranging from marsh management to reducing habitat fragmentation to providing for public use—it must be funded and staffed well above current levels. Securing adequate funding and personnel and then implementing a variety of programs to achieve the best balance of all objectives, through a system of coordinated planning, is the refuge's biggest challenge. In the interim, as the needed funding and personnel become available, the refuge must concentrate on its highest priorities without committing irreversible actions that would preclude future implementation of the desired management programs.

PHYSICAL RESOURCES

CLIMATE

Currituck National Wildlife Refuge exhibits a maritime climate because of its proximity to the Atlantic Ocean and the surrounding bays and sounds. Winter temperatures on the average are milder than those of mainland weather stations. The refuge's summer temperatures are also cooler than those on the mainland.

Because the flow of air over North Carolina is predominantly from west to east, the continental influence is much greater on most of the state than the ocean or marine influence. Therefore, the area experiences a fairly large variation in temperature from winter to summer.

The Gulf Stream current flows only a short distance off the North Carolina coast. One might think this "river" of warm water would have a profound effect on the climate. Its direct effects are limited by the fact that the prevailing winds in winter are westerly.

Lows usually reform along the coast as "Cape Hatteras lows" and then move north along the coast. Winter's low-pressure storms are usually more intense because of the large north-to-south contrasts.

Winter storms bring prolonged periods of steady rain and are responsible for most of the winter precipitation. The forms of precipitation in spring begin to change from steady rains to occasional thunderstorms. The Gulf of Mexico's warm, moist air produces warm, humid weather throughout the summer. Rainfall comes from occasional thunderstorms. Autumn, North Carolina's driest season, is to many people the most pleasant, with its many clear, warm days and cool nights with little rain. This weather usually lasts until November.

The study area is situated along a coastline with a long history of storm activity. Two basic storm types present a substantial threat to the coastal zone. Tropical storms and hurricanes, spawned over the warm ocean waters of the Gulf of Mexico and the Atlantic Ocean, are probably the best known and feared storms. Hurricanes, which are characterized by winds greater than 75 miles per hour and accompanied by intense rainfall, plague the Gulf and Atlantic seabords from midsummer to late autumn. During the 1950s, a total of nine hurricanes affected the North Carolina coastline. Since then, only seven major hurricanes have occurred along the Outer Banks.

Most storms pass off the coast east of the Currituck National Wildlife Refuge, but many bring large quantities of rain to the refuge. These extratropical storms, often called "northeasters," present a greater problem than hurricanes to the Atlantic coast, the Outer Banks in particular. Such storms may develop as strong low-pressure areas and move slowly offshore into the Atlantic Ocean. The winds, sometimes reaching hurricane force, blow onshore from a northerly or easterly direction for sustained periods of time. The damage from these storms may ultimately far exceed the destruction from a hurricane. The March 1962 "northeaster," also known as the "Ash Wednesday Storm," proved that point decisively. The flood height and duration of extratropical storms often have equaled or exceeded those of hurricanes affecting North Carolina.

Most North Carolina tornadoes occur in the Piedmont and the interior of the coastal plain, which spares Currituck County.

The average annual precipitation is 46 inches, and the average annual snowfall is 3 inches. The record daily snowfall was 14.2 inches at Norfolk, Virginia, and 25 inches at Elizabeth City, North Carolina. Snow accumulations of more than one inch for more than a day are rare. Rainfall is evenly distributed throughout the year; the average monthly rainfall ranges from 2.98 in November to 5.17 in July. Ten months have an average precipitation between 3 and 5 inches. Of the total annual precipitation, about 25 inches usually falls in April through September. The growing season for most crops falls within this period.

The average relative humidity in mid-afternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 85 percent. The sun shines 65 percent of the time in the summer and 60 percent in the winter. The prevailing wind is from the southwest. The average wind speed is highest, 10 miles per hour, in the spring. The average daily maximum temperature is 68 degrees Fahrenheit, and the average daily minimum is 51 degrees.

In January the average temperature is 40 degrees; the average daily minimum temperature is 32 degrees; and the average daily maximum is 48 degrees. In July the average temperature is 79 degrees; the average daily maximum temperature is 89; and the average daily minimum is 71.

The average growing season is 247 days long. The average last date of frost in the spring is March 20 and the first frost in the fall is November 23.

GEOLOGY

The northern Currituck Banks are part of an extensive coastal lowland that stretches from Newfoundland southward to Florida, and westward into the Gulf of Mexico. The submerged portion of this landmass, the continental shelf, varies in width from 300 miles off the coast of Newfoundland, 150 miles off the middle Atlantic coast, and to less than five miles off the coast of Florida. The emergent area of this land mass is the coastal plain, which extends from southern New Jersey to Florida. These two units comprise the Atlantic Coastal Plain, a major physiographic province (Fenneman 1938).

Continental Shelf. The continental shelf begins at the beach face where there is a steepening of slope to a depth of about 30 feet. The gradient then decreases to approximately two feet per mile until a depth of slightly over 100 feet is reached; then the gradient increases to approximately one foot per 20 feet.

Coastal Plain. Pliocene and lower Pleistocene sediments in the Carolinas were deposited in several distinct basins believed to be the result of structural downwarping, possibly due to reactivation of older fault systems. These depocenters were the loci of marine embayments and are bounded by arches over which less sedimentation has occurred. The major Pliocene–Pleistocene depocenter in North Carolina, the Albemarle embayment, occupied most of northeastern North Carolina and extended into southeastern Virginia (Ward et al. 1991).

The Coastal Plain Province lies east of the Piedmont Province. The boundary is the "Fall Line," which is a broad transition zone where the crystalline rocks of the Piedmont (i.e., the igneous and metamorphic rocks that cause the rapids in the Roanoke River at Roanoke Rapids) become buried by the marine sediments of the Coastal Plain. Near the western border of the coastal plain at elevations greater than 270 feet, the depositions are different from those found farther east and are classified as high level gravels, sand, and clay, indicative of continental origin. Underlying the coastal plain are older bedrock formations of Cretaceous age, overlain with deposits of sand and clay.

Below this elevation, the surface layers of sand and clays, which vary in thickness from 10 to 40 feet, occur as belts 10 to 15 miles wide that lie at different elevations of sea level and extend in a northeast–southwest direction across the region. It is commonly agreed that these are marine terraces of Pleistocene origin (Oaks and Coch 1973). Each terrace is located at an elevation that reflects the sea level at that time. Geologists have subdivided these terraces into more distinct ridges and scarps to better reflect their respective morphology and stratigraphy.

The tidewater region is bounded on the west by the Suffolk scarp, which passes just west of the Dismal Swamp in Virginia extending south into North Carolina, and on the east by a series of shallow embayments. This region of the coastal plain is characterized by low, often poorly drained land generally averaging less than 20 feet above sea level. The only other areas of greater elevation in this region are sand ridges, such as the Pungo and Knotts Island ridges in Virginia, the Powells Point ridge in North Carolina, and large sand hills located on the Currituck Banks.

Thin beds of Quaternary sediments were deposited on the surface of the Coastal Plain during the past three million years (Riggs and Belknap 1988). This Quaternary history and the resulting surface veneer of unconsolidated sediments directly dictates the general characteristics of the coastal plain, including the regional morphology and character of the drainage systems and flooded estuaries, soil types, and potential land use. Quaternary sediments were deposited by the coastal system, which rapidly migrated back and forth across the coastal plain–continental shelf as the sea level fluctuated in response to repeated episodes of glaciation and deglaciation. Within this rapidly changing coastal

system, extremely varied sediments (including gravel, sands, clays, and peat in all possible combinations) were deposited in river, estuarine, barrier island, and continental shelf environments. The Quaternary history continues today.

Barrier Islands. The last unit in the coastal plain physiography is the barrier island. These units were formed when melting glaciers caused a worldwide rise in the sea level. Later, the slowing of sea level rise set a combination of factors in motion to create barrier islands on the shallow shelf. The bays and estuaries that have formed behind these barriers have become shallow, due to sediments received from river systems draining the coastal plain and overwash from storm surges.

Along the Currituck Banks, inlets have periodically formed and reformed depending on the occurrence of storms, amount of sedimentation, the tidal heights, and degree of vegetation of the barrier beach. These inlets, when they were active, enabled the embayments to exist as true estuarine environments.

Theories of Barrier Island Formation. The Outer Banks barrier beach complex is of relatively recent geologic origin. When the sea level began to rise at the end of the last glacial period (15,000 years ago), coastal processes began to create this barrier island complex. There are various theories as to the method of formation of these islands. The earliest theories stated that barrier islands formed as the ocean pushed up ridges of sand off the sea floor, with new islands continually forming offshore (Johnson 1919).

Two other basic theories are presently being debated. Fisher (1962) has proposed that the barrier islands began as spits located downdrift from eroding headlands. Hoyt (1967) maintains that the barrier beach system formed during the last 5,000 years when the Holocene sea level rise slowed down. Dune ridges had a chance to build up along a seashore that was some distance seaward of the present coast. The rising sea then isolated the dune ridges from the mainland and lagoons or embayments formed behind them.

It appears that the “multiple causality” approach introduced by Schwartz (1971), which proposes a combination of factors, is the most valid of all proposed theories to date.

The formation of the Outer Banks represents a combination of several processes, with submergence being the primary process.

Barrier Island Dynamics. Currituck Spit and the surrounding Outer Banks islands are primarily perpetuated by the following processes: longshore currents, tides and tidal currents, wave action, storm surges and wind action. These dynamic ongoing processes, coupled with sea level rise, cause the shorelines and dune environments to undergo constant change. The adaptability of these islands to constant physical change is a major part of their natural ecology (Godfrey and Godfrey 1976). Unlike the much more stable interior lands such as the Appalachian Highlands and Piedmont, where ecosystems have changed little for thousands of years, the entire barrier island system is less than 5,000 years old. Some alterations of the dune system can be measured in centuries with noticeable changes occurring in mere decades. The Currituck Spit has undergone many physical changes, such as barrier island migration, inlet formation, and marsh building.

Shorelines along the Currituck coast from Cape Henry to Oregon Inlet have undergone varying degrees of erosion and accretion. Beach profile data for this area allows a comparison of recent beach changes and historical changes. Sutton and Goldsmith (1976) showed historical shoreline changes between Cape Henry and Cape Hatteras over the greatest period of time for which data is available. Studies by Goldsmith et al. (1977) and Dolan et al. (1979) involving measurements of beach profiles from Cape Henry to False Cape State Park, parallel the historic data and indicate alternating areas of erosion and accretion. Additional data indicates that the coastline south of False Cape State Park to Duck, North Carolina, also contains alternating areas of accretion and erosion.

Barrier Dunes. The Currituck Spit is 1-1/2 to 2 miles wide and extends from just south of Salt Pond near Sandbridge, Virginia, to Oregon Inlet, North Carolina, a distance of 69 miles. Two linear chains of dunes border the barrier beach along most of the coast. In Virginia, large portions of these dunes have been stabilized since the late 1930s through Civilian Conservation Corps programs and various state and federal dune maintenance programs. Elevations of dune crests typically range from 15 to 25 feet. A few large dunes such as Lewark Hill, north of Corolla, and Whalehead Hill, just south of Corolla, exceed 60 feet.

Goldsmith has divided the dunes into four basic types (Goldsmith et al. 1977): vegetated dunes, artificial or manmade dunes, medianos, and parabolic dunes.

Vegetated dunes form as sand accumulates around existing vegetation, which acts as a sand-trapping baffle, and also as an internal skeleton fixing the dunes in place. This type of dune is generally found in the foredune or frontal dune line. In the study area, the highest and most prominent vegetated dunes are located at the north end of Virginia Beach (Cape Henry) and in False Cape State Park where they reach 30 feet.

Artificially induced dunes have their origins in dune fencing, vegetation planting, bulldozing, and man-induced sedimentation. Frequently, these types of dunes are accidental in origin. Sand builds around beach homes, shipwrecks, or discarded vehicles. Municipalities and landowners in Currituck County use dune fencing in an effort to slow wave erosion and protect homes built close to the beach. They also carry out bulldozing on a small scale to prevent blowouts from forming on the frontal dunes.

Medianos are large isolated hills of sand, asymmetrical in profile and lacking vegetation. Within the study area, the tendency of medianos is to migrate in a southwesterly direction. These dunes have characteristic slipfaces of unconsolidated sand facing the southwest. There are about 24 medianos in Currituck County with elevations up to 75 feet, such as Lewark Hill, and with migration rates up to 40 feet per year, such as Jones Hill (1940–1975). The building of these medianos depends primarily on wind direction and intensities. It is these dunes that have historically destroyed or interfered with towns, roads, and maritime forests on the Outer Banks.

The last dune type, parabolic dunes, are similar to medianos in that they have a slipface formed in direct response to the wind and have a deflation zone within their concave side. Unlike medianos, their internal geometry is characteristic of vegetated dunes and is fixed in place. Parabolic dune complexes sometimes evolve from unvegetated sand sheets and often from medianos. They occur in False Cape State Park and also in southern Currituck County (Goldsmith et al. 1977).

Hennigar (1979) delineated a sequence of dune succession for Currituck Spit. Active, unvegetated sand sheets first break up into discrete sand hills, which in turn are stabilized by vegetation. These sand hills or medianos become semi-vegetated, large parabolic dunes. Dune fencing promotes this sequence by creating a stable foredune that reduces sand supply to the interior of the spit. Portions of the study area are presently in early stages of dune succession. Man's influence on these dunes during certain vegetation stages may be critical in affecting the stability of improvement within the area.

Wind Effects. The role of wind in both the erosion and accretion aspects of dune dynamics is obviously critical. Wind is essential in the dune building as well as other long-term processes such as barrier island migration and marsh formation. Prevailing winds on the Currituck Spit (north–northeast in September–February and southwest from March–August) have greatly influenced the establishment of an artificial frontal dune system in the Back Bay and False Cape area. Averaging 11.7 miles per hour throughout the year, winds have promoted dune succession by creating massive dune complexes from unvegetated sand sheets. There are examples of this wind effect in Currituck County. Some sand hills such as Barbour's Hill (just north of the Virginia/North Carolina line) and Whalehead Hill south of Corolla have migrated 2-1/2 feet per year and 18 feet per year, respectively (Gutman 1978). The migration rate differences are due primarily to the degree of vegetation of each hill and the supply of sediments. Besides sand movement within the barrier island complex, the prevailing winds create "blowouts" or cut into the foredune in unvegetated areas, thus allowing overwash during periods of storm surges. This can be detrimental or beneficial, depending on the barrier protection philosophies.

Wave Effects. Waves, along with other environmental factors such as wind, currents, tides, storms, and sea level rise, interact with the sand of the beach to form the complex and dynamic shoreline and beach characteristics observed daily and seasonally. Sand transport, which is influenced by wave direction and energy, is critical in both accretion and erosion processes along the study area coastline. Beach profile studies, conducted during periods of both low wave activity and periods of higher wave activity including storm surge, have confirmed the existence of alternating areas of erosion and accretion.

The overwash process is another factor of wave action. This process, defined as "continuation of the uprush over the crest of the most landward (storm) berm" (Shepard 1973), is essential in the survival of barrier islands during a period of slowly rising sea level. It allows the barrier island to "migrate" as a unit by depositing sediments toward the rear of the island and often into the lagoon behind. Areas along the foredune line that are weakened and/or lowered by blowouts and vehicular passage serve as corridors for penetration of the overwash. During severe storms, such as in March 1962, large sections of the barrier dune were flattened to form extensive washover flats with sediment being deposited into bay waters. Portions of the coastline north of Corolla and north of the Dare County line have been identified in *The Currituck Plan for Outer Banks* (1972) as areas of potential overwash and termed unsuitable for development.

Inlet Areas. Inlets are temporary features that form when a spit or barrier island is breached by severe storm surges. They are important both in the geomorphic evolution of the barrier island complex and in the maintenance of the ecological productivity of estuaries. Although there are no active inlets within the study area at the present time, several inlets have severed the Currituck Spit in previous years. Of the five inlets that have been active along the spit, two relict flood tidal deltas can easily be delineated. The relict delta of the "Old Currituck Inlet" is located on the west side of the barrier island in the Carova Beach area. This inlet, which was the basis for establishing the original North Carolina/Virginia boundary, migrated southward before closing in 1731.

The relict tidal delta for the “new Currituck Inlet” is located approximately four miles south of Carova Beach. This inlet was active from 1713 to 1828. Potential inlet areas can be identified by the narrowness of the barrier island, frequent overwash zones, and low profile foredune ridges (Fisher 1962).

SOILS

The soil types identified on the refuge are Corolla fine sand; Corolla and Duckston fine sands; Currituck mucky peat;* Duckston fine sands; Duneland; Duneland and Newhan fine sands; Newhan fine sands; Newhan and Corolla fine sands; Osier fine sand;* and Ousley fine sand (USDA Soil Conservation Service 1982a, 1982b). Soils with an asterisk are listed as hydric in *Hydric Soils of the United States* (USDA Soil Conservation Service 1985). Hydric soils are . . . "soils that in their undrained condition are saturated, flooded or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic (water-loving) vegetation" (USDA Soil Conservation Service 1985) (Figure 3 and Table 4).

Most of the refuge is Currituck mucky peat, an organic soil with 60 inches of mucky peat and muck over sand. It floods routinely with tidal fluctuations and has a water table from the surface to one foot below the surface. Currituck soils support freshwater and brackish herbaceous marsh vegetation.

Duckston fine sands occur on the eastern edge of the Currituck soils. They have 72 inches of fine sand with rapid permeability above the water table. They are somewhat poorly drained with water tables from one to two feet below the surface. They flood more than once every two years, but only for two to seven days. Duckston soils support shrub and herbaceous vegetation adapted to poor drainage.

Corolla fine sand and Newhan fine sand are well-drained soils that occur under the dunes on the eastern edge of the refuge. Corolla fine sand occurs on the backsides of dunes and has 15 inches of fine sand over sandy subsoil. The water table is one and a half to three feet below the surface. Corolla soils support herbaceous dune vegetation that is adapted to good drainage, but not necessarily tolerant of extremely droughty conditions. They are also excellent soils for building construction, but are poor filters for septic systems.

Newhan fine sand occurs on low flats along the edges of freshwater marshes and has five inches of fine sand over sandy subsoil. The water table is more than six feet below the surface. Newhan soils also support herbaceous vegetation that is the most drought tolerant and salt tolerant. They are also excellent soils for building construction, but are poor filters for septic systems.

Osier fine sand occurs on the tops of dunes and has 45 inches of fine sand over sandy subsoil. The water table extends from the soil surface to one foot below the surface. Osier soils support woody forest vegetation that is tolerant to high water tables. They are not suited for development.

Ousley fine sand occurs on flats near the sounds and has 80 inches of fine sand over sandy subsoil. The water table is one and a half to three feet below the surface. Ousley soils also support woody forest vegetation that is tolerant to high water tables. They are not suited for development.

Figure 3. Soils of Currituck National Wildlife Refuge

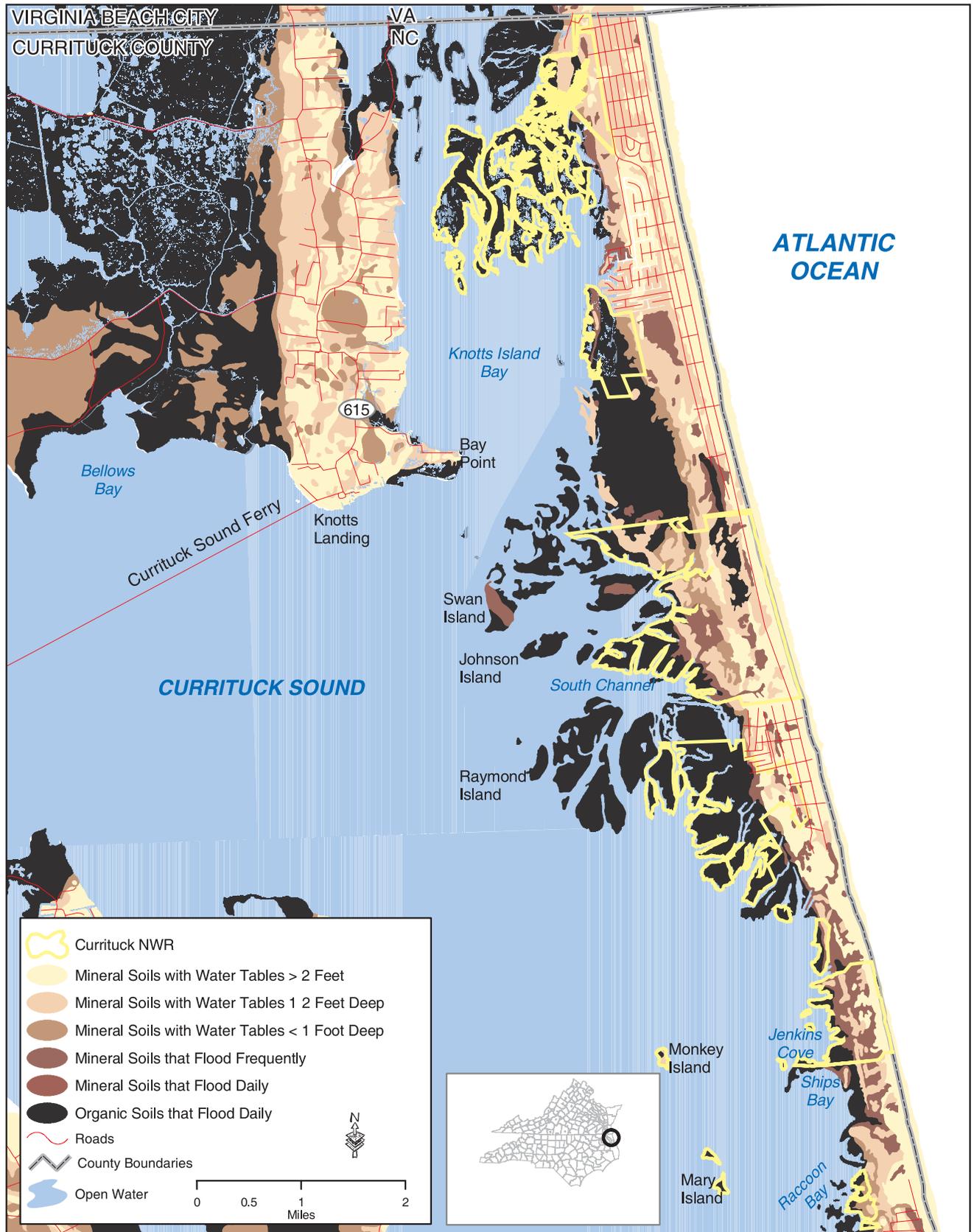


Table 4. Characteristics of soils of Currituck National Wildlife Refuge

Series	Approximate Acreage	Surface Texture	Muck Depth	Water Table Depth	Flooding Frequency ¹	Vegetation
Currituck*	2,584	Mucky Peat	60"	0-+1'	Routine	Marsh
Osier*	190	Fine Sand	None	0-1	Common	Forest
Duckston	300	Fine Sand	None	1-2'	Frequent	Shrub
Ousley	160	Fine Sand	None	1.5-3	Common	Forest
Corolla	440	Fine Sand	None	1.5-3	Rare	Dune Grass
Newhan	200	Fine Sand	None	6+'	None	Dune Grass
Beaches	225	Fine Sand	None	6+'	None	Dune Grass
Total	4,099					
* - hydric soil that has wetland hydrology and will support wetland plants						
¹ = frequent = more than once every two years, common = likely under normal conditions, rare = unlikely under normal conditions, none = not probable						

HYDROLOGY

The hydrologic setting of the Currituck Banks is similar to that of the Cape Hatteras area immediately to the south. Studies of that area have shown that the fresh ground water reservoir on the Outer Banks consists of two types of aquifers: an unconfined or water table aquifer that extends from the land surface to the first confining beds of silt and clay, and a confined or semiconfined aquifer beneath and between the silt and clay beds. The water table aquifer ranges in thickness from 10 feet to 50 feet and averages 15 feet. The water table altitude averages 3 feet above sea level along the narrower sections of the banks north of Cape Hatteras and as high as 10 feet in the Cape area itself (Winner 1975).

Maintenance of the fresh groundwater on the Outer Banks depends on the amount of rainfall. Measurements taken at Cape Hatteras indicate 55 inches per year. Because of the sandy nature of the soil, rainfall enters the water table aquifer with little or no surface runoff except during periods of intensive rainfall when the soil becomes saturated. Small intermittent fresh water ponds may then be formed. At present, a few open fresh water ponds exist on the Outer Banks in Currituck County, some of which are manmade and others exist as a result of barrier beach processes.

The deeper confined aquifers are as much as 30 feet thick and are below the first confining beds whose thickness ranges from five to 20 feet. Exact thicknesses are difficult to define due to the gradational nature of sediments below the water table aquifer.

The fresh groundwater on the Outer Banks may best be described as a lens-shaped mass floating on top of denser salt water. The quantity of water in this fresh water lens changes depending on the amount of recharge and discharge. Below the fresh water lens, a zone of diffusion occurs indicating the fresh water-salt water interface. This zone periodically changes in response to flooding, tidal movement, precipitation rates, and pumping rates.

Rainfall and Groundwater Recharge. In order to evaluate the availability of fresh groundwater on the Outer Banks, it is necessary to examine the methods of recharging the system. Rainfall at Cape Hatteras, south of the study area, averages 55 inches per year. At Norfolk, at the extreme northern end, it averages 44 inches per year. Monthly water balances at Cape Hatteras show that May, June, and July are water-deficit months, that is, there is insufficient rainfall or soil moisture to satisfy potential evapotranspiration. These deficit months are also peak months for water demand all along the barrier island because of the seasonality of water requirements. Rainfall during the months of August and September restore water losses of previous months. The amount of precipitation occurring from September to May is in excess of potential evapotranspiration losses and the result is a surplus ranging up to 20 inches in Cape Hatteras. Because runoff is negligible, all of this surplus water is used to charge the groundwater system.

Natural Groundwater Discharge. Natural discharge from the groundwater system occurs in two ways: lateral movement toward the sounds and bays, and through soil evaporation and plant transpiration. These two processes (soil evaporation and plant transpiration) are referred to collectively as evapotranspiration and account for a return to the atmosphere of 33 to 35 inches of rainfall per year on the Outer Banks.

When the rate of recharge is less than discharge, the lens of salt water underlying the barrier island rises. This problem of saltwater intrusion is common in coastal communities.

Surface Water Resources. Because of their location along the Atlantic Coast, the Outer Banks are extremely vulnerable to flooding from major storms. Overwash from these storms have in places breached the entire barrier island and sent large volumes of salt water into the adjoining embayment. Flooding has also occurred on the bay shoreline by wind tides, which frequently inundate low-lying areas. These flooding and overwash processes can contaminate the groundwater table, depending on salinity of overwash or floodwaters and amount of fresh water recharge following contamination.

WATER QUALITY

The Back Bay–Currituck Sound area is a highly productive ecosystem. Stretching from Sandbridge in Virginia, south to Kitty Hawk, North Carolina, this embayment complex exhibits a brackish to fresh wetland community.

Earliest references to this area indicate a true estuarine environment with inlets along the Currituck Banks. When there were inlets, shellfish beds flourished and provided a market access for harvestable marine resources.

In 1828, when the Currituck inlet closed along the northern portion of the Banks, the Back Bay–Currituck Sound complex began its reversion to a brackish environment.

Since that closure, the area has periodically been subjected to “rapid” increases in salinity due to beach overwash caused by major coastal storms. The last major increase in salinity occurred during the Ash Wednesday Storm of 1962. This rapid increase of salinity to 75% of sea strength resulted in massive fish kills and losses of aquatic vegetation important to waterfowl.

Following this major overwash, the salinity in portions of the Back Bay–Currituck area remained at 10–15% of seawater. Later as salinities decreased, the City of Virginia Beach instituted a pumping program. Under this program, the city pumped seawater across the barrier beach into Back Bay in order to reduce turbidity and increase the aquatic plant life. This pumping project attempted to keep salinities between 5–6% of seawater. Records indicate that pumping maintained the salinities within this range until late 1974. However, mechanical problems caused the program to operate intermittently after 1979, and the city has since discontinued the program.

Information from local water quality control boards as late as 1978 indicate that the water of the Back Bay–Currituck complex is that of high quality in an unpolluted, expansive, shallow, grassy brackish embayment; however, recent concern has been expressed for agricultural/chemical pollution as a possible source of disease outbreak among fish populations.

Dissolved oxygen levels continue to exceed state water quality standards (5 mg/liter), with the average being 7.5 mg/liter. Although this indicates a supersaturated condition due to photosynthetic activity, there has been a slight decrease over the past few years.

The pH values observed (7.5 to 10.0 pH units) are indicative of high photosynthetic activity.

The bacteriological water quality has also been monitored to detect the presence of animal or human waste contamination. Using the fecal coliform filter method, no colonies were counted in 159 of the 176 tests conducted (Jackson 1978).

The water quality on Currituck National Wildlife Refuge is related directly to the water quality in Currituck Sound. The refuge staff maintains the impoundment waters through exchange with Currituck Sound.

Developments and agricultural operations in the area located on hydric soils, nonhydric soils with high water tables, or soils with rapid permeability all have the potential to pollute the water table with septic system percolate, household wastes, and nutrients, pesticides, and petroleum products. Recreational use of the sounds and bays also has the potential to impact water quality.

There is only one facility on the Outer Banks of Currituck County in the National Pollution Discharge Elimination System (NPDES); the permit has had no violations. The State of North Carolina has classified the water bodies around Currituck National Wildlife Refuge for minimum water quality standards (Table 5). All water bodies and streams meet the standards established for the best uses. The State of North Carolina lists no water body or stream surrounding the refuge as impaired.

Table 5. Classifications of water bodies and streams surrounding Currituck National Wildlife Refuge

Water Body or Stream	Classification	Best Uses
Currituck Sound Knotts Island Bay Knotts Island Channel South Channel) Ships Bay Raccoon Bay	SC – Saltwater	Secondary Recreation, Fishing, Aquatic Life

AIR QUALITY

In North Carolina, state law mandates that no source of air pollution shall cause any listed ambient air quality standard (Section .0400) to be exceeded or contribute to a violation of any listed ambient air quality standard (Section .0400) except as allowed by Rules .0531 or .0532 [.0401(c), NCAC, Title 15A, Subchapter 2D - Air Pollution Control Requirements (North Carolina Department of Environment and Natural Resources)].

Subchapter 2D lists ambient air quality standards for sulfur oxides (measured as sulfur dioxide); total suspended particulates; carbon monoxide; ozone; hydrocarbons; nitrogen dioxide; lead; and particulate matter. Section .0508 enumerates control of particulates from pulp and paper mills. Section 0.0520 (7) indicates that fires purposely set to forest lands for forest management practices acceptable to the North Carolina Division of Forestry and the Environmental Management Commission are permissible if not prohibited by ordinances and regulations of governmental entities having jurisdiction. The regulation also includes a disclaimer that addresses certain potential liabilities of burning even though permissible.

The area closest to the refuge that an environmental agency monitors is the Virginia Beach–Norfolk metropolitan area. The Environmental Protection Agency monitors carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide and particulates in Norfolk, Virginia Beach, Hampton, Newport News, Suffolk, and Chesapeake. Despite the large population with the industry, traffic, and power plants, the area has exceeded only ozone level standards in 2002. Monitoring has indicated unhealthy levels twice and unhealthy levels for sensitive groups thirteen times. The air quality is due to the breezes blowing through the area from the ocean.

VISUAL RESOURCES/AESTHETICS

Currituck National Wildlife Refuge is part of an extensive complex of brackish marshes along the Currituck Sound. The marshes are largely undisturbed and are protected by the federal government at the Currituck, Mackay Island, and Back Bay national wildlife refuges; by the State of North Carolina at the 2,958-acre Northwest Marsh Game Land and the 14,657-acre North River Game Land; by the Commonwealth of Virginia at the 1,546-acre Princess Anne Wildlife Management Area, the 4,321-acre False Cape State Park, the 3,441-acre North Landing River Natural Area Preserve, and the 2,417-acre Northwest River Natural Area Preserve; by the City of Virginia Beach at the North Landing Park; and by The Nature Conservancy.

Visitors to the refuge have the opportunity to experience solitude, wildness, uninterrupted quiet, spirit and adventure, and observe the signs and sounds of the marsh and forested wetlands. Breezes off the water move the dune and marsh grasses like flags waving across a vast landscape. During the growing season, the marshes appear alive with neotropical songbirds, raptors, wading birds, marsh birds, mink, otter, and other wildlife species. The forests of loblolly pine, red maple, black gum, sweetgum, green ash, and wax myrtle echo the sounds of songbirds, wood ducks, and deer. During the late fall, winter, and early spring, migrating waterfowl and songbirds fill the air in the managed wetlands, sounds, bays, and streams with their sights and sounds.

BIOLOGICAL RESOURCES

HABITAT

Currituck National Wildlife Refuge is a typical southeastern United States coastal barrier island system that has formed dunes, brackish marshes and forested swamps in the Coastal Plain region. Seabeach amaranth (*Amaranthus pumilus*) is the only plant species from the federal endangered species list known to occur on the refuge. The National Wetlands Inventory describes the refuge as an estuarine emergent herbaceous or palustrine, forested wetland with deciduous or broad-leaved deciduous vegetation and a water regime ranging from temporarily flooded to semipermanently flooded (Cowardin et al. 1979). Schafale and Weakley (1990) identify five natural communities within the refuge boundary: dune grass, maritime dry grassland, maritime shrub, brackish marsh, and maritime swamp forest. Other habitats have been altered or created by man. The National Wetlands Inventory map delineates the refuge habitats (Figure 4). Vegetative communities on coastal barrier islands are spatially distributed in a pattern relative to the location of the ocean and sound (Figure 5).

The large number of plant species listed in Appendix IV is indicative of the diverse habitats on the refuge. Levy (1976) delineated 178 species representing 50 families and 132 genera in his study at Duck, North Carolina. Hosier and Cleary (1979) listed over 200 plant species but felt that intensive study would produce many more species. The vegetation communities present on the Outer Banks include extensive dune systems, maritime grasslands, maritime shrub thickets, maritime forests, and vast brackish marshes.

Man has had a substantial effect on the flora. Historic records suggest that livestock severely overgrazed the barrier beach system in the 19th century, resulting in the mobilization of large sand sheets (Hennigar 1979). Loggers have culled the forested areas numerous times in the past. That culling undoubtedly changed the vegetative composition of the area.

The coastal processes discussed in the previous section further serve to shape the vegetative distribution and diversity on the Banks. Local controlling factors, depth to water table, salt spray, substrate stability, water salinity, and tidal effects contribute to the vegetative pattern that exists on the Banks.

Salt spray is one of the most critical of the coastal processes affecting vegetation on the barrier system. Besides limiting the plant species along the beachfront, the spray serves to “deliver” nutrients to those plants growing in the sandy soils of the beachfront. The “pruning effect” of the spray on maritime shrubs and trees acts to tighten the tree and shrub canopy and provide shade during periods of low rainfall and high evaporation, thus conserving the limited freshwater resources.

Beach

Unvegetated beaches occupy 202 of the refuge’s 8,501 acres and occur on the eastern edge of the refuge above the normal high water elevation. These areas would be important nesting areas for colonial nesting birds and sea turtles if there was authority to limit access to the beach below the normal high water elevation. Extensive use of the beach for recreation discourages nesting efforts. Tire ruts would limit successful movement of bird chicks and turtle hatchlings if they hatched successfully.

Figure 4. National Wetland Inventory map of Currituck National Wildlife Refuge

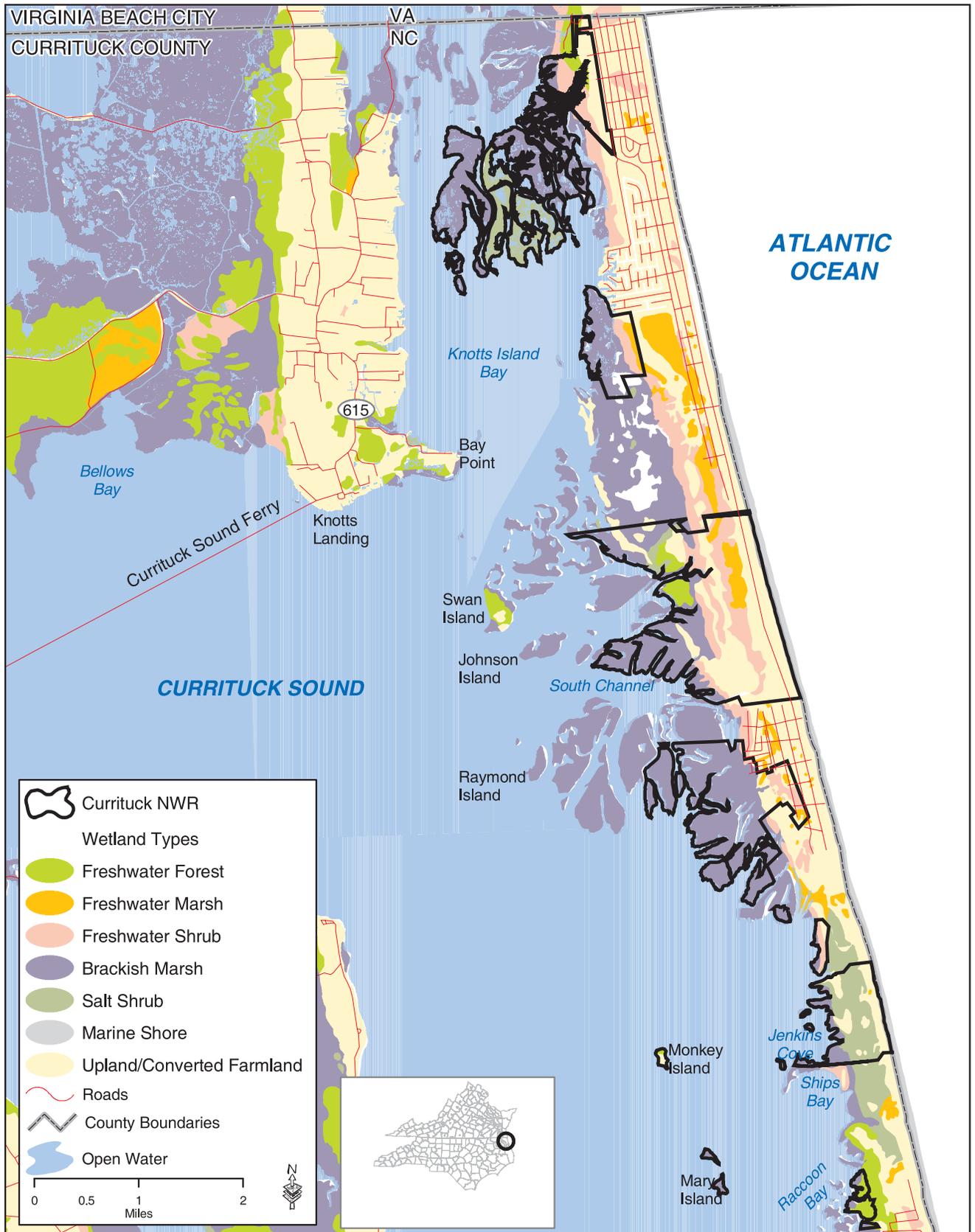
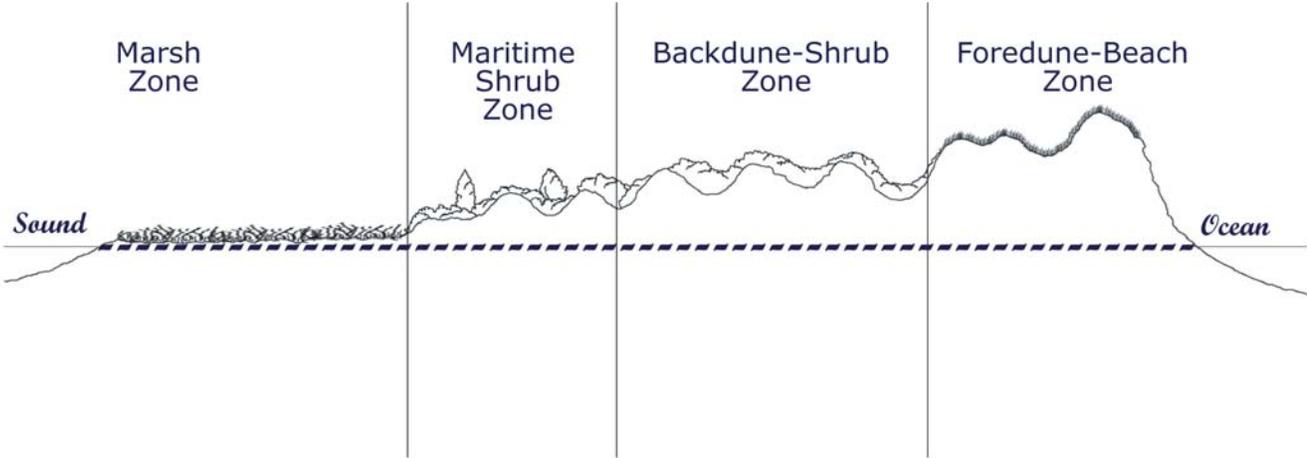


Figure 5. Profile of vegetative communities of coastal barrier islands



Dune Grass and Maritime Dry Grassland

Dunes and grasslands occupy 137 of the refuge's 8,501 acres and tend to occur in the eastern section of the refuge. The dunes immediately west of the beach are dominated by American beachgrass, bitter panicum, saltmeadow cordgrass, and sea oats. The grasslands west of the dunes are dominated by saltmeadow cordgrass with goldenrod, Indian blanket, and many other forbs in areas eroded by winds.

Dune Grass. The floral diversity and distribution on the North Carolina portions of the Currituck Banks are interesting and complex. The barrier beach system is located in a transition zone between northern and southern groups of plant species. The warm Gulf Stream waters turn offshore at Cape Hatteras and the Labrador Current moves southward along the Currituck Banks, creating a zone where northern species have their southern limits and southern species have their northern limits. American beachgrass is near its natural southern limit, while sea oats is considered to be at the northern limit of its range (Hosier and Cleary 1979).

Both American beachgrass and sea oats develop extensive horizontal and vertical rhizomes that capture moisture from rainfall. These rhizomes further serve to bind sand and stabilize sand surfaces. Beach grass and sea oats are adapted to tolerate stresses such as salt spray, overwash, sand blast, and drought, all of which are characteristic of the foredune area (Seneca et. al 1977). However, both species are extremely vulnerable to mechanical disturbance of the soils.

As the dunes are stabilized and conditions become more favorable, other species will invade the strand community. Sea rocket, evening primrose, seaside goldenrod, beach pea, sandspurs, daisy fleabane, and spurge are other common dune plants.

The width of the dunes varies along Currituck Banks. In those areas where artificial dunes have been built, the berm crest and backslope often no longer exist or are severely eroded. Generally, those areas with natural berms are wide, gently sloping and frequently overwashed by storm tides.

Maritime Dry Grassland. Two basic types of terrestrial grasslands cover Currituck National Wildlife Refuge. They are interdunal depressions and barrier flat grasslands. Interdunal depressions occur where sand is moved from the surface forming a blowout. Mesic conditions, a relatively diverse flora, and often standing water prevail in these areas. Barrier flat grasslands found on the overwash terraces comprise the other terrestrial grassland community.

Interdunal depressions occur between the fore and back dunes along the seashore. The depressions are "generally bowl-to-saucer shaped with semicircular-to-irregular perimeter" (Tyndall 1977). Aeolian sand transport and oceanic overwash are the generative forces in the formation of these depressions. The depth varies from just below to several feet above the water table. Floral development is in response to the erosion of these depressions to or below the water table. Some depressions possess standing water for varying amounts of the year.

A high diversity of plant species occurs in these depressions. At False Cape State Park and Back Bay National Wildlife Refuge, both in Virginia, 129 species of plants were surveyed (Tyndall 1977). Distribution and succession of these species are controlled by several abiotic and biotic factors, including soil moisture, interspecific competition, salt spray, migratory waterfowl activity, and feral hog disturbance (Tyndall 1977).

Dominant species in these depressions include salt meadow cordgrass, black needlerush, chair-maker's rush, and broom sedge. Other common herbaceous species include *Centella asiatica*, water pennywort, aster, and water purslane.

Species on the perimeter of these depressions include groundsel tree, wax myrtle, bayberry, black cherry, and live oak.

Availability of fresh water, diversity of seed-producing and food plants, as well as vegetative cover provide habitat for many species of wildlife. Hosier and Cleary (1979) believe that these depressions act as "reservoirs of genetic systems which, as conditions on the islands change, serve as a source of new species for colonizing the new environments."

The barrier flats begin on the backside of the beach berm and cover the flat overwash terraces. Salt spray and overwash develop and maintain this community. It is common in areas where dunes are low and have not been stabilized. The vegetation of this zone is adapted to withstand frequent storm tide inundation and sand burial. Dominant species consist of grasses, sedges, and some forbs. Species diversity on the flats adjacent to the beach berm is low. It is composed of salt meadow cordgrass, seaside goldenrod, and sea rocket. In an area where overwash is less frequent, diversity and cover are greater. In addition to the above-mentioned species are marsh fleabane, sandspurs, sea pink, and ladies tresses. Godfrey and Godfrey (1976) described similar terraces on Cape Lookout National Seashore as having greater than 50% cover and a standing crop of up to 1500 grams per square per year.

Dune buildup has occurred in several overwash passes and shrubs have invaded the terrace areas. Sea elder, wax myrtle, groundsel tree are common species.

Maritime Shrub

Shrubs occupy 778 of the refuge's 8,501 acres and tend to occur in the central part of the refuge between the dunes and the marshes. The maritime shrub occurs along the length of the refuge on areas that are naturally or artificially protected from oceanic influence. The buffering action provided by the fore- and mid-dunes is essential for the establishment of this arborescent zone. Where salt spray effects are the greatest, these species form a low spreading cover with many areas of maritime grassland in between. Away from the ocean, in the shrub-dominated area, the growth pattern is low and dense forming a closed canopy.

This community is dominated by wax myrtle, yaupon holly, American holly, groundsel tree, eastern red cedar, and stunted live oak. The understory of greenbrier, Virginia creeper, grape, poison ivy, and American beautyberry contributes substantially to its habitat value. The shrubs are sculpted by salt spray and susceptible to wild fires that can temporarily return the area to an herbaceous stage of succession.

Cleared edges, roadways, and rights-of-way have been invaded by shrub thicket stands. This pattern possesses large areas of "edge space," a habitat that many wildlife species prefer.

Brackish Marsh

Brackish marshes occupy 2,202 of the refuge's 8,501 acres and tend to occur on the poorly drained peat soils in the western section of the refuge. Tidal flooding is rare and usually less than one foot. Tides are generally wind driven with water levels dependent upon wind velocity and direction. Marsh salinity is a function of the salinity of the overlying water (which varies between 2% and 20%), the

relative frequency and duration of inundation caused by oceanic overwash, periodic wind-flooding waters, and the rate of flushing through the Currituck Sound (Odum et al. 1974). These wetlands are classified as slightly to moderately estuarine intertidal areas that irregularly flood and support persistent emergent vegetation (Cowardin et al. 1979).

The Northwest and North Landing rivers and Back Bay have high levels of dissolved oxygen, nutrients, and detritus material that feed Currituck Sound. Coupled with the suspended materials from periodic oceanic overwash, the marsh substrate provides a nutrient-rich area for plants.

These marshes are both physically and biologically important. The marshes of the sound act as buffer strips, protecting the Outer Banks from erosion by waves on the sound side. Without the marshes, the western shore of the Outer Banks would receive the full brunt of the waves. If not protected, the slope of the barrier island western shore would cause the expenditure of the energy contained in the waves over a smaller area. The higher the energy received in an area, the higher the likelihood of erosion. The nearly flat plains of the marshes allow for large areas of dissipation. Biologically, the marshes serve as important nesting and migrating grounds for numerous animal species at all trophic levels. The vegetation allows for good forage and cover.

The marshes are dominated by black needlerush and saltmeadow cordgrass with big cordgrass and seashore saltgrass in substantial quantities. With frequent fires, the black needlerush is suppressed and the other grasses dominate.

The black needlerush occurs just above mean high tide in relatively pure stands. Other species found with the needlerush include big cordgrass. The net primary productivity for needlerush marshes in Dare County averages 478 grams per square meter per year (Stiven and Plotecia 1976). This amount of dead or decaying marsh vegetation is contributed to the open estuary where it is utilized directly by consumer organisms, including important fish and shellfish. While this figure is less than the productivity of the smooth cordgrass marshes of Dare County, it is still important to the ecosystem.

The northern marshes exhibit a more heterogeneous composite of species including cattails, arrowheads, seashore mallow, smartweeds, Olney three square, salt grass, chair-maker's rush, and black needlerush. No primary productivity data were available for this area; however, based on related studies, productivity is assumed to be greater than the monotypic black needlerush stands.

Maritime Forest

The maritime forest occupies 637 of the 8,501 acres and tends to occur in the central part of the refuge between the dunes and marshes. Bellis and Proffitt (1976) defined the maritime forest community of North Carolina as "all forested areas occurring in relict sand dunes either on the Outer Banks or immediately adjacent to a permanently salty sound." The maritime forest of the refuge is generally located on the back dunes of the barrier beach system in areas not directly influenced by storm-tide flooding and migrating dune systems.

The forest is dominated by swamp black gum, red maple, sweetgum, white ash, loblolly pine, baldcypress, and water oak. It usually has a dense understory of wax myrtle, American hornbeam, swamp red bay, stiff dogwood, and other shrubs. There is usually not a notable herbaceous understory.

Forests that are close to the ocean are low, generally less than 20 feet, and exhibit dense lateral branching. This lack of apical dominance is caused by wind and salt spray. Dominant species include live oak, red cedar, and laurel oak. Understory shrub species include American holly, black cherry, poison ivy, Virginia creeper, and grape.

Forests that are further away from the ocean are taller (20 to 40 feet) and exhibit a more open canopy that is structurally more diverse. Loblolly pine is a dominant member in this community, along with live oak and American holly. Yaupon holly, hudsonia, greenbrier, and grape are common understory species.

Bellis and Proffitt (1976) found that the primary value of the maritime forest is that it helps reduce erosion caused by storm surge and wave action. Other benefits of the forest include protection of loose sandy soils from wind erosion; accumulation and storage of freshwater; mineral iron filtration; production of soil by trapping blowing sand; deposition of humus; and wildlife habitat.

Conservation Easements

There are 3,931 acres of easements in the refuge's 8,501 acres. These areas are predominately open water and brackish marshes owned by hunting clubs. The refuge assists the hunting clubs in managing the marshes with prescribed burning.

Managed Wetlands (Impoundments)

The refuge has 143 acres of impoundments managed to provide seed-producing herbaceous vegetation for migrating waterfowl. The staff manages the water levels in the areas and discs the vegetation to maintain an early successional stage vegetation that produces the most seed. The staff monitors the vegetation sporadically to assess the effectiveness of management (Table 6).

Table 6. Vegetative composition of the Swan Island Moist Soil Unit

Common Name	Scientific Name	Food Value	Percent Composition by Year				
			2002	2000	1994	1987	1986
Asian Pennywort	<i>Centella asiatica</i>	Fair	20.6	7.7	13.0	0.0	0.0
Buttonweed	<i>Diodia virginica</i>	None	12.9	0.2	8.5	15.2	10.7
Spikerush	<i>Elocharis parvula</i>	Good	12.4	27.2	0.0	0.0	0.0
Three Square	<i>Scirpus pungens</i>	Good	10.0	11.6	9.8	12.2	5.8
Water Hysop	<i>Bacopa</i> spp.	Good	8.7	1.5	4.5	9.4	0.7
Switchgrass	<i>Panicum virgatum</i>	Good	7.8	0.0	0.0	0.0	0.0
Fall Panicum	<i>Panicum dichotomflorm</i>	Good	6.5	0.5	0.0	0.0	0.0
Baldrush	<i>Fimbristylis</i> spp.	Fair	4.4	4.2	14.3	20.0	32.9
Smartweed	<i>Polygonum</i> spp.	Good	3.3	3.7	0.5	0.0	0.0
Cordgrass	<i>Spartina patens</i>	Fair	3.1	0.0	8.0	1.3	0.4
Water Primrose	<i>Ludwigia palustris</i>	None	0.0	7.3	0.3	0.0	0.0
Knotgrass	<i>Paspalum distichum</i>	Fair	0.6	5.6	3.3	12.7	4.4
Panicgrass	<i>Panicum</i> spp.	Fair	1.6	4.5	6.8	6.6	5.8
Foxtail	<i>Setaria</i> spp.	Good	0.3	0.0	4.8	5.1	4.2
Bermudagrass	<i>Cynodon dactylon</i>	None	0.0	0.0	4.3	8.4	8.6
Broomsedge	<i>Andropogon virginicus</i>	None	0.8	0.0	3.5	0.0	0.0
Rush	<i>Juncus</i> spp.	None	0.0	1.0	2.3	0.0	0.2
Pennywort	<i>Hrdrocotyle</i> spp.	Fair	0.4	1.2	0.3	4.1	0.5
Crabgrass	<i>Digitaria</i> spp.	Good	0.0	0.0	0.0	1.5	7.4
Total Good			61.2	45.5	20.4	30.7	19.2
Total Fair			27.7	24.0	46.7	44.0	44.2
Total None			11.1	30.5	32.9	25.3	36.6
Grand Total			100.0	100.0	100.0	100.0	100.0

Threatened and Endangered Plants

The threatened seabeach amaranth (*Amaranthus pumilus*) is the only federally listed plant on the refuge. The last citing was in 1989, when a biologist found a single plant on the refuge beach in association with a threatened piping plover nesting colony. Disturbance from unrestricted vehicular traffic on the beach destroys stands as they germinate. Seabeach amaranth also suffers from the absence of washover habitat between and in back of the dunes.

Two plant species listed as threatened in the North Carolina Natural Heritage Program's database occur on the Outer Banks in Currituck County. One is the seabeach amaranth; the other is the Carolina grasswort (*Lilaeopsis carolinensis*), an aquatic perennial herb.

Thirteen species are listed as rare. Twelve occur in marshes: the marsh straw sedge (*Carex hormathodes*); twig rush (*Cladium mariscoides*); toothed flatsedge (*Cyperus dentatus*); sand spikerush (*Eleocharis montevidensis*); beaked spikerush (*Eleocharis rostellata*); riverbank quillwort (*Isoetes riparia*); long-awned sprangletop (*Leptochloa fascicularis* var. *maritima*); awl-leaf mudwort (*Limosella australis*); winged seedbox (*Ludwigia alata*); long beach seedbox (*Ludwigia brevipes*); grassleaf arrowhead (*Sagittaria weatherbiana*); and pale mannagrass (*Torreyochloa pallida*).

Woolly beach heather (*Hudsonia tomentosa*) occurs behind the primary dune in open, sandy areas.

Insect and Disease Pests of Habitats

In recent years, the forest tent caterpillar has caused widespread defoliation in the state. Prolonged flooding and saturation on coastal plain soils adversely impacts the parasitic wasp that preys on the forest tent caterpillar. The parasitic wasp spends part of its life cycle in the ground. Prolonged flooding kills the wasp so that it can no longer serve as a check on the populations of forest tent caterpillar. This may account for the large outbreaks of forest tent caterpillars that resource managers have been observing during the last decade on the coastal plain.

Another insect pest, the gypsy moth, is now well established as far south as northeastern North Carolina. The North Carolina Division of Plant Industry and U.S. Forest Service closely monitor gypsy moth populations. Both agencies use pheromone traps located throughout the state, including refuge lands. When they detect large-scale outbreaks, they use integrated pest management techniques to suppress the outbreak, but not necessarily eliminate the species from the area.

The southern pine beetle is becoming a more common pest of pines in northeastern North Carolina. The beetles feed on the inner bark of stress-weakened trees. The needles turn yellow or straw-colored within two or three weeks of the attack, before finally turning reddish-brown. Land managers treat infected stands by cutting down a swath of trees around the area where the beetles are actively feeding, thus removing their food and starving them. Managers must monitor their pine stands and investigate any trees that appear infected.

WILDLIFE

The animal communities found on the refuge exhibit a low species diversity when compared to other coastal areas. Two notable exceptions are the unusually large number of migrating hawks that pass through the area each fall and the thousands of wintering waterfowl in Currituck Sound. Generally, the fauna of this area consist of ecologically tolerant forms that are rather widespread in the coastal plain, and some that are essentially statewide in distribution (Cooper et al. 1977).

The following text discusses five general species groups: birds, mammals, reptiles and amphibians, finfish and shellfish, and benthic invertebrates. Species lists are in Appendix IV.

Birds

The Outer Banks exhibits a great diversity and distribution of birds. This is due to many factors, including the location of this area within the Atlantic Flyway and along the Gulf Stream.

Observations of raptors during fall migrations indicate that large numbers follow the Outer Banks, notably accipiters and falcons (Lee and Lee 1978; Ward 1976). Many other species such as migrant warblers, shorebirds, gulls, terns, herons, and egrets use the Outer Banks as a migration corridor during spring and fall migrations. Currituck Sound and the barrier beach system are important wintering grounds for 23 species of waterfowl, as well as numerous other avian species. Additionally, offshore winds and hurricanes undoubtedly bring transient species to the barrier beach system.

Located in the transition zone between northern and southern groups, the refuge is the northern distribution limit for many southeastern coastal plain species. Additionally, species that are common to the mainland (indigo bunting, bobwhite) as well as those common to the barrier beach system (osprey, barn swallow) are represented on the refuge.

The variety of plant communities found on the refuge also contributes to the diversity and distribution of bird life. As vegetative complexity and mass increase, so do available habitats. The forest/shrub thicket communities support the majority of species on Currituck National Wildlife Refuge. This is due in part to the layering effect of understory, woody vine, and shrub and forest vegetation.

The threatened bald eagle has nested on Mackay Island National Wildlife Refuge across the Currituck Sound for the past seven years. Several species listed as high priority by the U.S. Fish and Wildlife Service and/or listed by the state as rare and of special concern include the prairie warbler; hooded warbler; black-throated green warbler; yellow-throated warbler; prothonotary warbler; northern parula; sharp-tailed sparrow; northern bobwhite; king rail; solitary sandpiper; semipalmated sandpiper; black tern; American black duck; American woodcock; short-eared owl; and American kestrel, to name a few. The endangered red-cockaded woodpecker has been seen on rare occasion, and the most recent sighting was more than 20 years ago. At least 182 species of birds, including 55 breeding species (16 migratory and 39 resident) use the refuge.

Wintering and migrating waterfowl make extensive use of the refuge's wetlands and the water bodies surrounding the refuge. Factors that affect waterfowl distribution and population in Currituck Sound include the overall Atlantic Flyway population, food availability, waterfowl disturbance, and local land use trends (Sincock et al. 1965). Aquatic plant production affects the persistence of wintering waterfowl in an area. The major change in aquatic plant production in Currituck Sound has been the growth of Eurasian water milfoil. Florshutz (1972) reported the use of milfoil as a food source by twelve species of waterfowl, most notably scaup, gadwall, and widgeon. A comprehensive survey of aquatic vegetation in Currituck Sound is now underway. Growth of submerged vegetation, once felt to be sufficient for waterfowl populations using the sound (Florshutz 1979), is now thought to be declining.

Disturbances that affect waterfowl distribution can take many forms, including boat activity and hunting. Currituck Sound has 737 licensed waterfowl blinds, the majority being blinds on platforms over the water (Snowden 1979).

Land use trends in surrounding areas have influenced the use of the sound by waterfowl. The availability of corn and winter wheat is important to field feeders such as mallard and black duck, as well as Canada and snow geese. Sincock et al. (1965) forecasted the effects of changes in agricultural practices and the conversion of farmland to other uses on waterfowl use on Currituck Sound. The refuge provides an area managed for moist soil vegetation that provides food and rest areas.

The Fish and Wildlife Service has identified areas that are of importance to wintering waterfowl in general and wintering black ducks in particular. In both the Black Duck Coastal Wintering Habitat Concept Plan and the Wintering Duck Concept Plan, the Service identified Currituck Sound as a habitat warranting preservation for waterfowl (U.S. Fish and Wildlife Service 1975 and 1979).

Principal species include the snow goose, tundra swan, mallard, wood duck, American black duck, American widgeon, blue-winged teal, green-winged teal, ruddy duck, and northern pintail (Table 7). The marshes surrounding Currituck Sound, Back Bay, and Knotts Island Bay provide habitat for a substantial portion of the duck species in North Carolina.

Table 7. Currituck National Wildlife Refuge waterfowl survey results, 2002-2003

Species	October	November	December	January	February
Gadwall		54	191	223	585
American Black Duck	94	205	92	182	268
Northern Pintail	8		270		290
Mallard	23	98	39	135	66
American Widgeon	42	104	10	78	80
Green-winged Teal	165			55	
Hooded Merganser		11	1		5
Ring-necked Duck					11
Tundra Swan	1		325	875	722
Canada Goose		25		23	7
Total Ducks	332	472	605	673	1305
Grand Total	333	497	930	1571	2035

Mammals

The mammal species composition for the refuge includes information from several sources, including trapping data from biologists working in the area and information from the North Carolina State Museum of Natural History. Nomenclature follows *A Field Guide to the Mammals* (Burt and Grossenbeider 1964). Appendix IV lists 24 species of mammals on the refuge.

Distribution and diversity of mammal populations on the refuge are defined by several factors, including habitat preference and/or dispersal ability of species and competition of native species with introduced species. Introduced species often reduce diversity by forcing native species to adapt to a wide range of ecological tolerances. For example, feral hogs (*Sus scrofa*) and horses (*Equus caballus*) have overgrazed areas near Carova Beach to the elimination of habitat for native mammal species. Other introduced species include nutria (*Myocaster coypus*), the house mouse (*Mus musculus*), and the Norway rat (*Rattus norvegicus*).

Habitat associations also influence the diversity and distribution of mammal species on Currituck National Wildlife Refuge. As the vegetative complexity increases in general, so do the number of species using the area.

Furbearers. The marshes on the backside of Currituck National Wildlife Refuge are valuable habitat for several mammals. Factors that influence distribution and density of these species include salinity, plant species present (for use as food and nest construction), depth and frequency of water inundation, and local weather conditions (Brower et al. 1976). Species that are most valuable commercially include muskrat, nutria, otter, and mink.

Feral Populations. Currituck National Wildlife Refuge supports a feral hog and horse population. No population estimates were available for the hogs. In the past, hogs were released in the area that is now False Cape State Park in the fall for grazing and collected in the spring. Collection of the hogs was incomplete, resulting in the present feral population (Tyndall 1977).

Feral horses of uncertain origin inhabit the refuge. Some residents and others believe that these horses have origins that date back to Spanish origins and indicate that these horses may have existed here for over 400 years. Other sources indicate that these horses were brought to the island to avoid mainland taxes and to provide summer grazing. Investigation of the genetics of the horses to determine the origin of the horses has been inconclusive. Currituck County has passed an ordinance to protect the horses. The county has also developed a group that advises the county commissioners on matters relating to the maintenance of the wild horse herd. The Wild Horse Advisory Board is composed of two citizen representatives and representatives from the Corolla Wild Horse Fund, the U.S. Fish and Wildlife Service, and the National Estuarine Research Reserve. The approved Currituck Banks Wild Horse Management Plan calls for the population of the horses to be maintained at or below 60 individuals. As funding becomes available, the Service will study the effects of the horses on refuge lands and incorporate recommendations based on the studies into the Currituck Wild Horse Management Plan.

Historically, grazing animals were left to forage wherever food was available; most of these animals fed in the marshes and dunes as the forests were not particularly conducive to grazing. The result of this grazing was the reduction of vegetation, encouraging the formation of sand sheets and sand hills, destabilizing much of Currituck Banks (Hennigar 1979).

Evidence of grazing exists south of Carova Beach where a large area is devoid of vegetation. The hog population has had a regressive successional effect on vegetation in the interdunal depressions (Tyndall 1977).

Reptiles and Amphibians

Reptiles and amphibians represent two separate groups of vertebrates that are considered together in this report. Forty-four reptiles occur on the Outer Banks in Currituck County, including 12 species of turtles, 8 species of lizards, and 25 species of snakes. Thirty-three species of amphibians occur in the area; 12 species are salamanders and 21 species are frogs and toads. A total of 77 species and subspecies of reptiles and amphibians occur in the area. The rich herpetofauna of the Outer Banks is explained, in part, by the diversity of habitats along the barrier beach system.

Examination of the distribution of refuge amphibians and reptiles reveals some geographic patterns. Many species reach the northern limits of their ranges in eastern North Carolina. Included in this category is the pinewoods snake, as well as other species. Many species occur only in the Atlantic Coastal Plain and have their centers of distribution or the greater part of their ranges in North Carolina. Included in this category are the many-lined salamander and Brimley's chorus frog.

Though the herpetofauna is relatively well known, basic information on the distribution and ecology of many species is lacking. Appendix IV lists the species present on the refuge.

Finfish and Shellfish

Ecologically dominant fish in the sound are represented by seven species. The species with the largest number of fish per acre are yellow perch, tidewater silverside, pumpkinseed, and blue spotted sunfish. The most important species on a weight per acre basis are carp, pumpkinseed, yellow perch, largemouth bass, and golden-shiner (Borawa et al. 1979).

Borawa et al. (1979) found that the length of largemouth bass is less at given age than in the early 1960s. Additionally, this same study found that bass also weigh less at a given length than during the 1960s. These changes in the bass population were apparently due to the increase in vegetative biomass in 1979, particularly Eurasian water-milfoil.

In addition to the largemouth bass, other important sport fish include the black crappie, chain pickerel, bream, white perch, and pumpkinseed. Striped bass, largemouth bass, and white perch are the most sought after species, with fishing pressure concentrated in the northern two-thirds of the sound (Sincock et al. 1965).

Surf fishing and haul seining are important recreationally and commercially along the ocean shore. Striped bass, bluefish, mullet, croaker, spot, and gray trout are important to those fisheries.

Currituck Sound is an important nursery ground for the young of many sport and commercial fish species found in North Carolina and Virginia. The abundance and distribution of these species are highly seasonal, with peak occurrences being related to migration and spawning periods. Currituck Sound is used by these species during three migration periods: inshore migration (juveniles) to estuarine nursery grounds after being spawned offshore; during upstream migration (adults) from sea to fresh water spawning; and downstream migration (adults) from freshwater for oceanic spawning.

Fish migration and nursery ground productivity are controlled by seasonal environmental factors such as salinity, temperature, water flow, food availability, food type, and bottom substrates.

The nursery areas are dominated by small spot and croaker during the winter and spring months, with menhaden and trout during the spring and summer. Shad, alewives, and striped bass move through the system on their way to river spawning areas in the spring, with juveniles moving back through the system on their way to the ocean later in the year. Important freshwater species such as white perch and catfish move down into the brackish water systems during the spring.

Benthic Invertebrates

The majority of benthic invertebrates use two habitats on the refuge, the ocean beach and the sound. Other areas such as freshwater ponds are more than likely to be inhabited by benthic organisms, but have not been studied to date. Appendix IV lists those organisms that are most commonly found in these areas.

The ocean zone is a narrow stretch of bare sand that extends from the surf to the landward reach of lunar tide. The subtidal and intertidal zones of the ocean beach present two distinct habitats and consequently a great diversity of organisms. Unconsolidated sediments and coarse sand that are subject to constant shifting and stirring underlie the subtidal area. Sand-burrowing, filter-feeding decapods, dependant upon tidal influx for their food, were the most common organisms in this zone (Levy 1976).

The intertidal or swash zone is firm, wet and sloping. Wave action and beach slope are limiting factors for organisms in this stretch. Mole crabs (*Emerita talpoida*), ghost crabs (*Ocyropsis quadrata*), coquina (*Donax sp.*), and various polychaetes exhibited the greatest diversity and density in this zone (Levy 1976).

Several investigators studied the organisms in the swash zone at Back Bay National Wildlife Refuge (Munse 1975; Leggett and Butler 1975). Distribution and population of burrowing organisms varied inversely with the amount of traffic on any one area. The type of travel (vehicular or foot) also reflected on the population size and distribution of these organisms. Those areas subject to foot travel exhibited greater densities of burrowing species than those areas subject to vehicular travel.

The marshes along Currituck Sound support a diverse macrobenthic community. Those species which are important to wildlife include the marsh periwinkle (*Littorina irrorata*), pulmonate snail (*Melampus bidentatus*), ribbed mussel (*Modiolus demissus*), and Carolina marsh clam (*Polymesoda caroliniana*) (Matta 1977). Various amphipods and isopods, characteristic of broad environmental tolerances, were common in the study area (Perry 1979). Of note from these collections were two uncommon beetles, *Paracymus nanus* and *Derallus altus*.

Nearshore benthos is mostly composed of burrowing amphipods that are able to escape exposure from wind tides. In the deeper waters, where substrate exposure from tides is negligible, invertebrate diversity increases. Oligochaetes, chironomids and brackish water clam (*Rangia cuneata*) were the most commonly sampled species (Matta 1977).

The diversity and density of benthic organisms is further increased in the submerged grass beds of Currituck Sound. The plant rhizomes provide a protective habitat for infauna. The leaves and stems of the vegetation are attachment sites for epifauna.

Threatened and Endangered Animals

Threatened and endangered animals on the refuge include six federally listed species and 63 species recognized by either the State of North Carolina or the State Museum of Natural History, both of which have published lists. Only the seven on the federal and state lists have the benefit of legal protection and regulation. The refuge will give state-listed species emphasis in planning and management actions.

After an absence of many years, the threatened bald eagle recently returned to nest on Mackay Island National Wildlife Refuge, across the sound from Currituck National Wildlife Refuge. There have been numerous incidental sightings of nonnesting bald eagles in Currituck County.

The federally listed piping plover occurs in Currituck County. The last documented sighting was in 2001 when a refuge staff member observed a single plover foraging. In 1999, volunteers conducted transects on eight occasions and observed at least one plover foraging each time. They observed as many as 13 plovers foraging on one occasion. Disturbance from unrestricted vehicular traffic on the beach discourages nesting. Plover nesting also suffers from the absence of washover habitat between and in back of the dunes.

There are records of the occurrence of the endangered red-cockaded woodpecker in the county from more than 20 years ago.

The only federally listed reptiles listed for Currituck County are the threatened loggerhead sea turtle and endangered leatherback sea turtle. There are records of loggerheads within the past 20 years; there was a stranded leatherback in the county in 1979. The last record of loggerhead nesting was in 1998 when eggs were laid in a nest 3.5 miles south of the North Carolina–Virginia state line. Biologists relocated the nest of 118 eggs from its original location below the high tide elevation to a location above the high tide elevation. Forty-five (38%) of the eggs hatched.

The turtles, inhabitants of the open ocean, nest just above high water on the open beaches. Mating takes place in the water near nesting beaches. The turtles lay eggs from April to early October, though most often through August. Eggs are subject to predation from a variety of creatures including hogs, dogs, crabs, raccoons, and humans. Disturbance from unrestricted vehicular traffic on the beach discourages nesting.

There have been incidental reports of endangered West Indian manatees in the county within the last twenty years. The county is well north of its normal range.

Unique Animal Associations

Various state agencies and research biologists have identified numerous unique animal associations along the barrier beach system. Following are brief descriptions of these associations that have not been covered in other sections.

Investigators have pinpointed several heron rookeries along the Currituck Sound. These colonies indicate that the area is an important breeding territory for wading birds. The colonies also reflect the health of the estuarine system. Osborne and Custer (1978) found that wading birds and their allies are a terminal link in many aquatic food chains and may be used to reflect changes in the ecosystem. The largest colony in Currituck Sound is located on Monkey Island that is within the study area. Five species totaling 935 adults are reported nesting on Monkey Island. Great blue herons, great egrets, glossy ibis, tricolored herons, and snowy egrets inhabit the island. Several other heron rookeries have been located in Currituck Sound and Back Bay (Osborne and Custer 1978).

Several investigators have identified the osprey (*Pandion haliaetus*) as meriting special concern (Cooper et al. 1977). During the 1950s and 1960s, the species suffered considerable losses in the North Carolina and Virginia area due to organochlorine pesticide contamination. The residues produced eggs with thin shells that were easily broken during incubation, causing severe reproductive losses (Cooper et al. 1977). The population in Currituck Sound and Back Bay has since stabilized and is thought to be increasing. The ospreys nest on channel markers, manmade platforms, and in trees, and are reasonably tolerant of man.

The peregrine falcon migrates through the area during the spring and fall of the year. During migration, peregrine falcons forage along the beaches and newly overwashed areas of the Banks. Segar (1979) considers the uninhabited beachfront and wash flats critical in the migratory habits of the peregrine falcon. Modification of these habitats may have a profound effect on the migratory ecology of the species.

Systematic monitoring of peregrine falcons along the Currituck Banks reported 138 individual sightings over a 28-day period during the 1979 fall migration (Nichols 1979). Thirty-one observations were made along False Cape State Park, Virginia, while 107 were made in North Carolina. These falcons continue to migrate south following the Outer Banks migration corridor.

The refuge staff will give primary consideration to the status and habitat requirements of the species listed in Table 8 when they plan and implement management actions.

Table 8. Species of management concern at Currituck National Wildlife Refuge

Species	Brackish Marsh	Maritime Shrub and Swamp Forest	Dune Grass and Dry Grassland	Managed Wetlands (Moist Soil Units)
Piping Plover*			X	
Loggerhead Sea Turtle*			X	
Leatherback Sea Turtle*			X	
Bald Eagle*	X			
West Indian Manatee*	X			
Seabeach Amaranth*			X	
Black Rail	X			
Sharp-tailed Sparrow	X			
Seaside Sparrow	X			
Yellow Rail	X			
King Rail	X			
Wood Stork	X			
Sedge Wren	X			
Prairie Warbler		X		
Eastern Painted Bunting		X		
Yellow-throated Warbler		X		
Northern Parula	X	X		
Red Knot			X	
Wilson's Plover			X	
Roseate Tern			X	
Least Tern			X	
Black Skimmer			X	
American Oystercatcher			X	
Reddish Egret			X	
Wood Duck		X		
Canada Goose				X
Snow Goose				X
Tundra Swan				X
American Black Duck				X
Mallard				X
American Widgeon				X
Blue-winged Teal				X
Green-winged Teal				X
Ruddy Duck				X
Ringneck Duck				X
Northern Pintail				X
Greater Scaup				X
Lesser Scaup				X

* = Federally Threatened and Endangered Species

EXOTIC ORGANISMS

Six exotic organisms are present within the area and are impacting or have the potential to impact refuge lands. They are the wild horse (*Equus caballus*), wild pig (*Sus scrofa*), Asian clam (*Corbicula fluminea*), common carp (*Cyprinus carpio*), nutria (*Myocaster coypus*), and the gypsy moth (*Lymantria dispar*). Exotic plants that threaten refuge resources include the common reed (*Phragmites australis*) and alligatorweed (*Alternanthera philoxeroides*).

CULTURAL RESOURCES

The refuge has three documented cultural resource sites located on Monkey Island. One site is a hunting club clubhouse that is falling down and is on an eroding island in Currituck Sound. The Service's Regional Archeologist has examined the site and determined that the structure cannot be saved. He has recommended that the refuge interpret the club and clubhouse at the refuge's visitor contact station.

The other two documented sites are oyster shell midden sites that were dated as being from between 50 and 1600 A.D. Ceramics have also been found on the island.

SOCIOECONOMIC ENVIRONMENT

The current area of Currituck National Wildlife Refuge lies in Currituck County, North Carolina, and Virginia Beach, Virginia. The refuge contributes to and affects the social and economic conditions in Currituck and Dare counties, North Carolina, and Virginia Beach, Virginia. The conditions in both counties and the city also affect the refuge. The refuge staff must consider the social and economic conditions of the counties in planning and implementing refuge activities. The land use in the communities influences the water and air quality in the water bodies surrounding the refuge and on the refuge. The relative availability of open space will affect the availability of land for wildlife habitat and the habitat off the refuge that wildlife use.

SOCIOECONOMIC CONDITIONS IN THE AREA

Currituck County

Currituck County is in the northeastern corner of North Carolina with the Atlantic Ocean to the east; Dare County, North Carolina, to the south; Camden County, North Carolina, to the west; and the city of Virginia Beach, Virginia, to the north. The county is split into east and west segments by the Currituck Sound. The only bridge over the sound is in the southern part of mainland Currituck County; it connects to northern Dare County on the Outer Banks, the barrier island next to the ocean. The southern tip of Currituck National Wildlife Refuge is 20 miles north of that bridge. Knotts Island, where Mackay Island National Wildlife Refuge is located, is only accessible from the Currituck Refuge by traveling from mainland Currituck County through the cities of Chesapeake and Virginia Beach, Virginia, or by ferry. A ferry connects the town of Currituck, North Carolina, to Knotts Island.

Despite the difficulty of traveling, Currituck County has experienced a great amount of growth in the last 30 years due to its proximity to Virginia Beach and the ocean. The county's unemployment and poverty rates are much lower than the state average.

Currituck County is still predominantly rural, with the largest town and county seat being Currituck (2000 population: 18,190). Like other rural areas throughout the country, outdoor activities are both popular and necessary. Hunting and recreational fishing are popular pastimes. Farming, commercial fishing, and forestry are important elements of the economy.

Dare County

Dare County is located in the northeastern part of North Carolina and is bounded by Currituck County to the north, Tyrrell County on the west, and Hyde County on the south. The Alligator River forms the western boundary of Dare County, the Albemarle Sound forms the northern boundary, and the Atlantic Ocean forms the eastern boundary.

Traditionally, Dare County has been in the forefront of economic growth or development in the State of North Carolina, and historically, unemployment has been lower than the state average. The closest areas of other economic growth and social life are Greenville, North Carolina, 100 miles west of the refuge, and Virginia Beach, Virginia, 27 miles north of the refuge.

Despite the growth on the Outer Banks, Dare County is still predominantly rural. Its largest town is Kill Devil Hills (2000 population: 5,897). Like other rural areas, outdoor activities are also popular and necessary in Dare County. Hunting, recreational fishing, and bird watching are popular pastimes and commercial fishing is an important element of the economy.

Virginia Beach

Virginia Beach is in the southeastern corner of Virginia with the Atlantic Ocean to the east, Currituck County, North Carolina, to the south, Chesapeake and Norfolk, Virginia, to the west, and the Chesapeake Bay to the north. The city is accessible to the Virginia capital of Richmond by Interstate Route 64 West. The national capital in Washington, D.C., is accessible from Virginia Beach by Interstate Route 64 West and Interstate Route 95 North.

Virginia Beach has experienced steady growth in the last 120 years due its proximity to the ocean, its importance as a location of military bases, and its access by water, railroad, highways, and air. The city's unemployment and poverty rates are much lower than the state average.

Virginia Beach occupies the area that was once Princess Anne County and is still 61 percent rural. Outdoor activities are also popular among the city's residents, with hunting and recreational fishing the preferred pastimes. Farming, commercial fishing, and forestry are still important elements of the economy.

HISTORY OF THE AREA

Currituck County

The inhabitants of Currituck County at the time of European settlement were Coastal Algonkians. These Algonkians were the southernmost extent of a tribe that inhabited the Atlantic Coast north to Canada. They settled in relatively dispersed patterns with capital villages, villages, seasonal villages, and camps for specialized activities. The settlements were along the sounds, estuaries, major rivers, and tributaries. Some of the villages had a regular internal organization with palisades and some were less organized with an open structure. The Algonkians settled where they could conduct agriculture, fishing, shell fishing, hunting, and gathering close to the village. The farmsteads were occupied by extended families. The Coastal Algonkians grew corn, squash, sunflowers, beans, and native plants on sandy ridges. They traded extensively with the Tuscarora that inhabited the area

west of the Tidewater region (Mathis and Crow 2000). The Algonkians called the area “Cora tank,” which means “The Land of the Wild Goose.”

The governor of colonial North Carolina established Currituck County in 1670 from part of Albemarle County. It was one of the five original ports in North Carolina and one of the first counties. The county built the original courthouse in 1723 and established the town of Currituck Court House in 1755. The county shortened the name of the county seat to Currituck. In 1875, the government built the Currituck Beach Lighthouse in Corolla on the Outer Banks to warn seafaring ships of the coast.

The first attraction to settlement was the abundant fish and game which gave the county a reputation as a “Sportsmen’s Paradise.” John Mackie purchased Orphan’s Island, on which the refuge is located, in 1761. The island became known as Mackie Island after his purchase and as Mackay Island after his death. In the early twentieth century, wealthy sportsmen established lavish hunting clubs in the county. These included the Swan Island Club in 1870; the Whalehead Club in Corolla in 1922; the Currituck Gunning and Fishing Club in 1923; the Monkey Island Hunt Club in 1931; and Joseph Knapp’s estate on Mackay Island in 1918. Joseph Knapp was a wealthy insurance businessman and philanthropist who contributed to and helped develop the education system in Currituck County. He also founded an organization known as More Game Birds in America, which later became Ducks Unlimited. The Knapp estate was located on land that is now the Mackay Island National Wildlife Refuge, where he experimented with wildlife management techniques.

As Virginia Beach has grown, suburban development has occurred on the mainland of the county over the last thirty years. In 1984, the State of North Carolina extended North Carolina Highway 12 thirteen miles north of Dare County into Currituck County. Extensive residential development of the dunes along the oceanfront began immediately after the state opened the highway.

Dare County

The original residents of Dare County were also Native Americans of the Coastal Algonkian linguistic group. One chiefdom was located on the Outer Banks on Hatteras Island (Haag 1958). They lived in permanent villages where they could hunt, fish, shellfish, and farm in close proximity to the village. The Algonkians used seasonal villages to follow migrating fish and wildlife populations. They grew corn, beans, sunflower, and squash in small gardens; and hunted deer, bear, alligators, turtles, and a variety of small mammals. Mention of the Algonkians ceased by the mid-eighteenth century (Mathis and Crow 2000).

As early as 1584, English officers spent two months exploring Roanoke Island and its surrounding area. In 1585, a fleet of seven vessels returned to Roanoke Island. The settlers established a headquarters called “the City of Raleigh.” An earthen structure known as Lane’s Fort protected it. A band of 15 men stayed with the fort while the commanding officer returned to England. In 1587, a total of 115 men, women, and children landed at Roanoke Island. They found no survivors of the 15 men, yet went on to rebuild and establish the first English colony in the New World. Later that year, the first child of English parents was born in America. Her name was Virginia Dare. Shortly thereafter, Governor John White returned to England for supplies. Problems in England delayed his return. When White finally arrived, he found no trace of the colony he had left except the words “Croatoan” and “Cro” carved in two trees near the fort. The fate of the “Lost Colony” remains a mystery (Sharpe 1954).

The area remained unpopulated for more than a half century after the disappearance of the Lost Colony. Sir John Colleton established the first permanent settlement on Collington Island on the Outer Banks in the winter of 1664–1665. Shipwrecked sailors and settlers from Virginia established the first settlements. These settlers made an effort to grow tobacco, grow grapes for a winery, and raise hogs. The only real profit was from oil extracted from beached whales. Raising livestock on the grasslands of the dunes became an important occupation. The only agriculture was in small gardens (Stick 1958).

In the early 1700s, pirates moved into the area to prey on ships that passed too close to the shore. The most famous of these pirates, Blackbeard, made his headquarters on the Outer Banks. His death in 1718 brought an end to piracy. Around 1726, residents built windmills to grind grain on Roanoke Island and the Outer Banks. The residents made a living from farming, fishing, hunting, and beachcombing (U.S. Department of the Interior 1981).

Modern tourists first found the Outer Banks of Dare County at Nags Head in the 1830s, when planters from inland counties came to escape the hot humid summer. Cottages and the Nags Head Hotel were home to visitors. The hotel was the scene of nightly dinners and dances, and the residents built a railway for transportation to the beach (Outer Banks Chamber of Commerce 2003).

In the early 1800s, the Outer Banks earned the name “Graveyard of the Atlantic” as numerous vessels sunk near the coast. During the Civil War, Union forces captured Fort Hatteras and Roanoke Island to secure access to North Carolina by sea. The Union ironclad ship *USS Monitor* sank in a gale off Cape Hatteras on December 30, 1862 (Outer Banks Chamber of Commerce 2003).

In 1870, the state assembly established Dare County from parts of Hyde, Currituck, and Tyrrell counties. During this time, most opportunities for work were in the Coast Guard, as lighthouse operators or weather station employees. The improvements of inlets and advances in navigation and transportation allowed commercial fishing to become an important part of the economy (Stick 1958).

On December 17, 1903, Wilbur and Orville Wright made the first successful power-driven airplane flight from Kill Devil Hills near Kitty Hawk on the Outer Banks. German submarines filled the waters off the North Carolina coast during World Wars I and II. Since World War II, tourism replaced hunting and fishing as the principal industry (Outer Banks Chamber of Commerce 2003).

The rivers and sounds were once the major transportation avenues in the area. As the area grew and the railroad arrived, boat traffic declined. In the twentieth century with the popularity of automobiles, the state developed a network of highways connecting the county to all areas of the eastern United States. The state replaced a drawbridge across the Croatan Sound on U.S. Highway 64 at Manns Harbor in 2002 with a high-rise bridge so motorists can bypass downtown Manteo on their way to the Outer Banks. Today, the state is widening U.S. Highway 64 to four lanes that will connect the area to interstate 95 and the Outer Banks. There are small local airports in Manteo and Frisco; regional airports in Greenville; and an international airport in Norfolk, Virginia. Amtrak provides passenger rail service as far east as Rocky Mount.

Virginia Beach

The inhabitants of Virginia Beach at the time of European settlement were also Coastal Algonkians. There were 12,000 people living in a 9,000-square-mile area. The tribes in the Tidewater area of Virginia included the Chesapeake, Powhatan, Arohatock, Appamattuck, Pamunkey, Youghtanund, and Mattaponi. All of these tribes except the Chesapeake eventually surrendered to the Powhatan. All the tribes spoke the Powhatan dialect of the Algonquin language.

They settled in relatively dispersed patterns with capital villages, villages, seasonal villages, and camps for specialized activities. The settlements were along the sounds, estuaries, major rivers, and tributaries. Some of the villages had a regular internal organization with palisades and some were less organized with an open structure. They settled where they could conduct agriculture, fishing, shell fishing, hunting, and gathering close to the village. The farmsteads were occupied by extended families. The Coastal Algonkians grew corn, squash, melons, pumpkins, sunflowers, beans, tobacco, and native plants on sandy ridges. They traded extensively with the Meherrin and Nottoway that inhabited the area west of the Tidewater region.

The first English colonists landed at the mouth of the Chesapeake Bay on April 26, 1607. They spent three days at the site of their first landing, erecting a cross and naming the spot Cape Henry. They later settled in Jamestown. In 1635, Captain Adam Thoroughgood earned a land grant of 5,350 acres and persuaded 105 people to settle in colonial Virginia Beach. The colonial governor formed Princess Anne County from the eastern section of Norfolk County in 1691 and named it in honor of the youngest daughter of King James. The livelihood of the early settlers depended on fishing. The early fishing industry prompted the dredging of the Lynnhaven Inlet to connect the Lynnhaven River with Chesapeake Bay.

Princess Anne County had a continuous shoreline from the North Carolina border, north along the Atlantic Coast to Cape Henry and then west along the banks of Chesapeake Bay to the Lynnhaven River. The extensive shoreline made merchant ships vulnerable to plundering by pirates. Until 1718 when Blackbeard was killed, piracy inhibited permanent settlement. Heavy ship traffic congested the waterways and resulted in many shipwrecks. Local volunteers lit bonfires to warn vessels of the shoreline. The state government built the Cape Henry Lighthouse in 1792 to facilitate safe passage.

The proximity of Virginia Beach to water also gave the area a role in the Revolutionary War. The French cut off the retreat route of Cornwallis' British troops at Cape Henry and forced the surrender of the British at Yorktown in 1781. Continuing shipwrecks along the coast prompted the construction of five lifesaving stations along the coast in Virginia Beach until 1915, when the Coast Guard replaced them.

Virginia Beach has been a popular tourist resort since 1883 when railroad service began from Norfolk. Tourism has spawned the area's economy and further settlement to support that economy. The military has established five installations in Virginia Beach: the Oceana Naval Air Station, Little Creek Amphibious Base, Fort Story Army Base, Camp Pendleton, and Dam Neck Naval Base. These five bases and other military installations in adjacent cities have added support to the economy and attracted even more residents. The area is also a popular retirement location for retired military veterans.

The local economy has diversified over the years and new residents have located in Virginia Beach to work. The 2000 population was 425,257. The city of Virginia Beach and Princess Anne County merged in 1963, adding the rural areas in the southern part of the county to the city.

LAND USE IN THE AREA

Currituck County

The historic land use in Currituck County depended for the most part on the nature of the land. Hydric soils cover 77 percent of the county and they remained in forest or marsh until the twentieth century. The major historic land uses have revolved around hunting upland game and waterfowl as the county was known as a "Sportsmen's Paradise." Native Americans and farmers descended from European settlers cultivated crops on the uplands for centuries. In the twentieth century, farmers drained much of the hydric mineral soil and shallow organic soil.

Today, Currituck County is 39 percent forested (64,343 acres), 29 percent marsh (47,921 acres), and 18 percent cropland (29,592 acres).

From 1997 to 2002, the land in farms decreased 12 percent from 39,571 acres to 34,802; the average size of farms decreased slightly to 424 acres; full-time farm operators increased 15 percent from 54 to 62 farms; the total market value of agricultural products sold decreased 38 percent to \$9,208,000; and the average market value of agricultural products sold per farm decreased 35 percent from \$174,005 to \$112,294 (Table 9).

In 2002, soybeans accounted for 15,587 acres of cropland, the largest of any single crop in the county. Corn and wheat have also been important crops in Currituck County. Production of cotton and hogs has also been important, but there were not enough to report in 2002 (Table 10) (U.S. Department of Agriculture 2002).

Within the refuge's approved acquisition boundary, the major land use is farming and waterfowl hunting. There is little residential construction in the wetlands surrounding the refuge. The county's well-drained areas have had extensive residential and commercial development.

Dare County

Logging and farming have never been important sources of income in Dare County due to the deep, sandy soils of the dunes; the saturated soils of the marshes on the Outer Banks; and the wetlands with deep organic soils on the mainland. The forest and marsh plant communities have always provided hunting opportunities, and the marshes are important nursery areas for fish. The beaches and dunes of the Outer Banks are the major attractions to tourists for their summer vacations.

There is limited residential construction in the marshes, pocosins, and forested wetlands of the county. The largest development has been on the northern end of the coastal barrier island known as the Outer Banks.

Before the Civil War, farmers cultivated up to 5,000 acres of corn and tobacco on mainland Dare County in a settlement known as Beechlands near Milltail Creek. They also grazed cattle on 25,000 acres of marsh. The Dare County Lumber Company harvested enough timber on 168,000 acres of mainland Dare County to set up a settlement called Buffalo City, which eventually went bankrupt. Both areas are now part of the Alligator River National Wildlife Refuge.

Today, Dare County is 57 percent forested (142,212 acres) and 3 percent farmland (4,961 acres).

From 1997 to 2002, the land in farms stayed the same at 4,961 acres; the average size of farms increased 13 percent from 551 to 620 acres; full-time farm operators remained the same at 6; the total market value of agricultural products sold increased 10 percent from \$836,000 to \$916,000; and the average market value of agricultural products sold per farm increased 23 percent from \$92,920 to \$114,470 (Table 11).

Soybeans are the most important crop in Dare County. Production has decreased between 1997 and 2002 (Table 12) (U.S. Department of Agriculture 2002).

Virginia Beach

The historic land use in Virginia Beach depended for the most part by the nature of the land. Hydric soils cover 74 percent of the city and they remained in forest or marsh until the twentieth century. Deep sandy dunes and beaches cover the eastern and northern sides of the city. The lack of access across the marshes and dunes restricted use of the barrier island.

The major historic land uses have revolved around fishing and hunting upland game and waterfowl. Native Americans and farmers descended from European settlers cultivated crops on the uplands for centuries. In the twentieth century, farmers drained much of the hydric mineral soil and shallow organic soil. Development of the dunes and beaches along the ocean and the Chesapeake Bay began in 1883, when the railroad extended service from Norfolk.

Today, Virginia Beach is 39 percent developed (71,557 acres); 25 percent forested (40,727 acres); 18 percent marsh (29,948 acres); and 14 percent cropland (23,873 acres).

From 1997 to 2002, the land in farms decreased 5 percent from 29,958 to 28,382 acres; the average size of farms decreased 20 percent from 204 to 164 acres; full-time farm operators decreased 10 percent from 71 to 64 farms; the total market value of agricultural products sold decreased 29 percent from \$13,638,000 to \$9,661,000; and the average market value of agricultural products sold per farm decreased 39 percent from \$92,778 to \$56,168 (Table 13).

In 2002, soybeans accounted for 13,306 acres of cropland, the largest of any single crop in the county. Corn and wheat have also been important crops in Virginia Beach. Production of hogs has also been important and has decreased so much it was not reported in 2002 (Table 14) (U.S. Department of Agriculture 2002).

Table 9. Currituck County agricultural statistics, 2002

Number of Farms	82
Acres in Farms	34,802
Average Size of Farms (Acres)	424
Market Value of Land Per Farm	\$1,324,800
Market Value of Land Per Acre	\$3,010
Market Value of Equipment Per Farm	\$100,534
Total Cropland (Acres)	29,594
Market Value of All Products Sold	\$9,208,000
Market Value of Products Sold Per Farm	\$112,294
Market Value of Crops Sold	\$8,918,000
Market Value of Livestock Sold	\$291,000
Operators with Farm as Principal Occupation	62
Operators with Another Occupation as Principal Occupation	20
Hogs in Inventory	0
Hogs Sold	0
Beef Cows in Inventory	280
Beef Cows Sold	109
Land in Soybeans (Acres)	15,587
Land in Corn (Acres)	10,392
Land in Wheat (Acres)	7,576
Land in Cotton (Acres)	0

Table 10. Commodity production in Currituck County, 1997 and 2002

Commodity	2002 Production	1997 Production	1997-2002 Change
Soybeans (acres)	15,587	18,489	Decreased 16%
Corn (acres)	10,392	11,309	Decreased 8%
Wheat (acres)	7,576	9,880	Decreased 23%
Cotton (acres)	0	1,780	N/A
Hog Inventory	0	4,270	N/A
Hogs Sold	0	11,205	N/A
Cattle Inventory	280	290	Decreased 3%
Cattle Sold	109	188	Decreased 42%

Sources: U.S. Department of Agriculture, Census of Agriculture 1997 and 2002

Table 11. Dare County agricultural statistics, 2002

Number of Farms	8
Acres in Farms	4,961
Average Size of Farms (Acres)	620
Market Value of Land Per Farm	\$1,098,170
Market Value of Land Per Acre	\$1,268
Market Value of Equipment Per Farm	\$100,232
Total Cropland (Acres)	4,954
Market Value of All Products Sold	\$916,000
Market Value of Products Sold Per Farm	\$114,470
Operators with Farm as Principal Occupation	6
Operators with Anther Occupation as Principal Occupation	2
Land in Soybeans (Acres)	1,506

Table 12. Commodity production in Dare County, 1997 and 2002

Commodity	2002 Production	1997 Production	1997-2002 Change
Soybeans (acres)	1,506	3,516	Decreased 57%
Wheat (acres)	471	0	N/A

Sources: U.S. Department of Agriculture, Census of Agriculture 1997 and 2002

Table 13. Virginia Beach agricultural statistics, 2002

Number of Farms	172
Acres in Farms	28,382
Average Size of Farms (Acres)	165
Market Value of Land Per Farm	\$649,775
Market Value of Land Per Acre	\$3.645
Market Value of Equipment Per Farm	\$47,521
Total Cropland (Acres)	23,873
Market Value of All Products Sold	\$9,661,000
Market Value of Products Sold Per Farm	\$56,168
Market Value of Crops Sold	\$7,716,000
Market Value of Livestock Sold	\$1,945,000
Operators with Farm as Principal Occupation	90
Operators with Other Occupation as Principal Occupation	82
Hogs in Inventory	0
Hogs Sold	0
Beef Cows in Inventory	0
Beef Cows Sold	0
Land in Soybeans (Acres)	13,306
Land in Corn (Acres)	5,809
Land in Wheat (Acres)	7,928

Table 14. Commodity production in Virginia Beach, 1997 and 2002

Commodity	2002 Production	1997 Production	1997-2002 Change
Soybeans (acres)	13,306	11,656	Increased 12%
Wheat (acres)	3,143	7,928	Decreased 60%
Corn (acres)	4,852	5,809	Decreased 16%
Hog Inventory	0	14,113	N/A
Hogs Sold	0	43,964	N/A
Cattle Inventory	0	259	N/A
Cattle Sold	0	166	N/A

Sources: U.S. Department of Agriculture, Census of Agriculture 1997 and 2002

DEMOGRAPHICS OF THE AREA

Currituck County

Currituck County is primarily rural with a total estimated population of 18,190 in 2000 (U.S. Department of Commerce, Bureau of the Census 2000a). The county gained 32% of its population between 1990 and 2000. Currituck, the county seat, is the largest town but the population is widely dispersed throughout the unincorporated areas of the county.

The population is 90.4 percent white, 7.2 percent black, 1.4 percent Hispanic, 0.5 percent Native American, and 0.4 percent Asian (U.S. Department of Commerce, Bureau of the Census 2000a). In 2000, the median family income was \$36,287, slightly above the state average of \$35,320. The poverty rate was 10.8 percent of the population, well below the state average of 12.6 (U.S. Department of Commerce, Bureau of the Census 2000c). The average unemployment rate in 2004 was 2.8 percent, well below the State of North Carolina's unemployment rate of 5.5 percent (North Carolina Employment Security Commission 2004) (Table 15).

The percentage of high school graduates in the population older than 25 years old is 77.6 percent; the percentage of college graduates is 13.3 percent. The state averages are 78.1 percent for high school and 22.5 percent for college (U.S. Department of Commerce, Bureau of the Census 2000a). The home ownership rate is 81.6 percent, well above the state average rate of 69.4. There are 2.61 persons per household in Currituck County, slightly above the state average of 2.49.

Dare County

Dare County is primarily rural with a total estimated population of 29,967 in 2000 (U.S. Department of Commerce, Bureau of the Census 2000a). The county population increased 32% between 1990 and 2000. Kill Devil Hills is the largest town with a population of 5,897.

The population is 94.7 percent white, 2.7 percent black, 2.2 percent Hispanic, 0.4 percent Asian, and 0.3 percent Native American (U.S. Department of Commerce, Bureau of the Census 2000a). In 2000, the median family income was \$35,258, about the same as the state average of \$35,320. The poverty rate was 8.1 percent, well below the state average of 12.6 (U.S. Department of Commerce, Bureau of the Census 2000c). The average unemployment rate in 2004 was 5.1 percent, slightly below the state's unemployment rate of 5.5 percent (North Carolina Employment Security Commission 2004) (Table 15).

The percentage of high school graduates in the population older than 25 years old is 60 percent; the percentage of college graduates is 16 percent. The state averages are 56 percent for high school and 14 percent for college (U.S. Department of Commerce, Bureau of the Census 2000a). The home ownership rate is 74.5 percent, above the state average rate of 69.4. There are 2.34 persons per household in Dare County, slightly below the state average of 2.49.

Table 15. Economic and population data for northeastern North Carolina counties

County	Average Income ¹	Poverty Rate (%) ¹	Average 2004 unemployment Rate (%) ^{2, 3}	2000 Population ¹	Population Trend ¹
North Carolina	\$35,320	12.6	5.5		+21% since 1990
Virginia	\$23,975	9.6	3.7		+14% since 1990
County in the Vicinity of the Currituck National Wildlife Refuge					
Currituck	\$36,287	10.8	2.8	18,190	+166% since 1970
Dare	\$35,258	8.1	5.1	29,967	+328% since 1970
Virginia Beach	\$22,365	6.5	3.6	425,257	+8% since 1970
Other Northeastern North Carolina Counties					
Beaufort	\$28,614	17.4	6.9	44,958	+6% since 1990
Bertie	\$22,816	12.6	8.2	19,773	Same as 1990
Camden	\$35,423	12.2	3.8	6,885	+16% since 1990
Carteret	\$34,348	11.8	4.7	59,383	+13% since 1990
Chowan	\$27,900	18.7	4.9	14,526	+7% since 1990
Craven	\$33,214	13.8	4.9	91,436	+12% since 1990
Gates	\$30,087	15.4	4.2	10,516	Same as 1900
Halifax	\$24,471	23.6	8.1	57,370	Same as 1950
Hertford	\$23,724	23.1	8.0	22,601	Same as 1960
Hyde	\$23,568	24.8	7.2	5,826	-37% since 1900
Martin	\$26,058	20.1	7.1	25,593	Same as 1940
Northampton	\$24,218	23.1	7.3	22,086	Same as 1980
Pamlico	\$28,629	16.8	4.7	12,934	+14% since 1990
Pasquotank	\$29,305	19.0	4.7	34,897	+11% since 1990
Perquimans	\$26,489	19.5	4.8	11,368	Same as 1920
Tyrrell	\$21,616	25.7	7.8	4,149	-17% since 1900
Washington	\$27,726	20.5	7.3	13,723	Same as 1960
¹ U.S. Census Bureau, 2000 Census of the United States					
² North Carolina Economic Security Commission, December, 2004					
³ Virginia Employment Commission, December, 2004					

Virginia Beach

Virginia Beach is a primarily suburban community with a total estimated population of 425,257 in 2000 (U.S. Department of Commerce, Bureau of the Census 2000a). The city gained 8.2% of its population between 1990 and 2000.

The population is 71.4 percent white, 19.0 percent black, 4.9 percent Asian, 4.2 percent Hispanic, and 0.4 percent Native American (U.S. Department of Commerce, Bureau of the Census 2000a). In 2000, the median family income was \$48,705, slightly above below the state average of \$46,677. The poverty rate was 6.5 percent of the population, well below the state average of 9.6 (U.S. Department of Commerce, Bureau of the Census 2000c). The average unemployment rate in 2004 was 3.6 percent, slightly below the Commonwealth of Virginia's unemployment rate of 3.7 percent (Virginia Employment Commission 2004) (Table 15).

The percentage of high school graduates in the population older than 25 years old is 90.4 percent; the percentage of college graduates is 28.1 percent. The commonwealth averages are 81.5 percent for high school and 29.5 percent for college (U.S. Department of Commerce, Bureau of the Census 2000a). The home ownership rate in Virginia Beach is 65.6 percent, below the state average rate of 68.1. There are 2.70 persons per household in Virginia Beach, slightly above the commonwealth average of 2.54.

EMPLOYMENT IN THE AREA

Currituck County

Real estate sales, renting, and leasing is the largest employer in Currituck County, employing more than 500 of the county's 1,600 employees with an annual payroll of \$25 million in 2000 (U.S. Department of Commerce, Bureau of the Census 2000b). This is due in large part to the Resort Quest of the Outer Banks (the largest single employer) that employs over 500 employees (North Carolina Economic Security Commission 2002).

The sectors employing the largest numbers of persons were in decreasing order as follows: real estate, retail trade, lodging and food service, health care, administrative and support services, and recreation (U.S. Department of Commerce, Bureau of the Census 1997).

Dare County

The hotel and food service and retail trade industries are the largest employer in Dare County, employing 3,028 and 3,022 of 12,543 employees with an annual payroll of \$281.6 million in 2000 (U.S. Department of Commerce, Bureau of the Census 2000b). This is due in large part to the tourist industry on the Outer Banks (North Carolina Economic Security Commission 2002).

In 2000, the sectors employing the largest numbers of persons were in decreasing order as follows: hotel and food service, retail trade, construction, real estate, wholesale trade, professional services, administrative support, and health care, manufacturing, and finance (U.S. Department of Commerce, Bureau of the Census 2000b).

Virginia Beach

The retail trade is the largest employer in Virginia Beach, employing 21,887 of 90,920 employees with an annual payroll of \$1.5 billion in 2000 (U.S. Department of Commerce, Bureau of the Census 2000b).

In 2000, the sectors employing the largest numbers of persons were in decreasing order as follows: retail trade, hotel and restaurant industry, administrative support, professional services, health care and social assistance, manufacturing, wholesale trade, and real estate, recreation, and agriculture (U.S. Department of Commerce, Bureau of the Census 2000b).

FORESTRY IN THE AREA

Currituck County

Timber has always been a source of wealth for Currituck County. However, settlers cleared much of the timber in order to cultivate the land for corn, soybeans, and other crops.

Today, Currituck County is approximately 39 percent forested, with 64,343 acres of forestland. In contrast, 60 percent of North Carolina is forested. Thirty-three percent of the county's forest is in oak–gum–cypress, 33 percent is in pine, 18 percent is in oak–pine, and 16 percent is in oak–hickory (USDA Forest Service 1991).

In 1990, private landowners owned 74 percent of the county's forested land. The state government owned 17 percent, the forest industry owned 8 percent, and federal, county, and local governments owned 2 percent (USDA Forest Service 1991).

Despite the diminished wooded acreage, timber is still a large source of income for Currituck County. In 1990, the value of the timber sold was \$2.7 million. The payroll from forest products was \$596,000 of the \$1 million from all manufactured products (USDA Forest Service 1991).

Dare County

Timber was a source of wealth for Dare County before the Civil War. However, much of the forestland is now managed primarily for wildlife habitat, and timber is a secondary product of the land.

Today, Dare County is approximately 57 percent forested, with 142,212 acres of timberland. In contrast, 60 percent of North Carolina is forested. Forty-nine percent of the county's forest is in loblolly pine and 45 percent is oak–gum–cypress (USDA Forest Service 1991).

Virginia Beach

In the past, timber was a source of wealth for Virginia Beach. However, settlers cleared much of the timber in order to cultivate the land for corn, soybeans, and other crops, and more recently to develop residential and commercial projects.

Today, Virginia Beach is approximately 25 percent forested, with 40,727 acres of forestland. In contrast, 63 percent of Virginia is forested. Thirty-one percent of the city's forest is in pine, 30 percent is in oak–gum–cypress, and 24 percent is in oak–hickory (USDA Forest Service 1992).

In 1990, private landowners owned 72 percent of the county's forested land. The forest industry owned 19 percent, the federal government owned 5 percent, the state government owned 2 percent, and county and local governments owned 2 percent (USDA Forest Service 1992).

OUTDOOR RECREATION IN THE AREA

Fish and wildlife resources have had a profound effect on recreation in the area. Currituck County has always had an abundance of fish and game, due to its diversity of lands and waters. As early as 1918, sportsmen's clubs were created in the area for the purpose of protecting game and wildlife. Later, as part of a comprehensive wildlife management program, Currituck National Wildlife Refuge was created to preserve and restore habitat for native wildlife and migratory birds (U.S. Fish and Wildlife Service 1980). In addition to the refuge, two North Carolina state game lands and one Virginia wildlife management area are located in the area.

Recreation in the area is also based on the water in the North Landing River, Back Bay, Knotts Island Bay, and the Currituck Sound. Boat ramps provide access to the river and sound. A few outfitters provide boats and guided tours. The North Carolina Coastal Plain Paddle Trails Guide lists a 10-mile trail along the Moyock Creek and Northwest River through the Northwest River Marsh Game Land in Currituck County (North Carolina Division of Parks and Recreation 2001). The State of North Carolina owns the 2,958-acre Northwest River Marsh Game Land in Currituck County and the 14,657-acre North River Game Land in Camden and Currituck counties for wildlife management and hunting opportunities. The Commonwealth of Virginia owns the 1,546-acre Princess Anne Wildlife Management Area, 4,321-acre False Cape State Park, 2,000-acre First Landing State Park, 3,441 North Landing River Natural Area Preserve, and the 2,417-acre Northwest River Natural Area Preserve. The City of Virginia Beach owns 3,200 acres of land in parks.

Local events that revolve around natural resources include the Knotts Island Wildlife Festival, whale watching and dolphin watching boat trips in Virginia Beach, the Wildlife Arts Show and Waterfowl International Art Show in Virginia Beach, and fishing tournaments in Virginia Beach.

OUTDOOR RECREATION ECONOMICS

Fish and wildlife are not only the focus of refuge management, but they are also important to the local economy. First, a commercial fishery is present in the Currituck Sound. Blue crab and flounder are the major species harvested. Secondly, hunting and fishing are economically important to local businesses, both directly as the local population spends money and indirectly as an attraction that draws sportsmen from outside the area.

Unfortunately, a general lack of regard for the preservation of fish and wildlife resources, combined with wetland clearing and draining, has led to the loss of valuable fishery spawning grounds and the loss of habitat for many wildlife species. In the attempt to restore and protect some of these resources, Currituck National Wildlife Refuge serves an important role, not only by providing habitat for a diversity of plant and wildlife species, but also as a place where people can go to enjoy these resources, either through observation, photography, hunting, or fishing.

The Fish and Wildlife Service surveyed participants in wildlife-dependent recreation in North Carolina in 2001. The survey documented an average expenditure of \$69 per day by anglers, \$74 per day for hunters, and \$199 per day for wildlife observers and photographers (U.S. Fish and Wildlife Service 2001).

The Partnership for the Sounds had a study done of the economic impact of its facilities. The study demonstrated that the average visitor spent \$108 per visit, with a range of \$63.70 to \$332.55 per day (Vogelsang 2001). A similar study of visitors at the Chincoteague National Wildlife Refuge in Virginia also showed a range of expenditures from \$62 to \$101 per day (U.S. Environmental Protection Agency 1997).

A study commissioned by the state of New Jersey demonstrated that the average visitor to the shorebird migration spent \$130 per day (New Jersey Department of Environmental Protection 2000). Birdwatchers on eight national wildlife refuges in New Jersey reported a range of expenditures from \$25 to \$41 per day (Kerlinger 1994).

Ecotourists on Dauphin Island, Alabama, spent an average of \$60 per visitor per day (Kerlinger 1999).

Bird watchers from the local area in High Island, Texas, reported an average expenditure of \$46 per day, and nonresidents reported \$693 per trip (Eubanks et al. 1993). The average visitor to the Great Texas Coastal Birding Trail spent \$78 per day (Eubanks and Stoll 1999).

Studies at the Santa Ana National Wildlife Refuge in south Texas demonstrated a range of expenditures from \$88 to \$145 per day on nature-based tourist activities. The Laguna Atascosa National Wildlife Refuge in south Texas reported a range of \$83 to \$117 per day (U.S. Environmental Protection Agency 1997).

Bird watchers to the Salton Sea National Wildlife Refuge in California spent an average of \$57 per day (National Audubon Society 1998).

When improved access, facilities and staffing are added, Currituck National Wildlife Refuge can serve as an important commodity in the economic life of the community. Ecotourism, hunting, fishing, wildlife observation and photography, and environmental interpretation are increasingly being seen as a desirable industry. As the population increases and the number of places left to enjoy wildlife decreases, the refuge may become even more important to the local community. It can benefit the community directly by providing wildlife-dependent recreational opportunities for the local population, and indirectly by attracting tourists from outside the county to generate additional dollars to the local economy.

TOURISM IN THE AREA

The area's tourism is based on its natural resources and cultural attractions. Boat ramps provide access to the rivers, bays, and sounds for fishing, hunting, and boating. Numerous outfitters provide boats and guided tours. The oceanfront attracts swimmers, surfers, sunbathers, and anglers.

More developed tourist attractions based on natural resources include Mackay Island National Wildlife Refuge, National Estuarine Research Reserve, and feral horses on the Outer Banks of Currituck County. Others in Virginia Beach include Back Bay National Wildlife Refuge, the First Landing and False Cape state parks, Munden Point City Park, Chesapeake Bay Center, and the Virginia Marine Science Museum. Local events that revolve around natural resources include those outlined in the Outdoor Recreation section.

Currituck National Wildlife Refuge could serve as an additional attraction to tourists visiting the area. If better trails and more facilities were provided within the refuge, tourists might be enticed to stay longer in the area to enjoy the opportunities provided for wildlife-dependent recreation and environmental education. This could generate more income for the local economy.

TRANSPORTATION

In its early days, residents of the area relied on water transportation. The sounds, rivers, and streams that crisscross the counties served as a means for transportation, trade, and communication between almost every community in the area. The Currituck Sound, Back Bay, and North Landing River were once the major transportation avenues in the area. As the area grew and the railroad arrived, commercial river and boat traffic declined. The waterways are still important as sources of income and for recreation. Ferries still provide access across the sounds.

In the twentieth century with the popularity of automobiles, the state developed a network of highways connecting the county to all areas of the eastern United States. State Route 168 and U.S. Highway 158 connect the Outer Banks to Virginia Beach, Norfolk, and Chesapeake, Virginia, through the mainland part of Currituck County. Interstate 64 connects the county with the northeastern United States. A number of smaller roads connect the various communities in the area. There is an international airport in Norfolk/Virginia Beach.

CULTURAL ENVIRONMENT

Currituck and Dare counties are in predominantly rural northeastern North Carolina. Cultural opportunities in the immediate area are limited to the history-based facilities outlined in the Tourism section; theater at local high schools and parks; music at local fairs, festivals, and nightclubs; and art at local fairs, festivals, and 20 small galleries. There is a summer-long production of “The Lost Colony” at the Fort Raleigh National Historic Site, commemorating the first English settlers on Roanoke Island. Greenville, North Carolina, and East Carolina University, which are located 100 miles west of the Outer Banks, offer the nearest opportunities for large theatrical or musical performances. Norfolk, Virginia, located 100 miles to the north, has the area’s largest art museums and venues for the performing arts, with national touring collections and companies.

Virginia Beach is in a major metropolitan area that supports a wide range of cultural facilities and events. The Virginia Beach Pavilion is a 63,000-square-foot convention center that hosts dozens of events annually from craft shows to musical and theatrical performances. The Little Theater of Virginia Beach hosts plays throughout the year. The 20,000-seat Virginia Beach Amphitheater is the site of live musical performances. The Contemporary Art Center of Virginia features changing exhibitions by national and international artists, as well as shows in the performing arts. It attracts 400,000 visitors annually. The Atlantic Wildfowl Museum celebrates the art of decoy making that was instrumental in the lives of many of the first settlers to the area.

The Scope in Norfolk is a 12,600-seat arena that hosts live music performances as well as sports events. The 2,400-seat Chrysler Hall is the site of theatrical performances. The historic Wells Theater is the 600-seat home to the Virginia Stage Company. The 675-seat Attucks Theater is the site of African-American stage performances. The 1632-seat Harrison Opera House is home to the Virginia Opera. The Chrysler Museum of Art is a venue for 30,000 pieces of paintings, sculptures, and decorative arts from the world over. The 12,067-seat Harbor Park is home to the Norfolk Tides baseball team.

REFUGE ADMINISTRATION AND MANAGEMENT

LAND PROTECTION AND MANAGEMENT

The Service acquired 1,770 acres in 1985 by fee simple purchase and 166 acres by conservation easement. Since 1985, the refuge has acquired 2,800 additional acres of fee simple purchase for a total of 4,570 acres. It has added 3,931 acres of conservation easements (Table 1). The refuge's approved acquisition boundary totals 18,015 acres (Figure 6).

The refuge staff manages the brackish marsh with prescribed fire on a three-year frequency. They manage the water levels with water control structures, and vegetative succession in the moist soil unit with prescribed fire and mechanical disturbance.

VISITOR SERVICES

Hunting

Visitors hunt waterfowl on the refuge from nine blinds on the shoreline of Currituck Sound. The refuge staff coordinates the hunts with the North Carolina Wildlife Resources Commission. The Commission advertises the hunts in its annual proclamation. Community volunteers help to prepare and administer the hunts and provide essential support to the refuge staff. The refuge currently supports 480 annual hunter use-days for waterfowl hunting.

Environmental Education

The refuge does not have a developed environmental education program. The staff has taken groups out on the refuge to teach them about the marsh and dune ecosystems and the wildlife that inhabit the marsh. About 100 students currently use the refuge annually.

Interpretation

There are no dedicated facilities for interpretation on Currituck National Wildlife Refuge. A small display references the refuge at the Joseph P. Knapp visitor contact station at Mackay Island National Wildlife Refuge. The Mackay Island staff occasionally leads groups to the Currituck Refuge for on-site interpretation. Currently, less than 100 visitors annually use the refuge for interpretation.

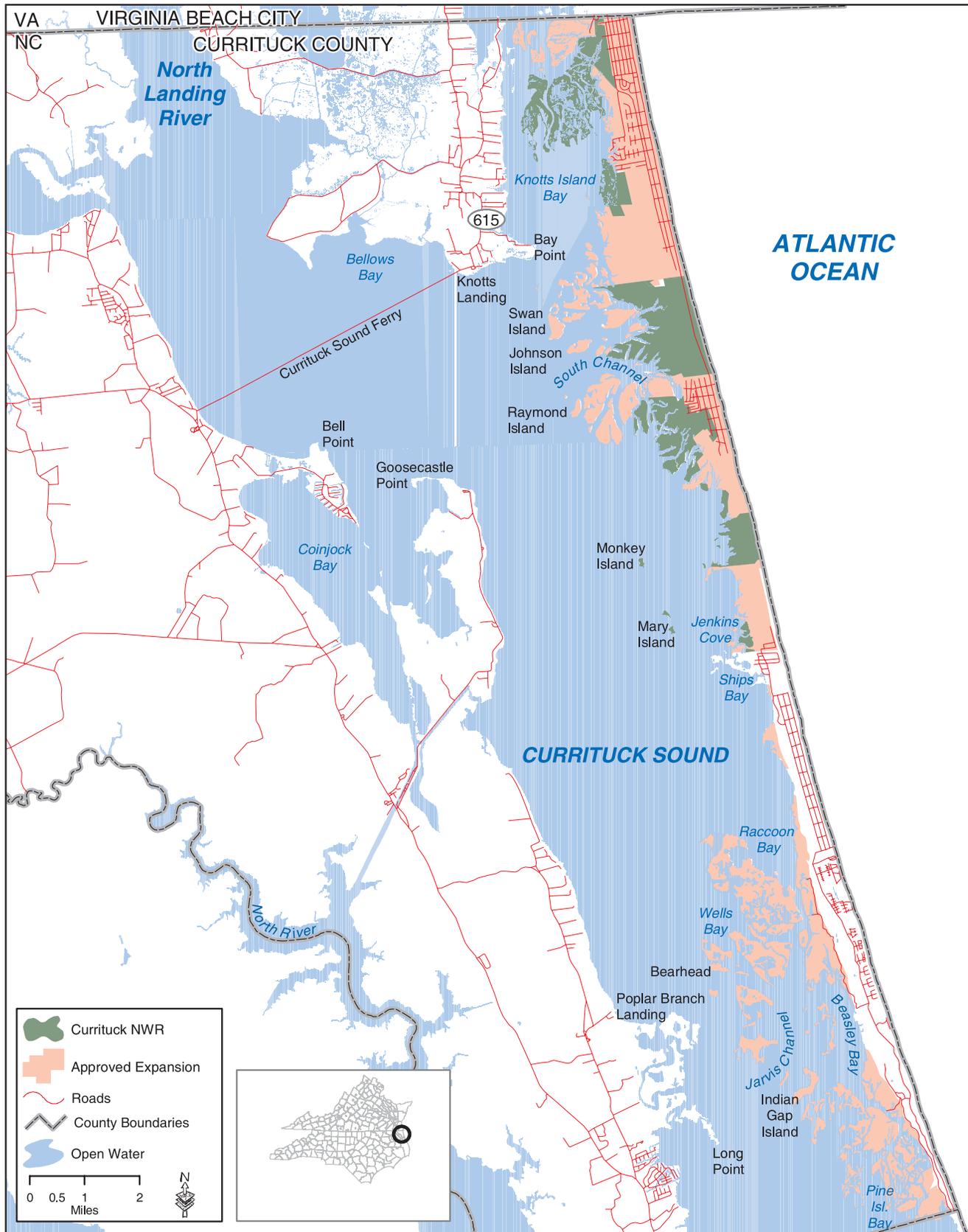
Wildlife Observation

The refuge has no improved facilities for wildlife observation. Visitors may observe wildlife almost anywhere on the refuge property during daylight hours. The various habitats found on the refuge provide for a diverse assemblage of birds and mammals. Sweeping marshlands and open coastal habitats provide uninterrupted viewing opportunities for wildlife. An estimated 25,000 visitors annually use the refuge for wildlife observation. Many of the visitors express an interest in the feral horses.

Wildlife Photography

No photography blinds are located on the refuge. Visitors may photograph wildlife almost anywhere on the refuge property during daylight hours. An estimated 250 visitors annually pursue wildlife photography on the refuge. Many other visitors participate in nature photography while on the refuge.

Figure 6. Approved acquisition boundary, Currituck National Wildlife Refuge



PERSONNEL, OPERATIONS, AND MAINTENANCE

Personnel

The refuge's current staff is headquartered at Mackay Island National Wildlife Refuge and manages both the Mackay Island and Currituck refuges. The staff includes seven positions (Table 16).

Table 16. Staff of Mackay Island and Currituck National Wildlife Refuges - 2005

Position	Status	Percent of Time on Currituck
Refuge Manager, GS-0485-13	PFT	45
Assistant Manager, GS-0485-09	PFT	35
Park Ranger, GS-0026-09	PFT	75
Office Assistant, GS-0303-05	PFT	15
Maintenance Mechanic, WG-4749-10	PFT	15
Engineering Equipment Operator, WG-5716-08	PFT	40
Forestry Technician, GS-0462-05 (Fire)	PFT	40
PFT = permanent full time; TFT = temporary full time; Fire = funded by fire budget		

Operations

Currituck National Wildlife Refuge is administered from an office located on Knotts Island along the North Landing River. The refuge staff administers 4,570 acres of fee title land and 3,931 acres of land with conservation easements on Currituck National Wildlife Refuge in Currituck County, North Carolina, and 8,047 acres of fee title land on Mackay Island National Wildlife Refuge on Knotts Island, North Carolina, and Virginia Beach, Virginia. The marshes on the western edge of the Currituck Refuge lie six miles east of the Mackay Island Refuge headquarters across Currituck Sound. The western marshes are one-half mile east of the boat ramp on Knotts Island Bay; the upland portion of Mackay Island National Wildlife Refuge is two miles east of the boat ramp. It is a 100-mile, two-hour drive by car on roads around the sound to Mackay Island National Wildlife Refuge (Figure 1).

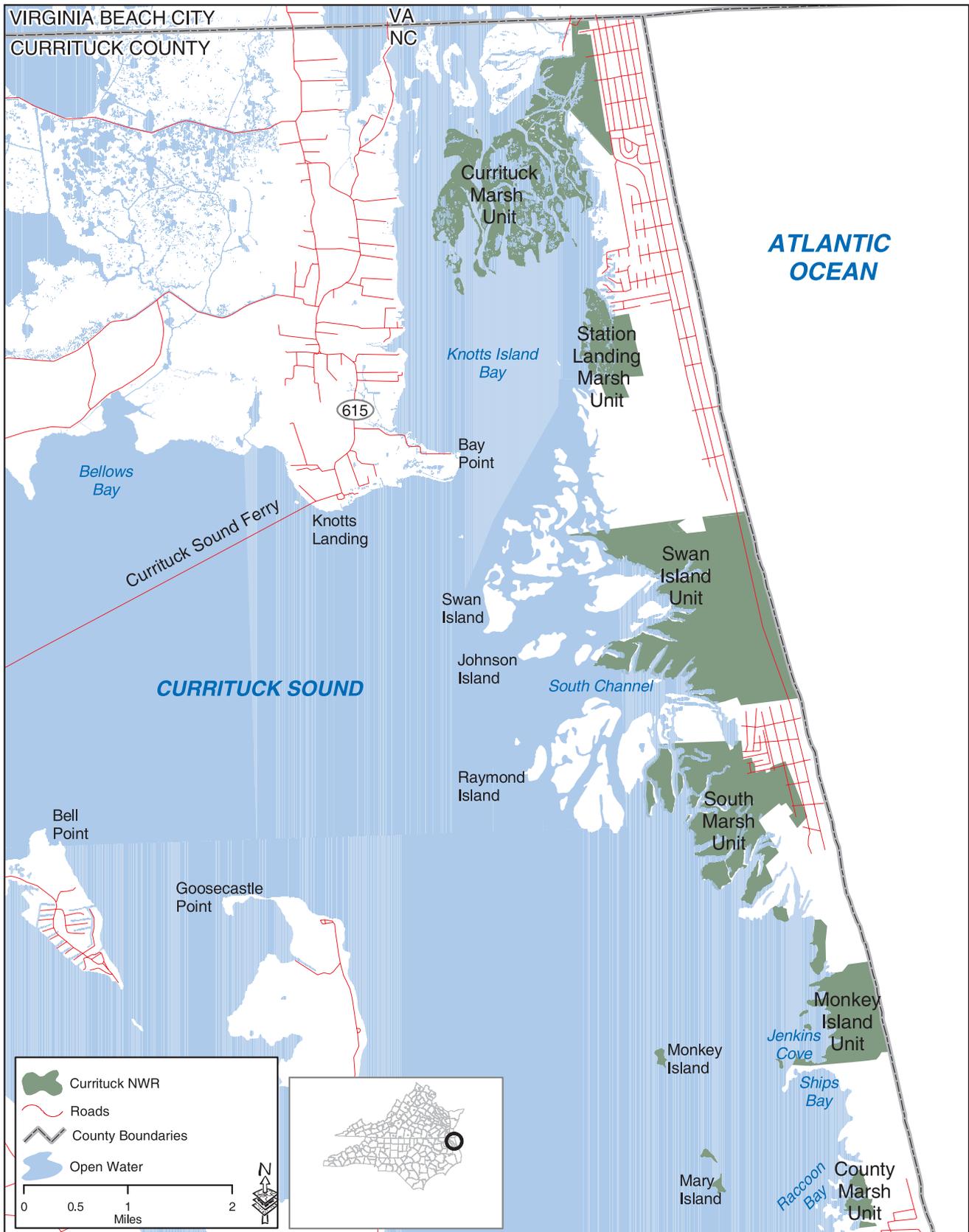
Refuge Infrastructure

Visitor Facilities. The refuge has waterfowl hunting blinds in the Currituck Sound (Figure 7). No other facilities are available to support public use on the refuge.

Roads and Trails. There are no public roads or trails on the refuge. The public may park on the beach and walk to the refuge. Visitors can also access the refuge by boat from Currituck Sound.

Utility Corridors and Distribution. Dominion Power Carolina has a right-of-way issued to provide power from the Corolla area through the refuge and private properties to the Virginia state line. This right-of-way provides the only source of power for the communities of North Swan Beach and Corova Beach. The buried power line transverses the Monkey Island, South Marsh, and Swan Island units of the refuge. Additionally, the primary telephone service is co-located along this corridor.

Figure 7. Current visitor facilities at Currituck National Wildlife Refuge



III. Plan Development

PUBLIC INVOLVEMENT AND THE PLANNING PROCESS

The Service formed a planning core team composed of representatives from its various divisions to prepare the Draft Comprehensive Conservation Plan and Environmental Assessment. Initially, the team focused on identifying the issues and concerns pertinent to refuge management. The team met on several occasions from January 2001 to October 2002. In addition, a biological review team met on the refuges in the ecosystem four times between December 1999 and December 2000 to assess the habitats on the refuges and the needs of wildlife species in the ecosystem, and make recommendations on land management and acquisition needs. The core team also sought the contributions of experts from various fields. The members of the planning core team, the biological review team, and expert contributors are identified in Chapter V, Consultation and Coordination, of the Draft Environmental Assessment (Section B).

Service and state wildlife agency personnel attended the initial planning meetings. At these initial meetings, they discussed strategies for developing the refuge's comprehensive conservation plan; identified the refuge staff's issues and concerns; and compiled a mailing list of likely interested government agencies, nongovernmental organizations, businesses, and individual citizens.

The Service invited agencies, organizations, businesses, and citizens to participate in four public scoping meetings on June 19, 21, 26, and 28, 2001, in Currituck, North Carolina; Corolla, North Carolina; Virginia Beach, Virginia; and Knotts Island, North Carolina, respectively. A total of 61 citizens attended these public meetings. At each meeting, the audiences were introduced to the refuge and its planning process, and asked to identify their issues and concerns. Prior to the meetings, the Service published announcements giving the locations, dates, and times for the public meetings in the *Federal Register* and legal notices in local newspapers. The Service also sent press releases to local newspapers and public service announcements to television and radio stations. Fifty posters announcing the meetings were placed in local post offices, local government buildings, and stores.

The planning team expanded the issues and concerns to include those generated by other government agencies, organizations, businesses, and citizens from the local community. These issues and concerns formed the basis for the development and comparison of objectives in the different alternatives described in the Draft Environmental Assessment (Section B).

After the team developed the alternatives, the refuge manager and the planning staff met with the North Carolina Wildlife Resources Commission in October 2002.

The objectives were subjects of discussion at a second round of public meetings on November 18, 19, 20, and 21, 2002, in Corolla, Currituck, and Knotts Island, North Carolina, and Virginia Beach, Virginia. Again, the Service published legal notices and press releases giving the locations, dates, and times for the public meetings, and sent public service announcements to television and radio stations. Seventy-five posters announcing the meetings were also placed in local post offices, local government buildings, and stores. Thirty citizens attended these four meetings.

PLAN REVIEW AND REVISION

This comprehensive conservation plan will be reviewed annually to determine the need for revision. A revision would occur if and when substantial information becomes available, such as a change in ecological conditions or a major refuge expansion. The final plan would be augmented by detailed step-down management plans and annual plans to address the completion of specific strategies in support of the refuge's goals and objectives. Substantial revisions to the comprehensive conservation plan and the step-down management plans would be subject to public review and comment in compliance with the National Environmental Policy Act.

WILDERNESS REVIEW

Refuge planning policy requires a wilderness review as part of the comprehensive conservation planning process. The Wilderness Act of 1964 defines a wilderness area as an area of federal land that retains its primeval character and influence, without permanent improvements or human inhabitation, and is managed so as to preserve its natural conditions and which

1. generally appears to have been influenced primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;
2. has outstanding opportunities for solitude or primitive and unconfined type of recreation;
3. has at least 5,000 contiguous roadless acres or is of sufficient size to make practicable its preservation and use in an unimpeded condition, or is a roadless island regardless of size;
4. does not substantially exhibit the effects of logging, farming, grazing, or other extensive development or alteration of the landscape, or its wilderness character could be restored through appropriate management at the time of review; and
5. may contain ecological, geological, or other features of scientific, educational, scenic, or historic value.

The lands within Currituck National Wildlife Refuge were reviewed for their suitability in meeting the criteria for wilderness, as defined by the Wilderness Act of 1964. No lands in the refuge were found to meet these criteria. Therefore, the suitability of refuge lands for wilderness designation is not further analyzed in this plan.

SUMMARY OF ISSUES, CONCERNS, AND OPPORTUNITIES

A number of issues and concerns were generated from the input of local citizens and public agencies, the team members' knowledge of the area, and the resource needs identified by the refuge staff and biological review team. The Fish and Wildlife Service assembled a planning team (see Table 37 in Chapter V, Consultation and Coordination, Section B) to evaluate the resource needs. The team then developed a list of goals, objectives and strategies to shape the management of the refuge for the next 15 years.

These issues provided the basis for developing the refuge's alternative management objectives and strategies. These issues played a role in determining the desired future conditions for the refuge and the staff considered them in the preparation of the long-term comprehensive conservation plan. The issues and concerns are described below. They are of local, regional, and national significance and reflect similar issues that were, in part, identified by the public at the public scoping meetings.

GLOBAL WARMING AND SEA LEVEL RISE

The majority of the refuge is at or near sea level. The marshes that flood with wind tides cover the majority of the refuge. Scientists predict that the sea level along the North Carolina coast will rise from two to three feet in the next 100 years due to global warming. That rise in water levels will change the types of vegetative cover on the refuge. The grass-dominated freshwater marshes that occupy the majority of the refuge will expand into areas currently covered by maritime forest and shrub. The lower-lying grass stands will become marshes.

As the habitats change, the wildlife species that inhabit those habitats will also change. Nesting birds that currently utilize tall trees along the sound will lose their roost sites as trees die and fall. Species that live in marshes will move east into areas that are currently low-lying grasslands.

FISH AND WILDLIFE POPULATIONS

General

The refuge staff currently performs some surveys to document the populations of certain species groups. The public and cooperating agencies have encouraged the refuge to continue performing those surveys for the most important wildlife resources as the staff takes on new responsibilities outlined in the plan.

Threatened and Endangered Species

Recovery and protection of threatened and endangered plants and animals is an important responsibility delegated to the Service and its national wildlife refuges. Six threatened or endangered animals and one plant are thought to use (or could use) Currituck National Wildlife Refuge: the piping plover, loggerhead sea turtle, bald eagle, red-cockaded woodpecker, West Indian manatee, leatherback sea turtle, and seabeach amaranth.

Piping plovers have historically nested along the beaches and overwash areas behind the dunes on the refuge. Unrestricted vehicular traffic on the beach below the high tide elevation discourages the plovers from nesting on the beaches. The refuge could create suitable habitat behind the dunes by clearing and excavating areas to mimic overwash areas with shallow pools of water. The last citing of nesting piping plovers was in 1989, when three birds were found on a refuge beach in association with a threatened seabeach amaranth plant. The last citing of foraging piping plover was in 2001.

Loggerhead turtles have nested along the beaches in the past. The last documented nest was a successful one in 1998. Unrestricted vehicular traffic and the tracks the vehicles leave greatly reduce the chances for the nests to be successful. There are limited opportunities to mitigate the effects of the traffic on turtles.

Threatened bald eagles nest on Mackay Island National Wildlife Refuge across the Currituck Sound from Currituck National Wildlife Refuge. They also nest in adjacent counties and travel the river corridor and shoreline of the sound. The refuge's habitat protection and management activities provide suitable habitat for nesting eagles.

Records of the occurrence of endangered red-cockaded woodpeckers in Currituck County are more than twenty years old. There is no suitable habitat on the refuge.

Endangered West Indian manatees are occasionally cited in Currituck County and areas further north, but Currituck County is outside the normal range of the manatee.

The last record of leatherback sea turtles in the county was a stranding in 1981.

The last citing of seabeach amaranth was in 1989, when a biologist found a single plant on the refuge beach in association with an endangered piping plover nesting.

Waterfowl

The scoping process identified the management of all refuge marshes, managed wetlands (moist soil units), and forests for waterfowl and expanding waterfowl hunting opportunities as issues. In order to meet the refuge's waterfowl purpose, the refuge must maintain the marsh, forest, and managed wetlands (moist soil units) to meet waterfowl habitat needs and provide sufficient sanctuary areas to provide undisturbed resting and feeding areas for waterfowl. Additional waterfowl hunting opportunities can be provided as the refuge acquires additional land, but the core waterfowl sanctuary needs to remain intact to meet the undisturbed resting and feeding needs of waterfowl.

The refuge's waterfowl purpose guides all operation and management actions on the refuge. The refuge manages forested wetlands to meet the feeding, resting, and breeding needs of migratory and resident waterfowl. Staff of the Fish and Wildlife Service and cooperating agencies and organizations conducted a biological review of Currituck National Wildlife Refuge in 1999 and 2000 as part of the comprehensive conservation planning process. They identified objectives to meet the minimum water, food, sanctuary, and resting/loafing habitat requirements of waterfowl.

Shorebirds

The refuge does not own the beach below the high tide elevation, but it does have the potential to develop shorebird habitat in the moist soil units (managed wetlands) by water management, and areas behind the coastal dunes by clearing and excavating areas to mimic overwash areas.

Neotropical Migratory Birds

Neotropical migratory birds are a species group of special management concern. Providing habitat (i.e., forest and marshes) for these birds is one of the refuge's major objectives. Strategic forest management compatible with the refuge's waterfowl habitat objectives would contribute to the forest needs of neotropical migratory birds. The biological review identified objectives needed to meet the minimum feeding and nesting habitat requirements of neotropical migratory birds. The neotropical migratory birds are also a major focus of the refuge's wildlife observation program, as many birders visit the refuge to observe nesting, feeding, and loafing birds.

Colonial Nesting Birds

There is a heron rookery on Monkey Island that is in danger of being lost to erosion. The rookery is recognized as an important resource by federal, state, and local conservationists. The refuge has proposed a project that would stabilize Monkey Island to protect the rookery from erosion.

Feral Horses

Feral horses of uncertain origin inhabit the refuge. Some residents and others believe that these horses have origins that date back to Spanish origins and indicate that these horses may have existed here for over 400 years. Other sources indicate that these horses were brought to the island to avoid mainland taxes and to provide summer grazing. Genetic work to determine the origin of the horses has been inconclusive. Currituck County passed an ordinance to protect the horses. The county has also developed a group that advises the county commissioners on matters relating to the maintenance of the wild horse herd. The Wild Horse Advisory Board is composed of two citizen representatives, the Corolla Wild Horse Fund, a Fish and Wildlife Service representative, the county manager, and a representative of the National Estuarine Research Reserve. The approved Currituck Banks Wild Horse Management Plan calls for the population numbers to be maintained within the plan's guidance (currently below sixty individuals). As funding becomes available, the Service will monitor the impacts of the horses on refuge lands. The results of monitoring would allow better population management recommendations that could be incorporated into the Currituck Wild Horse Management Plan.

HABITATS

Brackish Marsh and Managed Wetlands

Participants at the public scoping meetings expressed strong support for continued management of the marshes and managed wetlands (moist soil units) along the North Landing River, Back Bay, and Currituck Sound. They were well aware of the connection between that management and opportunities for hunting on adjacent lands (primarily for waterfowl). There is also public recognition of the role of the refuge's small forest area in white-tailed deer and neotropical migratory bird populations, and the public uses associated with the deer and the birds. The public also values the support the forest provides for other aspects of the refuge's public use program.

Currituck National Wildlife Refuge is situated near several large marshes in the South Atlantic Coastal Plain Physiographic Zone. Cooperative private–state–federal partnerships under the North American Waterfowl Management Plan, Partners in Flight, and the Atlantic Coast Joint Venture recommend maintenance and stabilization of the marsh. With strategic management, the staff can provide quality marsh habitat with the proper prescribed burning and aquatic weed control.

Submerged Aquatic Vegetation

There is widespread recognition by the Fish and Wildlife Service, state agencies, nongovernmental organizations, and the general public that submerged aquatic vegetation is on the decline in the areas around Currituck Sound. This decline has resulted in corresponding declines in migrating duck populations and fish nursery productivity. There are several possible reasons for the decline, ranging from poor water quality to rising salinities due to storms. The agencies, organizations, and the public have encouraged the refuge to get involved and stay involved in the monitoring of submerged aquatic vegetation and water quality monitoring to assess one potential cause of its decline.

PUBLIC USE

The refuge is located in Currituck County, North Carolina (2000 population 18,190) and adjacent to Virginia Beach, Virginia (2000 population 425,257) within 27 miles of the Virginia Beach business district. It is also the northern extent of North Carolina's Outer Banks, a destination for tourists from the entire East Coast. There are several local initiatives to promote nature-based tourism in northeastern North Carolina. A few commercial enterprises have interests in guiding canoeing and angling adventures. The refuge is an important link to the other natural areas that together make these experiences possible. Carefully selected and managed staff, programs, and facilities will provide the wildlife-dependent environmental education, interpretation, and recreation opportunities the refuge visitors expect. The refuge will require additional staff support to achieve its visitor service potential.

Hunting

Hunting and fishing are integral parts of rural North Carolina culture. It is not surprising that there is a considerable interest from the state agencies and local citizens in expanding hunting opportunities. The initial refuge strategy must be maintenance of the quality of hunting at existing levels. Any additional hunting opportunities will be dependent on providing safe, quality experiences that are compatible with refuge purposes. The refuge requires additional law enforcement personnel to administer any additional hunts.

Environmental Education and Interpretation

There is no staff assigned to the Currituck National Wildlife Refuge and no education and interpretation staff at Mackay Island National Wildlife Refuge. The public expressed a strong desire to have interpretative facilities and education programming at Currituck National Wildlife Refuge, especially during the summer vacation season. There are opportunities to develop partnerships with the North Carolina Wildlife Resources Commission in developing an environmental education center in Corolla; with the National Estuarine Research Reserve that already has an interpretative boardwalk on their property in Corolla; and with The Nature Conservancy that owns land adjacent to the refuge.

Outreach

The refuge staff is small and focuses its public outreach efforts on local fairs and festivals on Knotts Island and Open Roads Days at Mackay Island National Wildlife Refuge. The public expressed concern that the public use opportunities that are available on Currituck National Wildlife Refuge are not well publicized. They encouraged the refuge to utilize every avenue available (newspapers, television, local cable television, newsletters, posters in local schools and businesses) to let the community know what opportunities are available.

Roads and Trails, Exterior and Interior

There are no established trails on Currituck National Wildlife Refuge. Participants at the public scoping meetings expressed strong support for keeping the refuge unimproved. They were satisfied with the existing access and expressed concern about the negative impacts of providing additional access. They were specifically concerned about wildlife disturbance and habitat trampling.

RESOURCE PROTECTION

Cultural Resources

The clubhouse of the Monkey Island Hunt Club is in poor condition and sits on an eroding island in Currituck Sound. The house is beyond repair and the Regional Cultural Resources Specialist of the Fish and Wildlife Service has granted permission to dismantle the structure. There is local interest in commemorating the club's and the clubhouse's existence as one of the original reasons people settled Currituck County. The Service will commemorate the club and the clubhouse when it builds a visitor contact station at the Currituck National Wildlife Refuge.

Land Acquisition and Habitat Fragmentation

When the Service established the refuge, its role in providing managed wetlands (moist soil units) and brackish marsh was providing additional habitat types for migratory waterfowl. Reevaluation has determined that those habitats are as important for marsh birds and neotropical migratory songbirds (in support of Partners in Flight) as they are for waterfowl habitat. The refuge's current acquisition boundary reflects the importance of protecting and managing the most valuable brackish marsh. Those properties are important links in protecting areas along Currituck Sound. To maintain the potential to protect these lands, the Service must have the ability and authority to manage and protect (through acquisition of fee title interest or conservation easements) the substantial habitat within the current acquisition boundary. Acquisition of fee title interest in new lands would provide expanded public use opportunities if they are compatible; acquisition of conservation easements would not.

Law Enforcement and Refuge Regulation

The refuge has enforced the applicable laws and regulations through the use of one full-time law enforcement officer shared with Mackay Island National Wildlife Refuge and one dual function officer, currently the refuge manager. The use of dual function officers to perform enforcement functions utilizes a great deal of the time they could devote to refuge administration and support of the biological, public use, and maintenance programs. This is particularly evident during the hunting season when the law enforcement workload is at its highest. They are limited in their enforcement authority on the refuge's easement properties and must rely on state and county law enforcement officers to assist them. They are also limited in the amount of time they can devote to permit monitoring and enforcement of the conditions on the permits.

Other Resource Protection

There are other threats to refuge resources that require closer monitoring and management. Pest plants, such as phragmites, and animals, such as nutria, and wildlife disease are all concerns to which the refuge, with adequate personnel and funding, should be paying closer attention.

GENERAL ADMINISTRATION

Funding and Staffing

Funding has been insufficient to support refuge programs. Inadequate staff, facilities, and equipment have prevented the refuge from realizing its purpose and management objectives. Currently, the refuge is not meeting its wildlife habitat objectives beyond the moist soil unit. It conducts few wildlife inventories beyond waterfowl; has few public use facilities; has outdated habitat/wildlife management plans; and provides few nonhunting or nonfishing wildlife-dependent recreational opportunities. Other

priority public uses (such as environmental education, interpretation, wildlife observation, and wildlife photography) are only addressed as they are requested. The assistant manager performs the functions of a wildlife biologist and park ranger (public use) as well his/her management duties. The park ranger for law enforcement must divide his time between two refuges and there is no road access to or on the Currituck National Wildlife Refuge. The active land acquisition program at the refuge requires more time than the manager at Mackay Island can afford. A staff person on the refuge could handle acquisition more efficiently without monopolizing the manager. The refuge needs additional staff to meet its objectives. The biological and public use programs are currently the greatest needs.

IV. Management Direction

INTRODUCTION

This comprehensive conservation plan was derived from Alternative 2, the preferred alternative, of the Draft Environmental Assessment (Section B). Under this plan, the Service would protect, maintain, restore, and enhance refuge lands for resident wildlife, waterfowl, migratory nongame birds, and threatened and endangered species. The staff would initiate extensive wildlife and plant census and inventory activities to develop the baseline biological information needed to implement management programs on the refuge.

The refuge would direct all management actions towards achieving the refuge's primary purposes: (1) preserving nesting and migratory habitat for neotropical migratory songbirds; (2) providing production habitat for marsh birds and shorebirds; and (3) helping to meet the habitat conservation goals of the North American Waterfowl Management Plan. In addition, the Service would manage the refuge to contribute to other national, regional, and state goals for protecting and restoring populations of wildlife.

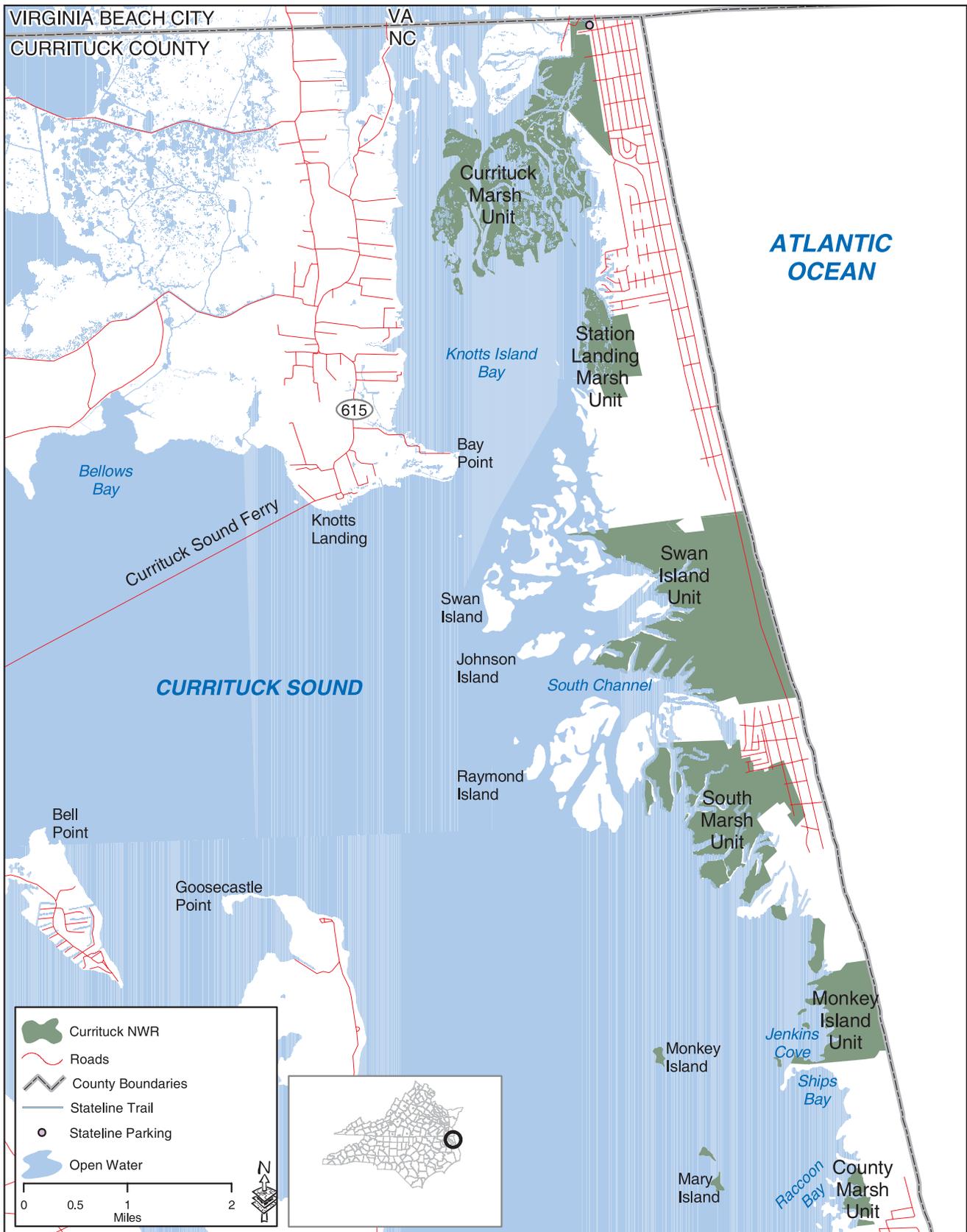
The staff would actively manage habitat through marsh and moist soil area management designed to provide a historically diverse complex of habitats that meets the foraging, resting, and breeding requirements for a variety of species.

Under this plan, the refuge would continue to seek acquisition of all willing seller inholdings within the present acquisition boundary. The primary purpose for this acquisition is to provide a coastal marsh and forest system of sufficient size and carrying capacity to reach regional objectives associated with waterfowl, marsh birds, shorebirds, colonial nesting birds, neotropical birds, anadromous fish, threatened and endangered species, and wetland landscapes. Lands acquired as part of the refuge would become available for compatible wildlife-dependent recreation and environmental education.

During the 15-year life of this plan, the staff would develop and implement a habitat management plan designed to create diverse habitats.

The Service would provide opportunities for high quality wildlife-dependent recreation (hunting, fishing, wildlife observation and photography) and environmental education and interpretation activities. The refuge would permit hiking use to support wildlife-dependent recreation to the extent that these opportunities do not significantly interfere or detract from the achievement of wildlife conservation. It would provide interpretive trails, boardwalks, and kiosks at specific sites to allow for fully accessible environmental education and interpretation programs (Figure 8). The Service would cooperate with the North Carolina Wildlife Commission in developing and conducting environmental education programs at their Outer Banks Environmental Education Center just south of the refuge. The staff would provide quality hunting programs, consistent with sound biological principles with sufficient focus on migratory bird needs for sanctuary, loafing, feeding, and courting requirements. The staff would develop and implement an environmental education plan, incorporating an aggressive and proactive promotion of both on- and off-site programs.

Figure 8. Proposed visitor facilities at Currituck National Wildlife Refuge under Alternative 2



VISION

The vision for the refuge is as follows:

The Currituck National Wildlife Refuge will provide habitat for migratory birds and endangered species as an integral part of the National Wildlife Refuge System. The refuge will restore, enhance, and maintain the natural processes and diversity of the unique habitats of the mid-Atlantic barrier island ecosystem. The refuge will also provide opportunities for compatible wildlife-dependent recreation. The refuge will develop and maintain partnerships with other agencies and organizations to accomplish refuge goals and objectives.

GOALS, OBJECTIVES, AND STRATEGIES

GOALS

Wildlife, Fish, and Plant Populations: Preserve, protect, and maintain healthy and viable populations of migratory birds, wildlife, fish, and plants, including federal and state endangered species and trust species.

Habitat: Restore, enhance, and maintain the natural processes and diversity of the beach, dune, interdunal, maritime forest, and marsh habitats to ensure optimum ecological productivity and protect the water quality of Currituck Sound.

Public Use: Provide the public with safe, high quality wildlife-dependent recreational and educational opportunities that focus on the wildlife and habitats of the refuge and the National Wildlife Refuge System.

Resource Protection: Protect refuge resources by limiting adverse impacts of human activities and development.

Administration: Acquire and manage adequate funding, human resources, facilities, equipment, and infrastructure to accomplish the other refuge goals.

OBJECTIVES AND STRATEGIES

The goals with their objectives, and strategies addressed below are the Service's responses to the issues, concerns, and needs expressed by the planning team, the refuge staff, and the public. These goals, objectives, and strategies reflect the Service's commitment to achieve the mandates of the National Wildlife Refuge System Improvement Act of 1997; the mission of the National Wildlife Refuge System; the North American Waterfowl Management Plan; and the purpose and vision for Currituck National Wildlife Refuge. Depending upon the availability of funds and staff, the Service intends to accomplish these goals, objectives, and strategies during the next 15 years.

Fish and Wildlife

Fish

Objective: Manage refuge resources to protect species of fish and other aquatic organisms in the refuge and adjacent waters.

Discussion: This plan provides for surveys of fish and aquatic organisms, and interpretation of the results of those surveys. As funds from grants become available or partners express an interest in conducting research on the refuge, they would perform more intensive surveys.

There are fish and other aquatic organisms in the managed wetlands (moist soil units) and ditches on the refuge. These species provide the prey base for mammals and birds on the refuge, and are the basis for recreational fishing opportunities. There is no database documenting the diversity or population of the species on the refuge, or the effect of management on the species.

Strategies:

Cooperate with other agencies, universities, and organizations performing studies and investigations on the refuge.

Feral Hogs

Objective: Monitor and control feral hogs.

Discussion: This plan provides for monitoring the effects of feral hogs, and developing and implementing a control plan. As funds from grants become available or partners express an interest in conducting research on the refuge, they would perform more intensive surveys.

Feral hogs from local farms have escaped from the farms onto local private land and the refuge. The hogs damage habitat on the refuge and landscaping and pastures on private land by rooting up vegetation on the surface of the ground.

Strategies:

Monitor the impacts of feral hogs on vegetation and habitat within five years of hiring a biologist.

Evaluate and implement potential control methods within five years of hiring a biologist.

Develop a hunt program to assist with feral hog control within two years of hiring a biologist.

Cooperate with other agencies, universities, and organizations performing studies and investigations on the refuge.

Feral Horses

Objective: Manage feral horses to minimize impacts to refuge resources.

Discussion: This plan provides for the management of feral horses based on the Currituck Banks Wild Horse Management Plan and vegetative monitoring to document the effects of the horses.

A population of feral horses occupies the Outer Banks in Currituck County, including the refuge. The horses are an important tourist attraction and have widespread support in the community. A Currituck Banks Wild Horse Management Plan has been developed in cooperation with the Currituck County Wild Horse Advisory Board and the Corolla Wild Horse Fund. The horse management plan currently provides for physical removal of horses when the population exceeds 60 animals.

Strategies:

Cooperate with the Currituck County Wild Horse Advisory Board and the Corolla Wild Horse Fund to implement the Currituck Wild Horse Management Plan.

Ensure that the Currituck Wild Horse Management Plan does not allow the impacts of horses to exceed acceptable levels.

Monitor the impacts of feral horses on vegetation and habitat within five years of hiring a biologist.

Invertebrate Species

Objective: Document diversity and populations of invertebrate species.

Discussion: This plan does not provide for surveys of invertebrate species, but does provide for documentation of their presence. As funds from grants become available or partners express an interest in conducting research on the refuge, they would perform more intensive surveys.

There are invertebrate species on the refuge that provide the prey base for mammals, reptiles, amphibians, fish, and birds on the refuge. There is no database documenting the diversity or population of the species on the refuge, or the effect of management on the species. This Alternative provides for documentation of invertebrates as the staff identifies them.

Strategies:

Document the presence of invertebrate species as they are identified.

Cooperate with other agencies, universities, and organizations performing studies and investigations on the refuge.

Land Birds

Objective: Provide resting, nesting, and foraging habitat for about 190 species of land birds.

Discussion: This plan provides for establishment of an inventory protocol and the development and implementation of an inventory plan for land birds. As funds from grants become available or partners express an interest in conducting research on the refuge, they would perform more intensive surveys.

There are 190 species of avian species on the refuge, some of which breed on the refuge and others that rest and feed on the refuge during migration. Many of the species are birds identified as high priority by Partners in Flight, a group of scientists from state and federal agencies, universities, and nongovernmental organizations who study and manage migratory bird populations. The birds are the basis for much of the refuge's wildlife observation and photography. There is no database documenting the diversity or population of the species on the refuge, or the effect of management on the species.

Strategies:

Note nesting activity of bald eagles.

Assist with banding activities as directed.

Establish an inventory protocol for neotropical migratory songbirds within five years of hiring a biologist.

Develop and implement an inventory plan for neotropical migratory songbirds and raptors within five years of hiring a biologist.

Cooperate with other agencies, universities, and organizations performing studies and investigations on the refuge.

Mammals

Objective: Document the diversity and populations of white-tailed deer.

Discussion: This plan only provides for limited surveys of deer and documentation of the presence of other mammals. As funds from grants become available or partners express an interest in conducting research on the refuge, they would perform more intensive surveys.

There are mammals on the refuge that provide the prey base for other mammals and birds of prey on the refuge. Some mammals are the basis for hunting and wildlife observation and photography. There is no database documenting the diversity or population of the species on the refuge, or the effect of habitat management on the species.

Strategies:

Respond to reports of marine mammal strandings.

Monitor, collect data from, and manage white-tailed deer populations.

Conduct abomasal parasite count every six years.

Document the presence of mammals as they are identified.

Cooperate with other agencies, universities, and organizations performing studies and investigations on the refuge.

Reptiles and Amphibians

Objective: Document presence of reptiles and amphibians and respond to reports of sea turtle nests and strandings.

Discussion: This plan provides for documentation of reptiles and amphibians from incidental sightings. It also provides for response to reports of sea turtle nests and strandings. As funds from grants become available or partners express an interest in conducting research on the refuge, they would perform more intensive surveys.

There are reptiles and amphibians on the refuge that provide the prey base for other reptiles and amphibians, mammals, wading birds, birds of prey, and fish on the refuge. There is no database documenting the diversity or population of the species on the refuge, or the effect of management on the species.

The refuge is within the nesting range of both threatened and endangered species of sea turtles. There has been little documentation of sea turtle nesting on the beaches between the refuge and the Atlantic Ocean. The public has unrestricted vehicular access to the beach for recreation and to their residences. There are subdivisions scattered among the refuge tracts.

Strategies:

Document the presence of reptiles and amphibians as they are identified from incidental sightings.

Respond to reports of sea turtle nests and strandings; collect data and tissue samples and send them to the state sea turtle coordinator.

Cooperate with other agencies, universities, and organizations performing studies and investigations on the refuge.

Shorebirds

Objective: Document diversity and populations of shorebirds.

Discussion: This plan only provides for limited surveys of shorebirds. As funds from grants become available or partners express an interest in conducting research on the refuge, they would perform more intensive surveys.

Strategies:

Conduct surveys seasonally.

Submit data to the coordinated shorebird website.

Assist the State of North Carolina with annual piping plover surveys.

Conduct productivity surveys of shorebird nests within ten years of hiring a biologist.

Assist with studies, investigations, and banding as requested.

Cooperate with other agencies, universities, and organizations performing studies and investigations on the refuge.

Wading Birds

Objective: Document diversity and populations of wading birds.

Discussion: This plan provides for performing regular surveys of wading birds and monitoring of the rookery on Monkey Island. As funds from grants become available or partners express an interest in conducting research on the refuge, they would perform more intensive surveys.

Strategies:

Conduct surveys in conjunction with shorebird surveys.

Monitor rookery on Monkey Island in cooperation with the North Carolina Wildlife Resources Commission.

Note the presence of other rookeries.

Stabilize the shoreline of Monkey Island as funding allows.

Assist with studies and investigations as requested.

Cooperate with other agencies, universities, and organizations performing studies and investigations on the refuge.

Waterfowl

Objective: Document diversity and populations of waterfowl. Monitor wood duck boxes and band wood ducks.

Discussion: This plan provides for surveys of wintering waterfowl and existing wood duck boxes. It also provides for the banding of waterfowl and resident Canada geese. As funds from grants become available or partners express an interest in conducting research on the refuge, they would perform more intensive surveys.

Strategies:

Monitor wintering waterfowl populations by conducting up to 10 biweekly aerial surveys throughout the wintering waterfowl season. Coordinate monitoring with other refuges in the Roanoke–Tar–Neuse–Cape Fear ecosystem and submit data to the coordinated waterfowl website.

Check up to 30 wood duck boxes for productivity annually.

Conduct or assist with the banding of wintering waterfowl when requested.

Assist with studies as requested.

Cooperate with other agencies, universities, and organizations performing studies and investigations on the refuge.

Habitat

All Habitats

Objective: Manage habitats to improve conditions for target species using water management techniques and prescribed fire.

Discussion: This plan provides for management of natural marshes and forests with fire and managed wetlands (moist soil units) by fluctuating water levels to achieve the desired effects. It also provides for the development and implementation of an overall habitat management plan.

Strategies:

Implement water management and fire management plans.

Develop annual water management plan.

Review fire management plan annually.

Revise fire management plan as needed.

Develop and implement an overall habitat management plan within ten years of hiring a biologist.

Dune and Beach

Objective: Protect 202 acres of healthy, functional beach habitat, and 137 acres of maritime grasslands to maintain it as a natural community.

Discussion: This plan provides for surveys of seabeach amaranth and areas with the potential to be piping plover habitat. It provides for no management of the habitat.

Strategies:

Allow natural processes to shape the beach profile.

Conduct regular seabeach amaranth surveys within ten years of hiring a biologist.

Maritime Shrub

Objective: Protect 778 acres of healthy, functional maritime shrub habitat to maintain it as a natural community.

Discussion: This plan provides only for protection of the habitat.

Strategies:

Manage wildfires on the refuge.

Clear and maintain firebreaks.

Investigate and consider the use of firebreaks.

Maritime Forest

Objective: Protect 637 acres of healthy, functional maritime forest habitat to maintain it as a natural community.

Discussion: This plan provides for only the protection of the habitat. There would be no inventories or management of the habitat.

Strategy:

Control wildfires on the refuge.

Brackish Marsh/Wet Meadow

Objective: Protect 2,202 acres of healthy, functional brackish marsh/wet meadow habitat to maintain it as a natural community. Protect adjacent areas by managing wildfires.

Discussion: This plan provides for the protection of the habitat and management with fire. It also provides for assessment of the effects of prescribed fire and adaptation of the fire management plan to the results of the monitoring.

Strategies:

Manage wildfires on the refuge.

Conduct prescribed burning according to the fire management plan.

Monitor the vegetation and assess the effects of fire on vegetation within five years of hiring a biologist.

Adapt the fire management plans to the results of monitoring.

Roads and Administrative Areas

Objective: Maintain 5 acres of road for public, administrative, and fire access.

Discussion: This plan provides for the maintenance of roads and administrative areas to Service standards.

Strategies:

Provide maintenance of roads to Service standards to assure passable condition for all-terrain vehicles.

Maintain administrative areas in a functional, environmentally sound manner.

Moist Soil Units (Managed Wetlands)

Objective: Protect and manage 143 acres of impoundments to provide wintering habitat for migratory waterfowl, shorebirds, wading birds, and land birds, and breeding habitat for marsh birds and land birds.

Discussion: This plan provides for the management of the habitat with a modest monitoring frequency and modest mudflat goal in the spring.

Strategies:

Manage units according to the water management plan using natural water sources and a well and pump.

Manage the units to achieve a 60% cover of plants rated as good every year.

Monitor moist soil vegetation every year.

Manage the units to provide 20% of the acreage in mudflats during the peak of spring shorebird migration (May).

Wood Duck Boxes

Objective: Maintain up to 60 wood duck boxes in the appropriate habitat annually.

Discussion: This plan provides for the maintenance of 30 wood duck boxes currently erected on the refuge, and the construction and maintenance of 30 new wood duck boxes. It also provides for adaptive management in response to dump-nesting.

Strategies:

Check and repair up to 60 wood duck nest boxes annually.

Document the nesting success of up to 60 wood duck nest boxes annually.

Construct 30 new wood duck nest boxes.

Erect new boxes as nest box use approaches 60%.

Firebreaks

Objective: Maintain 10 acres (3.0 miles) of firebreaks to facilitate wildfire suppression and provide early successional habitat for wildlife.

Discussion: This plan provides for the maintenance of firebreaks to Service standards and the clearing of new firebreaks to facilitate wildfire suppression or prescribed burning.

Strategies:

Maintain firebreaks in an effective, environmentally sound manner.

Clear new firebreaks in an effective environmentally sound manner.

Public Use

Hunting

Objective: Provide 480 annual high quality opportunities for hunting waterfowl and 300 opportunities for hunting deer and feral hogs.

Discussion: The refuge has a waterfowl hunting program administered by the refuge staff. The refuge publishes the hunting regulations in a refuge hunting brochure. This plan adds the development and implementation of a plan for deer and feral hog hunting.

Strategies:

Maintain nine waterfowl hunting blinds.

Revise refuge hunting brochure annually.

Provide an opportunity for a one-day youth waterfowl hunt.

Review and revise the waterfowl hunt plan as necessary.

Develop a hunt plan for deer and feral hogs.

Environmental Education

Objective: Provide environmental education opportunities for up to 200 people annually.

Discussion: This plan provides for additional environmental education opportunities by request and more planned opportunities. It provides for the coordination, planning, and equipment to carry out those opportunities.

Strategies:

Provide up to four environmental education programs by request annually.

Provide two planned environmental education program annually.

Coordinate activities with the Outer Banks Environmental Education Center.

Utilize partners and volunteers to conduct education opportunities.

Utilize the Sound to Sea Trail in programs.

Develop programs in cooperation with the Currituck County Board of Education, North Carolina Wildlife Resources Commission, North Carolina Division of Parks, Audubon Society, The Nature Conservancy, The North Carolina Estuarine Research Reserve, and the Whalehead Trust.

Interpretation

Objective: Provide interpretation opportunities for 2,000 visitors annually.

Discussion: This plan provides for a modest interpretation program. The staff would cooperate with the North Carolina Wildlife Resources Commission in the development of the Outer Banks Wildlife Education Center. The staff would maintain a refuge brochure, bird list, and web site. This plan adds the development and maintenance of an information kiosk and the leadership of two tours.

Strategies:

Develop and maintain one information kiosk and the exhibits in the kiosk.

Develop exhibits for the Outer Banks Environmental Education Center.

Develop a refuge brochure and revise it every five years.

Develop a refuge bird list and revise it every five years.

Maintain the refuge web site.

Cooperate with The Nature Conservancy and the North Carolina Estuarine Research Reserve to develop a Sound to Sea Trail.

Develop and maintain a State Marker Trail in cooperation with False Cape State Park within ten years.

Conduct two tours of the refuge.

Wildlife Observation

Objective: Provide wildlife observation opportunities for 35,000 people annually.

Discussion: This plan provides for a modest wildlife observation program. The staff would develop and maintain three trails to facilitate observation. The staff would also develop and maintain a refuge bird list.

Strategies:

Develop a refuge bird list and revise it every five years.

Cooperate with The Nature Conservancy and the North Carolina Estuarine Research Reserve to develop a Sound to Sea Trail.

Establish a Kuralt Trail site in cooperation with the Sound to Sea Trail.

Develop and maintain a State Marker Trail in cooperation with False Cape State Park within ten years.

Wildlife Photography

Objective: Provide wildlife photography opportunities for 350 people annually.

Discussion: This plan provides for a modest wildlife photography program. The staff would develop and maintain two trails to facilitate photography. The staff would also develop and maintain a refuge bird list.

Strategies:

Develop a refuge bird list and revise it every five years.

Cooperate with The Nature Conservancy and the North Carolina Estuarine Research Reserve to develop a Sound to Sea Trail.

Establish a Kuralt Trail site in cooperation with the Sound to Sea Trail.

Develop and maintain a State Marker Trail in cooperation with False Cape State Park within ten years.

Access

Objective: Maintain as much public access to the refuge as staffing allows and wildlife tolerates.

Discussion: This plan would provide limited daylight access to the refuge due to the sensitive nature of the ecosystem. Pedestrians and bicyclists have access to the entire refuge; vehicles must park on the beach or in designated parking areas.

Strategies:

Open the refuge during daylight hours.

Allow access to pedestrians and bicyclists west of the refuge boundary along the frontal dune.

Allow access by vehicles in the parking lot at the State Marker Trail on the North Carolina-Virginia state line behind the frontal dune line.

Provide emergency vehicles access to refuge roads for emergency response situations.

Outreach

Objective: Provide outreach designed for 250,000 people annually.

Discussion: This plan only provides for a modest outreach effort. The refuge maintains a refuge website and refuge brochure. The staff appears at local fairs and festivals, develops news releases, makes presentations to local groups, and has visibility on local access television stations.

Strategies:

Participate in the Whalehead Fourth of July Celebration, Wings over Water, Earth Day events, Career Days, Green Sea, and Fun Safety and Education Day.

Maintain the refuge website and the refuge brochure as the refuge program changes.

Develop three news releases annually.

Make up to three presentations to local organizations annually on request.

Publicize refuge events on local public access television stations after a public use specialist is hired.

Refuge Support

Objective: Work continuously and formally with groups that support the refuge to cultivate their support and inform the groups of the refuge's needs and ways to meet the needs.

Discussion: The refuge works with several groups in the area to promote the refuge and support the refuge's activities. One group, the Coastal Wildlife Refuge Society, is a traditional friends group that supports the refuge and assists the refuge in seeking grants, financial contributions, and volunteers. The others are groups that assist the refuge in the management of the refuge.

This plan also provides for the development of a local chapter of the Coastal Wildlife Refuge Society and a retail outlet in the visitor contact station.

Strategies:

Work with the Coastal Wildlife Refuge Society, The Nature Conservancy, the Network for Endangered Sea Turtles, and Ducks Unlimited.

Develop a Currituck Chapter of the Coastal Wildlife Refuge Society within fifteen years of hiring a public use specialist.

Establish a sales outlet in the visitor contact station within ten years of its construction.

Special Events

Objective: Host five events annually to celebrate national events and give the public an opportunity to see the refuge and meet the staff.

Discussion: The refuge would host one special event to provide exposure for the refuge.

Strategies:

Host a Beach Cleanup in cooperation with the Corolla and Carova Volunteer Fire Departments within ten years of hiring a public use specialist.

Resource Protection

Cultural Resources

Objective: Avoid all impacts to cultural resources continuously.

Discussion: Native Americans once had villages along the Atlantic Ocean, Currituck Sound, and Back Bay. There were also waterfowl hunting clubs along the Currituck Sound and Back Bay. The Monkey Island Hunt Club was on an island that is eroding rapidly and in a building that is beyond restoration. The refuge staff refers all proposed projects to the Regional Historic Preservation Officer for review and a determination for further action. The Regional Historic Preservation Officer consults with the state Historic Preservation Office and decides how to proceed in onsite investigations. The refuge staff patrols identified sites as part of its routine law enforcement efforts.

This plan provides for a comprehensive inventory of cultural resources and interpretation of the history of the Monkey Island Hunt Club.

Strategies:

- Evaluate all proposed projects and coordinate with the Regional Historic Preservation Officer before beginning a project.

- Protect identified cultural resource sites continuously.

- Conduct a comprehensive cultural resources inventory within ten years.

- Interpret the history of the Monkey Island Hunt Club in the visitor contact station.

Interagency Coordination and Cooperative Agreements

Objective: Maintain a minimum level of coordination with local, state, and federal public agencies and private organizations.

Discussion: The refuge staff coordinates with a wide variety of agencies and organizations to protect the resources on the refuge. The staff conducts much of the coordination through constant communication with local and state law enforcement officials who patrol the area around the refuge. They also conduct more deliberate coordination in meetings to establish rules and regulations and delegate responsibilities. This plan also provides for the development of a memorandum of understanding with the Currituck County Game Commission on waterfowl rest areas.

Strategies:

- Communicate informally and formally in 30 meetings each year.

- Review and revise formal cooperative agreements as time allows.

- Coordinate with the North Carolina Forest Service and other refuges on wildfire suppression annually.

- Develop an agreement with state agencies for co-management of navigable waters.

Develop a memorandum of understanding with the Currituck Game Commission for waterfowl rest areas within five years.

Land Protection

Objective: Continue to purchase land within the approved acquisition boundary.

Discussion: The refuge currently owns 4,570 acres in fee title ownership and conservation easements on 3,931 acres. There are 9,515 acres of inholdings within the approved acquisition boundary. The refuge staff is aware of the owners of the tracts and maintains contact with the owners and organizations that may assist in securing the land. The staff would post the boundaries of land acquired and inventory the habitat on the land.

Strategies:

Maintain contact with landowners within the approved acquisition boundary.

Cooperate with the Realty Division in the Regional Office to process the land of willing sellers.

Post the boundaries of newly acquired land.

Inventory the habitat on newly acquired land.

Law Enforcement

Objective: Enforce refuge regulations continuously.

Discussion: The refuge staff enforces regulations with a full-time park ranger (law enforcement) and a dual function officer. The park ranger patrols Mackay Island National Wildlife Refuge as well as Currituck National Wildlife Refuge. The dual function officer patrols the two refuges as his other duties allow and as activity on the refuge dictates. The staff coordinates with cooperating local, state, and federal agencies to enforce regulations on the refuge. This plan provides for improvement of the posting and enforcing of the exclusion from the unexploded ordnance site, and the development of written agreements with law enforcement agencies.

Strategies:

Enforce refuge regulations as time permits.

Improve the posting of and enforcement of exclusion of the public from the unexploded ordnance site on the Monkey Island Unit.

Pursue the cleanup of unexploded ordnance with the U.S. Army Corps of Engineers.

Provide assistance to and coordinate with appropriate local, state, and federal law enforcement agencies to facilitate compliance with local, state, and federal laws as time permits.

Develop written agreements with and improve cooperation with law enforcement agencies within fifteen years.

Navigable Waters

Objective: Consult with the State of North Carolina and the Currituck County Game Commission to establish a cooperative management agreement to regulate certain activities within selected waters.

Discussion: This objective pursues the agreement more proactively than the status quo. There are properties that are being impacted by activities on waters that directly affect refuge lands. There are incompatible activities that occur on these waters that threaten refuge habitat and fish and wildlife populations. The State of North Carolina has limited resources to enforce existing regulations on those waters. Under this plan, the Service would actively pursue cooperative management of those waters. The refuge will also continue to work cooperatively with the Currituck County Game Commission to establish prudent rest areas and designated waterfowl hunting blind locations within areas of Currituck County.

Strategy:

Coordinate selection of waters with Fish and Wildlife Service coordinating refuge manager.

Permits

Objective: Limit impacts to refuge resources by evaluating and enforcing special use permits.

Discussion: The refuge staff allows uses of the refuge by reviewing requests for special use permits and permitting some uses subject to conditions. Those uses must be compatible with the mission of the Fish and Wildlife Service, the purpose of the refuge, and the other priority public uses on the refuge. The conditions may restrict the use by limiting the area or season of the activity, the number of individuals participating in the activity, and the access to the refuge for the activity. The conditions may also limit the activity to a degree of habitat or wildlife disturbance that must be monitored by the refuge staff. This plan provides for the development of standardized special use conditions, monitoring of compliance with permit conditions, and an assessment of the effects of the use.

Strategies:

Evaluate approximately eight use proposals per year on a case-by-case basis.

Protect refuge resources by developing special conditions for those permitted uses that are compatible.

Develop standardized special conditions where possible.

Monitor permitted activities to ensure compliance and assess the effect of the use on the environment within fifteen years.

Pest Animals

Objective: Limit impacts to refuge resources by monitoring, controlling, or eradicating pest animals according to a nuisance animal control plan.

Discussion: The refuge staff only controls pest animals when the impacts of pest animals are obvious. Animals such as feral horses, feral hogs, and nutria may have an impact on habitat and other species, but the Service does not currently staff or fund the refuge to investigate that impact. The feral horses are managed according to a Wild Horse Management Plan. This plan provides for development of a nuisance animal control plan, and monitoring and control according to the plan.

Strategies:

Develop a nuisance animal control plan within five years of hiring a biologist.

Monitor pest animals and the damage to refuge resources and note the locations so staff can seek pest animals.

Control pest animals when they reach threshold levels identified in the plan.

Coordinate feral horse issues with the Currituck Banks Wild Horse Advisory Board.

Pest Plants

Objective: Improve plant communities and limit impacts to refuge resources from pest plants.

Discussion: The refuge staff currently monitors pest plants such as common reed (*Phragmites australis*). Control of the pest plants currently depends on the availability of staff and funds when the pest plant can be controlled by effective means. This plan provides for development of a pest plant control plan, and monitoring and control according to the plan.

Strategies:

Develop a pest plant control plan within five years of hiring a biologist.

Observe damage to refuge resources and note the locations so staff can monitor according to the plan.

Control pest plants when they reach threshold levels identified in the plan.

Significant Natural Heritage Areas

Objective: Limit impacts to the area to retain the natural character of the area.

Discussion: Much of the refuge is a registered state natural heritage area in North Carolina. The refuge manages the area to retain the natural character of the area to fulfill the purpose of the refuge, as well as meet the goals of the North Carolina Natural Heritage Program. The refuge's fire management plan currently prescribes burning the brackish marsh and maritime shrub communities to maintain plant diversity. This plan would implement the same strategies as Alternative 1, but provides for the hiring of a prescribed fire specialist to coordinate the implementation.

Strategies:

Implement the prescribed burning program to mimic the natural fire cycle.

Monitor the effects of prescribed burning on the area.

Review and update a fire management plan to adapt the plan based on the results of prescribed burning on the refuge.

Investigate the registration of areas with the North Carolina Natural Heritage Program as land is acquired and sites are identified.

Water Quality

Objective: Monitor water quality to assist the refuge staff in minimizing the impacts to natural resources on and off the refuge.

Discussion: The refuge staff does not currently monitor water quality. This plan provides for monitoring on the refuge.

Strategies:

Monitor water quality in impoundments, canals, and the Currituck Sound quarterly after a biologist is hired.

Cooperate with other agencies and organizations performing water quality sampling on the refuge.

Wilderness Areas

Objective: There are no candidate or designated wilderness areas on the refuge.

Discussion: There are no areas on the refuge of over 5,000 acres or without roads dissecting the areas. Mechanized travel through the marshes is required to provide fire protection and track down fire lines for prescribed fire.

Wildlife Disease Control and Prevention

Objective: Limit impacts to refuge resources from wildlife disease.

Discussion: The refuge staff casually observes wildlife on the refuge for signs of disease and would cooperate with any organized efforts to monitor and control disease.

Strategies:

Coordinate with local, state, and federal agencies as necessary to monitor and control wildlife disease.

Refuge Administration

Capital Property

Objective: Use increased levels of funding and staff to acquire, operate, maintain, and dispose of capitalized and noncapitalized property.

Discussion: The refuge staff would perform the minimum level of property management required by the Fish and Wildlife Service Manual and acquire the minimum equipment necessary to support refuge programs.

Strategies:

Conduct one capital property inventory and one noncapitalized property inventory annually.

Maintain administrative records on capital and noncapitalized property at Currituck National Wildlife Refuge.

Acquire the minimum equipment necessary to support refuge programs.

Evaluate the operating condition of capital property.

Maintain and upgrade capital and noncapital property to ensure safety of the staff and the general public.

Financial Management

Objective: Manage budget efficiently and provide accountability for funds.

Discussion: Financial management affects every aspect of refuge operations. Funding refuge operations is dependent on effective budgeting and requests for funds under the Refuge Operation Needs System (RONS) and Maintenance Management System (MMS). Proper administration of financial records is necessary to document proper expenditure of funds.

Strategies:

Prepare annual budget.

Maintain the Refuge Operation Needs System (RONS) and Maintenance Management System (MMS).

Administer payroll, travel, purchasing, and contract documents.

Field Office/Equipment Storage Facility

Objective: Operate and maintain the field office, equipment storage facility, and storage barn to ensure efficiency of operation, the safety of the staff and the public, and an aesthetically pleasing appearance.

Discussion: The refuge staff would perform the minimum level of property management required by the Fish and Wildlife Service Manual and construct a field office, equipment storage facility, and storage barn.

Strategies:

Construct a field office/equipment storage facility.

Construct storage barn.

Visitor Contact/Research Station

Objective: Operate and maintain a visitor contact and research station to ensure efficiency of operation, the comfort and safety of the staff and the public, and an aesthetically pleasing appearance.

Discussion: The refuge staff would perform the minimum level of property management required by the Fish and Wildlife Service Manual and construct a visitor contact station to inform the public and a research station to house university researchers, graduate students, and college interns.

Strategies:

Construct a visitor contact and research station.

Operate and maintain the visitor contact and research station in cooperation with the North Carolina National Estuarine Research Reserve and The Nature Conservancy.

Personnel

Objective: Recruit, hire, and manage staff shared with the Mackay Island National Wildlife Refuge at adequate levels (16 employees and 15 full-time equivalent positions).

Discussion: The refuge staff would perform the minimum level of personnel management required by the Fish and Wildlife Service Manual.

Strategies:

Provide staff professional, technical, and leadership development training as allowable under current funding levels.

Encourage staff to utilize up to one detail per year to broaden their experiences as workload allows and opportunities arise.

Evaluate performance continuously; manage performance and conduct in accordance with Service policy.

Recognize employee performance through the employee incentives program.

Real Property

Objective: Use increased levels of funding and staff to maintain buildings, grounds, roads, structures, and public use facilities in a clean and acceptable condition that protects the health and safety of the public and the refuge staff.

Discussion: The refuge staff would perform the minimum level of real property management required by the Fish and Wildlife Service Manual and acquire buildings and structures adequate to meet refuge program needs.

Strategies:

Conduct one real property inventory annually.

Manage all real property according to Service policy.

Acquire adequate buildings and structures to meet refuge program needs.

Pursue resolution of boundary disputes.

Volunteer Coordination

Objective: Support the refuge's biological and maintenance programs with 5,000 hours of service from local and college intern volunteers annually.

Discussion: The refuge uses volunteers from the community and college interns to support its programs. The volunteers assist the staff in all phases of refuge operations, from routine maintenance to outreach to wildlife and habitat inventories. The staff would expand its recruiting of volunteer interns from colleges, and provide housing and a stipend with which to purchase meals. The refuge staff manages volunteers as required by the Fish and Wildlife Service Manual.

Strategies:

Recruit, train, and coordinate volunteers to donate 5,000 hours of service annually.

Expand the college intern program.

Designate a new staff member as part-time volunteer coordinator to support designated refuge programs.

V. Plan Implementation

PROPOSED PROJECTS

To implement this proposed comprehensive conservation plan, the Service will utilize existing staff, facilities, and equipment and acquire additional staff, facilities, and equipment. Tables 17–21 below outline the strategies from Chapter IV and list the existing and new staff, facilities, and equipment required to implement the strategies. Appendix VIII contains details of the new staff, facilities, and equipment as Refuge Operation Needs System (RONS) projects or Maintenance Management System (MMS) projects, and includes the priorities of those projects. The refuge staff will implement the strategies associated with specific projects as the Service funds those projects.

Table 17. Projects supporting Wildlife Strategies

Personnel Projects	
Strategy	Projects
Conduct surveys, monitoring, studies, and investigations.	Utilize existing assistant manager and forestry technician. Recruit, hire, and train new wildlife biologist (RONS 97006) and biological technician (RONS 00013).
Encourage universities, other agencies, and organizations to conduct surveys, monitoring, studies, and investigations.	Utilize existing manager and assistant manager. Recruit, hire, and train new assistant manager (RONS 00011) and wildlife biologist (RONS 97006).
Administer public hunts to manage deer and feral hog population.	Utilize existing manager, assistant manager, and law enforcement officer. Recruit, hire, and train new assistant manager (RONS 00011).
Protect wildlife.	Utilize existing law enforcement officer.
Manage budget, contracts, personnel, and property.	Utilize existing refuge manager, assistant manager, and office assistant. Recruit, hire, and train new assistant manager (RONS 00011) and clerk (RONS 99004).
Apply for flexible fund and other grants.	Utilize existing manager and assistant manager. Recruit, hire, and train new assistant manager (RONS 00011) and wildlife biologist (RONS 97006).
Equipment Projects	
Replace equipment to survey and protect wildlife.	Replace equipment (various MMS projects).

Table 18. Projects supporting Habitat Strategies

Personnel Projects	
Strategy	Projects
Conduct surveys, monitoring, studies, and investigations. Develop annual burn and water management plans.	Utilize existing assistant manager and forestry technician. Recruit, hire, and train new wildlife biologist (RONS 97006) and biological technician (RONS 00013).
Conduct prescribed burning.	Utilize existing assistant manager, forestry technician, engineering equipment operators, and maintenance workers. Recruit, hire, train new assistant manager (RONS 00011), fire management specialist (RONS 00009), and maintenance worker (RONS 00019).
Protect habitat.	Utilize existing law enforcement officer.
Manage budget, contracts, personnel, and property. Manage refuge Operation Needs System (RONS), Maintenance Management System (MMS), Real Property Inventory (RPI), and Service Asset Maintenance management System (SAMMS).	Utilize existing refuge manager, assistant manager, and office assistant. Recruit, hire, and train new assistant manager (RONS 00011) and clerk (RONS 99004).
Apply for flexible fund and other grants.	Utilize existing manager and assistant manager. Recruit, hire, and train new assistant manager (00011) and wildlife biologist (RONS 97006).
Equipment Projects	
Replace equipment to manage habitat.	Replace equipment (various MMS projects).
Facility Projects	
Replace facilities to manage habitat.	Replace water control structures, fences, and pumping stations (various MMS projects).

Table 19. Projects supporting Public Use Strategies

Personnel Projects	
Strategy	Projects
Plan, design and conduct programs and outreach.	Utilize existing assistant manager. Recruit, hire, and train new outdoor recreation planner (RONS 97013).
Maintain education, interpretation, wildlife observation, and photography facilities.	Utilize existing engineering equipment operator and maintenance worker. Recruit, hire, and train new maintenance worker (RONS 00019).
Protect visitors.	Utilize existing manager and law enforcement officer.
Manage budget, contracts, personnel, and property.	Utilize existing refuge manager, assistant manager, and office assistant. Recruit, hire, and train new assistant manager (RONS 00011) and clerk (RONS 99004)
Apply for flexible fund and other grants.	Utilize existing refuge manager and assistant manager. Recruit, hire, and train new assistant manager (RONS 00011).
Equipment Projects	
Replace equipment to maintain facilities as necessary.	Replace equipment (various MMS projects).
Facility Projects	
Replace facilities as necessary.	Replace and rehabilitate trails, kiosks, facilities for observation and photography, field office, visitor contact station, and storage building (various MMS projects).

Table 20. Projects supporting Resource Protection Strategies

Personnel Projects	
Strategy	Projects
Maintain cooperation with agencies, organizations, and permit holders. Review permits and develop conditions for uses allowed by permits. Maintain contact with owners of property within acquisition boundary.	Utilize existing refuge manager and assistant manager. Recruit, hire, train new assistant manager (RONS 00011).
Protect cultural resources.	Utilize existing refuge manager, assistant manager, and law enforcement officer. Recruit, hire, train new assistant manager (RONS 00011).
Protect areas from wildfire; implement prescribed fire plan to manage fuel.	Utilize existing forestry technician. Recruit, hire, and train a fire management specialist (RONS 00009).
Monitor pest animals and plants and permitted uses.	Utilize existing assistant manager. Recruit, hire, and train new wildlife biologist (RONS 97006) and biological technician (RONS 00013).
Maintain equipment and facilities.	Utilize existing engineering equipment operator and maintenance worker. Recruit, hire, and train new maintenance worker (RONS 00019).
Enforce regulations.	Utilize existing law enforcement officer.
Manage budget, contracts, personnel, and property.	Utilize existing refuge manager, assistant manager, and office assistant. Recruit, hire, and train new assistant manager (RONS 00011) and clerk (RONS 99004)
Apply for flexible fund and other grants.	Utilize existing refuge manager and assistant manager. Recruit, hire, and train new assistant manager (RONS 00011).
Equipment Projects	
Replace equipment as necessary.	Replace equipment (various MMS projects).
Facility Projects	
Replace facilities as necessary.	Replace and rehabilitate trails, kiosks, water control structures, pumps, storage building, and field office (various MMS projects).

Table 21. Projects supporting Refuge Administration Strategies

Personnel Projects	
Strategy	Projects
Manage budget, contracts, personnel, and property; process payroll and travel vouchers; maintain RONS AND MMS.	Utilize existing refuge manager, assistant manager, and office assistant. Recruit, hire, and train new assistant manager (RONS 00011) and clerk (RONS 99004).
Maintain equipment and facilities.	Utilize existing engineering equipment operator and maintenance worker. Recruit, hire, and train, new maintenance worker (RONS 00019).
Budget Projects	
Equipment Projects	
Replace equipment as necessary.	Replace equipment (various MMS projects).
Facility Projects	
Replace, rehabilitate, and construct facilities as necessary.	Replace water control structures, pumping stations, kiosks, field office, and storage building (various MMS projects).

REFUGE ADMINISTRATION

Currituck National Wildlife Refuge is administered from an office located on Knotts Island along the North Landing River. The refuge staff administers 4,570 acres of fee title land and 3,931 acres of land with conservation easements on the Currituck National Wildlife Refuge in Currituck County, North Carolina and 8,047 acres of fee title land on the Mackay Island National Wildlife Refuge on Knotts Island, North Carolina, and Virginia Beach, Virginia. The marshes on the western edge of Currituck National Wildlife Refuge are located six miles east of the Mackay Island Refuge headquarters across the Currituck Sound. The western marshes are one-half mile east of the boat ramp on Knotts Island Bay; the upland portion of the Mackay Island National Wildlife Refuge is two miles east of the boat ramp. It is 100 miles and a two-hour drive to the Mackay Island National Wildlife Refuge around the sound by roads (Figure 1).

FUNDING AND PERSONNEL

Currently the Service has no approved staff at the Currituck national Wildlife Refuge. The seven permanent positions at Mackay Island National Wildlife Refuge serve the Currituck National Wildlife Refuge.

To complete the extensive wildlife habitat management and restoration projects and conduct the necessary inventorying, monitoring, and mapping activities, more staff is required. The proposed staffing plan (Table 22) would enable the refuge to achieve its plan objectives and strategies within a reasonable time. The annual cost (including salaries and benefits) would be \$431,900. The rate at which this refuge realizes its full potential to contribute locally, regionally, and nationally to wildlife conservation and appropriate wildlife-dependent recreation and environmental education is totally dependent upon receiving adequate staffing and funding.

Table 22. Proposed staffing plan for Mackay Island and Currituck National Wildlife Refuges

Position	Status	Percent of Time on Currituck
Administrative Staff		
Refuge Manager, GS-0485-13*	PFT	45
Assistant Manager, GS-0485-09*	PFT	35
Assistant Manager, GS-0485-09 (Currituck)**	PFT	95
Park Ranger (Enforcement), GS-0026-09*	PFT	75
Park Ranger (Enforcement), GS-0026-07**	PFT	95
Office Assistant, GS-0303-05*	PFT	15
Clerk, GS-0303-04**	PFT	45
Public Use Staff		
Park Ranger (Public Use), GS-0026-09**	PFT	60
Biological Staff		
Wildlife Biologist, GS-0486-09**	PFT	35
Biological Technician, GS-07**	PFT	90
Biological Technician, GS-07**	PFT	60
Maintenance Staff		
Maintenance Mechanic, WG-4749-10*	PFT	15
Maintenance Worker, WG-4749-08**	PFT	45
Engineering Equipment Operator, WG-5716-08*	PFT	40
Fire Management Staff		
Fire Management Specialist, GS-0401-09 (Fire)**	PFT	40
Forestry Technician, GS-0462-05 (Fire)*	PFT	40
* = Existing Staff, ** = Proposed New Staff		
PFT = permanent full time, TFT = temporary full time, Fire = funded by fire budget		

VOLUNTEERS

The refuge currently has no sustained volunteer program. Because all the staff is headquartered at Mackay Island, there is no perennial Service presence to recruit, train, and manage volunteers. The volunteer program generated on the refuge would depend upon the number of staff positions the Service provides the refuge. As the Service commits staff and resources to the refuge, the refuge would enhance opportunities to expand the volunteer program.

PARTNERSHIP OPPORTUNITIES

A major objective of this comprehensive conservation plan is to establish partnerships with local volunteers, landowners, private organizations, and state and federal natural resource agencies. In the immediate vicinity of the refuge, opportunities exist to establish partnerships with sporting clubs, elementary and secondary schools, and community organizations. At regional and state levels, the refuge will maintain its current partnerships with organizations such as the North Carolina Wildlife Resources Commission, North Carolina Division of Marine Fisheries, North Carolina Division of Coastal Management, The Nature Conservancy, Ducks Unlimited, and National Audubon Society. At the local level, the refuge will maintain its existing partnerships with the Corolla Volunteer Fire Company, Currituck County, the Outer Banks Wildlife Education Center (managed by the North Carolina Wildlife Resources Commission), the Currituck County Wild Horse Advisory Board, and the Corolla Wild Horse Fund. The refuge will establish new partnerships as needs arise and opportunities present themselves

STEP-DOWN MANAGEMENT PLANS

A comprehensive conservation plan is a strategic plan that guides the future direction of the refuge. Before some of the strategies and projects can be implemented, detailed step-down management plans will need to be prepared or updated. To assist in preparing and implementing the step-down plans, the refuge staff will develop partnerships with local agencies and organizations. These plans (Table 23) will be developed in accordance with the National Environmental Policy Act, which requires the identification and evaluation of alternatives and public review and comment prior to their implementation.

Habitat Management Plan (Develop), Draft Completion – 15 years after hiring a wildlife biologist: This plan will describe the overall desired future habitat conditions needed to fulfill the refuge's purposes and objectives. The plan will include three sections dealing with moist soil/water management units, forest and marsh. The plan will provide detailed procedures, techniques, and timetables for achieving the desired future conditions.

Moist Soil/Water Management Plan (Update), Draft Completion - 2006: This plan will describe the strategies and procedures (timing and duration of flooding and disturbance) for manipulating the refuge's water management units to meet habitat management objectives.

Forest Management Plan (Develop), Draft Completion – when funded: This plan will describe strategies for meeting refuge forest management objectives. It will include direction on reforestation, stand improvement, and harvest. Also, scrub/shrub habitat management will be addressed.

Fire Management Plan (Update), Draft Completion 2005: This plan will describe wild and prescribed fire management techniques that will be employed on the refuge. Wildfire control descriptions will include initial attack strategies and cooperative agreements with other agencies.

Integrated Pest Management Plan (Develop and Update), Draft Completion – 5 years after hiring a wildlife biologist: This plan will address the complex issue of bringing exotic and nuisance plants and animals to a maintenance control level on the refuge. It will cover chemical pesticide use (aerial and ground application), mechanical eradication, and biological controls. The Nuisance/Exotic Animal and Plant control plans will be sections of this plan.

Nuisance/Exotic Animal Control Plan (Update), Draft Completion – 5 years after hiring a wildlife biologist: This plan (as part of the Integrated Pest Management Plan) will describe survey, removal or control, and monitoring techniques for both terrestrial and aquatic nuisance and exotic animals (vertebrate and invertebrate). The plan will include feral swine and horse control.

Nuisance/Exotic Plant Control Plan (Develop), Draft Completion – 5 years after hiring a wildlife biologist: This plan (as part of the Integrated Pest Management Plan) will describe survey, removal or control, and monitoring techniques for both terrestrial and aquatic nuisance and exotic plants.

Biological Inventory/Monitoring Plan (Develop), Draft Completion – 5 years after hiring a wildlife biologist: This plan will describe inventory and monitoring techniques and time frames. The plan will include the inventory of all plant communities and associations in the refuge as well as all trust species (migratory birds including songbirds, neotropical passerines, and waterfowl), listed species (federal and state threatened, endangered and species of concern), and key resident species, and monitoring of population trends.

Visitor Services Plan (Develop), Draft Completion – 10 years after hiring a public use specialist: This plan will describe the refuge's wildlife-dependent recreation, environmental education, and interpretation. Specific issues or items that will be addressed include facility requirements, site plans, and handicapped accessibility. The environmental education, fishing, hunting, and sign plans will be sections of this plan.

Environmental Education Plan (Develop), Draft Completion – 10 years after hiring a public use specialist: This plan will reflect the objectives and strategies of the comprehensive conservation plan and address environmental education guidelines following Service standards.

Fishing Plan (Update), Draft Completion 2007: This plan (as part of the Visitor Services Plan) will address specific aspects of the refuge's fishing program. It will define fishing areas, methods, handicapped accessibility, facilities needed, and refuge specific regulations.

Hunting Plan (Update), Draft Completion 2006: This plan (as part of the Visitor Services Plan) will address specific aspects of the refuge's hunting program. It will define species to be hunted, season structures, hunt areas, methods, all-terrain vehicle use, universal accessibility, facilities needed, and refuge-specific hunting regulations.

Trapping Plan (Update), Draft Completion 2009: This plan (as part of the Visitor Services Plan) will address specific aspects of the refuge's hunting program. It will define species to be trapped, season structures, hunt areas, methods, all-terrain vehicle use, facilities needed, and refuge-specific trapping regulations.

Sign Plan (Update), Draft Completion 2008: This plan (as part of the Visitor Services Plan) will describe the refuge's strategy for informing visitors via signage. It will incorporate Service guidelines.

Law Enforcement Plan (Update), Draft Completion 2005: This plan will provide a reference to station policies, procedures, priorities, and programs concerning law enforcement.

MONITORING AND ADAPTIVE MANAGEMENT

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

To apply adaptive management, specific survey, the staff would adopt inventory, and monitoring protocols for the refuge. They would systematically evaluate the habitat management strategies to determine management effects on wildlife populations. The refuge would use this information to refine approaches and determine how effectively the objectives are being accomplished. Evaluations would include ecosystem team and other appropriate partner participation. If monitoring and evaluation indicate undesirable effects for target and non-target species and/or communities, the staff would make alterations to the management projects. Subsequently, the refuge would revise the comprehensive conservation plan.

The staff would describe specific monitoring and evaluation activities in the step-down management plans.

Table 23. Currituck National Wildlife Refuge step-down management plans

Plan	Completion Date
Habitat Management	15 years after hiring a Wildlife Biologist
Marsh Management	2006
Moist Soil/Water Management	2006
Forest Management	When funded
Fire Management Plan	2005
Integrated Pest Management	5 years after hiring a Wildlife Biologist
Nuisance Animal Control	5 years after hiring a Wildlife Biologist
Exotic Plant Control	5 years after hiring a Wildlife Biologist
Wildlife Inventory	5 years after hiring a Wildlife Biologist
Visitor Services	10 years after hiring a Public Use Specialist
Environmental Education	10 years after hiring a Public Use Specialist
Fishing	2007
Hunting	2006
Trapping	2009
Sign	2008
Law Enforcement	2005

SECTION B. DRAFT ENVIRONMENTAL ASSESSMENT

I. Background

PURPOSE AND NEED FOR THE ENVIRONMENTAL ASSESSMENT

The environmental assessment for the plan presents and evaluates a range of reasonable management alternatives for Currituck National Wildlife Refuge. The staff developed each alternative with the potential to be fully developed into a final comprehensive conservation plan. The environmental assessment also predicts and evaluates the biological, physical, and socioeconomic effects of implementing each alternative. From this range of alternatives, the Fish and Wildlife Service then identifies the proposed management action.

In accordance with the guidelines of the National Environmental Policy Act, the Service identified a number of issues, concerns, and needs through discussions with the public, agency managers, and professionals. From these issues and concerns the Service's planning team identified a range of three alternatives, evaluated the possible consequences of implementing each, and selected Alternative 2 as the proposed management action. In the opinion of the Service and the planning team, Alternative 2 is the best approach to guide the refuge's future management direction.

There is no current plan that identifies priorities and ensures consistent and integrated management for the refuge, thus necessitating the need for this environmental assessment. The National Wildlife Refuge System Improvement Act of 1997 requires that all national wildlife refuges have a comprehensive conservation plan in place within 15 years to help fulfill the mission of the System.

DECISION FRAMEWORK

Based on this draft environmental assessment, the Fish and Wildlife Service will select an alternative to implement the final Comprehensive Conservation Plan for Currituck National Wildlife Refuge. The Service will prepare a Finding of No Significant Impact (FONSI) if the selected alternative will not have a significant impact on the quality of the human environment. The Service will prepare an Environmental Impact Statement (EIS) if the selected alternative will have a significant impact on the quality of the human environment. The refuge staff will base this determination on an evaluation of the purposes for which the Service established the refuge, the mission of the Service and the National Wildlife Refuge System, and other legal mandates. Assuming that no significant impacts are found, implementation of the plan will begin, and the staff will monitor the impacts of the plan on an annual basis and revise it when necessary.

PLANNING STUDY AREA

Currituck National Wildlife Refuge is in northeastern North Carolina on a coastal barrier island known as the Outer Banks just west of the Atlantic Ocean, east of the Currituck Sound, south of Virginia Beach, Virginia, and north of Dare County, North Carolina. The city of Virginia Beach, Virginia, is the nearest major city and is immediately north of the refuge's northern boundary.

The planning study area for this environmental assessment includes lands outside the existing refuge boundary that are being studied for inclusion in the National Wildlife Refuge System and/or partnership planning efforts. The Service presently owns 4,570 acres and has conservation easements on 3,931 acres of the 18,015 acres identified as lying within the refuge's approved acquisition boundary. The Service seeks to acquire, from willing sellers, the remaining acres. This plan and environmental assessment will identify management on existing refuge lands.

AUTHORITY, LEGAL COMPLIANCE, AND COMPATIBILITY

The Service developed this plan in compliance with the National Wildlife Refuge System Improvement Act of 1997 and Part 602 (National Wildlife Refuge System Planning) of the Fish and Wildlife Service manual. The actions described within this plan also meet the requirements of the National Environmental Policy Act of 1969. The refuge staff achieved compliance with this Act through the involvement of the public and the incorporation of an environmental assessment in this document, with a description of the alternatives considered and an analysis of the environmental consequences of the alternatives (Chapters III and IV in this section). When fully implemented, the plan will strive to achieve the vision and purposes of Currituck National Wildlife Refuge.

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

COMPATIBILITY

The National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997, states that national wildlife refuges must be protected from incompatible or harmful human activities to ensure that Americans can enjoy Refuge System lands and waters. Before activities or uses are allowed on a national wildlife refuge, the uses must be found to be compatible. A compatible use "...will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge." In addition, "wildlife-dependent recreational uses may be authorized on a refuge when they are compatible and not inconsistent with public safety."

An interim compatibility determination is a document that assesses the compatibility of an activity during the period of time the Service first acquires a parcel of land to the time a formal, long-term management plan for that parcel is prepared and adopted. The Service has completed an interim compatibility determination for the six priority general public uses of the system, as listed in the National Wildlife Refuge System Improvement Act of 1997. These uses are hunting, fishing, wildlife observation, wildlife photography, environmental education and interpretation.

PLANNING PROCESS AND PUBLIC INVOLVEMENT

The Service formed a planning core team composed of representatives from its various divisions to prepare the Draft Comprehensive Conservation Plan and Environmental Assessment. Initially, the team focused on identifying the issues and concerns pertinent to refuge management. The team met on several occasions from January 2001 to October 2002. In addition, a biological review team met on the refuges in the ecosystem four times between December 1999 and December 2000 to assess the habitats on the refuges and the needs of wildlife species in the ecosystem, and make recommendations on land management and acquisition needs. The core team also sought the

contributions of experts from various fields. The members of the planning core team, the biological review team, and expert contributors are identified in Chapter V, Consultation and Coordination, of this section.

Service and state wildlife agency personnel attended the initial planning meetings. At these initial meetings, they discussed strategies for developing the refuge's comprehensive conservation plan; identified the refuge staff's issues and concerns; and compiled a mailing list of likely interested government agencies, nongovernmental organizations, businesses, and individual citizens.

The Service invited agencies, organizations, businesses, and citizens to participate in four public scoping meetings on June 19, 21, 26, and 28, 2001, in Currituck, North Carolina; Corolla, North Carolina; Virginia Beach, Virginia; and Knotts Island, North Carolina, respectively. A total of 61 citizens attended these public meetings. At each meeting, the audiences were introduced to the refuge and its planning process, and asked to identify their issues and concerns. Prior to the meetings, the Service published announcements giving the locations, dates, and times for the public meetings in the *Federal Register* and legal notices in local newspapers. The Service also sent press releases to local newspapers and public service announcements to television and radio stations. Fifty posters announcing the meetings were placed in local post offices, local government buildings, and stores.

The planning team expanded the issues and concerns to include those generated by other government agencies, organizations, businesses, and citizens from the local community. These issues and concerns formed the basis for the development and comparison of objectives in the different alternatives described in the Draft Environmental Assessment (Section B).

After the team developed the alternatives, the refuge manager and the planning staff met with the North Carolina Wildlife Resources Commission in October 2002.

The objectives were subjects of discussion at a second round of public meetings held on November 18, 19, 20, and 21, 2002, in Corolla, Currituck, and Knotts Island, North Carolina, and Virginia Beach, Virginia. Again, the Service published legal notices and press releases giving the locations, dates, and times for the public meetings, and sent public service announcements to television and radio stations. Seventy-five posters announcing the meetings were also placed in local post offices, local government buildings, and stores. Thirty citizens attended these four meetings.

PLAN REVIEW AND REVISION

This comprehensive conservation plan will be reviewed annually to determine the need for revision. A revision would occur if and when substantial information becomes available, such as a change in ecological conditions or a major refuge expansion. The final plan would be augmented by detailed step-down management plans and annual plans to address the completion of specific strategies in support of the refuge's goals and objectives. Substantial revisions to the comprehensive conservation plan and the step-down management plans would be subject to public review and comment in compliance with the National Environmental Policy Act.

ISSUES AND CONCERNS

A wide range of issues and concerns were generated from the input of local citizens and public agencies, the team members' knowledge of the area, and the resource needs identified by the refuge staff and biological review team. A complete summary of these issues and concerns is provided in Chapter III, Plan Development, of the Comprehensive Conservation Plan (Section A).

II. Affected Environment

For a description of the affected environment, please refer to Chapter II, Refuge Overview, in the Draft Comprehensive Conservation Plan (Section A).

III. Description of Alternatives

FORMULATION OF ALTERNATIVES

Alternatives are different approaches or combinations of management objectives and strategies designed to achieve the refuge purpose, vision, and the goals identified in the comprehensive conservation plan; the priorities and goals of the Roanoke–Tar–Neuse–Cape Fear Ecosystem Team; the goals of the National Wildlife Refuge System; and the mission on the Fish and Wildlife Service. Alternatives are formulated to address the significant issues, concerns, and problems identified by the Service and the public during public scoping.

The three alternatives identified and evaluated represent different approaches to provide permanent protection, restoration and management of the refuge's fish, wildlife, plants, habitats, and other resources. A major consideration in the formulation of the alternatives is the ability to obtain sufficient proprietary interest in lands to facilitate a physical and biological connection of dunes, maritime grasslands, maritime shrublands, and marshes; and to restore the functions and values of wetlands.

The refuge staff assessed the biological conditions and analyzed the external relationships affecting the refuge. This information contributed to the development of goals and objectives and, in turn, helped to formulate the alternatives. As a result, each alternative presents different sets of objectives for reaching refuge goals. The staff evaluated each alternative based on how much progress it would make and how it would address the identified issues related to fish and wildlife populations, habitats, land protection and conservation, education and visitor services, and refuge administration.

The staff designed all of the management alternatives for the area within the current approved acquisition boundary of 18,015 acres. Acquisition of a larger area beyond the existing boundary will require a revision of the comprehensive conservation plan to develop programs that consider the larger area.

ALTERNATIVES

Serving as a basis for each alternative, goals and sets of objectives were developed by managers to achieve the refuge's purpose and the mission of the National Wildlife Refuge System. Objectives are desired conditions or outcomes that are grouped into sets and for this planning effort, consolidated into three alternatives. These alternatives, overall, represent a range of different management treatments or approaches for managing the refuge over a 15-year time frame. The three alternatives are summarized below and in Tables 24 to 34.

ALTERNATIVE 1 – NO ACTION

This alternative represents the status quo, i.e., no change from current management of the refuge. Under this alternative, the Service would protect, maintain, restore, and enhance 4,570 acres of refuge lands for resident wildlife, waterfowl, migratory nongame birds, and threatened and endangered species. The staff would develop and implement refuge management programs with little baseline biological information. The refuge would direct all management actions towards achieving its primary purposes (preserving migratory habitat for waterfowl; providing production habitat for marsh birds and shorebirds; and helping to meet the habitat conservation goals of the North American Waterfowl Management Plan), while contributing to other national, regional, and state goals to protect and restore neotropical breeding bird, colonial nesting bird, and anadromous fish populations.

The staff would respond to sea turtle and marine mammal strandings. The Service would cooperate with the Wild Horse Management Plan and note the activity of feral hogs. The staff would implement active habitat management through water management in the managed wetlands (moist soil units) to provide 50% good vegetation for waterfowl. It would conduct prescribed burning in marshes.

The refuge would maintain the current level of wildlife-dependent recreation activities (hunting, fishing, and wildlife observation and photography, and interpretation and environmental education opportunities). It would make no improvements to improve access to the refuge. There would be no wildlife observation platforms and the interpretive kiosks. The Service would continue quality waterfowl hunting programs for 480 visitors consistent with sound biological principles. The staff would conduct environmental education, interpretative and outreach programs as the public requested them and staff is available. The refuge would attract 100 visitors for interpretation, 25,000 for wildlife observation, and 250 for wildlife photography. The staff would not promote the programs.

The Service would protect sites with identified cultural resources and evaluate proposed projects for cultural resources. Law enforcement officers would enforce refuge regulations. The staff would control pest animals and plants as they find them.

Under this alternative, the refuge would continue to seek acquisition of suitable willing seller properties within the present approved acquisition boundary. The Service would make lands acquired as part of the refuge available for compatible public wildlife-dependent recreation and environmental education opportunities. Purchases from willing sellers would be an option to expand conservation efforts in the acquisition area. Other important options include outreach and partnerships with adjacent landowners, hunt clubs, state agencies, nongovernmental organizations, and the Natural Resources Conservation Service through conservation easements, cooperative agreements, and federal programs such as the Wetlands Reserve Program. These land conservation options would promote the linkage of protected marshes and contribute to overall natural resource conservation within the acquisition area.

The refuge would not have any permanent buildings or assigned staff and would be managed by the staff of seven located at the Mackay Island National Wildlife Refuge. The staff spends 2.65 full-time equivalent staff years on the refuge. Employees would receive training as funding permits.

ALTERNATIVE 2 (PREFERRED ALTERNATIVE)

This is the Service's preferred alternative. Under this alternative, the refuge would implement a program to develop a habitat management plan and inventory neotropical migratory songbirds and shorebirds, and increase the public use program to provide all six priority public uses (hunting, fishing, environmental education, interpretation, wildlife observation, and wildlife photography). This alternative would also add the staff, equipment, and facilities to support the programs. It would enable the Service to protect, maintain, restore, and enhance 4,570 acres of refuge lands for resident wildlife, waterfowl, shorebirds, wading birds, migratory nongame birds, and threatened and endangered species. The staff would initiate limited wildlife and plant censuses and inventory activities to obtain the biological information needed to implement management programs on the refuge. The refuge would direct all management actions towards achieving the refuge's primary purposes (preserving migratory habitat for waterfowl; providing production habitat for marsh birds and shorebirds; and helping to meet the habitat conservation goals of the North American Waterfowl Management Plan), while contributing to other national, regional, and state goals to protect and restore habitat for neotropical breeding bird, colonial nesting bird, and anadromous fish populations.

The staff would monitor waterfowl with aerial surveys. They would assist with abomasal parasite counts of deer, monitor the deer population, and document the presence of other mammals. They would also assist with piping plover surveys and conduct shorebird surveys every ten days. Biologists would respond to sea turtle and marine mammal strandings and document the presence of reptiles and amphibians from incidental sightings. The Service would cooperate with the Wild Horse Management Plan, monitor the impacts of feral horses, and exclude horses from selected habitats if necessary. The refuge would note the activity of feral hogs, monitor their impacts, and evaluate and implement control methods. The staff would improve active habitat management of the managed wetlands (moist soil units) to provide 60% good vegetation for waterfowl and 20% mudflats in the spring for shorebirds. It would conduct prescribed burning in marshes and monitor the vegetative response to the burning.

The refuge would increase opportunities for wildlife-dependent recreation activities (hunting, fishing, and wildlife observation and interpretation) and environmental education opportunities. It would provide wildlife observation platforms, interpretive kiosks, and trails. The Service would continue quality waterfowl hunting programs for 480 visitors and conduct hunts for deer and feral hogs consistent with sound biological principles. The staff would conduct environmental education programs for 200 visitors and plan interpretative and outreach programs on a regular basis that would be promoted extensively. Tours would be scheduled, a visitor contact station and kiosks would be built and maintained, and printed interpretative materials developed. The refuge would attract 2,000 visitors for interpretation, 35,000 for wildlife observation, and 350 for wildlife photography. The refuge would seek partnership opportunities with the North Carolina Wildlife Resources Commission at its wildlife education center and the National Estuarine Research Reserve to provide programs available to the visiting public.

The Service would protect sites with identified cultural resources and evaluate proposed projects for cultural resources. Law enforcement officers would enforce refuge regulations and practice outreach to inform the public of regulations. The staff would develop plans to monitor and control pest animals and plants, monitor the pests, and control them when they exceed thresholds established in the plans.

Under this alternative, the refuge would continue to seek acquisition of suitable willing seller properties within the present acquisition boundary (Figure 6). Lands acquired as part of the refuge would be made available for compatible public wildlife-dependent recreation and environmental education opportunities. Purchases from willing sellers would be an option to expand conservation efforts in the acquisition area. Other important options include outreach and partnerships with adjacent landowners, hunt clubs, state agencies, nongovernmental organizations, and the Natural Resources Conservation Service through conservation easements, cooperative agreements, and federal programs such as the Wetlands Reserve Program. These land conservation options would promote the linkage of protected marshes and contribute to overall natural resource conservation within the acquisition area.

The refuge would build a field office/equipment storage facility and a visitor contact station/research center. It would have a staff of four assigned to the refuge and share the staff and other resources with the Mackay Island National Wildlife Refuge. Employees would receive training according to Service policy.

ALTERNATIVE 3

This alternative would develop and implement a program to manage the refuge's habitat in support of migratory birds and other wildlife, and increase the public use program to provide all six priority public uses (hunting, fishing, environmental education, interpretation, wildlife observation, and wildlife photography) with more emphasis on education, interpretation, and wildlife observation. This alternative would also add the staff, equipment, and facilities to support the programs. Under this alternative, the Service would protect, maintain, restore, and enhance 4,570 acres of refuge lands for resident wildlife, waterfowl, migratory nongame birds, and threatened and endangered species.

The staff would initiate extensive wildlife and plant censuses and inventory activities would be initiated to obtain the biological information needed to implement management programs on the refuge. This alternative would add surveys of invertebrates in moist soil units, waterfowl surveys from the ground, and reptile and amphibian inventories. The refuge would direct all management actions towards achieving the refuge's primary purposes (preserving migratory habitat for waterfowl and shorebirds; migratory and breeding habitat for neotropical migratory songbirds; providing production habitat for marsh birds and shorebirds; and helping to meet the habitat conservation goals of the North American Waterfowl Management Plan), while contributing to other national, regional, and state goals to protect and restore shorebird, neotropical breeding bird, colonial nesting bird, and anadromous fish populations.

The staff would monitor waterfowl with aerial and ground surveys and conduct banding. They would assist with abomasal parasite counts of deer, monitor and manage the deer population, document the presence of mammals, and monitor foxes and raccoons. They would also assist with piping plover surveys, conduct shorebird surveys every ten days, and perform productivity surveys. Biologists would respond to sea turtle strandings and develop and implement a sea turtle management plan. They would also respond to marine mammal strandings and document the presence of reptiles and amphibians from incidental sightings. The Service would cooperate with the Wild Horse Management Plan, monitor the impacts of feral horses, and exclude horses from selected habitats being impacted. The refuge would note the activity of feral hogs, monitor their impacts, and evaluate and implement control methods.

The staff would improve active habitat management of the managed wetlands (moist soil units) to provide 70% good vegetation for waterfowl and 20% mudflats in the spring and 10% mudflats in the fall for shorebirds. It would conduct prescribed burning in marshes and monitor the vegetative response to the burning. The staff would adapt prescribed burning plan to the results of the monitoring. They would also inventory vegetation in the maritime forest and develop a habitat management plan based on the inventory.

The refuge would increase opportunities for wildlife-dependent recreation activities (hunting, fishing, and wildlife observation and interpretation) and environmental education opportunities. It would provide wildlife observation platforms, interpretive kiosks, and trails. The Service would continue quality waterfowl hunting programs for 480 visitors and conduct hunts for deer and feral hogs for visitors consistent with sound biological principles. The staff would plan and conduct environmental education programs for 800 visitors, and plan more interpretative and outreach programs than in Alternative 2 on a regular basis and promote them more extensively than they would be in Alternative 2. They would schedule more tours than in Alternative 2, build and maintain a visitor contact station and kiosks, and develop printed interpretative materials. The refuge would attract 3,000 visitors for interpretation, 50,000 for wildlife observation, and 500 for wildlife photography.

The Service would protect sites with identified cultural resources, evaluate proposed projects for cultural resources, and conduct a comprehensive inventory. Law enforcement officers would enforce refuge regulations and practice outreach to inform the public of regulations. The staff would develop plans to monitor and control pest animals and plants, monitor the pests, and control them when they exceed thresholds established in the plans.

Under this alternative, the refuge would continue to seek acquisition of suitable willing seller properties within the present acquisition boundary (Figure 6). Lands acquired as part of the refuge would be made available for compatible public wildlife-dependent recreation and environmental education opportunities. Purchases from willing sellers would be an option to expand conservation efforts in the acquisition area. Other important options include outreach and partnerships with adjacent landowners, hunt clubs, state agencies, and nongovernmental organizations, and the Natural Resources Conservation Service through conservation easements, cooperative agreements, and federal programs such as the Wetlands Reserve Program. These land conservation options would promote the linkage of protected marshes and contribute to overall natural resource conservation within the acquisition area.

The refuge would build a field office/equipment storage facility and a visitor contact station/research center. It would share a staff of 21 with the Mackay Island National Wildlife Refuge. Employees would receive training according to Service policy.

Tables 24–34 summarize and compare the three management alternatives.

Table 24. Summary of Wildlife Objectives and Strategies

Wildlife	Activity	Alternative 1	Alternative 2	Alternative 3
Fish	Manage Refuge for Water Quality	Yes	Yes	Yes
	Cooperative Studies	Yes	Yes	Yes
	Perform Baseline Survey	No	Yes	Yes
Feral Hogs	Cooperative Studies	Yes	Yes	Yes
	Note Activity	Yes	Yes	Yes
	Monitor Impacts of Hogs on Habitat	No	Yes	Yes
	Investigate Hog Control Methods	No	Yes	Yes
	Implement Hog Control Methods	No	Yes	Yes
	Evaluate Effectiveness of Hog Control Methods	No	Yes	Yes
Feral Horses	Cooperate to Implement Wild Horse Management Plan	Yes	Yes	Yes
	Monitor Impacts of Horses on Habitat	No	Yes	Yes
	Exclude Horses from Selected Habitats	No	Yes	Yes
Invertebrates	Cooperative Studies	Yes	Yes	Yes
	Document Presence or Absence	No	Yes	Yes
	Document Density in Moist Soil Unit	No	No	Yes
	Analyze Results of Studies	No	No	Yes
Land Birds	Number of Species	190	190	190
	Cooperative Studies	Yes	Yes	Yes
	Assist with Banding	No	Yes	Yes
	Monitor Bald Eagle Nesting	No	Yes	Yes
	Establish Inventory Protocol	No	Yes	Yes
	Develop and Implement Inventory Plan	No	Yes	Yes
	Identify Priority Species	No	No	Yes
	Correlate Birds to Habitat	No	No	Yes

Table 24. Summary of Wildlife Objectives and Strategies (continued)

Wildlife	Activity	Alternative 1	Alternative 2	Alternative 3
Mammals	Cooperative Studies	Yes	Yes	Yes
	Conduct APC Counts	Yes	Yes	Yes
	Respond to Marine Mammal Strandings	Yes	Yes	Yes
	Monitor and Manage Deer Population	No	Yes	Yes
	Document Presence or Absence	No	Yes	Yes
	Monitor Fox and Raccoon.	No	No	Yes
Reptiles and Amphibians	Cooperative Studies	Yes	Yes	Yes
	Respond to Sea Turtle Nests and Strandings	Yes	Yes	Yes
	Document Presence or Absence	No	From Incidental Sightings	From Intensive Surveys
	Develop and Implement Sea Turtle Management Plan	No	No	Yes
	Analyze Results of Studies	No	No	Yes
Shorebirds	Cooperative Studies	Yes	Yes	Yes
	Assist with Piping Plover Surveys	Yes	Yes	Yes
	Assist with Banding, Studies, Investigations as Requested	No	Yes	Yes
	Conduct Surveys Every 10 Days	None	Seasonal	Regular
	Conduct Productivity Surveys	No	No	Yes
Wading Birds	Assist with Surveys as Requested	Yes	Yes	Yes
	Cooperative Studies	Yes	Yes	Yes
	Monitor Rookery on Monkey Island	Yes	Yes	Yes
	Stabilize Shoreline of Monkey Island	No	Yes	Yes

Table 24. Summary of Wildlife Objectives and Strategies (continued)

Wildlife	Activity	Alternative 1	Alternative 2	Alternative 3
Wading Birds	Observe Productivity of Rookeries	No	No	Yes
Waterfowl	Cooperative Studies	Yes	Yes	Yes
	Conduct 10 Bi-Weekly Aerial Surveys	As Funding Allows	Yes	Yes
	Conduct 10 Bi-Weekly Ground Surveys	No	No	Yes
	Conduct/Assist with Banding	No	Yes	Yes
	Check Wood Duck Boxes	30	60	60
	Assist with Studies as Requested	No	Yes	Yes

Table 25. Summary of Habitat Objectives and Strategies

Habitat	Activity	Alternative 1	Alternative 2	Alternative 3
All Habitats	Implement Water Management Plan	Yes	Yes	Yes
	Develop Annual Water Management Plan	Yes	Yes	Yes
	Revise Fire Management Plan	Yes	Yes	Yes
	Develop Habitat Management Plan	Yes	Yes	Yes
	Implement Habitat Management Plan	No	Yes	Yes
Brackish Marsh/Wet Meadow	Acres	2,202	2,202	2,202
	Manage Wildfire	Yes	Yes	Yes
	Prescribed Burning	Yes	Yes	Yes
	Monitor Vegetation for Fire Effects	No	Yes	Yes
	Adapt Habitat Management Plan to the Results of Monitoring	No	Yes	Yes
Maritime Forest	Acres	637	637	637
	Manage Wildfire	Yes	Yes	Yes
	Inventory Vegetation	No	No	Yes
	Develop and Implement Habitat Management Plan	Yes	Yes	Yes

Table 25. Summary of Habitat Objectives and Strategies (continued)

Habitat	Activity	Alternative 1	Alternative 2	Alternative 3
Dune and Beach	Acreage of Beach	202	202	202
	Acreage of Dune	137	137	137
	Allow Natural Processes	Yes	Yes	Yes
	Seabeach Amaranth Surveys	Sporadic	Regular	Regular
	Search for Piping Plover Habitat	No	Yes	Yes
	Establish Seabeach Amaranth	No	No	Yes
	Create Piping Plover Habitat	No	No	Yes
Firebreaks	Acreage	1	5	10
Moist Soil Unit	Acreage	143	143	143
	Good Vegetation Goal	50%	60%	70%
	Spring Mudflat Goal	None	20%	20%
	Fall Mudflat Goal	None	None	10%
	Evaluate Invertebrates	No	No	Yes
Roads	Acreage (Miles) Maintained	5 (3)	5 (3)	5 (3)
Wood Duck Boxes	Number of Boxes Maintained	30	60	60
	New Boxes Erected Beyond 60	No	As Use Reaches 60%	As Use Reaches 60%

Table 26. Summary of Public Use Objectives and Strategies

Topic	Activity	Alternative 1	Alternative 2	Alternative 3
Hunting	Annual Waterfowl Hunter Use Days	480	480	600
	Waterfowl Blinds	9	9	10
	Youth Waterfowl Hunt	Yes	Yes	Yes
	Revise Hunt Brochure	Yes	Yes	Yes
	Revise Hunt Plan	Yes	Yes	Yes
	Hunt Plan for Deer and Feral Hogs	No	Yes	Yes
	Estimated Annual Deer and Feral Hog Hunter Use Days	None	300	500
Environmental Education	Annual Visitors	100	200	800
	Annual Programs	2 on Request	2 Planned, 4 on Request	4 Planned 6 on Request
	Coordinate with Outer Banks Education Center	No	Yes	Yes
	Develop Programs for the Outer Banks Education Center	No	No	Yes
Interpretation	Annual Visitors	100	2,000	3,000
	Develop and Revise Refuge Brochure	No	Yes	Yes
	Develop and Revise Bird List	No	Yes	Yes
	Develop Exhibits for Education Center	No	Yes	Yes
	Develop State Marker Trail	Yes	Yes	Yes
	Maintain Web Site	Yes	Yes	Yes
	Kiosk Maintenance	0	1	3
	New Kiosk Development	0	1	3
	Develop Kiosk Interpretive Panels	No	Yes	Yes
	Annual Tours	0	2	6
Swan Island Unit Trail	No	No	Yes	
Develop Endangered Species Brochure	No	No	Yes	

Table 26. Summary of Public Use Objectives and Strategies (continued)

Topic	Activity	Alternative 1	Alternative 2	Alternative 3
Wildlife Observation	Annual Visitors	25,000	35,000	50,000
	Develop a Sea to Sound Trail	No	No	Yes
	Develop, Revise Bird List	No	Yes	Yes
	Develop and Maintain State Marker Trail	No	Yes	Yes
	Develop and Maintain Swan Island Unit Trail	No	No	Yes
Wildlife Photography	Annual Visitors	250	350	500
	Develop a Sea to Sound Trail	No	No	Yes
	Develop and Revise Bird List	No	Yes	Yes
	Develop and Maintain Swan Island Unit Trail	Yes	Yes	Yes
	Develop and Maintain State Marker Trail	No	Yes	Yes
Access	Regular Pedestrian	Daylight Hours	Daylight Hours	Daylight Hours
	Vehicular Access to State Marker Trail	None	Yes	Yes
	Vehicular Access to the Rest of the Refuge	None	None	None
Outreach	Target Audience	90,000	250,000	500,000
	Annual Local Events	4	5	8
	Annual Presentations to Local Organizations	0	3	6
	Annual News Releases	0	3	5
	Publish Newsletter	None	None	Annually
	Publicize on Local Access Cable	No	Yes	Yes
	Participate in State Fair	No	Yes	Yes
Refuge Support	Work with Established Groups	Yes	Yes	Yes
	Develop Currituck Chapter of CWRS	No	Yes	Yes
	Maintain Retail Outlet at Currituck NWR	No	No	Yes
Special Events	Number	0	1	2

Table 27. Summary of Resource Protection Objectives and Strategies

Topic	Activity	Alternative 1	Alternative 2	Alternative 3	
Cultural Resources	Protect Identified Sites	Yes	Yes	Yes	
	Evaluate Proposed Projects	Yes	Yes	Yes	
	Conduct Comprehensive Inventory	No	No	Yes	
	Interpret Monkey Island Hunt Club at Visitor Contact Station	No	Yes	Yes	
Interagency Coordination	Annual Formal and Informal Coordination Meetings	20	30	40	
	Review and Revise Agreements	Yes	Yes	Yes	
	Coordinate with NC Forest Service	Yes	Yes	Yes	
	Develop Agreement on Navigable Waters	Yes	Yes	Yes	
	Develop Agreement on Waterfowl Rest Areas	No	Yes	Yes	
	Land Protection	Acreage – Fee and Easement	8,570	8,570	8,570
		Post Boundary	Yes	Yes	Yes
Inventory Habitat		No	Yes	Yes	
Manage Area		No	No	Yes	
Law Enforcement	Ensure Health and Safety by:	Enforce Regulations	Enforce Regulations and Outreach	Enforce Regulations and Outreach	
	Coordinate with Others	Yes	Yes	Yes	
	Develop Relationships	Yes	Yes	Yes	
	Develop Written Agreements	No	Yes	Yes	
Permits	Evaluation Capacity	4	8	20	
	Develop and monitor Special Use Conditions	Yes	Yes	Yes	
	Develop Standardized Conditions	No	Yes	Yes	
	Assess Effects of Uses	No	Yes	Yes	

Table 27. Summary of Resource Protection Objectives and Strategies (continued)

Topic	Activity	Alternative 1	Alternative 2	Alternative 3
Pest Animals	Control Pests	Yes	Yes	Yes
	Implement Wild Horse Management Plan	Yes	Yes	Yes
	Develop Nuisance Animal Control Plan	No	Yes	Yes
Pest Plants	Monitor, Control, Eradicate	Yes	Yes	Yes
	Control Phragmites	As Funding Allows	Per Plan	Per Plan
	Develop Pest Plant Control Plan	No	Yes	Yes
State Natural Heritage Areas	Limit Impacts to Retain Character	Yes	Yes	Yes
	Prescribed Fire	Yes	Yes	Yes
Water Quality	Frequency of Monitoring in Impoundments, Canals, Sound	None	Quarterly	Monthly
	Cooperate with Other Agencies	Yes	Yes	Yes
Wilderness Areas	Acres Nominated	0	0	0
Wildlife Disease	Monitor and Control	Yes	Yes	Yes
	Coordinate with Others	Yes	Yes	Yes

Table 28. Summary of Administration Objectives and Strategies

Topic	Activity	Alternative 1	Alternative 2	Alternative 3
Capital Property	Annual Inventories	1	1	1
	Maintain Records	As Time Allows	Adequately	Adequately
	Evaluate Condition	No	Yes	Yes
	Maintenance/ Replacement Goal	As Breaks Down	Ensure Safety	Ensure Safety and Maximize Efficiency
Field Office/ Equipment Storage Facility	Operation and Maintenance Goal	Efficiency, Safety, Aesthetics	Efficiency, Safety, Aesthetics	Efficiency, Safety, Aesthetics
	Field Office/ Equipment Storage Facility Construction	No	As Funding Allows	As Funding Allows
Visitor Contact Station/ Research Center	Operation and Maintenance Goal	Efficiency, Safety, Aesthetics	Efficiency, Safety, Aesthetics	Efficiency, Safety, Aesthetics
	Visitor Contact Station/ Research Center Construction	No	As Funding Allows	As Funding Allows
Personnel	Staff Located at Currituck NWR	0	4	7
	Staff at Currituck and Mackay Island NWR	7	15	24
	FTE Levels Serving Currituck NWR	2.65	7.20	12.75
	Training	As Funding Allows	Per Service Policy	Per Service Policy
	Performance Evaluation	Yes	Yes	Yes
	Encourage Details for Training	Yes	Yes	Yes

Table 28. Summary of Administration Objectives and Strategies (continued)

Topic	Activity	Alternative 1	Alternative 2	Alternative 3
Real Property	Maintenance Goals	As Funding Allows	Cleanliness and Safety	Cleanliness and Safety
	Building Construction	None	To Adequate Levels	To Meet All Needs
	Annual Real Property Inventory	1	1	1
	Real Property Management	Per Manual	Per Manual	Per Manual
	Pursue Resolution of Boundary Disputes	Yes	Yes	Yes
Volunteer Coordination	Annual Target Hours	2,000	5,000	10,000
	Coordination	Collateral Duty	Designated Staff Member	Designated Staff Member
	Intern Program	Maintain	Expand	Expand

Table 29. Summary of projects proposed in each Alternative

Project Description	Alternatives		
	1	2	3
Staff Projects			
Utilize existing GS-12/13 manager (45% Currituck).	X	X	X
Utilize existing GS-9 assistant manager (35% Currituck).	X	X	X
Utilize existing GS-9 park ranger (law enforcement)(75% Currituck).	X	X	X
Utilize existing GS-7 office assistant (15% Currituck).	X	X	X
Utilize existing WG-10 maintenance mechanic (15% Currituck).	X	X	X
Utilize existing WG-8 equipment operator (40% Currituck).	X	X	X
Utilize existing WG-5 forestry technician (40% Currituck).	X	X	X
Recruit, hire train a new GS-9 biologist (RONS 97006) (35% Currituck).		X	X
Recruit, hire, train a new GS-9 outdoor recreation planner (Currituck)(RONS 97013)(60% Currituck).		X	X
Recruit, hire, train a new GS-4 clerk (RONS 99004) (45% Currituck).		X	X
Recruit, hire, train a new GS-7 biological technician (Currituck)(RONS 00001)(90% Currituck).		X	X
Recruit, hire, train a new WG-8 maintenance worker (RONS 00019)(45% Currituck).		X	X
Recruit, hire, train a new GS-9 fire management specialist (RONS 00009)(40% Currituck).		X	X
Recruit, hire, train a new GS-9 assistant manager (Currituck) (RONS 00011)(95% Currituck).		X	X
Recruit, hire, train a second new GS-7 biological technician (RONS 00013)(60% Currituck).		X	X
Recruit, hire, train a new GS-7 park ranger (law enforcement) (Currituck)(RONS 03000)(95% Currituck).		X	X
Recruit, hire, train a new WG-7 tractor operator (RONS 97004)(35% Currituck).			X
Recruit, hire, train a new GS-7 outdoor recreation planner (Mackay Island) (RONS 00018)(60% Currituck).			X
Recruit, hire, train a new GS-5 forestry technician (temporary) (35% Currituck).			X
Recruit, hire, train a new GS-4 clerk (half time) (RONS 02001) (45% Currituck).			X
Recruit, hire, train a new WG-8 maintenance worker (Currituck) (100% Currituck).			X
Recruit, hire, train a new GS-7 outdoor recreation planner (Currituck) (volunteer coordinator) (100% Currituck).			X
Recruit, hire, train a new GS-7 wildlife biologist (100% Currituck).			X

Table 29. Summary of projects proposed in each Alternative (continued)

Project Description	Alternatives		
	1	2	3
Budget Projects			
Process payroll, travel, purchasing, and contract documents.	X	X	X
Prepare annual budget and revise RONS and MMS.	X	X	X
Apply for grants.	X	X	X
Budget Projects (Currituck NWR)			
Conduct fisheries survey (RONS 00012)		X	X
Conduct research on the impact of feral horses. (RONS 00016)		X	X
Plan and implement big game program (RONS 04002)		X	X
Research history of Corolla Navy Gunnery Site (RONS 00017)			X
Equipment Projects (in Mackay Island NWR CCP, used on Currituck NWR)			
Maintain vehicles and boats.	X	X	X
Maintain heavy equipment and hand tools.	X	X	X
Maintain computers and software.	X	X	X
Replace Chevy Astro van (MMS 97033)	X	X	X
Replace 1989 Blue Dodge pickup truck (MMS 00003)	X	X	X
Replace 1998 airboat (MMS 01002)	X	X	X
Replace D-4 dozer (MMS 01003)	X	X	X
Replace heavy duty disc (MMS 01004)	X	X	X
Replace backhoe (MMS 01005)	X	X	X
Replace tracked marsh vehicle (MMS 01006)	X	X	X
Replace 14-foot rotary mower (MMS 01007)	X	X	X
Replace 16-inch high volume lift pump (MMS 01008)	X	X	X
Replace 1996 4x4 Ford tractor (MMS 01010)	X	X	X
Replace 1988 Case 585 tractor (MMS 01011)	X	X	X
Replace 1991 15-ton tilt bed tractor (MMS 01012)	X	X	X
Replace 1998 tilt-bed trailer (MMS 01013)	X	X	X
Replace 1996 4X4 Dodge Dakota (MMS 01014)	X	X	X
Replace 2001 Chevrolet Tahoe (MMS 01016)	X	X	X
Replace 1999 Ford F-250 4X4 truck (MMS 01017)	X	X	X
Replace 1998 Ford F-250 4X4 truck (MMS 01018)	X	X	X
Replace 1995 Ford F-250 4X4 truck (MMS 01019)	X	X	X
Replace 1995 Ford F-150 4X4 extended cab truck (MMS 01020)	X	X	X
Replace 18-foot, boat, 60-horsepower outboard motor, and trailer (MMS 02004)	X	X	X
Replace 2001 John Deere 670CH Motor Grader (MMS 02005)	X	X	X
Replace 2001 Kubota M8200 tractor (MMS 02006)	X	X	X
Replace 2001 Alamo side mower (MMS 02007)	X	X	X
Replace 2001 Ingersoll-Rand RT706H forklift (MMS 02008)	X	X	X
Replace 1991 Chevrolet fire engine (MMS 02009)	X	X	X
Replace 20-foot, boat, 70-horsepower outboard motor, and trailer (MMS 02011)	X	X	X
Replace 2003 Ford F250 extended cab truck (MMS 04001).	X	X	X

Table 29. Summary of projects proposed in each Alternative (continued)

Project Description	Alternatives		
	1	2	3
Equipment Projects (continued)			
Replace 2003 Freightliner 6X4 stake bed dump truck (MMS 04002).	X	X	X
Facility Projects			
Maintain roads.	X	X	X
Maintain parking lots and trails.	X	X	X
Maintain buildings.	X	X	X
Maintain public use facilities.	X	X	X
Maintain impoundment water control structure.	X	X	X
Construct electric fence (MMS 97008 – Old RONS)	X	X	X
Establish satellite office (MMS 99004 – Old RONS)		X	X
Post newly acquired tracts (RONS 00020)	X	X	X
Survey and post boundaries of disputed tracts (RONS 04001)	X	X	X
Stabilize Monkey Island rookery (MMS 00004)		X	X
Construct visitor contact station/research facility (MMS 02003)		X	X
Construct boardwalk, observation platform, and trail (RONS 97002)			X

Table 30. Summary of costs of projects proposed in all Alternatives

Projects	Costs		
	First Year or One Time Costs	Recurring Costs	Total First Year Costs
Alternative 1			
Staff Projects	\$0	\$158,000	\$158,000
Budget Projects	\$0	\$0	\$0
Facility Projects	\$150,000	\$0	\$150,000
Total for Alternative 1 Projects	\$150,000	\$158,000	\$308,000
Alternative 2			
Staff Projects	\$374,500	\$499,350	\$873,850
Budget Projects	\$100,000	\$40,000	\$140,000
Facility Projects	\$1,867,000	\$0	\$1,867,000
Total for Alternative 2 Projects	\$2,341,500	\$539,350	\$2,880,850
Alternative 3			
Staff Projects	\$684,625	\$726,750	\$1,411,375
Budget Projects	\$143,000	\$40,000	\$183,000
Facility Projects	\$2,007,000	\$22,000	\$2,029,000
Total for Alternative 3 Projects	\$2,834,625	\$788,750	\$3,623,375
All Alternatives			
Land Acquisition Costs (9,500 acres @ \$2,000 an acre)	\$19,000,000	\$0	\$19,000,000
All Alternatives (In Mackay Island NWR CCP, but serving Currituck NWR)			
Equipment Projects	\$1,262,000	\$0	\$1,262,000

Table 31. Cost of projects proposed in Alternative 1

Project Description	Costs		
	First Year or One Time Costs	Recurring Costs	Total First Year Costs
Staff Projects			
Existing GS-13 manager (45% Currituck).		\$158,000	\$158,000
Existing GS-9 assistant manager (35% Currituck).			
Existing GS-9 park ranger (75% Currituck).			
Existing GS-5 office assistant (15% Currituck).			
Existing WG-10 maintenance mechanic (15% Currituck).			
Existing WG-8 equipment operator (40% Currituck).			
Existing GS-5 forestry technician (40% Currituck).			
Total for Staff Projects	\$0	\$158,000	\$158,000
Budget Projects (Currituck NWR) (Contracts, Research)			
None	\$0	\$0	\$0
Total for Budget Projects	\$0	\$0	\$0
Equipment Projects	First Year or One Time Costs	Recurring Costs	Total First Year Costs
In Mackay Island NWR CCP			
Facility Projects (Currituck NWR)	First Year or One Time Costs	Recurring Costs	Total First Year Costs
Construct electric fence (MMS 97008 – Old RONS)	\$70,000	\$0	\$70,000
Post Newly Acquired Tracts (RONS 00020)	\$20,000	\$0	\$20,000
Survey and Post Disputed Boundaries (RONS 04001).	\$60,000	\$0	\$60,000
Total for Facility Projects	\$150,000	\$0	\$150,000
Grand Total	\$150,000	\$158,000	\$308,000

Table 32. Cost of projects proposed in Alternative 2 (Preferred Alternative)

Project Description Staff Projects	Costs		
	First Year or One Time Costs	Recurring Costs	Total Costs
Existing GS-13 manager (45% Currituck).		\$158,000	\$158,000
Existing GS-9 assistant manager (35% Currituck).			
Existing GS-9 park ranger (75% Currituck).			
Existing GS-5 office assistant (15% Currituck).			
Existing WG-10 maintenance mechanic (15% Currituck).			
Existing WG-8 equipment operator (40% Currituck).			
Existing GS-5 forestry technician (40% Currituck).			
New GS-9 biologist (RONS 97006) (35% Currituck).	\$22,750	\$22,050	\$44,800
New GS-9 outdoor recreation specialist (Currituck) (RONS 97013) (60% Currituck).	\$39,000	\$31,800	\$70,800
New GS-4 clerk (RONS 99004)(45% Currituck).	\$33,750	\$22,500	\$56,250
New GS-7 biological technician (Currituck) (RONS 00001) (90% Currituck).	\$58,500	\$47,700	\$106,200
New GS-9 fire management specialist (RONS 00009)(40% Currituck).	\$34,000	\$27,600	\$61,600
New GS-9 assistant manager (Currituck) (RONS 00011) (95% Currituck).	\$61,750	\$65,550	\$127,300
New GS-7 biological technician (RONS 00013)(45% Currituck).	\$33,750	\$33,300	\$67,050
New WG-8 maintenance worker (RONS 00019)(45% Currituck).	\$29,250	\$23,400	\$52,650
New GS-7 park ranger (law enforcement) (RONS 03000) (95% Currituck).	\$61,750	\$67,450	\$129,200
Total for Staff Projects	\$374,500	\$499,350	\$873,850

Table 32. Cost of projects proposed in Alternative 2 (Preferred Alternative) - (Continued)

Project Description	Costs		
	First Year or One Time Costs	Recurring Costs	Total First Year Costs
Budget Projects (Currituck NWR) (Contracts, Research)			
Conduct research on the impacts of feral horses (RONS 00016).	\$25,000	\$40,000	\$65,000
Plan and Implement Big Game Hunting Program (RONS 04002).	\$55,000	\$0	\$55,000
Conduct fisheries survey (RONS 000012).	\$20,000	\$0	\$20,000
Total for Budget Projects	\$100,000	\$40,000	\$140,000
Equipment Projects	First Year or One Time Costs	Recurring Costs	Total First Year Costs
In Mackay Island NWR CCP			
Facility Projects (Currituck NWR)	First Year or One Time Costs	Recurring Costs	Total First Year Costs
Post newly acquired tracts (RONS 00020).	\$20,000	\$0	\$20,000
Survey and post disputed boundaries (RONS 04002).	\$60,000	\$0	\$60,000
Construct electric fence (MMS 97008 – Old RONS).	\$70,000	\$0	\$70,000
Establish satellite office (MMS 99004 – Old RONS).	\$204,000	\$0	\$204,000
Replace Monkey Island bulkhead (MMS 00004).	\$1,200,000	\$0	\$1,200,000
Construct visitor contact station/research facility (MMS 02003).	\$313,000	\$0	\$313,000
Total for Facility Projects	\$1,867,000	\$0	\$1,867,000
Grand Total	\$2,341,500	\$539,350	\$2,880,850

Table 33. Cost of projects proposed in Alternative 3

Project Description	Costs			
	Staff Projects	First Year or One Time Costs	Recurring Costs	Total Costs
Existing GS-13 manager (45% Currituck).			\$158,000	\$158,000
Existing GS-9 assistant manager (35% Currituck).				
Existing GS-9 park ranger (75% Currituck).				
Existing GS-5 office assistant (15% Currituck).				
Existing WG-10 maintenance mechanic (15% Currituck).				
Existing WG-8 equipment operator (40% Currituck).				
Existing GS-5 forestry technician (40% Currituck).				
New WG-7 tractor operator (RONS 97004) (35% Currituck).	\$45,500	\$19,600		\$65,100
New GS-9 biologist (RONS 97006) (35% Currituck).	\$22,750	\$22,050		\$44,800
New GS-9 outdoor recreation specialist (Currituck) (RONS 97013) (60% Currituck).	\$39,000	\$31,800		\$70,800
New GS-4 clerk (RONS 99004) (45% Currituck).	\$33,750	\$22,500		\$56,250
New GS-7 biological technician (Currituck) (RONS 00001) (90% Currituck).	\$58,500	\$47,700		\$116,200
New GS-9 fire management specialist (RONS 00009) (40% Currituck).	\$34,000	\$27,600		\$61,600
New GS-9 assistant manager (Currituck) (RONS 00011) (95% Currituck).	\$61,750	\$65,550		\$127,300
New GS-7 biological technician (RONS 00013) (45% Currituck).	\$33,750	\$33,300		\$67,050
New GS-7 outdoor recreation planner (RONS 00018) (60% Currituck).	\$39,000	\$29,400		\$68,400
New WG-8 maintenance worker (RONS 00019) (45% Currituck).	\$29,250	\$23,400		\$52,650
New GS-4 clerk (RONS 02001) (45% Currituck).	\$7,875	\$11,250		\$19,125
New GS-7 park ranger (law enforcement) (RONS 03000) (95% Currituck).	\$61,750	\$67,450		\$129,200

Table 33. Cost of projects proposed in Alternative 3 - (Continued)

Table 33. Cost of projects proposed in Alternative 3 – (Continued)

Project Description	Costs		
	First Year or One Time Costs	Recurring Costs	Total Costs
Staff Projects (continued)			
New GS-5 forestry technician (35% Currituck).	\$22,750	\$17,150	\$39,900
New WG-8 maintenance worker (100% Currituck).	\$65,000	\$52,000	\$117,000
New GS-7 outdoor recreation planner (volunteer coordinator) (100% Currituck).	\$65,000	\$49,000	\$114,000
New GS-7 wildlife biologist (100% Currituck).	\$65,000	\$49,000	\$114,000
Total for Staff Projects	\$684,625	\$726,750	\$1,411,375
Budget Projects (Currituck NWR) (Contracts, Research)	First Year or One Time Costs	Recurring Costs	Total First Year Costs
Conduct research on the impacts of feral horses (RONS 00016).	\$25,000	\$40,000	\$65,000
Plan and implement big game hunting program (RONS 04002).	\$55,000	\$0	\$55,000
Conduct fisheries survey (RONS 000012).	\$20,000	\$0	\$20,000
Conduct research on the history of the Corolla Navy Gunnery Site (RONS 000017).	\$43,000	\$0	\$43,000
Total for Budget Projects	\$143,000	\$40,000	\$183,000
Facility Projects (Currituck NWR)	First Year or One Time Costs	Recurring Costs	Total First Year Costs
Build boardwalk, observation platform, and trail. (RONS 97002).	\$140,000	\$22,000	\$162,000
Post newly acquired tracts (RONS 00020).	\$20,000	\$0	\$20,000
Survey and post disputed boundaries (RONS 04002).	\$60,000	\$0	\$60,000
Construct electric fence (MMS 97008 – Old RONS).	\$70,000	\$0	\$70,000
Establish satellite office (MMS 99004 – Old RONS).	\$204,000	\$0	\$204,000
Replace Monkey Island bulkhead (MMS 00004).	\$1,200,000	\$0	\$1,200,000
Construct visitor contact station/research facility (MMS 02003).	\$313,000	\$0	\$313,000
Total for Facility Projects	\$2,007,000	\$22,000	\$2,029,000
Grand Total	\$2,834,625	\$788,750	\$3,623,375

Table 34. Cost of equipment projects benefiting all Alternatives

All Alternatives (Included in Mackay Island NWR CCP, but also Serving Currituck NWR)			
Equipment Projects	First Year or One Time Costs	Recurring Costs	Total First Year Costs
Replace Chevy Astro van (MMS 97033).	\$31,000	\$0	\$31,000
Replace 1989 Blue Dodge pickup truck (MMS 00003).	\$28,000	\$0	\$28,000
Replace 1998 airboat (MMS 01002).	\$27,000	\$0	\$27,000
Replace D-4 dozer (MMS 01003).	\$159,000	\$0	\$159,000
Replace heavy duty disc (MMS 01004).	\$10,000	\$0	\$10,000
Replace backhoe (MMS 01005).	\$90,000	\$0	\$90,000
Replace tracked marsh vehicle (MMS 01006).	\$94,000	\$0	\$94,000
Replace 14-foot rotary mower (MMS 01007).	\$14,000	\$0	\$14,000
Replace 16-inch high volume lift pump (MMS 01008).	\$8,000	\$0	\$8,000
Replace 1996 4X4 Ford tractor (MMS 01010).	\$87,000	\$0	\$87,000
Replace 1988 Case 585 tractor (MMS 01011).	\$47,000	\$0	\$47,000
Replace 1991 15-ton tilt-bed trailer (MMS 01012).	\$16,000	\$0	\$16,000
Replace 1998 tilt-bed trailer (MMS 01013).	\$9,000	\$0	\$9,000
Replace 1996 4X4 Dodge Dakota (MMS 01014).	\$33,000	\$0	\$33,000
Replace 2001 Chevrolet Tahoe (MMS 01016).	\$37,000	\$0	\$37,000
Replace 1999 Ford F-250 4X4 truck (MMS 01017).	\$26,000	\$0	\$26,000
Replace 1998 Ford F-250 4X4 truck (MMS 01018).	\$26,000	\$0	\$26,000
Replace 1995 Ford F-250 4X4 truck (MMS 01019).	\$26,000	\$0	\$26,000
Replace 1995 Ford F-150 4X4 extended cab truck (MMS 01020).	\$29,000	\$0	\$29,000
Replace 18-foot boat, 60-horsepower outboard motor, and trailer (MMS 02004).	\$13,000	\$0	\$13,000

Table 34. Cost of equipment projects benefiting all Alternatives - (continued)

Project Description Equipment Projects (continued)	Costs		
	First Year or One Time Costs	Recurring Costs	Total First Year Costs
Replace 2001 John Deere 670CH Motor Grader (MMS 02005).	\$157,000	\$0	\$157,000
Replace 2001 Kubota M8200 tractor (MMS 02006).	\$47,000	\$0	\$47,000
Replace 2001 Alamo side mower (MMS 02007).	\$8,000	\$0	\$8,000
Replace 2001 Ingersoll-Rand RT 706H forklift (MMS 02008).	\$42,000	\$0	\$42,000
Replace 1991 Chevrolet fire engine (MMS 02009).	\$84,000	\$0	\$84,000
Replace 20-foot boat, 70-horsepower outboard motor, and trailer (MMS 02011).	\$16,000	\$0	\$16,000
Replace 2003 Ford F250 extended cab truck (MMS 04001).	\$28,000	\$0	\$28,000
Replace 2003 Freightliner 6X4 stake bed dump truck (MMS 04002).	\$70,000	\$0	\$70,000
Total for Equipment Projects	\$1,262,000	\$0	\$1,262,000

FEATURES COMMON TO ALL ALTERNATIVES

LAND ACQUISITION

The acquisition of land adjacent to Service-owned lands within the refuge's approved acquisition boundary would be given the highest priority. All land acquisitions are subject to contaminant surveys.

Funding for land acquisition would come from the Land and Water Conservation Fund, Migratory Bird Conservation Fund, or donations from conservation organizations. The Service can sometimes use conservation easements and leases to obtain minimum interests necessary to satisfy refuge objectives if the refuge staff can adequately manage uses of the areas for the benefit of wildlife. The Service can negotiate management agreements with local, state, and federal agencies, and accept conservation easements. Other public or private conservation organizations may own some tracts within the approved refuge acquisition boundary. The Service would work with interested organizations to identify additional areas needing protection and provide technical assistance if needed. The acquisition of private lands is entirely contingent on the landowners and their willingness to participate.

REFUGE REVENUE-SHARING

Annual refuge revenue-sharing payments to Currituck County would continue at similar rates under each alternative. If lands are acquired and added to the refuge, the payments would increase accordingly and be paid to the Currituck County.

VISITOR SERVICES

As the refuge develops a visitor services program, the staff would continue to assess the program and its potential impact on refuge resources. The staff would implement changes in the program as needed to address any impacts identified and to respond to anticipated wildlife population increases. To ensure a quality wildlife-dependent recreational experience while achieving the wildlife first mandate, the Service may limit the number of users and conflicts among users by the following: (1) permitting uses; (2) designating roads, trails, and sites for specific kinds of wildlife-dependent recreational use; and (3) permitting uses at certain times of the year.

There are a number of situations where future refuge closures or restrictions on access may be warranted. Examples of these situations include, but are not limited to, the following: protection of endangered species; protection of nesting birds; restriction of recreation activities to achieve specific wildlife population objectives; minimization of conflicts with other refuge management programs; and limitations from inadequate funds and/or staff to administer the use.

REFUGE ADMINISTRATION

The maintenance and operation of the refuge's administrative facilities would continue, regardless of the alternative selected. Periodic updating of facilities is necessary for safety and accessibility and to support staff and management needs. The plan identifies funding needs for several projects, including providing additional facilities and equipment to support refuge operations and maintenance.

PROPOSED ACTION

The refuge staff selected Alternative 2 as the preferred alternative for the proposed comprehensive conservation plan for managing Currituck National Wildlife Refuge over the next 15 years. When the Service separates the Environmental Assessment portion of this combined Draft Comprehensive Conservation Plan and Environmental Assessment, the Final Comprehensive Conservation Plan will include the goals, objectives, and strategies listed for Alternative 2 that the staff would use to achieve the refuge vision.

The planning team evaluated two other alternatives for managing the refuge. The other alternatives evaluated were Alternative 1 - No Action and Alternative 3. Chapter IV, Management Direction, in the Draft Comprehensive Conservation Plan (Section A) describes the goals, objectives, and strategies that would be carried out to implement Alternative 2.

Implementing the proposed alternative would result in better habitat management and increased public use opportunities, while meeting the refuge's primary purpose of protecting habitat for migratory birds. Specific results would include increased songbird, marsh bird, and shorebird use and production; enhanced habitat and increased protection for other coastal marsh and dune-dependent wildlife; enhanced resident wildlife populations; optimum wetland conditions; and greater opportunities for a variety of compatible wildlife-dependent recreational and environmental education activities.

An overriding concern reflected in this plan is that wildlife conservation is the first priority in refuge management. The Service allows public uses if they are compatible and appropriate with wildlife and habitat conservation. The staff would emphasize wildlife-dependent public uses (hunting, fishing, wildlife observation and photography, and environmental education and interpretation).

COMPATIBLE SECONDARY USES

The National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997, states that national wildlife refuges must be protected from incompatible or harmful human activities to ensure that Americans can enjoy Refuge System lands and waters. Before the Service allows activities or uses on a national wildlife refuge, the staff must find the uses to be compatible. A compatible use will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge. The Service may authorize wildlife-dependent recreational uses on a refuge when they are compatible and not inconsistent with public safety.

An interim compatibility determination is a document that assesses the compatibility of an activity during the period of time the Service first acquires a parcel of land until the time the Service prepares and adopts a formal, long-term management plan for that parcel. The Service has completed an interim compatibility determination for the six priority general public uses of the system, as listed in the National Wildlife Refuge System Improvement Act. These uses are hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation. As applicants request special use permits for other uses, the refuge staff will determine the compatibility of those uses.

OTHER MANAGEMENT

The Service would conduct all management activities that could affect natural resources, including subsurface mineral reservations, utility lines and easements, soil, water and air, and historical and archaeological resources to comply with all laws and regulations. The Service has a legal responsibility to consider the effects of its actions on cultural resources. Under all three alternatives, the Service would manage these resources in accordance with public law and agency policy. Individual projects could require additional consultation with the Advisory Council on Historic Preservation and the State of North Carolina's Historic Preservation Office. The Service requires additional consultation, surveys, and clearance where it is conducting project development on the refuge or when activities would affect properties that are listed or eligible for listing on the National Register of Historic Places.

IV. Environmental Consequences

OVERVIEW

This chapter analyzes and discusses the potential environmental effects or consequences that can be reasonably expected by the implementation of each of the three management alternatives described in the previous chapter. The planning team selected the following impact topics for analysis: effects on fish and wildlife populations; effects on habitats; effects on public use; effects on resource protection and conservation; and effects on general administration. These topics were chosen based on the important issues and concerns that were identified during the public scoping meetings and planning team meetings. Each alternative portrays the expected outcomes for fish and wildlife species through 2018, varying as to the intensity of management. Table 36 (at the end of this chapter) compares the effects of Alternative 2 and 3 to Alternative 1, the existing condition.

COMPARISON OF EFFECTS AMONG MANAGEMENT ALTERNATIVES

The refuge's current management actions described in Alternative 1, such as its water management, prescribed burning, and waterfowl hunting program, and its present efforts to acquire inholdings within the approved acquisition boundary, would have minimal positive to no effects on the biological environment. Land acquisition of the well-drained areas within the boundary could have negative effects on the local socioeconomic environment as land is removed from the tax base that could be developed.

Most refuge acquisitions are on marshlands that cannot support significant development. The refuge's fee title acquisitions allow for a revenue-sharing payment to offset tax losses to the local taxing authority. In addition, refuge lands do not require the maintenance of infrastructure such as roads and water and sewer systems that would be required if the area was fully developed. In addition, the majority of the economy is based on tourism. As the area becomes more developed, the refuge will preserve the area's natural aspects of the area that have been a primary reason for tourist interest. Overall, the economic contribution of the users of refuge lands will provide a benefit to the overall economy of the area.

The proposed management actions described in Alternative 2, such as monitoring a wider range of habitats; developing programs for interpretation, environmental education, wildlife observation, and photography; and acquiring private property from willing sellers would have positive effects on the biological environment and society.

The proposed management actions described in Alternative 3, such as surveying wildlife species, implementing a forest management plan, and developing enhanced environmental education and wildlife observation programs, would have positive effects on the biological environment and society. Implementation of Alternatives 2 and 3 would produce new economic opportunities from the salaries of the new staff, refuge expenditures in the local economy, and refuge visitors participating in outdoor recreation and environmental education opportunities.

BIOLOGICAL ENVIRONMENT

Each alternative would protect existing habitat important to migratory birds, mammals, reptiles, amphibians, fish, and invertebrates. Alternative 2 would provide data on some species and a balanced effort to increase habitat management for neotropical migratory songbirds and forest-dependent waterfowl on the refuge. Alternative 3 would provide data on all species on the refuge and a balanced effort to increase habitat management for neotropical migratory songbirds and forest dependent waterfowl on and off the refuge.

The increased public use provided in Alternatives 2 and 3 may affect the refuge's wildlife populations due to disturbance and habitat trampling. However, nesting, resting, and foraging habitat for waterfowl and songbirds would improve under Alternatives 2 and 3 because of the improved management of forests and moist soil management areas. Breeding populations of wood ducks and songbirds would increase under Alternatives 2 and 3. Habitat for migrating waterfowl, shorebirds, and wading birds would increase under Alternative 2 and 3.

The white-eyed vireo, a management indicator species, nests in mature forests such as the maritime forests on Currituck National Wildlife Refuge. The Service has not managed them in the past. High levels of crown closure interspersed with large, emergent trees provide the best nest site locations and opportunities for breeding success for these birds. The forest management activities outlined in Alternative 3 would cause long-term benefits in improving the nesting habitat for this species. The refuge is also home to other high priority birds such as the prothonotary warbler, American woodcock, wood thrush, and hooded warbler. The management in Alternative 3 would also improve the habitat for those species.

Each alternative would protect sites important to forest interior-breeding birds and wood ducks. Alternative 3 has the potential to provide greater management capabilities and larger areas of habitat protection.

Although there are no known nesting areas on the refuge, bald eagles have been sighted. The nearest bald eagle nest in 2005 was in the False Cape State Park. Bald eagles are vulnerable to human activity around nesting areas and do not tolerate human disturbances during the breeding season. Recreational activities including hiking, hunting, and fishing off shore can be a major disturbance to bald eagles. The level of recreational use is least disturbing to wildlife under Alternative 1, and most disturbing under Alternatives 2 and 3. The level of recreational use expected under Alternatives 2 and 3 include disturbances related to hiking, hunting, and fishing and could preclude the possibility of eagles establishing a nest where most of the proposed recreational activities would occur. The expansion of forest management activities described in Alternatives 2 and 3 may also negatively affect bald eagles locating on the refuge over the short term. Hunting is primarily a winter season activity and could adversely affect bald eagle nesting. Over the long term, Alternatives 2 and 3 would produce a number of suitable nesting and roosting trees for bald eagles.

The deer population on the refuge is unknown. Under Alternatives 2 and 3, forest management actions could increase the deer population. The refuge's forests and adjacent shrub and marsh communities provide rich sources of forage for deer. Under Alternatives 2 and 3, deer populations would be monitored and hunting would be used where allowable by state and local laws to manage their populations in order to provide a compatible recreational activity and prevent habitat damage. Hunting would also ensure the health of the deer herd and minimize the effects to other wildlife species and habitat.

An integrated pest management plan would be developed under all alternatives. Alternative 1 would provide the least management, while Alternatives 2 and 3 would provide the most management. Whenever possible, all alternatives would use multiple pest control techniques to control these species. However, some quantity of pesticides would be used on an as-needed basis.

All alternatives would provide additional protection to wetlands beyond the protection afforded by existing wetland regulations. They would also protect landscape characteristics such as habitat connectivity and would provide sufficient proprietary interest in properties to restore habitats for waterfowl, shorebirds, wading birds, and forest interior-breeding birds.

Under all public use alternatives, the level of recreational use and ground-based disturbance from pedestrians would be largely concentrated to boardwalks, trails, and the refuge's office and maintenance areas. Despite this and dispersed activities including hunting, public use could still have a negative effect on nesting bird populations. It is unlikely that species such as bald eagles would establish nests near developed facilities.

PHYSICAL ENVIRONMENT

The most critical physical environment issue on the refuge is the traffic on the beaches and the effects of the traffic on sea turtles, piping plovers, and other shorebirds. The refuge only owns the land down to the normal high water level; the public has unlimited vehicular and pedestrian access to the beach. Only Alternative 3 provides for the development of habitat behind the dunes to meet the needs of shorebirds.

All alternatives would positively affect soil formation processes on lands the refuge acquires. Some disturbances to surface soils and topography would occur at those locations selected for administrative and public use facilities, maintenance operations, and forest management.

All alternatives would positively affect the water quality in individual streams and wetlands due to a relatively low level of soil disturbance and fertilizer and pesticide application. Other positive effects would result from the protection of groundwater recharge areas, runoff prevention, sediment retention, and minimizing non-point source pollution.

Each alternative would protect the aesthetic characteristics associated with dunes, marshes, shrublands, and forests. The staff would carry out management activities designed to improve habitat composition and structure in such a way to minimize any short-term negative impacts to aesthetics.

SOCIAL ENVIRONMENT

Alternative 1 concentrates on providing opportunities for waterfowl hunting. The refuge staff coordinates the hunts with the North Carolina Wildlife Resources Commission. The Commission advertises the hunts in their annual proclamations. Community volunteers help to prepare and administer the hunts and provide essential support to the refuge staff. The refuge staff provides law enforcement. The refuge allows the other priority public uses (environmental education, interpretation, wildlife observation and photography), but does not provide programs to support them. The staff conducts environmental education as requested and participates in major local outreach events.

Under Alternatives 2 and 3, hunting, wildlife observation and photography, and environmental education and interpretation opportunities would increase. Under each alternative, the staff would consider most of the currently owned and newly acquired lands opened for public hunting of deer and feral hogs, resulting in a net gain of public hunting opportunities in the area. Fruitville Township, in which the Currituck Marsh, Station Landing Marsh, and South Marsh are located, is closed to deer hunting. Poplar Branch Township is open to hunting with shotgun only; regulations prohibit the use of bows, pistols, and rifles. The Poplar Branch Township line runs through the Monkey Island Unit. Current state law opens only the Monkey Island and Swan Island units to hunting. The refuge cannot open these units to deer hunting unless the township changes its regulation.

Increases in waterfowl hunting opportunities for those units would depend on the location of newly acquired land, whether the land was suitable for blinds with access to Currituck Sound, and regulatory constraints. Alternatives 2 and 3 would also stimulate ecotourism and potentially increase tourism expenditures in the surrounding local communities. Alternative 3 provides substantially more education and interpretation opportunities that would add to the recreational opportunities available to summer residents of the Outer Banks.

All alternatives would limit public access to passage by foot or boat and minimize wildlife disturbance and habitat degradation, while allowing compatible wildlife-dependent recreation. Some areas, such as waterfowl sanctuaries, would be closed seasonally to all public entry to minimize disturbance to wintering waterfowl. Visitor access would increase in Alternatives 2 and 3, where the refuge would develop foot trails, kiosks, boardwalks, and partner in the North Carolina Wildlife Resource Commission's Outer Banks Environmental Education Center. Alternative 3 provides slightly more facilities than Alternative 2.

Visitor use management on refuges concentrates on the experience, not the number of people coming into a refuge. The types and intensity of visitor activities would vary from tract to tract depending on its size, habitat type(s), and wildlife uses. Because much of the land in Currituck County is currently in private ownership, the general public realizes only minimal access privileges on that land. As the Service acquires more land and places it in the public trust, more opportunities for public access would become available.

The wildlife-dependent recreational activities described under Alternatives 2 and 3 (i.e., expanded opportunities for hunting, wildlife observation, wildlife photography, and environmental education and interpretation) would increase visitation to the refuge and generate more opportunities for visitors to be educated and enjoy an experience of the refuge. The refuge reported an estimated 27,000 refuge visits in 2000.

Refuge visitation to support priority public uses would generally build over time as the Service hires a public use specialist, develops visitor service programs and facilities, provides operational funds, and acquires more land. Initially, much of the public use on the refuge is expected to come from local, county, and state residents and summer residents, although an increase in the number of tourists is predicted for hiking, wildlife photography, and wildlife observation. The number of visitors would depend on the season and would grow as the refuge land base increases and more public use programs are provided.

ECONOMIC ENVIRONMENT

Many of the wildlife-dependent recreational activities offered have yet to be discovered by local citizens. As a generator of economic benefits, each alternative identifies hunting and wildlife observation as important tourist attractions. Under Alternatives 2 and 3, development of wildlife-dependent recreation programs and facilities and improved publicity would lead to the greatest economic benefit from increased tourism. The staff estimates that visitation to the refuge for activities besides hunting would increase from 25,000 to 35,000 to 50,000 from Alternative 1 to 2 to 3. At an estimated \$100 per day (Vogelsang 2001), the visitation represents an increase from \$2.5 million to \$3.5 million to \$5 million. Alternative 2 represents a slight increase in contributions to the local economy; Alternative 3 represents a moderately beneficial effect.

The proposed levels of funding would vary greatly from Alternative 1 to 2 to 3. Alternative 1 would have a recurring annual funding of \$158,000; there would be \$150,000 in first-year or one-time funding as the Service hires employees, constructs buildings, or repairs facilities. Alternative 2 would have a recurring annual funding of \$499,350; there would be \$1,867,000 in first-year or one-time funding as the Service hires employees, constructs buildings, or repairs facilities. Alternative 3 would have a recurring annual funding of \$726,750; there would be \$2,029,000 in first-year or one-time funding as the Service hires employees, constructs buildings, or repairs facilities. The added expenditures of Alternative 2 would have a slightly positive effect on the local economy; Alternative 3 would have a moderately positive effect.

Land acquisition within the refuge's approved acquisition boundary would decrease the gross property tax revenues of Currituck County. However, there would be an increase in refuge revenue-sharing payments. Because the Service is a federal agency, it is not subject to state and local taxes. Under the Refuge Revenue Sharing Act, the Fish and Wildlife Service makes annual payments to the counties to offset the loss of property tax revenues. These annual refuge revenue-sharing payments for owned and acquired lands are computed on whichever of the following formulas is greatest: (1) three-fourths of 1 percent of the fair market value of the lands acquired in fee title; (2) 25 percent of the net refuge receipts collected; or (3) 75 cents per acre of the lands acquired in fee title within the counties. The Refuge Revenue Sharing Act also requires that Service lands be appraised every five years to ensure that payments to local governments remain equitable. In 2004, Currituck County received a revenue-sharing payment of \$35,301 for 4,099 acres (\$8.62 per acre) with an appraised value of \$10,100,848 at Currituck National Wildlife Refuge. This was only 47% of the amount due to the county under the Revenue Sharing Act. Congress did not appropriate sufficient funding to pay the full amount. If fully funded, revenue sharing would have paid \$75,756 to the county.

Currituck County has assessed the value of refuge land for its development potential at \$31,464,658. At the county tax rate of \$.62 per \$100 of assessed value, the tax for its development value would be \$195,081.

The State of North Carolina recommends that counties tax undeveloped land based on the present use of the land. The state publishes a use-value manual based on the area of the state (Major Land Resource Area or MLRA) and the soil series of the land. Currituck National Wildlife Refuge is in the Tidewater area (MLRA 153B) and has 3,749 acres of soils rated as unproductive, 190 acres of Osier soil (Class I) in forest, and 160 acres of Ousley soil (Class V) in forest (Table 35). The county tax rate is \$.62 per \$100 of assessed value. The county would have taxed \$243,160 of assessed value \$1,507.59 if the 4,099 acres (\$.36 per acre) of land were privately owned.

Table 35. North Carolina present use value calculation

Soil	Acreage	Class	Value/Acre	Total Value
Beaches	3,749	VI (Unproductive)	\$40	\$149,960
Corolla				
Currituck				
Duckston				
Newhan				
Osier	190	I (Forest)	\$440	\$83,600
Ousley	160	V (Forest)	\$60	\$9,600
Total	4,099			\$243,160

The Revenue-Sharing Act payment of \$35,301 is less than one-sixth of the county tax of \$195,081 based on its development value, and is more than twenty three times the state-recommended tax of \$1,507.59 based on the current land use. The Service would contribute revenue-sharing payments to all new acquisitions.

EFFECTS COMMON TO ALL MANAGEMENT ALTERNATIVES

REGULATORY EFFECTS

As indicated in Chapter I, Background, of the comprehensive conservation plan (Section A), the Service must comply with a number of federal laws, administrative orders, and policies in the development and implementation of its management actions and programs. Among these mandates are the Endangered Species Act of 1973, the Clean Water Act of 1977, and compliance with Executive Orders 11990 (Protection of Wetlands) and 11988 (Floodplain Management). The implementation of any of the three alternatives described in this environmental assessment would not lead to a violation of these or other mandates.

CULTURAL RESOURCES

All alternatives afford additional land protection and low levels of development, thereby producing little negative effect on the refuge’s cultural and historic resources. Potentially negative effects could include logging and construction of new trails with the soil disturbance required. In most cases, these management actions would require review by the Service’s Regional Cultural Resource Officer in consultation with the State of North Carolina’s Historic Preservation Office, as mandated by Section 106 of the National Historic Preservation Act. Therefore, the determination of whether a particular action within an alternative has the potential to affect cultural resources is an ongoing process that would occur during the planning stages of every project.

Service acquisition of land with known or potential archaeological or historical sites provides two major types of protection for these resources: protection from damage by federal activity and protection from vandalism or theft. The National Historic Preservation Act requires that any proposed federal action that may affect archaeological or historical resources be reviewed by the State Historic Preservation Office, and that the proposed action must avoid or mitigate the identified effects. The Service’s policy is to preserve cultural, historic, and archaeological resources in the public trust, and avoid any adverse effects wherever possible.

Land acquisition by the Service would provide some degree of protection to significant cultural and historic resources. If acquisition of private lands does not occur and these lands remain under private ownership, the landowner would be responsible for protecting and preserving cultural resources. Development of off-refuge lands has the potential to destroy archaeological artifacts and other historical resources, thereby decreasing opportunities for cultural resource interpretation and research.

Under Alternatives 2 and 3, the Service would conduct a comprehensive cultural resources survey of the refuge and interpret the history of the Monkey Island Hunt Club at the visitor contact station. The building that housed the club is not restorable and is on an eroding island in Currituck Sound.

ENVIRONMENTAL JUSTICE

The decision-making process used in developing this plan and environmental assessment followed the procedures in the National Environmental Policy Act (NEPA). The Service conducted eight public meetings throughout the area served by the refuge, and advertised the planning process and the meetings in the print media and with posters in government offices and business establishments. Management of the refuge is not intensive and does not involve the use of hazardous substances. The management practice with the most potential for environmental harm is prescribed burning. The Service uses prescriptions developed by the state of North Carolina to minimize the effects of smoke on human health. The hazards presented by the smoke are distributed equally among all residents of the area.

WATER QUALITY, WETLANDS, AND FLOODPLAINS

The water quality in the waters surrounding the refuge is good (Table 5). None of the proposed actions in this plan should reduce that water quality. The majority of the refuge is classified as wetlands (Table 4). The Service will apply for the appropriate permits from the federal and state agencies that regulate wetlands before starting any development on the refuge. The Service will avoid or minimize any disturbance to wetlands in its development process. The majority of the refuge also floods on a regular basis with wind tides. The major activity in the areas subject to flooding will be prescribed burning, waterfowl hunting, and wildlife surveys in the marsh. None of these activities have impacts on the frequency or extent of flooding.

PUBLIC HEALTH AND SAFETY EFFECTS

None of the three alternatives would have a significantly negative effect on public health and safety. The only potential safety problems involve the possibility of hiking accidents occurring on the refuge's trails, and accidents occurring during the hunting season. As indicated below in the Mitigation Measures section, time and space zoning has been used successfully on national wildlife refuges to minimize the possibility of potential accidents and conflicts between hunters and other refuge user groups.

REFUGE REVENUE SHARING

Under the Refuge Revenue Sharing Act, the Fish and Wildlife Service makes annual payments to the counties to offset the loss of property tax revenues. These annual refuge revenue-sharing payments for owned and acquired lands are computed on whichever of the following formulas is greatest: (1) three-fourths of 1 percent of the fair market value of the lands acquired in fee title; (2) 25 percent of the net refuge receipts collected; or (3) 75 cents per acre of the lands acquired in fee title within the counties. The Refuge Revenue Sharing Act also requires that Service lands be appraised every five years to ensure that payments to local governments remain equitable. In 2004, Currituck County received a revenue-sharing payment of \$35,301 for 4,099 acres (\$8.62 per acre) with an appraised value of \$10,100,848 at Currituck National Wildlife Refuge. This was only 47% of the amount due to the county under the Revenue Sharing Act. Congress did not appropriate sufficient funding to pay the full amount. If fully funded, revenue sharing would have paid \$75,756 to the county.

UNCERTAINTY OF FUTURE ACTION EFFECTS

In general, one of the components of each alternative is the inventory and monitoring of fish and wildlife populations on the refuge. Once this information is known, the Service would develop detailed step-down management plans to manage the fish and wildlife populations on the refuge, based on the application of sound fish and wildlife management principles and concepts. The specific content of the step-down management plans would provide the basis for further analysis of environmental effects. The alternatives in this plan do present sufficient information to assess the full potential environmental effects of plans to be developed in the future.

CUMULATIVE EFFECTS

Cumulative effects on the environment result from incremental effects of a proposed action when these combine with other past, present, and reasonably foreseeable future actions. While cumulative effects may result from individually minor actions, they may, when viewed as a whole, become significant over time.

The implementation of any of the three alternatives described in this document includes actions relating to site development, fish and wildlife habitat and population management, land acquisition, and recreational use programs. These actions would have both direct and indirect affects (e.g., site development would result in increased public use, thus increasing littering, noise, and vehicular traffic); however, the cumulative effects of these actions over the 15-year planning period are not expected to be significant.

MITIGATION MEASURES

Described below are the measures used to mitigate and minimize the potential adverse effects.

WILDLIFE DISTURBANCES

Disturbance to wildlife at some level is an unavoidable consequence of any public use program, regardless of the activity involved. Obviously, some activities innately have the potential to be more disturbing than others. All of the proposed alternative public use activities contained in this document have been carefully planned to avoid unacceptable levels of impact.

As currently proposed, the known and anticipated level of disturbance of the proposed alternative (Alternative 2) is not considered significant and is well within the tolerance level of known wildlife species and populations present in the area. Implementation of the proposed public use program would take place through carefully controlled time and space zoning, including the management of waterfowl sanctuary areas, establishment of protection zones around key sites such as rookeries and eagle nests (if necessary), and the routing of roads and trails to avoid contact with sensitive areas such as rookery habitats, etc. In addition, the refuge would conduct all public hunting activities (season lengths, bag limits, number of hunters) within the constraints of sound biological principles and refuge-specific regulations established to restrict illegal or nonconforming activities. The North Carolina Wildlife Resources Commission sets the hunting seasons and bag limits enforced on the refuge.

General wildlife observation and photography activities may result in minimal disturbances to wildlife. If visitors venture too close to foraging songbirds, waterfowl, wading birds, or other wildlife, disruption of foraging or resting activities could result in more severe disturbances. To mitigate these potential disturbances, the Service would design and construct all visitor trails and observation points with a buffer around key wildlife foraging and resting areas. The staff would educate visitors through signs and brochures to avoid disturbing wildlife. The refuge staff would fence areas of nesting shorebirds to exclude pedestrian traffic. Also, they would close any area on the refuge to the public if disturbance becomes excessive.

Temporary initial disturbances to wildlife and habitat would occur during the construction of new facilities such as trails, wildlife observation platforms, photo blinds, and interpretive sites. However, once the construction of such facilities is completed, the experience gained by the public would offset these disturbances. Allowing these nonconsumptive recreational opportunities on the refuge would help to maintain and build public support for the refuge and the Roanoke–Tar–Neuse–Cape Fear ecosystem.

The Service would monitor the impacts of its activities through wildlife inventories and assessments of public use levels and activities. The staff would adjust public use programs as needed to limit disturbance to acceptable levels.

USER GROUP CONFLICTS

As public use levels expand across time, unanticipated conflicts between user groups may occur. The staff would adjust the refuge's public use programs as needed to eliminate or minimize each problem and provide quality wildlife-dependent recreational opportunities. Experience has proven that time and space zoning (e.g., establishment of separate use areas, use periods, and restrictions on the number of users) is an effective tool in eliminating conflicts between user groups. The current practice of discouraging all public uses except hunting during the hunting season would continue.

EFFECTS ON ADJACENT LANDOWNERS

Implementation of the proposed action would not impact adjacent or inholding landowners. The plan allows essential access to private property through the issuance of special use permits. Future land acquisitions would occur on a willing seller basis only and at fair market values. In addition, under the preferred alternative of the proposed comprehensive conservation plan, the staff would conduct water quality sampling and monitoring activities to document current conditions and seek to improve the water quality, if necessary. The state's existing water quality criteria and use classifications are adequate to achieve desired on-refuge conditions. Thus, implementation of the proposed alternative would not impact adjacent landowners or users beyond the constraints already implemented under existing state standards and laws. Prescribed burning would minimize the threat of wildfire to adjacent landowners from the refuge's marshes or forests.

LAND OWNERSHIP AND SITE DEVELOPMENT

Land acquisition within the approved acquisition boundary would result in changes in land and recreational use patterns, since all uses on National Wildlife Refuges must meet compatibility standards. Land ownership by the Service also precludes any future economic development by the private sector on these lands. The land within the approved acquisition boundary is subject to regulation under the Clean Water Act that would limit development of the land for residential, commercial, industrial, or agricultural use.

Potential development of access roads, buildings, trails, water control structures, visitor parking areas and other improvements could lead to minor short-term negative impacts on plants, soils, and some wildlife species. When the refuge proposes site development activities, each activity would receive the appropriate National Environmental Policy Act consideration during pre-construction planning. At that time, the refuge staff would incorporate any required mitigation activities into the specific project to reduce the level of impacts to the human environment and to protect fish and wildlife and their habitats.

As indicated earlier, one of the direct effects of site development is increased public use; this increased use may lead to increased littering, noise and vehicle traffic. While the Service would allocate funding and personnel to minimize, these indirect effects, such allocations would make the resources unavailable for other programs.

SUMMARY OF ENVIRONMENTAL EFFECTS

Table 36 compares the environmental effects of Alternatives 2 and 3 to Alternative 1, the existing condition.

Table 36. Comparison of the effects of Alternatives 2 and 3 to Alternative 1

Area of Concern	Alternative 2	Alternative 3
Effect on Wildlife		
Feral Horse Population	No Change	No Change
Fish Population	No Change	No Change
Invertebrate Population	No Change	No Change
Land Bird Population	No Change	Moderate Increase
Mammal Population	No Change	No Change
Reptile and Amphibian Population	No Change	No Change
Shorebird Population	Slight Increase	Moderate Increase
Wading Bird Population	Slight Increase	Moderate Increase
Waterfowl Population	No Change	No Change
Pest Animal Populations	Moderate Decrease	Moderate Decrease
Area of Concern		
Effect on Wildlife Habitat		
Conditions of All Habitats	Moderate Improvement	Moderate Improvement
Dune Grass and Maritime Dry Grassland Conditions	No Change	Slight Improvement
Maritime Forest Conditions	No Change	Moderate Improvement
Maritime Shrub Conditions	No Change	Moderate Improvement
Brackish Marsh Condition	No Change	Slight Improvement
Moist Soil Unit Conditions	Slight Improvement	Moderate Improvement
Wood Duck Box Condition	No Change	No Change
Pest Plant Populations	Moderate Improvement	Moderate Improvement
Natural Heritage Area Condition	No Change	No Change
Effect on Physical Environment		
Soil Condition	No Change	No Change
Air Quality	No Change	No Change
Water Quality	Slight Improvement	Slight Improvement
Effect on Social Environment		
Hunting	Slightly Positive	Moderately Positive
Environmental Education	Slightly Positive	Moderately Positive
Interpretation	Slightly Positive	Moderately Positive
Wildlife Observation	Slightly Positive	Moderately Positive
Wildlife Photography	Slightly Positive	Moderately Positive
Outreach	Slightly Positive	Moderately Positive
Outreach Quality	Slightly Positive	Moderately Positive
Refuge Support	Slightly Positive	Moderately Positive
Cultural Resource Protection	No Change	No Change
Effect on Economic Environment		
Local Expenditures	Slight Increase	Moderate Increase
Local Property Taxes	No Change	No Change

V. Consultation and Coordination

The Service formed a planning core team composed of representatives from its various divisions to prepare the Draft Comprehensive Conservation Plan and Environmental Assessment. The members of this planning core team are identified in Table 37. Initially, the team focused on identifying the issues and concerns pertinent to refuge management. The team met on several occasions from January 2001 to October 2002.

In addition, a biological review team met on the refuges in the ecosystem four times between December 1999 and December 2000 to assess the habitats on the refuges and the needs of wildlife species in the ecosystem, and make recommendations on land management and acquisition needs. Table 38 lists the members of this biological review team.

Throughout the planning process, the core team also sought the contributions of experts from various fields (Table 39).

The core planning team began its work in January 2001. On June 19, 21, 26, and 28, 2001, the planning team held a series of public scoping meetings to gain the insights of local citizens and their perceptions on the issues and concerns facing the refuge. The issues and alternatives generated from these meetings, coupled with the input of the planning team, are summarized in Chapters I and III of this environmental assessment.

The planning team formulated the three alternatives based on expert opinion and local concerns. After the team developed the alternatives, the refuge manager and the planning staff met with the North Carolina Wildlife Resources Commission in October 2002. The refuge staff presented the three alternatives during a second round of public meetings held on November 18, 19, 20, and 21, 2002, to solicit public reaction to the alternatives.

Table 37: Currituck National Wildlife Refuge Core Planning Team members

Member	Affiliation
Tim Cooper, Project Leader Suzanne Baird, Former Project Leader Kendall Smith, Assistant Manager Mike Panz, Park Ranger Peggy Vanzant, Office Assistant	Mackay Island National Wildlife Refuge U.S. Fish and Wildlife Service Knott's Island, North Carolina
Robert Glennon, Natural Resource Planner David Brown, Former Habitat Protection Biologist	Ecosystem Planning Office U.S. Fish and Wildlife Service Edenton, North Carolina

Table 38. Biological Review Team members, Currituck National Wildlife Refuge

Member	Affiliation
Bob Noffsinger, Former Supervisory Wildlife Management Biologist	Migratory Bird Field Office U.S. Fish and Wildlife Service Manteo, North Carolina
Frank Bowers, Former Migratory Bird Coordinator	Southeast Regional Office U.S. Fish and Wildlife Service Atlanta, Georgia
Chuck Hunter, Former Nongame Migratory Bird Coordinator	Southeast Regional Office U.S. Fish and Wildlife Service Atlanta, Georgia
Ronnie Smith, Fisheries Biologist	Fisheries Assistance Office U.S. Fish and Wildlife Service Edenton, North Carolina
John Stanton, Wildlife Biologist	Mattamuskeet National Wildlife Refuge U.S. Fish and Wildlife Service Swan Quarter, North Carolina
Wendy Stanton, Wildlife Biologist	Pocosin Lakes National Wildlife Refuge U.S. Fish and Wildlife Service Columbia, North Carolina
Dennis Stewart, Wildlife Biologist	Alligator River National Wildlife Refuge U.S. Fish and Wildlife Service Manteo, North Carolina
Ralph Keel, Wildlife Biologist	Great Dismal Swamp National Wildlife Refuge U.S. Fish and Wildlife Service Suffolk, Virginia
John Gallegos, Wildlife Biologist	Back Bay National Wildlife Refuge U.S. Fish and Wildlife Service Virginia Beach, Virginia
David Allen, Nongame Wildlife Biologist	North Carolina Wildlife Resources Commission Trenton, North Carolina
Jeff Horton, Site Manager	The Nature Conservancy Windsor, North Carolina

Table 39. Expert contributors to the Currituck National Wildlife Refuge Comprehensive Conservation Plan and their area(s) of expertise

Name	Field of Expertise
Bill Grabill, Former Refuge Supervisor U.S. Fish and Wildlife Service Atlanta, Georgia	Refuge Management
Dwane Hinson, District Conservationist USDA, Natural Resources Conservation Service Currituck, North Carolina	Soil and Water Conservation Federal Land Conservation Programs
John Gagnon, Soil Scientist USDA, Natural Resources Conservation Service Edenton, North Carolina	Soil Science
Kevin Moody, Former NEPA Specialist U.S. Fish and Wildlife Service Atlanta, Georgia	National Environmental Policy Act
John Ann Shearer, Private Lands Biologist U.S. Fish and Wildlife Service Raleigh, North Carolina	Wetland Management, Partners for Fish and Wildlife Program
Richard Kanaski, Regional Archeologist U.S. Fish and Wildlife Service Savannah, Georgia	Cultural Resources

SECTION C. APPENDICES

Appendix I. Glossary

<i>Adaptive Management</i>	A process in which projects are implemented within a framework of scientifically driven experiments to test predictions and assumptions outlined within the comprehensive conservation plan. The analysis of the outcome of project implementation helps managers determine whether current management should continue as is or whether it should be modified to achieve desired conditions.
<i>Alternative</i>	Alternatives are different means of accomplishing refuge purposes, goals, and objectives and contributing to the National Wildlife Refuge System. A reasonable way to fix the identified problem or satisfy the stated need.
<i>Approved Acquisition Boundary</i>	A project boundary that the Director of the Fish and Wildlife Service approves upon completion of the detailed planning and environmental compliance process. This boundary provides a “working area” for acquisition. The refuge may purchase land from willing sellers within the boundary. It does not mean all lands within the boundary are targeted for acquisition.
<i>Biological Diversity</i>	The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur. The National Wildlife Refuge System focus is on indigenous species, biotic communities, and ecological processes.
<i>Biological Integrity</i>	The biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms, and communities.
<i>Canopy</i>	A layer of foliage; generally the uppermost layer in a forest stand. It can be used to refer to mid- or understory vegetation in multilayered stands. Canopy closure is an estimate of the amount of overhead tree cover (also canopy cover).
<i>Categorical Exclusion</i>	A category of actions that do not individually or cumulatively have a significant effect on the human environment and have been found to have no such effect in procedures adopted by a federal agency pursuant to the National Environmental Policy Act of 1969.
<i>CFR</i>	Code of Federal Regulations.

<i>Compatible Use</i>	A wildlife-dependent recreational use or any other use of a refuge that, in the sound professional judgment of the refuge manager, will not materially interfere with, or detract from, the fulfillment of the mission or the purposes of the refuge. A compatibility determination supports the selection of compatible uses and identifies stipulations or limits necessary to ensure compatibility.
<i>Comprehensive Conservation Plan</i>	A document that describes the desired future conditions of the refuge; provides long-range guidance and management direction for the refuge manager to accomplish the purposes, goals, and objectives of the refuge; and contributes to the mission of the National Wildlife Refuge System and meet relevant mandates.
<i>Conservation Easement</i>	A legal document that provides specific land use rights to a secondary party. A perpetual conservation easement usually grants conservation and management rights to a party in perpetuity.
<i>Cooperative Agreement</i>	A simple habitat protection action in which no property rights are acquired. An agreement is usually long-term and can be modified by either party. Lands under a cooperative agreement do not necessarily become part of the National Wildlife Refuge System.
<i>Corridor</i>	A route that allows movement of wildlife from one region or place to another.
<i>Cover Type</i>	The present vegetation of an area.
<i>Cultural Resources</i>	The remains of sites, structures, or objects used by people of the past.
<i>Cypress and Tupelo Swamp</i>	Found in low-lying areas, swales and open ponds that hold water several months, if not all of the year. Large hollow trees are used as bear den sites.
<i>Deciduous</i>	Pertaining to perennial plants that are leafless for sometime during the year.
<i>Ecological Succession</i>	The orderly progression of an area through time in the absence of disturbance from one vegetative community to another.
<i>Ecosystem</i>	A dynamic and interrelating complex of plant and animal communities and their associated non-living environment.
<i>Ecosystem Management</i>	Management of natural resources using systemwide concepts to ensure that all plants and animals in ecosystems are maintained at viable levels in native habitats and basic ecosystem processes are perpetuated indefinitely.

<i>Environmental Health</i>	The composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment.
<i>Even-aged Forests</i>	Forests that are composed of trees with a time span of less than 20 years between oldest and youngest individuals.
<i>Endangered Species</i>	A plant or animal species listed under the Endangered Species Act that is in danger of extinction throughout all or a significant portion of its range.
<i>Endemic Species</i>	Plants or animals that occur naturally in a certain region and whose distribution is relatively limited to a particular locality.
<i>Environmental Assessment</i>	A concise document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action, alternatives to such action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an environmental impact statement or finding of no significant impact.
<i>Fauna</i>	All the vertebrate or invertebrate animals of an area.
<i>Federal Trust Species</i>	All species where the federal government has primary jurisdiction, including federally threatened or endangered species, migratory birds, anadromous fish, and certain marine mammals.
<i>Fee Title</i>	The acquisition of most or all of the rights to a tract of land. There is a total transfer of property rights with the formal conveyance of a title. While a fee title acquisition involves most rights to a property, certain rights may be reserved or not purchased, including water rights, mineral rights, or use reservation (the ability to continue using the land for a specified time period, or the remainder of the owner's life).
<i>Finding of No Significant Impact</i>	A document prepared in compliance with the National Environmental Policy Act, supported by an environmental assessment, that briefly presents why a federal action will have no significant effect on the human environment and for which an environmental impact statement, therefore, will not be prepared.

<i>Floodplain Woods</i>	Bottomland hardwood forests. Consists of hardwoods (old-growth and midsuccessional-aged timber), cypress tupelo stands found on low ridges that drain slowly and subject to flooding, overcup, willow, water oaks, sweetgum, green ash. Old growth typically exceeds 120 years of age. Red oaks were removed in the 1940s. Mid-succession is logged timber that may need restoration to improve wildlife habitat. Some areas are missing several key oak species.
<i>Fragmentation</i>	The process of reducing the size and connectivity of habitat patches. The disruption of extensive habitats into isolated and small patches.
<i>Goal</i>	Descriptive, open-ended, and often broad statements of desired future conditions that convey a purpose but does not define measurable units.
<i>Geographic Information System</i>	A computer system capable of storing and manipulating spatial mapping data.
<i>Ground Story (Flora)</i>	Vascular plants less than one meter in height, excluding tree seedlings.
<i>Herbaceous Wetland</i>	Annually or seasonally inundated with vegetation consisting primarily of grasses, sedges, rushes, and cattail.
<i>Historic Conditions</i>	The composition, structure, and functioning of ecosystems resulting from natural processes that we believe, based on sound professional judgment, were present prior to substantial human related changes to the landscape.
<i>Habitat</i>	The place where an organism lives. The existing environmental conditions required by an organism for survival and reproduction.
<i>Indicator Species</i>	A species of plant or animals that is assumed to be sensitive to habitat changes and represents the needs of a larger group of species.
<i>Inholding</i>	Privately owned land inside the boundary of a national wildlife refuge.
<i>Issue</i>	Any unsettled matter that requires a management decision.
<i>Migratory</i>	The seasonal movement from one area to another and back.
<i>Monitoring</i>	The process of collecting information to track changes of selected parameters over time.

<i>National Environmental Policy Act</i>	Requires all agencies, including the Service, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate this Act with other planning requirements, and prepare appropriate policy documents to facilitate better environmental decision-making.
<i>National Wildlife Refuge</i>	A designated area of land, water, or an interest in land or water within the National Wildlife Refuge System.
<i>National Wildlife Refuge System</i>	Various categories of areas administered by the Secretary of the Interior for the conservation of fish and wildlife, including species threatened with extinction, all lands, waters, and interests therein administered by the Secretary as wildlife refuges, wildlife ranges, game ranges, wildlife management areas, or waterfowl production areas.
<i>Native Species</i>	Species that normally live and thrive in a particular ecosystem.
<i>Neotropical Migratory Bird</i>	A bird species that breeds north of the United States/Mexican border and winters primarily south of that border.
<i>Objective</i>	A concise quantitative (where possible) target statement of what will be achieved. Objectives are derived from goals and provide the basis for determining management strategies. Objectives should be attainable and time-specific.
<i>Planning Area</i>	A planning area may include lands outside existing planning unit boundaries that are being studied for inclusion in the unit and/or partnership planning efforts. It may also include watersheds or ecosystems that affect the planning area.
<i>Planning Team</i>	A team that prepares the comprehensive conservation plan. Planning teams are interdisciplinary in membership and function. A team generally consists of the planning team leader; refuge manager and staff biologists; staff specialists or other representatives of Service programs, ecosystems or regional offices; and state-partnering wildlife agencies as appropriate.
<i>Preferred Alternative</i>	The alternative determined by the decision-maker to best achieve the refuge's purpose, vision, and goals; contributes to the refuge system mission; addresses the significant issues; and is consistent with principles of sound fish and wildlife management.
<i>Purpose(s) of the Refuge</i>	The purpose(s) specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit.

<i>Refuge Operating Needs System</i>	A national database that contains the unfunded operational needs of each refuge. Projects included are those required to implement approved plans and meet goals, objectives, and legal mandates.
<i>Seral Forest</i>	A forest in the mature stage of development, usually dominated by large, old trees.
<i>Sink</i>	A habitat in which local mortality exceeds local reproductive success for a given species.
<i>Sink Population</i>	A population in a low-quality habitat in which the birth rate is generally less than the death rate and the population density is maintained by immigrants from source populations.
<i>Source</i>	A habitat in which local reproductive success exceeds local mortality for a given species.
<i>Source Population</i>	A population in a high-quality habitat in which the birth rate greatly exceeds the death rate and the excess individuals leave as migrants.
<i>Step-down Management Plans</i>	Specific plans that provide the details necessary to implement management strategies and projects identified in the comprehensive conservation plan.
<i>Strategy</i>	A specific action, tool, or technique or combination of actions, tools, and techniques used to meet unit objectives.
<i>Threatened Species</i>	Species listed under the Endangered Species Act that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.
<i>Trust Species</i>	Species for which the Fish and Wildlife Service has primary responsibility, including most federally listed threatened and endangered species, anadromous fish once they enter the inland coastal waterways, and migratory birds.
<i>Understory</i>	Any vegetation with a canopy below or closer to the ground than the canopies of other plants.
<i>Wildlife Corridor</i>	A landscape feature that facilitates the biologically effective transport of animals between larger patches of habitat dedicated to conservation functions. Such corridors may facilitate several kinds of traffic, including frequent foraging movement, seasonal migration, or the once-in-a-lifetime dispersal of juvenile animals. These are transition habitats and need not contain all the habitat elements required by migrants for long-term survival or reproduction.

Wildlife-dependent Recreation

A use of a refuge involving hunting, fishing, wildlife observation, wildlife photography and environmental education and interpretation. The National Wildlife Refuge System Improvement Act of 1997 specifies that these are the six priority general public uses of the National Wildlife Refuge System.

Appendix II. References and Literature Cited

- Beal, E.O. 1977. *A Manual of Marsh and Aquatic Vascular Plants of North Carolina with Habitat Data*. North Carolina Agricultural Experiment Station, Technical Bulletin 247. 277 pp.
- Bellis, V. and E. Proffitt. 1976. *Maritime Forest in Ecological Determinants of Coastal Area Management*. Volume II – Appendices. Sea Grant Program, North Carolina State University, Raleigh, North Carolina.
- Bellrose, F.C. 1976. *Ducks, Geese, and Swans of North America*. Stackpole Books, Harrisburg, Pennsylvania. 544 pp.
- Bookhout, T.A. 1994. *Research and Management Techniques for Wildlife and Habitats*. Fifth edition. The Wildlife Society, Bethesda, Maryland. 740 pp.
- Borawa, J.C., J.H. Kerby, M.T. Hiush and A.W. Mullis. 1979. Currituck Sound fish populations before and after infestation by Eurasian water-milfoil. *Proceedings of the Annual Conference of Southeastern Association of Fish and Wildlife Agencies* 32: 520–28.
- Brower, D., F. Parker, D. Frankenburg, B.J. Copeland and R. Alden. 1976. *Ecological Determinants of Coastal Area Management*. Sea Grant Program, North Carolina State University, Raleigh, North Carolina.
- Burt, W.H. and R.P. Grossenhelder. 1964. *A Field Guide to the Mammals*. Houghton Mifflin Company, Boston, Massachusetts. 266 pp.
- Coastal Zone Resources Corporation. 1974. Biophysical description and assessment of North Whalehead Beach Project Area, Currituck County, North Carolina. Prepared for Urban Developers, Inc., Norfolk, Virginia. 68 pp.
- Cooper, J.E., S.S. Robinson and J.B. Funderburg (eds). 1977. *Endangered and Threatened Plants and Animals of North Carolina*. North Carolina State Museum of Natural History, Raleigh, North Carolina.
- Cowardin, L., V. Carter, F.C. Golet and E.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. Washington, DC: U.S. Fish and Wildlife Service, Office of Biological Services FWS/OBS-79/31. 131 pp.
- Dolan, R., B. Hayden, C. Rea and J. Heywood. 1979. Shoreline erosion rates along the middle Atlantic Coast of the United States. *Geology* 7: 602-606.
- Eldridge, J. 1992. Management of habitat for breeding and migrating shorebirds in the Midwest. In M.K. Laubhan and D. Hamilton, eds., *Waterfowl Management Handbook*. U.S. Fish and Wildlife Service, Fort Collins, Colorado.
- Eubanks, Ted, Paul Kerlinger and R.H. Payne. 1993. High Island, Texas: A case study in avitourism. *Birding* 25(6): 415-420).

-
- Eubanks, Ted and John Stoll. 1999. *Avitourism in Texas: Two Studies of Birders in Texas and their Potential Support for the Proposed World Birding Center*. Texas Parks and Wildlife, Contract No. 44467.
- Fenneman, N.M. 1938. *Physiography of the Eastern United States*. McGraw-Hill, New York. 714 pp.
- Fisher, J.J. 1962. *Geomorphic Expression of Former Inlets among the Outer Banks of North Carolina*. M.A. Thesis, University of North Carolina, Chapel Hill. 120 pp.
- Florshutz, O., Jr. 1972. The importance of Eurasian water-milfoil (*Myriophyllum spicatum*) as a waterfowl food. *Proceedings of the Annual Conference, Southeastern Association of Game and Fish Commissions* 26:189-194.
- Florshutz, O., Jr. 1979. Personal communication.
- Frayer, W.E., T.J. Monahan, D.C. Bowen and F.A. Graybill. 1983. *Status and Trends of Wetlands and Deepwater Habitats in the Conterminous United States: 1950s to 1970s*. U.S. Fish and Wildlife Service, Washington, DC. 32 pp.
- Fredrickson, L.H. and M.E. Heitmeyer. 1988. Waterfowl use of forested wetlands of the southern United States: an overview. Pages 307-323 in M.W. Weller, ed., *Waterfowl in Winter*. University of Minnesota Press, Minneapolis, Minnesota.
- Fredrickson, L.H. and F. A. Reid. 1988. Nutritional value of waterfowl foods. In M.K. Laubhan and D. Hamilton, eds., *Waterfowl Management Handbook*. U.S. Fish and Wildlife Service, Fort Collins, Colorado.
- Fredrickson, L.H. 1991. Strategies for water level manipulation in moist soil systems. In M.K. Laubhan and D. Hamilton, eds., *Waterfowl Management Handbook*. U.S. Fish and Wildlife Service, Fort Collins, Colorado.
- Frost, C. 1995. Presettlement fire regimes in southeastern marshes, peatlands, and swamps. Pages 39-60 in Susan I. Cerulean and R. Todd Engstrom, eds., *Fire in Wetlands: A Management Perspective*. Proceedings of the Tall Timbers Fire Ecology Conference, No. 19. Tall Timbers Research Station, Tallahassee, Florida.
- Frost, C. 1998. Presettlement fire frequency regimes in the United States: a first approximation. Pages 70-81 in Teresa L. Pruden and Leonard A. Brennan, eds., *Fire in Ecosystem Management: Shifting the Paradigm from Suppression to Prescription*. Proceedings of the Tall Timbers Fire Ecology Conference, No. 20. Tall Timbers Research Station, Tallahassee, Florida.
- Godfrey, P.J. and M.M. Godfrey. 1976. *Barrier Island Ecology of Cape Lookout National Seashore and Vicinity, North Carolina*. National Park Service Scientific Monograph Series No. 9. U.S. Department of the Interior, National Park Service, Washington, DC. 159 pp.
- Godfrey, P.J., S. Leatherman and P. Buckley. 1978. Impact of off-road vehicles on coastal ecosystems. Pages 581-600 in *Symposium on Technical, Environmental, Socioeconomic, and Regulatory Aspects of Coastal Zone Planning and Management*. San Francisco, California, March 14-16, 1978.

-
- Goldsmith, V., A. Gutman, H. Hennigar, Y.E. Goldsmith, P.S. Rosen, M. Boule and E. Barnett. 1977. Coastal dune geomorphology and classification. Abstract. Proceedings of the American Association of Petroleum Geologists Annual Meeting, Washington, DC.
- Gutman, A.L. 1978. *The Interaction of Eolian Sand Transport, Vegetation and Dune Geomorphology, Currituck Spit, Virginia-North Carolina*. Virginia Institute of Marine Science, SRAMSOE No. 143.
- Haag, W.G. 1958. *The Archeology of Coastal North Carolina*. Louisiana State University, Coastal Study Series 2.
- Hamel, P.B. 1992. *The Land Manager's Guide to the Birds of the South*. The Nature Conservancy and U.S. Department of Agriculture, Forest Service. Atlanta, Georgia.
- Hefner, J.H. and J.D. Brown. 1984. Wetland trends in the southeastern United States. *Wetlands* 4:1-11.
- Hennigar, H.F., Jr. 1979. *Historical Evolution of Coastal Sand Dunes of Currituck Spit, Virginia-North Carolina*. M.S. Thesis. College of William and Mary, Williamsburg, Virginia. 120 pp.
- Hosier, P.E. and W.J. Cleary. 1979. *An Analysis of Selected Sites on Currituck Spit, North Carolina*. North Carolina Department of Natural Resources and Community Development, North Carolina Natural Heritage Program. Raleigh, North Carolina.
- Hoyt, J.S. 1967. Barrier island formation. *Geological Society of America Bulletin* 78: 1125-1136.
- Hunter, W.C., D.N. Pashley and R.E.F. Escano. 1992. Neotropical migratory landbird species and their habitats of special concern within the southeast region. Pages 159-169 in D.M. Finch and P.W. Stangel, eds., *Status and Management of Neotropical Migratory Birds*. U.S. Forest Service, General Technical Report RM-229, Fort Collins, Colorado.
- Hunter, W.C., L.H. Peoples and J.A. Collazo. 2001. *South Atlantic Coastal Plain Partners in Flight Bird Conservation Plan*. Partners in Flight, www.partnersinflight.org.
- Jackson, R.F., Jr. 1978. Back Bay complex – ambient water quality monitoring data review. State Water Control Board, Norfolk, Virginia.
- Johnson, D.W. 1919. *Shore Processes and Shoreline Development*. New York: John Wiley and Sons.
- Kerlinger, P. 1994. *The Economic Impact of Birding Ecotourism on Communities Surrounding Eight National Wildlife Refuges*. Washington, DC: National Fish and Wildlife Association.
- Kerlinger, P. 1999. Birding Tourism and Dauphin Island.
- Leggett, A.T., Jr. and G.L. Butler. 1975. Preliminary report on a population and behavior of the ghost crab (*Ocypode quadrata*) at the Back Bay National Wildlife Refuge. Unpublished report. Department of Biological Sciences, Old Dominion University, Norfolk, Virginia.

-
- Lee, B.B. and D.S. Lee. 1978. Observations of the autumn hawk migration along North Carolina's Outer Banks. *The ASB Bulletin* 25 (2).
- Levy, G.F. 1976. *Vegetative Study of the Duck Field Research Facility, Duck, North Carolina*. Miscellaneous Report 76-6, U.S. Army Corps of Engineers. Coastal Engineering Research Station, Fort Belvoir, Virginia.
- Mathis, M.A. and J.J. Crow, eds. 2000. *The Prehistory of North Carolina: An Archaeological Symposium*. Raleigh, North Carolina: North Carolina Division of Archives and History.
- Matta, J.F. 1977. *Beach Fauna Study of Coastal Engineering Research Facility, Duck, North Carolina*. Miscellaneous Report No. 77-6, U.S. Army Corps of Engineers. Coastal Engineering Research Center, Fort Belvoir, Virginia.
- Mitsch, W.J. and J.G. Gosselink. 1993. *Wetlands*. Second edition. New York: Van Nostrand Reinhold. 722 pp.
- Munse, C.M. 1975. Study of macroscopic flora and fauna of the intertidal zone on the open beach at Back Bay. Unpublished report. Department of Biological Sciences, Old Dominion University, Norfolk, Virginia.
- National Audubon Society. 1998. Campaign on HR 3267. National Audubon Society, New York, New York.
- New Jersey Department of Environmental Protection. 2000. *Wildlife-associated Recreation on the New Jersey-Delaware Bayshore*. New Jersey Division of Fish and Wildlife, Trenton, New Jersey.
- Nichols, T.R. 1979. Peregrine banding project – Back Bay National Wildlife Refuge, Virginia to Duck, North Carolina, 9/26/79 to 10/24/79. Unpublished report.
- North Carolina Economic Security Commission. 2002. Largest employers by county. www.ncesc.com.
- North Carolina Economic Security Commission. 2004. Unemployment rates by county. www.ncesc.com.
- North Carolina Division of Parks and Recreation. 2001. *North Carolina Coastal Plain Paddle Trails Guide*. North Carolina Division of Parks and Recreation, Seven Springs, North Carolina.
- North Carolina Natural Heritage Program. 1979. Data on natural heritage areas of Dare and Currituck counties, North Carolina. Unpublished report. North Carolina Department of Natural Resources and Community Development, Raleigh, North Carolina.
- Oaks, R.Q., Jr. and N.K. Coch. 1973. *Post-Miocene Stratigraphy and Morphology, Southeastern Virginia*. Virginia Division of Mineral Resources, Technical Bulletin 82. 135 pp.
- Odum, H.T., B.J. Copeland and E.A. McMahan, eds. 1974. *Coastal Ecological Systems of the United States*. Four volumes. Washington, DC: The Conservation Foundation.

-
- Osborne, R.G. and T.W. Custer. 1978. *Hérons and their Allies: Atlas of Atlantic Coast Colonies, 1975-1976*. Biological Services Program, U.S. Fish and Wildlife Service. FWS/OBS-7-108. 211 pp.
- Outer Banks Chamber of Commerce. 2003. *History of Dare County*. 5 pp. Outer Banks Chamber of Commerce, Kill Devil Hills, North Carolina.
- Perry, J.E. 1979. Preliminary ecological observations of Currituck and Dare County marshes. North Carolina Department of Natural Resources and Community Development, North Carolina Natural Heritage Program, Raleigh, North Carolina.
- Riggs, S.R. and D.K. Belknap. 1988. Upper Cenozoic processes and environments of continental margin sedimentation: eastern United States. Pages 131-176 in R.E. Sheridan and J.A. Graw, eds., *The Geology of North America, Volumes 1-2, the Atlantic Continental Margin*. U.S. Geological Society of America.
- Schafale, M.P. and A.S. Weakely. 1990. *Classification of the Natural Communities of North Carolina: Third Approximation*. North Carolina Natural Heritage Program, Raleigh, North Carolina. 325 pp.
- Schmidt, P.R. 1993. Memorandum - Information request regarding impacts of hunting on national wildlife refuges. U.S. Department of the Interior, Fish and Wildlife Service, Office of Migratory Bird Management, Washington, DC. 7 pp.
- Schwartz, M.L. 1971. The multiple causality of barrier islands. *Journal of Geology* 79: 91-94.
- Segar, W.S. 1979. Habitat use patterns of the peregrine falcon during autumn migration on Maryland and Virginia barrier islands. Unpublished report. 17 pp.
- Seneca, E.D., W.W. Woodhouse and S.W. Brome. 1977. *Dune Stabilization with Panicum amarum along the North Carolina Coast*. Center for Marine and Coastal Studies, Report No. 77-1, UNC-56-77-03.
- Shepard, P.P. 1973. *Submarine Geology*. New York: Harper and Row. 517 pp.
- Sincock, J.L., K.E. Johnston, J.L. Coggin, R.E. Wollitz, J.A. Kerwin and J. Grandy. 1965. Back Bay – Currituck sound data report. U.S. Fish and Wildlife Service, North Carolina Wildlife Resources Commission, and Virginia Commission of Game and Inland Fisheries. 1,600 pp.
- Snowden, A. 1979. Personal communication.
- Stick, D. 1958. *The Outer Banks of North Carolina: 1584-1958*. Chapel Hill, North Carolina: The University of North Carolina Press. 352 pp.
- Stiven, A. and R. Plotecia. 1976. *Salt Marsh Primary Productivity Estimates for North Carolina Coastal Counties: Projections from a Regression Model*. Sea Grant Program, University of North Carolina, Raleigh. UNC-56-76-06.
- Sutton, C.H. and V. Goldsmith. 1976. Regional trends in historical shoreline changes: New Jersey to Cape Hatteras, North Carolina. Paper presented at G.S.A. NE-SE Conference, March, 1976. Washington, DC.

-
- Tyndall, R.W. 1977. *Plant Distribution and Succession within Interdunal Depressions on a Virginia Barrier Dune System*. M.S. Thesis, Old Dominion University, Norfolk, Virginia.
- U. S. Department of Agriculture. 1997. Census of Agriculture, North Carolina, 1997. Washington, DC: U.S. Department of Agriculture.
- U. S. Department of Agriculture. 2002. Census of Agriculture, North Carolina, 2002. Washington, DC: U.S. Department of Agriculture.
- U. S. Department of Agriculture, Forest Service. 1991. *Forest Statistics for North Carolina Counties - 1991*. Resource Bulletin SE-120. Washington, DC: U.S. Government Printing Office.
- U. S. Department of Agriculture, Forest Service. 1992. *Forest Statistics for Virginia Counties - 1991*. Resource Bulletin SE-131. Washington, DC: U.S. Government Printing Office.
- U. S. Department of Agriculture, Soil Conservation Service. 1982a. *Soil Survey of Currituck County, North Carolina*. USDA Soil Conservation Service, Washington, DC.
- U. S. Department of Agriculture, Soil Conservation Service. 1982b. *Soil Survey of Virginia Beach, Virginia*. USDA Soil Conservation Service, Washington, DC.
- U.S. Department of Agriculture. Soil Conservation Service. 1985. *Hydric Soils of the State of North Carolina, 1985*. U.S. Department of Agriculture, Soil Conservation Service in cooperation with the National Technical Committee for Hydric Soils. Washington, DC. Unpaginated.
- U. S. Department of Commerce, Bureau of the Census. 1997. Economic Census, Currituck County, North Carolina. Washington, DC: U.S. Government Printing Office.
- U. S. Department of Commerce, Bureau of the Census. 2000a. U.S.A. Counties 2000, General Profiles: Currituck County, North Carolina; Dare County, North Carolina; and Virginia Beach, Virginia. Washington, DC: U.S. Government Printing Office.
- U.S. Department of Commerce, Bureau of the Census. 2000b. County Business Patterns: Currituck County, North Carolina; Dare County, North Carolina; and Virginia Beach, Virginia. Washington, DC: U.S. Government printing Office.
- U. S. Department of Commerce, Bureau of the Census. 2000c. Small Area Income and Poverty Estimates Program. 2000: Model-based Income and Poverty Estimates for Currituck County and Dare County, North Carolina, and Virginia Beach, Virginia. Washington, DC: U.S. Government Printing Office.
- U.S. Department of the Interior. 1981. *Report on Fisheries of the South Atlantic States*. U.S. Fish and Wildlife Service, Volume 11, 285 pp.
- U.S. Environmental Protection Agency. 1997. Nature-based Tourism.
- U.S. Fish and Wildlife Service. 1975. Waterfowl harvest and hunter activity in the United States during the 1974 hunting season. Administrative report. Office of Migratory Bird Management. Laurel, Maryland.

-
- U.S. Fish and Wildlife Service. 1979. *Black Duck Coastal Wintering Habitat Concept Plan, Category 5*. Region 5 Office, Newton Corner, Massachusetts.
- U.S. Fish and Wildlife Service. 2001. *National Survey of Fishing, Hunting, and Wildlife-associated Recreation - North Carolina*. Washington, DC.
- Virginia Employment Commission. 2004. Labor Market Analysis: Virginia Beach.
<http://www.velma.virtuallmi.com>.
- Vogelsang, Hans. 2001. *Assessing the Economic Impact of Ecotourism Developments on the Albemarle/Pamlico Region*. Greenville, North Carolina: East Carolina University, Department of Recreation and Leisure Studies.
- Ward, L. 1976. *The Status of Barrier Islands of the Southeastern Coast*. Open Space Institute, New York, New York. 300 pp.
- Ward, L.W., R.H. Bailey and J.G. Carter. 1991. Pliocene and early Pleistocene stratigraphy, depositional history, and molluscan paleobiography of the Coastal Plain. Chapter 16 (pages 79-92) in J.W. Horton, Jr. and V. Zullo, eds., *The Geology of the Carolinas*. Carolina Geological Society, 50th Anniversary Volume. Knoxville, Tennessee: The University of Tennessee Press.
- Winner, M.D., Jr. 1975. *Ground Water Resources of Cape Hatteras National Seashore, North Carolina*. U.S. Geological Survey, Hydrologic Investigations Atlas – 540.

Appendix III. Relevant Legal Mandates

NATIONAL WILDLIFE REFUGE SYSTEM AUTHORITIES

The mission of the Fish and Wildlife Service is to conserve, protect, and enhance the Nation's fish and wildlife and their habitats for the continuing benefit of the American people. The Service is the primary federal agency responsible for migratory birds, endangered plants and animals, certain marine mammals, and anadromous fish. This responsibility to conserve our Nation's fish and wildlife resources is shared with other federal agencies and state and tribal governments.

As part of this responsibility, the Service manages the national wildlife refuge system. This system is the only nationwide system of federal land managed and protected for wildlife and their habitats. The mission of the national wildlife refuge system is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

Currituck National Wildlife Refuge is managed as part of this system in accordance with the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997, the Refuge Recreation Act of 1962, Executive Order 12996 (Management and General Public Use of the National Wildlife Refuge System), and other relevant legislation, executive orders, regulations, and policies.

KEY LEGISLATION AND POLICIES FOR PLAN IMPLEMENTATION

The Currituck National Wildlife Refuge Draft Comprehensive Conservation Plan describes and illustrates management area projects with standards and guidelines for future decision-making and may be adjusted through monitoring and evaluation, as well as amendment and revision. The plan approval establishes conservation and land protection goals, objectives, and specific strategies for the refuge and its expansion. Compatible recreation uses specific to the refuge have been identified and approved by the refuge manager. This plan provides for systematic stepping down from the overall direction as outlined when making project or activity level decisions. This level involves site-specific analysis (e.g., Forest Habitat Management Plan) to meet National Environmental Policy Act requirements for decision-making.

Antiquities Act (1906): Authorizes the scientific investigation of antiquities on federal land and provides penalties for unauthorized removal of objects taken or collected without a permit.

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

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

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

Fish and Wildlife Act (1956): Established a comprehensive national fish and wildlife policy and broadened the authority for acquisition and development of refuges.

Fish and Wildlife Coordination Act (1958): Allows the Fish and Wildlife Service to enter into agreements with private landowners for wildlife management purposes.

Refuge Recreation Act (1962): Allows the use of refuges for recreation when such uses are compatible with the refuge's primary purposes and when sufficient funds are available to manage the uses.

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

National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997, 16 U.S.C. 668dd-668ee (Refuge Administration Act): Defines the National Wildlife Refuge System and authorizes the Secretary of the Interior to permit any use of a refuge provided such use is compatible with the major purposes for which the Service established the refuge. The Refuge Improvement Act clearly defines a unifying mission for the Refuge System; establishes the legitimacy and appropriateness of the six priority public uses (hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation); establishes a formal process for determining compatibility; establishes the responsibilities of the Secretary of the Interior for managing and protecting the System; and requires a comprehensive conservation plan for each refuge by the year 2012. This Act amended portions of the Refuge Recreation Act and National Wildlife Refuge System Administration Act of 1966.

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

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

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

Rehabilitation Act (1973): Requires that programmatic and physical accessibility be made available in any facility funded by the federal government, ensuring that anyone can participate in any program.

Clean Water Act (1977): Requires consultation with the U.S. Army Corps of Engineers for major wetland modifications.

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

Emergency Wetlands Resources Act (1986): Promotes the conservation of migratory waterfowl and offset or prevent the serious loss of wetlands by the acquisition of wetlands and other essential habitat, and for other purposes.

Federal Noxious Weed Act (1990): Requires the use of integrated management systems to control or contain undesirable plant species, and an interdisciplinary approach with the cooperation of other federal and state agencies.

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

Executive Order 12996 Management and General Public Use of the National Wildlife Refuge System (1996): Defines the mission, purpose, and priority public uses of the national wildlife refuge system. It also presents four principles to guide management of the system.

Executive Order 13007 Indian Sacred Sites (1996): Directs federal land management agencies to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, avoid adversely affecting the physical integrity of such sacred sites, and where appropriate, maintain the confidentiality of sacred sites.

Emergency Wetland Resources Act of 1986: This Act authorized the purchase of wetlands from Land and Water Conservation Fund moneys, removing a prior prohibition on such acquisitions. The Act also requires the Secretary of the Interior to establish a National Wetlands Priority Conservation Plan, requires the states to include wetlands in their Comprehensive Outdoor Recreation Plans, and transfers to the Migratory Bird Conservation Fund an amount equal to import duties on arms and ammunition.

Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884), as amended: Public Law 93-205, approved December 28, 1973, repealed the Endangered Species Conservation Act of December 5, 1969 (P.L. 91-135, 83 Stat. 275). The 1969 act amended the Endangered Species Preservation Act of October 15, 1966 (P.L. 89-669, 80 Stat. 926). The 1973 Endangered Species Act provided for the conservation of ecosystems upon which threatened and endangered species of fish, wildlife, and plants depend, both through federal action and by encouraging the establishment of state programs. The Act authorizes the determination and listing of species as threatened and endangered; prohibits unauthorized taking, possession, sale, and transport of endangered species; provides authority to acquire land for the conservation of listed species, using land and water conservation funds; authorizes establishment of cooperative agreements and grants-in-aid to states that establish and maintain active and adequate programs for threatened and endangered wildlife and plants; authorizes the assessment of civil and criminal penalties for violating the Act or regulations; and authorizes the payment of rewards to anyone furnishing information leading to arrest and conviction of anyone violating the Act and any regulation issued there under.

Environmental Education Act of 1990 (20 USC 5501-5510; 104 Stat. 3325): Public Law 101-619, signed November 16, 1990, established the Office of Environmental Education within the Environmental Protection Agency to develop and administer a federal environmental education program. Responsibilities of the Office include developing and supporting programs to improve understanding of the natural and developed environment, and the relationships between humans and their environment; supporting the dissemination of educational materials; developing and supporting training programs and environmental education seminars; managing a federal grant program; and administering an environmental internship and fellowship program. The Office is required to develop and support environmental programs in consultation with other federal natural resource management agencies, including the Fish and Wildlife Service.

Executive Order 11988, Floodplain Management: The purpose of this executive order, signed on May 24, 1977, is to prevent federal agencies from contributing to the adverse impacts associated with occupancy and modification of floodplains and the direct or indirect support of floodplain development. In the course of fulfilling their respective authorities, federal agencies shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains.

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

Antiquities Act (16 USC 431 - 433)--The Act of June 8, 1906, (34 Stat. 225): This act authorizes the President of the United States to designate as National Monuments objects or areas of historic or scientific interests on lands owned or controlled by the United States. The Act required that a permit be obtained for examination of ruins, excavation of archaeological sites and the gathering of objects of antiquity on lands under the jurisdiction of the Secretaries of Interior, Agriculture, and Army, and provided penalties for violations.

Archaeological Resources Protection Act (16 U.S.C. 470aa - 47011)-- Public Law 96-95, approved October 31, 1979, (93 Stat. 721): This act largely supplanted the resource protection provisions of the Antiquities Act for archaeological items. It established detailed requirements for issuance of permits for any excavation for or removal of archaeological resources from Federal and Indian lands. It also established civil and criminal penalties for the unauthorized excavation, removal, or damage of any such resources; for any trafficking in such resources removed from Federal and Indian lands in violation of any provision of federal law; and for interstate and foreign commerce in such resources acquired, transported or received in violation of any state or local law.

Public Law 100-588, approved November 3, 1988, (102 Stat. 2983) lowered the threshold value of artifacts triggering the felony provisions of the Act from \$5,000 to \$500, made attempting to commit an action prohibited by the Act a violation, and required the land managing agencies to establish public awareness programs regarding the value of archaeological resources to the nation.

Archaeological and Historic Preservation Act (16 U.S.C. 469-469c)--Public Law 86-523, approved June 27, 1960, (74 Stat. 220), and amended by Public Law 93-291, approved May 24, 1974, (88 Stat. 174): This act directed federal agencies to notify the Secretary of the Interior whenever a federal, federally assisted, or licensed or permitted project may cause loss or destruction of significant scientific, prehistoric or archeological data. The Act authorized use of appropriated, donated, and/or transferred funds for the recovery, protection and preservation of such data.

Historic Sites, Buildings and Antiquities Act (16 U.S.C. 461-462, 464-467)--The Act of August 21, 1935, (49 Stat. 666) popularly known as the Historic Sites Act, as amended by Public Law 89-249, approved October 9, 1965, (79 Stat. 971): This act declared it a national policy to preserve historic sites and objects of national significance, including those located on refuges. It provided procedures for designation, acquisition, administration and protection of such sites. Among other things, National Historic and Natural Landmarks are designated under authority of this Act. As of January 1989, thirty-one national wildlife refuges contained such sites.

National Historic Preservation Act of 1966 (16 U.S.C. 470-470b, 470c-470n)--Public Law 89-665, approved October 15,1966, (80 Stat. 915) and repeatedly amended: This act provided for preservation of significant historical features (buildings, objects and sites) through a grant-in-aid program to the states. It established a National Register of Historic Places and a program of matching grants under the existing National Trust for Historic Preservation (16 U.S.C. 468-468d).

The Act established an Advisory Council on Historic Preservation, which Congress made a permanent independent agency in Public Law 94-422, approved September 28,1976 (90 Stat. 1319). That Act also created the Historic Preservation Fund. The Act directs Federal agencies to take into account the effects of their actions on items or sites listed in, or eligible for listing in, the National Register of Historic Places. As of January 1989, ninety-one such sites on national wildlife refuges are listed in this Register.

Land and Water Conservation Fund Act of 1948: This act provides funding through receipts from the sale of surplus federal land, appropriations from oil and gas receipts from the outer continental shelf, and other sources of land acquisition under several authorities. Appropriations from the fund may be used for matching grants to states for outdoor recreation projects and for land acquisition by various federal agencies, including the Fish and Wildlife Service.

Migratory Bird Hunting and Conservation Stamp Act (16 U.S.C. 718-718j, 48 Stat. 452), as amended: The Duck Stamp Act, of March 16,1934, requires each waterfowl hunter, 16 years of age or older, to possess a valid federal hunting stamp. Receipts from the sale of the stamp are deposited in a special Treasury account known as the Migratory Bird Conservation Fund and are not subject to appropriations.

National and Community Service Act of 1960 (42 U.S.C. 12401:104 Stat. 3127), Public Law 101-610, signed November 16,1990: This act authorizes several programs to engage citizens of the United States in full- and/or part-time projects designed to combat illiteracy and poverty, provide job skills, enhance educational skills, and fulfill environmental needs. Several provisions are of particular interest to the Fish and Wildlife Service.

American Conservation and Youth Service Corps: A federal grant program established under Subtitle C of the law, the Corps offers an opportunity for young adults between the ages of 16-25, or in the case of summer programs, 15-21, to engage in approved human and natural resources projects which benefit the public or are carried out on Federal or Indian lands. To be eligible for assistance, natural resource programs must focus on improvement of wildlife habitat and recreational areas, fish culture, fishery assistance, erosion, wetlands protection, pollution control and similar projects. A stipend of not more than 100 percent of the poverty level will be paid to participants. A Commission established to administer the Youth Service Corps makes grants to States, the Secretaries of Agriculture and Interior and the Director of ACTION to carry out these responsibilities.

National Environmental Policy Act of 1959 (P.L. 91-190, 42 U.S.C. 4321-4347, January 1, 1970, 83 Stat. 852) as amended by Public Law 94-52, July 3, 1975, 89 Stat. 258, and Public Law 94-83, August 9, 1975, 89 Stat. 424): Title I of the 1969 National Environmental Policy Act requires that all federal agencies prepare detailed environmental impact statements for every recommendation or report on proposals for legislation and other major federal actions significantly affecting the quality of the human environment. The 1969 statute stipulated the factors to be considered in environmental impact statements, and required that federal agencies employ an interdisciplinary approach in related decision-making and develop means to ensure that unquantified environmental values are given appropriate consideration, along with economic and technical considerations. Title II of this statute requires annual reports on environmental quality from the President to the Congress, and established a Council on Environmental Quality in the Executive Office of the President with specific duties and functions.

National Wildlife Refuge System Improvement Act of 1997: Public Law 105-57, amended the National Wildlife Refuge System Act of 1966 (16 U.S.C. 668dd-ee), and provided guidance for management and public use of the refuge system. The Act mandates that the refuge system be consistently directed and managed as a national system of lands and waters devoted to wildlife conservation and management. The Act establishes priorities for recreational uses of the refuge system. Six wildlife-dependent uses are specifically named in the Act: hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation. These activities are to be promoted on the refuge system, while all nonwildlife-dependent uses are subject to compatibility determinations. A compatible use is one that, in the sound professional judgment of the refuge manager, will not materially interfere with, or detract from, fulfillment of the national wildlife refuge system mission or refuge purpose(s). As stated in the Act, The mission of the system is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans. The Act also requires development of a comprehensive conservation plan for each refuge and that management is consistent with the plan. When writing a plan for expanded or new refuges, and when making management decisions, the Act requires effective coordination with other federal agencies, state fish and wildlife or conservation agencies, and refuge neighbors. A refuge must also provide opportunities for public involvement when making a compatibility determination.

North American Wetlands Conservation Act (103 Stat. 1968; 16 U.S.C. 4401~4412) Public Law 101-233, enacted December 13, 1989: This act provides funding and administrative direction for implementation of the North American Waterfowl Management Plan and the Tripartite Agreement on Wetlands between Canada, the United States and Mexico. The Act converts the Pittman-Robertson account into a trust fund, with the interest available without appropriation through the year 2006, to carry out the programs authorized by the Act, along with an authorization for annual appropriation of \$15 million plus an amount equal to the fines and forfeitures collected under the Migratory Bird Treaty Act. Available funds may be expended, upon approval of the Migratory Bird Conservation Commission, for payment of not to exceed 50 percent of the United States' share of the cost of wetlands conservation projects in Canada, Mexico, or the United States (or 100 percent of the cost of projects on federal lands). At least 50 percent and no more than 70 percent of the funds received are to go to Canada and Mexico each year.

Refuge Recreation Act of 1952: This Act authorizes the Secretary of the Interior to administer refuges, hatcheries, and other conservation areas for recreational use, when such uses do not interfere with the area's primary purposes. It authorizes construction and maintenance of recreational facilities and the acquisition of land for incidental fish and wildlife oriented recreational development or protection of natural resources. It also authorizes the charging of fees for public uses.

Refuge Revenue Sharing Act (16 U.S.C. 715s): Section 401 of the Act of June 15, 1935, (49 Stat. 383) provided for payments to counties in lieu of taxes, using revenues derived from the sale of products from refuges. Public Law 88-523, approved August 30, 1964, (78 Stat. 701) made major revisions by requiring that all revenues received from refuge products, such as animals, timber and minerals, or from leases or other privileges, be deposited in a special Treasury account and net receipts distributed to counties for public schools and roads. Public Law 93-509, approved December 3, 1974, (88 Stat. 1603) required that moneys remaining in the fund after payments be transferred to the Migratory Bird Conservation Fund for land acquisition under provisions of the Migratory Bird Conservation Act. Public Law 95-469, approved October 17, 1978, (92 Stat. 1319) expanded the revenue sharing system to include National Fish Hatcheries and Service research stations. It also included in the Refuge Revenue Sharing Fund receipts from the sale of salmonid carcasses. Payments to counties were established as follows: on acquired land, the greatest amount calculated on the basis of 75 cents per acre, three-fourths of one percent of the appraised value, or 25 percent of the net receipts produced from the land; and on land withdrawn from the public domain, 25 percent of net receipts and basic payments under Public Law 94-565 (31 U.S.C. 1601-1607, 90 Stat. 2662). This amendment also authorized appropriations to make up any difference between the amount in the fund and the amount scheduled for payment in any year. Congress removed the stipulation that payments be used for schools and roads, but did require counties to pass payments along to other units of local government within the county that suffer losses in revenues due to the establishment of Service areas.

Wilderness Act of 1954: Public Law 88-577, approved September 3, 1964, directed the Secretary of the Interior, within 10 years, to review every roadless area of 5,000 or more acres and every roadless island (regardless of size) within National Wildlife Refuge and National Park Systems for inclusion in the National Wilderness Preservation System.

Appendix IV. Public Involvement

The Service invited agencies, organizations, businesses, and citizens to participate in four public scoping meetings on June 19, 21, 26, and 28, 2001, in Currituck, North Carolina; Corolla, North Carolina; Virginia Beach, Virginia; and Knotts Island, North Carolina, respectively. The Service introduced the audience of sixty-one citizens to the refuge and its planning process and asked them to identify their issues and concerns. The Service published announcements giving the locations, dates, and times for the public meetings in the *Federal Register* and legal notices in local newspapers. Press releases were also sent to local newspapers and public service announcements to television and radio stations. Service personnel placed fifty posters announcing the meetings in local post offices, local government buildings, and stores.

The planning team expanded the issues and concerns to include those generated by the agencies, organizations, businesses, and citizens from the local community. These issues and concerns formed the basis for the development and comparison of the objectives in the different alternatives described in the environmental assessment.

The objectives were subjects of discussion at a second round of public meetings held on November 18, 19, 20, and 21, 2002, in Corolla, Currituck, and Knotts Island, North Carolina and Virginia Beach, Virginia. The Service published announcements giving the locations, dates, and times for the public meetings as legal notices in local newspapers. The Service also sent press releases to local newspapers and public service announcements to television and radio stations. Service personnel placed seventy-five posters announcing the meeting in local post offices, local government buildings, and stores. Thirty citizens attended these four meetings.

The issues raised at the public meetings are recorded on the following pages. Worksheets completed by the workshop participants are also provided.

**Mackay and Currituck National Wildlife Refuges
Comprehensive Conservation Plan Scoping Meetings
June 19, 21, 26, 28, 2001**

Currituck National Wildlife Refuge Issues

Area of Concern	Issue	Disposition
Wildlife-General	Continue surveys.	In plan.
	Secure funding.	In plan.
	Continue to make survey data public.	In plan.
	Maintain water quality.	In plan.
	Hire a biologist.	In plan.
	Coordinate wildlife surveys with other agencies.	In plan.
Wildlife-Feral Hogs	Establish population of feral hogs.	Against Service policy (exotic animals).
Wildlife-Feral Horses	Include feral horses in plan.	In plan.
	Include Wild Horse Fund in management of feral horses.	In plan.
Wildlife-Fish	Investigate the impact of salinity from the Lynnhaven River Canal #2 connection to Currituck Sound on bass..	In plan.
Wildlife-Waterfowl	Establish waterfowl rest areas.	Plan to pursue agreement.
Habitat-General	Maintain flexibility in management.	In plan.
	Maintain prescribed burning program.	In plan.
	Expand NCWRC joint venture activity.	In plan.
	Hire a biologist.	In plan.
Habitat-Aquatic Habitat	Consider SAV restoration in cooperation with other agencies.	Beyond refuge jurisdiction.
Habitat-Moist Soil Units	Maintain management.	In plan.

Area of Concern	Issue	Disposition
Public Use-General	Hire staff to execute programs.	In plan.
	Limit use to prevent habitat damage.	In plan.
	Consider boat tours.	Tours in plan, mode of transportation will be discussed in Visitor Services step-down plan.
	Do not build a road through the refuge.	No vehicle access proposed.
	Do not build a bridge on the refuge.	No vehicle access proposed.
	Consider the effects of the refuge on False Cape State Park.	Considered in planning.
	Consider the effects of restrooms on the use of the refuge and parking lots.	Considered in planning.
Public Use-Hunting	Establish deer hunt.	Hunting step-down plan.
	Hunt feral hogs.	Hunting step-down plan.
	Maintain waterfowl hunting program and expand as much as possible.	In plan.
	Continue cooperation with NCWRC.	In plan.
Public Use-Wildlife Observation	Increase opportunities.	In plan.
	Provide walking tours.	In plan.
	Establish Kuralt Trail kiosk.	In plan.
	Organize tours by refuge staff.	In plan.
Public Use-Environmental Education	Increase environmental education.	In plan.
	Use refuge for education programs for children in cooperation with other agencies.	In plan.
	Use Monkey Island as an environmental education facility.	Will be interpreted off the refuge, island eroding.
	Cooperate with NCWRC in the education center.	In plan.
Public Use-Volunteers	Establish Friends group for Currituck Refuge	In plan.
	Utilize groups such as N.E.S.T. to monitor sea turtles.	In plan.
Public Use-Outreach	Advertise refuge programs more.	In plan.
	Publish refuge newsletter.	In plan.

Area of Concern	Issue	Disposition
Resource Protection-Cultural Resources	Cooperate with other agencies in cultural resource protection.	In plan.
Resource Protection-Land Acquisition	Hire staff for land acquisition.	In plan.
	Buy more land.	Acquisition boundary established, land approved for purchase from willing sellers.
	Do not buy more land.	Acquisition boundary established, land approved for purchase from willing sellers.
Resource Protection-Land Acquisition	Use cooperative management agreements to manage land without buying it.	Acquisition boundary established, land approved for purchase from willing sellers.
	Expand NCWRC joint venture activity.	In plan.
Resource Protection-Law Enforcement	Hire separate law enforcement staff for Currituck.	In plan.
Resource Management-Pest Plants	Use herbicides as necessary, especially on phragmites.	In plan.
	Track the invasion of pest plants and develop a pest plant management plan	In plan.
Resource Management-Water Quality	Increase water quality monitoring in the ocean and sound.	Monitoring in Sound in plan.
	Monitor to investigate the impact of Lynnhaven River Canal #2 connection to Currituck Sound.	In plan.
Resource Management-Wilderness	Incorporate wilderness into plan.	Do not have 5,000 contiguous acres.
	Allow staff to decide.	Do not have 5,000 contiguous acres.

**CURRITUCK NATIONAL WILDLIFE REFUGE
PLANNING ISSUES WORKSHEET (4 respondents)**

ACTIVITY	WHAT WOULD YOU LIKE US TO DO?	
	Keep the Same	Increase
WILDLIFE SURVEYS AND MANAGEMENT		
Waterfowl Survey and Management	75%	25%
Shorebird Survey and Management	50%	50%
Land Bird Survey and Management	75%	25%
Reptile/Amphibian Survey and Management	50%	50%
Fish Survey and Management	50%	50%
Endangered Species Survey and Management	50%	50%
White-tailed Deer Management	50%	50%
HABITAT MANAGEMENT ACTIVITIES		
Vegetation Survey	50%	50%
Water Quality Monitoring	50%	50%
Water Management (Farming, Moist Soil)	100%	0%
Prescribed Burning	100%	0%
Mechanical Vegetation Management	100%	0%
Chemical Vegetation Management	50%	50%
Shoreline Maintenance	100%	0%
Planting, Seeding, Clearing for Habitat Improvement	100%	0%
Habitat Restoration (Hydrology, Reforestation)	50%	50%
Wildlife Management	50%	50%
Plant Pest Insect and Disease Management	100%	0%
Exotic and Invasive Species Eradication	25%	75%
Special Protection Status (National Wilderness)	50%	50%
PUBLIC USE ACTIVITIES AND FACILITIES		
Hunting	50%	50%
Environmental Education (School Students)	0%	100%
Environmental Education (School Teachers)	0%	100%
Wildlife Interpretation (Formal Programs)	0%	100%
Wildlife Interpretation (Printed Material)	0%	100%
Wildlife Interpretation (Walking Trails)	0%	100%
Wildlife Interpretation (Buildings, Kiosks)	0%	100%
Wildlife Interpretation (Interpretative Signs)	0%	100%
Wildlife Photography Opportunities	50%	50%
Wildlife Observation Opportunities	50%	50%
Vehicle Parking Lots	100%	0%
Access for Fishing, Boating, Canoeing	50%	50%

ACTIVITY	WHAT WOULD YOU LIKE US TO DO?	
	Keep the Same	Increase
RESOURCE PROTECTION ACTIVITIES		
Visitor Protection	50%	50%
Wildlife Protection	0%	100%
Trespass Violations	0%	100%
Littering/Dumping Violations	0%	100%
Hunting and Fishing Compliance Checks	0%	100%
Other Regulations	50%	50%
Special Protection Status (National Wilderness)	50%	50%
Land Acquisition	50%	50%
OPERATION AND MAINTENANCE ACTIVITIES		
Canal Maintenance	100%	0%
Road and Firebreak Maintenance	100%	0%
Facilities Maintenance (Signs, Buildings)	50%	50%
Dike and Trail Maintenance	50%	50%
Water Control Structures, Pump Stations	50%	50%
Boundary Posting	100%	0%
Dump Cleanup	50%	50%

**CURRITUCK NATIONAL WILDLIFE REFUGE
PLANNING ALTERNATIVES WORKSHEET (9 respondents)**

ACTIVITY	WHICH ALTERNATIVE WOULD YOU LIKE US TO DO? (CAN MIX AND MATCH DIFFERENT ALTERNATIVES FOR DIFFERENT ACTIVITIES)		
	Alternative 1	Alternative 2	Alternative 3
Wildlife Management			
Feral Horses	11%	78%	11%
Feral Hogs	22%	33%	45%
Fish	33%	56%	11%
Invertebrates	0%	67%	33%
Mammals	0%	67%	33%
Land Birds	12%	44%	44%
Reptiles and Amphibians	11%	22%	67%
Shorebirds	11%	11%	78%
Wading Birds	11%	22%	67%
Waterfowl	22%	33%	45%
Habitat Management			
All Habitats	22	45	33
Maritime Forest	33	11	56
Maritime Shrub	22	22	56
Brackish Marsh	11	22	67
Dune and Beach	11	33	56
Roads	56	22	22
Firebreaks	45	22	33
Utility Rights of Way	67	11	22
Wood Duck Boxes	33	22	45
Moist Soil Units	11	33	56
Public Use			
Hunting	22	56	22
Environmental Education	11	78	11
Interpretation	11	56	33
Wildlife Observation	11	33	56
Wildlife Photography	0	44	56
Access	67	11	22
Outreach	33	33	33
Refuge Support	22	45	33
Special Events	11	78	11

ACTIVITY	WHICH ALTERNATIVE WOULD YOU LIKE US TO DO? (CAN MIX AND MATCH DIFFERENT ALTERNATIVES FOR DIFFERENT ACTIVITIES)		
	Alternative 1	Alternative 2	Alternative 3
Resource Protection			
Land Protection	11%	22%	67%
Cultural Resources	22%	22%	56%
Interagency Coordination	0%	67%	33%
Law Enforcement	11%	56%	33%
Permits	11%	78%	11%
Pest Animals	11%	67%	22%
Pest Plants	11%	67%	22%
Significant Natural Heritage Areas	22%	67%	11%
Water Quality	0%	44%	56%
Wilderness Areas	33%	22%	45%
Wildlife Disease	33%	33%	33%

Appendix V. Decisions and Approvals

INTRA-SERVICE SECTION 7 BIOLOGICAL EVALUATION

Originating Person: Tim Cooper
Telephone Number: 252-429-3100
E-Mail: tim_cooper@fws.gov
Date: August 1, 2005

Project Name: Currituck National Wildlife Refuge Comprehensive Conservation Plan

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: North Carolina/ U.S. Fish and Wildlife Service

III. Station Name: Currituck National Wildlife Refuge

IV. Description of Proposed Action (attach additional pages as needed): Implementation of the Comprehensive Conservation Plan for Currituck National Wildlife Refuge by adopting the preferred alternative that will provide guidance, management direction and operation plans for the next 15 years.

V. Pertinent Species and Habitat:

A. Include species/habitat occurrence map:

Bald eagles are occasionally seen during winter months on the Refuge. There is an active nest on the Mackay Island National Wildlife Refuge across the Currituck Sound, but there are no nests on the Currituck National Wildlife Refuge.

2. Complete the following table.

SPECIES/CRITICAL HABITAT	STATUS ¹
Bald Eagle	Threatened
Loggerhead Sea Turtle	Threatened
Leatherback Sea Turtle	Endangered
Piping Plover	Endangered
Red-cockaded Woodpecker	Endangered
West Indian Manatee	Endangered
Seabeach Amaranth	Threatened

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. Ecosystem Number and Name:** Roanoke - Tar - Neuse - Cape Fear No. 34
- B. County and State:** Currituck, North Carolina
- C. Section, township, and range (or latitude and longitude):**
- D. Distance (miles) and direction to nearest town:** Adjacent to and immediately south of Virginia Beach, Virginia
- E. Species/habitat occurrence:**

Bald Eagle - occasionally observed during winter. No active nests.

Loggerhead Sea Turtle – Record of occurrence within 20 years.

Leatherback Sea Turtle – Record of occurrence within 20 years.

Piping Plover – Record of occurrence within 20 years.

Red-cockaded Woodpecker - Record of occurrence more than 20 years old.

West Indian Manatee - Incidental record of occurrence outside of its normal range.

Seabeach Amaranth – Record of occurrence within 20 years.

VII. Determination of Effects:

A. Explanation of effects of the action on species and critical habitats in item V. B (attach additional pages as needed).

SPECIES/ CRITICAL HABITAT	IMPACTS TO SPECIES/CRITICAL HABITAT
Bald Eagle	Disturbance by staff and visitors during nesting season.
Loggerhead Sea turtle	Disturbance by staff and visitors during nesting season.
Leatherback Sea Turtle	Disturbance by staff and visitors during nesting season.
Piping Plover	Disturbance by staff and visitors during nesting season.
Red-cockaded Woodpecker	Disturbance by staff and visitors during nesting season. Lack of understory management.
West Indian Manatee	Disturbance by boaters and anglers. Water quality degradation and lack of submerged aquatic vegetation.
Seabeach Amaranth	Trampling of plants by staff and visitors before seed maturation.

B. Explanation of actions to be implemented to reduce adverse effects.

SPECIES/ CRITICAL HABITAT	ACTIONS TO MITIGATE/MINIMIZE IMPACTS
Bald Eagle	Restrict access to nesting area.
Loggerhead Sea Turtle	Restrict access to nesting area.
Leatherback Sea Turtle	Restrict access to nesting area.
Piping Plover	Restrict access to nesting area.
Red-cockaded Woodpecker	Restrict access to nesting area. Allow pines to grow old enough to develop cavities. Manage understory to maintain height below cavities.
West Indian Manatee	Restrict access when manatees are in the area. Cooperate with state agencies to monitor and improve water quality.
Seabeach Amaranth	Restrict access to areas with plants until after seed maturation.

VIII. Effect Determination and Response Requested:

SPECIES/ CRITICAL HABITAT	DETERMINATION ¹			RESPONSE ¹
	NE	NA	AA	
Bald Eagle		X		
Loggerhead Sea Turtle		X		
Leatherback Sea Turtle		X		
Piping Plover		X		
Red-cockaded Woodpecker		X		
West Indian Manatee		X		
Seabeach Amaranth		X		

¹DETERMINATION/RESPONSE REQUESTED:

NE = no effect. This determination is appropriate when the proposed action will not impact directly, indirectly, or cumulatively, 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

CURRITUCK NATIONAL WILDLIFE REFUGE COMPATIBILITY DETERMINATIONS

Uses: The following uses were considered for compatibility determination reviews: hunting, fishing, wildlife observation, photography, environmental education, interpretation, and trapping of selected furbearers for nuisance animal management. A description and anticipated biological impacts for each use are addressed separately in this Compatibility Determination.

Refuge Name: Currituck National Wildlife Refuge.

Date Established: August 2, 1983.

Establishing and Acquisition Authority(ies): 16 U.S.C. Sec. 664 (Migratory Bird Conservation Act of 1929).

Refuge Purpose: The purpose of Currituck National Wildlife Refuge, as reflected in the refuge's authorizing legislation, is to protect and conserve migratory birds, and other wildlife resources through the protection of wetlands, in accordance with the following laws:

...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds... 16 U.S.C. Sec. 664 (Migratory Bird Conservation Act of 1929);

...for (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species and threatened species... 16 U.S.C. Sec 460k-1 (Refuge Recreation Act of 1962)

The refuge's purpose and importance to migratory birds, particularly waterfowl, is: *To preserve wintering habitat for waterfowl and wintering and production habitat for wood ducks to meet the habitat goals presented in the Ten-Year Waterfowl Habitat Acquisition Plan and the North American Waterfowl Management Plan.*

National Wildlife Refuge System Mission:

The mission of the System, as defined by the National Wildlife Refuge System Improvement Act of 1997, is:

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

Other Applicable Laws, Regulations, and Policies:

Antiquities Act of 1906 (34 Stat. 225)
Migratory Bird Treaty Act of 1918 (15 U.S.C. 703-711; 40 Stat. 755)
Migratory Bird Conservation Act of 1929 (16 U.S.C. 715r; 45 Stat. 1222)
Migratory Bird Hunting Stamp Act of 1934 (16 U.S.C. 718-178h; 48 Stat. 451)
Criminal Code Provisions of 1940 (18 U.S.C. 41)
Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d; 54 Stat. 250)
Refuge Trespass Act of June 25, 1948 (18 U.S.C. 41; 62 Stat. 686)
Fish and Wildlife Act of 1956 (16 U.S.C. 742a-742j; 70 Stat. 1119)
Refuge Recreation Act of 1962 (16 U.S.C. 460k-460k-4; 76 Stat. 653)

Wilderness Act (16 U.S.C. 1131; 78 Stat. 890)
Land and Water Conservation Fund Act of 1965
National Historic Preservation Act of 1966, as amended (16 U.S.C. 470, et seq.; 80 Stat. 915)
National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd, 668ee; 80 Stat. 927)
National Environmental Policy Act of 1969, NEPA (42 U.S.C. 4321, et seq. 83 Stat. 852)
Use of Off-Road Vehicles on Public Lands (Executive Order 11644, as amended by Executive Order 10989)
Endangered Species Act of 1973 (16 U.S.C. 1531 et seq. 87 Stat. 884)
Refuge Revenue Sharing Act of 1935, as amended in 1978 (16 U.S.C. 715s; 92 Stat. 1319)
National Wildlife Refuge Regulations for the Most Recent Fiscal Year (50 CFR Subchapter C; 43 CFR 3101.3-3)
Emergency Wetlands Resources Act of 1986 (S.B. 740)
North American Wetlands Conservation Act of 1990
Food Security Act (Farm Bill) of 1990 as amended (HR 2100)
The Property Clause of The U.S. Constitution Article IV 3, Clause 2
The Commerce Clause of The U.S. Constitution Article 1, Section 8
The National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57, USC668dd)
Executive Order 12996, Management and General public Use of the National Wildlife Refuge System. March 25, 1996
Title 50, Code of Federal Regulations, Parts 25-33
Archaeological Resources Protection Act of 1979
Native American Graves Protection and Repatriation Act of 1990

Compatibility determinations for each description listed were considered separately. Although for brevity, the preceding sections from uses through other applicable laws, regulations and policies are only written once within the plan, they are part of each descriptive use and become part of that compatibility determination if considered outside of the comprehensive conservation plan.

Description of Use: *Hunting*

The refuge is a mixture of marshes, managed wetlands (moist soil areas), and maritime forests and scrub, dunes, and interconnected streams, ditches, and backswamps. The forests have a great variety of species that includes live oak, loblolly pine, eastern red cedar, flowering dogwood, American holly, yaupon holly, waxmyrtle, beautyberry, greenbrier, muscadine grape, and Virginia creeper. This forest provides good habitat for a number of game species including white-tailed deer, squirrel, and raccoon.

Many of the local residents enjoy an informal, rural lifestyle that includes frequent recreational use of the area's natural resources. Hunting and fishing have been, and continue to be, popular uses of refuge lands. Waterfowl hunting has been permitted since November 1999, when the Service first approved waterfowl hunting on the refuge. The administration of, as well as special regulations for hunting, has changed over time but the majority of the program has remained unchanged.

The comprehensive conservation plan calls for the continued hunting of waterfowl, and new hunting of deer and hogs. All hunts fall within the framework of the State's open seasons and follow state regulations. Fruitville Township, in which the Currituck Marsh, Station Landing marsh, and South Marsh are located, is closed to deer hunting. Poplar Branch Township is open to hunting with shotgun only; regulations prohibit the use of bows, pistols, and rifles. The Poplar Branch Township line runs through the Monkey Island Unit. Current state law opens only the Monkey Island and Swan Island Units to hunting. The refuge cannot open these units to deer hunting unless the township

changes its regulation. There are additional refuge specific regulations to supplement State regulations. The Service reviews these refuge-specific regulations annually and incorporated into the refuge hunting brochure. The draft comprehensive conservation plan would increase law enforcement presence during hunting seasons; would evaluate the hunt program annually; and modify seasons, hunt areas or regulations if necessary. The refuge could add hunting areas could be added as the refuge expands through an active land acquisition program. Implementation of the proposed alternative, as described in the comprehensive conservation plan, would ensure that opportunities for various types of wildlife-dependent recreation would continue for future generations.

Availability of Resources: Based on a review of the refuge's budget allocated for this activity, there is not adequate funding to ensure compatibility and to administer this use at its current level. Additional fiscal resources are needed to conduct this use as proposed. A permanent, full time law enforcement officer and public use specialist are needed to assist with hunting program administration and visitor service.

Anticipated Impacts of the Use: The deer herd has expanded and increased substantially since the Service established the refuge. Prior to refuge establishment this portion of Currituck County was subject to excessive deer poaching that maintained the deer herd at low levels. Following refuge establishment and initiation of effective wildlife law enforcement program the deer herd has increased in and around the refuge. The refuge's marsh and forest habitat provides ideal habitat conditions for whitetail deer.

Harvest management of big game (white-tailed deer) is the art of combining wildlife science and landowner objectives for the attainment of a specific management goal. Refuge hunt plan objectives should determine harvest management strategies. A complete analysis of biological data should determine the objectives. Specific harvest objectives allow the setting of hunting regulations. The refuge staff will thoroughly evaluate the results of each hunting season to ensure that the harvest management program meets refuge objectives and provides a quality hunting experience for the public.

Current literature suggests that user take (<50% of total mortality) of most upland game is compensatory; that factors such as immigration from adjacent areas and density-dependent production operate in most upland game populations; and that hunting does not substantially impact populations. Hunting is substituted for natural mortality. Production of large, annual surpluses of young allows for lengthy seasons and generous bag limits with little concern for over-harvest and minimal chance of population impacts in most areas (Bookhout 1994).

The refuge's great variety and abundance of high quality wetland areas provide outstanding habitat for a variety of waterfowl and wading birds. Primary species include American black duck, gadwall, mallard, green-wing teal, snowy egret, and great egret. The area's habitat for neotropical migratory birds is also outstanding. Neotropical migrants use the marsh and forested areas and edges. Disturbance to all migratory birds would be minimal and temporary, as the staff would alter habitat slightly for the betterment of these species.

Threatened and endangered loggerhead sea turtles, piping plovers, and seabeach amaranth have all been found on the Currituck National Wildlife Refuge in the past twenty years. None have been found on the refuge in the last ten years as use of the beach has increased dramatically. It is anticipated that the current levels and expected future levels of hunting or other wildlife-dependent recreation activities would not directly, indirectly, or cumulatively impact any listed, proposed, or candidate species or designated/proposed critical habitat. Data gathered from future biological surveys regarding the importance or potential importance of the refuge to threatened or endangered species or critical habitat (or proposed threatened, endangered, or critical habitat), could result in changes to public use activities across time; however, these changes will have no effect on listed species.

Incidental take of other wildlife species, either illegally or unintentionally, may occur with any consumptive use program. At current and anticipated public use levels, incidental take will be very small and would not directly or cumulatively impact current or future populations of wildlife either on this refuge or in the surrounding areas. Implementation of an effective law enforcement program and development of site-specific refuge regulations and special conditions will eliminate most incidental take problems.

Determination (check one below):

Use is Not Compatible

Use is Compatible With Following Stipulations

Stipulations Necessary to Ensure Compatibility: The refuge permits hunting in accordance with State of North Carolina's regulations and licensing requirements. An Environmental Assessment is on file at the refuge headquarters as part of the Hunting Plan. Following completion of the comprehensive conservation plan, the staff will revise the Hunting Plan.

The following stipulations will help ensure the refuge hunting program is compatible with refuge purposes.

Access is only by vehicles parked on the beach or boat only. Travel on the refuge is limited to foot travel only.

Firearms, bows, and other weapons are prohibited except during designated hunting seasons.

Hunting deer with dogs is not allowed on the refuge.

All hunts are designed to provide quality user opportunities based upon sustainable wildlife population levels and biological parameters. Hunt season dates and bag limits will be adjusted as needed to achieve balanced wildlife population levels within carrying capacities, regardless of impacts to user opportunities.

As additional data is collected and a long-range hunt plan developed, additional refuge-specific regulations could be implemented. These regulations could include, but may not be limited to, season dates that are more restrictive than those in surrounding state zones, refuge permit requirements, and closed areas. The objectives of the regulations may be to reduce disturbance to specific wildlife species or habitats, such as bird rookeries, wintering waterfowl or threatened and endangered species, to allow hunting when staff is available to administer it, or to provide for public safety).

Justification: Hunting is compatible with the purposes for which the Service established the refuge and the mission of the national wildlife refuge system. It is one of the public use recreational activities that are specifically identified in the 1997 National Wildlife Refuge System Improvement Act to be allowed where possible on refuges. The refuge uses deer hunts as management tools to protect the diverse ecosystem.

Mandatory 10- or 15-year Re-evaluation Date: _____

Description of Use: *Wildlife Observation and Photography*

Nonconsumptive wildlife observation uses such as birdwatching, hiking, and nature photography are popular due to the area's proximity to Virginia Beach and vacation destinations on the Outer Banks. It is estimated that 25,000 visitors per year for wildlife observation and related activities.

The refuge staff anticipates that an increase in nonconsumptive wildlife-dependent uses will occur over the next few years as the refuge improves facilities and especially as the public and conservation groups become more aware of the excellent birding and wildlife viewing opportunities on the refuge.

Availability of Resources: Based on a review of the refuge's budget allocated for this activity, there is not adequate funding to ensure compatibility and to administer the use at its current level. The refuge needs additional fiscal resources to provide this use as proposed. To provide safe, high quality wildlife observation and photography opportunities, the Service will develop wildlife observation points and provide directional and interpretive signage.

Anticipated Impacts of the Use: Wildlife observation and photography activities might result in some disturbance to wildlife, especially if visitors venture too close to bald eagle nests, colonial nesting bird rookeries, or resting waterfowl in migration. The refuge will prohibit visitors from traveling in areas around nest, rookeries, and managed wetlands. The staff will locate foot trails, boardwalks and wildlife observation platforms opened to pedestrian use by the public to minimize disturbance that could occur in these sensitive areas. If the staff identifies unacceptable levels of disturbance at any time, they will close sensitive sites to public entry. Some minimal trampling of vegetation also may occur.

Construction of foot trails, boardwalks, observation platforms, and upgrading refuge roads will alter small portions of the natural environment. Proper planning prior to construction, sediment retention and grade stabilization features will reduce negative impacts to wetlands, threatened and endangered species and species of special concern. Impacts such as trampling vegetation and wildlife disturbance by refuge visitors do occur, but is presently not significant. Visitors cause other potential negative impacts violating refuge regulations such as littering or illegally taking plants or wildlife. Use of refuge roads by the public does incur added maintenance costs.

Determination (check one below):

Use is Not Compatible

Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility: Prior to construction, the refuge staff will obtain permits from local, state and federal regulatory agencies to reduce the possibility of negatively impacting wetlands, cultural resources or protected species. Law enforcement patrol of public use areas will continue to minimize violations of refuge regulations. The staff will monitor public use for wildlife observation and photography to document any negative impacts. If any negative impacts become noticeable, the Service will take corrective action to reduce or eliminate the effects on wildlife.

Justification: Wildlife observation and photography are an important and preferred public uses on Currituck National Wildlife Refuge and the national wildlife refuge system. The 1997 National Wildlife Refuge System Improvement Act identified wildlife observation as a priority public recreational use to be facilitated on refuges. It is through permitted, compatible public uses such as this, that the public becomes aware of and provides support for our national wildlife refuges.

Mandatory 10- or 15-year Re-evaluation Date: _____

Description of Use: *Environmental Education and Interpretation*

Environmental education and interpretation are those activities that seek to increase the public's knowledge and understanding of wildlife, national wildlife refuges, ecology and land management, as well as contribute to the conservation of natural resources. If the comprehensive conservation plan is enacted, the refuge will develop interpretation and environmental education programs.

Environmental education and interpretation activities have been largely nonexistent in prior years. The refuge staff plans to develop this program with structured activities conducted by refuge staff or trained volunteers. refuge staff will develop and provide curriculum and support materials to area teachers for use both on and off the refuge. Informational kiosks and interpretive panels will be developed at key refuge entrance points, and wildlife observation platforms constructed as part of the environmental education and interpretation program.

Availability of Resources: Based on a review of the refuge's budget allocated for these activities, funding is inadequate to ensure compatibility and to administer these uses at current levels. The refuge needs additional fiscal resources to conduct these uses at the proposed levels. Current staffing is extremely limited with no public use staff. The management of a volunteer program will be essential to successfully implement the education and visitor use program. The refuge staff will recruit and train volunteers to assist in developing and implementing environmental education and interpretive programs. The refuge needs a permanent public use specialist and additional facilities including access roads, boardwalks, signs, parking and trailhead development, kiosks, and environmental education materials to provide and conduct wildlife observation, wildlife photography, and environmental education and interpretation activities.

Anticipated Impacts of the Use: Construction of facilities such as boardwalks, kiosks and observation platforms will alter small portions of the natural environment on the refuge. Proper planning and placement of facilities will ensure that wetlands, threatened or endangered species, or species of special concern are not negatively impacted. The refuge staff will obtain proper permits through the county, state and federal regulatory agencies prior to construction to ensure resource protection. The use of on-site, hands-on, action-oriented activities to accomplish environmental education and interpretive tours may impose a low-level impact on the sites used for these activities. These low-level impacts may include trampling of vegetation and temporary disturbance to wildlife species in the immediate area. Educational activities held off-refuge would not create any biological impacts on the resource.

Determination (check one below):

Use is Not Compatible

Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility: Zoning of visitor activities by time and space, clustering public use facilities, proper monitoring, educating visitors, and enforcement will ensure compatibility with the purposes of the refuge and mission of the national wildlife refuge system. Through periodic evaluation of trails and visitor contact points, the visitor services program will assess resource impacts. If the refuge staff determines that human impacts are detrimental to important natural resources, the staff will take actions to reduce or eliminate those impacts. Major portions of the refuge will remain undeveloped, without public interpretive facilities.

Justification: The 1997 National Wildlife Refuge System Improvement Act identified interpretation and environmental education as activities that should be provided and expanded on refuges. Educating and informing the public through structured environmental education courses, interpretive materials, and guided tours about migratory birds, endangered species, wildlife management, and ecosystems will lead to improved support of the Service's mission to protect our natural resources.

Mandatory 10- or 15-year Re-evaluation Date: _____

Description of Use: *Trapping of Selected Furbearers for Management*

The staff may direct management through trapping raccoon and nutria. The species are at a sufficiently high level on the refuge to adversely affect ecosystem functions. Excessive numbers of raccoons can have negative effects on the reproduction of sea turtles, forest breeding birds, and wood ducks. Nutria are exotic animals that consume great quantities of marsh grass and burrow into dikes of managed wetlands (moist soil units). Protection and management of habitat and improvements in game and nongame populations are central components of the plan. To this end, trapping and/or hunting remain the only viable methods to reduce population levels of raccoon and nutria. The Service would issue Special Use Permits to administer a trapping program consistent with sound biology, refuge purposes, and conservation of ecosystem functions.

Availability of Resources: Additional resources are needed to conduct this use. The existing staff cannot administer permits and monitor this use as part of routine management duties.

Anticipated Impacts of the Use: Targeted removal of raccoon and nutria from portions of the refuge will reduce the negative impacts these species are having on ecosystem functions. Regulated trapping of raccoon populations will reduce the nest predation this species causes to sea turtles, neotropical birds, and wood ducks. Nutria management will protect marsh grass and dikes of managed wetlands (moist soil units). However, no trapping program, regardless of how well it is designed, can prevent the possible take of other species. The refuge staff will require trappers to report the incidental take of other species. There will be a negligible impact on other wildlife species in both the short and long term.

Determination (check one below):

Use is Not Compatible

Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility: As the refuge staff implements a trapping program on the refuge, it will monitor the program closely to assess the potential adverse effects on other wildlife as well as the benefits to game and nongame species and their habitats. The staff will modify the program as needed to maintain compatibility. Trappers will carry out all trapping activities under a refuge special use permit. The staff will limit trappers by number, area, and season in order to target problem areas and minimize any negative impacts. The staff will require each trapper to report the number and location of all traps and all wildlife taken. The implementation of a trapping program, under controlled conditions, provides an essential population control management tool and is compatible with the purposes of the refuge.

Justification: The purposes of Currituck National Wildlife Refuge emphasize conservation of wetlands and migratory birds. Trapping is a wildlife population management tool used to regulate the population of certain wildlife species when those species are disrupting ecosystem functions. There is documentation that raccoons cause negative impacts to forested wetlands and nesting birds. Nutria are exotic animals that cause negative impacts on marsh grass and the dikes of managed wetlands (moist soil units). When these negative impacts become significant on the refuge, wildlife managers need trapping as a management tool to control the level on damage. Certainly, the native and raccoons are important components of the ecosystem, but when their populations and negative impacts become significant, wildlife managers need a regulated trapping program to reduce their populations to acceptable levels.

Mandatory 10- or 15-year Re-evaluation Date: _____

Description of Use: *Jogging, Walking, and Hiking*

Continue to allow recreational jogging, walking, and hiking on the refuge.

Jogging for recreational purposes is allowed only on refuge roads and beaches. Walking and hiking can occur on roads, beaches, trails, and other refuge lands open to public use. Pets may also accompany users as they participate in this activity. All pets must be kept on a ten-foot or shorter leash and be under control of the owner at all times. This use is prohibited in all closed areas including an unexploded ordinance site.

This use primarily occurs on the beach due to limited parking areas, roads, and trails elsewhere on the refuge. The refuge boundary extends down to mean high tide on the Swan Island and Monkey Island Units. The other four units do not extend to the beach. Below the mean high tide line, the state of North Carolina regulates and allows this activity as well as parking and driving on the beach.

This use occurs most frequently during spring, summer, and fall. During the peak summer vacation period, an average of ten people per day participate in this activity. However, it is more prevalent on the state-owned beaches adjacent to refuge property.

Availability of Resources: One-quarter mile of roads and three miles of beach support this use. Annual maintenance is minimal. An Equipment Operator is able to fulfill any maintenance requirements. Other staff members provide law enforcement and administrative support. Current levels of funding and staff are adequate to support this use.

Anticipated Impacts of the Use: Short-term disturbance to wildlife may occur during these activities. Disturbance would occur primarily in those areas adjacent to the roads or the beach. Nesting shorebirds may be disturbed at times. Though some nesting occurs, primarily by least terns, no sizeable nesting colonies currently exist in these areas. No piping plover nests have been located here in the past ten years.

Participation in these activities will likely increase in the future as the beach communities adjacent to the refuge continue to be developed.

Public Review and Comment: Comments from the public were solicited by posting a notice in two local newspapers, at the refuge office, refuge kiosks, the Knotts Island Market, and the Knotts Island Post Office. The posting and comment period lasted for fourteen days (DATES).

Determination (check one below):

Use is Not Compatible

Use is Compatible With Following Stipulations

Stipulations Necessary to Ensure Compatibility:

1. These activities will only be allowed during daylight hours.
2. Pets must be kept on a ten-foot or shorter leash and be under control of the owner at all times.
3. These activities will be monitored and regulated if needed to prevent significant disturbances.

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

Categorical Exclusion without Environmental Action Statement

Categorical Exclusion and Environmental Action Statement

Environmental Assessment and Finding of No Significant Impact (1995)

Environmental Impact Statement and Record of Decision

Justification: Jogging, walking, and hiking have been determined to be compatible provided the above stipulations are adhered to. This use will not materially interfere with the refuge's purpose of providing a sanctuary for migratory birds. Participation in this use is minimal and should not cause any significant disturbances.

Mandatory 10- or 15-year Re-evaluation Date: _____

Description of Use: *Horseback Riding*

Allow horseback riding on the refuge.

This use would involve people traveling across refuge lands on horseback. It would occur in all refuge habitats but would be excluded in the Swan Island flats and the unexploded ordinance site. If allowed, this use is expected to occur on an infrequent basis under current conditions. Steady development adjacent to the refuge will likely increase the frequency of this use in the future.

Availability of Resources: No parking areas are available to support this use. Only two sand roads exist on refuge property. Both are one-half mile long and closed to public vehicular traffic. Annual maintenance is required to maintain these roads. An Equipment Operator is able to fulfill these maintenance requirements. Other staff members provide law enforcement and administrative support. Current levels of funding and staff are adequate to support this use.

Anticipated Impacts of the Use: Free-roaming feral horses currently exist in the vicinity of the refuge and cause detrimental impacts at their current levels. These impacts include trampling and consuming vegetation, increasing erosion, and disbursing exotic seeds. Horses used for horseback riding would have similar impacts on the habitats and therefore only add to the detriment. In the absence of roads or designated trails, impacts from this use would be disbursed across the landscape. It would also be more likely to impact wildlife-dependant, priority public uses since the activity would not be concentrated or limited to certain locations.

Public Review and Comment: Comments from the public were solicited by posting a notice in two local newspapers, at the refuge office, refuge kiosks, the Knotts Island Market, and the Knotts Island Post Office. The posting and comment period lasted for fourteen days (DATES).

Determination (check one below):

Use is Not Compatible

Use is Compatible With Following Stipulations

Stipulations Necessary to Ensure Compatibility:

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

Categorical Exclusion without Environmental Action Statement

Categorical Exclusion and Environmental Action Statement

Environmental Assessment and Finding of No Significant Impact (1995)

Environmental Impact Statement and Record of Decision

Justification: Horseback riding has been determined to be an incompatible use. This use would interfere with the refuge's purpose of providing a sanctuary for migratory birds. Impacts such as trampling and consuming vegetation, increasing erosion, and disbursing exotic seeds would negatively impact habitat for migratory birds. Although low participation in this use would be expected, the impacts would be additive in relation to the impacts already caused by the existing feral horses. The cumulative impact of these two factors exceeds acceptable levels of disturbance.

Mandatory 10- or 15-Year Re-evaluation Date: _____

Literature Cited

- Bookhout, T.A. 1994. Research and management techniques for wildlife and habitats. Fifth edition. The Wildlife Society, Bethesda, MD 740pp.
- Eldridge, J. 1992. Management of habitat for breeding and migrating shorebirds in the Midwest. In Laubhan, M.K., and D. Hamilton. Waterfowl Management Handbook. U.S. Fish and Wildlife Service, Fort Collins, CO
- Fredrickson, L.H. and M.E. Heitmeyer. 1988. Waterfowl Use of Forested Wetlands of the Southern United States: An Overview. Pages 307-323 in M.W. Weller, editor. Waterfowl in Winter. University of Minnesota Press, Minneapolis, Minnesota.
- Fredrickson, L.H. and F. A. Reid. 1988. Nutritional value of waterfowl foods. In Laubhan, M.K., and D. Hamilton. Waterfowl Management Handbook. U.S. Fish and Wildlife Service, Fort Collins, CO
- Fredrickson, L.H. 1991. Strategies for water level manipulation in moist soil systems. In Laubhan, M.K., and D. Hamilton. Waterfowl Management Handbook. U.S. Fish and Wildlife Service, Fort Collins, CO
- Frost, C. 1995. Presettlement fire regimes in southeastern marshes, peatlands, and swamps. Pages 39-60 in Susan I. Cerulean and R. Todd Engstrom, eds. Fire in wetlands, a management perspective. Proceedings of the Tall Timbers Fire Ecology Conference, No. 19. Tall Timbers Research Station, Tallahassee, FL.
- Frost, C. 1998. Presettlement fire frequency regimes in the United States: a first approximation. Pages 70-81 in Teresa L. Pruden and Leonard A. Brennan, eds. Fire in ecosystem management: shifting the paradigm from suppression to prescription. Proceedings of the Tall Timbers Fire Ecology Conference, No. 20. Tall Timbers Research Station, Tallahassee, FL.
- Hunter, W.C., L.H. Peoples, and J.A. Collazo. 2001. South Atlantic Coastal Plain Partners in Flight Bird Conservation Plan.
- Schmidt, P.R. 1993. Memorandum - Information request regarding impacts of hunting on national wildlife refuges. U.S. Department of the Interior, Fish and Wildlife Service, Office of Migratory Bird Management, Washington, D.C. 7pp.

Approval of Compatibility Determination

The signature of approval is for all compatibility determinations considered within the comprehensive conservation plan. If one of the descriptive uses is considered for compatibility outside of the comprehensive conservation plan, the approval signature becomes part of that determination.

Refuge Manager: _____
(Signature/Date)

**Regional Compatibility
Coordinator:** _____
(Signature/Date)

Refuge Supervisor: _____
(Signature/Date)

**Regional Chief, National
Wildlife Refuge System,
Southeast Region:** _____
(Signature/Date)

Appendix VI. Refuge Biota

BIRDS

Total Species - 191

A = Abundant, C = Common, U = Uncommon, O = Occasional, R = Rare

BIRD_SPECIES	SPRING	SUMMER	FALL	WINTER
Avocet, American	C	C	C	C
Bittern, American	U	R	U	U
Bittern, Least	O	O	O	
Blackbird, Red-winged	C	C	C	C
Blackbird, Rusty			O	R
Blackbird, Yellow-headed		R	R	
Bluebird, Eastern	C	C	C	C
Bobolink	U		C	
Bobwhite, Northern	U	U	U	U
Booby, Masked	O	O	R	
Brant				C
Bufflehead			C	C
Bunting, Snow			O	O
Canvasback			C	C
Catbird, Gray	C	C	C	C
Cardinal, Northern	C	C	C	C
Chat, Yellow-breasted	C	O	R	R
Chickadee, Carolina	C	C	C	C
Chuck-will's Widow	C	U		
Cormorant, Double-crested	C	O	C	C
Cormorant, Great	O		O	U
Coot, American	C	O	C	C
Cowbird, Brown-headed	C	C	U	U
Cowbird, Shiny		R		
Creeper, Brown	U		U	U
Crow, American	C	C	C	C
Crow, Fish	C	C	C	C
Cuckoo, Black-billed	O	R		
Cuckoo, Yellow-billed	C	C	U	
Curlew, Long-billed	R	R	R	
Dickcissel			R	
Dove, Eurasian Collared		R	R	
Dove, Mourning	C	C	C	C
Dove, Rock	U	U	U	U
Dove, White-winged	R	R	R	R
Dowitcher, Long-billed	U	O	C	U
Dowitcher, Short-billed	C	C	C	U
Duck, American Black	C	C	C	C
Duck, Fulvous Whistling	R	R	R	R
Duck, Red-necked				C
Duck, Ruddy	O			C
Duck, Wood	U	U	U	U

BIRD_SPECIES	SPRING	SUMMER	FALL	WINTER
Dunlin	C	O	C	C
Eagle, Bald (Threatened)	O	O	O	O
Elder, Common	R	R	R	O
Elder, King				O
Egret, Cattle	C	C	C	R
Egret, Great	C	C	C	C
Egret, Snowy	C	C	C	U
Falcon, Peregrine	U		C	U
Finch, House	C	C	C	C
Finch, Purple	C	C	C	C
Flicker, Northern	U	U	C	C
Flycatcher, Acadian		O		
Flycatcher, Great Crested	C	C	O	
Flycatcher, Least		R		
Flycatcher, Scissor-tailed		R	R	
Flycatcher, Yellow-bellied		R		
Flycatcher, Willow		R	R	
Frigate Bird, Magnificent		R		
Fulmar, Northern	C			R
Gadwall	C	C	C	C
Gannet, Northern	C	R	O	C
Gnatcatcher, Blue-gray	C	C	O	R
Godwit, Hudsonian			U	
Godwit, Marbled	U	U	C	U
Goldeneye, Common				U
Goldfinch, American	O		U	U
Goose, Blue	O			U
Goose, Canada	O	O	C	C
Goose, Greater White-fronted				R
Goose, Ross			R	R
Goose, Snow	O	O	C	C
Grackle, Boat-tailed	C	C	C	C
Grackle, Common	C	C	U	U
Grebe, Eared				R
Grebe, Horned	R		R	C
Grebe, Pied-billed	C	U	C	C
Grebe, Red-necked				R
Grosbeak, Blue	U	U	U	
Grosbeak, Evening	R	U	R	R
Grosbeak, Rose-breasted	U		U	
Gull, Black-headed	R			R
Gull, Bonaparte's	C	R	O	C
Gull, California				R
Gull, Glaucous	R			O
Gull, Great Black-backed	C	C	C	C
Gull, Herring	C	C	C	C
Gull, Iceland				O
Gull, Laughing	C	C	C	O

BIRD_SPECIES	SPRING	SUMMER	FALL	WINTER
Gull, Lesser Black-backed Gulf	O	O	U	C
Gull, Little	R			R
Gull, Ring-billed	C	C	C	C
Gull, Thayer's				R
Gull, Herring	O		O	O
Gull, Ring-billed	U		U	U
Harrier, Northern	O	U	C	C
Hawk, Broad-winged	R			
Hawk, Cooper's	O		U	U
Hawk, Red'-shouldered	U	U	U	U
Hawk, Red-tailed	R	R	U	U
Hawk, Rough-legged				R
Hawk, Sharp-shinned	U		C	C
Heron, Black-crowned Night	C	C	C	C
Heron, Great Blue	C	U	C	C
Heron, Green-backed	O	C	C	R
Heron, Little Blue	C	C	C	O
Heron, Tricolored	C	C	C	U
Heron, Yellow-crowned Night		U	U	R
Hummingbird, Ruby-throated			R	R
Hummingbird, Rufous	C	C	U	O
Ibis, Glossy	C	C	C	O
Ibis, White	C	C	C	C
Jaeger, Long-legged	R			
Jaeger, Parasitic	O	R	U	R
Jaeger, Pomarine	O	R	U	R
Jay, Blue	C	C	C	C
Junco, Dark-eyed	O		C	O
Kestrel, American	O		C	C
Killdeer	U	U	U	C
Kingbird, Eastern	C	C	C	
Kingbird, Grey	R	R		
Kingbird, Western			O	
Kingfisher, Belted	C	O	C	C
Kinglet, Golden-crowned	O		C	C
Kinglet, Ruby-crowned	U		C	C
Kite, Mississippi	R			
Kite, Swallow-tailed	R			
Kittiwake, Black-legged	R			O
Knot, Red	U	C	C	C
Lark, Horned				R
Loon, Common	C	R	R	C
Loon, Red-throated	C		R	C
Mallard	C	O	C	C
Martin, Purple	C	C	R	
Meadowlark, Eastern	C	C	C	C
Merganser, Common	R			R
Merganser, Hooded			C	C

BIRD_SPECIES	SPRING	SUMMER	FALL	WINTER
Merganser, Red-breasted	C	R	C	C
Merlin	O		C	U
Mockingbird, Northern	C	C	C	C
Moorhen, Common	O	O	O	O
Nighthawk, Common	U	U	O	
Nuthatch, Brown-headed	C	C	C	C
Nuthatch, Red-breasted	O		R	U
Oldsquaw				U
Oriole, Baltimore	U		C	R
Oriole, Orchard	U	U		
Osprey	C	C	C	R
Ovenbird	C	U	U	O
Owl, Barn	R	R	R	R
Owl, Eastern Screech	C	C	C	C
Owl, Great Horned	C	C	C	C
Owl, Short-eared	O			O
Oystercatcher, American	C	C	C	U
Pelican, American White	O	R	R	O
Pelican, Brown	C	C	C	C
Petrel, Black Capped	C	C	C	C
Phalarope, Red	R		R	R
Phalarope, Red-necked	R	R	R	
Phalarope, Wilson's	R	U	R	
Pheasant, Ring-necked	R	R	R	R
Phoebe, Eastern	C		C	C
Pintail, Northern	O		C	C
Pipit, American Water	R		U	O
Plover, American Golden	R	R	R	C
Plover, Black-bellied	C	U	C	C
Plover, Piping	U	U	U	U
Plover, Semipalmated	C	O	C	U
Plover, Wilson's	U	U	U	
Rail, Black	U	U	O	O
Rail, Clapper	C	C	C	C
Rail, King	C	C	C	U
Rail, Virginia	C	U	C	C
Rail, Yellow	R		R	R
Redhead	R		C	C
Redstart, American	O	O	C	
Robin, American	U	U	C	C
Ruff	R	R		
Sanderling	C	C	C	C
Sandpiper, Baird's			O	
Sandpiper, Buff-breasted			O	
Sandpiper, Curlew		O	R	
Sandpiper, Least	C	C	C	U
Sandpiper, Pectoral	U	C	C	
Sandpiper, Purple	U		U	U

BIRD_SPECIES	SPRING	SUMMER	FALL	WINTER
Sandpiper, Semipalmated	C	C	C	
Sandpiper, Solitary		U	U	
Sandpiper, Spotted	C	C	O	
Sandpiper, Upland	R	O		
Sandpiper, Western	C	U	C	C
Sandpiper, White-rumped	C	U	U	
Sapsucker, Yellow-bellied	U		C	C
Scaup, Greater			U	U
Scaup, Lesser			C	C
Scoter, Black	C	R	C	C
Scoter, Surf	C	R	C	C
Scoter, White-winged	O		U	U
Shearwater, Audubon	O	C	C	O
Shearwater, Cory's	O	C	C	
Shearwater, Greater	O	C	U	R
Shearwater, Manx	O			O
Shearwater, Sooty		R	R	
Shoveler, Northern	C		C	C
Shrike, Loggerhead	R	R	R	R
Siskin, Pine	R		R	R
Skimmer, Black	C	C	C	O
Skua, South Polar		R		
Snipe, Wilson's	C	R	C	C
Sora	C		C	U
Sparrow, Chipping			C	O
Sparrow, Clay-colored			O	
Sparrow, Field	C	C	C	C
Sparrow, Fox			O	U
Sparrow, Grasshopper			R	
Sparrow, House	C	C	C	C
Sparrow, Ipswich			O	O
Sparrow, Lapland			O	R
Sparrow, Lark			O	
Sparrow, Lincoln's			R	
Sparrow, Nelson's Sharp-tailed	C		C	C
Sparrow, Saltmarsh Sharp-tailed	C		C	C
Sparrow, Savannah	C		C	C
Sparrow, Seaside	C	C	C	U
Sparrow, Song	C	C	C	C
Sparrow, Swamp	C		C	C
Sparrow, Vesper			R	
Sparrow, White-crowned	R		U	O
Sparrow, White-throated	C		C	C
Starling, European	C	C	C	C
Stilt, Black-necked		C	C	
Storm-Petrel, Band-rumped		U		
Storm-Petrel, Leach's	O	U	O	R
Storm-Petrel, White-faced		R	R	

BIRD_SPECIES	SPRING	SUMMER	FALL	WINTER
Storm-Petrel, Wilson's	C	C	C	R
Swift, Chimney	C	C	U	
Swallow, Bank	O	O		
Swallow, Barn	C	C	C	
Swallow, Cliff	R	R	R	
Swallow, Northern Rough-winged	U	U		
Swallow, Tree	U	U	C	U
Swan, Tundra	O	O	O	C
Tanager, Scarlet	R		U	
Tanager, Summer	U	O	O	
Teal, American Green-winged	C		C	C
Teal, Blue-winged	C	O	C	O
Teal, Eurasian				O
Tern, Black	O	C	R	
Tern, Caspian	U	U	C	
Tern, Common	C	C	O	
Tern, Forster's	C	C	C	C
Tern, Least	C	C	R	
Tern, Roseate		R	R	
Tern, Royal	C	C	C	U
Tern, Sandwich	C	C	C	
Tern, Sooty	O	O	R	
Tern, Common	O			
Tern, Forster's			R	
Thrasher, Brown	C	C	C	C
Thrush, Gray-cheeked	U		U	
Thrush, Hermit	C		C	C
Thrush, Swainson's	U		U	
Thrush, Wood	U		U	
Titmouse, Tufted			R	R
Towhee, Eastern	C	C	C	C
Tropicbird, White-tailed	O	O		
Turnstone, Ruddy	C	C	C	U
Veery	U		U	
Vireo, Blue-headed	O		O	C
Vireo, Philadelphia		O		
Vireo, Red-eyed	C	C	C	
Vireo, Warbling		R		
Vireo, Warbling		R		
Vireo, White-eyed	O	C	C	O
Vireo, Yellow-throated	R		O	
Vulture, Turkey	U	U	C	C
Warbler, Bay-breasted			O	
Warbler, Black-and-white	U		C	R
Warbler, Black-throated Blue	O		C	
Warbler, Black-throated Green	U		U	
Warbler, Blackburnian	O		O	
Warbler, Blackpoll	C		C	

BIRD_SPECIES	SPRING	SUMMER	FALL	WINTER
Warbler, Blue-winged			O	
Warbler, Canada	R		R	
Warbler, Cape May	R		C	
Warbler, Chestnut-sided	O		O	
Warbler, Connecticut			R	
Warbler, Golden-winged			O	
Warbler, Hooded	U		O	
Warbler, Kentucky	R		R	
Warbler, Magnolia	U		C	
Warbler, Mourning			R	
Warbler, Nashville			U	
Warbler, Northern Parula	U	R	U	
Warbler, Orange-crowned	O		O	C
Warbler, Palm	U		C	U
Warbler, Pine	C	C	C	C
Warbler, Prairie	C	C	O	R
Warbler, Prothonotary	C	C	U	
Warbler, Tennessee			R	
Warbler, Wilson's			U	
Warbler, Worm-eating	U		O	
Warbler, Yellow	U	R	C	
Warbler, Yellow-rumped	C		C	C
Warbler, Yellow-throated	C	U	O	
Waterthrush, Northern	O		U	
Waxwing, Cedar	C	O	C	C
Whimbrel	C	C	U	R
Whip-poor-will				R
Wigeon, American	C		C	C
Wigeon, Eurasian	R		O	O
Willet	C	C	C	C
Woodcock, American	O	R	O	U
Woodpecker, Downy	C	C	C	C
Woodpecker, Hairy			R	R
Woodpecker, Pileated	C	C	C	C
Woodpecker, Red-bellied	C	C	C	C
Woodpecker, Red-headed	O		O	
Wood-pewee, Eastern	U	O	U	
Wren, Carolina	C	C	C	C
Wren, House	U		C	C
Wren, Marsh	U	U	C	C
Wren, Sedge	C		C	C
Wren, Winter	O		U	U
Yellow-throat, Common	C	C	C	U
Yellowlegs, Greater	C	C	C	C
Yellowlegs, Lesser	C	C	C	U

MAMMALS	
COMMON NAME	SCIENTIFIC NAME
Cottontail, Eastern	<i>Sylvilagus floridanus</i>
Deer, White-tailed	<i>Odocoileus virginianus</i>
Fox, Grey	<i>Urocyon cinereogreus</i>
Hog, Feral (Exotic)	<i>Sus scrofa</i>
Horse, Feral (Exotic)	<i>Equus caballus</i>
Mink	<i>Mustela vison</i>
Mole, Eastern	<i>Scalopus aquaticus</i>
Mouse, Cotton	<i>Peromyscus gossypinus</i>
Mouse, Eastern Harvest	<i>Reithrodontomys humilis</i>
Mouse, House	<i>Mus musculus</i>
Mouse, White-footed	<i>Peromyscus leucopus</i>
Muskrat	<i>Ondatra zibethicus</i>
Nutria (Exotic)	<i>Myocastor coypus</i>
Opossum	<i>Didelphidae virginiana</i>
Otter, River	<i>Lutra canadensis</i>
Rabbit, Marsh	<i>Sylvilagus palustris</i>
Raccoon	<i>Procyon lotor</i>
Rat, Marsh Rice	<i>Oryzomys palustris</i>
Rat, Norway (Exotic)	<i>Rattus norvegicus</i>
Shrew, Least	<i>Cryptotis parva</i>
Shrew, Shorttail	<i>Blarina brevicauda</i>
Shrew, Southeastern	<i>Sorex longirostris</i>
Squirrel, Eastern Grey	<i>Sciurus carolinensis</i>
Vole, Meadow	<i>Microtus pennsylvanicus</i>

TURTLES	
COMMON NAME	SCIENTIFIC NAME
Cooter, Florida	<i>Chrysemys floridana floridana</i>
Loggerhead, Atlantic	<i>Caretta caretta caretta</i>
Mudturtle, Eastern	<i>Kinosternon subrubrum subrubrum</i>
Stinkpot	<i>Sternotherus odoratus</i>
Terrapin, Northern diamond back	<i>malaclemys terrapin terrapin</i>
Turtle, Chicken	<i>Deirochelys reticularia</i>
Turtle, Eastern box	<i>Terrapeme carolina carolina</i>
Turtle, Eastern Painted	<i>Chrysemys picta picta</i>
Turtle, Red-bellied	<i>Chrysemys rubiventris</i>
Turtle, Snapping	<i>Chelydra serpentina</i>
Turtle, Spotted	<i>Clemmys guttata</i>
Turtle, Yellow-bellied	<i>Chrysemys scripta scripta</i>
SNAKES	
COMMON NAME	SCIENTIFIC NAME
Copperhead, Southern	<i>Agkistrodon contortrix</i>
Cottonmouth, Eastern	<i>Agkistrodon piscivorus</i>
Racer, Northern Black	<i>Coluber constrictor constrictor</i>
Rattlesnake, Canebrake	<i>Crotalus horridus atricaudatus</i>
Snake, Black Rat	<i>Elaphe obsoleta obsoleta</i>
Snake, Brown Water	<i>Natrix taxispilota</i>
Snake, Coastal Plain Milk	<i>Lampropeltis triangulum</i>
Snake, Corn	<i>Elaphe guttata guttata</i>
Snake, Eastern Garter	<i>Thamnophis sirtalis sirtalis</i>
Snake, Eastern hognose	<i>Heterodon platyrhinos</i>
Snake, Eastern King	<i>Lampropeltis getulus getulus</i>
Snake, Eastern Mud	<i>Farancia abacura abacura</i>
Snake, Eastern Ribbon	<i>Thamnophis sauritus sauritus</i>
Snake, Eastern Smooth earth	<i>Virginia valeriae</i>
Snake, Eastern Woods	<i>Carphophis amoenus amoenus</i>
Snake, Northern Brown	<i>Storeria dekayi dekayi</i>
Snake, Northern Scarlet	<i>Cemophora coccinea copei</i>
Snake, Northern Water	<i>Natrix sipedon sipedon</i>
Snake, Pine Woods	<i>Rhadinae flavilata</i>
Snake, Rainbow	<i>Farancia erythrogram</i>
Snake, Red-Bellied	<i>Storeria occipitomaculata</i>
Snake, Red-Bellied Water	<i>Natrix erythrogaster erythrogaster</i>
Snake, Rough Earth	<i>Virginia striatula</i>
Snake, Rough Green	<i>Opheodrys aestivus</i>
Snake, Southern Ringneck	<i>Diadophis punctatus punctatus</i>

SALAMANDERS	
COMMON NAME	SCIENTIFIC NAME
Amphiuma, Two-toed	Amphiuma means
Newt, Red-Spotted	Notophthalmus viridescens viridescens
Salamander, Eastern Mud	Pseudotriton montanus montanus
Salamander, Eastern Tiger	Ambystoma tigrinum tigrinum
Salamander, Many-Lined	Stereochilus marginatus
Salamander, Marbled	Ambystoma opacum
Salamander, Red-Backed	Plethodone Cinereus Cenerous
Salamander, Slimy	Plethodone glutinosus glutinous
Salamander, Souther Dusky	Desmognathus auriculatus
Salamander, Spotted	Ambystoma muculatum
Siren, Greater	Siren lacertina
Waterdog, Dwarf	Necturus punctatus
LIZARDS	
COMMON NAME	SCIENTIFIC NAME
Anole, Green (Carolina Anole)	Anolis carolinensis
Lizard, Fence	Sceloporus undulatus hyacinthinus
Racerunner, Six-Lines	Cnemidophorus sexlineatus
Skink, Ground	Leiopisma laterale
Skink, Five-Lined	Eumeces fasciatus
Skink, Broad-Headed	Eumeces laticeps
Skink, Southeastern Five-Lined	Eumeces inexpectatus
Lizard, Slender Glass	Ophisaures attenuatus

FROGS AND TOADS	
COMMON NAME	SCIENTIFIC NAME
Bullfrog	<i>Rana catesbeiana</i>
Frog, Brimley's Chorus	<i>Pseudacris brimleyi</i>
Frog, Carpenter	<i>Rana virgatipes</i>
Frog, Gray Tree	<i>Hyla chrysoscelis</i> (diploid form)
Frog, Gray Tree	<i>Hyla versicolor</i> (polyploid form)
Frog, Green	<i>Rana clamitans melanota</i>
Frog, Green tree	<i>Hyla gratiosa</i>
Frog, Northern Cricket	<i>Acris crepitans crepitans</i>
Frog, Northern Cricket	<i>Hyla crucifer crucifer</i>
Frog, Pickerel	<i>Rana palustris</i>
Frog, Pine Woods Tree	<i>Hyla femoralis</i>
Frog, Southern Cricket	<i>Acris gryllus gryllus</i>
Frog, Southern Leopard	<i>Rana utricularia</i>
Frog, Squirell Tree	<i>Hyla squirella</i>
Frog, Upland Chorus	<i>Pseudacris triseriata feriarum</i>
Grog, Little Grass	<i>Limnaoedus ocularis</i>
Peeper, Northern Spring	<i>Hyla cinera cinera</i>
Spadefoot, Eastern	<i>Scaphiopus holbrooki holbrooki</i>
Toad, Eastern Narrow-Mouthed	<i>Gastrophryne carolinensis</i>
Toad, Fowlers	<i>Bufo woodhousei fowleri</i>
Toad, Oak	<i>Bufo quercicus</i>
Toad, Southern	<i>Bufo terrestris</i>

FISH	
COMMON NAME	SCIENTIFIC NAME
Alewife	<i>Alosa pseudoharengus</i>
Anchovy, Bay	<i>Anchoa mitchilli</i>
Bass, Largemouth	<i>Micropterus Salmoides</i>
Bass, Spotted	<i>Micropterus punctulatus</i>
Bass, Striped	<i>Morone saxatilis</i>
Bluegill	<i>Lepomis macrochirus</i>
Bowfin	<i>Amia Calva</i>
Bullhead, Black	<i>Ictalurus Melas</i>
Bullhead, Brown	<i>Ictalurus Nebulosis</i>
Bullhead, Yellow	<i>Ictalurus Natalis</i>
Carp	<i>Cyprinus Carpio</i>
Catfish, Channel	<i>Ictalurus Punctatus</i>
Catfish, White	<i>Ictalurus catus</i>
Chubsucker, Lake	<i>Erimzon sucetta</i>
Crappie, Black	<i>Pomoxis nigromaculatus</i>
Croaker, Atlantic	<i>Micropogon undulatus</i>
Drum, Red	<i>Sciaenps ocellata</i>
Drum, Star	<i>Stellifer lanceolatus</i>
Eel, American	<i>Anguilla Rostrata</i>
Fish, Lady	<i>Elops saurus</i>
Flier	<i>Centrarchus marcopterus</i>
Flounder, Southern	<i>Paralichthys lethostigma</i>
Flounder, Summer	<i>Paralichthys dentatus</i>
Gar, Longnose	<i>Lepisosteus osseus</i>
Goby, Darter	<i>Gobionellus boleosoma</i>
Goby, Naked	<i>Bogiosoma bosci</i>
Herring, Blueback	<i>Alosa aestivalis</i>
Killifish, Banded	<i>Fundulus diaphanus</i>
Killifish, Marsh	<i>Fundulus confluentus</i>
Madtom, Tadpole	<i>Noturus gyrinus</i>
Menhaden, Atlantic	<i>Brevoortia tyrannus</i>
Mullet, Striped	<i>Mugil cephalus</i>
Mullet, White	<i>Mugil curema</i>
Perch, Silver	<i>Bairdiella chrysur</i>
Perch, White	<i>Morone americana</i>
Perch, Yellow	<i>Perca flavescens</i>
Pickrel, Chain	<i>Esox niger</i>
Pickrel, Redfin	<i>Esox Americans</i>
Pinfish	<i>Lagodon rhomboides</i>
Pipefish, Gulf	<i>Syngnathus scovelli</i>
Pumpkinseed	<i>Lepomis gibbosus</i>
Seatrout, Spotted	<i>Cynoscion nebulosus</i>
Shad, American	<i>Alosa sapidissima</i>
Shad, Gizzard	<i>Dorosoma cepedianum</i>
Shiner, Golden	<i>Notemigonus crysoleucas</i>
Silverside, Tidewater	<i>Menidia beryllina</i>

FISH	
COMMON NAME	SCIENTIFIC NAME
Snapper, Gray	<i>Lutjanus griseus</i>
Spot	<i>Leiostomus xanthurus</i>
Sunfish, Bluespotted	<i>Enneacanthus gloriosus</i>
Warmouth	<i>Lepomis gulosus</i>

INSECTS	
COMMON NAME	SCIENTIFIC NAME
Beatles, Whirligig	Gyrinus sp.
Beetle, Burrowing Water	Suphisellus sp.
Beetle, Water Scavenger	Berosus sp.
Beetle, Water Scavenger	Derallus altus
Bluets	Enallagma durum
Boatman, Water	Corixa sp.
Caddisflies	Lepotoceridae
Casemakers, Longhorned	Oecetis sp.
Damselfly, Common Blu	Enallagma sp.
Fork-Tail, Common	Ischnura verticalis
Mayfly	Baetidae
Midge	Polypedium sp.
Midge	Tanytarsus sp.
Pirate, Blue	Pachydiplax longipennis
Punkies, No-see-ums	Palpomyia sp.
Scorpion, Water	Ranatra so.
Waterscorpions	Anax junius
	Arthripsodes sp.
	Coelotanypus concinnus
	Collotanaypus sp.
	Corethra sp.
	Cryptochironomus sp.
	Paracymus nanus
	Procladius sp.
	Tendipes riparius
	Tendipes sp.
	Triaenodes sp.
	Uvarus sp.

FLORA	
COMMON NAME	SCIENTIFIC NAME
TREES	
Bay, Sweet	Magnolia virginiana
Cedar, Eastern Red	Juniperus virginiana
Cherry, Black	Prunus serotina
Dogwood, Flowering	Cornus florida
Holly, American	Ilex opaca
Locust, Black	Robinia pseudo-acacia
Oak, Laurel	Quercus laurifolia
Oak, Live	Quercus virginiana
Oak, Water	Quercus nigra
Persimmon, Common	Diospyros virginiana
Pine, Loblolly	Pinus taeda
Sweetgum	Liquidambar styraciflua
Tree, Toothache	Zanthoxylum clava-herculis
Tupelo, Swamp	Nyssa sylvatica var. biflora
Willow, Black	Salix nigra
Willow, Coastal Plain, Ward's, Swamp	Salix caroliniana
SHRUBS	
Bay, Red	Persea borbonia
Bayberry, Northern	Myrica pensylvanica
Blackberry, Serrate'Leaf	Rubus argutus
Blackberry, Sand	Rubus cuneifolius
Blueberry, Black Highbush	Vaccinium atrococcum
Blueberry, Elliott's	Vaccinium elliotti
Elder, Marsh	Iva imbricata
Elderberry, American	Sambucus canadensis
Fetterbush, Swamp	Leucothoe racemosa
Groundsel Tree, High Tide Bush	Baccharis halimifolia
Holly, Yaupon	Ilex vomitoria
Huckleberry, Squaw	Vaccinium stamineum
Rose, Swamp	Rosa palustris
Shadbush, Serviceberry	Amelanchier canadensis
Sumac, Winged	Rhus copallina
Waxmyrtle	Myrica cerifera

FLORA (CONTINUED)	
COMMON NAME	SCIENTIFIC NAME
WOODY VINES	
Creeper, Virginia	Parthenocissus quinquefolia
Grape, Muscadine	Vitis rotundifolia
Grape, Pigeon	Vitis cinerea var. floridana
Greenbrier, Cat	Smilax gluca
Greenbrier, Common	Smilax rotundifolia
Greenbrier, Ear-leaf	Smilax auriculata
Greenbrier, Laurel-Leaf	Smilax laurifolia
Greenbrier, Saw	Smilax bona-nox
Honeysuckle, Coral	Lonicera sempervirens
Ivy, Poison	Rhus radicans
Vine, Pepper	Ampelopsis arborea

FLORA (CONTINUED)	
COMMON NAME	SCIENTIFIC NAME
FORBS (BROADLEAF HERBACEOUS PLANTS)	
Arrowhead, Awl-leaf	<i>Sagittaria subulata</i>
Arrowhead, Bulltongue	<i>Sagittaria falcata</i>
Aster, Slender	<i>Aster tenuifolius</i>
Beach Heath	<i>Hudsonia tomentosa</i>
Bean, Wild	<i>Strophostyles helvola</i>
Bedstraw, Catchweed	<i>Galium aparine</i>
Beggarticks, Smooth	<i>Bidens laevis</i>
Buttercup, Celery-Leaf	<i>Ranunculus sceleratus</i>
Cactus	<i>Opuntia compressa</i>
Camphor Weed	<i>Pluchea purpurascens</i>
Cherry, Ground	<i>Physalis viscosa</i> ssp. <i>maritima</i>
Chickweed, Mouse-Ear	<i>Cerastium vicosum</i>
Cocklebur, Rough	<i>Xanthium strumarium</i>
Cranesbill, Carolina	<i>Geranium carolinianum</i>
Cress, Bitter	<i>Cardamine hairsuta</i>
Cucumber, Creeping	<i>Melothria pendula</i>
Cudweed, Narrow-Leaf	<i>Gnaphalium purpureum</i> var. <i>falcatum</i>
Daisy Fleabane	<i>Erigeron canadensis</i>
Daisy, False	<i>Eclipta alba</i>
Dandelion, Dwarf	<i>Krigia virginica</i>
Dock, Water	<i>Rumex verticillatus</i>
Dog Fennel, Small	<i>Eupatorium capillifolium</i>
Dropwort, Water	<i>Oxypolis rigidior</i>
Duckweed, Minute	<i>Lemna perpusilla</i>
Duckweed, Greater	<i>Spirodela polythiza</i>
Elephant's Foot	<i>Elephantopus nudatus</i>
Feather, Parrot	<i>Myriophyllum brasiliense</i>
Fimbry, Forked	<i>Fimbristylis dichotoma</i>
Goldenrod, Aniscented	<i>Solidago odora</i>
Goldenrod, Seaside	<i>Solidago sempervirens</i>
Goldentop, Slender	<i>Euthamia tenuifolia</i>
Grasswort, Carolina	<i>Lilaeopsis carolinensis</i>
Grasswort, Eastern	<i>Lilaeopsis chinensis</i>
Grousel, Wooly	<i>Senecio tomentosus</i>
Hemlock, Poison	<i>Cicuta maculata</i>
Hempweed, Climbing	<i>Mikania scandens</i>
Horehound, Water	<i>Lycopus virginicus</i>
Hyssop, Water	<i>Bacopa monnieri</i>
Jessamine, Yellow	<i>Gelsemium sempervirens</i>
Lobelia, Downy	<i>Lobelia puberula</i>
Loosestrife, False	<i>Ludwigia alternifolia</i>
Mallow, Seashore	<i>Kosteletzkya virginica</i>
Milfoil, Water	<i>Myriophyllum exalbescens</i>
Monarda, Dotted	<i>Monarda punctata</i>
Morningglory, Saltmarsh	<i>Ipomoea sagittata</i>

FLORA (CONTINUED)	
COMMON NAME	SCIENTIFIC NAME
FORBS (BROADLEAF HERBACEOUS PLANTS)	
Mudflower, Shade	<i>Micranthemum umbrosum</i>
Mudwort, Awl-leaf	<i>Limosella subulata</i>
Pearlwort, Trailing	<i>Sagina decumbens</i>
Pennywort, Many-Flower	<i>Hydrocotyle umbellata</i>
Pennywort, Floating	<i>Hydrocotyle ranunculoides</i>
Pennywort, False	<i>Centella asiatica</i>
Pickeralweed	<i>Pontederia cordata</i>
Pimpernel, Water	<i>Samolus parviflorus</i>
Pink, Sea	<i>Sabatia stellaris</i>
Pinweed, Hairy	<i>Lechea mucrontha</i>
Pinweed, Leggett's	<i>Lechea pulchella</i>
Plantain, Pale Seed	<i>Plantago virginica</i>
Pondweed, Leafy	<i>Potamogeton foliosus</i>
Pondweed, Sago	<i>Potamogeton pectinatus</i>
Pondweed, Clasping-Leaf	<i>Potamogeton perfoliatus</i>
Pondweed, Bushy	<i>Najas flexilis</i>
Pondweed, Horned	<i>Zannichellia palustris</i>
Pondweeds	<i>Najas spp.</i>
Primrose, Evening	<i>Oenothera humifusa</i>
Primrose, Evening	<i>Oenothera laciniata</i>
Purslane, Water	<i>Ludwigia palustris</i>
Rabbit Tobacco	<i>Gnaphalium obtusifolium</i>
Ragweed, Annual	<i>Ambrosia artemisiifolia</i>
Redstem, Pink	<i>Ammania teres</i>
Rocket, American Sea	<i>Cakile edentula</i>
Rocket, Harper's Sea	<i>Cakile harperi</i>
Salad, Corn	<i>Valerianella radiata</i>
Sandmat, Seaside	<i>Chamaesyce polygonifolia</i>
Smartweed, Dotted	<i>Polygonum punctatum</i>
Sorrel, Sheep	<i>Rumex hastatulus</i>
St. Andrews Cross	<i>Hypericum stragalum</i>
Starwort, Water	<i>Callitriche heterophylla</i>
Tea, Mexican	<i>Chenopodium ambrosioides</i>
Thistle, Russian	<i>Salsola kali</i>
Thistle, Yellow	<i>Cirsium horridulum</i>
Thoroughwort	<i>Eupatorium pilosum</i>
Toadflax	<i>Linaria canadensis</i>
Tresses, Ladies	<i>Spiranthes vernalis</i>
Violet, Bog White	<i>Viola lanceolata</i>
Watercress	<i>Nasturtium officinale</i>
Weed, Mermaid	<i>Proserpinaca palustris</i>
Wild Sensitive Plant	<i>Cassia nictitans</i>
Wintergreen, Spotted	<i>Chimaphila maculata</i>
Wort, St. Johns	<i>Hypericum hypericoides</i>
Yarrow, Common	<i>Achillea millefolium</i>

FLORA (CONTINUED)	
COMMON NAME	SCIENTIFIC NAME
GRASSES	
Beachgrass, American	<i>Ammophila breviligulata</i>
Bluegrass, Annual	<i>Poa annua</i>
Bluestem, Little	<i>Schizachyrium scoparium</i>
Broomsedge	<i>Andropogon virginicus</i>
Cordgrass, Big	<i>Spartina cynosuroides</i>
Cordgrass, Saltmeadow	<i>Spartina patens</i>
Cutgrass, Rice	<i>Leersia oryzoides</i>
Deertongue	<i>Dichanthelium clandestinum</i>
Eelgrass	<i>Vallisneria americana</i>
Grass, American Cupscale	<i>Sacciolepis striata</i>
Grass, Blue-eyed	<i>Sisyrinchium mucronatum</i>
Grass, Widgeon	<i>Ruppia maritima</i>
Grass, Yellow-eyed	<i>Xyris difformis</i>
Grass, Yellow-eyed	<i>Xyris jupicai</i>
Maidencane	<i>Panicum hemitomom</i>
Orangegrass	<i>Hypericum gentianoides</i>
Panicum, Bitter	<i>Panicum amarum</i>
Panicum, Fall	<i>Panicum dichotomiflorum</i>
Plumegrass, Sugarcane	<i>Saccharum giganteum</i>
Reed, Common	<i>Phragmites australis</i>
Saltgrass, Seashore	<i>Distichlis spicata</i>
Sandspur	<i>Cenchrus tribuloides</i>
Sawgrass, Jamaica	<i>Cladium jamaicense</i>
Seaots	<i>Uniola paniculata</i>
Switchgrass	<i>Panicum virgatum</i>

FLORA (CONTINUED)	
COMMON NAME	SCIENTIFIC NAME
GRASSLIKE PLANTS	
Beakrush, Clustered	Rhynchospora glomerata
Beakrush, Loosehead	Rhynchospora chalarocephala
Bulrush, Softstem	Scirpus validus
Cattail, Common	Typha latifolia
Cattail, Narrow-leaf	Typha angustifolia
Cattail, Southern	Typha domingensis
Flatsedge, Slender	Cyperus fillicinus
Rush, Turnflower	Juncus biflorus
Rush, Black Needle	Juncus roemerianus
Rush, Leathery	Juncus coriaceus
Rush, Soft	Juncus effusus
Sedge, Japanese	Carex kobomugi
Spikerush, Blunt	Eleocharis obtusa
Spikerush, Dwarf	Eleocharis parvula
Spikerush, Small-Fruit	Eleocharis microcarpa
Spikerush, Yellow	Eleocharis flavescens
Threesquare, Common	Scirpus americanus
Threesquare, Olney	Scirpus olneyi
MOSS	
Moss, Spanish	Tillandsia usneoides

Appendix VII. Priority Bird Species and their Habitats

Species	Status	Habitat			
		Brackish Marsh	Maritime Shrub and Swamp Forest	Dune Grass and Dry Grassland	Managed Wetlands (Moist Soil Units)
(FL=Federally-listed, FSC=Federal Species of Concern, SC=Species of Management Concern)					
Bald Eagle	FL	X			
Black Rail	FSC	X			
Sharp-tailed Sparrow	SC	X			
Seaside Sparrow	SC	X			
Yellow Rail	SC	X			
King Rail	SC	X			
Sedge Wren	SC	X			
Prairie Warbler	SC		X		
Eastern Painted Bunting	SC		X		
Yellow-throated Warbler	SC		X		
Northern Parula	SC		X		
Wood Duck	SC		X		
Piping Plover	FL			X	
Red Knot	SC			X	
Wilson's Plover	SC			X	
Roseate Tern	SC			X	
Least Tern	SC			X	
Black Skimmer	Sc			X	
American Oystercatcher	SC			X	
Reddish Egret	SC			X	
Canada Goose	SC				X
Snow Goose	SC				X
Tundra Swan	SC				X
American Black Duck	SC				X
Mallard	SC				X
American Widgeon	SC				X
Blue-winged Teal	SC				X
Green-winged Teal	SC				X
Ruddy Duck	SC				X
Ringneck Duck	SC				X
Northern Pintail	SC				X
Greater Scaup	SC				X
Lesser Scaup	SC				X

Appendix VIII. Budget Requests

REFUGE OPERATION NEEDS SYSTEM (RONS) PROJECTS

Projects are ordered by the project number the first two digits of which stand for fiscal year the project was developed. The numbers are listed in the management alternatives.

Projects are listed as tier 1 projects that support approved critical mission or approved minimum staff or tier 2 projects that do not.

Stations ranks are listed for both Mackay Island and Currituck National Wildlife Refuges (NWR). Since both refuges are managed as one administrative unit, many projects listed as Currituck NWR projects will benefit Mackay Island NWR equally.

Project 97004 Habitat Improvement for Waterfowl and Shorebirds
First Time Request \$130,000, Recurring Request \$56,000
Station Rank - 6 (Currituck NWR Tier 2)

This project will provide the funding to improve management on a 150-acre natural impoundment (flats) on the Currituck NWR and initiate and force account farming program on 250 acres of cropland on the Mackay Island NWR. The refuge will install a pumping system to provide a dependable water supply to flood the impoundment and increase monitoring to manage the area for optimum migratory waterfowl and shorebird habitat. Currently the impoundment does not have an adequate supply and is not monitored sufficiently due to access. The flooded impoundment will provide important feeding and resting habitat for waterfowl, shorebirds, wading birds, and other species. Ducks Unlimited's MARSH project funding of \$30,000 is available to cost share this project. This project will also provide a maintenance worker to convert the cooperative farming program at Mackay Island NWR to a force account program. There is currently only one farmer available to enroll in the cooperative agreement and it is possible that he will discontinue his participation. At that time the refuge will initiate a force account program. The primary purpose of this program will be to provide winter feeding habitat for migratory Canada geese and other waterfowl.

Project 97006 Refuge Complex Biological Program Enhancement
First Year Request \$65,000, Recurring Request \$63,000
Station Rank – 2 (Mackay Island NWR Tier 1)

This project will provide the funding to employ a wildlife biologist to conduct annual studies of wildlife and their habitats essential to the management of the natural resources of the Mackay Island NWR and Currituck NWR. The biologist will also gather, analyze, and summarize data needed for planning purposes, including information to be used in the Comprehensive Conservation Planning process. Examples of work include, but are not limited to, monitoring waterfowl, water bird and songbird populations; surveying and protecting endangered species and their habitats; surveying and monitoring invasive species; water quality monitoring; and monitoring and mapping submerged aquatic vegetation in refuge impoundments. Much of this biological data is currently gathered sporadically or not at all. This project will help provide biological data that is currently not available for making compatibility determinations and other management and legal decisions.

Project 97009 Cultural Resource Surveys
One Time Request \$80,000
Station Rank - 9 (Mackay Island NWR Tier 2)

This project will provide the funding for a contract to conduct comprehensive archeological resource surveys on Mackay Island NWR and Currituck NWR. The surveys will document historical use by Native Americans, European colonists, and other groups. The area of the refuge and the area surrounding the refuge have a rich history, primarily due to its location near water and abundant natural resources. The survey will focus on Native American, early colonial, Revolutionary War, and Civil War cultural resources. The refuge needs this survey to develop resource and public use plans and the comprehensive conservation plan.

Project 97011 Fire Management Program Improvements

First Year Request \$81,000, Recurring Request \$2,000

Station Rank - 4 (Mackay Island NWR Tier 2)

This project will provide the funding for a contract a multi-year (3-5 year) study on Mackay Island NWR to evaluate the effects of the current prescribed fire program on marsh habitat. The refuge burns 1,500 to 2,000 acres of marsh habitat by prescription annually using a three-year rotation. The staff needs additional information to determine if the prescribed fire program is meeting planned objectives, and if needed, to modify the scope and/or intensity of annual burns to better meet habitat management objectives.

Project 97013 Interpretation, Education, and Outreach Program Development

First Year Request \$65,000, Recurring Request \$53,000

Station Rank - 1 (Currituck NWR Tier 1)

This project will provide the funding to employ a public use specialist (outdoor recreation planner) to develop and implement interpretation, education, and outreach programs to include development of interpretative materials, programs, and displays at the Mackay Island NWR and Currituck NWR. The position will also develop and implement environmental education materials for local schools and civic organizations. Currently the refuge is not adequately addressing outreach opportunities due to inadequate materials and staffing. Mackay Island and Currituck Refuges are on the edge of a large metropolitan with over one million residents. Requests for environmental education and interpretative programs are more than the current facilities and staff can accommodate.

Project 99001 Phragmites Control

First Year Request \$43,000, Recurring Request \$3,000

Station Rank - 1 (Mackay Island NWR Tier 1)

This project will provide the funding to control exotic phragmites on Mackay Island and Currituck national wildlife refuges. This species quickly spreads in wetland habitats, forms dense stands, and essentially eliminates native plant species where these dense stands form. Phragmites has limited value for native wildlife. The weed currently covers approximately 200 acres of the refuges. This exotic plant will continue to expand in the refuge's extensive wetlands unless control measures are implemented. Ducks Unlimited partnered with the refuge to control approximately 60 acres of this species in 1998 and will likely contribute to future efforts.

Project 99003 Forest Management Plan Development

One Time Request \$67,000

Station Rank - 5 (Mackay Island NWR Tier 2)

This project will provide the funding to inventory existing forest resources and develop forest management plans for Mackay Island NWR and Currituck NWR by contract. The refuges have more than 2,750 acres of forest habitat that the refuge staff has not inventoried or managed. The habitat is beginning to deteriorate due to lack of management (i.e., frequent disease outbreaks, wind damage).

Project 99004 Administrative Management Improvement
First Year Request \$77,500, Recurring Request \$44,000
Station Rank - 2 (Mackay Island NWR Tier 2)

This project will provide the funding to employ a full time office assistant to improve administrative operation and outreach for Mackay Island NWR and Currituck NWR. The staff for both refuges is six permanent and two seasonal employees. As the biological and public use programs expand, the workload will be more than one office assistant can handle. The current position handles budgeting, purchasing, time-keeping, and personnel, as well as all other clerical duties.

Project 00001 Endangered Species and Wetland Management Program Enhancement
First Year Request \$65,000, Recurring Request \$53,000
Station Rank - 2 (Currituck NWR Tier 1)

This project will provide the funding to employ a biological technician to conduct annual studies and surveys of wildlife and their habitats essential to management of the natural resources of the Mackay Island NWR and Currituck NWR. The technician will also gather, analyze, and summarize data needed for planning purposes, including information to be used in the Comprehensive Conservation Planning process. Surveys and monitoring of threatened and endangered species include, but are not limited to, piping plovers, loggerhead sea turtles, and seabeach amaranth. Other duties include monitoring the impacts of feral animals and invasive species, monitoring and mapping submerged aquatic vegetation in refuge impoundments. Much of this information is currently not being gathered and impacting the ability to make management decisions.

Project 00002 Outreach from Visitor Contact Station
First Year Request \$70,000, Recurring Request \$16,000
Station Rank - 3 (Mackay Island NWR Tier 1)

This project will provide the funding to develop new outreach tools to include displays, interpretative materials, and signs for the Visitor Contact Station. The project will also develop color brochures and pamphlets for each refuge and portable displays and presentation materials for local and regional events (i.e., festivals, exhibits, and workshops). Outreach is not adequately addressed due to inadequate materials. Mackay Island and Currituck Refuges are on the edge of a large metropolitan area with more than one million residents. Requests for environmental education and interpretation programs are more than current facilities can accommodate.

Project 00003 Great Marsh Habitat Alteration Grazing Research and Restoration
One Time Request \$60,000
Station Rank - 6 (Mackay Island NWR Tier 2)

This project will provide the funding for a college graduate student to research and evaluate the changes in marsh habitat beginning in the 1920's to the present. The student will compare current aerial photographs of the Middle Marsh area of the Mackay Island NWR with historic photographs to determine the amount of habitat lost to open ponds. Goose grazing, nutria feeding, or other conditions may have caused the loss. The project will evaluate the causes and recommend a restoration plan. Small openings in the marsh may have enlarged over the years resulting in loss of habitat. If the loss continues unabated, the loss may become significant and restoration may become difficult or unlikely due to a loss of soil.

Project 00005 Water Quality Monitoring
First Year Request \$15,500, Recurring Request \$6,500
Station Rank - 6 (Mackay Island NWR Tier 1)

This project will provide the funding to purchase water quality monitoring equipment and fund water testing in refuge impoundments and mitigation area on the Mackay Island NWR. The monitoring will evaluate the impact of impoundments on water quality and document habitat changes in the mitigation area. State Coastal Zone Permit requirements for the construction of the Kitchin Impoundment require intensive monitoring of specific water quality parameters.

Project 00006 Migratory Bird Management

Tier 1 Project

First Year Request \$41,000, Recurring Request \$35,000

Station Rank - 4 (Mackay Island NWR Tier 1)

This project will provide the funding to provide an aircraft for additional waterfowl and shorebird surveys, contract neotropical migratory songbird and habitat surveys, and establish habitat enclosures on the Mackay Island NWR and Currituck NWR. The project will add six waterfowl surveys and six shorebird surveys that the refuge had discontinued due to rising costs. The surveys will contribute valuable information to regional and national databases. Little is known about the neotropical birds on Mackay Island and Currituck Refuges. This information will allow the staff to make sound management decisions. The project will fund two habitat surveys annually. It will allow an annual survey of the Swan Island Impoundment on Currituck NWR to help make management decisions. The staff has not completed the survey in five years. The project will also fund habitat enclosures to monitor the impacts of wild horses on Currituck NWR.

Project 00009 Fire Management Program Expansion

First Year Request \$85,000 Recurring Request \$69,000

Station Rank - 3 (Mackay Island NWR Tier 2)

This project will provide the funding to employ a fire management specialist and purchase equipment to facilitate the management of an expanded fire management program. The project will allow the Mackay Island NWR and Currituck NWR to increase the area of prescribed fire by 3,500 acres and respond to wildfires. Current refuge acreage for the two refuges is approximately 12,000 acres. Both refuges are expanding and have a total acquisition boundary of 19,000 acres. More than half of the existing and proposed area on the refuges is brackish marsh. Proper management for the marsh is to prescribed burn on a three-year rotation.

Project 00010 Fisheries Survey

One Time Request \$20,000

Station Rank - 10 (Mackay Island NWR Tier 2)

This project will provide the funding for a comprehensive survey of existing fisheries on the Mackay Island NWR. The survey will sample impoundments, bays, creeks, and canals on the refuge. Nobody knows much of the existing fish populations. More than five trust species utilize the refuge. An evaluation is necessary to help determine management needs.

Project 00011 Refuge Management Improvement

First Time Request \$65,000, Recurring Request \$69,000

Station Rank - 5 (Currituck NWR Tier 2)

This project will provide the funding to employ an assistant manager for Currituck NWR. The assistant manager will oversee the daily management and biological program of an expanding refuge. The refuge has an active acquisition program. The manager and assistant manager at Mackay Island NWR currently manage the Currituck NWR office on Krotts Island, North Carolina. As the Currituck NWR grows, it will become more and more difficult to manage the refuge from across the sound. When acquisition is complete, the refuge will span 25 miles from the NC/VA state line to the Dare County line. The refuge is long and linear following the barrier island known as the Outer Banks in North Carolina.

Project 00012 Fisheries Survey

One Time Request \$20,000

Station Rank - 8 (Currituck NWR Tier 2)

This project will provide the funding for a comprehensive survey of existing fisheries on the Currituck NWR. The survey will sample impoundments, bays, creeks, and canals on the refuge. Nobody knows much of the existing fish populations. More than five trust species utilize the refuge. An evaluation is necessary to help determine management needs.

Project 00013 Exotic Nutria Control

First Year Request \$75,000, Recurring Request \$74,000

Station Rank - 8 (Mackay Island NWR Tier 2)

This project will provide the funding to employ a biological technician to establish a program to monitor and control the rapidly increasing nutria population on the Mackay Island NWR. Nutria are exotic animals from South America. There is a substantial population on the refuge. These animals are damaging habitat and infrastructure. They burrow into dikes and levees, enlarge ponds, consume great quantities of marsh vegetation, and feed in farm fields. The population seems to be growing and the impacts are increasing. Failure to control this population will lead to the continuation of habitat destruction.

Project 00014 Equipment Wash Rack

First Year Request \$18,000, Recurring Request \$4,000

Station Rank - 5 (Mackay Island NWR Tier 1)

This project will provide the funding to construct a vehicle and equipment wash rack behind the existing shop that would comply with environmental standards of the State of North Carolina. The staff currently washes equipment immediately behind the shop on a gravel and mud driveway; this site creates a large muddy area for several days. Mud, oil, and diesel fuel washes into the ground on the site in violation of state water quality standards.

Project 00016 Feral Horse Impact Research

First Year Request \$25,000, Recurring Request \$40,000

Station Rank - 3 (Currituck NWR Tier 2)

This project will provide the funding for two studies on the impacts of feral horses on the habitat of Currituck NWR. One will be an enclosure study to evaluate the habitat impacts resulting from the feral horses. The second will be a movement study to determine animal movements on a seasonal basis. Each will be an extensive three-year research study. Currently a small herd of feral horses roam the outer banks areas north of Corolla, North Carolina. An intensive evaluation is needed to determine impacts and make management recommendations. Due to the disjunct nature of the refuge, horses travel on and off the refuge year round. Management options are limited by local regulations and sentiment about the horses. Failure to evaluate this threat may result in significant habitat impacts that could damage threatened and endangered species and migratory bird habitat.

Project 00017 Corolla Navy Gunnery Site History Research

One Time Request \$43,000

Station Rank - 7 (Currituck NWR Tier 2)

This project will provide the funding for a research study of the history of the Corolla Navy Gunnery Site on the Monkey Island Unit of the Currituck NWR. Nobody knows much about this historic use. Some unexploded ordinance is present and occasional passing storms uncover additional ordinance. The refuge needs research into the extent of ordinance on the refuge to help determine the level of cleanup necessary and the level of public use that can currently occur in this area. Without this research, the refuge cannot plan development on this unit.

Project 00018 Weekend Public Access Improvement

First Year Request \$65,000, Recurring Request \$49,000

Station Rank - 7 (Mackay Island NWR Tier 2)

This project will provide the funding to hire a public use specialist (outdoor recreation planner) to staff the Mackay Island NWR headquarters and visitor contact station on weekends from April through October. Currently the headquarters and the surrounding refuge area are closed on weekends for security reasons. This project will allow that area and the Kitchin Impoundment to be open for wildlife observation, wildlife photography, interpretation, environmental education, and outreach. The public use specialist will also manage the Currituck NWR waterfowl hunts. Demand for public use activities is increasing every year. The demand will increase even more when the refuge develops the recreation facilities at the Kitchin Impoundment. The demand for weekend activity in the refuge is growing more than the demand for activity during the week. Failure to staff the headquarters on the weekend will limit our ability to provide wildlife-oriented recreation opportunities when the public wants them.

Project 00019 Vehicle and Equipment Maintenance

First Year Request \$65,000, Recurring Request \$52,000

Station Rank - 1 (Mackay Island NWR Tier 2)

This project will provide the funding to employ an additional maintenance worker to maintain vehicles and equipment. As the staff and refuges increase in size, there will be additional needs for maintenance work. Currently the two employees perform all the maintenance on the 12,000 acres of both Mackay Island NWR and Currituck NWR. They struggle at keeping up with the current workload. This position will allow the refuge to properly maintain vehicles and equipment, and allow the other two employees to concentrate on other maintenance needs. Failure to fund this project will limit the proper maintenance of vehicles and equipment.

Project 00020 Newly Acquired Tract Posting

One Time Request \$20,000

Station Rank - 9 (Currituck NWR Tier 2)

This project will provide the funding to post the boundaries of three newly acquired tracts on Currituck NWR with signs. The tracts are: Currituck Marsh, Station Landing, and Ocean Associates. The project will fund signs, posts, and hardware. Currently the staff has only posted a few signs in the more visible areas. Failure to post these areas will result in more violations and disturbance to wintering waterfowl.

Project 02001 Administrative Management Improvement

First Year Request \$17,500, Recurring Request \$25,000

Station Rank - 11 (Mackay Island NWR Tier 2)

This project will provide the funding to employ a half time office assistant to improve administrative operation and outreach for Mackay Island NWR and Currituck NWR. The staff for both refuges is six permanent and two seasonal employees. As the biological and public use programs expand, the workload will be more than one office assistant can handle. The current position handles budgeting, purchasing, time-keeping, and personnel, as well as all other clerical duties.

Project 03000 Refuge Officer

First Year Request \$65,000, Recurring Request \$71,000

Station Rank - 1 (Currituck NWR Tier 2)

This project will provide the funding to employ a law enforcement officer. With the Department of the Interior's mandated reduction in dual function officers, this refuge will have a lack of law enforcement presence. By providing an additional refuge officer to fill the void, the safety of the visiting public will be increased as well as our ability to provide much needed protection for refuge natural resources and facilities. The addition of a full time officer will provide a position whose primary responsibility is protecting the resource. Officer presence, surveillance, and visitor contacts are important to visitor safety and are critical in reducing crime on the refuge.

Project 04001 Survey and Post Disputed Refuge Boundaries

One Time Request \$60,000

Station Rank - 2 (Currituck NWR Tier 2)

This project will provide the funding to survey and post disputed refuge boundaries.

Project 04002 Plan and Implement Big Game Hunting Program

One Time Request \$55,000

Station Rank - 4 (Currituck NWR Tier 2)

This project will provide the funding to plan and implement a big game hunting program.

Currituck National Wildlife Refuge				
Refuge Operation Needs System (RONS) Projects Listed by Station Rank				
Station Rank/ Tier	Project Number	Cost (First Year, Recurring)	Positions	Project Title
1/1	97013	65K, 53K	1.0	Interpretation, Education, Outreach
2/1	00001	65K, 53K	1.0	Refuge Endangered Species and Wetland Management Enhancement
3/1	97002	140K, 22K		Boardwalk, Observation Platform, and Trail Construction
1/2	03000	65K, 71K	1.0	Law Enforcement Officer
2/2	04001	60K		Survey and Post Disputed Boundaries
3/2	00016	25K, 40K		Feral Horse Impact Research
4/2	04002	55K		Plan and Implement Big Game Program
5/2	00011	65K, 69K	1.0	Refuge Management Improvement
6/2	97004	130K, 56K	1.0	Habitat Improvement for Waterfowl and Shorebirds
7/2	00017	43K		Corolla Navy Gunnery Site History Research
8/2	00012	20K		Fishery Survey
9/2	00020	20K		Newly Acquired Tract Posting

Mackay Island National Wildlife Refuge Refuge Operation Needs System (RONS) Projects Listed by Station Rank				
Station Rank/ Tier	Project Number	Cost (First Year, Recurring)	Positions	Project Title
1/1	99001	43K, 3K		Phragmites Control
2/1	97006	65K, 63K	1.0	Biological Program Enhancement
3/1	00002	70K, 16K		New Outreach Tools
4/1	00006	41K, 35K		Migratory Bird Management
5/1	00014	18K, 4K		Equipment Wash Rack
6/1	00005	15.5K, 6.5K		Water Quality Monitoring
1/2	00019	65K, 52K	1.0	Vehicle and Equipment Maintenance
2/2	99004	58K, 25K	1.0	Administrative Management Improvement
3/2	00009	85K, 69K	1.0	Fire Management Program Expansion
4/2	97011	81K, 2K		Fire Management Program Improvement
5/2	99003	67K		Forest Management Plans
6/2	00003	60K		Great Marsh Research and Restoration
7/2	00018	65K, 49K	1.0	Weekend Public Outreach
8/2	00013	75K, 74K	1.0	Exotic Nutria Control
9/2	97009	80K		Cultural Resource Survey
10/2	00010	20K		Fisheries Survey
11/2	02001	17.5K, 25K	0.5	Administrative Management Improvement

MAINTENANCE MANAGEMENT SYSTEM (MMS) PROJECTS (CURRITUCK)

Project Number	Project Name	Year Planned	Cost	Station Rank	Station Name
97008 Old RONS	Electric Fence Construction	2011+	\$70,000	25+	Currituck NWR
99004 Old RONS	Satellite Headquarters Construction	2011+	\$204,000	9	Currituck NWR
00004	Monkey Island Bulkhead Replacement	2011+	\$1,200,000	1	Currituck NWR
02003	Visitor Contact Station/Research Facility Construction	2011	\$313,000	5	Currituck NWR

MAINTENANCE MANAGEMENT SYSTEM (MMS) PROJECTS (MACKAY ISLAND)
(Equipment Projects Benefit Currituck National Wildlife Refuge)

Project Number	Project Name	Year Planned	Cost	Station Rank	Station Name
94001	Mackay Island Road Resurfacing	2011+	\$342,000	25+	Mackay Island NWR
95004	Bulls Bay Bulkhead Replacement	2009	\$129,000	12	Mackay Island NWR
95005	Bellows Bay Bulkhead Replacement	2008	\$169,000	13	Mackay Island NWR
96003	Long Dike Resurfacing	2011+	\$1,082,000	20	Mackay Island NWR
96005	Fire Cache Rehabilitation	2005	\$51,000	1	Mackay Island NWR
96008	Mackay Island Road Resurfacing	2011+	\$514,000	21	Mackay Island NWR
97003 Old RONS	Observation Platform and Fishing Pier Construction	2011+	\$31,000	6	Mackay Island NWR
97006	Office Bulkhead Replacement	2009	\$37,000	7	Mackay Island NWR
97007 Old RONS	Observation/ Photography Blind Construction	2011+	\$31,000	8	Mackay Island NWR
97007	East Pool Parallel Dike Rehabilitation	2007	\$32,000	8	Mackay Island NWR
97033	Astro Van Replacement	2004	\$31,000	25+	Mackay Island NWR
99002	Long Dike Repair	2006	\$135,000	3	Mackay Island NWR
00003	1989 Blue Dodge Pickup Truck Replacement	2004	\$28,000	25+	Mackay Island NWR
00008 Old RONS	Fire Management Facility Expansion	2011+	\$80,000	25+	Mackay Island NWR
00011	Office Entrance Road Rehabilitation	2011+	\$131,000	25+	Mackay Island NWR
00015 Old RONS	Additional Shop Bay Construction	2011+	\$78,000	10	Mackay Island NWR
00016	Office Parking Lot Rehabilitation	2011+	\$62,000	25+	Mackay Island NWR

Project Number	Project Name	Year Planned	Cost	Station Rank	Station Name
00017	Office Entrance Road Rehabilitation	2011+	\$274,000	25	Mackay Island NWR
00018	Refuge Headquarters Expansion	2010	\$334,000	4	Mackay Island NWR
01001	Mackay Island Bulkhead Replacement	2011	\$814,000	2	Mackay Island NWR
01002	1998 Airboat Replacement	2011+	\$27,000	17	Mackay Island NWR
01003	D-4 Dozer Replacement	2011+	\$159,000	24	Mackay Island NWR
01004	Heavy Duty Disc Replacement	2011+	\$10,000	25+	Mackay Island NWR
01005	Backhoe Replacement	2011+	\$90,000	25+	Mackay Island NWR
01006	Tracked Marsh Vehicle Replacement	2011+	\$94,000	16	Mackay Island NWR
01007	14-Foot Rotary Mower Replacement	2011+	\$14,000	4	Mackay Island NWR
01007	14-Foot Rotary Mower Replacement	2011+	\$14,000	4	Mackay Island NWR
01008	16-Inch High Volume Lift Pump Replacement	2011+	\$8,000	10	Mackay Island NWR
01010	1996 4X4 Ford Tractor Replacement	2011+	\$87,000	25+	Mackay Island NWR
01011	1988 Case 585 Tractor Replacement	2011+	\$47,000	14	Mackay Island NWR
01012	1991 15 Ton Tilt Bed Trailer Replacement	2011+	\$16,000	23	Mackay Island NWR
01013	1998 Tilt Bed Trailer Replacement	2011+	\$9,000	25+	Mackay Island NWR
01014	1996 4X4 Dodge Dakota Replacement	2011+	\$33,000	5	Mackay Island NWR
Project	Project Name	Year	Cost	Station	Station

Number		Planned		Rank	Name
01016	2001 Chevrolet Tahoe Replacement	2011+	\$37,000	25+	Mackay Island NWR
01017	1999 Ford F-250 4X4 Truck Replacement	2011+	\$26,000	22	Mackay Island NWR
01018	1999 Ford F-250 4X4 Truck Replacement	2011+	\$26,000	19	Mackay Island NWR
01019	1995 Ford F-250 4X4 Truck Replacement	2011+	\$26,000	11	Mackay Island NWR
01020	1995 Ford F-150 4X4 Extended Cab Truck Replacement	2011+	\$29,000	9	Mackay Island NWR
01022	East Pool Pump Replacement	2004	\$40,000	25+	Mackay Island NWR
02001	New Office Building Construction	2011	\$972,000	12	Mackay Island NWR
02002	Great Marsh Natural Hydrology Restoration	2011	\$577,000	25+	Mackay Island NWR
02004	18-Foot Boat, 60-HP Motor, and Trailer Replacement	2011+	\$13,000	25+	Mackay Island NWR
02005	2001 John Deere 670CH Motor Grader Replacement	2011+	\$157,000	25+	Mackay Island NWR
02006	2001 Kubota M8200 Replacement	2011+	\$47,000	25+	Mackay Island NWR
02007	2001 Alamo Side Mower Replacement	2011+	\$8,000	25+	Mackay Island NWR
02008	2001 Ingersoll-Rand RT 706H Forklift Replacement	2011+	\$42,000	25+	Mackay Island NWR
02009	1991 Chevrolet Fire Engine Replacement	2011+	\$84,000	6	Mackay Island NWR

Project Number	Project Name	Year Planned	Cost	Station Rank	Station Name
02010	Refuge Parking Lot Resurfacing	2011+	\$42,000	25+	Mackay Island NWR
02011	20-Foot Boat, 70-HP Motor, and Trailer Replacement	2011+	\$16,000	25+	Mackay Island NWR
02012	Proclamation Boundary Re-Survey and Posting	2006	\$26,000	2	Mackay Island NWR
03001	Shop Entrance Road Rehabilitation	2011+	\$95,000	25+	Mackay Island NWR
03002	Live Oak Point Road Rehabilitation	2011+	\$435,000	25+	Mackay Island NWR
03003	Hog Pen Point Road Rehabilitation	2011+	\$568,000	25+	Mackay Island NWR
03004	Cross Dike Road Rehabilitation	2011+	\$317,000	25+	Mackay Island NWR
03005	Office Entrance Road Rehabilitation	2011+	\$430,000	25+	Mackay Island NWR
03006	Five Refuge Parking Lots Rehabilitation	2011+	\$57,000	25+	Mackay Island NWR
03007	Storage Building/Garage Construction	2010	\$77,000	11	Mackay Island NWR
04001	2003 Ford F250 Extended Bed Truck Replacement	2011+	\$28,000	25+	Mackay Island NWR
04002	2003 Freightliner 6X4 Stake Bed Dump Truck Replacement	2011+	\$70,000	25+	Mackay Island NWR
04003	30-Inch Pump and Bulkhead Replacement	2011+	\$60,000	15	Mackay Island NWR
04004	Bunkhouse Replacement	2011+	\$38,000	18	Mackay Island NWR
04005	Fire Cache/Quarters Replacement	2011+	\$400,000	7	Mackay Island NWR

Project Number	Project Name	Year Planned	Cost	Station Rank	Station Name
04005	Residence Entrance Road Rehabilitation	2011+	\$60,000	25+	Mackay Island NWR
04006	Shop Building Replacement	2011+	\$600,000	3	Mackay Island NWR

Appendix IX. Biological Review

U.S. Fish & Wildlife Service Biological Review of National Wildlife Refuges of the Roanoke–Tar–Neuse–Cape Fear (RTNCF) Ecosystem in Northeastern North Carolina and Southeastern Virginia

July 2002

Introduction. Currituck National Wildlife Refuge was established in 1984. The refuge has 4,570 acres of fee simple ownership and 3,931 acres of conservation easements. The primary purpose of the refuge is to protect the coastal dune ecosystem and habitat for wintering waterfowl that is the focus of the emergent wetlands on the west side of the island and one impoundment in the Swan Island Unit. The refuge now consists of seven units scattered amongst private lands (many supporting beach homes) from the Virginia-North Carolina border to North Carolina National Estuarine Research Reserve and a narrow band of property owned by The Nature Conservancy north of Corolla, North Carolina. Most of our discussion focused on the beach and dune (east) side of the refuge. The amount of public use on the beach was excessive but controlled only by the vehicles that were able to negotiate soft sands. Refuge staff will likely have little control over access since many people live all along the barrier island. This is the clearest and most direct problem facing the future integrity of this refuge.

Biological Review Overview. Work to restore quality beach nesting habitat by allowing the natural processes to occur, i.e., storm-driven blowouts in dunes. Maintain as wide as possible a line from high tide line through dunes into coastal scrub-shrub that is free of development or roads on public lands.

Protect to the maximum degree possible known or suspected beach nesting bird habitat from April through July. Most likely sites are existing blowouts in the dunes and adjacent high beach, especially with broken shells strewn throughout.

Where suitable nesting substrate exists for beach-nesting birds consider within an area of at least ½ acre in size creating a depression area that would hold rainwater during the breeding season behind to nesting area but within a recent blow-out area. This would reduce conflicts between piping plover chicks and recreationists on the beaches.

Within the framework of open hunting areas and navigable waterways, continue to enforce closed areas for waterfowl sanctuaries as much as possible.

Develop water-pumping capabilities for the Currituck Flats impoundment as soon as possible. In the interim, install a flap gate that slides into the existing flash board riser slots and will allow high wind tide events to push water onto the flats.

Manage the Currituck Flat Impoundment to provide a variety of early successional plant stages by dividing it into three vegetation management units and staggering disking/burning/mowing done on these units.

In the long term (3 to 15 years) an additional 80 to 200 (2 to 3 units) acres of managed wetlands should be developed. Any ditched and drained wetlands that are acquired should be considered for meeting this objective.

Continue and expand exclosures in various plant communities to determine effect of horses on vegetation composition and structure. Work towards minimizing already demonstrated effects of wild horses on the marshes located between the coastal scrub-shrub and the high beach, primarily saltmeadow cordgrass (*Spartina patens*).

No obvious need for management of coastal shrub-scrub and maritime forest communities other than to minimize losses to encroaching development.

Monkey Island is a locally (for northeast North Carolina) important heronry, but also is a historic site. In addition, the island is eroding away.

Restrict public use, historic site restoration, and island restoration activities on Monkey Island to the non-breeding season (September to late February).

Beaches and dunes. Besides waterfowl, the most important resources on the refuge are associated with the beach and dune systems, especially for sea beach amaranth, nesting sea turtles, and beach-nesting shorebirds, terns, and skimmers. Piping plovers formally nested on Currituck, but are not known to at present. Sea beach amaranth occurs here but present status is unclear. In the past seven years six sea turtle nests have been documented (three in 1995) along this ten-mile stretch of beach. Better survey efforts are needed to determine the status of these and other species. Additional biological staff is necessary to do the surveys needed (covered under surveys below).

There is pressure for a permanent road behind the dunes from Corolla to all the housing to the north. There already are underground utility cables along the west edge of the dunes on the refuge. The cables follow a right-of-way on the Monkey Island Unit and an easement on the Swan Island Unit. Short of total resistance to a road, if one becomes inevitable, the team recommends working to eliminate vehicular access and pets on the beach during the nesting season and position the road as far to the west through the coastal scrub-shrub as possible. The former consideration is to provide better chances for success for beach nesting birds by reducing human disturbance and the latter for allowing movement of dunes and blowouts from storm events to increase the quality of beach-nesting bird habitat over time. A third consideration especially for nesting piping plovers is availability of water and moist substrate for foraging chicks, but many hazards exist for chicks required to move from the high beach to the ocean with the existing heavy vehicular use of this beach.

Work to restore quality beach nesting habitat by allowing the natural processes to occur, i.e., storm-driven blowouts in dunes. Maintain as wide as possible a line from high tide line through dunes into coastal scrub-shrub that is free of development or roads on public lands.

Protect to the maximum degree possible known or suspected beach nesting bird habitat from April through July. Most likely sites are existing blowouts in the dunes and adjacent high beach, especially with broken shells strewn throughout.

Where suitable nesting substrate exists for beach-nesting birds consider within an area of at least ½ acre in size creating a depression area that would hold rainwater during the breeding season behind the nesting area but within a recent blow-out area. This would reduce conflicts between piping plover chicks and recreationists on the beaches.

Marshes/coves The major habitat management in marshes on the west side of Currituck are burning on a 3-year rotation. Most are dormant-season and single-ignition fires. Most marshes and coves within the refuge serve as sanctuary sites except where hunting occurs in the Currituck Marsh and South Marsh units. Disturbance may come from navigable waterways in other areas.

Within the framework of open hunting areas and navigable waterways, continue to enforce closed areas for waterfowl sanctuaries as much as possible.

Explore opportunities with the state to control certain navigable waters through a memorandum of agreement.

Managed Wetlands. The impoundment on the Swan Island Unit is being managed as a moist soil unit. During the review, the effect of the horse exclusion fence was very obvious. On the same wetland complex outside the refuge boundary and outside the exclusion fence the moist soil vegetation was non-existent except for dwarf spike rush. The area on the refuge, within the exclusion fence, had excellent dwarf spikerush as well as three square, fall panicum, smartweed and bacopa. Keeping the horses and other livestock out of this area is critical to producing good waterfowl foods on this unit. The good growth of dwarf spikerush that resulted from the wetter conditions in 2000 highlighted the advantages that would accrue from being able to keep the flats wetter than we can under normal conditions. (When the vegetation transects were performed this fall, 27% of the composition was dwarf spike rush whereas it never showed up on previous surveys.) The ability to pump some water onto the flats during the growing season should be a priority for the area. We know that the refuge is currently pursuing pumping capabilities for the area. In the interim you should consider a flapgate to allow wind tides to put some water on the area during the growing season. A flapgate that slides into the existing water control structure at the flats would be a low cost option. With the flapgate in the riser you would hold rainwater; but high tides would put water on the area through the flapgate if water levels were low behind the riser. Of course there is the problem of debris leaving the flapgate stuck open. It would have to be checked routinely.

When the impoundment needs plant succession set back, to maintain good seed/food producing plants, the area should not be disked/mowed/burned all at once. (The need for disking etc. will be determined by your fall vegetation sampling.) The review team noted that some of the later successional moist soil, still producing a good proportion of waterfowl foods, was good habitat for rails and associated marsh sparrows (especially sharp-tailed). The earliest stages, i.e. right after disking or in the spring after waterfowl feeding and winter have created areas of sparse vegetation, also provide good shorebird habitat. On refuges with multiple impoundments this range of successional stages is provided for by staggering treatments by impoundment. Since Currituck currently has only one managed impoundment you could achieve this by timing your treatment for successional shifts in different vegetation units within the impoundment (see a suggested breakout into three vegetation units in Map). This will provide not only a range of successional habitats good for shorebirds to sharp-tailed sparrows, but will also give a better diversity of waterfowl foods from the earlier successional food plants (e.g. fall panicum and wild millet) to the later (e.g. rice cutgrass and *Bidens* sp.). Also if a portion of the area does not produce good moist soil plants in a given year, consider disking the area in August and flooding to provide southbound shorebird migration habitat rather than waiting until the next spring to set back succession. This will be most practical when you have pumping capabilities.

Currituck National Wildlife Refuge should utilize the existing 143 acres and develop additional managed wetlands, to eventually provide 150 to 270 acres of well-managed moist soil and/or permanent water impoundments to help meet migrating and wintering needs of dabbling/diving ducks and other wetland birds.

Develop water-pumping capabilities for the Swan Island Unit impoundment as soon as possible. In the interim, install a flap gate that slides into the existing flash board riser slots and will allow some high wind tide events to push some water onto the flats.

Manage the Swan Island Unit Impoundment to provide a variety of early successional plant stages by dividing it into three vegetation management units and staggering disking/burning/mowing done on these units.

In the long term (3 to 15 years) an additional 80 to 200 (2 to 3 units) acres of managed wetlands should be developed. Any ditched and drained wetlands that are acquired should be considered for meeting this objective.

Horses. Horses on Currituck have been an important management issue since the establishment of the refuge. Regardless of sentimental value these horses have with the public, they are exotic and potentially damaging to vegetation under active management. The effect horses have on sea beach amaranth (if any) needs to be determined, as does interdune grasslands and marshes. Also noted during review was the difference between areas where horses are excluded versus where they freely feed. Clearly horses have a dramatic effect on the development of moist soil associated plants and therefore waterfowl use later in the year.

Continue and expand exclosures in various plant communities to determine effect of horses on vegetation composition and structure. Work towards minimizing already demonstrated effects of wild horses on the marshes located between the coastal scrub-shrub and the high beach, primarily saltmeadow cordgrass (*Spartina patens*).

Impoundments

Control invasive, non-desirable plant communities (alligator weed, Phragmites, etc.) so it does not impact more than 10 percent coverage of any impoundment.

Utilize chemical, fire, disking, water control, etc., to reduce impact of invasive/non-desirable plants.

If poor quality waterfowl foods or invasive plants equal or exceed 50% of coverage, then extreme control measures are needed (even fall disking or multi-year deep flooding).

Recognizing personnel and budgetary limitations, work with and support migratory bird conservation efforts on nearby Private Lands.

Contact/visit at least 75% of the adjacent landowners currently managing wetlands/forest, etc., for migratory birds and provide technical aid.

Promote, encourage only 3 one-half days of hunting (or less) on private sites.

Encourage landowners to keep holding water until mid-March or at least late February for waterfowl and do slow drawdown. Where possible hold and drawdown slowly through April-early May for migrating wading and shorebirds.

Via membership on ecosystem teams and whenever State meetings occur, give support and priority to the State/Federal/Private Land sanctuary area program and North Carolina Partners activities.

After hunting seasons, if landowner's corn is still standing, work with him/her to recommend mowing or knocking down for better waterfowl use.

Meet wood duck banding quota and help band/observe swans and geese.

Work to band your quota of wood ducks, with emphasis on June, July, August, and early September periods and age/sex quotas. Record results in annual narrative.

Each month (mid-October to early March) help band and/or observe collared swans.

Check and monitor wood duck box use at least twice a year (right before spring nesting period and after peak spring/summer nesting - probably July). If feasible, check boxes every 35-40 days during peak nesting periods (March, April, May).

Review Regional Guidelines for data recording, or utilize other standardized data recording sheets. Show results in Annual Narrative.

Remove the boxes that are in poor condition, ensure all boxes have predator guards.

If use of present boxes exceeds 60%, add up to 50 more wood duck boxes if personnel (volunteers, etc.) are available to clean and monitor boxes (follow procedures in Regional wood duck guidance).

All refuges should use scientifically sound inventory/monitoring methods to survey numbers and trends of focus wildlife species, plant communities, and management programs. Properly recorded/archived data will be collected to (1) evaluate habitat management actions and wildlife responses and (2) allow use of adaptive management procedures that improve subsequent management/restoration decisions.

Utilize standardized aerial and ground surveys to census waterfowl on all impoundments and aerial surveys to monitor Lake/Bay/Sound usage. Twice a month (preferred) conduct aerial counts (mid-October - mid March) and twice a month conduct ground surveys of impoundments (early October - late March). Continue coordinating these surveys through Roanoke – Tar – Neuse – Cape Fear Ecosystem as is currently being done.

Continue to work with Migratory Bird Division pilot/biologists to cooperatively fly aerial surveys. Be sure and have refuge flown during the official mid-winter survey.

Record ground survey data by individual impoundments or at least by impoundment units.

All survey data should be available in refuge's annual narrative and entered into the web site maintained by the Manteo Migratory Bird Field Office Office/Raleigh Ecological Services Office. Survey routes and techniques should be described and repeatable.

If water is present in September, survey teal use.

Actively record biweekly (i.e. every 2 weeks) water levels and plant germination progress in all managed impoundments during spring and summer to determine subsequent/follow up actions.

Prepare proposed water management plan for next year's actions.

Utilize water gauges in all impoundments to record biweekly/monthly water levels (especially in early spring/summer).

Sample plant germination during early spring/after drawdown, identify dominant plant species, and modify management strategy as needed. Utilize Migratory Bird Field Office biologist to help with surveys.

Record results of plant responses to impoundment management actions by conducting plant surveys in late summer/early fall. Determine coverage of preferred waterfowl plant species. Work with Roanoke – Tar – Neuse – Cape Fear Ecosystem Biologist Group to standardize survey methods and data analysis.

Consult with Migratory Bird Field Office biologist to conduct standardized sampling of plant communities (record data in repeatable format).

Present results in next years water management plan and in annual narrative.

Maritime Grasslands. About 137 acres of this habitat type exists primarily on the Monkey Island Unit of Currituck National Wildlife Refuge.

Burning program should maintain grassy interdune areas free of invading shrubs, but should not be used to reduce well-developed shrub-scrub on elevated hummocks.

Coastal scrub-shrub and maritime forest. Along much of the Currituck National Wildlife Refuge, wide patches of coastal scrub-shrub exist behind the primary dunes. These patches vary from very dense to more open (with bare ground and grassy patches). The team saw no obvious need from a biological perspective to change anything through management recognizing importance of both of these conditions, primarily for migratory landbirds. In the more open patches, field sparrows were singing and it is possible such habitat may also support prairie warblers. However, there may be a need to occasionally reduce fuel load in the denser stands, which may require consideration of prescriptive burning. In more protected areas, maritime forests persist and these remnants should be important for canopy foraging neotropical migrants.

No obvious need for management of coastal shrub-scrub and maritime forest communities other than to minimize loses to encroaching development.

Monkey Island is a locally (for northeast North Carolina) important heronry, but also is a historic site. In addition, the island is eroding away.

Restrict public use, historic site restoration, and island restoration activities on Monkey Island to the non-breeding season (September to late February).

Goals, Objectives, and Strategies

Beachfront (202 acres)

Goal. - Maintain, improve, and protect nesting habitat for sea turtles; nesting, foraging and roosting habitat for shorebirds and colonial waterbirds; and habitat supporting seabeach amaranth.

Objective. - Convene a meeting including national and local sea turtle experts, all refuges subject to this review (Back Bay, Currituck, and Pea Island), national seashores, and other sea turtle nesting areas along the outer banks to resolve how best to conserve these species in areas where nests are doomed to fail from consistently high tides washing over nests.

Objective. - Survey for seabeach amaranth and fully protect sites where this endangered plant is found.

Objective. – Maintain and improve nesting, roosting, and foraging habitat for shorebirds and colonial waterbirds.

Objective. - Survey for plover and colonial waterbird nesting areas and at minimum determine number of pairs and if prudent determine productivity.

Objective. – Maintain and improve nesting habitat for:
piping plover (federally threatened),
American oystercatcher,
black skimmer,
least tern,
common tern, and
gull-billed tern.

Strategy - Roanoke – Tar – Neuse – Cape Fear Ecosystem Migratory Bird Committee – develop ecosystem population goals from the Southeastern Coastal Plains-Caribbean Regional Shorebird Plan/North American Waterbird Conservation Plan to the Roanoke – Tar – Neuse – Cape Fear Ecosystem area. Determine habitat needed to provide for the number of pairs /reproductive rate.

Strategy. - Work to restore quality beach nesting habitat by allowing the natural processes to occur, i.e., storm-driven blowouts in dunes. Maintain as wide as possible a line from high tide line through dunes into coastal scrub-shrub that is free of development or roads on public lands.

Strategy. - Protect to the maximum degree possible known or suspected beach nesting bird habitat from April through July. Most likely sites are existing blowouts in the dunes and adjacent high beach, especially with broken shells strewn throughout.

Strategy. - Where suitable nesting substrate exists for beach-nesting birds consider within an area of at least ½ acre in size creating a depression area that would hold rainwater during the breeding season behind to nesting area but within a recent blow-out area. This would reduce conflicts between piping plover chicks and recreationists on the beaches.

Objective. - Improve foraging habitat by minimizing “beach restoration” after storm surges, thereby providing important overwash habitats.

Objective. - Survey for beach foraging shorebirds during migration and winter using International Shorebird Survey protocol.

Objective. - Protect regularly used shorebird and colonial nesting bird roosting and loafing areas from repeated disturbances from the public, including both sites on the beach proper and unvegetated areas behind the dune line (including hard panne).

Objective. - Search for roosting concentrations of shorebirds and determine relative threat from repeated disturbances.

Marshes (predominantly Brackish and Fresh Water - 2,202 acres)

Goal. – Manage marshlands to maintain a diversity of plant species and patchy structure for supporting priority birds (both waterfowl and nongame species), diamondback terrapin, and fisheries.

Objective. – Survey using secretive marshbird protocol for occurrence of priority species to identify both sites that should be maintained as well as sites in need of improvement through management, principally for:

American bittern
least bittern
yellow rail
black rail
clapper rail
king rail
saltmarsh seaside sparrow
seaside sparrow

Objective. - Burn marshlands annually on a 1-4 year fire frequency to maintain or improve species diversity, improve plant productivity, and restore the upland marshes back to grasses.

Objective. - Explore alternate firing techniques to mimic natural wildfires in marshes (e.g. single point ignitions).

Objective. - Perform Phragmites and cattail control where needed.

Objective. - Monitor effects of marsh burning and various firing techniques on “secretive marsh birds” such as bitterns, rails, and sparrows. Use findings to make recommendations to mitigate impacts on these species in the future.

Objective. - Monitor vegetation response to burning and that of the biotic community at large to adapt management techniques. (Issues: timing, frequency, prescriptive criteria of burns, etc.).

Objective. – Develop monitoring protocol for tracking diamondback terrapin populations.

Managed Wetlands (i.e., impoundments with canals and dikes that may include open water, moist soil, exposed flat, trees (green tree reservoirs) and emergent vegetation with varying amounts and management regimes, as well as management of vegetation on dikes and levees; 143 acres)

Goal. - Manage and maintain impoundments to achieve habitat and migratory bird objectives for waterfowl, shorebirds, marshbirds, colonial waterbirds, other waterbirds, and associated landbirds.

Objective. - Monitor water quality on a periodic basis.

Objective. - Spot surveys of submerged aquatic vegetation (SAV) for affected open water areas and manage appropriately to maintain suitable to optimal conditions for wintering waterfowl and other waterbirds.

Objective. - Currituck National Wildlife Refuge should utilize the existing 143 acres and develop additional managed wetlands, to eventually provide 200 to 300 acres of well-managed moist soil and/or permanent water impoundments to help meet migrating and wintering needs of dabbling/diving ducks and other wetland birds.

Strategy. - Develop water-pumping capabilities for the Swan Island Unit impoundment as soon as possible. In the interim, install a flap gate that slides into the existing flash board riser slots and will allow some high wind tide events to push some water onto the flats.

Strategy. - Manage the Swan Island Unit Impoundment to provide a variety of early successional plant stages by dividing it into three vegetation management units and staggering mowing/burning/mowing done on these units.

Strategy. - In the long term (3-10 years) an additional 130-230 acres of managed wetlands (2-3 units) should be developed. Any ditched and drained wetlands that are acquired should be considered for meeting this objective.

Strategy. - Continue and expand exclosures in various plant communities to determine effect of horses on vegetation composition and structure. Work towards minimizing already demonstrated effects of wild horses on the marshes located between the coastal scrub-shrub and the high beach, primarily saltmeadow cordgrass (*Spartina patens*).

Objective. - Control invasive, non-desirable plant communities (alligator weed, Phragmites, etc.) so it does not impact more than 10 percent coverage of any impoundment.

Strategy. - Utilize chemical, fire, disking, water control, etc., to reduce impact of invasive/non-desirable plants.

Strategy. - As appropriate, farmer coop. rent should be used to control invasive plants.

Strategy. - If poor quality waterfowl foods or invasive plants equal or exceed 50% of coverage, then extreme control measures are needed (even fall disking or multi-year deep flooding).

Objective. - Recognizing personnel and budgetary limitations, work with and support migratory bird conservation efforts on nearby Private Lands. Contact/visit at least 75% of the adjacent landowners currently managing wetlands/forest, etc., for migratory birds and provide technical aid.

Strategy. - Promote, encourage only 3 one-half days of hunting (or less) on private sites.

Strategy. - Encourage landowners to keep holding water until mid-March or at least late February for waterfowl and do slow drawdown. Where possible hold the water and drawdown slowly through April or early May for migrating wading and shorebirds.

Strategy. - Via membership on ecosystem teams and whenever State meetings occur, give support and priority to the State/Federal/Private Land sanctuary area program and North Carolina Partners activities.

Strategy. - After hunting seasons, if landowner's corn is still standing, work with him/her to recommend mowing or knocking down for better waterfowl use.

Objective. - Meet wood duck banding quota and help band/observe swans and geese.

Strategy. - Work to band your quota of wood ducks, with emphasis on June, July, August, and early September periods and age/sex quotas. Record results in annual narrative.

Strategy. - Each month (mid-October - early March) help band and/or observe collared swans.

Objective. - Check and monitor wood duck box use at least twice a year (right before spring nesting period and after peak spring/summer nesting - probably July). If feasible, check boxes every 35 to 40 days during peak nesting periods (March, April, May).

Strategy. - Review Regional Guidelines for data recording, or utilize other standardized data recording sheets. Show results in Annual Narrative.

Strategy. - Remove boxes that are in poor condition, ensure all boxes have predator guards.

Strategy. - If use of present boxes exceeds 60%, add up to 50 more wood duck boxes if personnel (volunteers, etc.) are available to clean and monitor boxes (follow procedures in Regional wood duck guidance).

Goal. - All refuges should use scientifically sound inventory/monitoring methods to survey numbers and trends of focus wildlife species, plant communities, and management programs. Properly recorded/archived data will be collected to (1) evaluate habitat management actions and wildlife responses and (2) allow use of adaptive management procedures that improve subsequent management/restoration decisions.

Objective. - Utilize standardized aerial and ground surveys to census waterfowl on all impoundments and aerial surveys to monitor Lake/Bay/Sound usage. Twice a month (preferred) conduct aerial counts (mid-October - mid March) and twice a month conduct ground surveys of impoundments (early October - late March). Continue coordinating these surveys through Roanoke to Tar – Neuse – Cape Fear Ecosystem as is currently being done. Where possible count other waterbirds using a standardized approach (to be determined). If possible– utilize weekly ground counts – including ground counts same week as aerial survey.

Strategy. - Continue to work with Migratory Bird Division pilot/biologists to cooperatively fly aerial surveys. Be sure and have refuge flown during the official mid-winter survey.

Strategy. - Record ground survey data by individual impoundments or at least by impoundment units.

Strategy. - All survey data should be available in refuge's annual narrative and entered into the web site maintained by the Manteo Migratory Bird Field Office/Raleigh Ecological Services Office. Survey routes and techniques should be described and repeatable.

Strategy. - If water is present in September, survey teal use.

Objective. - Actively record biweekly water levels and plant germination progress in all managed impoundments during spring and summer to determine subsequent/follow up actions.

Strategy. - Prepare proposed water management plan for next year's actions.

Strategy. - Utilize water gauges in all impoundments to record biweekly/monthly water levels (especially in early spring/summer).

Strategy. - Sample plant germination during early spring, identify dominant plant species and modify management strategy as needed. Utilize Migratory Bird Field Office biologist to help with surveys.

Objective. - Record results of plant responses to impoundment management actions by conducting plant surveys in late summer/early fall. Determine coverage of preferred waterfowl plant species. Work with Roanoke – Tar – Neuse – Cape Fear Ecosystem Biologist Group to standardize survey methods and data analysis.

Strategy. - Consult with Migratory Bird Field Office biologist to conduct standardized sampling of plant communities (record data in repeatable format).

Strategy. - Present results in next years water management plan and in annual narrative.

Objective. – Survey using secretive marshbird protocol for occurrence of priority species to identify both sites that should be maintained as well as sites in need of improvement through management, principally for:

American bittern
least bittern
yellow rail
black rail
clapper rail
king rail
saltmarsh seaside sparrow
seaside sparrow

Objective. - Burn marshlands annually on a 1-4 year fire frequency to maintain or improve species diversity, improve plant productivity, and restore the upland marshes back to grasses.

Objective. - Explore alternate firing techniques to mimic natural wildfires in marshes (e.g. single point ignitions).

Objective. - Monitor vegetation response to burning and that of the biotic community at large to adapt management techniques. (Issues: timing, frequency, prescriptive criteria of burns, etc.).

Objective. - Control Phragmites/cattail encroachment and control other exotic pest invasions.

Objective. - Monitor effects of marsh burning and various firing techniques on “secretive marsh birds” such as bitterns, rails, and sparrows. Use findings to make recommendations to mitigate impacts on these species in the future.

Objective. – Provide exposed mudflat for shorebirds April to May and July to October (Acreage objectives should be guided by the Southeastern Coastal Plain-Caribbean Regional Shorebird Plan that gives goals for the Southeastern Virginia-North Carolina Region. These goals and a listing of the planned shorebird habitat for the current migration will be available on the South Atlantic Migratory Bird Initiative (SAMBI) web page).

Objective. - Survey for foraging and roosting shorebirds during migration and winter using International Shorebird Survey protocol.

Objective. – Record results of invertebrate responses to impoundment management actions by conducting surveys. Work with the Roanoke – Tar – Neuse – Cape Fear Ecosystem Biologist Group to standardize survey methods and data analysis. Survey conditions and seasons most likely to support high aquatic invertebrate densities in support of peak shorebird migration and wintering populations.

Objective. - Manage vegetation along dikes as necessary for maintenance, but maintain flexibility for maintaining quality landbird habitat during migration as much as possible (especially at Pea Island).

Objective. – For wooded areas/edges along dikes, track use of habitat use during landbird migration using standardized migration monitoring protocol.

Maritime Grasslands (includes Dune Grass, 137 acres)

Goal. – Restore and maintain grassy conditions throughout interdune systems for grassland priority species, while maintaining shrub and small tree patches on elevated hummocks for landbird migrants.

Objective. – Apply prescribed fire to reduce dense shrub-scrub coverage and increase grassy conditions, but maintain shrub and small tree patches on hummocks.

Objective. – Monitor migrant and winter grassland bird communities using Project Prairie Bird protocol (especially search for “Ipswich” savannah sparrows) and raptor roadside surveys.

Maritime Shrub (778 acres)

Goal. – Monitor condition of maritime shrub communities and use by wildlife.

Objective. – Determine management need based on surrounding conditions.

Strategy. - No obvious need for management of maritime shrub-scrub communities other than to minimize losses to encroaching development, though some attention to fire hazard may also be needed.

Objective. – Monitor use by migrant and breeding songbirds using Migration Monitoring protocol and point counts as appropriate.

Maritime Forest (637 acres)

Goal. – Monitor condition of maritime forest communities and use by wildlife.

Objective. - No obvious need for management of maritime forest communities other than to minimize losses to encroaching development.

Objective. – Monitor use by migrant songbirds at least during southbound migration using Migration Monitoring protocol, compare with Kitty Hawk and Nags Head Woods.

Administrative Areas

Goal. - Provide for efficient management access and care of equipment and safety of personnel. Wherever possible, work to reduce the numbers and widths of roads, firebreaks, and other administrative features that may contribute to habitat fragmentation and elevated depredation of bird nests.

Objective. - Either maintain administrative buildings and maintenance areas off-refuge as much as possible or concentrate them in areas of already extensive open land on the refuge.

Objective. - As habitats are restored, the need may be a reduced need to maintain existing road networks. Each refuge should plan accordingly.

Objective. - Although many refuge lands temporarily require more frequent prescribed burning than would be recommended due to past fire suppression practices, after several cycles the numbers and widths of firebreaks should be reduced.