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**MERRITT ISLAND NATIONAL WILDLIFE REFUGE**

**DRAFT COMPREHENSIVE CONSERVATION PLAN**

And

**ENVIRONMENTAL ASSESSMENT**

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

***November 2006***

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## SECTION A. DRAFT COMPREHENSIVE CONSERVATION PLAN

# *I. BACKGROUND*

## INTRODUCTION

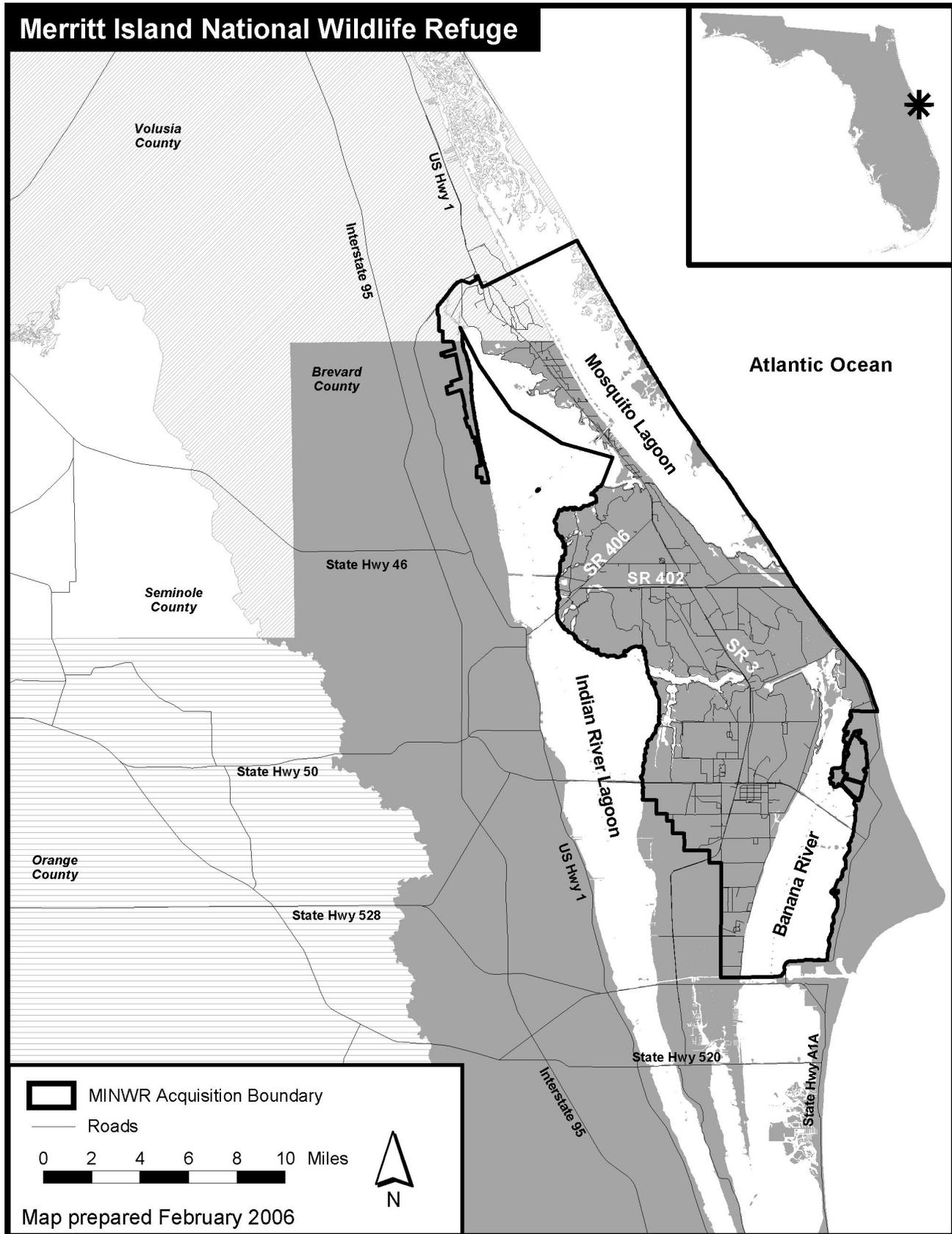
Located along Florida's east central coast about 60 miles east of the city of Orlando in Brevard and Volusia Counties, Merritt Island National Wildlife Refuge was established by agreement as an overlay of the National Aeronautics and Space Administration's John F. Kennedy Space Center (see Figure 1). The over 140,000 acres of the refuge support over 500 wildlife species and over 1,000 plant species, including a variety of waterfowl, shorebirds, and neotropical migratory birds, as well as 93 federally or state listed species and native wildlife and habitat diversity through a mix coastal habitats, including the beach and dune system, estuarine waters, forested and non-forested wetlands, impounded wetlands, and upland shrublands and forests. Located along the Atlantic Ocean, the refuge includes three major water bodies, which are all part of the Indian River Lagoon system: Indian River Lagoon, Mosquito Lagoon, and Banana River. The refuge supports important bird rookeries, a juvenile sea turtle nursery, sea turtle nesting beaches, fish spawning and settlement sites, and important manatee habitat. The refuge is an important overwintering and stopover site for a variety of waterfowl, shorebirds, and neotropical migratory birds. And, the refuge protects historical and archaeological sites. The refuge holds several special designations, including: Outstanding Florida Waters; Essential Fish Habitat; Honorary Historic Landmark of Brevard County, Florida; Great Florida Birding Trail Eastern Gateway; Candidate Marine Protected Area; and Globally Important Bird Area. A growing human population, along with ongoing development and other human activities, currently threatens the fragile, but highly productive waters of the Indian River Lagoon system and the refuge.

This Draft Comprehensive Conservation Plan for Merritt Island National Wildlife Refuge was prepared to guide future refuge management and provides two documents required by federal laws: the Merritt Island National Wildlife Refuge Comprehensive Conservation Plan (required by the National Wildlife Refuge System Improvement Act of 1997) and an Environmental Assessment (required by the National Environmental Policy Act of 1969). A planning team developed a range of alternatives that best met the goals and objectives of the refuge. Following a public review and comment period on this draft plan, a final decision will be made by the Fish and Wildlife Service that will guide refuge management programs and projects over a 15-year planning period. While the plan provides general guidance, subsequent step-down plans will provide more detailed management direction and actions.

## 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. As part of its mission, the Service administers the National Wildlife Refuge System, a national network of lands and waters established for the management and protection of these resources.

Figure 1. Refuge Location and Acquisition Boundary



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## National Wildlife Refuge System

To date, the Refuge System is comprised of more than 540 national wildlife refuges and over 3,000 small waterfowl breeding and nesting sites covering nearly 100 million acres, the world's largest collection of lands and waters specifically managed for fish and wildlife. The majority of these lands, 77 million acres, are in Alaska. The remaining acres are spread across the other 49 states and several island U.S. territories. The mission of the Refuge System is:

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

National Wildlife Refuge System Improvement Act of 1997

The wildlife and habitat vision for national wildlife refuges stresses that wildlife come first; that ecosystems, biodiversity, and wilderness are vital concepts in refuge management; that refuges must be healthy; that the growth of refuges and the Refuge System must be strategic; and that the Refuge System serves as a model for habitat management with broad participation from others. This broad participation includes local, state, and federal government partners; organizations; the local business communities; individuals; and volunteers. Volunteers continue to be a major contributor to the success of the Refuge System and in 1999, some 36,000 of them contributed more than 1.3 million hours on refuges nationwide, representing an economic value of more than \$20 million.

The National Wildlife Refuge System Improvement Act of 1997 established, for the first time, a clear legislative mission of wildlife conservation for the National Wildlife Refuge System. Activities were initiated in 1997 to complement the direction of this new legislation, including an effort to complete 15-year management plans (i.e., comprehensive conservation plans) for all refuges. These plans, which are conducted with full public involvement, help guide the future management of refuges, including providing management direction for natural resources and recreation and education programs. The Improvement Act states that each refuge shall be managed to:

- fulfill the mission of the Refuge System;
- fulfill the individual purposes of each refuge;
- consider the needs of 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; and
- recognize that wildlife-dependent recreation activities, including hunting, fishing, observing wildlife, photographing wildlife, and participating in environmental education and interpretation, are legitimate and priority public uses of national wildlife refuges.

The National Wildlife Refuge System hosts over 35 million annual visitors. Economists found that these refuge visitors contribute more than \$400 million annually to local economies. In 2001 on conservation lands throughout the nation, approximately 37.8 million people participated in wildlife related activities, most to observe wildlife in their natural habitats. These visitors represent nearly 40 percent of the country's adults who spent \$108 billion on wildlife-related pursuits in 2001, according to the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (U.S. Department of Interior, Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau 2001). As visitation continues to grow on conservation lands and waters in general and specifically on refuges, adjacent local communities are realizing economic benefits.

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## LEGAL POLICY CONTEXT

Administration of national wildlife refuges is guided by the mission and goals of the National Wildlife Refuge System, congressional legislation, Presidential executive orders, and international treaties. Policies for management options of refuges are further refined by administrative guidelines established by the Secretary of the Interior and by policy guidelines established by the Director of the Fish and Wildlife Service. Management options are guided by a refuge's establishing authorities, Public Law 104, Stat. 2957 (§108, H.R. 3338), and the National Wildlife Refuge System Improvement Act of 1997 (see Appendix C for more information on legal and policy guidance for the operation of national wildlife refuges). Key guidance and direction can be found in:

- National Wildlife Refuge System Administration Act of 1966;
- Refuge Recreation Act of 1962;
- Title 50 of the Code of Federal Regulations;
- U.S. Fish and Wildlife Service Manual; and
- National Wildlife Refuge System Improvement Act of 1997.

Since refuges must be managed for wildlife first, lands and waters within the National Wildlife Refuge System are closed to public uses unless specifically and legally opened under specified conditions providing for compatibility with the refuges' purpose(s). All programs and uses of a refuge must be evaluated based on mandates set forth in the National Wildlife Refuge System Improvement Act, including to:

- contribute to ecosystem goals, as well as to refuge purpose(s) and goals;
- conserve, manage, and restore fish, wildlife, and plant resources and their habitats;
- monitor the trends of fish, wildlife, and plants;
- manage and ensure compatible wildlife-dependent visitor uses as those uses which benefit the conservation of fish and wildlife resources and which contribute to the enjoyment of the public (these uses include hunting, fishing, observing wildlife, photographing wildlife, and participating in environmental education and interpretation); and
- ensure that visitor activities are compatible with refuge purpose(s).

## NATIONAL CONSERVATION PLANS AND INITIATIVES

In addition to these guiding principles, several national landscape level conservation plans and initiatives also impact the management of the refuge's resources, including those listed.

- U.S. Department of the Interior, Fish and Wildlife Service Strategic Plan
- Wildlife Fire and Air Quality National Strategic Plan
- U.S. Fish and Wildlife Service, Fulfilling the Promise: The National Wildlife Refuge System
- North American Bird Conservation Initiative
- North American Waterfowl Management Plan
- North American Colonial Waterbird Conservation Plan
- Southeastern U.S. Region Waterbird Conservation Plan
- U.S. Shorebird Conservation Plan
- U.S. Shorebird Conservation Plan: Southeastern Coastal Plains-Caribbean Region
- Western Hemisphere Shorebird Reserve Network
- Partners in Flight Bird Conservation Plans
- Atlantic Coast Joint Venture Management Plan
- Atlantic Coast Joint Venture Waterfowl Implementation Plan

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- North Florida Ecosystem Unit Management Plan for Fish and Wildlife Service Trust Resources
  - Fish and Wildlife Service Florida Manatee Recovery Plan
  - Fish and Wildlife Service Florida Scrub-jay Recovery Plan (in preparation)
  - Fish and Wildlife Service Recovery Plan for Anastasia Island Beach Mouse and Southeastern Beach Mouse
  - Fish and Wildlife Service Recovery Plan for Leatherback Turtles *Dermochelys coriacea* in the Caribbean, Atlantic, and Gulf of Mexico
  - Fish and Wildlife Service Recovery Plan for the U.S. Population of the Atlantic Green Turtle *Chelonia mydas*
  - Fish and Wildlife Service Recovery Plan for the U.S. Population of Loggerhead Sea Turtle (*Caretta caretta*)
  - Recovery Plan for Marine Turtles. National Marine Fisheries Service
  - Fish and Wildlife Service Southeastern States Bald Eagle Recovery Plan
  - Fish and Wildlife Service Eastern Indigo Snake Recovery Plan
  - Fish and Wildlife Service Revised Recovery Plan for the U.S. Breeding Population of the Wood Stork
  - Fish and Wildlife Service Atlantic Coast Piping Plover Recovery Plan

## **RELATIONSHIP TO STATE PARTNERS**

The Fish and Wildlife Service is committed to encouraging and maintaining partnerships with others to improve the environmental health of ecosystems and the National Wildlife Refuge System. Partnerships are recognized by the Service as vital to fulfill its mission and help share advocacy for fish and wildlife resources. Some of the current partners include federal and state agencies, environmental organizations, outdoor sporting groups, industry, local governments, and private landowners. A provision of the National Wildlife Refuge System Improvement Act of 1997 and subsequent agency policy provides 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.

For Merritt Island Refuge, state agency partners include: Florida Fish and Wildlife Conservation Commission, Florida Department of Environmental Protection, Florida Division of Forestry, Florida Inland Navigation District, and St. Johns River Water Management District. Management of state fish and wildlife is administered by the Florida Fish and Wildlife Conservation Commission (<http://www.floridaconservation.org/>) and the Florida Department of Environmental Protection (<http://www.dep.state.fl.us/>). These state agencies are charged with enforcement responsibilities relating to migratory birds, trust species, and fisheries, as well as with management of natural resources of the state. Both agencies manage state lands and waters. The Fish and Wildlife Conservation Commission manages 4.3 million acres of public lands and 220,000 acres of private lands for recreation and conservation purposes. The Department of Environmental Protection manages 150 state parks covering nearly 600,000 acres and 57 coastal and aquatic managed areas, totaling over 5 million acres of submerged lands and coastal uplands. Various agencies within the state government have participated in a mix of refuge projects, including the planning process to develop a 15-year management plan for the refuge. The State of Florida's participation and contribution throughout this comprehensive conservation planning process provide for ongoing opportunities and open dialogue to improve the ecological sustainment of fish and wildlife in Florida. An integral part of the comprehensive conservation planning process is integrating common mission objectives, where appropriate.



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## *II. Refuge Environment*

### **INTRODUCTION**

At over 140,000 acres, Merritt Island National Wildlife Refuge is located along the Atlantic coast of east central Florida in one of the most productive estuaries in the country - the Indian River Lagoon (Figure 1). The Lagoon has more species of plants and animals than any other estuary in North America (South Florida Water Management District 2005). Since it is located where the temperate and tropical zones overlap and since it is located within the Indian River Lagoon, the refuge is uniquely situated to support a wide variety of resident and migratory species. The refuge derives its name from Merritt Island, which, along with Cape Canaveral, is a barrier island complex that formed during the Pleistocene and Holocene periods. The complex is one of the last extensive undeveloped barrier islands on the east coast of Florida. The lagoon's location, combined with its large size and other physical characteristics make it one of the most diverse estuaries in North America. As a result, a wide array of habitats exist on the refuge, including the beach and dune system, estuarine waters, forested and non-forested wetlands, impounded wetlands, and upland shrublands and forests. These diverse refuge habitats support over 1,000 plant species and are utilized by over 500 fish and wildlife species, including 10 regularly occurring federally listed threatened and endangered species.

The refuge, established on August 28, 1963, was the 286<sup>th</sup> refuge of the National Wildlife Refuge System. It is an overlay refuge that was established through a management agreement between National Aeronautics and Space Administration and the Service at Kennedy Space Center. According to the agreement, the lands and waters of the space center are primarily to serve the space program and secondarily to serve as a wildlife refuge or park.

Primary habitat management activities on the refuge involve applying prescribed fire, using mechanical treatments in upland scrub, employing chemical control of exotic plants, and managing water levels in impounded wetlands. Low-intensity prescribed burning activities help to enhance and maintain vegetative communities that are dependent upon or positively influenced by fire, for the benefit of wildlife; to promote nutrient cycling; and to reduce an unnatural buildup of fuels that could otherwise create hazardous, high-intensity wildfires. Among 76 impounded wetlands of the refuge, water levels in 33 are seasonally manipulated to benefit migratory waterfowl, wading birds, shorebirds, and other wildlife. The other wetlands are managed for fisheries and restoration. Additional upland management activities include the periodic thinning of pine flatwoods to enhance nesting habitat for bald eagles, as well as the control of exotic, invasive, and nuisance species.

### **REFUGE HISTORY AND PURPOSES**

By 1962, the National Aeronautics and Space Administration had purchased most of the northern portion of the barrier island known as Merritt Island in order to launch rockets into space. Located adjacent to the U.S. Air Force's Cape Canaveral Air Force Station, the new site was named John F. Kennedy Space Center. Sufficient lands to serve as safety and security buffer zones in order to launch the heavy lift booster rockets for manned space exploration were acquired through fee title purchases, condemnation, and negotiation with the State of Florida for state lands and waters. On August 28, 1963, the Fish and Wildlife Service entered into a cooperative agreement with NASA to establish the Merritt Island National Wildlife Refuge, where space operations have priority. In this initial interagency agreement, NASA transferred management authority to the refuge for only a portion of Kennedy Space Center's lands and waters. This agreement authority was expanded in the 1960s and by 1972 it included all non-operational areas of the space center. A new updated agreement between NASA and the Service was signed by both parties in May 2002. The most

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recent agreement reflects the changes in operations of the two agencies and the coordination procedures that have occurred over time.

On April 2, 1975, Congress established the Canaveral National Seashore. This act transferred management responsibility of Playalinda Beach and approximately 1,000 acres north of the Gomez Grant Line to the National Park Service. At the same time approximately 34,345 acres in and around Mosquito Lagoon were designated as a joint management area between Park Service and the Service. Natural resource management of much of the joint jurisdiction area remained under refuge management, while the Park Service assumed management of all cultural resources in this overlap area. Generally, the Seashore manages those areas in the refuge/Seashore overlap east of the beach or sand road and the refuge manages the remainder of that overlap.

Due to its nature as an overlay of Kennedy Space Center and its unique location and resources, the refuge has two traditional purposes, as well as an additional purpose stemming from legislation that created a unit of the National Park Service. Recognizing the high migratory bird benefits served by the lands and waters of the refuge, the Service administratively designated Merritt Island Refuge in 1963 under the Migratory Bird Conservation Act, outlining a primary purpose of these lands and waters:

"...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."

16 USC §715d (Migratory Bird Conservation Act)

Further reading of the Migratory Bird Conservation Act also recognizes benefits to other species, including those designated threatened or endangered:

"...to conserve and protect migratory birds...and other species of wildlife that are listed...as endangered species or threatened species and to restore or develop adequate wildlife habitat."

16 USC §715i (Migratory Bird Conservation Act)

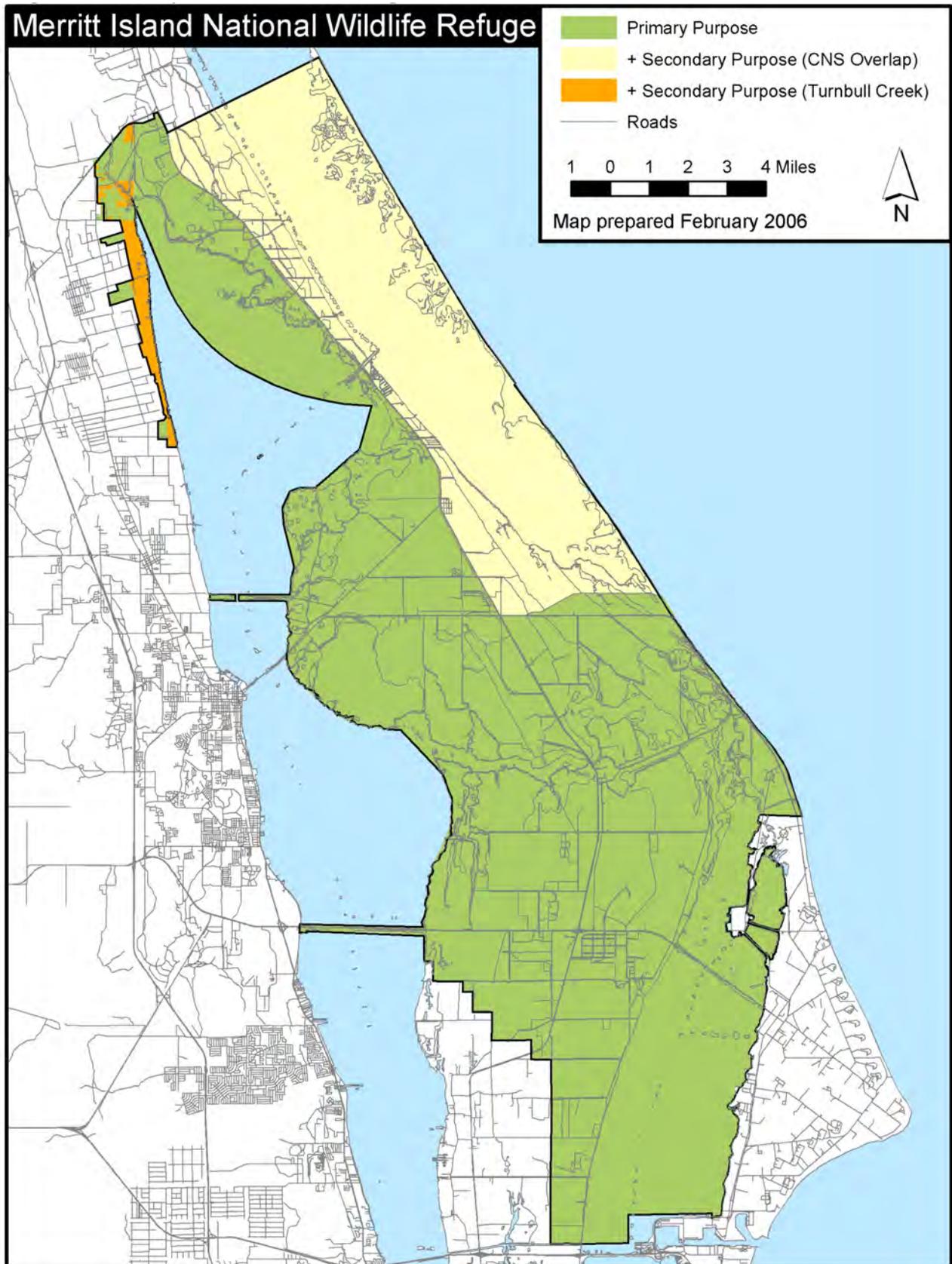
The refuge's primary purpose applies to all lands and waters managed by the refuge, regardless of when they were added to the refuge (Figure 2). Since the refuge has management agreements with NASA and the State of Florida, lands and waters under those management agreements are also subject to the conditions of those agreements.

In 1995, the refuge and its partners began purchasing additional lands and waters in the northwest corner of the refuge, the Turnbull Creek area:

"(1) to protect, enhance, restore, and manage an appropriate distribution and diversity of wetland ecosystems and other habitats for migratory birds and other fish and wildlife in North America; (2) to maintain current or improved distributions of migratory bird populations; and (3) to sustain an abundance of waterfowl and other migratory birds consistent with the goals of the North American Waterfowl Management Plan and the international obligations contained in the migratory bird treaties and conventions and other agreements with Canada, Mexico, and other countries."

16 USC §4401(2)(b) (North American Wetlands Conservation Act)

Figure 2. Purposes of the Refuge



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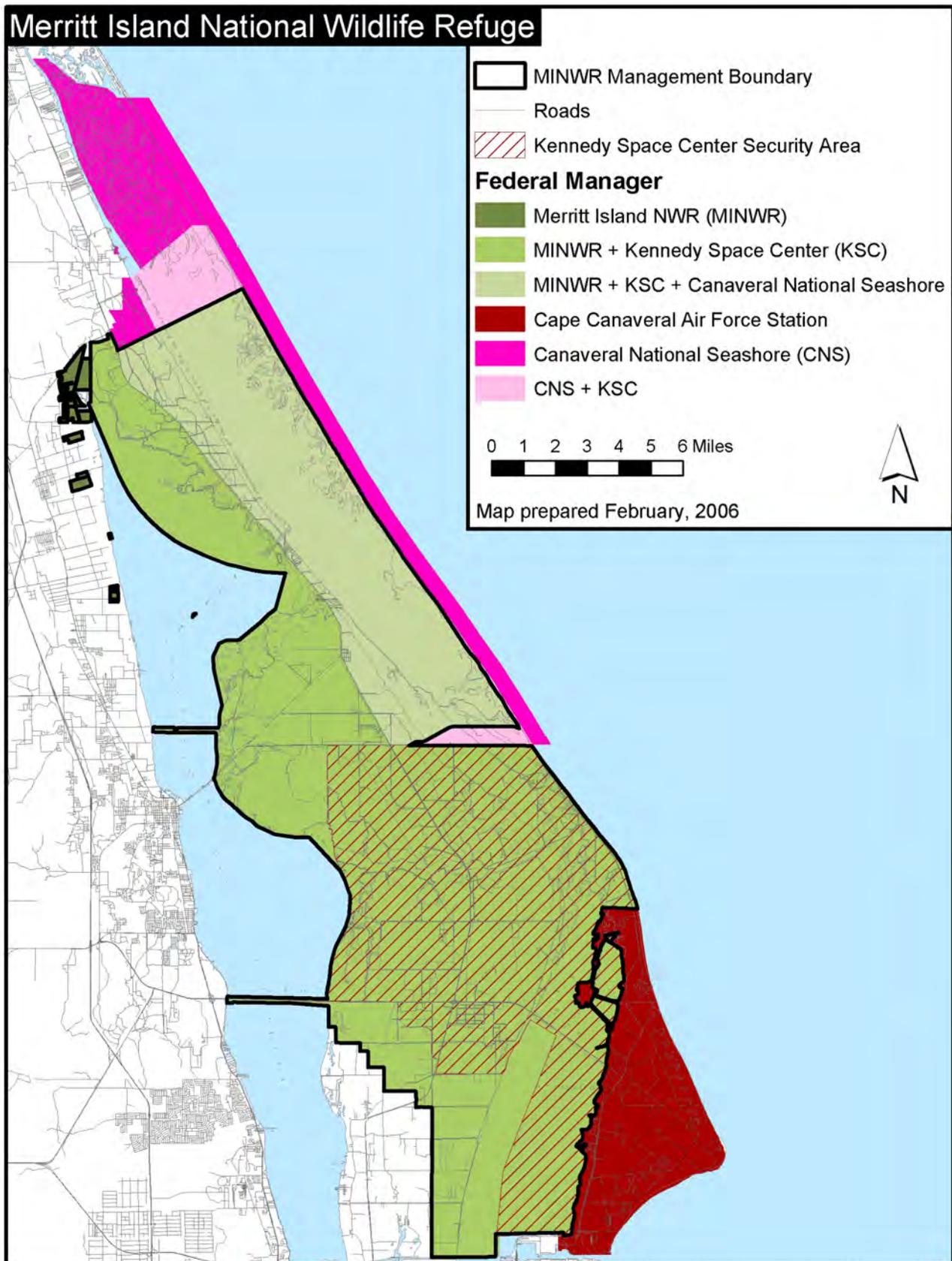
This secondary purpose applies only to those lands and waters of the Turnbull Creek area of the refuge (Figure 2), whether owned by the Service or managed under some sort of agreement as part of the refuge. However, the primary purpose also applies to the lands and waters of the Turnbull Creek area. Again, since the refuge has management agreements with the State of Florida for lands and waters in the Turnbull Creek area, those lands and waters are also subject to the conditions of those agreements.

Congruent to the discussion of the traditional purposes of the refuge is the congressional enabling legislation in 1975 that established Canaveral National Seashore as a unit of the National Park Service. Congress established a national seashore partially on new lands and waters and partially as an overlay of NASA's Kennedy Space Center on lands and waters that were already being managed as part of Merritt Island National Wildlife Refuge. In the legislation, Congress outlined that the majority of the overlay portion of the Seashore would be managed as a refuge. The overlay area encompasses approximately 34,345 acres and includes southern Mosquito Lagoon. Figure 3 outlines the complex land ownership and management picture for this area. The Seashore was established "...to preserve and protect the outstanding natural, scenic, scientific, ecologic, and historic values...and to provide for public outdoor recreation use and enjoyment of the same...the Secretary shall retain such lands in their natural and primitive condition, shall prohibit vehicular traffic on the beach except for administrative purposes, and shall develop only those facilities which he deems essential for public health and safety" [16 USC 459(j)]. This language applies much as a Wilderness designation might apply, making this a secondary purpose for the 34,345 acres in the overlap area.

## **SPECIAL DESIGNATIONS OF THE REFUGE**

The refuge holds several special designations. The State of Florida has designated numerous national parks, a national memorial, national wildlife refuges, state parks and recreation areas, state preserves and reserves, and other waters as Outstanding Florida Waters for their exceptional ecological values and water quality. Merritt Island Refuge was designated an Outstanding Florida Water in 1979. In 1997, the refuge was designated under the Magnuson-Stevens Act as Essential Fish Habitat to conserve and enhance the habitats necessary for fish to carry out their life cycles. In 1994, Brevard County designated the refuge an Honorary Historic Landmark. Managed by the Florida Fish and Wildlife Conservation Commission, the Great Florida Birding Trail is a collection of sites throughout Florida which serve as excellent bird watching sites and/or bird education opportunities. Due to the refuge's importance to resident and migratory birds, the refuge was designated in 2000 as one of three gateways to the eastern section of the Great Florida Birding Trail, which generally extends from the Florida-Georgia border in Nassau County to south of Fort Pierce and from the Atlantic Ocean to west of Ocala. Also in 2000, the refuge was listed as a candidate Marine Protected Area for its protection of estuarine waters. (Since the Marine Protected Area system is currently being designed, this designation holds the potential to benefit and/or constrain refuge management activities. Further, the State of Florida has also expressed concern regarding the impacts to management of such a designation. The Service is working with the Department of the Interior, the President's Marine Protected Area advisory council, the state, and other agencies regarding the designation of marine protected areas. In 2001, the American Bird Conservancy recognized 500 sites worldwide as Globally Important Bird Areas, including 183 national wildlife refuges, such as Merritt Island National Wildlife Refuge.

Figure 3. Management Agency



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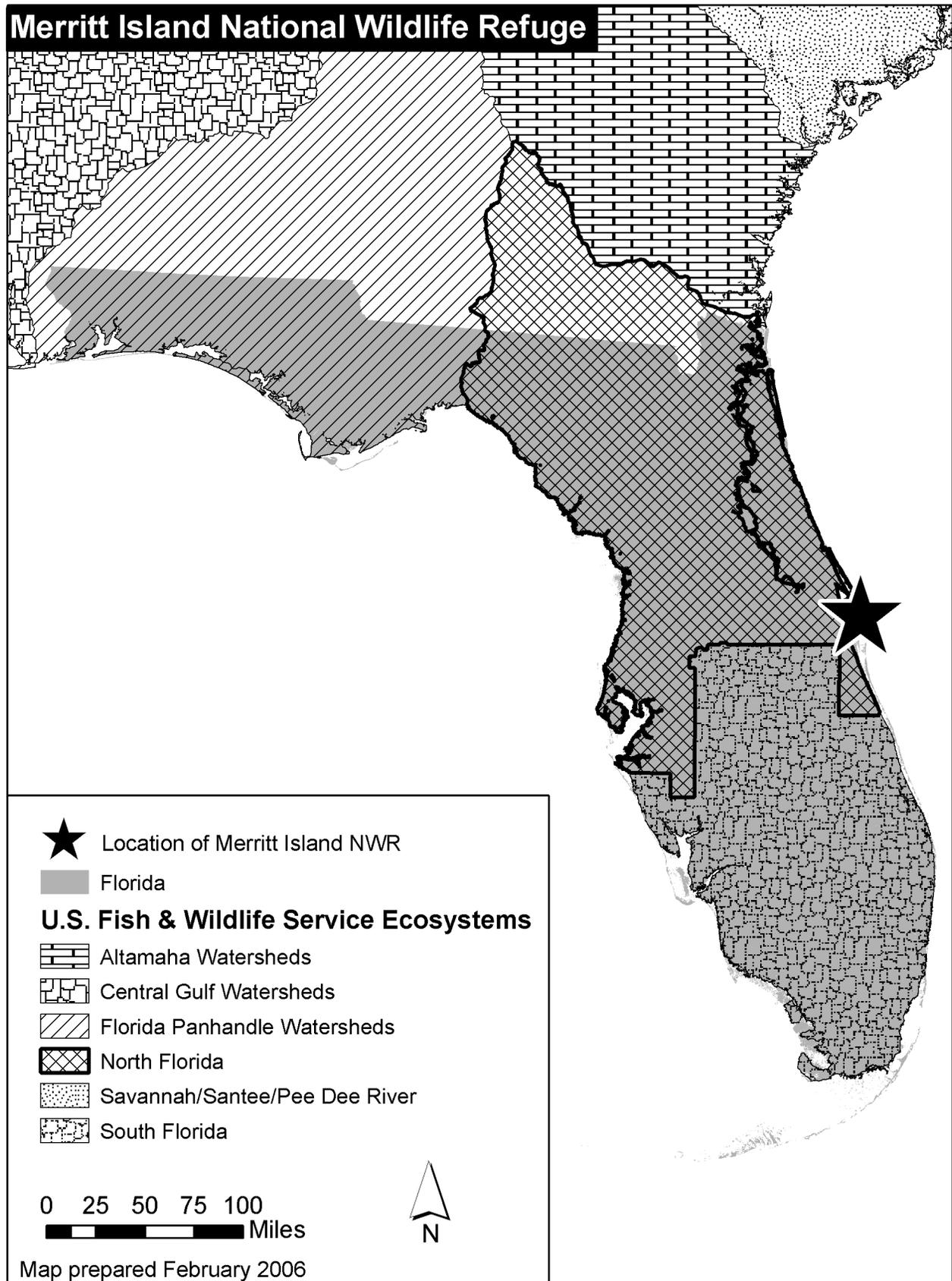
## Ecosystem Context

Comprising one of the 52 ecosystems around the country, the Fish and Wildlife Service's North Florida Ecosystem includes portions of southern Georgia and most of northern and central Florida (Figure 4), spanning 33 Florida counties and 19 Georgia counties. The North Florida Ecosystem includes several important areas with protective designations, including Ocala National Forest and Okefenokee and Merritt Island National Wildlife Refuges. In total, thirteen national wildlife refuges and one national fish hatchery occur in the North Florida Ecosystem. Various other local, state, and federal conservation areas are also located within the North Florida Ecosystem. The North Florida Ecosystem spans temperate and subtropical climates, numerous physiographic districts, and a wide variety of habitats. Barrier islands, xeric scrub, pine flatwoods, freshwater marshes, lakes, streams, springs, mixed hardwood/pine forests, cypress swamps and domes, dry prairies, maritime forests, hardwood hammocks, estuarine marshes, pine rocklands, sandhill woodlands, coastal strands, sawgrass prairies, sloughs, and tree islands of the North Florida Ecosystem serve a variety of native wildlife, including over 100 federally listed species, as well as interjurisdictional fishes, neotropical migratory birds, non-game waterbirds, and waterfowl. The biggest problem facing the North Florida Ecosystem is the loss of habitat through direct destruction and fragmentation, as well as through impacts from human activities. The predominant stresses for the North Florida Ecosystem are: population growth, tourism, agriculture, silviculture, mining, water channelization, urbanization, aquifer depletion, fire suppression, exotic species, non-point source pollution, and point source pollution (U.S. Fish and Wildlife Service 1996). The actions of the North Florida Ecosystem Team are guided by two categories: trust resources and management issues. The trust resources include: migratory birds, anadromous fish, endangered species, and marine mammals. The management issues focus on: habitat protection and management, habitat restoration, contaminants, regulatory compliance, law enforcement, and biodiversity.

To address these threats, the management issues, and the needs of the trust resources, the North Florida Ecosystem Team pursues a mix of objectives under five goals:

- Goal 1: Protect, conserve, and enhance migratory birds and their habitats in the North Florida Ecosystem;
- Goal 2: Protect, conserve, recover, and restore fish, aquatic species, and their habitats in the North Florida Ecosystem;
- Goal 3: Protect, conserve, and enhance wetlands in the North Florida Ecosystem;
- Goal 4: Protect, conserve, enhance, and recover listed and candidate threatened and endangered species and their habitats; and
- Goal 5: Protect and manage units of the National Wildlife Refuge System and the National Fish Hatchery System (U.S. Fish and Wildlife Service 1996).

Figure 4. North Florida Ecosystem



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## REGIONAL CONSERVATION PLANS AND INITIATIVES

To address these and other threats and management issues, several regional level conservation plans and initiatives also impact the management of the refuge's resources, including those listed (Figure 5 outlines conservation lands around the refuge).

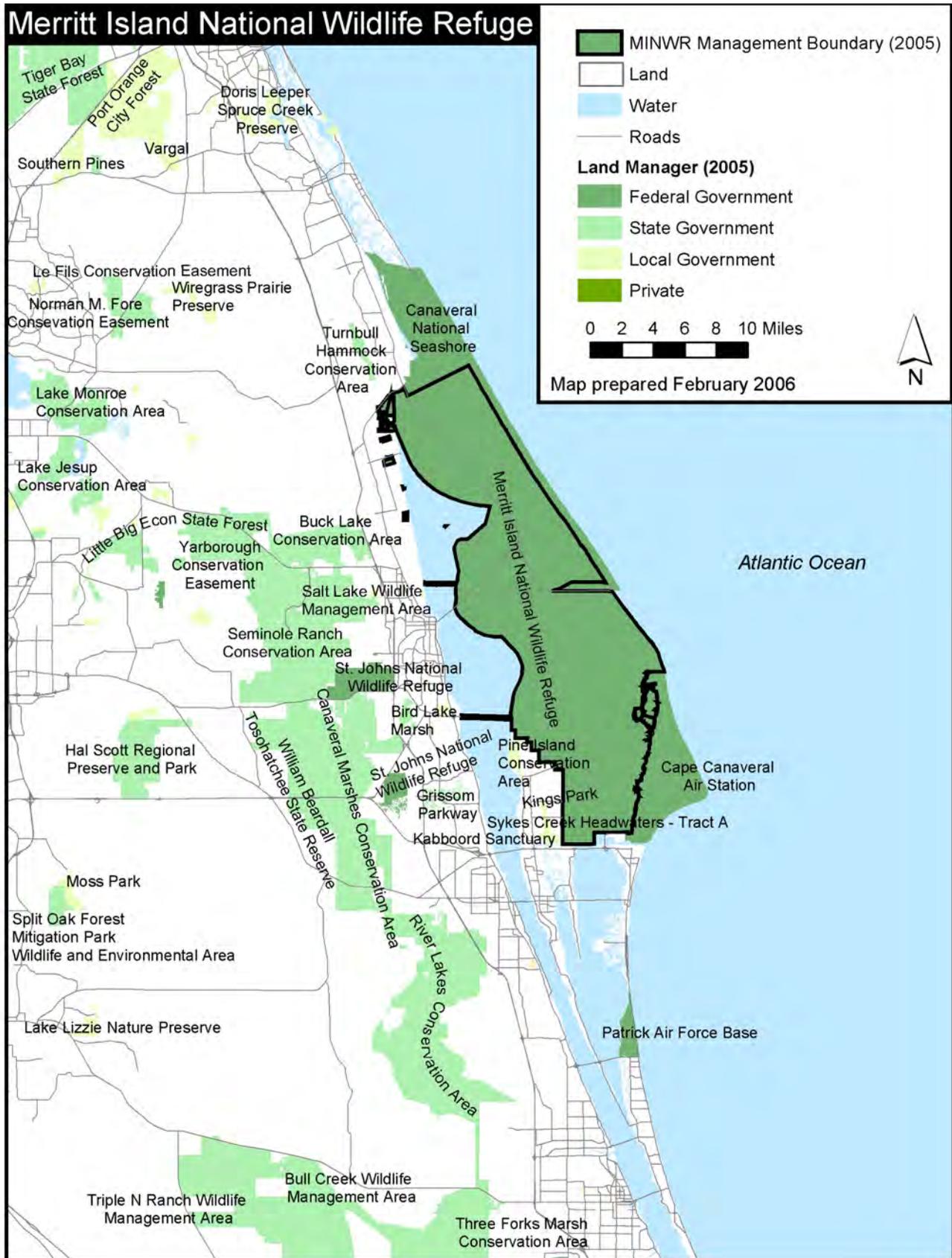
- Indian River Lagoon Surface Water Improvement and Management Plan, SJRWMD
- Indian River Lagoon Comprehensive Conservation and Management Plan, SJRWMD
- Indian River Lagoon North Feasibility Study, Comprehensive Everglades Restoration Plan, U.S. Army Corps of Engineers and SJRWMD
- Mosquito Lagoon Aquatic Preserve Management Plan, Florida Department of Environmental Protection
- Banana River Aquatic Preserve Management Plan, Florida Department of Environmental Protection
- NASA's Facilities Master Plan for John F. Kennedy Space Center
- Cape Canaveral Spaceport Master Plan
- Future land use plans of Brevard and Volusia Counties
- City of Titusville Future Land Use Plan
- State of Florida Greenway Plan
- South Atlantic Marine Fisheries Council Fisheries Management Plan
- South Atlantic Marine Fisheries Council Ecosystem-Based Fisheries Management Plan
- General Management Plan, Canaveral National Seashore, National Park Service
- Resource Management Plan, Canaveral National Seashore, National Park Service
- Florida's Wildlife Legacy Initiative – Comprehensive Wildlife Conservation Strategy: Planning for the Future for Florida's Wildlife, Florida Fish and Wildlife Conservation Commission
- 45<sup>th</sup> Space Wing Integrated Natural Resources Management Plan, Cape Canaveral Air Force Station, U.S. Air Force

## ECOLOGICAL THREATS AND PROBLEMS

Merritt Island National Wildlife Refuge is in a key location, not only to serve and support biological diversity in the Indian River Lagoon and central Florida, but also to serve continental populations of migratory birds along the Atlantic Flyway. Human impacts and underlying threats to biological diversity on and off the refuge include:

- the direct loss of habitat due to development and other human activities;
- the simplification and degradation of remaining habitats, including habitat alteration and fragmentation;
- the loss and decline of species and biological diversity;
- the effects of constructing navigation and water diversion facilities;
- the introduction and spread of exotic, nuisance, and invasive species;
- the lack of environmental regulation and enforcement;
- the cumulative effects of land and water resource development projects;
- the ongoing wildlife disturbance due to development and other human activities; and
- the impacts of non-point sources of pollution and water quality degradation.

**Figure 5. Area Conservation Lands**



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As a result of these threats, some species endemic to the northern Indian River Lagoon have become extinct, endangered, or threatened. The refuge supports 10 federally threatened or endangered species that regularly occur on the refuge. Further, the refuge also supports an additional 47 species listed by the State of Florida as either threatened, endangered, special concern, or commercially exploited. Of those species which have a state or federal designation, 46 species are listed by the Florida Committee on Rare and Endangered Plants and Animals, 53 species are listed by the Florida Natural Areas Inventory and 26 species are on the Audubon Society's Watch List. (See Appendix D for a complete listing of these species.) [Nationally, 1,262 species are federally listed with 986 listed as endangered (including 388 animals and 598 plants) and 276 listed as threatened (including 129 animals and 147 plants). Further, 257 species are listed as candidates for federal listing.]

The refuge serves to protect, maintain, and enhance the high productivity and biological diversity within this system. Increasing human population growth and impact have altered many ecological characteristics of Indian River Lagoon. The refuge faces ongoing threats from contaminated air, soil, and water; from erosion and sedimentation; and from cumulative habitat impacts from land and water resource development activities adjacent to and on the refuge (e.g., NASA's operations facilities). Rapid population growth and development have resulted in long-term negative impacts to Merritt Island National Wildlife Refuge, including increased boat traffic in the shallow waters of the lagoon, increased use and development of natural resources in the area, local habitat fragmentation, and the introduction and spread of exotic species.

Native terrestrial habitats that once dominated uplands include hardwood hammocks, which are very important for mammals and migratory birds. Urbanization and agricultural operations (e.g., large citrus groves) now dominate land uses in upland areas along the entire Indian River Lagoon. Historically, citrus and other agricultural operations, such as cattle pastures, dominated the area's landscape, but these are quickly being replaced by urban and suburban sprawl. Stormwater inputs, saltwater exchange through fortified ocean inlets, pollution, habitat destruction, and continual land and water use practices are constant threats to fish and wildlife resources in this area. By the year 2015, Florida is expected to have over 20 million residents, while the four-county area around the refuge is anticipated to reach nearly 3 million (Lenze 2002).

The reduction of ecological function and connection are major concerns, especially in areas where the modification of inland waterways has caused declines in fisheries and aquatic resource productivity. Beaches, seagrass beds, salt marshes, mangrove islands, and hammocks are subject to further loss or elimination. Some known environmental modification includes the construction of causeways (e.g., impacting seagrasses), the construction and maintenance of the Intracoastal Waterway (e.g., changing hydrological functions and salinity), and the development of beaches and shorelines (e.g., impoundments, impacting fragile coastal habitats for migratory birds, small mammals, and nesting sea turtles), as well as fishing activities (e.g., increasing recreational and commercial uses) in transitional and aquatic communities and habitats. Causeway construction, canal dredging, and commercial agricultural operations have contributed to the long-term loss and elimination of aquatic resources and habitats. And, declining water quality due to increased sediment and nutrient runoff are likely to adversely impact seagrass communities, resulting in declines in fish and mollusk (fisheries and aquatic resource) production.

Estuarine wetlands (native salt marsh and mangrove swamps) on the refuge were impounded to meet mosquito control needs. Refuge wetland management objectives include reconnecting impoundments and restoring natural-like flow and biological interchange, while maintaining mosquito control and migratory bird habitats.

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Invasive exotic plants have displaced many native species in upland and wetland communities. Brazilian pepper and Australian pine are two invasive species that are widespread throughout the refuge. Citrus trees for agricultural harvest cover other large areas. As adjacent urbanization and suburbanization continue to increase, the refuge is likely to experience an increased threat from feral animals, free roaming pets, recreational boating, elevated nutrient loading, and pollution, as well as from the increased demand for public use activities that are not directly linked to fish and wildlife goals. Additionally, new recreational technologies are likely to be developed that may not be compatible with fish and wildlife management.

Increased disturbance of fish spawning areas and nesting and roosting birds, and impacts to water quality and habitat are likely to lower the refuge's biological integrity. Management overlap of refuge lands and waters is shared by multiple agencies and a continual challenge is to coordinate conservation management with the more than 100 agencies and organizations which share the responsibility of managing the Indian River Lagoon watershed (Indian River Lagoon National Estuary Program 1996).

The lack of Service ownership of most of the refuge presents a difficult management challenge. The Service owns ±925.7 acres, manages ±320.04 acres under lease or management agreement with the State of Florida, and manages nearly 135,000 acres through a management agreement with NASA (plus the Service manages over 4,000 acres in operational areas at Kennedy Space Center for specific responsibilities, including removing nuisance wildlife from these areas).

State and federal assessments of the coastal zone to vulnerability from current and future sea level rise reflect coastal changes, particularly to coastal barrier island systems. Leatherman and Kershaw (2001) reported an approximate rate of 2 mm/year, which was estimated to accelerate over time to 20-30 cm by 2100 along the Florida Atlantic coast (Ron Schaub, Dynamac, Inc., personal communication). The average rate of sea level rise at Mayport, Florida is 2.43 mm/yr with a standard error of 0.18 mm/yr based on monthly mean sea level data from 1928 to 1999 (National Oceanic and Atmospheric Administration 2001). Impacts to the refuge could include beach and dune habitat changes that would pose threats to several federally listed sea turtles and the southeastern beach mouse. Loss of dune systems and lowered dune profile could increase sea turtle disorientation from lighting at NASA's and the U.S. Air Force's launch facilities. The refuge's beach has been changing with a mix of points of accretion and erosion since the 1800s with no observed long-term trend (Ron Schaub, Dynamac, Inc., personal communication). However, increased sea level would exacerbate beach erosion and may reconfigure the beach and shoreline contour (e.g., the beach could experience increased overwash and the formation of an inlet in Mosquito Lagoon). Additionally, impacts could include inundation of low-lying areas along the Mosquito Lagoon, Indian River Lagoon, and Banana River, including marshes, impoundment dikes, marsh islands, spoil islands. The changes could include habitat transitions from upland to coastal wetlands. Saltwater intrusion into aquifers and increased flooding potential (increasing the potential for impacts from disasters) are also important considerations, particularly in beach areas that have been developed (Leatherman and Kershaw 2001). Coastal wetland ecologists have suggested that coastal marshes may be impacted if they cannot maintain the detrital building process and the marsh elevation due to sea level rise (accretion deficit; Reed and Cahoon 1993). They suggest that some marsh management practices (e. g., burning or migratory bird management) would inhibit marsh accretion in a system that has a narrow tidal range, low sediment accretion rate, and a low tolerance for accelerated sea level rise (Cahoon et al 2004). The rise in sea level could effectively cause the transition of high marsh systems to lower marshes and the migration of high marshes into the fringing upland ecotones. Marsh expansion may have beneficial impacts; however, the increase in salt marsh may also increase the production potential of the salt marsh mosquito.

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## PHYSICAL RESOURCES

The climate, geology and topography, soils, air quality, and hydrology and water quality form the foundation of the physical environment of the refuge.

### CLIMATE

#### General Climatic Conditions

The main factors influencing climate at Merritt Island National Wildlife Refuge are latitude and the proximity of large bodies of water. Generally, the climate at the refuge can be described as subtropical with short, mild winters and hot, humid summers, with no appreciable spring or fall seasons. Summer weather patterns usually begin in April and prevail for nine months.

#### Temperature

Summer temperatures (measured in Fahrenheit degrees) range from the low 70s at dawn to the upper 80s and low 90s during the afternoon. November may have some cool days, but winter weather typically starts in December and lasts through March. Average temperatures during the winter range from lows in the 50s to highs near 75°. Temperature extremes range from a low of 19° to a high of 100° (Patrick Air Force Base 2004).

#### Atmospheric Moisture

As one would expect with the large bodies of water in and around the refuge, the relative humidity (RH) is typically high. Mean dawn RH is between 88 and 95 percent throughout the year, while readings in the mid-afternoon are between 55 and 67 percent. Very low RH can occur with the passage of cold fronts in the winter. Readings in the 30 to 40 percent range are common and a RH as low as 26 percent has been recorded. On the other end of the spectrum, an RH of 100 percent is not uncommon with fog occurring 90 days per year on average.

#### Precipitation

The average annual precipitation for the refuge, as recorded at the Shuttle Landing Facility, is 49 inches (Patrick Air Force Base 2004). Rainfall typically occurs during two time periods separated by dry seasons. Between late May and early October, weather patterns are dominated by the effects of the Bermuda High. This system causes southeast winds, which bring moist warm air on shore leading to the formation of thunderstorms. These rainfall events are short duration, high intensity localized storms. The refuge averages 83 thunderstorm days per year. Sixty percent of the annual precipitation days occur during these months.

From November to February, the weather patterns are influenced by cold continental air masses. Rainfall during this period comes from the effects of frontal passage. Rain events are more widespread and less intense than those in the summer. The transitional periods between these two wet seasons tend to be dry. Although uncommon, snow does occur on the refuge. The Shuttle Landing Facility has reported snow in both December and January; however accumulations were less than 0.05 inches.

Annual precipitation amounts can vary widely. In 1998, the annual rainfall was only 34.1 inches. The total accumulation of rainfall for the months of April, May, and June was only 1.03 inches as compared to the expected amount of 10.42 inches. Conversely, in the year 2001 the refuge received a total of 61.80 inches of rain or 12.80 inches above the average recorded for the Shuttle Landing Facility.

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These fluctuations in precipitation can impact refuge management operations. In 1998, for example, many of the impoundments on the refuge dried out completely. The dry conditions contributed to numerous wildfires, one of which reached over 4,000 acres in size. On the other hand, the wet conditions in 2001 made the maintenance of non-paved roads difficult. The frequent rains and generally wet conditions also resulted in decreased opportunities for prescribed burning.

### **Lightning**

Because of its importance in fire management, a major refuge management activity, lightning deserves a special mention. The National Weather Service Office in Melbourne, Florida states that Florida is the “lightning capital of the United States” (National Weather Service 2005). The National Weather Service data estimate that over 22,000 lightning strikes occur in Brevard County each year. Regarding the intensity of lightning on the refuge itself, research on Kennedy Space Center shows that within cloud and cloud-to-ground discharges average 2.4 per minute per storm, with a rate of 30.6 discharges per minute recorded during a storm on July 14, 1980 (National Aeronautics and Space Administration 1984).

### **Wind**

Wind is another important weather condition that greatly impacts the refuge. Wind patterns change throughout the day due to such factors as sea breezes and erratic winds around thunderstorms. High winds, above 20 miles per hour at the 20-foot level, are common in the winter and spring months, with occasional days with 35 to 40 mph winds. High winds are also associated with tropical systems in the summer. Several days of light and variable winds can occur in summer months when subsiding air is entrenched over the central Florida area. Since there is essentially no elevation change over the entire refuge, and therefore no barriers to the flow of air masses, the influences of weather apply equally to all portions of the refuge.

### **Tropical Cyclones**

Tropical depressions, storms, and hurricanes can impact refuge activities and infrastructure. Large amounts of rainfall can accompany tropical cyclones. In addition, wind and wave action can result in major damage to important refuge habitats. In 2004, three hurricanes impacted the central Florida area. Beach erosion destroyed sea turtle nests and damaged beach mouse habitat on the refuge. The combination of wind and wave action resulted in several millions of dollars in damage to the refuge’s impoundment dikes. Several refuge buildings also suffered damage. On top of all this a substantial staff time was spend in addressing hurricane damage both on Merritt Island National Wildlife Refuge and other refuges in Florida.

## *GEOLOGY AND TOPOGRAPHY*

### **Geology**

Florida has a complex geologic history with repeated periods of deposition when the Florida Plateau was submerged and with erosion during periods of lower sea level when the land was exposed (Randazzo 1997). The Avon Park limestone formation is the oldest deposit known to exist under Brevard County. This was deposited in the early Eocene in an open ocean. A period of lower sea levels, with resultant erosion followed. In the late Eocene, seas rose once again and the limestone of the Ocala group formation was deposited. Following another sea level falling and rising, the Hawthorne formation of calcareous clay, phosphoric limestone, phosphorite, and radiolarian clay was laid down in the late Miocene. Overlying the Hawthorne formation are unconsolidated deposits of fine sand, shells, clay, and calcareous layers of the late Miocene or Pliocene ages. The surface strata of Merritt Island are primarily unconsolidated white-to-brown quartz sand containing beds of coquina of Pleistocene and Recent ages. (Preceding summarized from Schmalzer et al 2001.)

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## Topography

The alternating high and low sea levels during the Pleistocene and Holocene shaped the land surface of the refuge. The outer barrier island formed after sea levels rose when the Wisconsin glaciers retreated. Merritt Island itself was formed as a prograding barrier island complex. The eastern edge of Merritt Island, where it joins Mosquito Lagoon and Banana River, forms a relic cape aligned with False Cape. The ridge and swale topography of the island is apparently the result of successive stages of the growth of this cape (White 1970). The ridges rise to a maximum of about 10 feet above sea level, while trough elevations are near sea level.

The western side of the island is substantially older. Erosion has reduced old dune ridges and the area is flatter. Elevations at the center of the island approach four feet above sea level and drop off to around one half foot at the Indian River Lagoon shoreline.

## SOILS

Relatively minor differences in elevation and internal drainage of the land have resulted in major differences in soil types. Over twenty soil series, representing four soil orders, are found on the refuge. Detailed maps and descriptions of these can be found in the *Soil Survey of Brevard County, Florida* (Soil Survey Staff 1974). Based on soils characteristics, five general associations of soils have been identified on the refuge, as listed.

Paola-Pomello-Astatula Association: These are soils found on narrow ridges in the area between the Indian River Lagoon and Banana River. They are well to excessively drained acid sands. Internal drainage is rapid, and water tables are generally below three feet. Slopes range from nearly level to strongly sloping. The natural vegetation is scrub oaks, palmetto, and grasses.

Canaveral-Palm Beach-Welaka Association: These soils are nearly level to gently sloping sands that are well to excessively drained. They are found on narrow ridges and sloughs parallel to the Atlantic Ocean. Natural vegetation is scrub oaks, cactus, palmetto, and some pine.

Myakka-Eau Gallie-Immokalee Association: These associations are nearly level, poorly drained, acid soils. They are sandy to a depth of 40 inches and loamy below. They are found on flatwoods sites between the ridges. Water tables are usually within 30 inches of the surface, and there may be standing water on these sites for short periods of time after heavy rainfall. The natural vegetation is palmetto and pines.

Copeland-Wabasso Association: These soils are nearly level and poorly or very poorly drained. The pH of these areas is higher than that of most flatwoods soils due to the presence of limestone or coquina. Natural vegetation is palm, mesic hardwoods, and pine.

Salt Water Marsh-Salt Water Swamp Association: These associations are nearly level, very poorly drained saline to brackish soils of variable texture. The marsh soils are shallow sands covered with marl or limestone, irregularly stratified mixed sand and shell, or silty clays over sand and shell. The natural vegetation is that of the salt marsh community. Swamp soils consist of mixed sand and organic matter. Natural vegetation includes salt tolerant trees, such as mangroves.

## AIR QUALITY

The air pollutants of major concern in Florida are carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide (Florida Department of Environmental Protection 1999). The

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primary sources of these pollutants are vehicle emissions, power plants, and industrial activities. In 1999, all areas of Florida were air quality attainment areas (Florida Department of Environmental Protection 1999). The Indian River Lagoon area is considered to have good air quality. However, occasional temperature inversions, lasting up to 48 hours, can temporarily degrade local air quality below acceptable levels

Kennedy Space Center and, therefore, the Merritt Island National Wildlife Refuge, are considered an attainment, or clean area, under the Clean Air Act. The ambient air quality is influenced by NASA operations; land management practices, such as prescribed burning; vehicle traffic; and off-site emission sources. The daily air quality conditions are most influenced by the considerable on-site vehicle traffic, utilities fuels combustion (two regional power plants are within 10 miles of the refuge), NASA's refurbishment and maintenance operations, and incinerator operations. Space launches, training fires by the Kennedy Space Center Fire Department, prescribed burning, and wildfires on the refuge influence air quality as episodic events. Smoke from wildland fires can disrupt space center operations, such as launches, landings, and payload preparation.

Ambient air quality at Kennedy Space Center and the refuge is monitored by one Permanent Air Monitoring System. This is located at NASA's Environmental Health Facility. This station is equipped with analyzers for sulfur dioxide (SO<sub>2</sub>), nitrogen dioxide (NO<sub>2</sub>), carbon monoxide (CO), ozone (O<sub>3</sub>), and total inhalable particulates (10-micron).

## *HYDROLOGY AND WATER QUALITY*

### **Surface Water Hydrology**

The primary surface waters on and around the refuge is the Indian River Lagoon system, which has been designated as an Estuary of National Significance. The lagoon system includes the Indian River Lagoon, Banana River, Mosquito Lagoon, and Banana Creek. These bodies of water drain approximately 838 square miles of land. They can best be described as shallow estuarine lagoons with water depths less than five feet with the exception of the Intracoastal Waterway which, with a project depth of 12 feet, is the deepest part of the entire system. The Banana River is directly connected to the Atlantic Ocean by an artificial inlet and locks at Port Canaveral. The Indian River Lagoon is indirectly connected to the Atlantic Ocean on the north by Haulover Canal, Mosquito Lagoon, and the Ponce de Leon Inlet, and on the south by Sebastian Inlet. Water circulation within the lagoons are not affected by tides, but instead are affected by the Intracoastal Waterway (e.g., navigation channel maintenance and boat usage), winds, inlets, and causeways.

In addition to the lagoon system, numerous creeks, mosquito control impoundments, borrow ponds, and miscellaneous wetlands exist on the refuge. By the 1960s, many of the marshes were impounded to control the production of the salt marsh mosquito (*Aedes* spp.). These impoundments contain about 7,660 acres of open water and 15,500 acres of wetlands. And over 900 acres of borrow ponds, 5,900 acres of grassy swales, and numerous canals are on the refuge.

### **Surface Water Quality**

The quality of the surface waters of the refuge is generally good, with the best areas being those adjacent to undeveloped land. These would include both the Mosquito Lagoon and the northern portion of the Indian River Lagoon, which have been designated as Class II waters by the State of Florida. The rest of the lagoon system has been designated as Class III waters. All of the surface waters within the boundaries of the refuge have been designated as Outstanding Florida Waters. All of these designations place restrictions on the use of the surface waters. The Indian River Lagoon

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does have several identified water quality parameters of concern: cadmium, lead, mercury, nutrients, selenium, thallium, and dissolve oxygen (U.S. Environmental Protection Agency 2000). Monitoring of water quality is conducted by both Kennedy Space Center and the refuge.

### **Ground Water Hydrology**

Ground water of the refuge occurs under both non-artesian (unconfined) and artesian (confined) conditions. The surficial (non-artesian) aquifer supports the freshwater wetlands and provides groundwater discharge to the surrounding lagoons (Clark 1987). This aquifer occurs in saturated Pleistocene and Holocene deposits of sand, shell coquina, silt, and marl. The upper boundary is the water table, while the lower limit is the confining layer at the base of the Pleistocene and Holocene deposits. The surficial aquifer is recharged by direct infiltration from local rainfall. The high sand ridges in the center of the refuge, which are composed of permeable sands, are especially important for recharge of the surficial aquifer

The surficial aquifer can be divided into several sub systems. The first of these is the Dune or Barrier Island subsystem, which has a lens of freshwater three meters or less thick on top of intruded salt water. The primary dune acts as the principle recharge area. The second subsystem is the Dune-Swale subsystem, which runs north to south in the center of the refuge. Most of it is east of Kennedy Parkway (State Route 3) and includes high ridges which serve as recharge areas. The pine flatwoods and swale soils in this area have pronounced humic hardpans (spodic or B<sub>h</sub> horizons) that restrict infiltration. Water perches above this layer and will only infiltrate slowly. The West Plain subsystem is the third division and is located in the flatwoods and hammock areas west of Kennedy Parkway. Spodic horizons limit infiltration in much of the area north of Banana Creek. South of Banana Creek, a limestone hardpan is the limiting factor. The fourth division of the surficial aquifer, the Marsh subsystem, is found under the impoundments.

The artesian aquifers found under the refuge include the Floridian aquifer. This is associated with Eocene limestones and is artesian. Secondary artesian aquifers occur within the Hawthorne formation and in the Caloosahatchee Marl Equivalent.

### **Ground Water Quality**

Ground water can be contaminated from either point sources or non-point sources. Merritt Island National Wildlife Refuge/Kennedy Space Center has been used since the 1960s as the Nation's primary launch site for space exploration. Many hazardous chemicals have been used to support space operations over the years, and, especially in the early years, less than adequate care had been taken in the handling and disposal of these chemicals. Point source pollution has been documented on the refuge/Kennedy Space Center in several instances. Contaminated areas have been found in and around launch pads A and B, landfill sites, and sewage treatment plants, as well as at some abandoned processing sites. The locating and meditating of contaminated sites is an ongoing process, the majority of which is handled by NASA. The refuge has been involved on a limited basis in detecting possible point sources in the citrus grove areas where chemicals have been stored.

The citrus grove operations also have the potential for non-point source pollution. The application of fertilizer, insecticides, and other chemicals during grove caretaking operations falls under the area of non-point source pollutants. The refuge is cooperating with Florida Research Center for Sustainable Agriculture in a study to determine the impacts of various citrus management practices on the environment, including on ground and surface waters (Adair 2003).

The areas of the refuge subject to known point source pollution and agricultural activities are relatively small. A recent study of the surficial aquifer on the refuge found that contamination in large

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areas of the refuge was low (Schmalzer, Hensley, and Dunlevy 2001). This investigation looked at number of possible pollutants. Organochlorine pesticides, aroclors, and chlorinated herbicides were below detection levels. Seven polycyclic aromatic hydrocarbons occurred at low concentrations in some areas. These hydrocarbons can have both natural and human activity sources. Most trace elements were below detection levels or were found in low concentrations. They concluded that widespread contamination of the surficial aquifer on the refuge has not occurred.

## **BIOLOGICAL RESOURCES**

The habitats on the refuge and their condition are the end result of both the physical environment and past anthropological activities. The climate, soils, and hydrology have determined which plant and animal species can exist here. Humans have then exerted their influences on the biota.

The influence of human activity on the landscape has been going on for a considerable time. Native Americans probably did little to modify the physical landscape, but may have modified ecological processes through their use of fire. The numerous thunderstorms that occur during the summer months frequently ignited wide ranging wildland fires (Duncan et al 1999). Many of the vegetation types found on the refuge are dependent on periodic fires for their continued existence. Native Americans used fire outside of this time period for various purposes, such as hunting and warfare (Robbins and Myers 1992).

When European settlers arrived, they also varied the natural fire regime. They also began to modify the physical landscape, starting with the construction of roads, drainage ditches, and canals. The use of the land for agriculture increased the construction of infrastructure, but major alterations to the landscape did not occur until the 1950s. During the next several decades, fire was excluded from the landscape. The vegetation on the land which is now the refuge became overgrown, reducing its utility for some native wildlife.

During this time, other important changes occurred. Some of the land was converted to agriculture, where most of it became citrus groves. In the early 1960s fragmentation of the land increased as the infrastructure for the John F. Kennedy Space Center was constructed. To help control mosquitoes, many of the marshes were impounded.

Since the refuge was founded, much management has been done. Some management activities were directed towards restoring portions of the landscape to more natural conditions. Other activities maintained or modified the existing structures, such as the impoundments, to increase their value to wildlife. The mix of upland, wetland, and aquatic habitats that are the end result of the various natural and anthropologic phenomena are described. See Figure 6 for the refuge's existing impoundment management units and Figure 7 for the refuge's burn units.

Figure 6. Impoundments Management Units

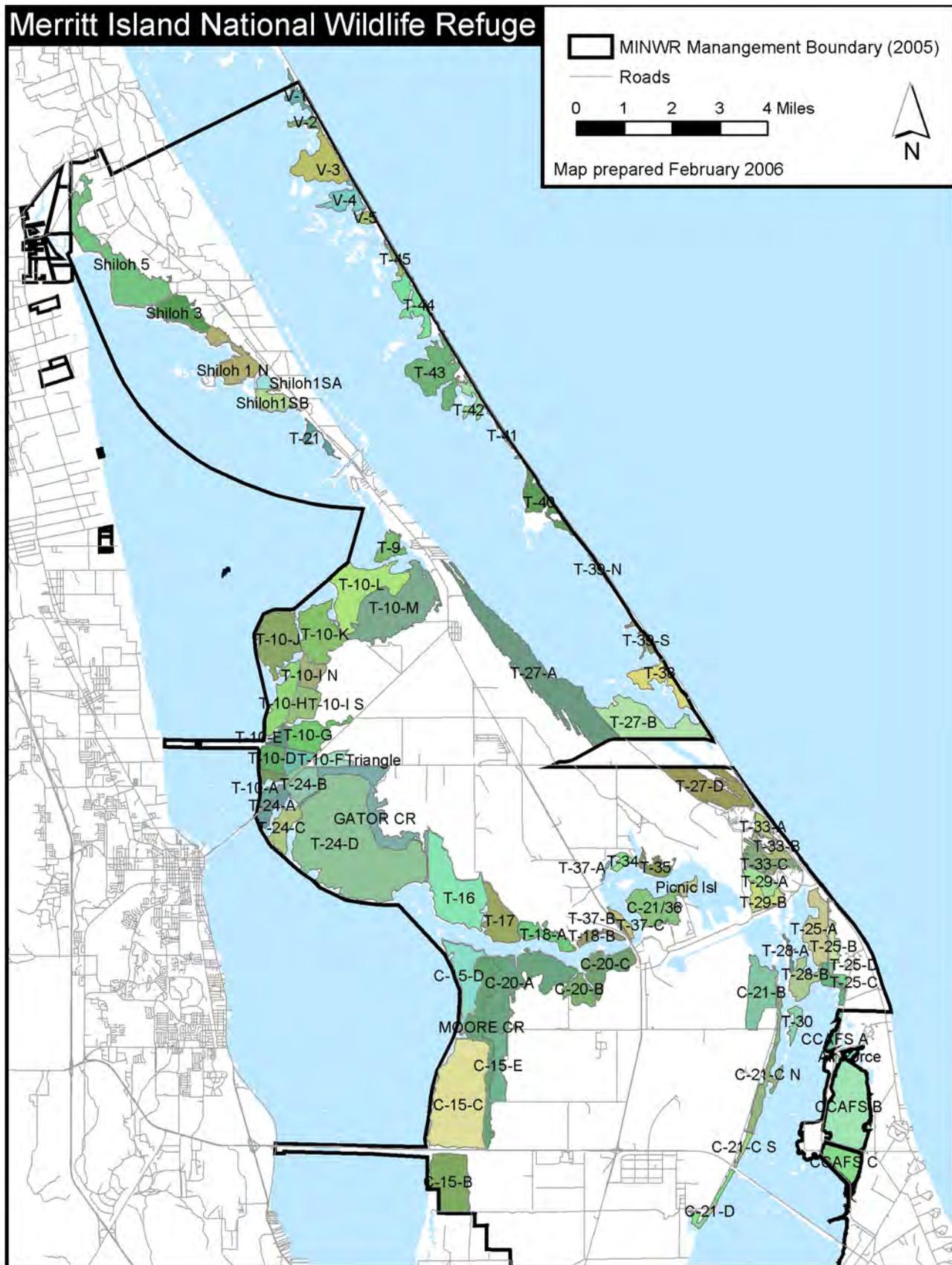
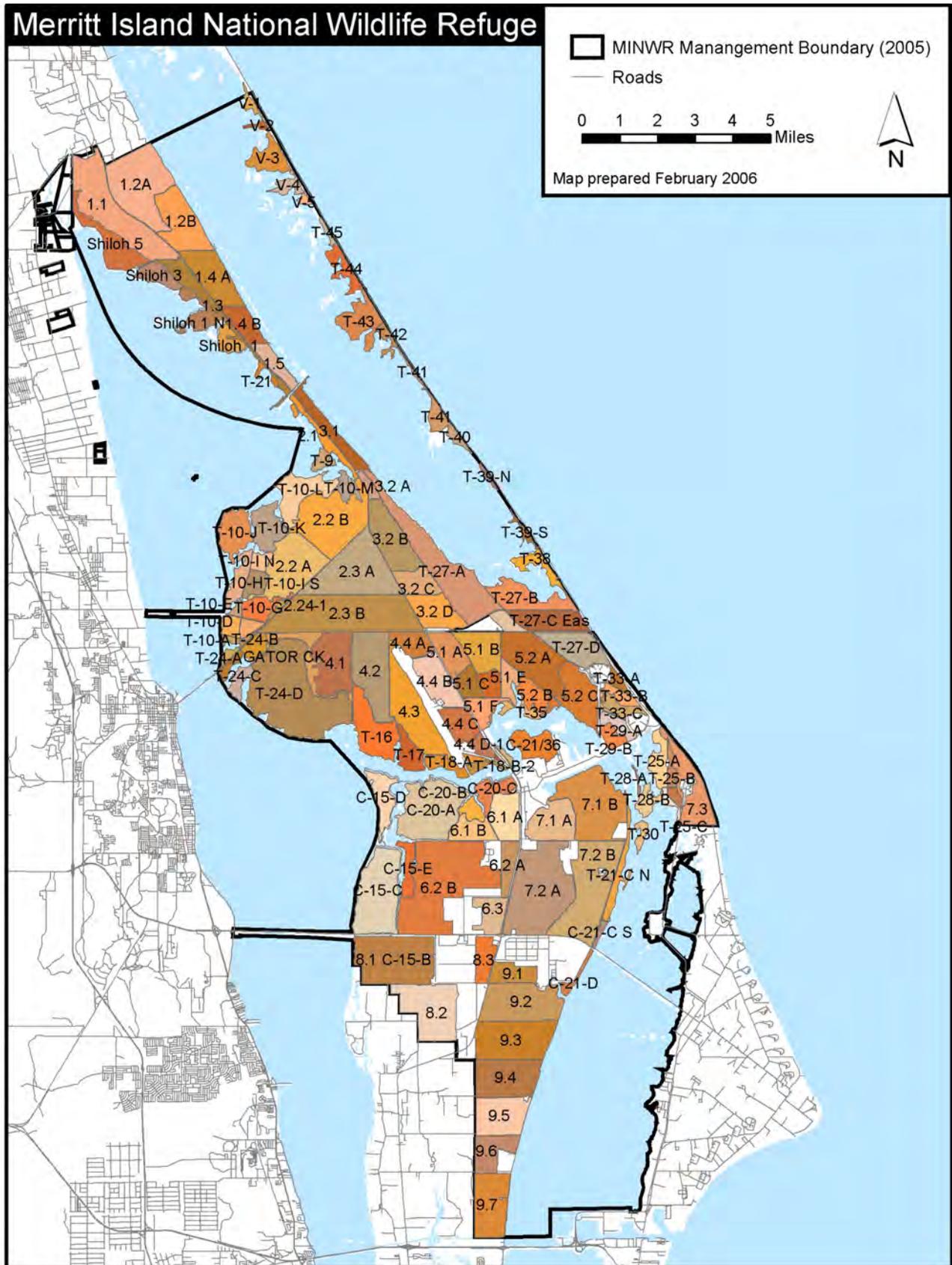


Figure 7. Burn Units



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## HABITAT

Schmalzer (Schmalzer et al 2002) lists 1,024 species of plants on the refuge. Of these 803 are native and 221 are introduced. These plants are organized into vegetative communities. A habitat/vegetation map delineating these communities has been developed for the area inside the acquisition boundary of Merritt Island National Wildlife Refuge (Figure 8). Vegetation was classified using the terminology of the National Vegetation Classification System. In this classification system, the floristic association is the most applicable level to refer to when managing the vegetation on the refuge. However, the terminology of the classification system is seldom used by on-the-ground practitioners. Therefore, the cover types shown on the map are the colloquial names that have been used in the local area for many years. Table 1 provides the mandated classification system terminology for the alliance and association levels, along with a colloquial name for the various habitat types found on the refuge. The complete table, giving the entire classification system hierarchy, is in the refuge's administrative files. A detailed description of the individual habitat types can also be found in the refuge's Habitat Management Plan (see Appendix F).

### Wetland Herbaceous Communities

*Marsh – saltwater (Salt marsh, impounded or otherwise); (SPARTINA BAKERII – DISTICHLIS SPICATA TIDAL HERBACEOUS ALLIANCE, Spartina bakerii – Distichlis spicata Association)*

Most of the salt marshes at the refuge were impounded for mosquito control in the 1950s and 1960s. As a result, waters within the impounded salt marshes tend, on average, to have lower salinities (depending on current impoundment management and precipitation) than would otherwise be expected in unmodified salt marsh habitats. Despite this, most impoundments currently retain vegetation associations that could still be described as salt marsh. The salt marshes of the refuge (both impounded and un-impounded) are dominated by Baker's cordgrass (*Spartina bakerii*) and salt grass (*Distichlis spicata*). Other salt tolerant plants frequently encountered within the salt marshes include black needle rush (*Juncus roemerianus*), glassworts (*Salicornia spp.*), and saltwort (*Batis maritima*). In some impounded salt marshes, other, less salt tolerant plant species may also be found, including cattail (*Typha spp.*) and sawgrass (*Cladium jamaicense*).

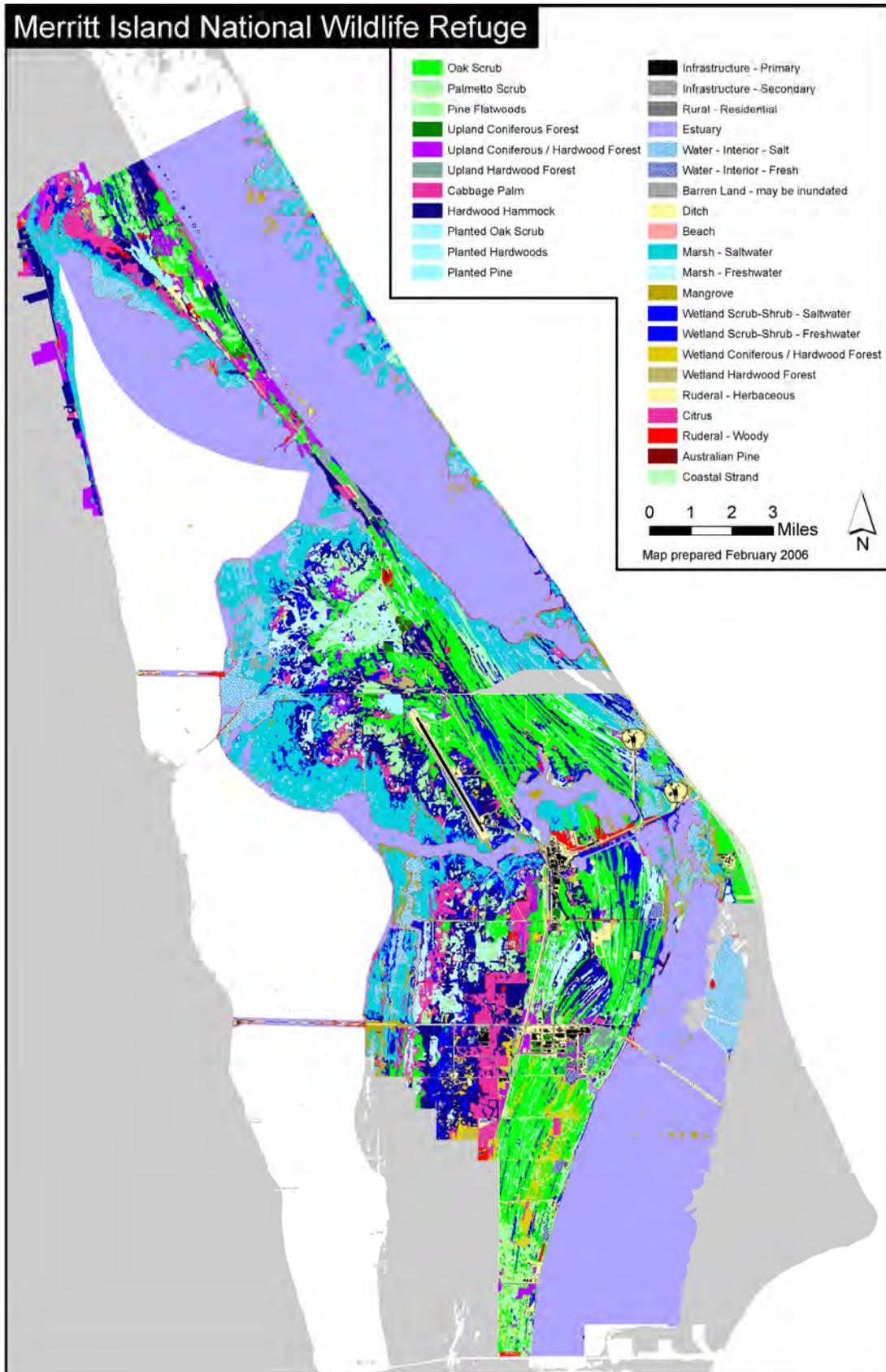
*Wetland Shrub - saltwater; (BORRICHIA FRUTESCENS TIDAL SHRUBLAND ALLIANCE)*

This alliance includes areas within both impounded and un-impounded salt marsh that, in addition to Baker's cordgrass, contain shrub species, including sea oxeye (*Borrichia frutescens*); wax myrtle (*Myrica cerifera*); scattered mangroves; and the invasive, exotic Brazilian pepper (*Schinus terebinthifolius*). These shrub areas often occur above mean high water and are typically adjacent to landward areas.

*Marsh – freshwater; (SPARTINA BAKERII SEASONALLY FLOODED HERBACEOUS ALLIANCE, Spartina bakerii Association)*

Freshwater marshes typically occupy interdunal swale areas and are seasonally flooded (although deeper marshes may stay flooded in all but the driest years). These marshes are dominated by Baker's cordgrass, but may also contain beardgrass (*Andropogon spp.*) and sawgrass (*Cladium jamaicense*). In the absence of fire, these wetlands are often encroached by woody species such as willow, wax myrtle, and red maple.

Figure 8. Refuge Vegetation



**Table 1. Vegetation and cover types on Merritt Island National Wildlife Refuge**

<b>Cover Type and (Colloquial terminology from Vegetation Map &amp; HMP Text)</b>	<b>Floristic Alliance (NVCS)</b>	<b>Floristic Association (NVCS)</b>	<b>Acres</b>
Infrastructure-primary	N/A	N/A	1390.36
Infrastructure-secondary	N/A	N/A	726.91
Rural-residential	N/A	N/A	46.24
<b>Total Non-habitat Acres</b>			<b>2163.51</b>
Estuary	N/A	N/A	53069.68
Barren land-may be inundated	N/A	N/A	260.76
Water-interior-salt (Open water in impoundments)	N/A	N/A	7660.05
Marsh-saltwater (Salt marsh, impounded or otherwise)	Spartina bakerii-distichlis spicata tidal herbaceous alliance	Spartina bakerii-Distichlis spicata Association	13635.37
Wetland shrub-scrub-saltwater	Borrichia frutescens shrubland alliance	N/A	1893.92
Mangrove	Avicennia germinans-languncularia racemosa-rhizophora mangle tidal shrubland alliance	Avicennia germinans-Languncularia racemosa-Rhizophora mangle Association	1659.84
<b>Total Saline Wetland Acres</b>			<b>78179.62</b>
Ditch	N/A	N/A	375.36
Water-interior-fresh (Borrow Pond)	N/A	N/A	960.73
Marsh-freshwater (Swale)	Spartina bakerii seasonally flooded herbaceous alliance	Spartina bakerii Association	5912.51
Wetland shrub-scrub-freshwater (Willow)	Salix caroliniana temporarily flooded shrubland alliance	Salix caroliniana Association	5488.89

Cover Type and (Colloquial terminology from Vegetation Map & HMP Text)	Floristic Alliance (NVCS)	Floristic Association (NVCS)	Acres
<b>Total Freshwater Wetlands</b>			<b>12737.49</b>
Beach	N/A	N/A	65.98
Coastal strand	Serenoa repens-coccoloba uvifera shrubland alliance	Serenoa repens-Coccoloba uvifera Association	718.02
<b>Total beach and dune</b>			<b>784.00</b>
Oak scrub (Also scrubby flatwoods)	Quercus geminata-quirecus myrtifolia-serenoa repens shrubland alliance	Quercus geminata - Quercus myrtifolia-serenoa repens Association	15344.24
Palmetto scrub	Serenoa repens-ilex glabra-lyonia spp. Shrubland alliance	Serenoa repens-Ilex glabra-Lyonia spp. Association	3142.76
Planted oak scrub	Quercus geminata-quercus myrtifolia-serenoa repens shrubland alliance	Quercus geminata - Quercus myrtifolia-serenoa repens Association	24.81
<b>Total Upland Shrubland</b>			<b>18511.81</b>
Wetland hardwood forest	Acer rubrum-ulmus americana seasonally flooded forest alliance	Acer rubrum - Ulmus Americana Association	1185.64
Wetland coniferous/hardwood forest	Pinus elliottii-quercus virginiana saturated temperate forest alliance	Pinus elliottii-Quercus virginiana Association	1603.24
<b>Total Wetland Forest</b>			<b>2788.88</b>
Cabbage palm (Palm Hammock)	Sabal palmetto temperate forest alliance	Sabal palmetto Association	2880.61
Hardwood Hammock	Virginiana-sable palmetto forest alliance	Quercus virginiana-Sabal palmetto Association	9569.24
Upland hardwood forest	Quercus virginiana-sable palmetto forest alliance	Quercus virginiana-Sabal palmetto Association	594.57

Cover Type and (Colloquial terminology from Vegetation Map & HMP Text)	Floristic Alliance (NVCS)	Floristic Association (NVCS)	Acres
Planted hardwoods	Quercus virginiana-quercus laurifolia forest alliance	Quercus virginiana-Quercus laurifolia Association	285.41
Pine flatwoods	Pinus elliotti-serenoa repens alliance	Pinus elliotti-Serenoa repens Association	2999.18
Upland coniferous/hardwood forest	Pinus elliottii-quercus virginiana saturated temperate forest alliance	Pinus elliottii-Quercus virginiana Association	2730.07
Upland coniferous forest	Pinus elliotti-senora repens alliance	Pinus elliotti-Senora repens Association	274.53
Planted pine	Elliottii tropical forest alliance	Pinus elliottii var densa Association	203.98
<b>Total Mesic and Upland Forest</b>			<b>19537.59</b>
Ruderal-herbaceous (Lawns, disturbed areas)	No floristic dominance	N/A	3745.96
Australian pine	Casurina spp. Forest alliance	Casurina spp. Association	111.71
Ruderal-woody* (Brazilian pepper)	Schinus terebinthifolius-myrica cerifera shrubland alliance	Schinus terebinthifolius-Myrica cerifera Association	1540.83
Citrus	Citrus spp. Woodland alliance	Citrus spp. Association	1930.92
<b>Total Non-native Vegetation*</b>			<b>7329.42</b>
<b>TOTAL MINWR ACRES</b>			<b>142032.32</b>

*\*Although some areas are dominated by non-native vegetation as the primary vegetation cover type, as detailed in the table, all refuge habitats are likely to have the presence of non-native vegetation.*

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## **Wetland Shrublands**

*Mangrove; (AVICENNIA GERMINANS-LANGUNCULARIA RACEMOSA-RHIZOPHORA MANGLE TIDAL SHRUBLAND ALLIANCE, Avicennia germinans-Languncularia racemosa-Rhizophora mangle Association)*

Mangroves are found along the fringes of the marine waters and in some impoundments. The major species here are black mangrove (*Avicennia germinans*), white mangrove (*Languncularia racemosa*), red mangrove (*Rhizophora mangle*), and buttonwood (*Conocarpus erecta*). Mangroves trap and collect sediment to help stabilize shorelines and reduce flood damage. Over 100 species of fish and shellfish are dependent on mangroves. Key animal species found in this habitat include mangrove water snakes, river otters, raccoons, snook, pelicans, wood storks, herons, egrets, shorebirds, periwinkle snails, and juvenile and predatory fish.

*Willow Swamp; (SALIX CAROLINIANA TEMPORARILY FLOODED SHRUBLAND ALLIANCE, Salix Caroliniana Association)*

Willow stands also have standing water on them for most of the year. They are dominated by Carolina willow (*Salix caroliniana*) with some red maple and wax myrtle. In many cases, willows have invaded upland swales and impoundments.

## **Wetland Hardwood Forests and Woodlands**

*Wetland Hardwood Forest; (ACER RUBRUM-ULMUS AMERICANA SEASONALLY FLOODED FOREST ALLIANCE); Acer rubrum - Ulmus Americana Association)*

The hardwood swamp areas have standing water for large portions of the year. They are dominated by red maple (*Acer rubrum*) and elm (*Ulmus Americana*), but may have cabbage palm and water tolerant oaks. Some of these areas were once grassy swales that have changed over time as the result of alterations in hydrology and/or from the exclusion of fire.

*Cabbage Palm Hammock; (SABAL PALMETTO TEMPERATE FOREST ALLIANCE; Sabal palmetto Association)*

These hammocks are almost pure stands of cabbage palms (*Sabal palmetto*). The understory is usually open with a scattering of palmetto and other vegetation. Although cabbage palms can grow on soils with a wide range of moisture regimes, they are typically found on more or less saturated soils, such as those along the edges of impoundments. As the soils become better drained, the vegetation grades into the mesic oak/palm hammocks.

Cabbage palm hammocks can also be found on disturbed sites. Land that was once cleared for home sites or for agriculture often times comes back as stands of exotics and cabbage palms when abandoned. This situation is especially noticeable in the case of citrus groves that have gone fallow.

## **Mesic Hardwood Forests and Woodlands**

*Hardwood Hammock; (QUERCUS VIRGINIANA-SABLE PALMETTO FOREST ALLIANCE; Quercus virginiana-Sabal palmetto Association)*

These hammocks are dominated by large live oaks (*Quercus virginiana*), cabbage palms, and laurel oaks (*Q. laurifolia*). The understory in some of these hammocks is palmetto (*Sabal palmetto*), while others have a mix of subtropical shrubs, such as wild coffee (*Psychotria* spp.), nakedwood (*Myrcianthes frarans*), *Ardisia* spp., and ferns, along with the palmetto.

*Upland Hardwood Forest; (QUERCUS VIRGINIANA-SABLE PALMETTO FOREST ALLIANCE; Quercus virginiana-Sabal palmetto Association)*

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Although classified the same as the hardwood hammocks, the upland hardwood forests occupy slightly better drained soils. These are mixed hammocks that have not only cabbage palms and live and laurel oaks, but also elms, ashes (*Fraxinus* spp.), red mulberries (*Morus rubra*), sugar berries (*Celtis laevigata*), and other overstory species. The understories may have nakedwood, wild coffee, and southern red cedar (*Juniperus virginiana* var. *siliciola*).

*Oak-Cedar Hammocks; (QUERCUS VIRGINIANA-SABAL PALMETTO FOREST ALLIANCE; Quercus virginiana-Sabal palmetto-Juniperus virginiana var siliciola Association)*

These stands are similar to the upland hardwood hammocks, but have a substantial amount of southern red cedar in them. The majority of these stands are found in the Turnbull Creek area.

*Planted Hardwoods; (QUERCUS VIRGINIANA-QUERCUS LAURIFOLIA FOREST ALLIANCE; Quercus virginiana-Quercus laurifolia Association)*

These stands were planted on old citrus groves in the northern portion of the refuge during 1991 and 1992. The original planting density was six feet within row spacing with 12 feet between rows. By 2004 the crowns have closed within the rows. The understory consists mainly of exotic grasses left over from the citrus operation.

### **Xeric Hardwood Forest**

*Xeric Hammock; (QUERCUS GEMINATA-QUERCUS MYRTIFOLIA ALLIANCE; Quercus geminata-Quercus myrtifolia Association)*

This type is found on the Paola-Pomello-Astatula soil association, which is deep, well to excessively drained soils. The overstory vegetation is sand live oak (*Quercus geminate*), myrtle oak (*Q. myrtifolia*), and Chapman's oak (*Q. chapmanii*). This vegetation type is often the end result of long periods of fire exclusion. The vegetation has become a dense, almost impenetrable stand reaching heights of 30 or more feet. The understory is sparse, consisting of clumps of palmetto. There is little in the way of an herbaceous layer. Much of this vegetation type has been restored to oak scrub. Most remaining stands are too small in area to warrant mapping.

### **Pine Forests and Woodlands**

*Pine Flatwoods; (PINUS ELLIOTTI-SERENOA REPENS ALLIANCE; Pinus elliotii-Serenoa repens Association)*

The pine flatwoods forests and woodlands are generally found on the poorly drained spodosols of the Myakka-Eau Gallie-Immokalee soil association. The overstory consists of two species of pines. South Florida slash pine (*Pinus elliotii* var. *densa*) makes up the vast majority of the pine population. Pond pine (*P. serotina*) can be found in small stands on very wet areas. Pine stands range widely in stocking densities, age, and height. The understory of the pine flatwoods varies depending on the elevation of the site. Common to all flatwoods sites is saw palmetto. Additional understory species on the mesic sites can include wax myrtle (*Myrica cerifera*), gallberry (*Ilex glabra*), and *Lyonia* spp. As the soils become dryer with increased elevation, the gallberry and wax myrtle become fewer and sand live oak, myrtle oak, and Chapman's oak begin to appear. The higher flatwoods, with a high proportion of scrub oaks, are locally known as scrubby flatwoods. The pine flatwoods forests are of special interest because they provide nesting habitat for the bald eagle (*Haliaeetus leucocephalus*). Where the pine overstory is sparse, the scrubby flatwoods can provide habitat for the Florida scrub-jay (*Aphelocoma coerulescens*).

*Upland Coniferous Forests; (PINUS ELLIOTTI-SENORA REPENS ALLIANCE; Pinus elliotii-Senora repens Association)*

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The upland coniferous forest and woodlands occur on both the Myakka-Eau Gallie-Immokalee and the Canaveral-Palm Beach-Welaka soil associations. South Florida slash pine is the predominate tree species, but small patches of sand pine (*Pinus clausa*) are also found. Many of the sites occupied by these stands have been disturbed in the past. The understory has many of the same species as is found in the flatwoods, including palmetto and *Lyonia*. Shrub species favoring drier soils are also found, including sand live oak, myrtle oak, and Chapman's oak. On the disturbed sites the understory shrub layer may be absent or scattered. These areas may also contain a number of exotic grasses and forbs.

*Planted Pine; (PINUS ELLIOTTII TROPICAL FOREST ALLIANCE; Pinus elliotii var densa Association)*

Abandoned citrus groves were planted to south Florida slash pine in the late 1980s and early 1990s. These have developed into uniform stands. The understory consists of exotic grasses left over from citrus operations.

### **Mixed Pine Hardwood Forests**

*Wetland Coniferous/Hardwood Forests; (PINUS ELLIOTTII-QUERCUS VIRGINIANA SATURATED TEMPERATE FOREST ALLIANCE; Pinus elliotii-Quercus virginiana Association)*

These stands can be found on the Copeland-Wabasso soil association. The overstory is predominately live oak, south Florida slash pine with some cabbage palms. There may be some red maple and other wetland species in the mid-story. The understory can have palmetto, wax myrtle, and other moist-soil species.

*Upland Coniferous/Hardwood Forests; (PINUS ELLIOTTII-QUERCUS VIRGINIANA FOREST ALLIANCE; Pinus elliotii-Quercus spp. Association)*

These stands can be found on the Copeland-Wabasso soil association, but at a slightly higher elevation. South Florida slash pine and live oak are the predominant overstory species. There may be other mesic hardwoods in the canopy, such as elms, ashes, red mulberries, and sugar berries.

### **Shrubland Communities**

*Oak Scrub and Scrubby Flatwoods; (QUERCUS GEMINATA-QUERCUS MYRTIFOLIA-SERENOA REPENS SHRUBLAND ALLIANCE; Quercus geminata -Quercus myrtifolia-serenoa repens Association)*

This community is found on the well-drained soils of the Paola-Pomello-Astatula soil association, which are located on the higher ridges of the refuge. The vegetation consists of palmetto (*Serenoa repens*), sand live oak (*Quercus geminata*), myrtle oak (*Q. myrtifolia*), and Chapman's oak (*Q. chapmanii*). As the elevation decreases towards palmetto, flatwoods, or swales, more mesic vegetation can be found. The species mix here would include gallberry (*Ilex glabra*) and various *Lyonia* species. This lower elevation species complex is also known as the scrubby flatwoods. Pines can be associated with both the true oak scrub and the scrubby flatwoods. Sand pine (*Pinus clausa*) is present on the dryer sites, while south Florida slash pine (*P. elliotii var densa*) is found in the scrubby flatwoods.

Fire is essential in maintaining both the vertical and horizontal structure of the oak scrub and scrubby flatwoods. Historically, fires ranged through oak scrub areas, keeping the oaks short. The stands were open in nature with numerous sandy openings. Pine stands, although always an important component of the landscape, were scattered and sparse. In the absence of fire during the 1960s and 1970s, the oaks and palmettos became tall dense thickets with no open areas. Pine stocking increased dramatically in some areas, effectively changing the landscape from shrubland to forest.

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Many of these overgrown oak scrub areas have been cut and burned over the past 15 years in an attempt to create a more natural landscape. In addition, pines densities have been reduced through commercial harvesting, burning, and using mechanical treatment. Although much success has resulted in recreating the vertical structure of oak scrub, persistent openings remain lacking in many areas.

*Palmetto Scrub; (SERENOA REPENS-ILEX GLABRA-LYONIA SPP. SHRUBLAND ALLIANCE; Serenoa repens-Ilex glabra-Lyonia spp. Association)*

The palmetto scrub occurs on the soils of the Myakka-Eau Gallie-Immokalee soil association. The majority of the vegetation is palmetto, gallberry, wax myrtle (*Myrica cerifera*), and several species of *Lyonia*. In many instances, this type is found in close association with the oak scrub. There is no real definitive break between these two types, but rather a gradual progression from one to the other. As the elevation on the land rises, scrub oaks can be found mixed in with the palmetto scrub vegetation.

*Planted Oak Scrub; (QUERCUS GEMINATA-QUERCUS MYRTIFOLIA-SERENOA REPENS SHRUBLAND ALLIANCE; Quercus geminata -Quercus myrtifolia-serenoa repens Association)*

An attempt to restore a 10-acre abandoned citrus grove near WSEG Road was conducted in 1992. Prior to planting, old citrus trees were removed and an attempt was made to control exotic grasses on the site. Sand live oak, myrtle oak, and Chapman oak were planted at a stocking rate of 400 stems per acre in August 1992. Additional oaks were planted in 1993 along with palmetto, rusty lyonia (*Lyonia fruticosa*), shiny blueberry (*Vaccinium myrsinites*), and south Florida slash pine. This effort was marginally successful.

*Coastal Strand; (SERENOA REPENS-COCCOLOBA UVIFERA SHRUBLAND ALLIANCE, Serenoa repens-Coccoloba uvifera Association)*

Coastal strand is found in a narrow band immediately inland from the beach. Salt spray and poor, sandy soils are the limiting factors. The most common plants found here are saw palmetto (*Serenoa repens*), sea grape (*Coccoloba uvifera*), snowberry (*Chiococca alba*), sea oats (*Uniola paniculata*), beach grass (*Panicum amarum*), and wax myrtle (*Myrica cerifera*). Vegetation seldom reaches a height of over four feet and shows marked evidence of hedging from salt spray.

## **Non-Native Plant Communities**

*Citrus Groves; (CITRUS SPP. WOODLAND ALLIANCE; Citrus Spp. Association)*

Various species of citrus were planted prior to the acquisition of the lands of the refuge by the government for Kennedy Space Center. Some of these have been allowed to go fallow, while others are being managed by the Florida Research Center for Sustainable Agriculture in an effort to develop more environmentally friendly citrus culture methods.

*Brazilian Pepper; (SCHINUS TEREBINTHIFOLIUS-MYRICA CERIFERA SHRUBLAND ALLIANCE, Schinus terebinthifolius-Myrica cerifera Association)*

Many disturbed areas, including dikes and abandoned facilities, have been invaded by Brazilian pepper and other exotics, along with native species, such as wax myrtle. These stands are thick, almost impenetrable thickets. There is little in the way of ground vegetation.

*Australian Pine; (CASURINA SPP FOREST ALLIANCE, Casurina spp. Association)*

Australian pine was planted around citrus groves and home sites as wind breaks. These are dense stands of *Casurina* with little, if any, understory. The ground cover is almost exclusively needles and other debris from the trees.

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## WILDLIFE

Merritt Island National Wildlife Refuge supports a high diversity of fish and wildlife species. This high biodiversity is, in part, the result of the refuge's location on the Indian River Lagoon, which is often touted as having the greatest biodiversity of any estuary in North America. However, the undeveloped nature of the refuge's landscape and diversity of habitats also contributes the high biodiversity. The estuarine waters of the refuge support a wide variety of resident and migratory birds, mammals, reptiles and amphibians, fish, and invertebrates. The estuary also provides important habitat to marine mammals (including Atlantic bottlenose dolphins and West Indian manatees) and marine reptiles (including juvenile green sea turtles). Upland and freshwater wetland areas provide additional habitats to support a variety of species.

The refuge serves as a key area for biodiversity, species richness that is very important to the overall ecological integrity and health of the Indian River Lagoon and the North Florida Ecosystem. The Service manages refuge resources and coordinates with neighboring land managers and agencies to conserve biological diversity.

The refuge also serves as an important site for the recovery of federal and state listed threatened and endangered species. The refuge's location and habitat features provides protection and management opportunities for the future of 10 federally listed threatened and endangered species that regularly occur on the refuge, as well as for the future of three additional wildlife species listed by the State of Florida as threatened or endangered (Epstein and Blihovde 2006). The 10 federally listed wildlife species that regularly occur on the refuge are: West Indian manatee; southeastern beach mouse; Florida scrub-jay; bald eagle; wood stork; piping plover; eastern indigo snake; and loggerhead, green, and leatherback sea turtles. Of the total listed animal species in the refuge's records, 17 are federally listed. However, seven of these species (i.e., American alligator, Kemp's ridley sea turtle, Hawksbill sea turtle, Atlantic salt marsh snake, snail kite, Audubon's crested caracara, and roseate tern) either have a special listing (i.e., alligator) or have rarely or never (i.e., Atlantic salt marsh snake) been recorded on the refuge. This brings the actual number of state or federally listed species that regularly occur on the refuge to 41: 10 federally and 31 state listed species (which excludes the alligator and includes 28 plant species). (For additional information on listed and designated species on the refuge, please refer to Appendix D.)

### **Birds**

Avian species are a highly important refuge resource. To date, over 300 bird species (both resident and transient) have been identified utilizing the refuge for nesting, roosting, feeding, or loafing. This includes seven bird species which are federally listed as threatened or endangered (i.e., Audubon's crested caracara, bald eagle, Florida scrub-jay, piping plover, roseate tern, snail kite, and wood stork), 42 species federally listed as Birds of Conservation Concern, 11 species listed by the State of Florida as threatened or endangered, and 12 species listed by the State of Florida as Species of Special Concern (see Appendix D for a listing of these birds.) Of the seven species federally listed as threatened or endangered, four species regularly depend on the habitat provided by the refuge: Florida scrub-jay, bald eagle, piping plover, and wood stork. In addition to serving as important habitat for threatened and endangered species, the refuge supports a wide variety of other resident and migratory bird species. Waterfowl, wading birds, shorebirds, and neotropical migratory birds (i.e., song birds or passerines) all depend on the diverse habitats offered by the refuge.

#### *Florida Scrub-jay*

The federally threatened Florida scrub-jay (*Aphelocoma coerulescens*) is one of the most intensively managed species on the refuge. In fact, the refuge is the site of the second largest population (about 550 family groups) of scrub-jays in Florida and in the world (Ocala National Forest in the northern part

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of central Florida is the number one site). Areas occupied by Florida scrub-jays are characterized as a mosaic of oak scrub, oak/palmetto, and coastal scrub habitats, as well as ruderal and disturbed areas in the coastal regions of Merritt Island and Cape Canaveral. Many of these areas include patches of remnant scrub in a human altered landscape. Population size of the Florida scrub-jay is influenced by the amount of available habitat and habitat suitability. Prescribed fire management is a major tool in scrub habitat management.

#### *Bald Eagle*

The refuge currently supports an annual average of 11 to 13 breeding pairs of the federally threatened Southern bald eagle (*Haliaeetus leucocephalus*). Eagles are known to use various pine flatwood habitats within the refuge and have used mature live pine, pine snags, and abandoned radio towers for nest sites. Bald eagles have been shown to nest within the vicinity of large water bodies, particularly with abundant access to fish and migratory waterfowl. The refuge's wetland and estuarine complex provides a diversity of excellent foraging habitats.

#### *Piping Plover*

The federally threatened piping plover (*Charadrius melodus*) uses coastal areas of the refuge during spring and fall migration. Small numbers of wintering piping plovers are known to use coastal areas north and south of the refuge. Although piping plovers do not presently winter on the refuge, they are known to use the refuge beach during fall migration. Currently no habitat on the refuge is being managed specifically for piping plovers.

#### *Wood Stork*

The federally endangered wood stork (*Mycteria Americana*) is of special interest to the Service. Wood stork populations have declined sharply in Florida, from 60,000 in the 1930s to 5,000 pairs today, with the complete loss of wood stork nesting on the refuge. Wood storks were first breeding in the refuge's Moore Creek colony in 1972 (with 35 nests). Nest numbers peaked in 1980 (with 350 nests) and varied in number until 1986. A severe freeze occurred in the 1985-86 winter that destroyed all of the mangrove nest sites in the Banana River and Moore Creek. Although 250 nests were recorded in 1986 at Moore Creek, the storks abandoned the freeze damaged rookery and no successful nesting has occurred on the refuge since 1986. Approximately 250 wood storks currently use the refuge for feeding and roosting.

#### *Waterfowl*

Refuge estuarine waters and impounded areas provide important habitat to both resident and wintering waterfowl. Seventeen waterfowl species regularly utilize the refuge, although only mottled ducks typically nest on the refuge. Waterfowl numbers on the refuge vary dramatically during the year, with tens of thousands using the refuge during the winter months, but only an estimated several hundred resident mottled ducks present during the summer months. The refuge historically supported a vast numbers of wintering waterfowl, including blue-winged teal, American widgeon, northern pintail, lesser scaup, redhead, and mergansers. However, wintering population numbers have varied through the years with recent counts generally low. Of particular concern are northern pintail and lesser scaup.

Pintail population numbers have steadily declined on the refuge over the past decades from a mid-winter count of about 20,000 in 1978, to 8,315 birds in 1989, to 3,141 in 1999, and to a low of 1,376 birds in January 2003 (representing a 93 percent decline from 1978). The northern pintail stands a serious chance of being extirpated from a historical wintering area at the refuge.

The continental population of lesser scaup has been declining since the mid-1980s. Merritt Island Refuge and its adjacent estuarine areas (in the Banana River, Indian River Lagoon, and Mosquito

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Lagoon) provide the most valuable wintering habitat for scaup on the Atlantic Flyway, harboring up to 62 percent of Atlantic Flyway scaup and 15 percent of the continental scaup population (Herring 2003).

#### *Wading Birds*

Sixteen species of wading birds (e.g., egrets, herons, and ibises) can be found on the refuge. Of these, one is federally listed as endangered (i.e., the wood stork) and eight species are designated Birds of Conservation Concern (BCC - federal) or Species of Special Concern (SSC - state) (see Appendix D for a list of designated species). Fourteen of these species commonly nest on the refuge. Wading birds at the refuge utilize a broad range of wetland habitat types for foraging, roosting, and nesting. Refuge habitats frequented by wading birds include both natural and man-made features, including the open estuary, natural freshwater wetlands, impoundments, and roadside ditches. In addition, many wading birds utilize vegetated dredge spoil islands in the Indian River Lagoon and Banana River as roosting and nesting sites.

#### *Shorebirds*

As a result of its location along the Atlantic coast, the refuge provides valuable habitat to a wide variety of shorebirds. Thirty-five species of shorebirds regularly utilize the refuge during fall and spring migrations, taking advantage of habitat provided along the coast, along shore areas of the estuary, and within impoundments. Fourteen species commonly winter on the refuge in high numbers and seven species have been recorded as nesting on the refuge. Of the species that regularly utilize the refuge, one species, the piping plover, is listed both federally and by the state as threatened, while two other species (i.e., red knot and semipalmated sandpiper) are federally designated as Birds of Conservation Concern (see Appendix D). Suitable habitat for shorebirds is provided via the current system of managing refuge impoundments for multiple species.

#### *Passerines*

The refuge hosts a great diversity of passerines, with approximately 170 species regularly occurring on the refuge. While 38 species have been recorded nesting on the refuge, the greater majority of passerines are transient, utilizing refuge habitats during spring and fall migrations. The threatened Florida scrub-jay (discussed above) is the only federally listed passerine that occurs on the refuge.

#### **Mammals**

The mammalian fauna of the refuge is characteristic of the central Florida coastal barrier ecosystem. Thirty mammal species are known to occur on the refuge, including two marine mammals (i.e., West Indian manatee and Atlantic bottlenose dolphin) which frequent lagoon and offshore waters. The refuge provides important habitat to two federally listed species, the West Indian manatee (state and federally listed as endangered), and the southeastern beach mouse (state and federally listed as threatened).

#### *West Indian Manatee*

Refuge waters serve primarily as a safe harbor and seagrass feeding site for an average of 300 West Indian manatees (*Trichechus manatus*) year-round and may host a peak population of over 600 individuals during months with warm water temperatures. Over a third of Florida's manatee population is found in the Indian River Lagoon system (Indian River Lagoon National Estuary Program 1996).

#### *Southeastern Beach Mouse*

The federally threatened southeastern beach mouse (*Peromyscus polionotus niveiventris*) is a subspecies of the old field mouse (*P. polionotus*) that inhabits the sand dunes and adjoining scrub along the Atlantic coastline. Extensive coastal development has resulted in the loss of coastal dunes

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and fragmentation of nearly all beach mouse habitats in Florida. The refuge provides habitat and protection to one of the last remaining core populations of this species.

### **Reptiles and Amphibians**

The refuge provides habitat to 71 species of reptiles and amphibians, including three marine reptiles (i.e., green, leatherback, and loggerhead sea turtles). Five species (i.e., American alligator, Eastern indigo snake and the three sea turtles) are federally listed as threatened or endangered. Three additional species are also listed by the state as species of special concern (i.e., Florida pine snake, gopher frog, and gopher tortoise) (see Appendix D).

Terrestrial herps have been studied on the refuge since the 1970s. Long-term monitoring has provided considerable existing data on the biodiversity of herps on the refuge (Seigel and Pike 2003) and will be invaluable to detect long-term changes in the refuge herpetofauna. Reptiles and amphibians are critical components of refuge ecosystems. The biomass of reptiles and amphibians (i.e., herps) may exceed that of all other vertebrates in aquatic and terrestrial systems (Seigel and Seigel 2000). The ecological distribution of reptiles and amphibians on Merritt Island Refuge is a function of available habitat, which mostly reflects wetland, freshwater communities. However, several species are specific to and use terrestrial habitats and certainly are linked to the coastal ridge and trough topography on the refuge. Exotic species are becoming potential threats to the refuge. Presently on the refuge, the brown anole (*Anolis sagrei*) may be displacing native species (Campbell 2000, Campbell and Echternacht 2002). The Cuban frog (*Osteopilus septentrionalis*), which consumes smaller species, has been positively identified on the refuge. Additional research and monitoring is being conducted on gopher tortoise distribution, fecundity, and on upper respiratory tract disease.

#### *American Alligator*

The American alligator (*Alligator mississippiensis*) is federally listed as threatened only as a result of its similarity in appearance to the federally endangered American crocodile. The species is not regulated under Section 7 of the Endangered Species Act and is not in danger of becoming extinct. American alligators are abundant on the refuge, with an estimated population of over 3,000 individuals.

#### *Eastern Indigo Snake*

Eastern indigo snakes (*Drymarchon couperi*) became federally listed as threatened under the Endangered Species Act in 1978. Once common from the southern tip of South Carolina west to southeastern Mississippi and throughout Florida, the current range is restricted to southern Georgia and peninsular Florida, with a few small populations located in the Florida panhandle and Key Largo. Eastern indigo snakes have very large home ranges and use a variety of habitat types found within the refuge, including oak scrub, oak hammock, pine flatwoods, fresh and brackish wetlands, and disturbed habitats (Becky Smith and Mike Legare, Dynamac, Inc., personal communication). The species also shares a commensal relationship with the state listed gopher tortoise (*Gopherus polyphemus*), whose burrows it uses as shelter from predation and temperature extremes.

#### *Sea Turtles*

Three different sea turtle species annually nest along the nearly 10-kilometer stretch of refuge beach between March and September. These turtles include the federally threatened loggerhead sea turtle (*Caretta caretta*), federally endangered green turtle (*Chelonia mydas*), and federally endangered leatherback turtle (*Dermochelys coriacea*). The loggerhead is the primary nesting turtle on the refuge with over 95 percent of the nesting and with previous annual averages of 1,300 nests (Popotnik and Epstein 2002). Green sea turtle nest numbers oscillate between 50 and 200 every other year. Leatherback sea turtles nest infrequently on the refuge beach, with only one or two nests recorded in

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a typical year. Management for these species includes beach protection, NASA coordination efforts, nest monitoring during the nesting season, and predator control. Primary nest predators include raccoons (*Procyon lotor*), feral hogs (*Sus scrofa*), and ghost crabs (*Ocypode quadrata*). Nest depredation was greater than 90 percent of nests during the late 1970s before predator control (Lew Ehrhart, personal communication). Today, an active predator control program has decreased depredation of nests well below an annual rate of 10 percent. Lighting disorientation impacts from NASA and U.S. Air Force facilities are a concern for nesting and hatchling sea turtles. NASA monitors annual disorientation for the space shuttle and Air Force launch pad facilities. Refuge coordination efforts with NASA and the Air Force help to reduce or eliminate adverse effects of lighting on sea turtle nesting and hatchling disorientation.

Beyond the nesting beaches, the refuge also provides a juvenile sea turtle nursery. The Mosquito Lagoon is considered a developmental habitat for sub-adult loggerhead and green sea turtles. The lagoon once supported vast numbers of wintering juvenile sea turtles and an historic sea turtle fishery that extended into the 1960s, which was thought to contribute to the decline in population numbers. Turtles may remain in Mosquito Lagoon until maturity. Turtles wintering in the lagoon are plagued by winter freezes, which can cold stun the animals and can cause mortality. The refuge has developed a plan to coordinate the handling of cold stunned turtles and prevent mortalities (Epstein 2001a). Monitoring of wintering sea turtles in the Mosquito Lagoon in the mid 1970s (Ehrhart and Yoder 1978) found higher numbers than presently found (Provanca et al 2002) and found an increase in sea turtle fibropapillomas.

### **Fish**

Over 140 freshwater and saltwater fish species are known to utilize refuge estuarine areas, impoundments, and freshwater wetlands. Of the fish species known to occur in refuge waters, none are currently federally or state listed. Fish species within the refuge are important not only to commercial and recreational interests, but also to the ecology of the area. The refuge protects important fish habitats, such as fish spawning and fish settlement sites, ensuring healthy, sustainable fish populations. The open water estuary habitat of the Indian River Lagoon is one of the most renowned sport fishing sites in the world (Roberts et al 2001). This system is essential to several interjurisdictional and economically important fish species, including snook, tarpon, red and black drum, spotted sea trout, and striped mullet.

### **Invertebrates**

A wide variety of marine, freshwater, and terrestrial invertebrates are found within the refuge's boundary. While some research has been conducted regarding benthic macro-invertebrates inhabiting the open estuary and select impoundments, no systematic survey has been performed for freshwater or terrestrial invertebrates of the refuge. A keystone species, the horseshoe crab (*Limulus polyphemus*) which generally inhabits estuarine areas of the refuge, has been in decline (Jane Provanca and Gretchen Ehlinger, Dynamac, Inc., personal communication). The reason for the decline in horseshoe crab abundance is currently unknown.

### **Exotic, Invasive, and Nuisance Species**

The occurrence and spread of exotic, invasive, and nuisance plant and animal species have been identified by Service staff and intergovernmental partners as one of the priority management issues facing Merritt Island National Wildlife Refuge. Further, nuisance native animal species are also known to have negative impacts on threatened and endangered species and on human safety. Although numerous exotic, invasive, and nuisance species occur on the refuge, only a small number have been identified by the refuge as management concern species.

In Florida, almost one-third of the plants occurring in the wild are exotic, and of the estimated 1,200 exotic species in Florida, approximately 11percent are invasive in natural areas (Schmalzer et al 2002). Schmalzer and others reported over 50 invasive exotic plants in and around the refuge. Although there has been no comprehensive survey of exotic plants on the refuge itself, 25 of these have been observed by refuge personnel on refuge lands.

The Florida Exotic Pest Plant Council maintains a list of Category I invasive exotic plants that are altering native plant communities and Category II invasive exotic plants that have increased, but that have not yet altered native plant communities (Florida Exotic Pest Plant Council 2005). The refuge has 17 known Category I plants and two known Category II plants (Table 2) that are of management concern. These species have invaded all refuge wetland and upland habitats, as well as disturbed sites. Invasive species can have negative impacts to natural plant diversity and to wildlife habitat. Invasive species can also have negative economic and public health and safety impacts. No comprehensive survey of exotic plants has been conducted on the refuge. Control efforts by refuge staff have historically been uncoordinated and typically focused on controlling invasive plants in public use areas and along selected roads and dikes. The refuge currently receives no funding for invasive plant control. All invasive plant control efforts have been funded out of limited operations' monies and through partnerships. In 2000, the refuge began participation in a Florida Department of Environmental Protection program where public land management agencies could submit proposals for invasive plant control project funding. To date, the refuge has had eight projects funded with a value of \$740,110. In addition, Canaveral National Seashore has completed four projects in cooperation with the Florida Department of Environmental Protection within the joint refuge/Seashore area. The Department's projects have focused on protecting native plant diversity and protecting wildlife habitat.

**Table 2. Selected exotic species occurring on Merritt Island National Wildlife Refuge**

Scientific Name	Common Name(s)	Category <sup>1</sup>
<b>Plants</b>		
<i>Albizia julibrissin</i>	Mimosa, Silk Tree	1
<i>Abrus precatorius</i>	Rosary Pea	1
<i>Bambusa</i> spp.	Bamboo	N/A
<i>Bruhinia variegata</i>	Orchid Tree	1
<i>Casuarina</i> spp.	Australian Pine	1
<i>Dioscorea bulbifera</i>	Air-Potato	1
<i>Eichhornia crassipes</i>	Water-Hyacinth	1
<i>Enterolobium cyclocarpum</i>	Costa Rica Ear Tree	N/A
<i>Eucalyptus</i> spp.	Eucalyptus	N/A
<i>Ficus</i> spp.	Fig	1
<i>Imperata cylindrical</i>	Cogangrass	1
<i>Lygodium microphyllum</i>	Old World Climbing Fern	1

Scientific Name	Common Name(s)	Category <sup>1</sup>
<i>Melaleuca quinquenervia</i>	Paper Bark Melaleuca	1
<i>Melia azedarach</i>	Chinaberry Tree	2
<i>Nephrolepis cordifolia</i>	Boston Fern/Erect Sword Fern	1
<i>Panicum maximum</i>	Guinea Grass	2
<i>Psidium</i> spp.	Guava	1
<i>Pueraria Montana</i>	Kudzu	1
<i>Rhynchelytrum repens</i>	Natal Grass	1
<i>Ricinus communis</i>	Castor Bean	2
<i>Ruellia brittoniana</i>	Mexican Petunia	1
<i>Sapium sebiferum</i>	Chinese Tallow Tree	1
<i>Senna pendula</i>	Christmas senna	1
<i>Sporobolus indicus</i>	Smut Grass	N/A
<i>Schinus terebinthifolius</i>	Brazilian Pepper	1
Animals		
<i>Sus scrofa</i>	Feral Hog	N/A
<i>Felis domesticus</i>	Feral Cat	N/A
<i>Perna viridius</i>	Green Mussel	N/A
<i>Pterygoplichthys</i> spp.	Armored Catfish	N/A

1. Florida Exotic Pest Plant Council Category

Invasive animals can also cause negative natural resource impacts through direct mortality to native wildlife and by competition with native wildlife for food resources. Two invasive animal species are known to occur on the refuge: feral hogs and feral house cats. Hogs are an invasive species which are present in large numbers in all upland and marsh habitats. Hogs cause extensive habitat damage and the Service suspects that they also negatively impact wildlife by direct mortality and through competition for food. Hogs are also a safety hazard due to impacts with vehicles. They cause economic damage through vehicle collisions and through destruction of landscaped areas and road shoulders by rooting. Estimates of the hog population on the refuge have varied from 5,000 to 12,000. Current control efforts include trapping by permittees and shooting by refuge staff, removing approximately 2,500 hogs from the refuge each year. The number of feral house cats occurring on the refuge is small and is usually associated with refuge and NASA facilities. It is assumed that all feral house cats occurring on the refuge are released by the public, while some are subsequently fed by the public.

Raccoons are the primary nuisance native wildlife species on the refuge. Raccoons are predators on the nests of sea turtles. The refuge operates a program to control raccoon numbers on the refuge's

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nesting beach to reduce the level of depredation on sea turtle nests. Other nuisance wildlife species are limited to birds, alligators, and a variety of other species which impact the Space Program operations at Kennedy Space Center. Refuge staff respond to Space Center calls regarding nuisance wildlife and deal with the animal using the least intrusive method available.

The infestation of invasive plants and feral hogs is extensive on the refuge and without control efforts the level of infestation is anticipated to continue to increase resulting in even greater impacts to refuge habitats and wildlife populations.

## **CULTURAL RESOURCES**

From its gradual emergence from the sea about a quarter million years ago to the space age, Merritt Island has remained a unique natural area attracting a diverse array of wild creatures and human occupants. The forces of wind, wave action, and fluctuating levels of the ocean formed the alternating ridges, swales, and marshes of Merritt Island. The land continues to change as the dynamic natural forces of the barrier island constantly shape and sculpt the Island.

### *HISTORICAL OVERVIEW*

#### **Indian Period**

Over the millennium, human occupation of the island ebbed and flowed. Archaeologists say that the Island was occupied by seven distinct Native American cultures dating back 6,000 years. The first human visitors were probably small bands of nomadic hunters and gatherers that wandered in from the St. Johns River basin. At this time, sea levels were much lower than present and the shoreline could have been miles eastward, so most evidence of their culture was lost with the last sea level rise. Shellfish formed an important part of the indigenous peoples' diets as evidenced by the numerous shell middens that exist today and which have provided archaeologists with important information concerning their societies. Beginning about 2,000 B.C., the Native Americans developed clay pottery and this event marked the beginning of the Orange Period which lasted about 1,000 years. This was followed by the Transitional, St Johns I, and St Johns II periods, and finally, after 1565, the St. Augustine period.

Each period of Native American culture was marked by a distinctive type of pottery and shards of these various utensils are found in many of the middens. Evidence indicates that early indigenous people spent their winters on the barrier island in and around Mosquito Lagoon and Banana River, moving inland to the St. Johns River basin during the summer months to escape the intolerable salt marsh mosquitoes.

By the time the first European explorers arrived, the refuge formed the line between two distinctive Indian cultures. The Timucuan, a peaceful agrarian tribe, occupied the area along Mosquito Lagoon northward to Jacksonville. To the south, beginning at Cape Canaveral and the Banana River, the coast was inhabited by the fierce Ais Indians. Most of what is known of the Ais culture came from the Jonathan Dickinson Journal of 1696. Both the Timucuan and the Ais tribes disappeared in historical times, having succumbed to war, disease, and slavery at the hands of the Spanish and English. Following early English raids, some of the Ais moved to Cuba with the Spanish. Other than occasional incursions by the Seminoles, Indian occupation of the Cape area ended after the early 1700s.

#### **Early European Settlement**

For nearly 300 years, during the 16<sup>th</sup>, 17<sup>th</sup>, and 18<sup>th</sup> centuries, the Cape area was on the fringe of Spanish activity. Neither Spanish settlements nor missions were known to have occurred in the area

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of the refuge, though evidence of their occasional passage through the region was indicated by the presence of wild orange groves.

Following the Spanish occupation, British settlers moved into the area for a brief period from 1763 to 1784. The American Revolution brought an end to the British occupation.

### **Second Spanish Period**

The period from 1784-1821 was termed the second Spanish Period and during this era several Spanish Land Grants were established on the refuge. The Gomez Grant forms the current northern boundary of the refuge. It became clear that Spain could no longer hold Florida and it was forced into signing the Adams-Onis Treaty in 1819 that led to the transfer of Florida to the United States in 1821.

### **American Period**

Florida was established as a Territory in 1821 with Andrew Jackson serving as the first territorial governor. In 1835, the Second Seminole War broke out and all plantations and settlements south of St. Augustine in east Florida were destroyed. The Second Seminole War stimulated the first substantial modern development of transportation and fortifications on the refuge. From November 1837 to April 1838, Fort Anne, near present day Haulover Canal, was constructed and occupied. In 1854 the first Haulover Canal was constructed, which served to bring in settlers and goods and to send produce to northern markets.

With the end of the Seminole War, Douglas Dummitt settled on a piece of land south of Fort Anne. Over the next 36 years he established a 1,700-tree orange grove that was reported to be the largest in the state. Dummitt's grove was the forerunner of the citrus industry in Florida and the origin of the famous Indian River Fruit industry. Dummitt's grove lasted until after his death in 1873, but in December 1894 and February 1895 two successive freezes destroyed the grove.

By 1896, the lower portion of Mosquito Lagoon was the property of the Canaveral Shooting Club and the land was spared from development. Around the same period, the Indian River Club acquired the marshes around Banana River and Banana Creek, having the same positive results in maintaining the natural values of the area. These efforts by conservationist proved beneficial to NASA, some 60 years later, when it acquired the property for the Kennedy Space Center.

In 1903 Pelican Island, located 70 miles south of Merritt Island, was established as the nation's first national wildlife refuge. However, despite efforts to protect the nesting brown pelican colony on Pelican Island, the birds abandoned Pelican Island in the mid-1920s. Paul Kroegel, the Refuge Manager, discovered that the birds had moved to Mosquito Lagoon and, in 1928, the island where they were nesting was designated as the North Brevard National Wildlife Refuge. The birds eventually returned to Pelican Island to the south, but the designation as the North Brevard Refuge remained. From 1930 to the end of 1950, the area was devoted to cattle grazing and citrus. Several small residential communities were becoming better established, but the ever present salt marsh mosquito remained a factor in limiting large scale residential land use on Merritt Island.

Across the Banana River on Cape Canaveral was the site where America began its exploration of space. The early focus of these launch operations was at Cape Canaveral, but by the end of the 1950s it became evident that additional lands were needed for the future of the space program. In the late 1950s and early 1960s, NASA acquired land in fee simple title and acquired submerged land from the State of Florida. The property cost was \$72,872,000. During the acquisition stage, NASA approached the Service to include the lands of the North Brevard Refuge as part of the Kennedy Space Center. A local naturalist and photographer by the name of Allan Cruickshank and others

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lobbied NASA to preserve some of the area for its wildlife values. NASA was under intense pressure from the citrus industry and others to retain some of the established uses of the area and viewed the establishment of the refuge as a means to appease these interests.

In 1962, the later named John F. Kennedy Space Center was officially established. On August 28, 1963 NASA entered into an agreement with the Fish and Wildlife Service to manage a portion of the Space Center as a refuge and Merritt Island National Wildlife Refuge was established. The original refuge was 25,300 acres and included the marshes east of Titusville north and south of State Route 402 and State Route 406. In subsequent years, additional lands were turned over to the refuge, including management of about 2,500 acres of orange groves. In 1975, Congress established Canaveral National Seashore, which withdrew a portion of the refuge and turned it over to the National Park Service. A joint refuge/Seashore area was established in Mosquito Lagoon, where duties and responsibilities were divided, but where the refuge retained management of wildlife and most public use activities, including hunting and fishing. Today most of NASA's lands are managed by the Department of the Interior as a national seashore and national wildlife refuge. NASA has retained title to the property and the agreement allows NASA to withdraw lands required to support space related purposes. Today the refuge manages over 139,000 acres of NASA lands and about 1,246 acres of Service and state land along the headwaters of Indian River Lagoon. Within the refuge/Seashore overlap, the National Park Service takes the lead on cultural resources.

#### *CULTURAL RESOURCE PROTECTION*

Since the refuge includes several historical and archaeological sites and since these sites are fairly accessible to disruption, vandalism, and theft, several archaeological surveys have been conducted on the refuge. Some of these sites are eligible for listing in the National Register. In the event that a previously undetected archaeological site is uncovered, activity must stop and the refuge must coordinate with the Service's Regional Archaeologist and Florida's State Historic Preservation Office.

#### *NATIONAL REGISTER*

Of the 100 known archaeological sites of Kennedy Space Center/refuge, 5 archaeological sites are listed in the National Register of Historic Places, 23 archaeological sites are considered eligible for listing, 8 sites are potentially eligible for listing, 17 sites lack sufficient information to evaluate eligibility for listing, 47 sites were evaluated to be not potentially eligible, and 8 sites either could not be relocated or sufficiently tested to evaluate the potential for listing (Deming, Scupholm, and Hinder 2001). As of 1998, 116 temporal/cultural components were identified on the known 100 archaeological sites, with 78 percent of these components being prehistoric (including artifact scatters, shell middens, middens, burial mounds, lithic scatters, and single artifact occurrences) and 22 percent were historic in nature (including 15 refuse deposits, six cemeteries, a fort, canal, saltworks, homestead/grove, and sugar mill ruins) (Deming, Scupholm, and Hinder 2001).

A variety of NASA facilities at Kennedy Space Center are historically significant, since they represent America's first ventures into space and America's first spaceport. In 1973, the LC-39 site was the first NASA facility at the Space Center to be listed in the National Register of Historic Places. At the time, this listing included approximately 7,000 acres and a variety of NASA facilities. By 2001, the recommendation was to alter the listing into individual nominations for 10 historic facilities (including the Vehicle Assembly Building, Launch Control Center, Crawlerway, Press Site Clock and Flag Pole, Missile Crawler Transporter Facilities, Pad A, Pad B, Headquarters Building, Central Instrumentation Facility, and Operations and Checkout) with hundreds of contributing and non-contributing resources under the multiple property category (Deming, Scupholm, and Hinder 2001).

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## SOCIOECONOMIC ENVIRONMENT

The refuge is located in the Indian River Lagoon region, which was generally unaffected by human activities until the early 1800s. Early activities included growing citrus, harvesting palmetto berries, and growing pineapple. By the late 1800s, commercial fisheries opened up the lagoon's resources. With repeated freezes devastating agricultural crops, cattle grazing increased in the region. Various military facilities were developed in the region during World War II. By the 1960s, NASA's space program instigated considerable growth in the area. The modern economy of the Indian River Lagoon is based on tourism and agriculture, as well as on fishing, manufacturing, real estate, services, and government. In the 1990s, citrus was a \$2.1 billion industry in the lagoon region (Indian River Lagoon National Estuary Program 1996).

By 2000, Florida's population had soared to 16 million, with 77 percent living in Florida's 35 coastal counties. The resident counties of the refuge, Brevard and Volusia, are in the top 10 most populated Florida counties. In 2000, over 919,000 people lived in these two resident counties of the refuge, with another 1.26 million in the two adjacent counties, while the average growth rate from 1990-2000 in the four-county area around the refuge was over 25 percent with a 2000 total for this area of nearly 2.2 million (Table 3) (U.S. Census Bureau 2000b).

**Table 3. The resident and nearby counties grew between 19% and 33% from 1990-2000 (U.S. Census Bureau 2000b)**

County	2000 Population	Growth Rate from 1990-2000 (Percentage)	Location in Relation to Refuge
Brevard	476,230	19.4	resident county
Volusia	443,343	19.6	resident county
Seminole	365,196	27.0	~13 miles west of the refuge
Orange	896,344	32.3	~9 miles west of the refuge
Four County Total	2,181,113	25.7	

Although the resident and adjacent counties of the refuge grew at an average rate of 25 percent from 1990-2000, over the same time period the nearby cities grew at varying rates from 7 to 50 percent (Table 4) (U.S. Census Bureau 2000b).

**Table 4. The cities adjacent to the refuge have grown at varying rates during the 1990-2000 decade (U.S. Census Bureau 2000b)**

Adjacent City	2000 Population	Growth Rate from 1990-2000 (Percentage)	Location in Relation to Refuge
Titusville	40,670	3.24	~5 miles west of the refuge
Cocoa	16,412	-7.39	~6 miles south of the refuge
Cape Canaveral	8,829	10.17	~2 miles south of refuge
Oak Hill	1,378	50.27	~2 miles northwest of the refuge
New Smyrna Beach	20,048	21.19	~11 miles north of the refuge

Population projections through 2015 indicate that the change in the area's county population is expected to increase at a rate of approximately 18.9 percent by 524,000 persons from 2005 to 2015 (Table 5). The projected population of the State of Florida is expected to increase by 16 percent from 2005 to 2015 to over 20 million. Highest area population growth rates are expected in Osceola County (at 26 percent), followed by Orange County (at 22 percent) and Seminole County (at 16 percent). Brevard, Indian River, and Volusia Counties are projected to grow by 14-16 percent over the 2005 population to 1.3 million. Orange County is expected to remain the most populated county in the vicinity of the refuge. (Lenze 2002)

**Table 5. Projected population growth is outlined for several area counties (Lenze 2002)**

County	2005 Population	2010 Population	2015 Population	Projected Growth (2005) (Percentage)
Brevard	519,100	562,300	599,400	15.5
Indian River	126,400	136,300	144,000	13.9
Orange	1,029,500	1,147,100	1,258,800	22.3
Osceola	202,600	232,100	255,400	26.1
Seminole	413,700	452,700	480,700	16.2
Volusia	483,300	525,400	560,100	15.9
State of Florida	17,616,400	19,075,600	20,388,600	15.7

Economic conditions are generally good for the two resident counties of the refuge. While the median household income for Florida in 1999 was \$38,819, Brevard County's was \$40,099 and Volusia County's was \$35,219 (U.S. Census Bureau 2000b). While these values are slightly below the national average, it is estimated that approximately 9.5 percent of the population of Brevard

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County live below the poverty level, while 11.6 percent of the population of Volusia County live below the poverty line, which are both less than the national poverty rate of 12.4 percent (U.S. Census Bureau 2000a). Further, in 2000, the unemployment rate for Brevard County was below the state and national rates at 4.9 percent and Volusia County's unemployment rate was above the state and national rates at 6.3 percent (the State of Florida's rate was 5.6 percent and the United States' rate was 5.8 percent in 2000) (U.S. Census Bureau 2000b). According to the 2002 Florida Price level Index, the cost of living in Brevard County was 4.61 percent below the state average and in Volusia County it was 4.94 percent below the state average (Bureau of Economic and Business Research 2002). In both counties, food costs were above the state average, while healthcare, housing, other goods and services, and transportation costs were below the state average (Bureau of Economic and Business Research 2002).

Despite the good economic conditions of Brevard County in general, the city of Titusville, directly adjacent to the refuge and five miles from the refuge's Visitor Center, has a more mixed picture, relying heavily on NASA's Kennedy Space Center and related businesses. About 12.4 percent of the population in Titusville reported incomes that were below the poverty threshold (Bureau of Economic and Business Research 2002). The city of Titusville's poverty level is equal to the state and national averages, as are the poverty rates of two other adjacent cities (Oak Hill and Mims).

Natural and agricultural lands of the area are increasingly being converted to urban and suburban uses. This rapid growth and its associated impacts dramatically impact the refuge and its resources. This growth extends to the borders of the refuge, with the less intensive growth of NASA occurring within the refuge's boundary. See Figure 9 to view the land use/land cover classifications in and around the refuge and see Figure 10 for an aerial view, showing the development surrounding the refuge (showing imagery taken in 1999 with 1-meter resolution). To the west of the refuge, across the Indian River Lagoon and the highly utilized Intracoastal Waterway is the city of Titusville. Development west of the refuge includes residential uses (e.g., single-family homes, condos, and mobile home parks), city parks, commercial uses (e.g., gas stations, restaurants, automobile and boat dealers, a marina, and small businesses), minor undeveloped lands, citrus groves, and urban development. To the north of the refuge are residential uses, agricultural uses, and Canaveral National Seashore. The Port of Canaveral, Cape Canaveral Air Force Station, residential uses, and citrus groves are south of the refuge.

Within the 15-year life of this comprehensive conservation plan, the State of Florida is anticipated to reach 20.4 million by 2015 (Lenze 2002). Also by 2015, the two resident and two adjacent counties of the refuge are anticipated to grow to 2.9 million (Lenze 2002). The populations of Brevard and Volusia Counties continue to be predominantly white (87 percent and 86 percent, respectively) and older, with considerable increases in the Hispanic category. Brevard County's median age rose to 41.4 years of age with 20 percent aged 65 and older, while Volusia County's median age is 42.4 with over 22 percent aged 65 and older (U.S. Census Bureau 2000b). The challenges and opportunities represented by projected growth and changes in the population around the refuge include the challenges associated with a rapidly aging population and the subsequent impacts on the economy in terms of available workforce, the challenge of a weakening per capita income and the impacts of a low labor force participation rate and a weak job mixture (e.g., Brevard County is overly reliant on low-paying retail sector jobs with few higher-paying jobs in other job sectors), the challenge of diversifying the local economy (especially in and around Titusville) in the face of possible downsizing activities or relocation of NASA operations at Kennedy Space Center, and the opportunity to capitalize upon strong social and economical conditions (e.g., Brevard County has a low crime rate, low poverty rate, strong job growth, well-educated population, and an attractive climate, and access to the Intracoastal Waterway and the Atlantic Ocean) (Market Street Services, Inc., 2001).

Figure 9. Land Use/Land Cover

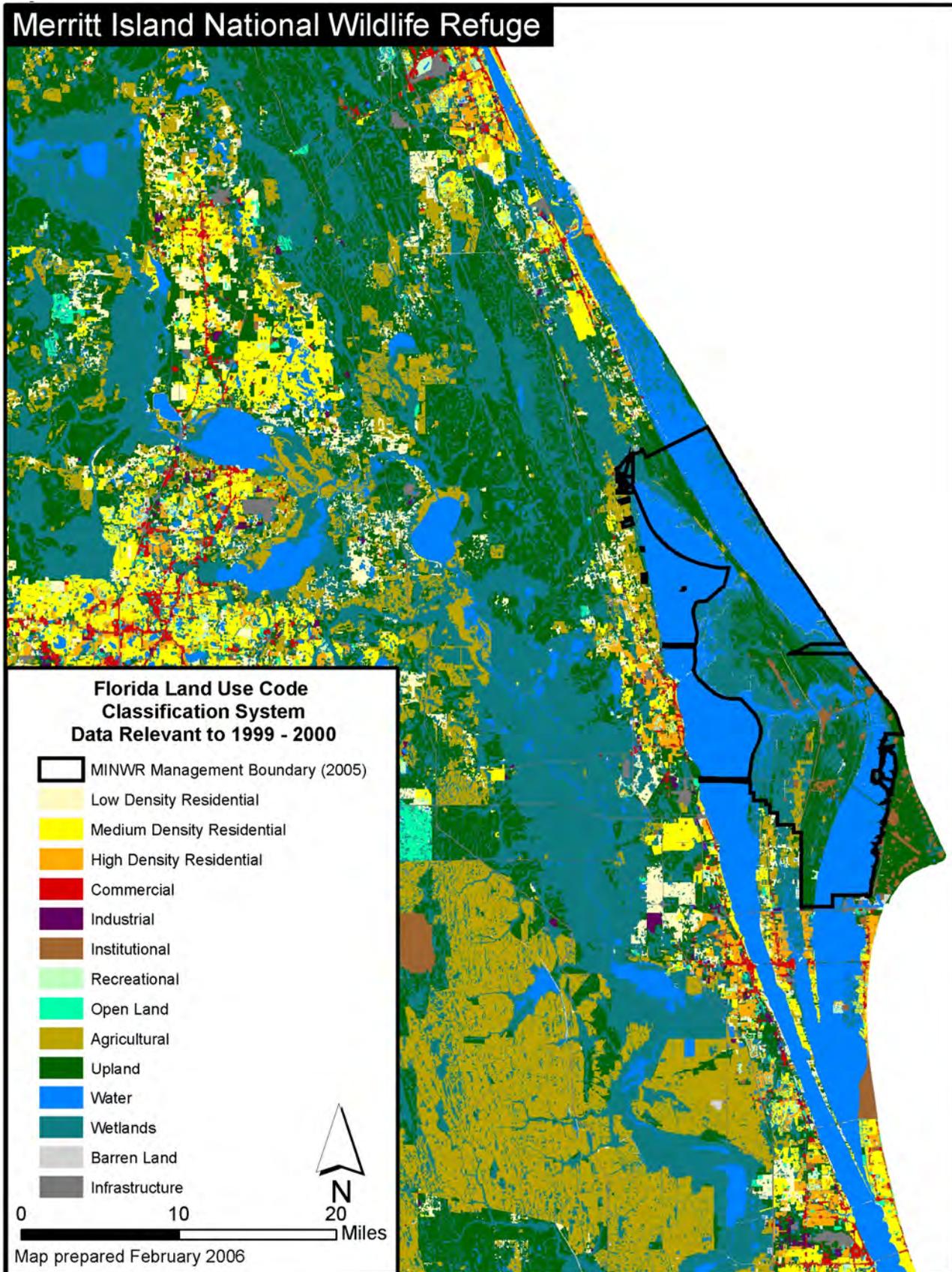
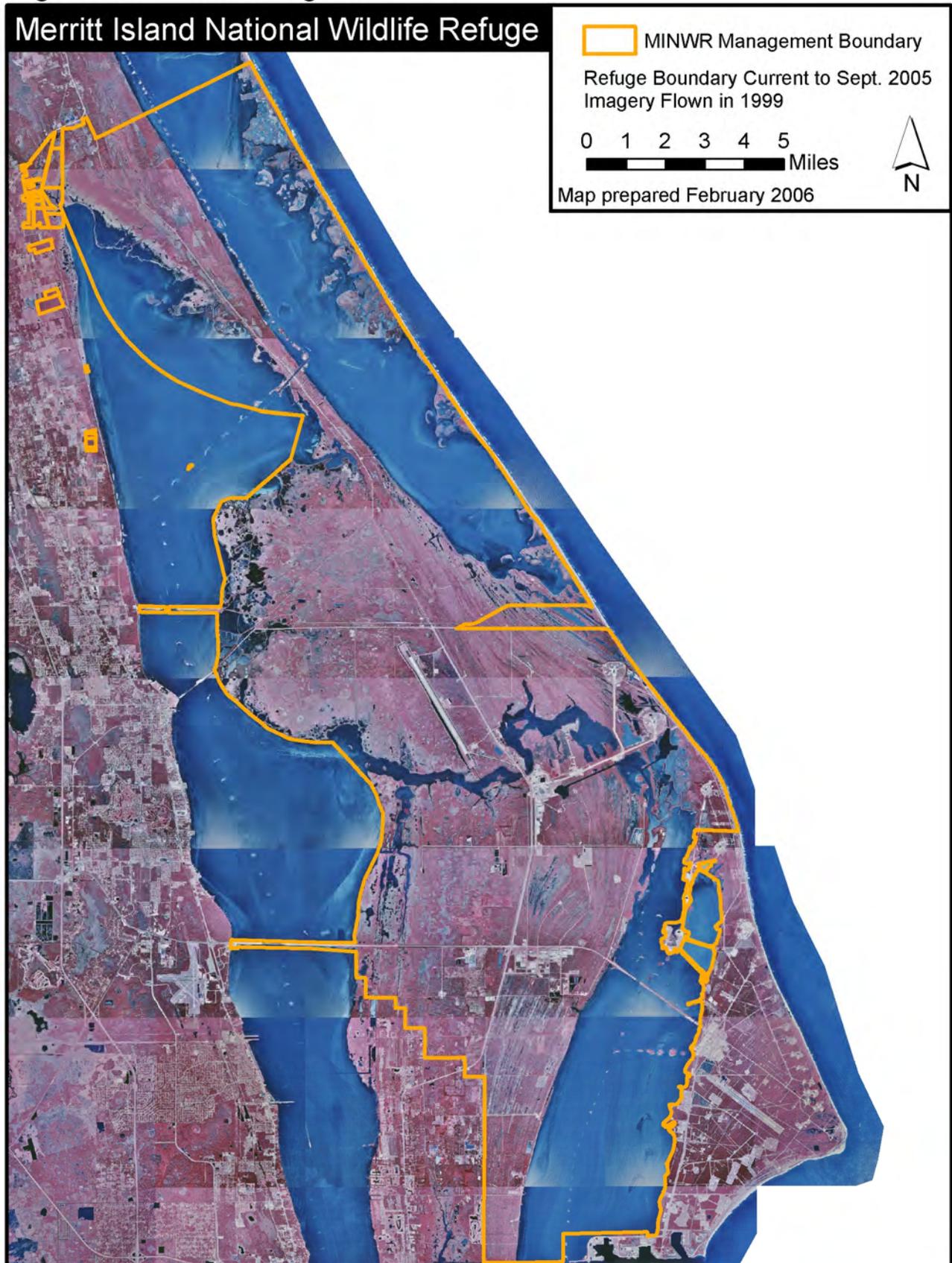


Figure 10. Aerial Image



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The Indian River Lagoon is renowned for its recreational and ecotourism opportunities and for its world class fishing. The seagrass beds of the Indian River Lagoon act as nursery grounds that support an 800-million-dollar industry to the local economy (Apogee 1996). Commercial and sport fishing, tourism, and real estate development are the mainstay in this area. In 1995 residents and tourists valued the Indian River Lagoon at over \$733 million, including spending on recreational activities (e.g., rental of fishing boats), commercial fish landings (e.g., seafood sales), and lagoon-front property (e.g., home purchases) (Apogee 1996). [Of this \$733 million, access to the resources, valued at \$200 million, is not reflected in market transactions (Apogee 1996).] An estimated \$54 million was spent on recreational fishing in the lagoon in 1990 with an anticipated escalation to \$87 million by 2010 (Milon and Thunberg 1993). Over 15 percent of Florida's restaurants and hotels are located within the Indian River Lagoon region (Indian River Lagoon National Estuary Program 1996). Fishing activity in the Indian River Lagoon comprises 50 percent of Florida's east coast catch (Brevard Nature Alliance 2001). Brevard County's Office of Tourism estimated that more than 650,000 anglers fished in these waters in 2001 (Brevard Nature Alliance 2001).

Wildlife viewing has emerged as an important economic value to the State of Florida, generating an estimated \$477 million in retail sales in Florida alone from birdwatching (Florida Fish and Wildlife Conservation Commission 2000). The Florida Fish and Wildlife Conservation Commission estimates that the economic impact of wildlife viewing in the state of Florida is nearly \$1.8 billion (Harding 2004b) and that out-of-state visitors spend \$192 per day on wildlife viewing activities (Harding 2004a). Brevard County pulls in an economic value of over \$56 million from wildlife viewing activities (Florida Fish and Wildlife Conservation Commission 2004). This new trend is pulling in substantial dollars for the State of Florida and the Fish and Wildlife Conservation Commission has developed birding calling cards that visitors can leave at area businesses that state they have come to that community specifically to birdwatch. The Commission also developed the Great Florida Birding Trail, a 2000-mile trail that links bird watching sites in Florida. With over 40 Great Florida Birding Trail sites in the Indian River Lagoon region, the Commission selected the refuge in 2001 as the Eastern Gateway for this trail.

Merritt Island National Wildlife Refuge is a destination spot for a variety of visitors, from the local fisherman to the international birder. The refuge is situated in northern Brevard and southern Volusia counties and adjacent to the most visited county in Florida, Orange County (VISIT FLORIDA 2003). Orange County offers traditional tourism activities, such as Walt Disney World, Sea World, or Universal Studios in the Orlando area, and represented 26.1 percent of 2001 Florida visitors (VISIT FLORIDA 2003). In 2002, the Orlando area hosted 43 million visitors and is expected to reach 51.9 million in 2006 (Orlando/Orange County Convention and Visitors Bureau, Inc., 2004). Just 45-minutes from Orlando, the refuge receives many visitors from Orange County. Volusia County sees 4.4 percent and Brevard County see 2.9 percent of all Florida visitors (VISIT FLORIDA 2003). With nearly 1 million annual visitors to the refuge in 2003 (including over 350,000 to the refuge's exhibit at Kennedy Space Center's Visitor Center and the Space Center tours) and with over 550,000 to the South District of Canaveral National Seashore (i.e., Playalinda Beach), the local economy benefits greatly from the federal conservation lands of the refuge and seashore. The wetlands of the refuge draw thousands of waterfowl every winter, which in turn attracts waterfowl hunters from all over the southeastern United States. Hunters spend almost \$11 million in Brevard County, generating \$657,634.00 in state tax dollars (Florida Fish and Wildlife Conservation Commission 2004). The refuge offers 36,000 acres to waterfowl hunting, half of which is managed under a \$12.50 refuge hunting permit, which can generate up to \$16,500 for the Fish and Wildlife Service to administer this hunt program.

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## REFUGE ADMINISTRATION AND MANAGEMENT

Due to the unique nature of protecting wildlife and habitat in and amongst an active space program, administration and management of the refuge involves much more than normal refuge operations. The refuge is situated in a unique position as an overlay of the Kennedy Space Center. This overview of refuge management activities is divided into land protection and conservation; visitor services; and personnel, operations, and maintenance. The habitat diversity and species richness coupled with monitoring launch impacts is cause for an intense interest in research on the refuge. Over thirty permits are issued each year for that activity. In addition special use permits are issued for everything from star gazing to weddings. Coordinating and planning within the confines of a spaceport complete with sensitive and top secret processing and payloads require continuous contact with Space Center and Cape Canaveral Air Force Station officials. The range of coordination issues includes smoke impacts to sensitive payloads; interdiction of illegal aliens; review of site plans for new development; maintenance of pumps and ditches; tours for visiting dignitaries; special events coordination; search and rescue; animal removal; biological data collection; and long-range planning.

Merritt Island Refuge also serves as the administrator for two un-staffed refuges: St Johns and Lake Wales Ridge. Both refuges have their own unique sets of issues and therefore also impact the management of Merritt Island Refuge.

### *RESOURCE PROTECTION*

The Service is involved in a variety of land protection and conservation activities at Merritt Island Refuge, including lease and management agreements with the State of Florida and the management agreement with NASA, as well as coordination and agreements with Canaveral National Seashore. The refuge manages the majority of the lands and waters of the refuge through a management agreement with NASA. Additional lands and waters are managed as part of the refuge through a lease agreement with the State of Florida for Tank Island and management agreements with the State of Florida for properties in the Turnbull Creek area. Thus, it is important that the refuge, Seashore, NASA, and the State of Florida coordinate management to minimize injury, mortality, and disturbance of the West Indian manatee, the Florida scrub-jay, and trust species, as well as native wildlife and habitat in general.

Although active acquisition of land is not currently occurring for the refuge, the refuge's approved acquisition boundary totals over 142,000 acres. This acquisition boundary includes about 1,480 acres of inholdings in the Turnbull Creek portion of the refuge. (See Table 6 for the breakdown of the acquisition boundary, Figure 11 for the overall land status, and Figure 12 for a detail of the land status of the Turnbull Creek area.)

**Table 6. The status is outlined for all properties within the refuge's acquisition boundary**

Property Owner	Property Status	Acres
FWS	ownership (Turnbull Creek area)	925.70
NASA	management agreement	134,890.00
NASA	inholdings*	4,415
State of Florida	lease agreement (Tank Island)	1.00
State of Florida	management agreement (Turnbull Creek area)	320.04
Private Landowners	inholdings**	1,480.59
<b>Total Acres within the Refuge's Acquisition Boundary (as of September 30, 2005)</b>		<b>142,032.33</b>

\* The publicly owned inholdings are the NASA operational areas. As the NASA operational areas continue to grow and expand, additional acres are extracted from the refuge. This portion of the inholding acreage figure is expected to increase over time. However, under the agreement with NASA, the Service continues to have management responsibilities in these areas.

\*\* The private inholdings are located within the Turnbull Creek acquisition area.

The over 140,000-acre management area of the refuge includes over 4,400 acres of operational areas of Kennedy Space Center. Table 7 summarizes the Service owned and managed lands and waters within the refuge, where most of the refuge is managed under some sort of agreement either with NASA or with the State of Florida.

**Table 7. Service owned and managed lands and waters within the refuge's acquisition boundary total 136,136.74 acres (as of September 30, 2005)\***

Property Owner	Method of FWS Control	Acres
FWS	Ownership (Turnbull Creek area)	925.70
NASA	management agreement*	134,890.00
State of Florida	lease agreement (Tank Island)	1.00
State of Florida	management agreement (Turnbull Creek area)	320.04
<b>Total Acres Under Refuge Management (as of September 30, 2005)</b>		<b>136,136.74</b>

Although the NASA operational areas (4,415 acres) are extracted from the refuge, refuge management continues to have some level of responsibility for these areas as outlined in the refuge's management agreement with NASA (e.g., removal of certain wildlife from operational areas), making the refuge management total 140,551.74 acres.

Beyond NASA and the refuge, additional federal agencies manage lands and waters adjacent to the refuge, including: the National Park Service at Canaveral National Seashore and the U.S. Air Force at Cape Canaveral Air Force Station. These federally managed lands and waters total over 181,000 acres (see Table 8). (See Figure 3 for an overview of the federal lands and waters in and around the refuge.)

**Table 8. Federal lands in and around the refuge total 181,497.74 acres**

<b>Manager</b>	<b>Ownership/Management Type</b>	<b>Acreage</b>
Merritt Island National Wildlife Refuge, FWS	Ownership	925.70
Merritt Island National Wildlife Refuge, FWS	Management and Lease Agreements with the State of Florida	321.04
Merritt Island National Wildlife Refuge, FWS	Overlay of NASA through Management Agreement	100,545.00
Merritt Island National Wildlife Refuge, FWS and Canaveral National Seashore, NPS	Overlay of NASA through Congressional Designation and Management Agreement	34,345.00
KSC Operational Areas, NASA	Ownership	4,415.00
Canaveral National Seashore, NPS	Overlay of NASA through Congressional Designation and Management Agreement	6,655.00
Canaveral National Seashore, NPS	Ownership (transferred from NASA)	1,088.00
Canaveral National Seashore, NPS	Ownership	17,775.00
Cape Canaveral Air Force Station, USAF	Ownership	15,428.00
<b>Total Federal Ownership/Management in the Area (as of September 30, 2005)</b>		<b>181,497.74</b>

### *VISITOR SERVICES*

The purpose of the visitor services program is to provide opportunities for appropriate and compatible wildlife-dependent recreation to enable the public to enjoy the refuge. Figure 13 provides an overview of existing public use facilities. Merritt Island Refuge is considered one of the flagship refuges in the southeast and receives roughly 550,000 visitors each year and another nearly 350,000 visitors per year who enjoy a refuge exhibit and/or tour at the Kennedy Space Center Visitor Center. The refuge has become an international destination for birdwatchers and more than 250,000 annually visit Black Point Wildlife Drive or one of the other trails designed to reward visitors with diverse wildlife viewing experiences. The refuge also protects some of the best estuarine flats fishing in east central Florida and roughly 160,000 fishermen annually ply the shallow lagoon waters of the refuge in search of trophy redfish and seatrout. The refuge's Visitor Services Program also provides environmental education programs for school groups, as well as opportunities for canoeing and kayaking, wildlife photography, and waterfowl hunting. Table 9 provides a breakdown of refuge visits by category.

Figure 11. Refuge Status

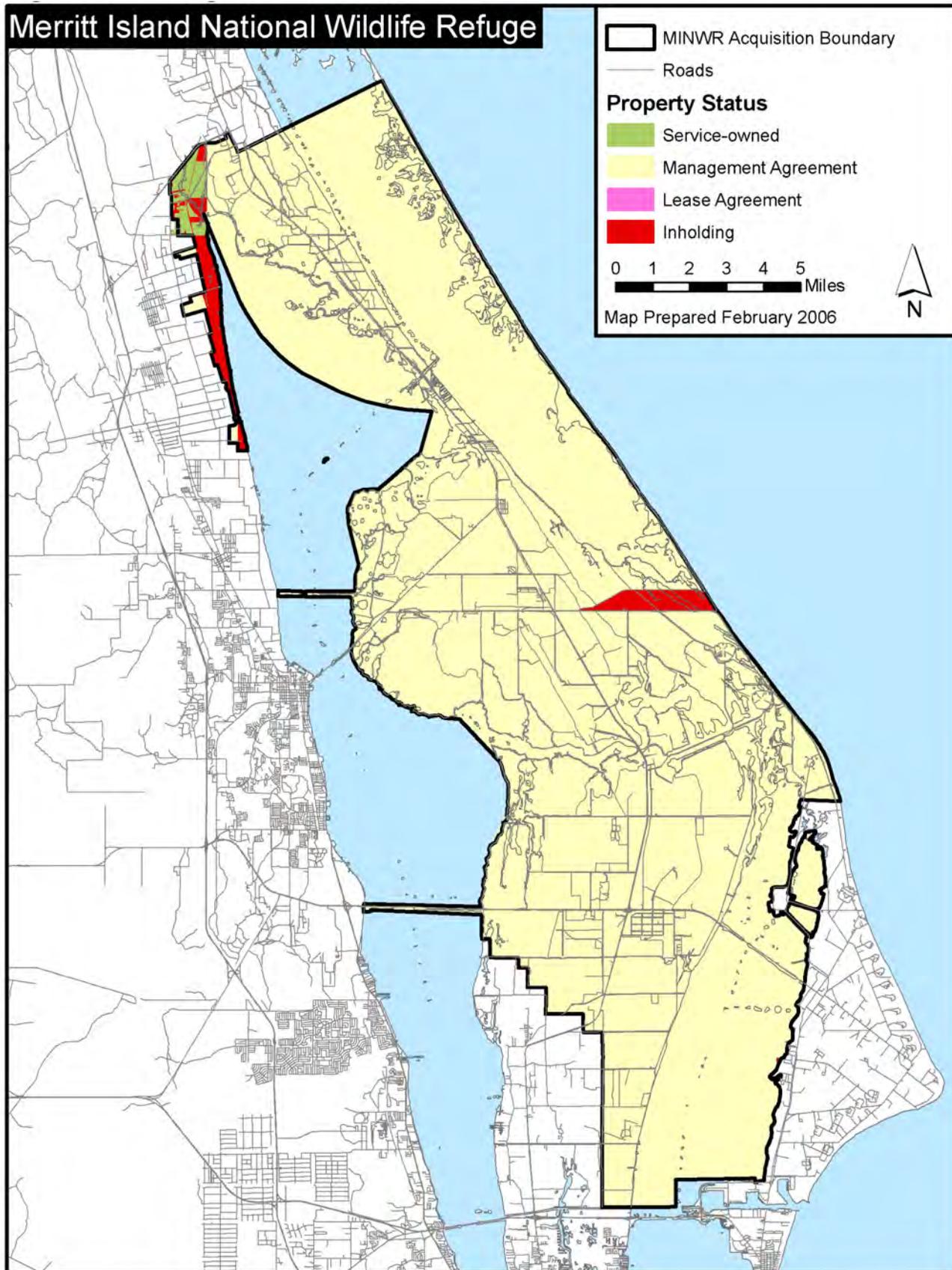
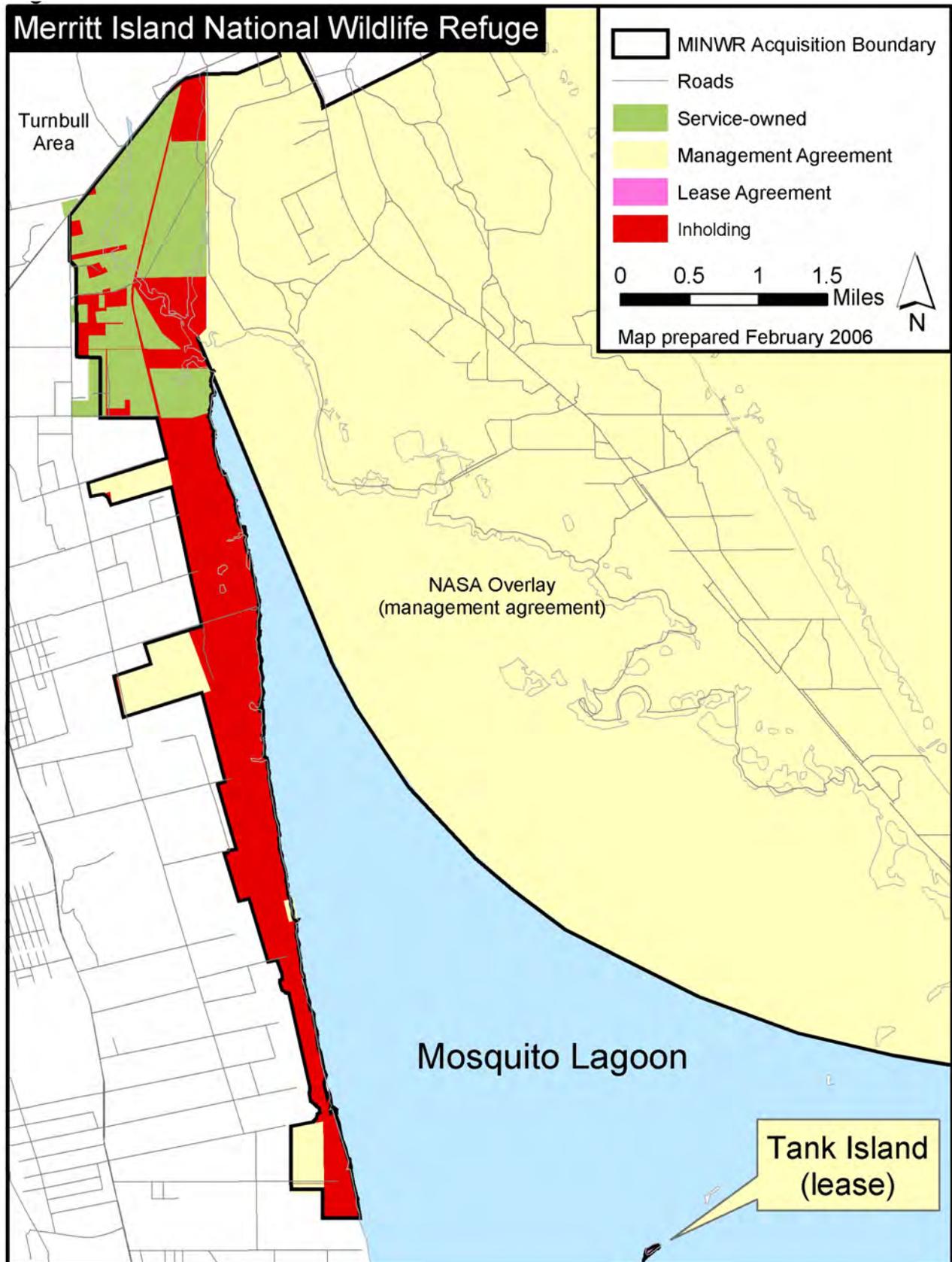


Figure 12. Status for Turnbull Creek Area



**Table 9. 2003 refuge visitation**

Site/Activity	Number of Visitors
Visitor Center	51,043
Kiosks	102,086
Trails	30,626
Black Point Wildlife Drive	126,845
Observation Tower	80,142
Hunting	985
Fishing	163,670
<b>Total Visitation (not including Kennedy Space Center Exhibit)</b>	<b>555,397</b>
Kennedy Space Center Exhibit	336,089
<b>Total 2003 Visitation</b>	<b>891,486</b>

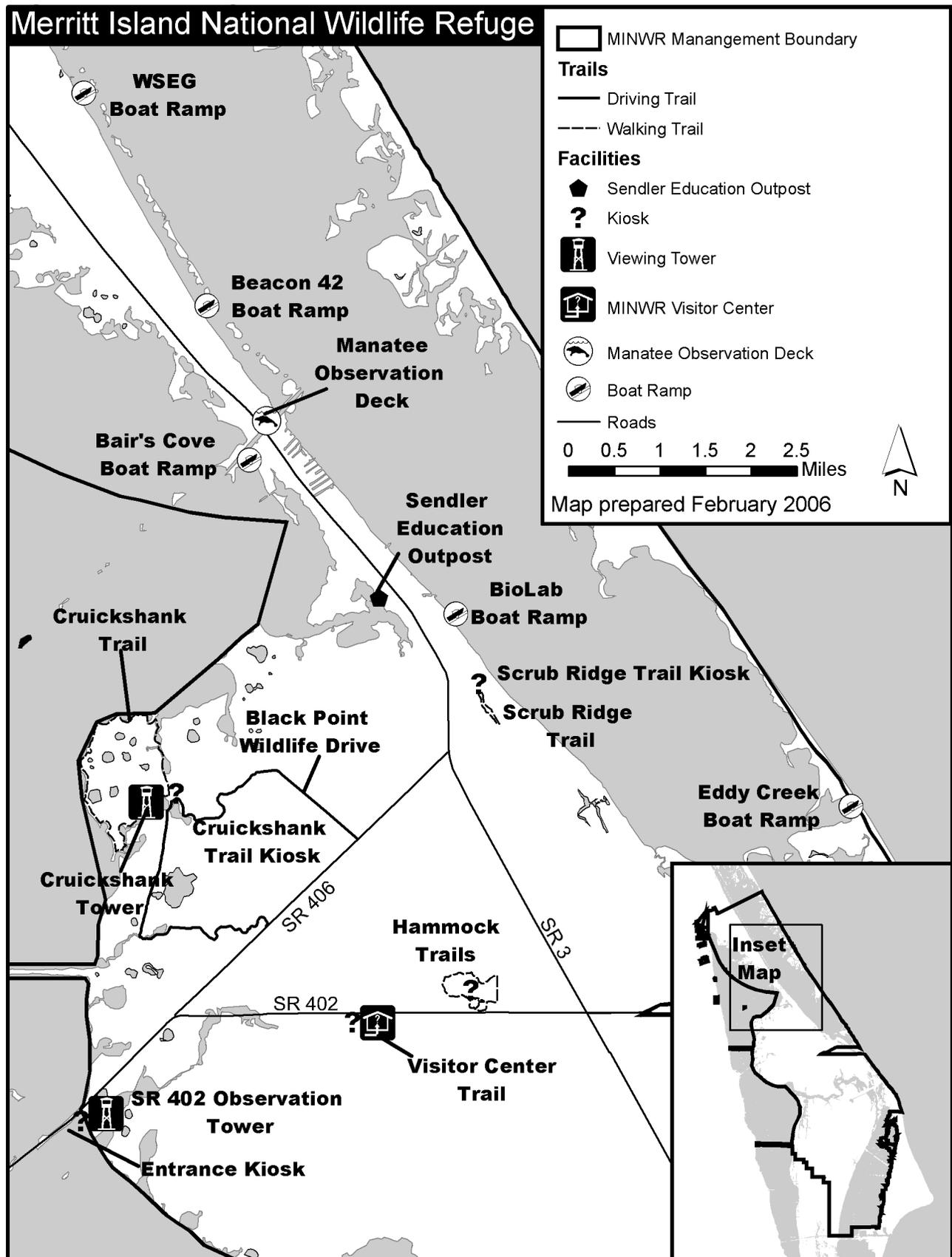
**Visitor Use Areas**

Three paved former state roads provide access through the refuge: 402, 406, and 3. They are connected to two major arteries: I-95 and U.S. 1 (see Figure 1). Directional signs are located at I-95 and U.S. 1 guiding visitors to the refuge and to visitor facilities. Most public use facilities are clustered around an area referred to as the Triangle (the area contained between State Routes 402, 406, and 3). Containing most developed public use facilities within this area concentrates public impacts and helps to minimize wildlife disturbance on the refuge. Visitors can make the circuit around the triangle and sample all major habitats to experience what makes the refuge special. The listed developed, public use facilities are located in the Triangle area.

• Visitor Center	• Black Point Wildlife Drive
• Visitor Center Trail	• Oak Hammock and Palm Hammock Trails
• Cruickshank Trail	• Scrub Ridge Trail
• Manatee Observation Deck	• West Information Kiosk
• BioLab Road	• BioLab Boat Ramp
• Haulover Canal Boat Ramp	• Bair's Cover Boat Ramp

Not all visitor facilities are contained within this primary public use zone. Several boat ramps, key fishing areas, waterfowl hunting areas, canoe/kayak areas, and additional wildlife viewing sites are located outside the primary public use zone. These more dispersed uses are located within the secondary use zone. The only public use facility the refuge has south of State Route 402 is an exhibit located at NASA's Kennedy Space Center Visitor Complex. Annual visitation to NASA's Visitor Center is much greater than the combined total of all visits to the northern half of the refuge.

Figure 13. Existing Visitor Facilities and Trails



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## **Environmental Education**

With the assistance of Merritt Island Wildlife Association (the refuge's non-profit friends group) and other partnerships, the refuge developed the Sandler Education Outpost. The facility is located at Dummitt Cove and includes a 20-foot by 40-foot covered pavilion and restrooms. The facility is designed to accommodate school groups visiting the refuge. The refuge is working with the local school board in the development of a curriculum-based program that meets state standards and incorporates the refuge's education programs and messages into the schools' teaching curriculum. The refuge hosts at least one teacher workshop per year to familiarize and train teachers in the program. Volunteers and interns are used to assist teachers in conducting the program. The refuge networks with Canaveral National Seashore, Brevard Zoo, and other organizations to promote and conduct environmental education programs at the Sandler facility.

## **Interpretive Programs**

The refuge's Visitor Center serves as the departure point for refuge interpretive tours. The emphasis of the interpretive programs is in two general areas: 1) informing the public of management activities and 2) educating the public on wildlife needs and habitat requirements. The over-arching purpose of the programs is building better understanding and support for the refuge and the Refuge System. An emphasis is placed on growing the interpretive programs by recruiting and training volunteers and interns. The refuge generally conducts about 130 interpretive programs per year.

## **Interpretive Drive, Trails, and Sites**

Black Point Wildlife Drive is the most heavily used interpretive trail and is the best wildlife viewing area of the refuge. The drive is the best location to interpret water level management and the importance of the refuge to migratory birds and these themes are emphasized in the interpretive materials. Over the years certain activities that disturb wildlife viewing on the Wildlife Drive have been eliminated. Busses and vehicles over 29 feet are no longer allowed on the Wildlife Drive. Boating, fishing, crabbing, and canoe launching are also prohibited uses.

The refuge maintains five trails and each is used to interpret different aspects of refuge management or to offer special wildlife viewing opportunities. The use of prescribed burns is the most misunderstood management practice and an increased emphasis is placed on interpreting this important management tool. Fire information panels have been installed on Scrub Ridge Trail. The manatee observation deck is becoming one of the most popular interpretive destinations for visitors. On most days when temperatures are above 70 degrees, manatees are present.

## **Fishing**

Saltwater fishing is the fastest growing public use activity. Twenty years ago, about 25,000 anglers a year used the lagoon. Today the number has increased to about 163,000. Over the last 10 years alone fishing pressure has nearly tripled. An analysis of survey data from refuge boat ramps indicates that the largest segment of anglers (52 percent) travel 51-100 miles to fish the refuge and come from the rapidly expanding metropolitan area of central Florida. This is followed by local residents (45 percent) who come from the neighboring counties of Brevard and Volusia. By 2015, the population growth in the six surrounding counties is expected to increase 19 percent from 2005 to 2015, reaching 3.3 million residents (Lenze 2002). With this rapid population growth the Service anticipates fishing pressure to escalate at similar rates.

The increase in fishing pressure has resulted in habitat impacts to Mosquito Lagoon. Prop scarring on the flats is increasing. Prop scarring occurs when power boats operating in shallow water cut into the bottom and destroy linear strips of rooted sea grass and dredge cuts into the bottom. This impacts sea grasses and stirs up bottom sediment which increases turbidity. Studies show

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increasing levels of boating activity also negatively impact populations of waterfowl and other water birds. A study completed at Merritt Island in 2002 showed that lesser scaup were changing their feeding habits from daytime to nighttime. Bird nesting on historic nesting islands has also declined.

With the lack of fresh water, the refuge has limited opportunities for freshwater fishing. Most freshwater fishing occurs in several man-made borrow pits which were dug for road construction material. These pits provide easy access and provide bank fishing opportunities for individuals who do not have a boat. But these ponds can become over-fished and need management to sustain quality fisheries.

## **Hunting**

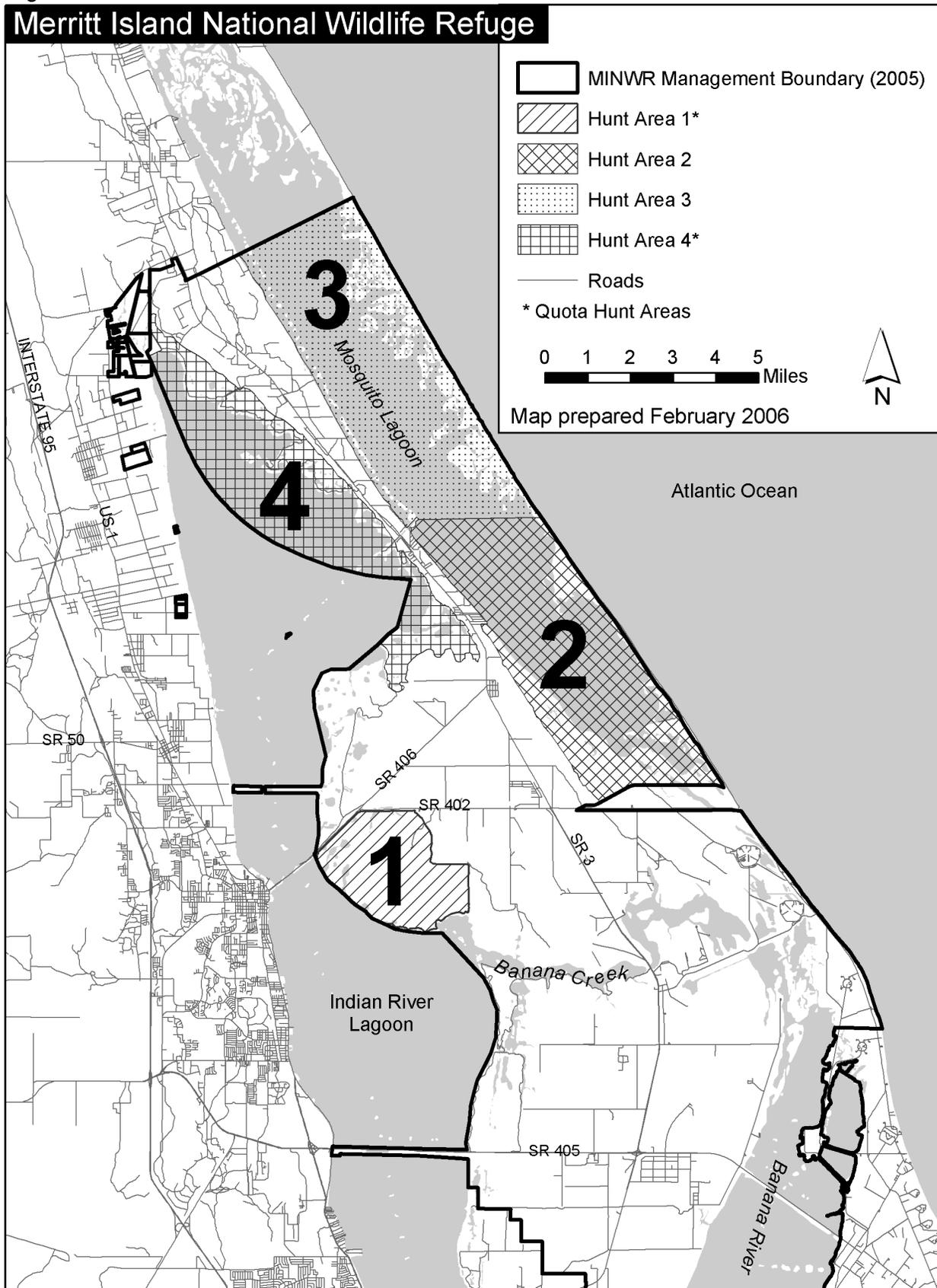
Waterfowl hunting is the only hunting opportunity available on the refuge (see Figure 14 for the existing hunt areas). Waterfowl hunting has a long tradition at Merritt Island and has been permitted since 1964. Even before the refuge was established, the Canaveral Shooting Club and the Indian River Club had most of the wetlands and marshes of the refuge tied up in hunt leases. This proved to be a positive factor when NASA began acquiring lands, as large blocks were undeveloped and under a small number of owners. During the negotiations for land purchases, NASA made commitments to retain hunting and the original interagency agreement between NASA and the refuge made provisions to continue this use.

Over the years the waterfowl hunt program has evolved. Currently, waterfowl hunting is allowed on 36,000 acres of the refuge. Half-day hunts are allowed on Wednesdays, Saturdays, Sundays, and designated federal holidays during the State of Florida hunt season. Quota permits are required in half of the hunt areas during the months of November and December. The quota system was implemented to improve the quality of the hunt and feedback from hunters indicates they are satisfied with the system.

The number of waterfowl hunters has remained relatively constant over the years. Over the last five years, the mean number of waterfowl hunters per year is 1,770. In 2003, it was estimated that 985 waterfowl hunters used the refuge. The downward trend in waterfowl hunting relates to two factors. First, in 2000 the refuge implemented Quota Hunt Permits. Second, national trends show a decline in the number of waterfowl hunters. Looking at these trends, it appears that the waterfowl hunting program is not increasing like other public uses.

Hunting more than most other public uses must be integrated with other refuge activities. The strategy is to separate waterfowl hunting by providing closed hunting zones, which separate hunting areas from non-hunting areas. This provides a safety zone for the public and sanctuaries for waterfowl.

Figure 14. Current Waterfowl Hunt Areas



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## **Wildlife Viewing and Photography**

Wildlife viewing is one of the most popular activities on the refuge. In 2003, 206,987 visitors participated in this activity. To provide opportunities to see the widest variety of wildlife, the refuge maintains a system of trails and other wildlife viewing facilities through the major habitats. The marshes of Merritt Island provide the best sites for wildlife viewing and Black Point Wildlife Drive and Cruickshank Trail receive the most use. This followed by the Manatee Observation Deck, the hammock trails, and Scrub Ridge Trail. The refuge designs improvements along the trails to enhance wildlife viewing opportunities.

## *PERSONNEL, OPERATIONS, AND MAINTENANCE*

About half of the refuge is located in a NASA security zone that restricts public access. Therefore care must be taken in managing official access, whether to support space operations or to support refuge operations. Each person must be badged by Kennedy Space Center to enter the restricted zone. This includes hog trappers, citrus growers, bee keepers, researchers, volunteers, official visitors, and refuge staff and volunteers. In addition, refuge staff responds to requests from the Space Center to deal with wildlife/human interactions, such as alligators resting under cars, birds nesting in structures and buildings, and vultures interfering with operations. Additional training is required to enter some of the sensitive facilities on the Space Center. Further, as NASA expands facilities at the Space Center, additional areas are extracted from regular refuge management and put into the Space Center's operational areas (for which the refuge retains certain management responsibilities).

When the refuge was established, about 2,000 acres of citrus groves were active on the refuge. NASA requested that the refuge manage the groves and consolidate them under a commercial contract. In 1990 the grove contracts were valued at three million dollars. Over the years much has changed in the citrus industry. Winter freezes, increased costs of growing, and competition with international growers has caused the industry to decline in recent years. Currently only about 700 acres of citrus groves are being managed. These groves are not being managed as a commercial venture, but as a research effort with The Florida Research Center for Agricultural Sustainability. The current contract is set to expire in 2008. The Research Center is attempting to validate that growing citrus with a minimum of pesticides and fertilizers can be done, while still producing a marketable crop. Since beekeeping was a commercial activity associated with citrus groves, it has been continued. The beekeepers now make several crops of honey including palmetto, citrus, and Brazilian pepper.

Actions by the Brevard County and Volusia County mosquito control districts to impound the salt marshes of the refuge in the 1950s and 1960s resulted in 76 distinct impoundments. The refuge was required under the initial agreement with Kennedy Space Center to work closely with the mosquito control districts to minimize the impacts of mosquitoes to Space Center operations. The result was that water levels were maintained at higher levels and for longer periods than necessary in relation to refuge objectives. Over the years more water control structures have been added, which has diversified the water management program. In a couple of instances the dikes have been removed and the impoundment area has been restored. The refuge is responsible for maintenance of the dikes and water control structures. Currently four pumping stations are shared between Brevard County Mosquito Control District and the refuge to meet operation and maintenance needs of both agencies.

The unfortunate loss of life during a wildfire on the refuge in 1981 resulted in an influx of interest in the refuge and its management. The special focus was on fire management. Additional funding made it possible to construct a maintenance compound of six buildings and a Visitor Center/office. In

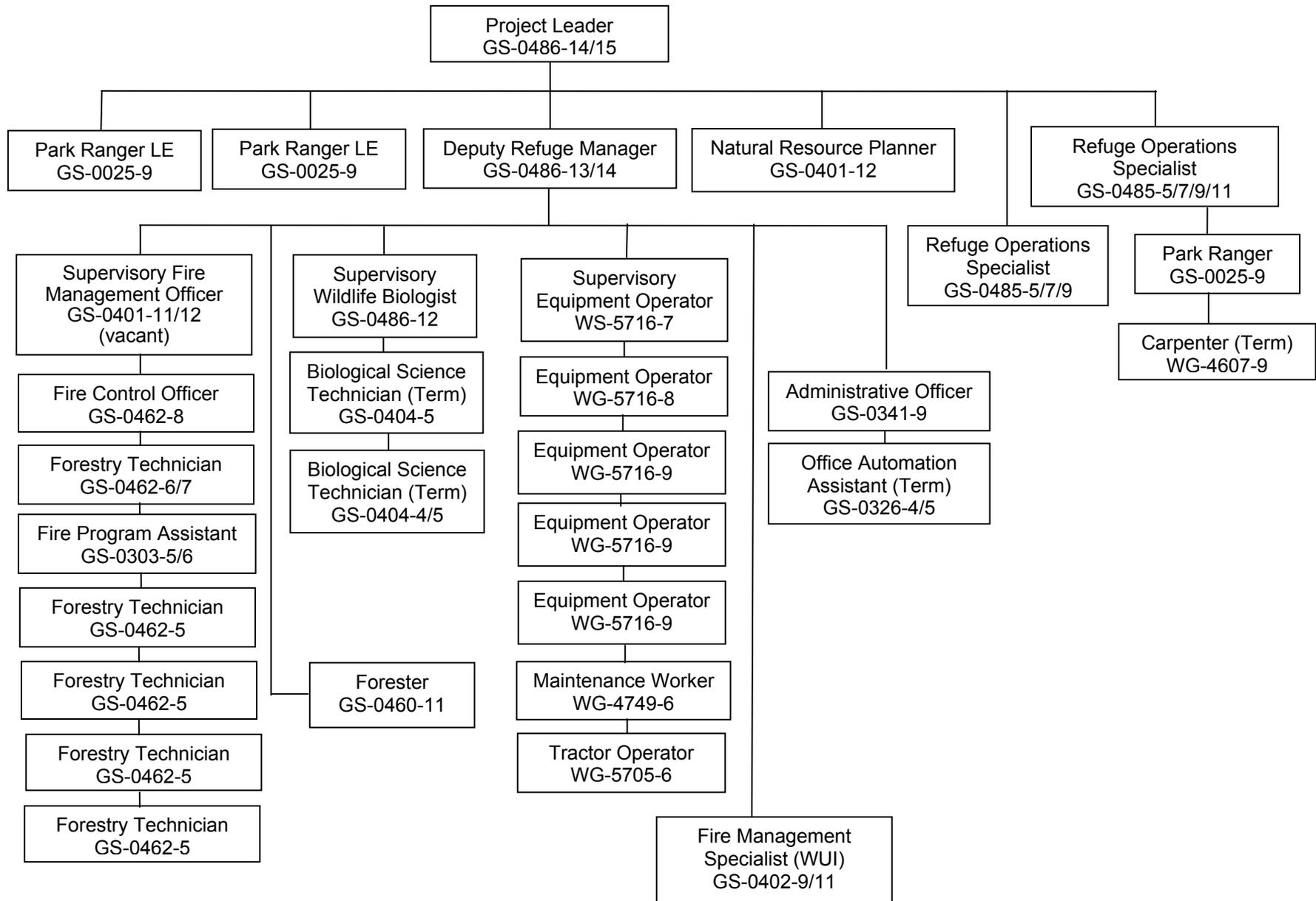
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1992 a Fire Program office was added. These buildings provide office space, equipment storage and maintenance space, warehouse space, and public interaction space. The size and complexity of the refuge is depicted in the infrastructure required to support the refuge. The refuge has 167 roads and dikes; 14 buildings; 11 boat ramps and parking lots; and 15 pumps. Thirty-eight heavy and specialized pieces of equipment are needed to manage refuge habitat and facilities.

The refuge currently has about 25 permanent staff members (of an approved total of 30), 11 of which are directed to the Fire Program. The remaining 14 are directed toward planning, administration, law enforcement, public use, and maintenance. Figure 15 outlines the current staffing chart. As funding allows, seasonal and temporary staff are hired to support various programs. Seventy regular volunteers annually contribute 6,500 hours to the refuge. Another ninety-seven volunteers only work occasionally. These staff and volunteer positions are shared amongst the three refuges of the Complex: Merritt Island (~141,000 acres), St. Johns (~6,300 acres), and Lake Wales Ridge (~1,800 acres). All of the staff members, except one, are housed at Merritt Island Refuge. The Service has stationed a Wildland Urban Interface Specialist in Polk County, near Lake Wales Ridge Refuge. This position serves refuges across Florida and assists with Lake Wales Ridge Refuge. The satellite refuges, St. Johns and Lake Wales Ridge, are currently closed to public access. Special use permits govern research and other access into these refuges.

Refuge facilities are limited at the satellite refuges with a barn building at St. Johns and no real facilities at Lake Wales Ridge (other than fencing and signage). As the main refuge of the Complex, Merritt Island has the bulk of the facilities and the equipment.

**Figure 15. Current Organization Chart**





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## *III. Plan Development*

### **OVERVIEW**

Although Merritt Island Refuge has had several step-down management plans in the past, no comprehensive management plan existed to address all refuge programs. In 1979, the refuge developed a master plan that only addressed future public use facilities (U.S. Fish and Wildlife Service 1979). The comprehensive conservation planning process allowed the Service, the governmental and non-governmental partners, and the public the opportunity to take a comprehensive look at the refuge and its management, resources, and future. The planning process provides for public involvement in developing a plan for the future management of a refuge. Plans are revised every 15 years, or earlier, if monitoring and evaluation determine that significant changes are needed to achieve refuge purposes, vision, goals, and/or objectives. The basic steps of the planning process involve gathering information, scoping for public input, developing the draft plan, gathering public input on the draft plan, developing the final plan, and implementing and monitoring the actions identified in the final plan.

### **PUBLIC INVOLVEMENT AND PLANNING PROCESS**

The planning process begins with gathering information. As part of this process, the Service conducted several reviews: Wildlife and Habitat Management Review, Visitor Services Review, and Wilderness Review. And, the Service developed a Core Planning Team which took input from the public and from an Intergovernmental Coordination Planning Team.

Consisting exclusively of Service staff, the Core Planning Team involved staff from the Merritt Island Refuge Complex. This team was the primary decision-making team for this plan. Key tasks of this group involved defining and refining the vision; identifying, reviewing, and filtering the issues; defining the goals; outlining the alternatives; and providing a reality check. The Planning Team members are listed.

- Fred Adrian, Forester, Merritt Island NWR Complex
- Cheri M. Ehrhardt, AICP, Natural Resource Planner, Merritt Island NWR Complex
- Marc Epstein, Refuge Biologist, Merritt Island NWR Complex
- Ron Hight, Project Leader, Merritt Island NWR Complex
- Steve Johnson, former Refuge Operations Specialist, Merritt Island NWR Complex
- Ralph Lloyd, Deputy Refuge Manager, Merritt Island NWR Complex
- James Lyon, Biological Science Technician, Merritt Island NWR Complex
- Gary Popotnik, former Biological Science Technician, Merritt Island NWR Complex
- Glen Stratton, Forestry Technician, Merritt Island NWR Complex
- Dorn Whitmore, Supervisor, Refuge Ranger, Merritt Island NWR Complex

Members of the Service's Core Planning Team met regularly to review public comments, data, and information collected to write the plan. Professional reviews of the refuge were conducted to determine the status, trends, and conditions of refuge resources and facilities. Experts from the Service, State of Florida, Brevard Mosquito Control District, University of Central Florida, and NASA's Kennedy Space Center/Dynamac participated in Wildlife and Habitat Management reviews of the refuge in 2001. A Wilderness Review was conducted in 2002 by Service staff. In review of the federally owned lands within the legislatively defined boundary of the refuge, no additional lands were found suitable for designation as Wilderness at this time. A Visitor Services Review was conducted in 2002 involving public use specialists and outdoor recreation planners from the Service, the National

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Park Service, and the Florida Fish and Wildlife Conservation Commission. This review focused on existing activities and provided specific recommended actions to improve program development and public use facilities. The information garnered from these reviews helped the planning team analyze and develop recommendations for this draft plan and environmental assessment.

Following the initial gathering of information, a notice of intent to prepare a comprehensive conservation plan was published in the Federal Register on August 26, 2002. The Service also placed advertisements in local newspapers, posted information on the refuge's web site regarding upcoming meetings and how to submit comments, posted meeting information in the local community (e.g., at local shops, at the refuge's Visitor Center, and at the local libraries), and sent out flyers announcing the public meetings. An open house at the refuge's Visitor Center kicked off the public scoping phase on September 21, 2002. More than 180 people attended the open house which was followed by three public scoping meetings: October 23, 2002 in south Merritt Island with 31 attendees; October 28, 2002 in New Smyrna Beach with 17 attendees; and October 29, 2002 in Titusville with 55 attendees. During September and October 2002, 10 planning-related articles appeared in three local papers: Florida Today, Orlando Sentinel, and Press Tribune. One article appeared in November 2002 to review the wide range of comments submitted to the Service. During public scoping, over 1,600 written comments were submitted by individuals and organizations spanning 49 states and 11 countries. Two planning updates kept the public informed of the progress of the comprehensive conservation plan. Follow up meetings were schedule in 2004 to address the public's concerns specific to Mosquito Lagoon: April 29, 2004 in Titusville with 65 attendees; May 12, 2004 in New Smyrna Beach with 25 attendees; November 8, 2004 in Titusville with 7 attendees; and November 22, 2004 in New Smyrna Beach with 32 attendees. To date, over 1,500 people are on the refuge's comprehensive conservation plan mailing list.

The Service is seeking comments regarding this draft plan as the next stage of public involvement. Adjustments will be made to the draft plan accordingly, in preparation for the final plan.

## **SCOPING OF ISSUES AND CONCERNS**

During the preplanning and public scoping phases of plan development, a myriad of issues, concerns, and opportunities were raised by the public, the Service, and other public agencies. Issue identification is a major factor in determining future management goals and objectives and future projects. In addition to the general public scoping meetings, a series of meetings were conducted with federal, state, and local governmental agencies (i.e., the Intergovernmental Coordination Planning Team). Coordination with the governmental partners and the public is essential to ensure support for the plan and identified projects. While some of the issues and concerns raised during scoping are directly related to the future of the refuge, many are not within the Service's management jurisdiction or authority, and some are completely outside of the Service's control. Several opportunities raised during scoping are addressed by the Service in this draft plan. The Core Team later developed a list of goals, objectives, and strategies to shape the management of the refuge for the 15-year life of the plan.

In accord with the 1997 National Wildlife Refuge System Improvement Act, the Core Planning Team, including the Service's Ecological Services North Florida Field Office, met with representatives from the Florida Fish and Wildlife Conservation Commission, including its Regional Director, to identify the priority issues for the refuge to address during the 15-year life of the plan. These priority issues are listed.

- 
- The Spread of Exotic, Invasive, and Nuisance Species
  - The Threats to Threatened, Endangered, and other Imperiled Species
  - The Threats and Impacts of an Increasing Human Population and the Demand for Public Use Activities
  - The Management/Maintenance of Impounded Wetlands
  - The Coordination between Intergovernmental Partners
  - The Decline in Migratory Birds and Habitats

In addition to these priority issues, other issues also include the trust responsibilities of the refuge. The issues for the refuge to address during the 15-year life of the plan are divided into four categories: wildlife and habitat management; resource protection; visitor services; and refuge administration.

### *WILDLIFE AND HABITAT MANAGEMENT*

Over 500 species of wildlife and over 1,000 species of plants have been documented on the refuge. The Merritt Island Refuge is one of the richest and biologically diverse refuges in the south Atlantic coastal zone. The size, habitat diversity, and location of the refuge offer fish and wildlife, including federally and state listed species, migratory birds, and native species on an undeveloped landscape of prime habitat. However, increased human population growth, urbanization and suburbanization, and the development of lands around the refuge will eventually increase public use demands on the refuge and are expected to increase associated impacts to the refuge. Direct and indirect activities that may impact the refuge include commercial, residential, and recreational uses (e.g., potentially resulting in reduced water quality, the spread of exotic species, and increased wildlife and habitat disturbance). Ongoing development of the landscape is consuming and fragmenting remaining off-refuge habitats, which are also used and needed by many refuge wildlife (e.g., for breeding, nesting, loafing, feeding, migrating, and dispersing). The spread of exotic, invasive, and nuisance species; the threats to threatened, endangered, and other imperiled species; the management/maintenance of impounded wetlands; and the decline in migratory birds and associated habitats are priority wildlife and habitat management issues to be addressed in the 15-year life of the plan.

#### **Exotic, Invasive, and Nuisance Species**

Although the refuge includes numerous exotic, invasive, and nuisance species which are likely to be found in every refuge habitat, the most troublesome known exotic, invasive, and nuisance species known to occur on the refuge include: Australian pine, Brazilian pepper, Old World climbing fern, cogongrass, melaleuca, feral hogs, feral cats, and raccoons. Although raccoons are the only native species currently on this list, given their higher than normal numbers, lack of predators, and devastating impact on globally declining sea turtles, raccoons are lethally controlled on the refuge when and where they are predators on sea turtle nests. Unknown impacts from exotic, invasive, and nuisance species may prove to be even more troublesome in the future, especially for aquatic species. Exotic, invasive, and nuisance species disrupt natural systems and processes, sometimes eliminating the natural functions of a habitat. For example, advanced succession and exotic species have made some refuge islands unsuitable for ground and shoreline nesting birds. Over time, the landscape is expected to continue to be developed and new exotic, invasive, and nuisance species are expected to find their way to the refuge, further negatively impacting native wildlife and habitats.

#### **Threatened, Endangered, and Imperiled Species**

The refuge provides habitat for 93 species that regularly occur on the refuge and that are listed by the Federal Government or the State of Florida as endangered, threatened, special management concern, or commercially exploited, including globally declining species. These regularly occurring

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listed species include 10 federally listed wildlife species, plus three state listed wildlife species, plus 36 federal management concern wildlife species, plus 11 state wildlife species of special concern, plus 33 state listed plant species. The refuge is especially important to sustaining and recovering several threatened, endangered, and imperiled species, including the Florida scrub-jay, southeastern beach mouse, sea turtles, wood stork, West Indian manatee, and bald eagle. The refuge is a highly important site for the Florida scrub-jay and is the only site currently meeting recovery goals for scrub-jays. As the southeastern beach mouse is no longer found in other locations, the refuge's population may serve as a source population for reintroduction of this species to former habitats. The refuge provides important sea turtle nesting beaches and a juvenile sea turtle nursery in the estuary. Although wood storks do not seem to currently nest on the refuge as in the past, wood storks are numerous on the refuge. The refuge provides nearly year-round habitats for the West Indian manatee and provides a no motor zone sanctuary. Bald eagles consistently nest on the refuge.

Ongoing human development throughout the landscape, wildlife and habitat disturbance, habitat fragmentation on and off the refuge, and degrading habitat quality further impact these species.

### **Impounded Wetlands**

Under the agreement between the Service and NASA, the refuge works with the local mosquito control districts and other governmental agencies in managing the impounded wetlands of the refuge. In managing these impoundments to meet wildlife and habitat goals, while also meeting mosquito control goals, the refuge has created several management designations for the impounded wetlands. Managed (primary) impoundments are those that have greatest potential for wetland wildlife management. Impoundments having had marginal management potential are identified for fisheries management and characterized as having a potential for either being reconnected or restored. An unmanaged impoundment is one that is kept open-flowing and is primarily managed for fisheries. If the impoundment produces unacceptable levels of mosquitoes, then the management type would be coordinated with local mosquito control districts. However, if unmanaged impoundments do not produce mosquitoes, they would be considered for restoration. Impoundments characterized as restoration were determined not to be manageable for wildlife for various reasons and approved for restoration by the Brevard Mosquito Control District. Needless to say, the numerous agencies involved with the refuge have differing and sometimes conflicting missions and ideas regarding management/maintenance of the impounded wetlands of the refuge.

### **Migratory Birds**

The combination of the large open estuary habitats, natural and spoil islands, impounded wetlands, ridge and swale topography, pine flatwoods, and palm and oak hammocks of the refuge is an important ecological landscape feature that represents a large collection of relatively undisturbed habitats which are utilized by a variety of migratory birds. The refuge is designated a Globally Important Bird Area and serves as a key overwintering and stopover site for a variety of waterfowl, shorebirds, and neotropical migratory birds. As the landscape continues to develop, the refuge will become even more important to these species as one of the remaining undeveloped tracts along the Atlantic Flyway.

The refuge currently plays an important role for a few specific species of migratory birds, including lesser scaup, northern pintail, and mottled duck. Large numbers of migratory and resident waterbirds use the estuarine waters and adjacent habitats of the refuge for feeding and loafing. Within the Atlantic Flyway (i.e., the entire east coast of the U.S.), no other site winters such large numbers of interior lesser scaup - a waterfowl species well below national density levels and goals of the flyways

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and the Service. The refuge is an area of national importance, harboring up to 62 percent of all Atlantic Flyway wintering lesser scaup and 15 percent of the continental population (Herring 2003). However, scaup populations wintering at the refuge have declined over the last six years.

### **Other Wildlife and Habitat Management Issues**

Refuge habitats serve other key roles in supporting wildlife, including providing important fish spawning and settlement sites, a juvenile fish nursery, and bird rookeries. The estuarine waters of the refuge are large, shallow, and saline to brackish basins that do not have a direct connection to the ocean. Extensive submerged beds of sea grasses form the vegetative nursery and basis for an aquatic community of oysters, clams, shrimp, crabs, and hundreds of species of fish that thrive in the warm shallow waters. The refuge's seagrass beds are some of the highest quality in the lagoon system, presumably from the undeveloped nature of the landscape surrounding the lagoon waters. Four species of sea grass are common to the refuge: Shoal grass (*Halodule wrightii*), Manatee grass (*Syringodium filiforme*), Turtle grass (*Thalassia testudinum*), and Widgeon grass (*Ruppia maritima*). Water quality and clarity are critical components in the distribution patterns of the seagrass beds in the refuge. Protection of seagrass habitat has an important, logical connection to the density of many fish and macrofaunal invertebrates using the refuge's estuarine waters. The refuge seagrass community is often stated to be the best and most extensive, representing 40 percent of the entire Indian River Lagoon system. Water quality and appropriate and compatible public use are important to sustaining these seagrass beds and the wildlife which rely on them into the future. Further, the seagrass beds of the refuge are highly important to a variety of species. One hundred and thirty-two fish species have been identified in the lagoon waters of the refuge (Paperno 2001). The refuge provides habitats supporting important life history needs of many of these fish species, most importantly red drum, black drum, and spotted seatrout. Water quality and appropriate and compatible public use are important to sustaining these fishery resources into the future. The refuge's lagoon waters also harbor important colonial wading bird nesting rookeries and roost sites. The natural marsh and spoil marsh islands are used extensively by several key wading bird species for nesting and loafing. Increased disturbance by refuge users is a growing problem for birds these nesting and loafing areas.

### **RESOURCE PROTECTION**

Resource protection issues include acquiring or otherwise managing inholdings, protecting cultural resource sites, and providing sufficient law enforcement.

Although the refuge has minor issues with inholdings in the Turnbull Creek area, no significant land protection conservation issues exist. Although a partnership acquisition effort by the Service, the State of Florida, Brevard County, and Volusia County began in 1990 for the Turnbull Creek area of the refuge and despite the fact that about 1,246 acres were acquired and/or turned over to the refuge for management (as of September 30, 2005), acquisition has generally stopped. About 1,480 acres of inholdings exist in the Turnbull Creek area. Brevard County has very recently renewed its interest by reopening negotiations and acquiring new appraisals on various properties within the acquisition boundary.

The refuge includes 110 known cultural resource sites dating from prehistory to very modern times: from Indian burial mounds and shell middens to forts, cemeteries, sugar mills, and canals to space rocket launch pads. Although many of the cultural resource sites are located within the Security Area of the Kennedy Space Center and are not open to the general public, they are not protected from potential use by over 15,000 badged personnel. Neither the refuge nor the Space Center knows the exact locations of all the known sites, making protection and management difficult. Looking to the future, issues to be addressed involving the refuge's historical and archaeological resources include the potential for disturbance, vandalism, and theft.

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High and increasing demands for public use of the refuge are likely to continue to result in increased user conflicts, increased illegal activities, and increased wildlife and habitat disturbance. The refuge currently has only two law enforcement officers to cover millions of annual visitors and commuters (to the refuge, to the Seashore, and to Kennedy Space Center) accessing and using the refuge 24 hours a day; to cover over 140,000 acres, spanning 35 miles in length, including over 50,000 acres of estuarine habitats in three separate waterways; and to cover two satellite refuges (i.e., St. Johns and Lake Wales Ridge).

### *VISITOR SERVICES*

The priority visitor services management issues are related to the growth of the human population, the impacts associated with the growing population, and the associated demand for public use activities. The Service is committed to providing appropriate, compatible, and quality public use opportunities and to increasing awareness and understanding of wildlife and habitats to limit the impacts to and disturbance of wildlife and habitat. This planning process identified the importance of addressing the increasing impacts from human activities and use (e.g., lethal and sub-lethal impacts from boating activities; collisions; wildlife disturbances; decreased water quality; erosion; development; and increased pollution, runoff, trash, and illegal access).

The refuge currently has over one million annual visitors (where, based on 2003 visitation, >550,000 were direct visits to the refuge and >350,000 were incidental visits to the refuge's display at the Space Center's visitor center and on the tour of the Space Center and the refuge). The current population of the four counties in and around the refuge is over two million with three million expected by 2015 (Lenze 2002). The State of Florida has over 900,000 registered recreational boats (Florida Fish and Wildlife Conservation Commission 2004) with an additional 400,000 seasonal boats entering the state annually (Shelly Gurr, FWC, 2005 personal communication), many of which use the Intracoastal Waterway and pass through the refuge. The growth rate from 2005 to 2015 for the communities around the refuge is expected to average over 30 percent, with the State of Florida's anticipated growth rate for the same time period at 27 percent (Lenze 2002). The refuge is facing a variety of negative impacts from the increasing human population and public use activities. For example, increased boat traffic along the Intracoastal Waterway and elevated fishing pressure are negatively impacting users, wildlife, and habitat, especially in Mosquito Lagoon, which experienced nearly triple the users from 1990 to 2000 to nearly 124,000 boats annually.

### *REFUGE ADMINISTRATION*

Key issues related to refuge administration involve staffing and funding, intergovernmental coordination, and commercial harvesting. Lack of sufficient staffing and funding to address management concerns continue to be issues for the refuge. In addition to having overlays with NASA and the National Park Service, the refuge has over 60 governmental partners, including various local governments, state agencies, federal agencies, and tribal governments. Given the complexity of management of the refuge and the need for the involvement of multiple partners in developing and implementing solutions, intergovernmental coordination was identified as one of the priority issues to be addressed in the comprehensive conservation plan. Wildlife and habitat impacts and conflicts with other users from commercial harvesting activities is another important issue for the refuge to address.

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## *IV. Management Direction*

### **INTRODUCTION**

The Service manages fish and wildlife habitats considering the needs of all resources in decision-making. However, first and foremost, fish and wildlife conservation assumes priority in refuge management. The National Wildlife Refuge System Improvement Act of 1997 requires the Service to maintain the ecological health, diversity, and integrity of refuges. A refuge is a vital link in the overall function of an ecosystem. Refuges in the North Florida Ecosystem include imperiled coastal areas and lagoonal islands, such as those protected at Merritt Island Refuge. To offset the historic and continued loss of habitats within the ecosystem, the refuge and other public lands and waters provide a biological safety net for native species, trust resources, and state and federally listed species.

### **VISION**

Merritt Island National Wildlife Refuge was established as an overlay of NASA's Kennedy Space Center, where technology and the environment peacefully coexist, where bald eagles nest in plain view of NASA launch pads.

Through a motivated, experienced, highly skilled, and well-trained workforce of staff and volunteers and with the active participation of the partners, the refuge will strive to maintain its unique natural wildlife and habitat diversity and its important ecological landscape features as a model of excellence in natural resource management. The management of wildlife and habitat on the refuge will be an active, science-driven, comprehensive endeavor. The refuge will actively seek partnerships with all possible sources to further conservation stewardship and protection of natural resources. Research projects conducted on the refuge will support the information needs of the refuge.

The major component habitat types of the refuge will be maintained in a viable and sustainable condition. As one of the three core populations of Florida scrub-jay, the refuge will maintain the last, large, relatively unfragmented tract of scrub on the east coast of Florida. Merritt Island Refuge will be a leader in the use of fire to manage habitats and fuels in central Florida. Estuarine habitats will have good water quality and will support healthy seagrass beds. And refuge lands will be kept free of exotic, invasive, and nuisance species. Refuge fish and wildlife populations will be naturally diverse and self-sustaining. Fish and wildlife populations will be maximized consistent with refuge goals and available habitat to also benefit the visiting public. The refuge will take necessary actions to maximize the reproductive success of rare, threatened, and endangered species. Migratory birds, threatened and endangered species, and other trust species will have priority in management decisions. Waterfowl, songbirds, wading birds, and waterbirds will be abundant and easily viewed by visitors. Fish populations will be abundant and will be protected from over harvest by recreational and commercial users. The refuge will take necessary actions to minimize the impacts of wildlife to space program activities and to the safety of Space Center employees, official visitors, and the visiting public.

The refuge will promote, maintain, and develop appropriate and compatible public use opportunities, which will enhance the public's awareness and appreciation of the refuge's natural resources and of the National Wildlife Refuge System. Emphasis will be placed on providing quality, wildlife-dependent recreational activities that are compatible with the purposes and natural resources of the refuge and with the Refuge System's directive of wildlife first. The refuge will work in partnership with Canaveral National Seashore, Kennedy Space Center, Merritt Island Wildlife Association, Florida Fish and Wildlife Conservation Commission, and others to coordinate and enhance visitor services and

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protection and to provide current and consistent information in order to best serve the public. The neighboring community will realize that the refuge enhances the quality of their lives by providing opportunities for wildlife observation, wildlife-dependent recreation, and eco-tourism. The community will support and serve the refuge through ethical outdoor behavior, partnerships, volunteer programs, and cooperative events.

## **GOALS, OBJECTIVES, AND STRATEGIES**

The goals, objectives, and strategies delineated are the Service's response to the resource problems, issues, concerns, and needs expressed by the Service, the public, and the governmental partners. They reflect the Service's commitment to achieve the purposes and vision of Merritt Island National Wildlife Refuge, the mission of the National Wildlife Refuge System, and the mandates of the Fish and Wildlife Service. The Service intends to accomplish these goals, objectives, and strategies over the 15-year life of this comprehensive comprehensive plan.

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 the Refuge System long into the future. Before activities or uses are allowed on a national wildlife refuge, the uses must be found to be compatible. A compatible use is one that will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge [§668ee(1) USC]. "Wildlife-dependent recreational uses may be authorized on a refuge when they are compatible and not inconsistent with public safety" [§668dd(d)(3)(A)(iii) USC]. See Appendix E for the draft compatibility determinations.

### ***WILDLIFE AND HABITAT MANAGEMENT***

Wildlife and habitat management goals include rare, threatened, and endangered species; migratory birds; exotic, invasive, and nuisance species; and wildlife and habitat diversity.

#### **Wildlife and Habitat Management Goal 1: Rare, Threatened, and Endangered Species**

*Conserve, protect, and enhance populations of rare, threatened, and endangered species of plants and animals at existing or increased levels on the refuge and conserve, protect, manage, and restore their native east central Florida coastal and estuarine habitats occurring on the refuge to contribute to recovery goals.*

*Discussion:* Listed species are plants or animals that have been listed by a state and/or federal agency with special protection or conservation designations. Those species with regulatory protection are protected by law, such as state and federal threatened and endangered species. There may be species in Florida that are protected, but not listed here because the species either has not been confirmed, it has been extirpated from the refuge, or it only occurs rarely or incidentally (see Epstein and Blihovde 2006 for additional information).

The refuge's expansive and protected habitats provide undisturbed, natural-like habitat for many species. The refuge serves as a vital area for species like the southeastern beach mouse, Florida scrub-jay, and West Indian manatee. Many protected areas are a combination of refuge and NASA restrictions and these sanctuaries are important to many fish and wildlife species. Due to its location, size and diversity of undisturbed habitats, level of federal protection, and unique landscape features, the refuge lends itself to the possible future of a number of species and possible future reintroduction of declining species.

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There are no known federally listed plants on the refuge and all listings for plants are state designations. Of the total listed animal species, 17 are federally listed. However, 7 of these species (i.e., American alligator, Kemp's ridley sea turtle, Hawksbill sea turtle, Atlantic salt marsh snake, snail kite, Audubon's crested caracara, and roseate tern) either have a special listing (i.e., alligator) or have rarely been recorded on the refuge. This brings the actual number of state or federal listed wildlife species that regularly occur on the refuge to 41: 10 federal and 31 state species (which excludes the alligator and includes 28 plant species). Currently, 93 plant and animal species regularly occurring on the refuge have a state or federal designation (as threatened, endangered, special concern, or commercially exploited). However, 124 species occurring on the refuge have a special state, federal or non-governmental organization designation: 1 amphibian, 10 reptiles, 69 birds, 6 mammals, and 38 plants. These are plants and animals that include listed species, species of special management concern, or have a non-regulatory designation.

### **Objective 1(a). Florida Scrub-jay - Scrub Habitat**

*Discussion:* Four Primary Core Recovery Units are delineated within the State of Florida. These units are the only sites where it would be possible to support at least 400 breeding pairs of scrub-jays in perpetuity. The continued existence of all of the units is essential for the continued existence of the species. The Florida scrub-jay population on the refuge is part of the Merritt Island Primary Core Recovery Unit, which also includes lands owned and/or managed by Cape Canaveral Air Force Station and Canaveral National Seashore.

The primary core recovery unit presents a unique opportunity to manage habitat for the Florida scrub-jay. In spite of the presence of some infrastructure, large tracts of relatively unfragmented, contiguous habitat are present, especially on the refuge. A large population of scrub-jays exists here and the ongoing program focuses on managing and restoring scrub habitat. A long-term database exists on jay demographics provided by monitoring efforts from NASA's environmental program at Kennedy Space Center. These assets should help enable the refuge to successfully support Florida scrub-jay recovery. Maintaining viable scrub habitat would not only improve the chances of long-term survival of the scrub-jay, but would also address the conservation of many other scrub associated species.

The management of the Florida scrub-jay landscape can be a complex venture. The effects of past land use and management practices have had a profound effect on the suitability of the area for jays and other scrub fauna. The shrubland areas of the refuge have changed dramatically over the years (Duncan and Schmalzer 2004). Aerial photography flown in 1943 shows that this landscape was much more open than it is now. Openings consisting of sand and some herbaceous vegetation were common throughout most of the oak scrub areas. The coverage of pine woodlands in both the scrub and palmetto areas was scattered. Although there were stands of hardwoods throughout the refuge, most were small in area. The swales associated with the shrublands were grassy, with few woody species present. Although there were some roads present, they were narrow and few and far between. Duncan and Schmalzer (2004) showed that with little human alteration to the landscape, naturally ignited fires in the 1920s and 1940s would have spread extensively. Present day observations of fires in the shrubland areas would lead us to believe that many of these fires would have been very intense (Adrian 2003). (For the locations of shrubland habitats, see Figure 8 for an overview of refuge vegetation and Figure 7 in the Habitat Management Plan for the locations of just the shrubland habitats.)

Over time, the landscape that now makes up the refuge was altered by development. The once large patches of shrublands were fragmented by roads, agriculture, and structures. The hydrology of the area was changed through ditching for drainage associated with increased infrastructure. Fire, an

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important component to the shrubland ecosystem, was excluded from much of the region. The removal of fire from the landscape allowed the vegetation to become overgrown, reducing its suitability as habitat for the scrub-jay and other scrub fauna. To effectively manage the shrub landscape to the benefit of scrub-jays, the effect of these past actions must be addressed.

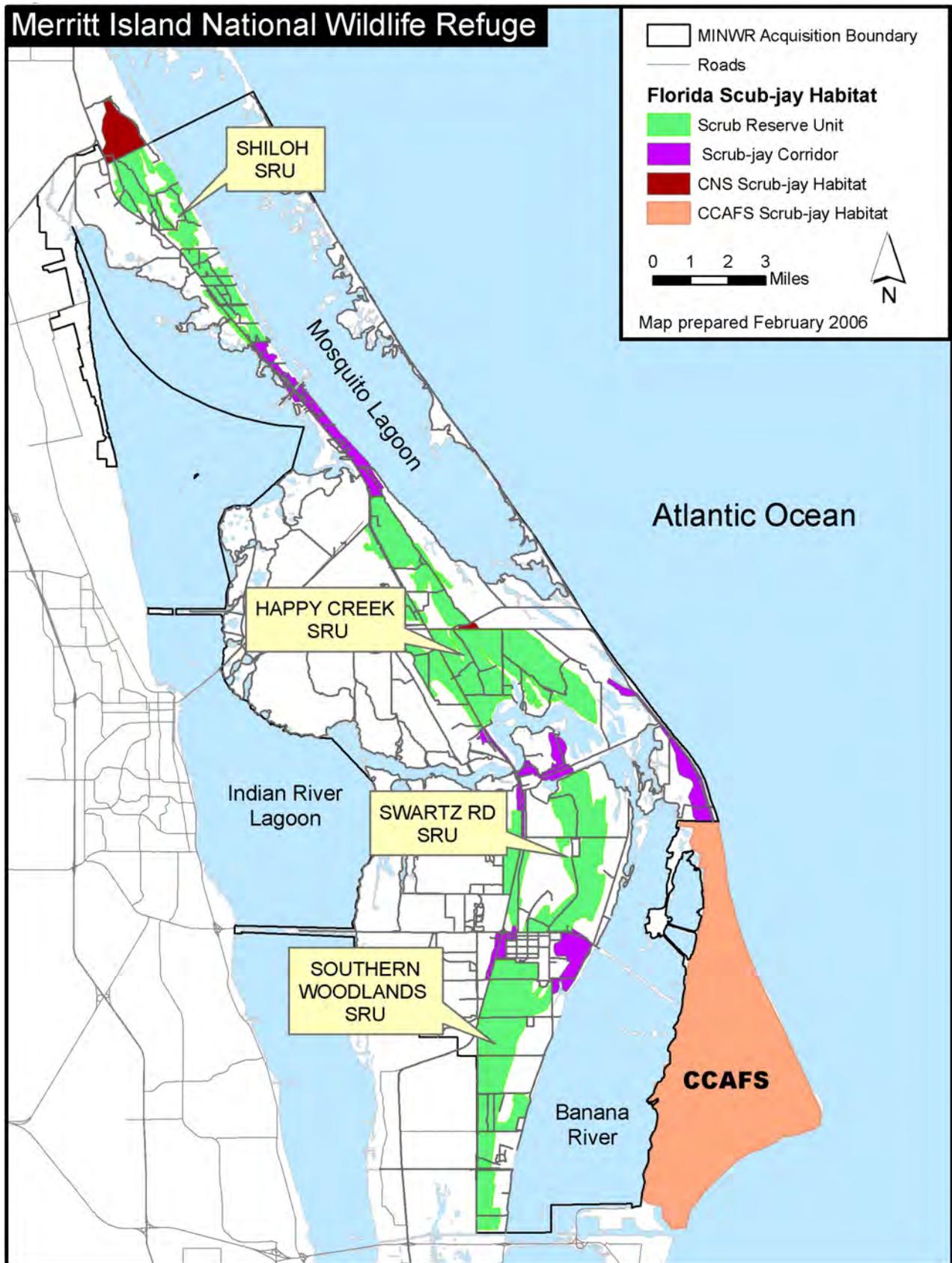
Optimal scrub-jay habitat landscapes include focal patches that have optimal characteristics within a matrix of habitat that does not lower the suitability of the focal patches. Optimal focal patches have 20 to 30 percent of the area in openings, have greater than 50 percent of the shrub layer comprised of scrub oaks (*Quercus* spp.), have a shrub height between three and six feet, have a pine canopy cover of less than 15 percent, and are 300 feet from a forest edge. As noted above, the landscape matrix in which these patches reside consists of areas of palmetto, scattered pines, and grassy swales. This presents a vista that is open with few visual barriers.

It is obvious therefore, that to achieve a viable scrub-jay population in and around the refuge, it would be necessary not only to restore and manage specific patches of scrub, but also to restore the landscape in which these patches exist. This would require the transformation, as much as possible, of the landscape to the way it appeared prior to the impacts of the aforementioned anthropological activities. The aerial imagery, from the 1940s, is available to help target historical conditions. Since this imagery was taken before the fire exclusion period and before most of the present infrastructure was constructed, the vegetative matrix represented by this photography has been selected as a target for the restored landscape.

Specific management actions required to achieve restoration would include reducing the height of overgrown scrub areas, removing woody vegetation from swales, reducing forest cover and density, and removing the visual barriers that are found along perimeters of scrub management units. Both mechanical treatment of vegetation and the judicious application of fire would be necessary in most restoration activities. Once restored, the proper maintenance of scrub areas is essential. The re-treatment of scrub patches should be based on field inventory, rather than some assigned rotation. In other words, rather than assign a fire rotation of four years to a site, managers should periodically assess the area, scheduling a burn when the height of the scrub approaches six feet.

Another important consideration in maintaining a viable scrub-jay population is the transfer of genetic material between sub-populations found in an area. Four areas of the refuge have extensive acreages of oak scrub and scrubby flatwoods. These are known as Scrub Reserve Units (Breininger et al 1996) (Figure 16). It is important that connectivity be maintained between these areas. Again, the use of mechanical treatment and fire would be required to open and maintain these linkages. In addition, the construction of additional roads and buildings in these corridors should be discouraged.

Figure 16. Locations of Scrub Reserve Units



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It is important to consider that when altering the present landscape, such as reducing forest coverage, scrub and scrub-jay management activities should not impact the objectives pertaining to eagle habitat or native wildlife and habitat management. When planning where to concentrate restoration or landscape alteration, it should also be remembered that it has been shown that scrub-jays do not move far. For this reason, it is best to concentrate on restoring scrub which is adjacent to occupied areas. A more complete description of planned activities, along with a detailed description of optimal scrub conditions, is documented in Chapter 4 of the Merritt Island National Wildlife Refuge Habitat Management Plan (see Appendix F).

In order to effectively carry out the strategies under the several objectives listed, it would be necessary to develop at least two staff positions. One would be at the professional level and should be knowledgeable in scrub landscape ecology. The other might be at the technician level and should be familiar with inventory methods for both wildlife and vegetation. In both cases, knowledge of how fire works in the scrub landscape would be required. It would be helpful if the individuals associated with scrub management be skilled in the application of fire.

*Objective 1.a(1):* Annually maintain 500-650 Florida scrub-jay family groups with 350-500 territories being in optimal condition to support scrub-jay recovery efforts.

*Discussion:* The 2001 population estimate of Florida scrub-jays in this core recovery unit was 665 pairs, which is close to the recovery population size of 697 pairs. In that year, Cape Canaveral Air Force Station accounted for 114 family groups (Stevens and Knight 2003). This indicates that the number of jay groups on the refuge could be expected to be about 550. While this population meets the stated goal, it would be preferable to support as many jay families as the habitat would allow.

*Objective 1.a(2):* Continue to annually provide 11,000 to 13,000 acres of oak scrub/scrubby flatwoods in optimal condition to support Florida scrub-jay recovery efforts.

*Discussion:* Table 1 shows that the refuge has a little over 15,340 acres of oak scrub and scrubby flatwoods on the refuge. Using 23 acres per family group territory as an average territory size, one would estimate that 12,650 acres of scrubland is occupied, leaving approximately 2,700 acres of potential jay habitat unoccupied. It is likely that some of this habitat occurs in small isolated patches that are not large enough to sustain jays. However, some habitat is not occupied because it is in poor condition. Restoration would be required to attract jays to these areas.

It is important to realize that not all of this scrub could be in optimal condition at the same time. Management activities would, of necessity, remove some well managed territories from optimal status for a period of time. When vegetation is removed by fire or mechanical means, there are from one to two years where the vertical structure is too short to meet optimal conditions. On the other end of the management cycle, just prior to subsequent burning, there would be times when the vertical structure may well be too tall. In a well managed scrub landscape, approximately 70 percent of the scrub habitat would be optimal, while the other 30 percent is either recovering from or being prepared for treatment. Seventy percent of the scrub habitat shown in Table 1 is 10,738 acres. In order to increase this to the acreage targeted, conversion of vegetation from other types would be necessary. Plans are being developed to remove the majority of timber from approximately 1,000 acres of scrubby flatwoods in the southern part of the refuge, as well as to restore 100 acres of fallow groves to scrubland.

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## 1.b. Bald Eagle - Flatwood and Scrub Habitats

Objective 1.b(1): Annually maintain 11-15 successful nesting pairs of bald eagles on the refuge.

*Discussion:* In the 1880s it had been estimated that approximately 100 pairs of bald eagles (*Haliaeetus leucocephalus*) nested in the vicinity of Merritt Island. During the early part of the 20<sup>th</sup> Century, bald eagles on Merritt Island numbered between 15 and 24 breeding pairs (Howell 1954). Anthropogenic changes in the landscape, especially during the 1950s, reduced this number to only one or two pairs by the 1970s (Hardesty and Collopy 1990). Declines in eagle abundance appeared greater on Merritt Island than was experienced on the mainland. The most likely cause of this was exposure to organochlorine compounds which were applied extensively during the 1940s and 1950s (Hardesty and Collopy 1990). Refuge annual narratives reported that no eagles were nesting on refuge lands in 1963. Since then the number has increased to an average of 12 nests.

Bald eagle habitat encompasses not only nesting substrate, but also foraging areas, perch trees, and areas devoid of disturbance. The impoundments and marshes on the refuge, along with portions of the Indian River Lagoon system both on and adjacent to refuge provide ample foraging habitat. While these areas are not specifically managed for eagle foraging, activities aimed at maintaining populations of migratory birds provide prey for the eagles. Fishery resources in the impoundments and estuaries also provide an important food source.

Hardesty and Collopy (1990) described various aspects of eagle habitat on the refuge. On the landscape scale, the distance between active nests averaged approximately 1.4 miles. Where alternate nests were present, the distance between the primary and alternate nest was about 0.3 miles. The distance from active nest trees to the nearest water averaged around 3,000 feet. Nest sites tended to be in areas without human disturbance. Distances to primary roads averaged 4,700 feet, while the distance to occupied buildings was about 13,000 feet. There are notable exceptions to this norm however. A large nest has existed for many years close to Kennedy Parkway (SR 3), just south of the Vehicle Assembly Building. In addition, in recent years, eagle nests have been found in both dead trees and on artificial structures. Regardless of these anomalies, selection of potential nesting sites for management should use the parameters described by Hardesty and Collopy (1990).

Eagle nest trees are described as being large, living south Florida slash pine (*Pinus elliottii* var. *densa*). The heights of these trees were almost 21 percent greater than surrounding trees, with heights of the nests themselves at the approximate level of the surrounding canopy. Nest trees had substantially larger diameters at both breast height and nest height than did the overall stand. Crowns were typically shallower than surrounding trees and nests were situated at the junction of several large branches (Hardesty and Collopy 1991). This crown configuration is common in mature to senescent south Florida slash pines.

The stands of pines in which the nest trees resided also had specific characteristics. These stands had basal areas of about 35 square feet per acre. They also had more snags than similar non-nest stands. Hardesty and Collopy (1990) do not address specific nest stand size, rather they recommend that a primary management zone of 1,500 feet, and a secondary zone with a one-mile radius be established for each active nest. This equates to 160 acres in the primary zone and over 3,000 acres in the secondary zone. There are few pine stands on the refuge that are 3,000 acres in size, and most do not even reach the 160-acre limit. It would seem more reasonable for management activities directed towards providing nesting habitat be limited to a distance of 0.5 miles from an existing and/or historic eagle nesting site.

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Most refuge management activities concerning eagle habitat would fall into the realm of forest and woodlands management. While these are discussed in detail in Chapter V of the Habitat Management Plan (Appendix F), some discussion is warranted here. The purpose of these activities is to protect existing nest sites and to ensure that suitable nesting substrate is available in the future. Management in stands containing existing nests should involve maintaining stocking level near 35 square feet of basal area per acre. To achieve this, thinning would need to be done occasionally. Marking of trees to be removed is recommended to provide positive control of the operation. Trees in competition with the nest tree should be considered for removal. Other large trees in the stand should also have competing trees removed. Further away from the actual nest tree, efforts should be made to create a range of stem densities. Thinning should be heavier around trees that have the potential to become future nest trees, while a lighter cut could be done elsewhere. This would not only provide sufficient stocking to provide for mortality, but would also create diversity within the pine forest. Harvesting would be done by commercial timber companies.

In addition to managing mature stands, efforts must be made to provide a range of age classes within the forest. To do this, small areas, about five to ten acres in size, should be selected for regeneration. The most efficient way for the refuge to regenerate pine stands is through natural regeneration. Seed trees are left on the site until sufficient seedlings are present. The parent trees could be left for a considerable period of time and removed when harvest operations are conducted nearby.

The use of prescribed fire is important to the maintenance of the pine forest ecosystem. However, fire, both wildfire and prescribed fire, could pose a threat to existing eagle nests. Procedures have been developed, and are constantly being refined, to reduce this threat. Reduction of vegetation under the nest tree immediately prior to the ignition of a prescribed fire is one part of this endeavor. Careful burn out under the tree along with wetting the nest with helicopter bucket drops are also techniques that have been used successfully.

Management of the eagle population on the refuge is not limited to manipulation of forests and foraging areas. The refuge must work closely with Kennedy Space Center to reduce the impact of their operations on eagles. This obviously includes discouraging the building of structures and other facilities in close proximity to existing nests. Construction should also be discouraged in areas that have the potential to become nesting habitat.

Reduction of mortality is another arena where coordination with the Space Center is needed. Kennedy Space Center employees need to be made aware of the possibility of eagles feeding on road kills. Efforts to get these employees to reduce their speeds when driving by flocks of vultures on the chance that an eagle may be present should be made.

The refuge conducts an annual eagle nest survey each January to determine the occupancy of known eagle nests. This information is shared with the Fish and Wildlife Conservation Commission, NASA Master Planning, and Dynamac Corporation. The data is used to determine eagle habitat characteristics using GIS and to develop a spatial-temporal baseline of eagle nesting.

### **1.c. Sea Turtles - Beach and Estuary Habitats**

*Objective 1.c(1):* Continue to annually maintain 6.3 miles (10 km) of refuge beach in a high-quality condition for nesting leatherback, green, and loggerhead sea turtles to support an annual target of 1,250 loggerhead sea turtle nests and a bi-annual target of 210 green sea turtle nests to support sea turtle recovery efforts.

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*Discussion:* The coastal beach and dune system serves as habitat for many listed species, including: threatened or endangered sea turtles and endemic species (e.g., Florida beach mouse, *Peromyscus polionotus* sp.). The undeveloped 10-km barrier beach extends from the south boundary of the Canaveral National Seashore to the north boundary of the Cape Canaveral Air Station. The Merritt Island beach is a coastal barrier beach and part of the Canaveral coastal barrier complex. The beach has a generally stable, low energy profile; however, the mid section receives more wave energy than the north or south ends. The higher energy section experiences erosion and the marine scarp extends to the dune face and into the transitional scrub habitat. Erosion is threatening specific points of the beach and dune near NASA's shuttle launch pads. The lower energy sites have typical beach and dune foreshore development with a low erosion upper beach. The upper sandy beach is largely bare with little vegetation, except for isolated beach plants (e.g., sea rocket, *Cakile* spp.). The dunes are vegetated primarily with sea oats (*Uniola paniculata*), morning glories (*Ipomoea* sp.), and typical dune grasses (Johnson and Barbour 1990), but do not have an extensive secondary dune field. There is a very quick transition from the primary dune to coastal strand and a saw palmetto/scrub community.

The loggerhead sea turtle (*Caretta caretta*), green sea turtle (*Chelonia mydas*), and leatherback sea turtle (*Dermochelys coriacea*) nest on the Merritt Island beach from April through September (Popotnik and Epstein 2002). From 1991-2001, the mean annual nests recorded for loggerheads was 1,338 [standard deviation (SD) = 320.6] and for green sea turtles was 54 (SD = 72.0). In total, six leatherback nests were recorded between 1991 and 2001. In 2005, there were a total of 881 nests found, but the actual number of nests would be higher due to periodic beach access closures from hazardous operations and launches at Kennedy Space Center and Cape Canaveral Air Force Station. Of the 881 nests found in 2005, 695 were loggerhead nests, 183 were green nests, and 3 were leatherback nests. The short-term trend of the number of nesting sea turtles is down since 2001, however, the impact of the 2004 and 2005 hurricanes may have influenced nesting in the last couple of years.

Mosquito Lagoon has been shown to be an important wintering area for juvenile loggerhead and green sea turtles. Mosquito Lagoon is considered a developmental habitat primarily for sub-adult loggerhead and green sea turtles (Mendonca et al 1982). Turtles may remain in the lagoon until maturity. Turtles wintering in the lagoon are plagued by winter freezes, which can cold stun the animals and can cause mortality. The refuge has developed a plan to coordinate the handling of cold stunned turtles and prevent mortalities (Epstein 2001a). The Mosquito Lagoon was thought to have supported thousands of sea turtles at one time. A sea turtle fishery that existed extended into the 1960s was thought to contribute to the decline in population. Monitoring of wintering sea turtles in the Mosquito Lagoon in the mid-1970s (Ehrhart and Yoder 1978) found higher numbers than presently found (Provancha et al 2002) and found that the recent occurrence of sea turtle fibropapillomas is apparent. Additionally, recent trends suggest a shift in species composition with the increased occurrence of green sea turtles and decreased numbers of loggerhead sea turtles than was observed in the past (Jane Provancha, Dynamac, Inc., personal communication).

Primary conservation efforts would be to work with NASA and Cape Canaveral Air Force Station to reduce development and adverse beach activities, such as educational efforts with Space Center employees, providing data and feedback on lighting and disorientation issues, and to encourage monitoring of coastal erosion rates. Other factors that may negatively influence sea turtle production on the refuge beach relate to impacts to beach habitat from storms that erode shoreline and dune systems. Additionally, this would lower the beach dune profile that protects (shades) nesting and hatchling sea turtles from lighting on nearby NASA and Air Force launch pads. Both the Air Force and NASA are presently working with the Fish and Wildlife Service's Ecological Services Office to develop appropriate lighting plans for the conservation of sea turtles on refuge beaches.

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The refuge beach and dune system is an important habitat for many species. For further information, see Chapter VII of the Habitat Management Plan on beach and dune habitat management and conservation.

*Strategies:*

- Continue to encourage the monitoring of juvenile sea turtles in Mosquito Lagoon.
- Provide consideration for the conservation of marine turtles in Mosquito Lagoon and other refuge estuaries.
- Identify potential impacts and adapt management to maintain lagoonal habitats for sea turtles.
- Continue to coordinate winter cold stun events with multiple agencies. [See the refuge's cold stun protocols (Epstein 2001a).]

*Objective 1.c(2):* Continue to annually maintain an annual sea turtle nest depredation rate of less than 10 percent to support sea turtle recovery efforts.

*Discussion:* Primary sea turtle nest predators at the refuge include: raccoons (*Procyon lotor*), feral hogs (*Sus scrofa*), and ghost crabs (*Ocypode quadrata*). Overall, a depredation rate of sea turtle nests over the past 11 years is approximately 6 percent. Sea turtle nest depredation is well documented. Llewellyn Ehrhart (personal communication) indicated that nest depredation was as great as 90 percent during the late 1970s along the same refuge beaches. Recent data show that an active and highly effective predator control program has kept the overall depredation of sea turtle nests well below an annual rate of 10 percent. Furthermore, a recent evaluation of nest depredated suggests that mortality of eggs from depredated nests may be lower than previously believed.

*Strategies:*

- Seek Service support through the Endangered Species program to hire a staff member (Biological Science Technician) to annually monitor and conduct the predator control program on the beach in conjunction with sea turtle survey work.
- Continue to work closely with the refuge's exotic mammal trappers in conjunction with the removal of hogs and other potential large predators from refuge beaches. (For additional information, see Chapter IX of the Habitat Management Plan, addressing Exotic, Invasive, and Nuisance Species.)

#### **1.d. Southeastern Beach Mouse - Beach and Dune Habitats**

*Objective 1.d(1):* Continue to annually maintain about 100 acres of coastal dune community dominated by forbs and beach grasses to support southeastern beach mouse recovery efforts.

*Discussion:* The 328-acre refuge beach extends from Canaveral National Seashore's southern boundary to Cape Canaveral Air Force Station's northern boundary. This coastal beach and dune system serves as habitat for many federally listed species, including the southeastern beach mouse (*Peromyscus polionotus niveiventris*). The refuge may harbor one of the few remaining sustainable populations of this subspecies of the old field mouse, which inhabits undeveloped, contiguous beach systems of the Canaveral National Seashore, Merritt Island Refuge, and the Cape Canaveral Air Force Station. The historic range of this small mammal has been reduced by approximately 80 percent. This suggests that the refuge may, in part, harbor a core population of this subspecies. Therefore, the refuge population may be a valuable source for consideration of reintroductions to other sites. The primary and secondary dune system is the principal habitat for the southeastern beach mouse at Merritt Island. In a recent pilot study (Tombs 2001), beach mice were most often found along the primary dune line in areas where sea grape (*Coccoloba uvifera*) was abundant.

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In addition, Tombs noticed that beach mice were not normally found in areas of dense stands of saw palmetto, perhaps because the sand was too dense and difficult for burrowing. In many locations along the study area, small mammal communities are comprised of three species: *Peromyscus polionotus*, *Peromyscus gossypinus*, and *Sigmodon hispidus*. This finding, along with the observation that *Sigmodon hispidus* were most often found in the scrub areas where beach mice seemed to be excluded, may warrant further studies of the small mammal communities in this area. Recent erosion from oceanic storms has caused the westward migration of the beach into the coastal strand. The rate of beach and dune migration is being monitored by Dynamac Corporation in consultation with the refuge. The refuge beach and dune systems transition quickly into coastal scrub, which would be impacted by sea level rise.

### **1.e. West Indian Manatee - Estuary Habitats**

*Objective 1.e(1):* Continue to annually maintain and protect 50,000 acres of refuge estuarine habitat to support an anticipated spring peak population target of 500 or more West Indian manatees.

*Discussion:* The Florida manatee (*Trichechus manatus latirostris*) is a federally endangered subspecies of the West Indian manatee and inhabits estuaries, lagoons, and slow-moving rivers. The Florida manatee was listed as endangered in 1967 and Critical Habitat was designated in 1976 (U.S. Fish and Wildlife Service 2001). Manatees are found along most of Florida's coastal waters and rivers and are year-round residents of the refuge. Statewide numbers are thought to be less than 4,000 individuals. The Florida Fish and Wildlife Conservation Commission estimates that 47 percent of the state's manatee population is distributed along the state's Atlantic coast (FWC unpublished data).

Manatees consume on average 10-15 percent of their body weight of submerged aquatic vegetation daily. Manatees feed on a wide variety of aquatic vegetation, but seagrasses are their primary foods in coastal areas (i.e., manatee grass, *Syringodium filiforme* and shoal grass, *Halodule wrightii*). Thus, maintaining quality seagrass meadows in refuge waters is an important objective. Submerged aquatic vegetation mapping of the Banana River, Indian River Lagoon, and Mosquito Lagoon (collectively the Indian River Lagoon system) shows that the refuge provides excellent foraging habitat for manatees (Provancha and Provancha 1988). Although the health of seagrass meadows has shown a trend towards degradation over time in most of the Indian River Lagoon, current data suggest that seagrass distribution within the refuge's boundaries has been relatively stable and healthy over the past decade (Robert Virnstein, personal communication). Since 1991, annual counts of manatees within the waters of the refuge have increased from approximately 150 animals to over 350 presently. In 1990, a 13,568-acre manatee refuge (sanctuary) was established south of the NASA causeway in the Banana River under the National Wildlife Refuge System Administration Act. The new area protected the largest warm water concentration of manatees in the United States (Merritt Island National Wildlife Refuge Annual Narrative 1990 unpublished report). The designation established a no motor zone in the Banana River.

The area remains open to public use (with new limits after September 11, 2001), however, motorized watercraft are prohibited. Observations made before and after the manatee refuge was established revealed an increase in the number of manatees using this habitat. The northern Banana River and Indian River Lagoon are the most important spring habitat along the east coast of Florida (U.S. Fish and Wildlife Service 2001). Injury from boat strikes is the most important threat to the species. The no motor zone protects manatees from contact with boats during times when they are present in the area.

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## 1.f. Wood Stork

*Objective 1.f(1):* Within the 15-year life of this comprehensive conservation plan, re-establish wood stork nesting on the refuge to support wood stork recovery efforts.

*Discussion:* The Moore Creek impoundment (600 acres) is the site of a former, large wood stork nesting colony. Wood stork nest numbers peaked in 1980 (350 nests) and varied in number until 1986. A severe freeze occurred in 1985-86 that destroyed all of the mangrove nest sites. Although there were 250 nests in 1986, the storks abandoned the rookery and no confirmed nesting has occurred at this site since 1986. In 1997, 25 wood stork artificial nest structures were constructed and installed at the former rookery area in hopes of restoring the rookery. However, great blue herons are the only bird to use the structures to date. There are approximately 200-300 wood storks using the refuge for feeding and roosting, with highest densities in winter.

For additional information on wood stork nesting and recovery on the refuge, please refer to Chapter IV of the Habitat Management Plan (see Appendix F).

### **Wildlife and Habitat Management Goal 2: Migratory Birds**

*Maintain and actively manage refuge coastal barrier island wetlands and uplands primarily to contribute to migratory bird priorities of the refuge and peninsular Florida physiographic area, while providing consistency with regional and national goals.*

*Discussion:* The refuge's wetlands rank highest in the State of Florida regarding numbers of migrating waterfowl counted during the official U.S. mid-winter counts, and rank as one of the highest regarding the number of successful waterfowl hunters (birds per hunter trip). Within the Atlantic Flyway (the entire east coast of the United States), no other site winters such large numbers of lesser scaup - a waterfowl species well below national density levels/goals of the flyways and the Fish and Wildlife Service. The refuge is an area of national importance, harboring up to 62 percent of all Atlantic Flyway wintering scaup and 15 percent of the continental population (Herring 2003, Herring and Collazo 2004). However, scaup populations wintering at the refuge have declined over the last six years. Additionally, Merritt Island Refuge is a highly important area for east coast pintails. Historically and presently, Merritt Island Refuge has ranked second in wintering pintail populations along the Atlantic coast. Pintail population numbers have steadily declined on the refuge over the past decades from a mid-winter count of about 20,000 in 1978, to 8,315 birds in 1989, to 3,141 in 1999, and to a low of 1,376 birds in January 2003: a 93 percent decline from 1978. The northern pintail stands a serious chance of being extirpated from a historical wintering area at the refuge. Consistent low annual population counts at the refuge supports the need to prioritize the evaluation of this species. The refuge plays an important role because (1) pintails are and have been well below nationally set density goals and (2) those pintails that do migrate to the Atlantic coast may be a unique population segment of the entire North American population - a segment with an affinity for historically used sites below Virginia (e.g., coastal North and South Carolina and eastern Florida).

The refuge's impoundments and their freshwater/brackish vegetative communities provide life history requirements for many species of wetland wildlife (Epstein 2001b), such as the Florida mottled duck, a resident duck unique to the State of Florida. The managed wetlands also harbor federally listed species, such as the wood stork, southern bald eagle, American alligator, and over 15 federal species of special management concern.

Because migration chronologies of waterfowl and shorebirds vary seasonally (e.g., overwintering birds, early spring migrants, and late spring migrants), management must provide suitable habitat conditions and food resources for a variety of species at different times (e.g., winter, early spring, and

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late spring). Providing diversity in management and habitat within the complex of wetlands would assist in meeting resource needs for multiple species. Staggered (graduated) drawdown is still a recommended management practice because it provides a continuous supply of habitat over the course of the season. Gradual drawdown is also used because it provides a diversity of habitat (e.g., mudflat, shallow water, and moderate water) due to variation in wetland bottom contour. However, the particular manipulations need to reflect seasonal differences in precipitation and management objectives (e.g., desirable habitats).

Management emphasizes achieving desired habitats to accommodate the different waterfowl and shorebird species by maintaining a diversity of preferred habitats, including a high interspersion of vegetation and open water/mudflat, where applicable. Within the wetland management program, emphasis is placed on multi-species use through water level management and by having diversified management objectives among impoundments. Gradually decreasing water depths in selected impoundments from winter to spring accommodates the needs of different water depth preferences among the wide range of migratory and resident waterfowl, shorebirds, wading birds, and diving birds. Many other species benefit from these conditions, such as feeding bald eagles, osprey, other raptors, alligators, reptiles, birds, and mammals. Therefore, a fish and wildlife guild is developed based on the habitat structure and quality. Having impoundments in varying habitat conditions from those in submerged aquatic vegetation management to those that are free flowing and supporting dense emergent wetlands augments the diversity and availability of different habitats to these species. In managed systems, habitats are managed for featured species groups; however the primary focus may change over time to allow the wetlands to rejuvenate. Thus, the wetland management program is dynamic and changes to meet the needs of multiple species, while achieving a high standard in habitat quality.

Approximately 16,000 of 22,000 impounded wetlands acres (~73 percent) would be managed with waterfowl as the primary focus during August through January. After January and the end of the waterfowl hunting season, impoundment management may shift towards meeting multi-species objectives, including meeting water depth preferences and habitat for migratory shorebirds and wading birds. Therefore, after January, there would be an additional 11,000 of the 16,000 acres (69 percent) that may be used for multi-species management. However, habitat management objectives would supersede wildlife population objectives in that water management may reflect the required need to manage wetlands to ensure that proper and/or healthy habitats are available in the future. Impoundments managed with a focus of waterfowl would also provide for food and cover habitat for multiple species, including rails, wading birds, shorebirds, and diving birds.

Figure 17 outlines the primary management focus of the refuge's impoundments. For additional information on specific impoundments, habitat management and habitat manipulation, please see Chapter IV of the Habitat Management Plan (see Appendix F).

## **2.a. Waterfowl**

*Objective 2.a(1):* Maintain 15,000-16,000 acres within impounded wetlands with a primary management focus on waterfowl from August to January of each year.

### *Strategies:*

- Continue to develop water level management capabilities to limit stress on waterfowl and shorebirds from uncontrolled water level changes due to fluctuations in lagoon water levels.
- Within 12 years of the approval of this plan, evaluate the featured species management of wetlands for waterfowl to accommodate multiple species, including the percentage use of

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wetlands by waterfowl, shorebirds, and wading birds. Evaluate the potential of individual impoundments to seasonally provide for multiple species groups.

- Encourage preferred emergent vegetation, including annual and perennial seed producing native species.
- Provide suitable habitat (water/salinity/vegetation) to accommodate annual foraging, sanctuary, molting, and other life history needs for a minimum of 25,000 dabbling ducks and 38,000 diving ducks (e.g., scaup and redheads).
- Consider changes to the refuge's Visitor Services Program to help sustain refuge's waterfowl population.

*Objective 2.a(2):* Continue to annually maintain and protect 50,000 acres of refuge estuarine habitat to support an average annual migration of 60,000 lesser scaup.

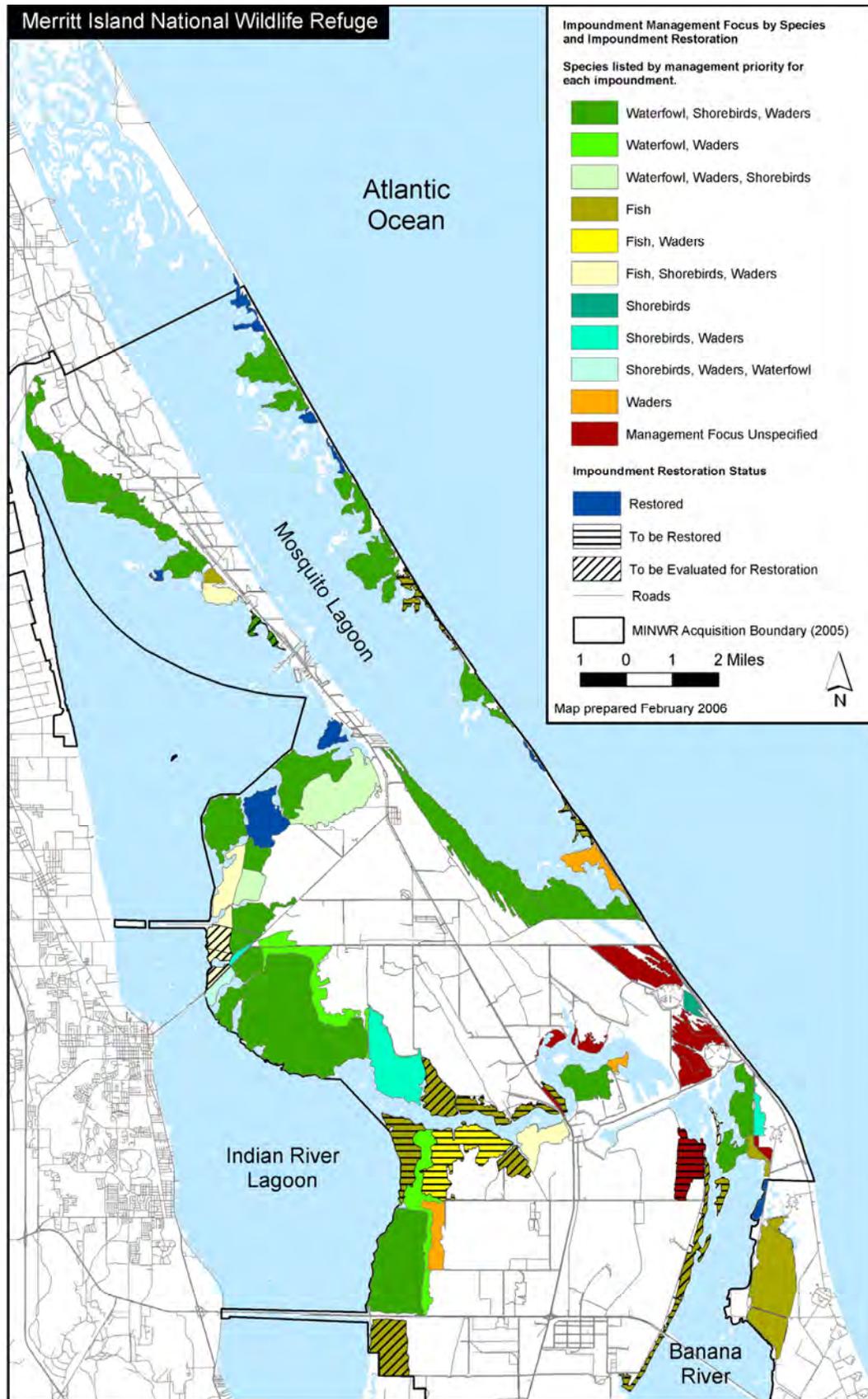
*Discussion:* Not usually thought of as primary waterfowl habitat, the Indian River Lagoon serves as one of the most important waterfowl habitat systems in the country, primarily for lesser scaup (Herring 2003). However it may also have been historically important to migratory populations of redhead (*Aythya Americana*) and canvasback (*A. valisineria*) ducks. Presently, lesser scaup are the primary species using the lagoon in great numbers, which have been recorded in the hundreds of thousands in the open water habitat of the Indian River Lagoon.

Recent studies (Herring 2003) indicate that Merritt Island National Wildlife Refuge and the adjacent estuarine areas south to Vero Beach provide the most valuable wintering habitat for scaup in the Atlantic Flyway. However, surveys of scaup populations suggest that the species is declining. The refuge's survey in 2001 yielded 83,173 scaup in the lagoon, a value 26.6 percent below the 30-year mean for the region. However, Herring (2003) found that although the Indian River Lagoon appears to be providing good, wintering habitat, the birds may still be arriving back on the breeding grounds in poor condition. Although this suggests they are not fulfilling their nutritional requirements after leaving Florida in the spring, Herring (2003) also suggested that increasing boater disturbance to flocks rafting on open water could reduce their health and additional studies are needed to determine the overall impacts to wintering scaup populations.

*Strategies:*

- Protect scaup and their habitat from disturbance.
- Educate NASA and Cape Canaveral Air Force Station security staff to limit disturbance to scaup, especially from airboat use in the North Banana River.
- Educate the refuge's users on the value of the lagoon to scaup and why lower disturbance is needed to help maintain scaup populations.
- Encourage research to determine why scaup use certain areas over other areas with equally good habitat.
- Continue to work with the partners to address water quality issues in and around the refuge.
- Work with the partners to address disturbance issues on and adjacent to the refuge.

**Figure 17. Impoundment Management Focus**



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*Objective 2.a(3):* Support an average annual breeding population target of 250 pairs of mottled duck.

*Discussion:* Unique to peninsular Florida, the Florida mottled duck (*Anas fulvigula fulvigula*) is prized as a game bird and has an intrinsic aesthetic value. Changes in south Florida's landscape from agricultural to urban development raised concerns about the status of mottled duck. The refuge provides an important habitat base for mottled ducks in the rapidly developing east-central portion of the state. Management that emphasizes high-quality, dense upland nesting cover in close proximity to shallow, emergent aquatic habitat is recommended (Steve Rockwood, FWC, personal communication). Providing relatively large blocks of dense nesting habitat would help minimize depredation. Additionally, the close proximity of shallow, emergent aquatic habitat would enhance duckling and female survival. For additional information, please refer to the Chapter IV of the Habitat Management Plan (see Appendix F).

## **2.b. Shorebirds**

*Objective 2.b(1):* Annually maintain a minimum of 2,500 acres of impounded wetlands with a primary management focus on migratory shorebird habitat.

*Discussion:* Migratory shorebirds represent a very diverse group of waterbirds that range in size from the five-inch-long least sandpiper (*Calidris minutilla*) to the 16-inch-long large marbled godwit (*Limosa fedoa*) that are relatively common migrants on the refuge. This group of birds is considered the neotropical wetland migrants because they usually breed in the arctic and northern Canada and migrate south across the states to the southern reaches of South America and back to the Arctic in one season. Increasing habitat changes and fragmentation along their migration routes have increased the need to provide protection and quality habitat such that these species could secure their nutritional needs for long open-ocean migration. The coastal location of the refuge and the importance of the managed wetland habitats could be linked directly to shorebird species, such as dunlin (*C. alpina*), greater and lesser yellowlegs (*Tringa melanoleuca* and *T. flavipes*, respectively), dowitchers (*Limnodromus spp.*), peep sandpipers (*Calidris spp.*), and plovers (*Charadrius spp.*) that use the refuge as a wintering or staging area. Recent studies have demonstrated the importance of the refuge to dunlins (Kelly 2000) and other shorebirds. Further studies are presently documenting the migration and use patterns of different waterbirds on the refuge (Collazo and Epstein, unpublished data). Understanding the migration patterns, food, habitat, and water depth requirements of these species and incorporating these considerations into annual water level management plans would be vital for development of multi-species management actions on the refuge. For additional information on shorebirds and wetland management, please see Chapter IV of the Habitat Management Plan (see Appendix F).

### *Strategies:*

- Within 12 years of the approval of this plan, evaluate each managed impoundment to determine the acres suitable for migratory, overwintering, and breeding shorebird habitat.
- Also within 12 years of plan approval, determine seasonal water level conditions needed to accommodate each species group on the refuge.
- Develop integrated mosquito control and migratory bird management practices. Work with Brevard and Volusia mosquito control districts.
- Coordinate with national and regional shorebird management plans.

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## 2.c. Wading Birds

*Objective 2.c(1):* Annually maintain a minimum of 1,500 acres of impounded wetlands with a primary management focus on wading bird habitat.

*Discussion:* The refuge has a rich diversity of long-legged wading birds that utilize refuge habitats for breeding, nesting, feeding, and roosting. Approximately 17 species of wading birds (*Ardeidae*) are commonly found with some species very abundant [e.g., white ibis (*Eudocimus albus*), snowy egret (*Egretta thula*), and great egret (*Ardea alba*)] and/or others not so abundant, but which may have state or regional management concern designations, including the reddish egret (*Egretta rufescens*), roseate spoonbill (*Ajaia ajaja*), and the endangered wood stork (*Mycteria Americana*). The wetland management program for featured species includes consideration of providing preferred habitat, food, and resource availability for wading birds. Under this program, wading birds benefit as water levels drop from winter to spring. The drop in water levels concentrates fish for enhanced availability at times of the year linked with wintering and breeding. Stolen and Collazo (2004) found that impoundments can produce abundant fish populations and that impoundment habitats managed as a complex of wetlands under a variety of hydrologic conditions were highly beneficial to wading birds. The refuge also continues to work with the local mosquito control districts to improve management actions for wading birds. For additional information and strategies on wading bird and multi-species management, please see Chapter IV in the Habitat Management Plan (see Appendix F).

## 2.d. Water Control Structures

*Objective 2.d(1):* Within 1 year of the approval of this plan, develop a standardized riser size and a tamper-proof design for all water control structures to be installed in refuge impoundments, as replacement or installation is necessary.

*Discussion:* The refuge's water control structures need to be capable of fully controlling water within and among the impoundments. At present, many of the water control structures allow uncontrolled flow of estuarine water into the impoundments, which disrupts water management and water quality objectives in impoundments with set seasonal water depth goals. Having water control structures that stabilize water level management capabilities to limit stress on habitat, waterfowl, and shorebirds during water level changes (e.g., changes in lagoon amplitude) is desirable. These water control structures would provide the means to stop, manage, or allow water to flow within and among impoundments, based on the stated focus of a particular impoundment. Development of improved water control structures is an ongoing process within the framework of the existing hydrology and management needs. For detailed design information about these structures, please see Chapter IV of the Habitat Management Plan (see Appendix F).

## 2.e. Neotropical Migratory Birds

*Objective 2.e(1):* Within 5 years of plan approval, initiate research to determine usage and habitat requirements of neotropical migratory birds on the refuge.

*Discussion:* Merritt Island Refuge has approximately 46,000 acres of upland habitats. The coastal physiography, including ridge and trough topography across the uplands, provides a mixture of dry and wet habitats. Much of the uplands are crisscrossed by wetlands and wetland potholes. Upland habitats include mature maritime forest (live oak) in both mesic and hydric hammocks, palm hammocks (hydric palmetto hammocks), pine flatwoods (mostly slash pine), beach, dune, back barrier coastal strand, and Florida scrub (wet and dry areas, with a coastal characteristic). Of the approximate 1,900 acres of citrus groves, about 800 acres are presently being phased out of

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management. The primary focus of management of upland habitats is for threatened and endangered species, with special attention given to the Florida scrub-jay. Prescribed fire and mechanical manipulation are the principle components used to manage upland habitats. Generally, uplands (which may include interspersed wetlands) are burned on a five- to eight-year rotation that provides a wide diversity of habitats. Merritt Island Refuge's size and location along the central Atlantic coast makes the refuge a potentially important site for neotropical migratory birds and may be more important to specific guild species (Hunter 1999). Special attention could be given to integrating neotropical migratory bird management into the current upland habitat management program that is geared primarily to recovery efforts for the Florida scrub-jay. The refuge lacks baseline information on neotropical migratory birds and associated habitats.

*Strategies:*

- Encourage educational institutions to carry out research projects that would determine migratory bird use in shrub lands, pine lands, and hammock areas of the refuge.
- Continue breeding bird surveys.
- Continue the use of volunteers to assist in bird monitoring programs.
- Develop baseline inventories and monitoring programs for neotropical migratory birds.
- Determine refuge management activities that could be integrated with on-going programs (e.g., for Florida scrub-jays) that would enhance habitats for neotropical birds.
- Promote understory growth for native species that produce fleshy fruit. In many cases, such as palmetto, the continued application of fire would encourage fruiting of these plants.
- Promote diversity of native species and community structure to provide appropriate food and cover. Prescribed fire could be useful in both altering vegetative structure and encouraging native plants.
- Monitor mesic hammocks to ensure their continued health and survival. In the past, sufficient regeneration has transpired in openings that have occurred from natural phenomena, such as wind throw, lightning strikes, or other mortality of the canopy trees. If this is not sufficient in the future, active management may become necessary.
- Protect habitats that are known to be important to migratory birds, such as coastal scrub and hardwood hammocks.
- Link refuge migratory bird conservation efforts to efforts and plans of the North Florida Ecosystem, as well as to regional and national efforts and management plans.
- Focus management considerations on Florida Priority Bird Species (Hunter 1999).
- Determine the role of Merritt Island Refuge to local conservation efforts.
- Develop partnerships and/or volunteer programs to survey birds on the refuge and on local, adjacent conservation lands.
- Develop and provide specific burn rotation prescriptions where necessary, recognizing the importance of maintaining hardwood hammocks and other areas with low frequency fire return intervals.
- Include considerations for cabbage palm removal in abandoned citrus groves for improved painted bunting habitat, in addition to providing corridors for other wildlife.
- Determine the role and importance of optimum scrub habitat for migratory land birds.
- Promote grassy-herbaceous ground cover in wetland swale/trough habitats for migratory species (e.g., wintering Henslow's sparrows).

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## 2.f. Migratory Birds

*Objective 2.f(1):* Annually maintain about 300 acres of beach and dune habitat for migratory bird use.

*Discussion:* The coastal beach and dune system is exceedingly vulnerable and important to many species, including Wilson's and piping plovers (*Charadrius wilsonia* and *C. a. tenuirostris*, respectively) and colonial nesting shorebirds (Charadriiformes) (Millsap et al 1990, Johnson and Barbour 1990). The Florida coastal zone is one of the most attractive areas for people to live and work. However, continued loss, modification, and disturbance of coastal habitats augment the necessity to protect and manage the refuge's beach and dune habitat. The refuge has conducted bird surveys on the beach in accordance with the International Shorebird Survey protocol. Data suggest there are summer (shorebirds, May - October) and winter (diving birds, October - April) components to bird guilds using the beach area. Wilson's plovers nest on the upper beach and dune system at the refuge from April through July (Epstein 1999). The refuge recognizes the importance of the beach and dune habitats for multiple species, such as nesting sea turtles, the southeastern beach mouse, and migratory birds, and would adapt management plans to ensure the protection and management of this habitat. For additional information on habitat management of the refuge's beach and dune system, please refer to Chapter IV of the Habitat Management Plan (see Appendix F).

### **Wildlife and Habitat Management Goal 3: Exotic, Invasive, and Nuisance Species**

*Control and eliminate, where feasible, exotic, invasive, and nuisance species on the refuge to maintain and enhance the biological integrity of the refuge's native coastal and estuarine habitats of east central Florida.*

*Discussion:* The occurrence of exotic plants and animals on the refuge has been identified by staff and governmental partners as one of the most important management issues facing the refuge. Over 50 invasive exotic plants have been reported in and around refuge areas (Schmalzer et al 2002) and 25 exotic plant species have been observed by refuge personnel on refuge lands (see Table 2). Exotic plants currently with the greatest known infestation levels on the refuge include Brazilian pepper, Australian pine, melaleuca, Guinea grass, air potato, and cogongrass. Two exotic animal species are known to occur on refuge lands: feral hogs and feral house cats. Feral hogs occur in all refuge habitats and population levels are high. Feral cat population levels are low and they tend to occur in the vicinity of human developments on the refuge and on NASA controlled lands. Invasive species have negative impacts to natural plant diversity and to wildlife habitat. In addition, exotic animal species also cause direct mortality to native wildlife and compete with native wildlife for food resources. Exotic species could also have negative economic and public health and safety impacts. The infestation of exotic plants and feral hogs is extensive on the refuge and without control efforts the level of infestation is anticipated to continue to increase, resulting in even greater negative impacts to refuge habitats and wildlife populations. The constant threat also exists for new exotic species to colonize the refuge and for new exotic species to become established in Florida and on the refuge. It is important to constantly monitor the occurrence of exotic species on the refuge and to be alert to new species in the state and in the vicinity of the refuge. A more complete discussion of exotic, invasive, and nuisance species and their management on the refuge is included in the Merritt Island National Wildlife Refuge Habitat Management Plan (Appendix F).

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### 3.a. Exotic Plants

*Objective 3.a(1):* Within two years of plan approval, develop and annually thereafter maintain a refuge-wide baseline exotic plant database.

*Discussion:* The first step in managing invasive plants on the refuge is to complete an exotic plant database, including a GIS component, of all refuge lands. This database should identify the number of exotic/invasive plant species present on the refuge and the coverage and stocking level for each species. Every five years refuge lands should be re-surveyed to identify infestations of new exotic plants and to determine the coverage and stocking level for all exotic plant species in order to assess the effectiveness of control efforts and to re-direct ongoing control efforts as needed. The exotic plant GIS database should also be updated every five years in conjunction with re-survey efforts. After the initial exotic plant survey, an operational plan should be prepared identifying level of control efforts to be devoted to each exotic plant species, priority treatment areas, and other factors.

The refuge currently receives no funding for exotic plant control. To date, all exotic plant control has been funded out of limited operations' monies and by grants received from the Florida Department of Environmental Protection. Exotic plant control would be enhanced through several actions: partner with NASA and Dynamac to provide GIS assistance, seek funding for contractors to do exotic plant surveys, seek funding for a Wildlife Biologist to oversee the exotic plant control program, seek funding to help support a GIS Specialist, continue to work in partnership with Canaveral National Seashore to coordinate control efforts and seek funding for exotic plant control, and continue to seek funding from Florida Department of Environmental Protection to hire contractors to control exotic plants.

*Objective 3.a(2):* Within five years of plan approval, eliminate all known Old World climbing fern, Australian pine, *Melaleuca*, cogongrass, kudzu, bamboo, and eucalyptus from the refuge and annually maintain a level of no infestation of these seven species on the refuge.

*Discussion:* The level of infestation and biology of certain exotic plant species make it possible to eliminate these species from the refuge. These species include: Old World climbing fern, Australian pine, melaleuca, cogongrass, kudzu, bamboo, and eucalyptus. The only exception to this is Australian pine around actively farmed citrus groves. These Australian pines would remain and not be treated until citrus farming ends and the groves are restored to native habitats. The exotic species identified would be considered eliminated when all known new plants and all re-growth from previous infestations could be killed each year. It is anticipated that this level of control could be attained within five years after plan approval. The key to elimination of these exotic species is annual surveys and control efforts. When available, the refuge should use biological control agents.

*Objective 3.a(3):* Integrate the exotic plant program into all refuge resource management programs to annually treat 30 percent of the refuge to control and, where feasible, eliminate exotic plants, including Brazilian pepper and Guinea grass.

*Discussion:* Several exotic plant species (i.e., Brazilian pepper and Guinea grass) would be extremely difficult to eliminate from the refuge due to their current high infestation levels, their extensive distribution, and their high propagation rates. Elimination of these species would also be extremely costly. For these species, the management strategy would be to apply as much control as possible to a specified portion of the refuge each year, concentrating on upland and wetland areas away from dikes, roads, and public use areas. To make control of these species within these areas as effective as possible, exotic plant control would also be incorporated into other refuge management activities, such as prescribed burning, scrub restoration, and water level management. Key to the effectiveness of these wide-area control efforts would be advances in biological controls of

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exotic plant species. Advances in biological control agents for exotic plants would be monitored and when biological control agents become effective and available, the refuge would pursue the introduction of these agents into refuge populations of exotic plants.

Each year one-third of the refuge would be identified for control efforts and funding and manpower would be concentrated in this area. Treatment areas would move each year so that on a three-year cycle the entire refuge would be covered. When possible and where feasible, efforts would be made to re-treat the previous year's treatments.

*Objective 3.a(4):* Annually spray along the perimeter of all dikes, firebreaks, public use roads, and other public use areas to treat these target areas for exotic plants.

*Discussion:* The areas along dikes, public use roads, fire breaks, and other public use areas (including parking lots, boat ramps, and viewing areas) are easily accessible. Exotic plants in these areas are easily treated with power sprayers and wick applicators and by mowing. These areas include approximately 200 miles of dikes and 150 miles of public use roads and fire breaks and total approximately 2,500 acres in area. If left untreated, exotic plants along dikes, roads, and fire breaks tend to move into new habitats through seed and propagule transport enhanced by mowing and maintenance activities. So it is extremely important to control exotic plants along these features. Also, control of exotic plants in public use areas and along public use roads helps provide a natural viewscape for refuge visitors. Exotic plants and control activities in public use areas provide the opportunity to interpret the negative impacts of exotic plants and the techniques and management activities used to control these plants.

In addition to chemical and mechanical treatments, the refuge would also control exotic plants on dikes by seeking partners to restore impoundments which are not needed for refuge management activities or for mosquito control. Impoundment restoration includes removing the dike and reconnecting the impounded wetland habitats to the estuary. This technique not only eliminates the exotic plants which grow on the dike, it could help control exotic plants in the wetland by increasing salinity and water levels, while also providing other habitat and wildlife benefits identified elsewhere in this plan.

### **3.b. Feral Hogs**

*Objective 3.b(1):* Within two years of plan approval and for three consecutive years thereafter, annually remove a minimum of 4,000 feral hogs from refuge lands. After these three years, evaluate the estimated hog population and adjust the target take to continue to lower the feral hog population on the refuge.

*Discussion:* Feral hogs are one of the most abundant exotic animals of the refuge. Estimates of the feral hog population vary from 5,000 to 12,000. Feral hogs cause substantial damage to wildlife habitat and compete with native wildlife for food resources. Feral hogs also cause direct mortality to some species of native wildlife (e.g., feral hogs predated 38 sea turtle nests in 2003). In addition, feral hogs cause damage to lawns, road shoulders, and other areas by their rooting activities. They are also a safety hazard being involved in numerous vehicle collisions each year. The goal is to reduce the feral hog population to the lowest level possible. Numerous research efforts have shown that it is very difficult and expensive to eliminate feral hogs from a large tract of good habitat. Refuge staff acknowledges that eliminating feral hogs from the refuge is probably not feasible.

Efforts to control feral hogs on the refuge began in 1972. From 1972 through 1995 volunteers were utilized to trap and capture feral hogs. From 1995 through 2004, three permitted hunters were used

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to remove feral hogs from the refuge. From 1995 through 2004 the use of traps was not required. In an attempt to increase the number of hogs removed from the refuge, the number of trappers and permit requirements regarding trapping were changed in 2004. The current system employs four permitted trappers and up to 50 assistant trappers. Trappers are selected by random drawing from a pool of applicants. Permits are valid for five years and are renewed annually subject to satisfactory performance by the trapper. Each trapper is required to operate a certain number of traps each month from October through April. Trappers are also allowed to capture hogs with the use of trail dogs. All hogs must be removed from the refuge alive and are considered property of the trapper when removed. Trappers must dispose of the hogs in accordance with the law. On occasion, refuge staff shoots hogs that pose an immediate problem due to safety concerns, property damage, or wildlife/habitat impacts.

Recently, trappers have removed approximately 2,500 hogs from the refuge each year. Refuge staff feels that the number of hogs removed from the refuge needs to be increased to about 4,000. In attempt to do this, the changes outlined above were implemented in 2004. Refuge staff would monitor the number of hogs taken and work in cooperation with the trappers to attempt to increase the take to 4,000. After three years, staff would evaluate the hog population and adjust the target take figure to a level which would keep the hog population at a low level.

#### **Wildlife and Habitat Management Goal 4: Wildlife and Habitat Diversity**

*Protect, manage, and enhance the natural diversity of fish, wildlife, and habitats and the important landscapes of the refuge's coastal barrier island system to ensure that refuge fish and wildlife populations remain naturally self sustaining.*

*Discussion:* The intrinsic landscape at the refuge is very diverse and ecologically supports many native and migratory species of animals and plant communities that are both aquatic and upland in nature. The diversity of habitats includes an oceanic, maritime interface that transitions to beach and dune communities. The barrier island topography includes extensive estuarine wetlands and lagoon systems and an upland landscape characterized by diverse vegetative communities that are largely fire maintained. Inherent within this system is a complex of aquatic resources, including an extensive fishery (e.g., fish nursery areas, sport fishes, and shellfish) that is highly influenced by water quality and public uses. The refuge supports colonial bird nesting and roosting areas, neotropical migratory birds, resident and wintering waterfowl, shorebirds, wading birds, and ten federally threatened and endangered species [two of which are considered statewide core populations (i.e., Florida scrub-jay and the southeastern beach mouse)].

Maintaining the natural integrity and biodiversity of the refuge includes having the professional staff with the knowledge and background of the ecology and management of these systems (e. g., fire and wetland ecology, fisheries and coastal zone management, and wetland and upland wildlife). As adjacent landscapes and habitat become more stressed with increased fragmentation and development, the refuge would become more important to species that are displaced, as a sanctuary area from disturbance, and simply as an area that could support native habitats and fish and wildlife populations. Integrated within the managed forest, scrub, and wetland habitats is an effort to restore degraded habitats to natural-like systems. This includes citrus grove and scrub restoration, coastal wetland restoration, and exotic species control. The complexity of maintaining self-sustaining fish and wildlife populations would be reflected in the Service's ability to properly manage and maintain the biological integrity of refuge habitats.

The refuge overlays the Kennedy Space Center and is contiguous with Cape Canaveral Air Force Station. These installations are potential sources of contamination on the refuge with the rapid development of the space program and decades of farming (primarily citrus). Several Superfund

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sites have been identified at Cape Canaveral and zinc and PCB contamination is documented on refuge property associated with the space shuttle launches. Biota samples collected on the refuge contained detectable levels of contaminants, including DDE, endosulfan sulfate, arsenic, cyanide, and zinc (Youngman 1998). Because of the surrounding and historical land use, the potential exists for trust resources on the refuge to be exposed to environmental contaminants through dietary ingestion and other means. The National Wildlife Refuge System Improvement Act mandates that the health and integrity of refuge lands be maintained. The refuge would continue to coordinate among all Service and NASA programs to develop baseline data to help identify existing and future threats. This information would provide needed baseline data for the refuge in fulfilling its requirements under the National Wildlife Refuge System Improvement Act of 1997.

For additional information, see Chapter IV in the Habitat Management Plan (see Appendix F).

#### **4.a. Natural and Spoil Islands**

*Objective 4.a(1):* Within 5 years of plan approval, evaluate and characterize all spoil, altered natural, and natural marsh islands for restoration and management.

Many spoil islands were created with the dredging of the Atlantic Intracoastal Waterway and the Kennedy Space Center barge canals on the refuge have been documented to subsequently be important rookeries sites for colonial wading birds, shorebirds, and mottled ducks. Similarly, many natural marsh islands within the refuge's boundary are rookery sites for wading birds and/or shorebirds. Vegetative succession has advanced over many of the islands, which have become forested with mangrove, oaks, palmetto, and exotic species. Many of the forested islands are now used by colonial nesting birds as important breeding areas. However, on some of the spoil islands, advanced succession has made them unsuitable for ground and shoreline nesting birds. The refuge has identified some islands to clear and restore to sandy habitats for gulls, terns, plovers, and mottled ducks. When newly created, these spoil islands would provide bird habitat (Erwin et al 1994, Erwin et al 2003). The refuge remains open to using these sites for controlled dredge spoil deposition for habitat restoration. Some natural marsh islands that were historically drag-lined ditched for mosquito control have been identified for wetland restoration.

##### *Strategies:*

- Survey all islands to determine which serve as rookery sites, in need of protection.
- Consider a diversity of habitats to include providing nesting habitat for black skimmers, least terns, and mottled ducks.
- Determine how to protect islands from erosion and from issues associated with recreational use of the area (e.g., boat wake issues and wildlife disturbance).
- Provide for exotic species control on these islands.
- Where appropriate, reuse sand/shell material from islands scraped down to elevate other islands (i.e., consider using dredge material or unneeded material from other islands).

*Objective 4.a(2):* Within the 15-year life of the plan, restore to native vegetation seven altered natural islands in Mosquito Lagoon.

*Objective 4.a(3):* Within 10 years of plan approval, select, clear, and maintain three islands down to the sand/shell substrate within the Banana River for terns and other ground nesting birds.

*Objective 4.a(4):* Within 10 years of plan approval, select, clear, and maintain two to three islands down to grassy and herbaceous cover within the Banana River for mottled ducks and other grass nesting birds.

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*Objective 4.a(5):* Within 5 years, evaluate the options for shoreline stabilization of Tank and Mullethead islands to ensure continued existence of these important rookeries.

*Objective 4.a(6):* Establish buffers of 300 to 450 feet for nesting and roosting islands, including Bird, Little Bird (Preacher's), Pelican, Tank, and Mullethead islands.

#### **4.b. Seagrass Beds**

*Objective 4.b(1):* Work with the partners to maintain the current level of approximately 27,000 acres of seagrass beds on the refuge.

*Discussion:* The refuge includes approximately 76,500 acres of estuarine habitat. The open estuary waters include areas of the Banana River, Banana Creek, Mosquito Lagoon, and the Indian River Lagoon. In 1991, the lagoon became a part of the National Estuary Program. Collectively, all open water and wetlands of the refuge are part of the Indian River Lagoon system. The State of Florida designated the waters of the refuge as Outstanding Florida Waters. The refuge harbors over half of the wetland acreage and more than 40 percent of the seagrass coverage in the entire lagoon system. The system is designated as Essential Fish Habitat (Magnuson-Stevens Act) and a candidate site under consideration for designation as a Marine Protected Area. The Atlantic Intracoastal Waterway traverses the refuge through the Indian River Lagoon and Mosquito Lagoon.

Protection of primary seagrass habitat has an important, logical connection to the density of many fish and macro-faunal invertebrates using the refuge's estuarine waters. This primary fish habitat has an estimated fisheries economic impact of about \$12,000 per acre per year (Virnstein and Morris 1996). Based on this estimate, the 28,000 acres of seagrass within the refuge's boundaries (based on 1999 mapping) would contribute over \$300 million per year in fisheries resources. The seagrass communities are presently being mapped and monitored by the St. Johns River Water Management District and NASA. Any refuge effort to protect and restore seagrass habitat would be consistent with local, state, regional, and national goals.

#### *Strategies:*

- Within two years of plan approval, work with the partners and use existing plans (e.g., Walters et al 2001 and St. Johns River Water Management District Surface Water Improvement and Management Plan) to develop and integrate a comprehensive environmental monitoring program for the Indian River Lagoon system within the refuge to ensure environmental health and biological integrity of estuarine fish and wildlife resources, populations, and habitats.
- Work with the partners to monitor water quality, especially related to petroleum.
- Work with partners to address water quality, especially off site non-point source pollution sites.
- Evaluate ways to stabilize dike slopes to minimize associated runoff and erosion to limit turbidity in the estuarine waters to benefit seagrass beds.
- Monitor and prevent degradation of seagrass beds below existing estimated coverage by managing or denying uses that would further degrade the aquatic communities.
- Use an adaptive management approach to incorporating ongoing research and monitoring results into management options and decisions impacting seagrass beds.
- Consider additional research needs, including impacts of large quantities of drift macroalgae, their relationship to nutrients, suspended solid concentrations, and nitrogen, with site specific characteristics (e.g., high total phosphorous and nitrogen concentrations in Turnbull Creek).

*Objective 4.b(2):* Within the 15-year life of this plan, decrease prop scarring to levels at or below the Florida Fish and Wildlife Conservation Commission's established definition of light scarring where less than 5 percent of the seagrasses are scarred.

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*Discussion:* The estuarine waters of the Mosquito Lagoon, the Indian River Lagoon, and Banana River are generally large, shallow basins that do not have a direct connection to the ocean. The closest oceanic inlets are Ponce Inlet (20 miles north) and Sebastian Inlet (40 miles south). Therefore, there is very little to no daily tidal amplitude in the generally shallow lagoon waters of the refuge. The lagoon waters are affected by seasonal tidal amplitude produced by the equinoxes (sun and moon gravitational affects that produce spring tides). There are two spring tides: one each spring and fall. The fall amplitude brings the highest water level conditions to the lagoon waters and refuge wetlands. However, wind speed and direction directly impacts daily amplitude. A strong southerly wind (e.g., southwest) pushes water north in the lagoon and increases water levels or river amplitude in the northern Indian River Lagoon and Banana River. At the same time, this could lower river amplitude in the Mosquito Lagoon as the water is pushed north. Salinity is largely a factor of seasonal rainfall.

Except for the Intracoastal Waterway, the lagoon waters are characteristically shallow flats (five feet or less) that support highly productive seagrass meadows. The refuge's seagrass beds are some of the highest quality in the entire Indian River Lagoon system, presumably due to the undeveloped nature of the landscape surrounding the Lagoon waters. Seagrass coverage within the refuge waters as mapped in 1999 was approximately 27,065 acres (Joe Beck, St. Johns River Water Management District, personal communication). Seagrass coverage for the major water bodies within the refuge's boundaries was Banana River (10,306 acres), Indian River Lagoon (5,279 acres), and Mosquito Lagoon (11,480 acres). Four species of seagrasses are common to the refuge, including: Shoal grass (*Halodule wrightii*), Manatee grass (*Syringodium filiforme*), Turtle grass (*Thalassia testudinum*), and Widgeon grass (*Ruppia maritima*). The seagrass meadows have remained largely unchanged over the past 55 years in refuge waters (Virnstein 1999), except that propeller scarring from outboard motors is widespread in the shallow waters of the Mosquito Lagoon. Water quality and clarity are critical components in the distribution patterns of the seagrass bed in the refuge.

*Strategies:*

- Use the Florida Fish and Wildlife Conservation Commission's propeller-scarring evaluation system to determine existing and future impacts to seagrass communities. "Light scarring is defined as the presence of scars in less than 5 percent of the delineated polygon, moderate scarring as the presence of scars in 5 to 20 percent of the polygon, and severe scarring as the presence of scars in more than 20 percent of the polygon" (page 11, Sargent et al 1995).
- Evaluate the implementation and effectiveness of the new Pole and Troll zones to limit impacts to seagrasses.
- Monitor and protect seagrass beds from further impacts by managing or eliminating adverse activities.
- Evaluate the human uses of estuarine systems to help management maintain biological integrity (e.g., water quality conditions, wildlife disturbance, and impacts to substrates and seagrasses).
- Identify shallow water areas where seagrass needs to be protected (e.g., from propeller scarring) and implement protection measures based on seagrass mapping, water depth, severity of disturbance, and agency recommendations.
- Develop zones of use for public use that are consistent with meeting multiple objectives of fisheries and aquatic resource management and protection.
- Use existing workshops and conferences to assist in identifying monitoring and research needs, combining common efforts, and sharing information and data.

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#### 4.c. Fisheries

*Objective 4.c(1):* Within five years of approval of this plan, develop an inventory of the baseline estuarine fisheries resources of the refuge and then every fifth year thereafter re-inventory to evaluate management actions necessary to maintain population levels.

*Discussion:* The Indian River Lagoon system is characterized by high biodiversity and productivity, and ranked as one of the most diverse systems in the world (Indian River Lagoon National Estuary Program 1996). Within the Lagoon waters of the refuge, 132 fish species have been identified (Paperno 2001). A keystone species of the Lagoon system, the horseshoe crab (*Limulus polyphemus*) generally inhabits estuarine systems and was very common in refuge waters. In recent years, researchers have noticed a decline in the numbers of horseshoe crabs (Jane Provancha and Gretchen Ehlinger, Dynamac, Inc., personal communication). The reason for the decline in horseshoe crabs is presently unknown. Horseshoe crabs influence species diversity and productivity in the lagoon and their eggs are a vital prey component of numerous species, including migrating shorebirds and many species of fish.

The refuge's open estuary and wetland habitats are used as stopover and wintering habitat for hundreds of thousands of migratory birds, many of which are dependent on fisheries for food. The open water estuary habitats are some of the most renowned sport fishing sites in the world (Roberts et al 2001). As user demand for fishing increases with the popularity of the area, the refuge could expect to receive increased boating activity within the seagrass communities, impacting fisheries and the species which rely upon them. The Mosquito Lagoon wetlands, seagrass beds, open bottom, and channel habitats support a diverse biota which includes some of the most valuable regional recreational fisheries, including several interjurisdictional and economically important fishes. The species most sought by recreational and commercial sport anglers are the red drum (redfish), spotted seatrout, and black drum. Other species, such as common snook (*Centropomus undecimalis*), tarpon (*Megalops atlanticus*), and jacks (family Carangidae), are a smaller part of these fisheries, but are not as common, nor are they as locally valued as the previously mentioned species. All three of these latter species belong to the same family, Sciaenidae (the drum-croaker family). This family is found in estuaries worldwide and has been prized as prime food fishes. They are well known as sound producers, yet primarily produce sound to call mates to spawn at night beginning as the sun sets. Each species produces a distinctive sound. This has allowed the spawning sites and period for each species in the Mosquito Lagoon to be determined based on underwater sound recordings. Sound intensity for each species is directly proportional to the number of eggs/larvae in the water column following a spawning event. Effective spawning is extremely important for any aquatic species so that it could replenish local populations which are constantly suffering natural mortalities due to predation, aging, and disease, as well as harvest by humans. After spawning, the larvae and early juvenile stages seek vital nursery grounds where they could avoid predation, yet obtain sufficient food to grow rapidly and mature. In the Mosquito Lagoon these nursery grounds are primarily seagrass meadows. Wetlands, deeper channels, and mouths of freshwater tributaries are also important. The importance of fish spawning areas has been described as analogous to bird rookery areas (Grant Gilmore, personal communication).

Increased regional human population growth and recreational and commercial use of refuge waters are coupled with the lack of knowledge of the resources and the proper management required to adequately sustain viable fish populations and other aquatic resources. Recreational and commercial harvests have increased and expanded in refuge waters to include fin fishes, mollusks, and crustaceans. Recreational and commercial boating activities have damaged seagrass beds (i.e., through prop dredging) and may also disrupt wildlife populations. However, appropriate and compatible boating activities are very manageable and the refuge could promote quality environmental and recreational conditions.

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*Strategies:*

- Protect habitats and critical life history needs for native fish and wildlife populations.
- Continue to encourage monitoring and research of species that represent the native biological diversity of refuge waters.
- Encourage monitoring of any resources that may indicate serious ecological disturbance in the refuge lagoonal system, such as horseshoe crabs.
- Determine the requirements for self-sustaining red drum, spotted seatrout, and black drum fisheries populations.
- Coordinate with the Service's South Florida Fisheries Resource Office and the Florida Fish and Wildlife Conservation Commission to conduct creel surveys and other independent surveys to determine catch per unit effort and angler success on waters adjacent to the refuge.
- Encourage periodic monitoring of fish spawning and settlement sites.
- Evaluate fish larval survival dynamics within the different management basins of the Banana River restricted area, no motor zone, and open public water bodies.
- Ensure longevity of fish spawning sites and research needs.
- Encourage research on the impacts of large quantities of drift macroalgae, their relationship to nutrients, suspended solid concentrations, and nitrogen, with site specific characteristics (e.g., high total phosphorous and nitrogen concentrations in Turnbull Creek).
- Develop fish tagging programs, including sonic monitoring of movements within the refuge's lagoon system.
- Coordinate with the Service's South Florida Fisheries Resource Office on all aspects of fisheries management on waters adjacent to the refuge.

#### **4.d. Estuarine Wetlands**

*Discussion:* The refuge manages 90,917 acres in the estuary, wetlands, and impoundments. Managing NASA lands and waters at the Kennedy Space Center, which includes a national wildlife refuge and mosquito control activities, requires a highly coordinated effort. The majority of the estuarine wetlands of the refuge are now impounded as a result of the original mosquito control activities conducted between early-1950 and mid-1960. Additionally, many acres of marsh islands were modified by dragline ditching and draining for the purpose of mosquito control. Between 1963 and 1993, the refuge installed as many water control structures in the impoundments as budgets would allow. In 1994, the refuge entered into a partnership with the Brevard Mosquito Control District and the St. Johns River Water Management District to reconnect the impoundments to the estuary by installing culverts through the dikes. The purpose of reconnecting the impoundments to the lagoon system was to enhance and restore hydrological connection. It also provided a limited means of managing water depths and vegetative community types. The refuge continues to evaluate the estuarine wetlands to provide best management practices and to find opportunities to restore modified systems to more natural-like marshes. For additional information on estuarine wetland management and restoration, see Chapter IV of the Habitat Management Plan.

*Objective 4.d(1):* Within the 15-year life of the plan, restore approximately 1,200 acres across 10 targeted impounded wetlands to mimic natural hydrologic function.

*Discussion:* Specific impoundments have been identified for restoration to natural-like conditions. For additional information and to review an outline of identified restoration sites see Table 3 in the Habitat Management Plan, Appendix F.

*Objective 4.d(2):* Within the 15-year life of the plan, evaluate the potential to restore approximately 3,100 acres across 11 targeted impounded wetlands to mimic natural hydrologic function.

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*Discussion:* Specific sites have been identified that need to be further evaluated for restoration to natural-like conditions (designated To Be Evaluated for Restoration). This may require additional coordination efforts with partners and/or further evaluation on impacts to refuge programs. For additional information and to review an outline of identified sites, see Table 3 in the Habitat Management Plan, Appendix F.

*Objective 4.d(3):* Within seven years of plan approval, re-evaluate management of all impounded wetlands to ensure that best management practices are being used among impoundment habitats.

*Discussion:* The refuge has elevated the importance and the value of having more natural-like habitats with very ambitious upland and wetland restoration and enhancement programs. Over 550 wetland acres have been completely restored since 1996. The wetland restoration program has coordinated closely with the Service's Division of Fisheries, local mosquito control districts, Kennedy Space Center and St. Johns River Water Management District to accomplish restoration projects. The purpose is to promote native plant and animal communities and less altered hydrological fluctuations by completely restoring certain impoundment wetlands, dragline-ditched wetlands, and other altered wetlands to a more natural-like or enhanced condition. Where restoration is not an option and where reconnection of impoundments is not necessary or needed to meet stated migratory bird or other refuge objectives, the refuge would provide consideration to the reconfiguration of impoundments, including restoring/reconnecting some portions, while maintaining some portions as managed systems. For additional information on fisheries management, please refer to Chapter IV of the Habitat Management Plan (see Appendix F).

*Strategies:*

- Consider restoring impoundments to more natural-like wetlands and systems that are not actively managed for wildlife, while also ensuring that they do not become mosquito production issues.
- Consider using open marsh water management for controlling mosquitoes in impoundments and restored wetlands that may pose mosquito production issues that are in proximity (20 miles) to urban communities.
- Where full restoration is not an option, identify impoundments that could be managed with an open connection to the estuary to promote a more natural-like hydrological exchange.
- Continue to work with the St. Johns River Water Management District to identify appropriate restoration sites and alternative methods to increase hydrological exchange between marshes and the lagoon system.
- Within 10 years of the plan approval, inventory and characterize the invertebrate fauna in aquatic communities in 12 impoundments: three waterfowl impoundments, three rotational impoundment management (RIM) impoundments, three restored impoundments, and three open impoundments to further refine the restoration objectives.

*Objective 4.d(4):* Within the 15-year life of the plan, restore approximately 200 acres across six dredge impacted wetlands in Mosquito Lagoon to mimic natural-like hydrologic function and evaluate and identify an additional 100 acres of degraded ditched estuarine wetlands on other parts of the refuge that require restoration.

*Discussion:* Dragline-ditched wetlands include the natural marsh islands in the Mosquito Lagoon, including the ditched islands and interior wetlands previously identified by the refuge and Kennedy Space Center (National Aeronautics and Space Administration 2001) for mitigation. These include, but may not be limited to the islands west of V-3 and V-4 (e.g., Vann's Island), T-42, T-40 (i.e., Widgeon Bay and Cucumber islands), Banana Creek (C-20-C Island), and east Banana Creek's dredged wetlands.

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#### 4.e. Interior Wetlands

*Objective 4.e(1):* Within the 15-year life of the plan, evaluate and restore altered freshwater wetlands as integral parts of the landscape to mimic natural hydrologic function.

*Discussion:* In an effort to promote native plant and animal communities and less altered hydrological fluctuations, the refuge has identified potential freshwater wetlands that could be restored by filling historically ditched wetlands and returning other altered wetlands to a more natural-like or enhanced condition (National Aeronautics and Space Administration 2001). The interior wetlands are a key ecological feature of the refuge's landscape due to the coastal ridge and swale topographic and physical profile. The majority of these wetlands is not a part of wetland manipulations, but is managed passively within the confines of the upland blocks or the refuge burn units and integrated landscape features. Where hydrology has been altered and/or fire suppression has caused the wet swales to succeed to woody vegetation, mechanical manipulation or herbicides may be used for vegetation restoration. These wetlands would primarily be managed as part of the contiguous upland landscape. Where altered, efforts to restore natural features would be made to mimic natural conditions and functions. Additional information on interior wetlands is located in Chapter IV of the Habitat Management Plan (see Appendix F).

*Strategies:*

- Identify, enhance, and/or restore interior freshwater systems to a more natural-like system by filling ditches, reestablishing hydrological conditions, and restoring native plant communities in altered sites (e.g., citrus groves).
- Continue to work with Kennedy Space Center on planned restoration of freshwater systems on the refuge.
- Plug or fill ditches as necessary.
- Target overgrown swales in the scrub/shrub landscape for restoration to enhance scrub-jay habitat.

#### 4.f. Upland Habitat Diversity

*Objective 4.f(1):* Within the 15-year life of the plan, determine the appropriate matrix of upland vegetative communities necessary to support native wildlife diversity.

*Discussion:* The uplands of Merritt Island National Wildlife Refuge have a wide variety of vegetation types, both native and exotic. Table 1 lists eleven distinct native vegetation types along with three non-native species groups. The refuge's location on the central east coast of Florida (see Figure 1) contributes to this diversity, as does its subtropical climate. As one would expect, the wide range of upland habitats on the refuge support a great number of wildlife species. Included in this array are four federally listed species: the Florida scrub-jay (*Aphelocoma coerulescens*), the bald eagle (*Haliaeetus leucocephalus*), the eastern indigo snake (*Drymarchon couperi*), and the southeastern beach mouse (*Peromyscus polionotus niveiventris*). The uplands also support numerous other native species of birds, mammals, reptiles, and amphibians.

In order to maintain this diversity of plants and animals, active management is required. Although by necessity some management actions would be directed towards maintaining or improving habitat for a specific species, it is important to recognize where that particular patch of habitat exists in the overall landscape. The work done on one particular segment of refuge may well affect adjacent areas. For example, the filling of old drainage ditches when restoring citrus groves would change the amount of water reaching wetland areas. To make the situation even more complex, habitat

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management activities designed to enhance conditions for one species could sometimes make that particular area of the refuge less suitable for another species. One example concerns the trade offs between managing the scrubby flatwoods. On one hand, the removal of timber to create a shrubland habitat would increase the suitability of the area for the Florida scrub-jays. On the other hand, timber harvesting would reduce the amount of potential future bald eagle nest trees. One of the approaches to resolving this dilemma is to select a landscape that, in the past, has provided habitat for most, if not all, of the indigenous species on the refuge and direct management activities toward recreating this landscape scene. The refuge is fortunate in that aerial photography of Merritt Island from 1943 is available. These aerial photographs show how the landscape looked before the infrastructure and facilities developed to support Kennedy Space Center were constructed. It also gives management a view of how the vegetation was configured prior to excluding fire and planting citrus groves.

When analyzing these photographs, one finds that the refuge had much less forest present in the 1940s than present today. Hardwood hammocks have increased in size since the 1940s, and hardwoods have invaded the once grassy swales that are scattered throughout the upland areas. The pine component of the landscape has also increased. In many of the scrubby flatwoods areas, the pine stocking has increased from two to five stems per acre by ten or twenty fold. The imagery from the 1940s also shows that the shrubland areas were more open. Scrub oaks and palmetto stands were broken up by patches of sandy openings and herbaceous plants. These changes in the vegetation mix have most likely altered the suitability of habitat for many species. The reestablishment of the proportions of forests and shrublands that existed in the 1940s could help solve the conflict between eagle nesting strata and Florida scrub-jay habitat previously mentioned. Since sustainable populations of both species were present during that time period, it follows that by simulating that landscape, the refuge could continue to provide for both species in the future.

Another important component in maintaining the biological integrity of the refuge would be to ensure that fire is once again a viable ecological force. Although other factors are involved in the equation, the removal of fire from the landscape during the 1950s, 1960s, and 1970s was one of the more important management actions altering the landscape. The exclusion of fire not only contributed to the increase of forest cover, but also resulted in the closing in of the shrublands. In the absence of fire, many of the open areas within the shrublands disappeared, and the scrub oak and palmetto vegetation became tall and thick. Using prescribed fire would help open up the shrublands and reduce the extent and density of forests. Fire also increases diversity by creating a matrix of burned and unburned patches throughout the landscape. As burned vegetation grows back, a series of niches develops. By using fire periodically throughout the refuge uplands, the various serial stages could be provided in perpetuity.

Other means of altering the vegetation exist to create and maintain diversity in the uplands. Timber harvesting has been used successfully in the past. Mechanical treatment of overgrown scrub has also worked well. In addition, both the planting of scrub and the chemical treatment of woody vegetation in the upland swales show promise as management tools.

More detailed descriptions of these and other management options in the upland areas of the refuge are available in the refuge's Habitat Management Plan (see Appendix F).

#### **4.g. Herpetological Species**

*Objective 4.g(1):* Within five years of plan approval and every third year afterwards, monitor a minimum of 5 percent of the refuge for changes in herpetological population dynamics.

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*Discussion:* Terrestrial herps have been studied on the refuge since the 1970s. Long-term monitoring has provided a considerable existing data on the biodiversity of herps on the refuge (Seigel and Seigel 2000) and would be invaluable to detect long-term changes in the refuge's herpetofauna. Reptiles and amphibians are a critical component of refuge ecosystems. The biomass of reptiles and amphibians (herps) may exceed that of all other vertebrates in aquatic and terrestrial systems (Seigel and Seigel 2000). The ecological distribution of herps on Merritt Island Refuge would be a function of available habitat, which mostly reflects wetland communities. However, several species are specific to and use terrestrial habitats and certainly are linked to the coastal ridge and trough topography on the refuge. Exotic herp species are becoming potential threats to the refuge. Presently on the refuge, the brown anole (*Anolis sagrei*) may be displacing native species (Campbell 2000, Campbell and Echternacht 2002). The Cuban frog (*osteopilus septentrionalis*), which consumes smaller species, has been positively identified on the refuge. Additional research and monitoring is being conducted on gopher tortoise distribution, fecundity, and on upper respiratory tract disease.

*Strategies:*

- Work with existing partners and researchers to identify a habitat-based protocol for monitoring 5 percent of the refuge every third year for changes in reptile and amphibian populations.
- Encourage studies to continue to document long-term terrestrial reptile and amphibian populations on the refuge.
- Determine the relationship of herp populations to habitat conditions and management.
- Encourage studies of the relationship of snakes, habitat, and scrub-jay populations.
- Develop a baseline inventory of the forested uplands of the refuge to determine their importance for herpetological species.

#### **4.h. Citrus Groves**

*Discussion:* Citrus groves were present on Merritt Island when NASA acquired the land for the Kennedy Space Center. When the refuge was created by agreement with NASA, the management of the groves was turned over to the refuge. Originally there were about 2,000 acres of groves. At first the owners of the groves at the time of acquisition were allowed to continue to farm them. In the 1970s the groves were bid out to commercial citrus interests and operated under contract. The government received a percentage of the gross grove receipts. In the middle 1980s abnormally cold winters resulted in severe damage to the groves in the north end of the refuge. These were taken out of production and planted to native oaks and pines. By 1989, only 1,500 acres of groves were in production. A severe freeze occurred on Christmas of that year. The damage to the trees from this freeze, along with unfavorable economic conditions, led to the termination of commercial citrus operations on the refuge by the middle 1990s. An additional 26 acres of fallow citrus groves were added when lands in the Turnbull area were acquired. The current locations of citrus groves are shown in Figure 18.

Fallow groves soon become overgrown with Brazilian pepper, exotic grasses, and cabbage palms. The refuge has, in the past, submitted projects to restore fallow groves to native habitat. In the meantime, to prevent the entire grove area from becoming stands of exotic plants, the refuge entered into a Memorandum of Understanding with the Kerr Center for Sustainable Agriculture, a non-profit organization, to manage some of the citrus areas. Under this Memorandum of Understanding, the Kerr Center, which eventually became The Florida Research Center, manages 714 acres of citrus. The remaining 780 acres has been abandoned. The Florida Research Center's mission is to develop more environmentally benign methods for growing citrus. Reduced use of pesticides for insect and weed control and alternative methods of fertilization have been used to reduce the amount of chemicals used in citrus care-taking. The refuge's current agreement with the Florida Research Center expires in 2008.

Eventually the refuge plans to eliminate citrus groves, but it is unlikely that this would be accomplished within the 15-year life of this comprehensive conservation plan. For this time period, there are four possibilities for the groves (Table 10). Restoration to native habitat is planned for 301 acres. Of this, 80 acres on fallow groves on sandy soils is programmed to be converted to scrub vegetation (Figure 19). The other 221 acres, which are on more moist soils, would be restored to mesic hardwood hammock (Figure 20). Some additional acreage may be partially restored and used as corridors to connect some of the sub-populations of scrub-jays on the refuge. The second possibility is to use the groves for new construction of NASA facilities, rather than allowing that development in more natural areas. NASA has been and would continue to be encouraged to build facilities in fallow groves. Recently, NASA planned to put an industrial park in a grove area. However, the partnership with the State of Florida on this is progressing slowly and, at the present time, it is unlikely to occur in the near future.

At best, the first two options would only account for approximately a third of the groves. About 700 acres of the remaining acreage would continue to be farmed by either the Florida Research Center or some other entity. Although this does not fit exactly with the refuge’s overall mission, it is preferable to allowing these areas to become overgrown with exotic plants. Unfortunately, only economically viable groves could be farmed. The remainder would have to be allowed to go fallow. Exotics need to be controlled in these fallow areas. More details concerning the options for citrus grove management is available in Chapter VI of the Habitat Management Plan (see Appendix F).

*Objective 4.h(1):* Before 2008, evaluate the role of approximately 1,100 acres of citrus groves on the refuge to determine which groves are targeted for future restoration to native habitat and which groves are targeted for development by NASA. In the interim, the refuge will continue to manage these groves to limit the presence of exotic, invasive, and nuisance species.

*Objective 4.h(2):* Within the 15-year life of the comprehensive conservation plan, restore 200 targeted acres of abandoned citrus groves to native habitat: 120 acres for Florida scrub-jay habitat on sand ridge sites and 80 acres for neotropical migratory birds in the more mesic areas.

**Table 10. Present and future disposition of citrus groves**

Group	Total Acres	Present Disposition		Future Disposition			
		Farmed	Fallow	Farmed	Restored	Return to NASA	Not Determined
1	231.9	199.5	32.4	199.5	0.0	0.0	32.4
2	285.0	262.2	22.8	262.2	0.0	0.0	22.8
3	313.4	29.0	284.4	0.0	0.0	0.0	313.4
4	369.4	223.6	145.8	223.6	0.0	0.0	145.8
5	526.0	0.0	529.0	0.0	301.5	80.1	17.4
TB*	26.3	0.0	26.3	0.0	0.0	0.0	26.3
AB**	178.9	0.0	178.9	0.0	0.0	0.0	178.9
<b>Total</b>	<b>1930.9</b>	<b>714.3</b>	<b>1219.6</b>	<b>685.3</b>	<b>301.5</b>	<b>80.1</b>	<b>737.0</b>

\*TB = Turnbull Area

\*\* Acres located in the MINWR Acquisition Boundary, but not yet managed by the refuge.

Figure 18. Locations of Citrus Groves

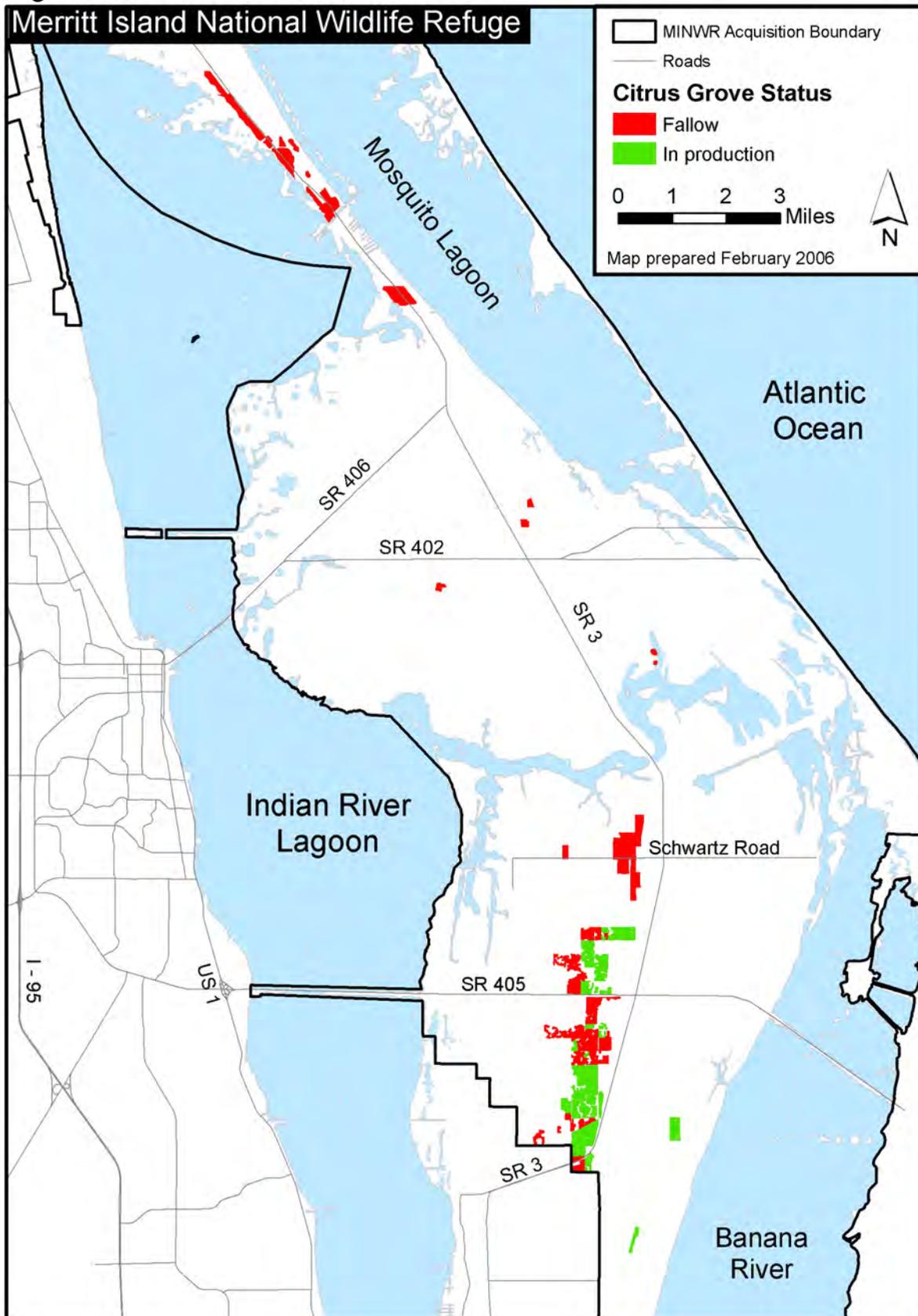


Figure 19. Fallow Groves Selected for Restoration to Florida Scrub-jay Habitat

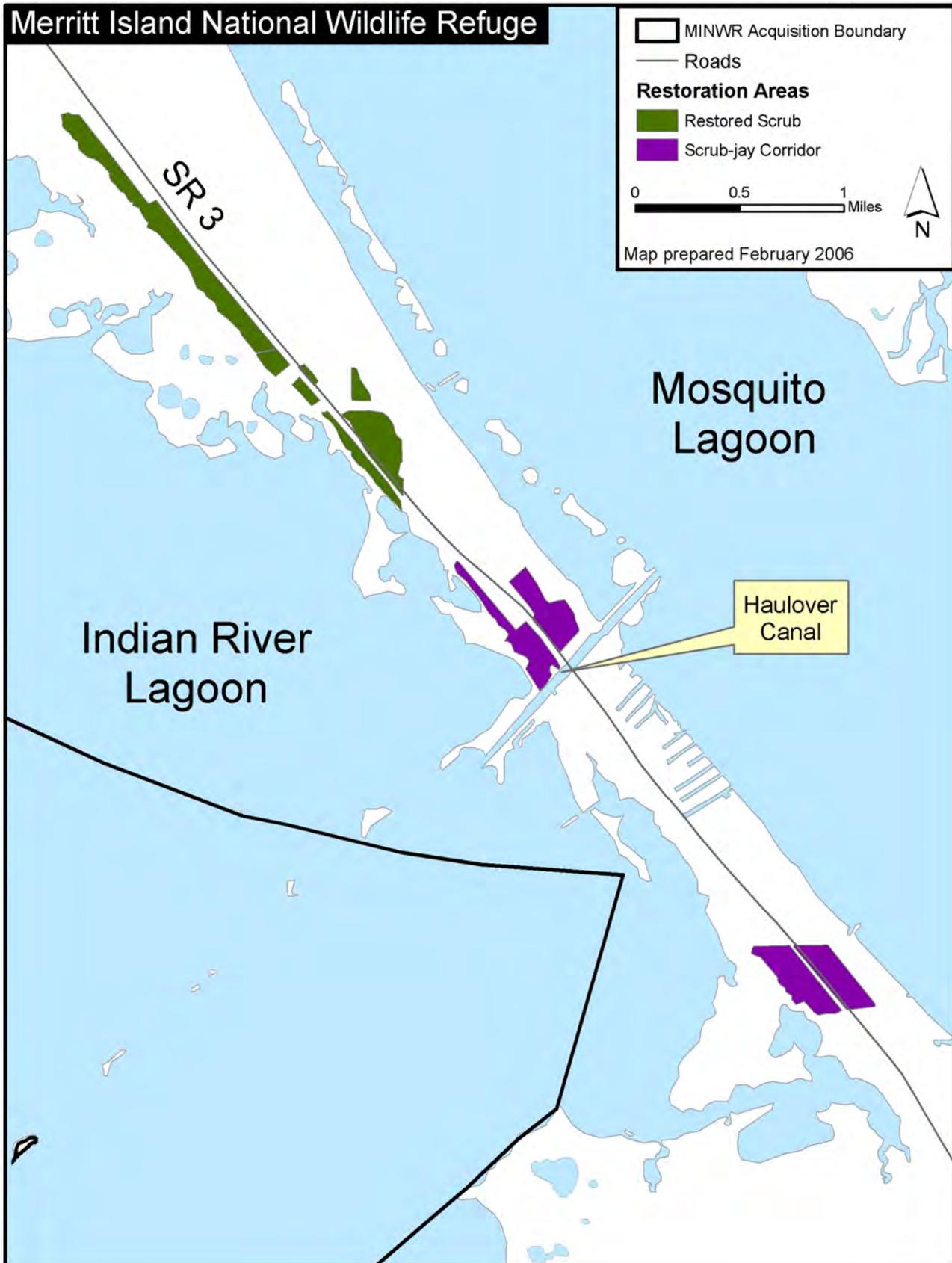
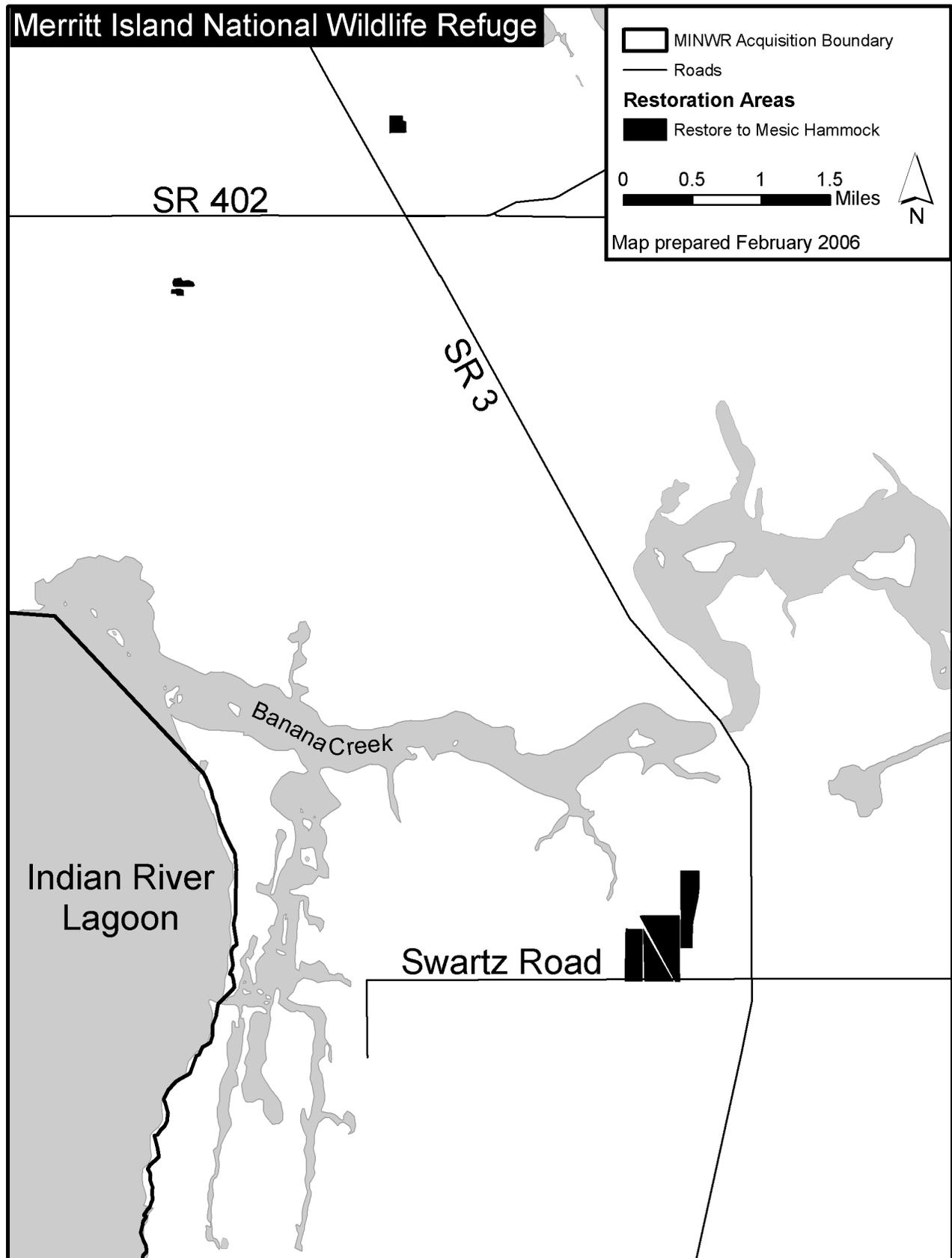


Figure 20. Fallow Groves to be Restored to Mesic Hammock



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#### 4.i. Roadways

*Objective 4.i(1):* Minimize the loss of wildlife due to vehicular impacts.

*Discussion:* The refuge has several former state roads (i.e., routes 3, 402, and 406) that provide access to the area for the public, as well as for employees of Kennedy Space Center, Cape Canaveral Air Force Station, Canaveral National Seashore, and the refuge. With approximately 15,000 employees at the Space Center, traffic along these roads is substantial, particularly during shift changes. The refuge has observed that shift changes that occur during dusk and dawn hours could seriously impact wildlife. Road kills (e.g., river otters, raccoons, opossums, hogs, deer, armadillos, and various reptiles and birds) are common. Scrub-jays are especially vulnerable to vehicular collisions. This not only poses a threat to public safety and personal property, but it also greatly impacts refuge wildlife. Secondary impacts then occur from the abundance of road kills and carrion left on roadways, including vehicles striking animals that are feeding on carrion (e.g., bald eagles and vultures). Vulture population numbers (e.g., black and turkey vultures) at the Space Center appear to be excessively high and the road kill carrion may be supporting an abnormally large resident population. The vultures in turn cause damage to personal property, buildings, and equipment. Further, health concerns may exist related to excrement left at roost sites and on or around buildings and facilities used by vultures as roosting and loafing areas. The refuge would like to find ways to reduce road kills and reduce the adverse secondary impacts from the abundance of carrion on roadways.

*Strategies:*

- Develop an educational program for the Space Center and Cape Canaveral Air Force Station employees to increase awareness and understanding regarding the impacts of road kills (e.g., from speeding) to wildlife and to the Space Center.
- Close State Route 406 from State Route 402 to State Route 3 to all nighttime traffic.
- Develop and install appropriate warning signs in sensitive wildlife crossing areas.
- Work with the Space Center to reduce speed limits in sensitive wildlife crossing areas.
- Develop baseline data to measure mortality on refuge roadways that would compliment existing information and document wildlife mortality.
- Seek additional ideas to assist in reducing road strike hazards.
- Evaluate habitat management activities adjacent to roadways (e.g., citrus groves).
- Work with the Florida Fish and Wildlife Conservation Commission to develop upland hunts to better manage a growing white-tailed deer population and to help control the feral hog population along State Route 3 north of Haulover Canal.

#### *RESOURCE PROTECTION*

Resource protection goals of the refuge address the existing acquisition boundary, a minor boundary expansion, and cultural resources.

##### **Resource Protection Goal 1: Existing Acquisition Boundary**

*Acquire or obtain management authority for the east central Florida coastal and estuarine natural resources found within the refuge's existing acquisition boundary.*

*Discussion:* Figures 11 and 12 provide the land status for the refuge, especially by identifying the remaining inholdings in the Turnbull Creek area.

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### **1.a. Existing Acquisition Boundary**

*Objective 1.a(1):* Throughout the life of the plan, work with the State of Florida, Brevard and Volusia counties, and other partners to complete acquisition of the ±1,480.59 acres of inholdings within the refuge boundary area known as Turnbull Creek.

*Discussion:* These inholdings are part of the refuge's approved acquisition boundary and are part of a multi-partner effort to protect these lands in perpetuity. The Service, Brevard County, Volusia County, and St. Johns River Water Management District have all purchased lands in and around the Turnbull Creek area.

*Strategies:*

- Prioritize the purchase of the Munson property (Volusia County parcel number 43-19-34-02-00-0031). Once acquired, convert it to a residence for a refuge law enforcement officer.
- Annually contact the owners of each inholding tract to verify the status and to express the Service's interest in acquiring these properties.
- Attempt to obtain a first right of refusal agreement on each tract.
- Encourage the tract owners to participate in the Partners for Wildlife Program.
- Work with the partners for the refuge to manage all properties acquired within the Turnbull Creek area.

### **Resource Protection Goal 2: Minor Boundary Expansions**

*Conduct minor boundary expansions of the refuge's acquisition boundary to restore former refuge lands, to include lands currently under management and/or service ownership, and to address proposed lease changes.*

#### **2.a. Bill's Hill**

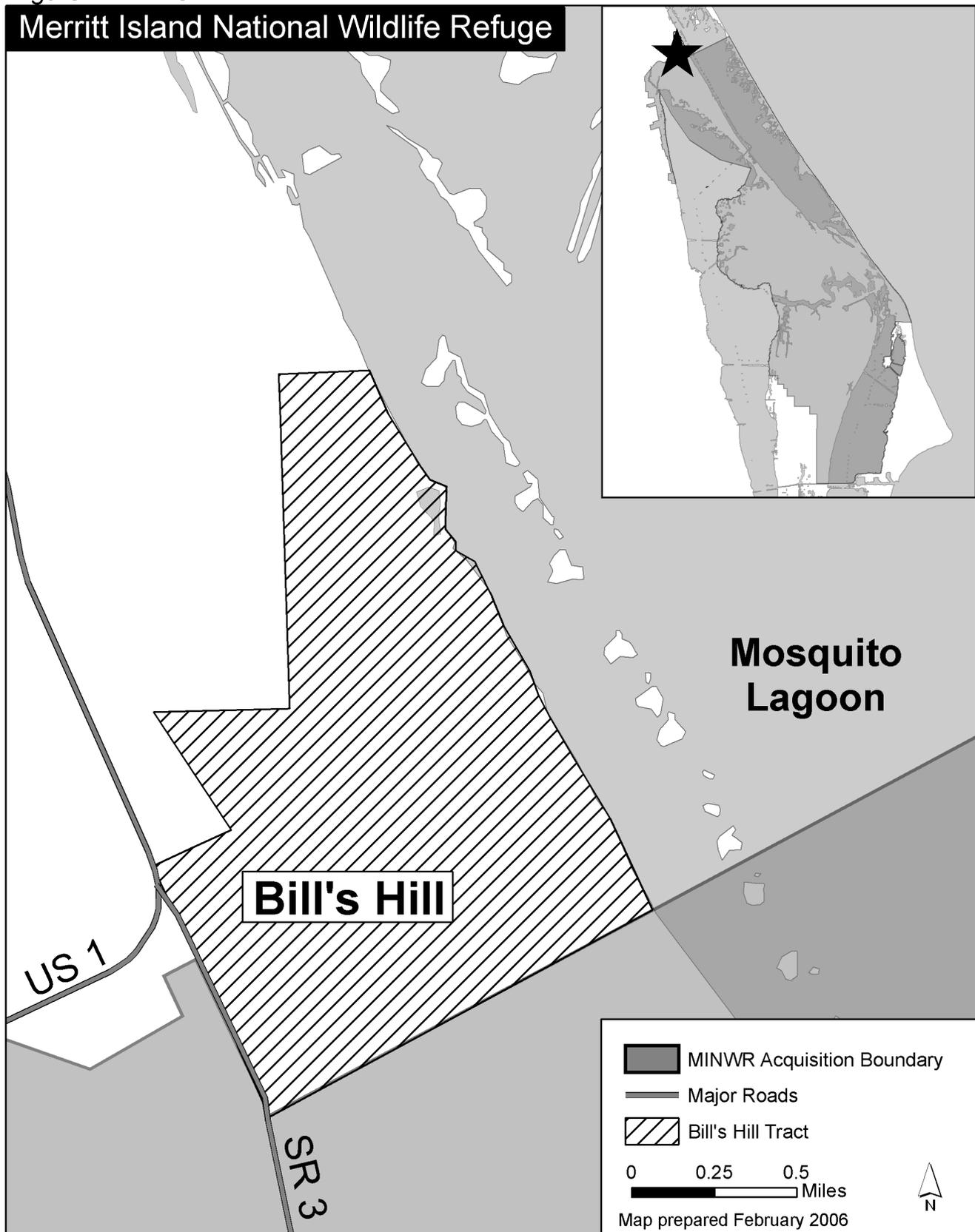
*Objective 2.a(1):* Work with Canaveral National Seashore to obtain management authority or fee title ownership to the Bill's Hill property.

*Discussion:* Although previously managed as part of the refuge, the Bill's Hill property (see Figure 21) was transferred by NASA in fee simple to the National Park Service as a site for a future visitor center, based on the language in the congressional legislation that established the Seashore. Bill's Hill is located half way between the north and south districts of the Seashore along U.S. Highway 1. Over time, the concept of a Seashore visitor center at this site has diminished. The property contains approximately 1,088 acres of scrubby flatwoods that are contiguous to the refuge's Habitat Management Unit 1 (see Chapter IV of the Habitat Management Plan, CCP Appendix F). This acreage could be easily added into the management unit with specific habitat objectives. The National Park Service is currently conducting its own planning effort to update its General Management Plan. If it concludes that the property would not have a public use objective, then the property could be transferred to the refuge. This action would require a minor expansion to the refuge's currently approved acquisition boundary.

#### **2.b. Lands Currently Under Refuge Management**

*Objective 2.b(1):* Modify the existing refuge management boundary to reflect current agreements with NASA and the State of Florida and to include lands currently under refuge management.

Figure 21. Bill's Hill Tract



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*Discussion:* This objective is administrative in nature. As part of the refuge, the Service currently manages small pieces of property that are outside of the refuge's approved acquisition boundary. Often this is a result of a land acquisition, where the tract acquired includes property within and outside of the approved acquisition boundary.

### **2.c. Tank Island**

*Objective 2.c(1):* Seek approval from the State of Florida to amend the existing lease agreement for Tank Island to include the water bottoms out 450 feet from shore to create a protective buffer for this productive rookery island.

*Discussion:* The refuge has a lease agreement with the State of Florida to manage a spoil island known locally as Tank Island (Figure 22). The lease is No. 4163 and was executed on March 10, 1999. The Island has been a historic rookery for multiple species of wading birds. Prior to 1999, human activity, such as camping and shore fishing, caused the birds to abandon the Island. After it became part of the refuge and was closed to public access, the birds returned. The current lease agreement places refuge management jurisdiction at the mean high water line. A recent study by Rodgers and Schwikert (2002) indicates various set-back distances to prevent disturbance to the birds. The refuge should work with the State of Florida to develop an amendment to the lease to enable the refuge to enforce a closure zone out to 450 feet around the Island. This action would also require a minor expansion of the refuge's approved acquisition boundary.

### **Resource Protection Goal 3: Cultural Resources**

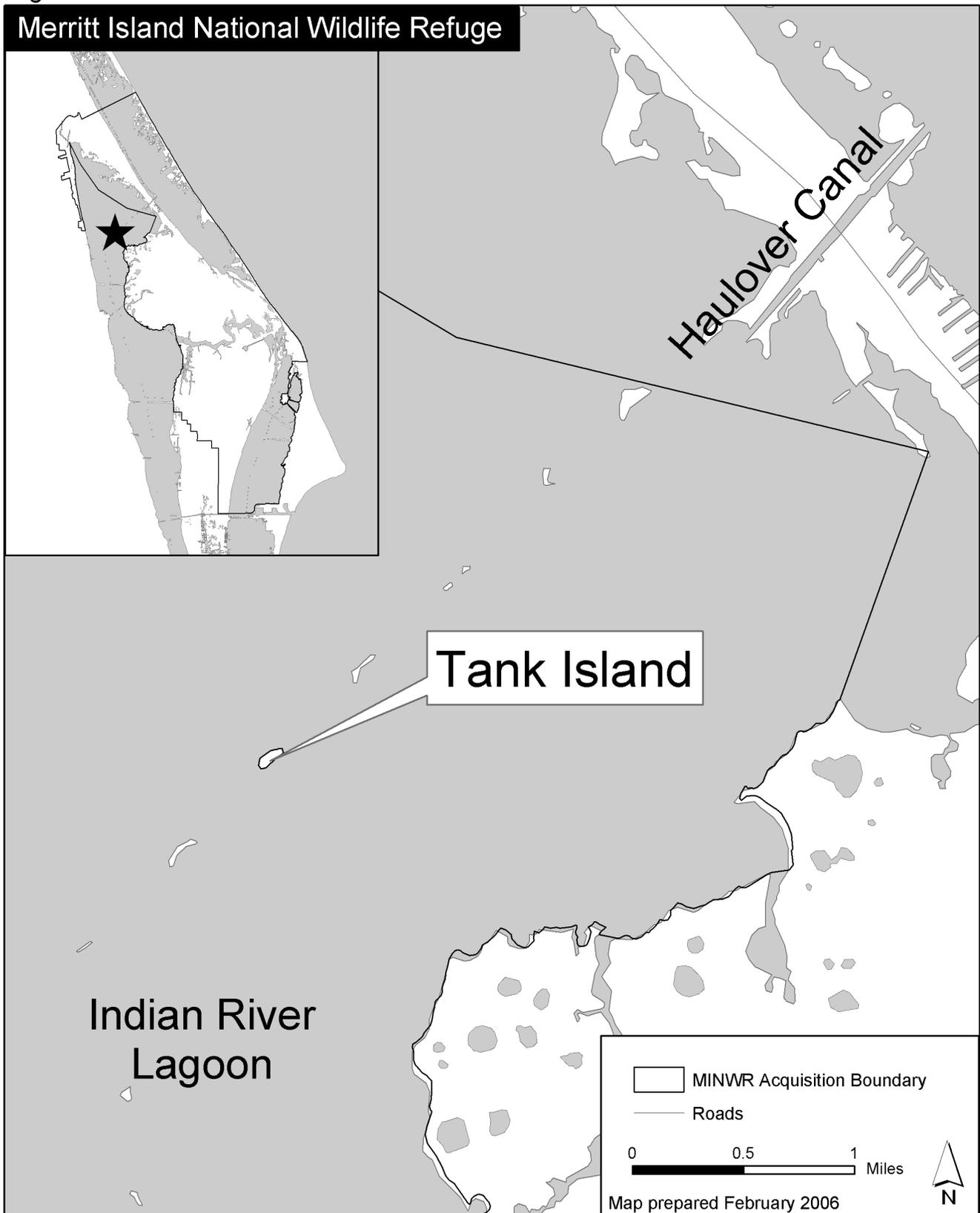
*Maintain and preserve in perpetuity the archaeological and historical resources of the refuge exemplifying the natural and cultural history of coastal Florida and the north Indian River Lagoon system dating from the archaic period to the present.*

*Discussion:* Over much of the refuge, cultural resources are protected by the Kennedy Space Center, Canaveral National Seashore, and/or the refuge. Cultural resources on federal lands are protected under several acts and agency policy. Before any of the three agencies could commence new construction, an archaeological assessment must be completed. In the overlap area with Canaveral National Seashore, the National Park Service takes the lead in managing cultural resources and NASA takes the lead in the operational areas of Kennedy Space Center. Outside of these areas, the refuge is the lead agency for cultural resource protection.

The refuge would collaborate with the other agencies to: review literature to document known and unknown cultural sites; consult with the Seminole and Miccosukee tribes when artifacts are discovered; consult with the State Historic Preservation Office, local historians, and the Regional Archaeologist when new sites are discovered or known sites are found disturbed; and add any new discoveries to the cultural resources' database. During patrols, law enforcement officers would routinely check known sites for damage or for signs of vandalism or disturbance.

Within the newly acquired refuge lands which fall outside the Kennedy Space Center, cultural resources are not as well documented. The refuge would conduct literature searches and would talk with the State Historic Preservation Office, local historians, and other agencies to document the location of known sites, adding any new discoveries to the database. Within the 15-year life of the plan, the refuge would seek funding to complete a cultural resources assessment on the acquired Turnbull Creek lands and make it a regular practice to visit these sites during routine law enforcement patrols.

Figure 22. Tank Island



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### 3.a. Kennedy Space Center Overlay

*Objective 3.a(1):* Locate or relocate and protect all known cultural resource sites found within the refuge's overlay of Kennedy Space Center within five years of plan approval.

*Discussion:* Although several archaeological studies have been conducted by NASA and National Park Service on and around the refuge, several cultural resource sites have not been able to be relocated. The refuge would continue to work with NASA and the Park Service to protect known sites.

*Strategies:*

- Coordinate with the Regional Archaeologist.
- Coordinate with appropriate staff from Canaveral National Seashore and Kennedy Space Center.
- Coordinate with Seminole and Miccosukee Native American tribes, especially when artifacts are discovered or turned in to the refuge.
- Utilize key refuge staff with detailed knowledge before these staff retire or leave the refuge.
- Develop a secured cultural resources' GIS database.
- Develop a protection program.
- Develop a regular patrol and enforcement program for the refuge's cultural resource sites within one year of plan approval.

### 3.b. Turnbull Creek Area

*Objective 3.b(1):* Within five years of plan approval, identify and protect any cultural resource sites in the refuge's Turnbull Creek area.

*Discussion:* Little is known about the cultural resources that may exist in the properties of the Turnbull Creek area. To date, the Service has not conducted any studies or assessments on these properties.

*Strategies:*

- Conduct literature reviews.
- Coordinate with the Regional Archaeologist.
- Coordinate with appropriate staff from Canaveral National Seashore, Kennedy Space Center, Brevard and Volusia counties, and Oak Hill.
- Coordinate with Seminole and Miccosukee Native American tribes, especially when artifacts are discovered or turned into the refuge.
- Consult with the State Historic Preservation Officer.
- Consult with the local historical society.
- Add any qualifying sites to the refuge's cultural resources' database and protection program.
- Develop a protection program.
- Develop a regular patrol and enforcement program for the refuge's cultural resource sites within one year of plan approval.

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## Visitor Services

The vision of the National Wildlife Refuge System includes a strong people component, where visitors find national wildlife refuges welcoming, safe, and accessible, with a variety of opportunities to enjoy and appreciate fish, wildlife, and plants. The National Wildlife Refuge System Improvement Act sets forth hunting, fishing, wildlife viewing, wildlife photography, environmental education, and interpretation as priority uses of the Refuge System. These wildlife-dependent uses are to be accommodated when and where appropriate and compatible with the purpose(s) of a refuge. The recreational activities occurring on the refuge, by policy, cannot materially interfere with or detract from the refuge's purposes. Compatibility determinations have been completed for all approved recreational activities and are found in Appendix E of this plan. To ensure a quality wildlife-dependent recreation experience, while achieving a wildlife first mandate, a high level of coordination must occur between visitor programs and other refuge management activities. Figure 23 outlines the existing and proposed visitor facilities.

A Visitor Services Plan has been developed and included as part of this comprehensive conservation plan. This section provides goals, objectives, and some discussion of the recreational activities and visitor services planned for the next 15 years. Readers looking for a more detailed discussion of these topics should refer to the Visitor Service Plan found in Appendix G.

### **Visitor Services Goal 1: Welcome and Orient Visitors**

*Visitors will feel welcome and find accurate, timely, and appropriate orientation material and information on visitor facilities, programs, and management activities.*

#### **1.a. Information**

*Objective 1.a(1):* Within two years of plan approval, at least 75 percent of sampled adult visitors who stop at the Visitor Center or entrance kiosks will find appropriate and sufficient information to guide themselves to refuge facilities as determined by regular sampling.

*Objective 1.a(2):* Within two years of plan approval, at least 75 percent of sampled adult visitors who stop at the Visitor Center will indicate, through regular sampling, that they received the information they needed and were treated in a courteous and friendly manner.

*Objective 1.a(3):* Within five years of plan approval, at least 25 percent of adult visitors who stop at Kennedy Space Center's Visitor Center will indicate through regular sampling that they received information about the refuge and could find refuge visitor facilities.

### **Visitor Services Goal 2: Provide Quality Hunting Opportunities**

*Hunters will enjoy quality hunting experiences that lead to support for refuge management.*

#### **2.a. Waterfowl Hunting**

*Discussion:* As identified in the National Wildlife Refuge System Improvement Act, hunting is identified as one of the six priority wildlife-dependent recreation uses. Hunting must be appropriate and compatible with the refuge's purposes. To ensure a quality wildlife-dependent recreation experience, while achieving a wildlife first mandate, the number of individuals participating in the activity and conflicts among users may be limited by (1) establishing special regulations, (2) zoning and separating different uses, (3) permitting uses at certain times of the year, and (4) establishing quotas. Other situations exist where future refuge closures or restrictions may be warranted. Examples of these situations include, but are not limited to, protection of endangered species,

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protection of colonial bird nesting colonies or roost sites, establishment of sanctuaries areas for waterfowl, closure of a hunt due to population declines, and safety of other visitors.

Waterfowl hunting is well established on the refuge, dating back to the early 1960s when the refuge was first established. Deer and feral hog hunts are a new proposed use, but are a management action to help control populations. Both animals are responsible for numerous traffic accidents and impact Space Center employees, especially individuals working the late shifts. In the case of hogs, the animal is feral and competes with native mammals, impacts habitats by up-rooting vegetation, and may contribute to the spread of noxious exotic plants. This hunt would only be proposed for lands north of Haulover Canal. Alligator hunts would be evaluated, and if deemed necessary, may be used to control populations. The deer/hog and alligator hunts would be administered in cooperation with the Florida Fish and Wildlife Conservation Commission.

See Figure 24 for the expanded waterfowl hunt areas.

*Objective 2.a(1):* At least 75 percent of the sampled waterfowl hunters who go through the waterfowl hunt check station annually will understand and support refuge wetland management and waterfowl hunting programs.

*Objective 2.a(2):* Through annual critiques of the waterfowl hunting program, improvements will be made where waterfowl hunters will have minimal conflicts with other visitors, experience no hunting-related safety incidents, experience hunter densities not exceeding one party per 40 acres, and regularly have the opportunity to see and harvest waterfowl.

## **2.b. Upland Game Hunting**

*Objective 2.b(1):* Within two years of plan approval, the refuge will work with the Florida Fish and Wildlife Conservation Commission to develop a deer and feral hog hunt program.

*Objective 2.b(2):* At least 75 percent of the sampled upland game hunters who go through the upland hunt check station annually will understand and support the refuge's fire, forestry, and upland game hunting programs.

*Objective 2.b(3):* Annually, deer and feral hog hunters will have minimal conflicts with other visitors, will have no hunting-related safety incidents, will average hunter densities not exceeding one hunting party per 100 acres, and will have the opportunity to see and harvest deer and feral hogs.

*Discussion:* See Figure 25 for the proposed deer and feral hog hunt area.

**Figure 23. Existing and Proposed Visitor Facilities**

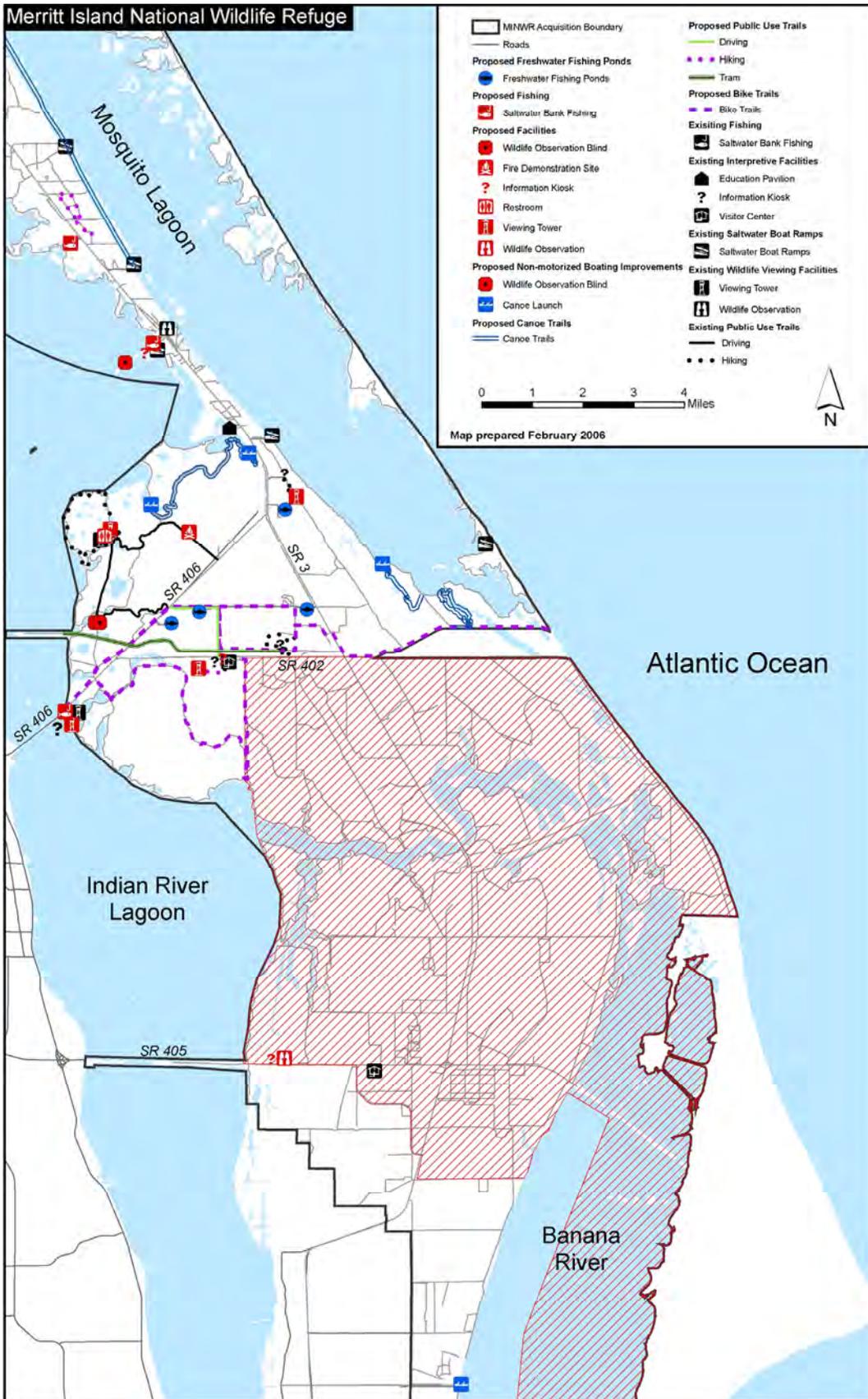


Figure 24. Proposed Additions to Waterfowl Hunt Areas

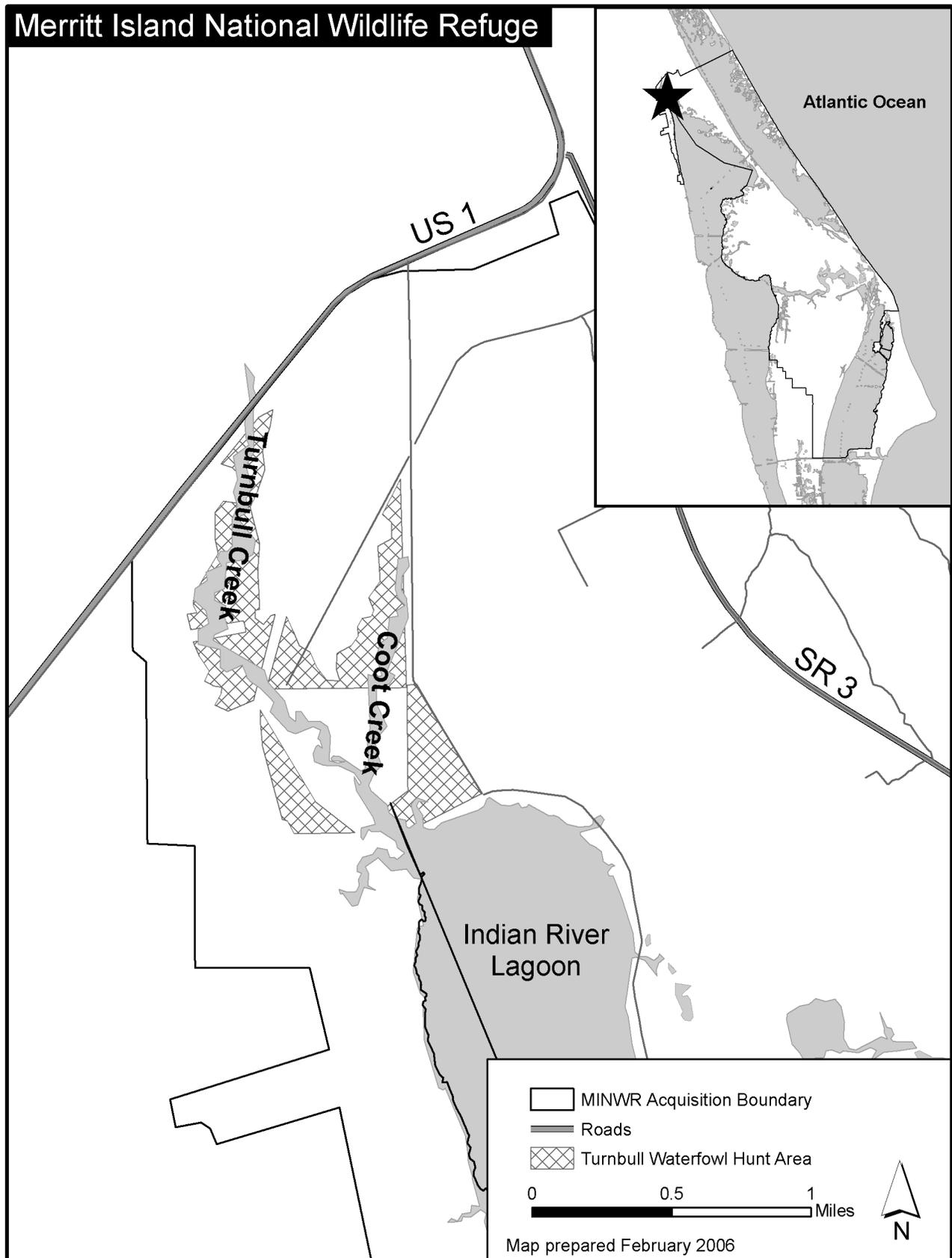
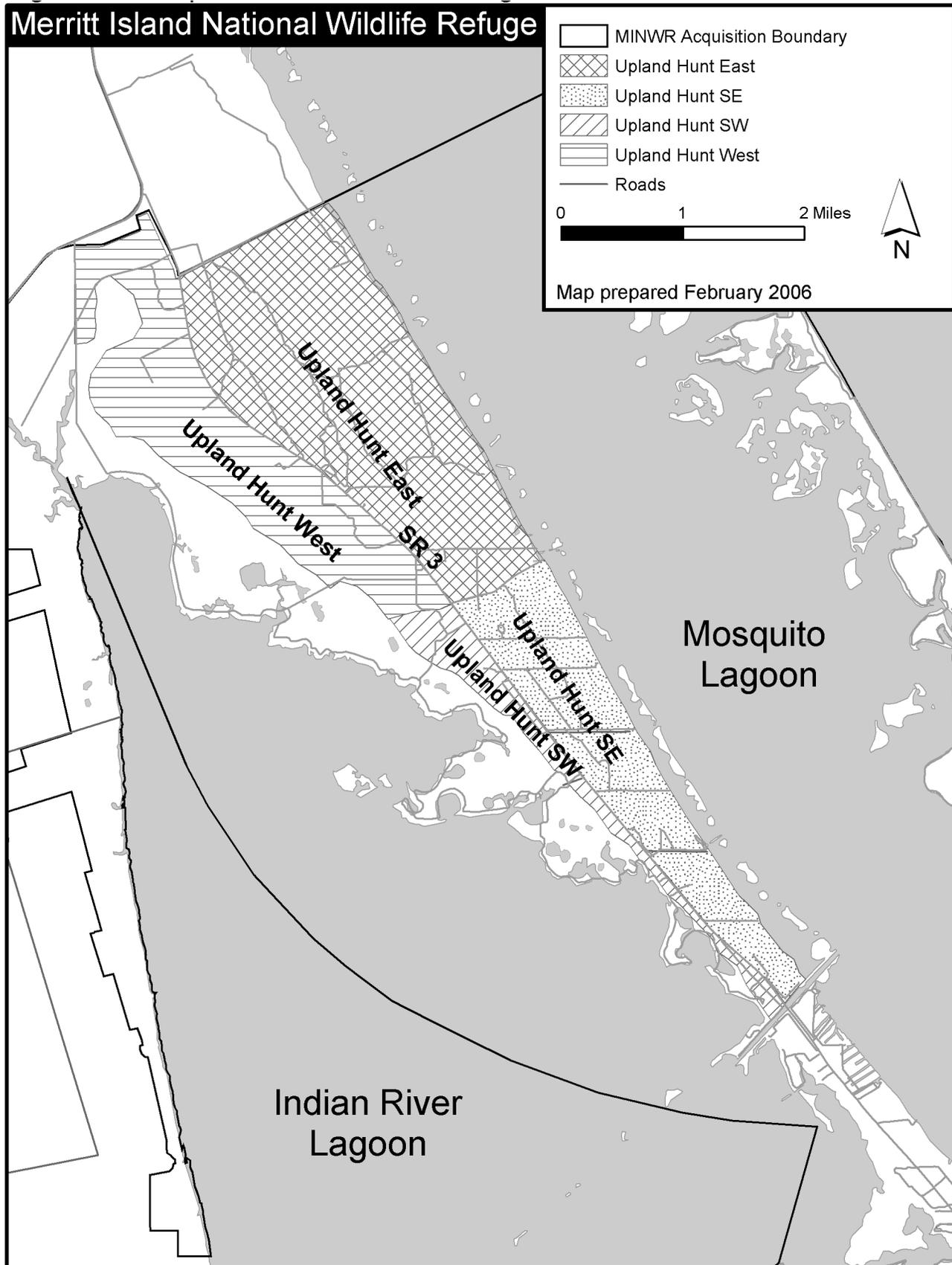


Figure 25. Proposed Deer and Feral Hog Hunt Area



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## **2.c. Alligator Hunting**

*Objective 2.c(1):* Within the 15-year life of the plan, evaluate the feasibility of developing a limited alligator hunt program in cooperation with the Florida Fish and Wildlife Conservation Commission.

*Discussion:* Before alligator hunting could be approved for the refuge, a compatibility determination would need to be prepared.

### **Visitor Services Goal 3: Provide Quality Fishing Opportunities**

*Members of the fishing public will enjoy their fishing experiences, display ethical behavior, and support refuge management.*

*Discussion:* Fishing is identified in the National Wildlife Refuge System Improvement Act as a priority recreational use and has been determined to be compatible (see Appendix E). To ensure a quality recreation experience and to meet the wildlife first mandate, this activity is regulated through (1) establishing special regulations, (2) zoning different uses, (3) regulating boat speeds and equipment, and (4) establishing closed areas. Other restrictions or refuge closures may be warranted to protect endangered species, wintering waterfowl, and colonial bird nesting colonies or roost sites, including closing areas due to habitat impacts, over-fishing, safety of visitors, and whether resources are available to administer the program.

Flats fishing is a use that has increased rapidly over the last 10 years due to the development of boats which could operate in shallow water and due to the population growth in central Florida. Flats fishing boats have caused impacts to the shallow water grass flats through prop scarring and the level of use has affected the quality of the fishing experience. Pole and Troll zones have been established in about 3,000 acres of the 20,000-acre Mosquito Lagoon as an adaptive management action to improve the quality of the fishing experience and to decrease habitat impacts. Regulations within the zones may be modified to achieve the desired results. The Pole and Troll zones have been met with widespread public support from the fishing and environmental communities. If this strategy proves successful, additional zones may be designated in other shallow water portions of the refuge.

## **3.a. Estuary Flats Fishing**

*Objective 3.a(1):* Within five years of plan approval, a quality flats fishing program will be developed that is supported by at least 75 percent of the regularly sampled fishing public, allowing users to see and harvest fish, and ensures that minimal conflicts occur between fishermen or with other users of the lagoon system.

## **3.b. Estuary Bank Fishing**

*Objective 3.b(1):* Within five years of plan approval, bank fishing improvements will be made at three locations, which will allow users of all abilities to enjoy saltwater fishing on the refuge.

## **3.c. Freshwater Fishing**

*Objective 3.c(1):* Within five years of plan approval, enter into a partnership to enhance freshwater fishing opportunities, improving four freshwater ponds that will allow members of the fishing public to harvest fish and minimize conflicts with other users.

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**Visitor Services Goal 4: Provide Quality Wildlife Observation and Photography Opportunities**

*Wildlife observers and photographers of all abilities will enjoy and value the diversity of refuge wildlife and will support efforts to maintain high-quality wildlife habitat.*

**4.a. Wildlife Viewing Improvements**

*Objective 4.a(1):* To improve wildlife viewing on Black Point Wildlife Drive, within three years of plan approval, develop and maintain two 10-person wildlife viewing observation blinds with two spotting scopes and create needed vegetative buffers.

*Objective 4.a(2):* To improve accessibility, within 10 years of plan approval, develop and maintain Americans with Disabilities Act-approved restrooms and a viewing tower on Black Point Wildlife Drive.

**4.b. Other Viewing Enhancements**

*Objective 4.b(1):* To enhance wildlife viewing and photography opportunities, by 2014, three new trails will be developed and one trail expanded, including: a connecting road between the Visitor Center and Black Point Wildlife Drive, Pine Flatwoods Trail, Huntington Road Trail, and an extension to the Visitor Center Trail.

**4.c. Non-Motorized Boating Improvements for Wildlife Viewing**

*Objective 4.c(1):* Within five years of plan approval, wildlife viewing and fishing access will be enhanced by developing canoe/kayak trails or launch sites in ten locations.

*Objective 4.c(2):* Within five years of plan approval, enhance wildlife viewing of a wading bird rookery through the development of a viewing complex that includes a kiosk and canoe/kayak launch facility on the northwest corner of Haulover Canal and a dock and observation blind near Mullet Head Island.

**Visitor Services Goal 5: Environmental Education**

*Provide quality, appropriate, and compatible wildlife-dependent environmental education opportunities to promote understanding and awareness of the value of the refuge, its natural resources, and the human influences on ecosystems.*

**5.a. Environmental Education**

*Objective 5.a(1):* Within two years of plan approval, provide two teacher workshops per year for north Brevard County teachers to acquaint them with refuge environmental educational curriculums.

*Objective 5.a(2):* Within two years of plan approval, recruit and train 5-10 volunteers to independently assist teachers in conducting the environmental education programs.

*Objective 5.a(3):* Within five years of plan approval, at least 30 percent of north Brevard grades 4-9 will participate in curriculum-based environmental education programs that focus on the importance of habitat diversity.

*Objective 5.a(4):* Within five years of plan approval, develop four curriculum-based environmental education programs that are geared to four habitats of the refuge: lagoon waters, wetlands, scrub, and pine flatwoods.

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## **6. Interpret Key Resources**

### **Visitor Services Goal 6: Interpretation**

*Visitors of all abilities will enjoy their visits and increase their knowledge, understanding, and support for the refuge and the National Wildlife Refuge System.*

#### **6.a. Visitor Center**

*Objective 6.a(1):* Within five years of plan approval, at least 75 percent of adult visitors regularly sampled at the Visitor Center will be able to identify that they are visiting a national wildlife refuge where wildlife comes first.

#### **6.b. Interpretive Programs**

*Objective 6.b(1):* Within five years of plan approval, increase the number of interpretive programs by 25 percent over 2005 levels.

*Objective 6.b(2):* After attending a program, at least 75 percent of adult visitors sampled will be able to successfully identify one wildlife management technique used by the refuge or identify the connection between managing habitat and wildlife populations.

#### **6.c. Interpretive Trails**

*Objective 6.c(1):* Within five years of plan approval, at least 75 percent of adult visitors sampled at Black Point Wildlife Drive will be able to successfully identify water level management as a positive factor in managing for migratory birds.

*Objective 6.c(2):* Within five years of plan approval, at least 75 percent of adult visitors sampled at Black Point Wildlife Drive, Scrub Ridge Trail, or Pine Flatwoods Trail will be able to successfully identify the positive wildlife and habitat values of prescribed burning in the coastal ecosystem.

#### **6.d. Manatee Observation Deck**

*Objective 6.d(1):* Within five years of plan approval, at least 75 percent of adult visitors regularly sampled at the Manatee Observation Deck will be able to successfully identify the positive benefits and importance of manatee protection.

#### **6.e. Guided Interpretive Tours**

*Objective 6.e(1):* Within 10 years of plan approval, increase interpretive opportunities by providing a guided tour using an alternative transportation system, such as a tram or train.

#### **6.f. Kennedy Space Center Visitor Complex**

*Objective 6.f(1):* Within five years of plan approval, at least 75 percent of sampled adult visitors who have taken NASA's Kennedy Space Center bus tour will be able to identify that Merritt Island National Wildlife Refuge as part of the National Wildlife Refuge System where wildlife comes first.

### **Visitor Services Goal 7: Recreation**

*All public use activities will be appropriate and compatible and visitors will support priority public use activities that minimize wildlife and habitat disturbance.*

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*Discussion:* The National Wildlife Refuge Improvement Act identifies six specific high-priority wildlife-dependent recreation uses. They are hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation. Fundamental to the provisions of these uses are viable and diverse fish and wildlife populations and the habitats upon which they depend. These priority uses, along with all other uses, must be appropriate and compatible with the refuge purposes and the mission of the National Wildlife Refuge System.

To ensure a quality wildlife-dependent recreational experience, while achieving a wildlife first mandate, the number of refuge uses is limited and certain actions are taken to limit conflicts between users by (1) zoning activities; (2) designating trails, dikes roads, structures, and sites for specific recreation activities; (3) establishing closed areas to provide wildlife sanctuaries; (4) establishing special regulations; (5) minimizing conflicts with other management or visitor programs; and (6) controlling or prohibiting certain recreational activities that disturb wildlife. Several current uses would be affected with the implementation of this plan.

Jogging does not meet the definition of a wildlife-dependent recreation activity and would be eliminated as an approved activity. Bicycle riding on refuge walking trails presents a safety concern for other trail users and would be eliminated. Bicycle riding would be restricted to established roads where it does not present a safety concern to bicyclists or motorists. The refuge would work with partners to establish three bicycle trails for wildlife viewing where safety issues could be reduced and wildlife impacts eliminated. When one or more of these bicycle trails are established, bicycle riding on Black Point Wildlife Drive would be eliminated.

Other uses would be studied and adaptive strategies developed to deal with activities that cause wildlife disturbance, such as activities or vehicles that generate loud noises and disturb wildlife. The area of greatest concern is on Black Point Wildlife Drive, where the potential for visitors versus wildlife conflicts are greatest. Strategies such as developing “stay in your vehicle zones,” developing new signs which stress proper wildlife viewing etiquette, establishing vegetative screens, and developing other strategies to reduce the potential for wildlife disturbance may be implemented. These and other adaptive strategies may be used at other locations if wildlife conflicts arise.

### **7.a. Ethical Wildlife Viewing - Delivering the Message and Correcting Problems**

*Objective 7.a(1):* Over the life of the plan, the Visitor Center will provide current information related to appropriate and compatible recreational activities and will help visitors understand that their behavior can reduce wildlife disturbance.

*Objective 7.a(2):* Within two years of plan approval, work a wildlife viewing etiquette message into the interpretive materials for Black Point Wildlife Drive.

*Objective 7.a(3):* Within two years of plan approval and periodically thereafter, develop signs and update brochures to inform the public of wildlife disturbances and prohibited activities.

*Objective 7.a(4):* Within five years of plan approval, evaluate the wildlife impacts of the most common recreational activities occurring on Black Point Wildlife Drive and make modifications to reduce or eliminate the disturbances.

*Objective 7.a(5):* Within seven years of plan approval, at least 50 percent of sampled visitors on Black Point Wildlife Drive will display ethical wildlife viewing behavior, as determined through observational surveys.

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*Objective 7.a(6):* Within seven years of plan approval, wildlife/visitor and visitor/visitor conflicts on Black Point Wildlife Drive will be reduced by 50 percent from 2006 levels, as determined through observational surveys.

*Objective 7.a(7):* Within 10 years of plan approval, develop three bicycle trails and make other facility improvements to move bicycle riders into appropriate areas where wildlife disturbance and visitor impacts will be reduced.

*Objective 7.a(8):* With plan approval, eliminate jogging.

#### 7.b. Establishing Visitor Zones

*Objective 7.b(1):* With plan approval, two visitor use zones will be established to concentrate the most intensive visitor use activities and facilities within an identified primary zone and disperse other less intense uses in a secondary zone.

*Discussion:* See Figure 26 for the proposed public use zones.

### **Visitor Services Goal 8: Communicate Key Issues with off-site Audiences**

*Kennedy Space Center workers and local residents will recognize the refuge and support its purposes.*

#### **8.a. Kennedy Space Center Workers**

*Objective 8.a(1):* Within five years of plan approval, at least 75 percent of regularly sampled members of Kennedy Space Center's workforce will be able to recognize that the refuge overlays NASA lands and will understand the importance of the refuge to migratory birds, threatened and endangered species, and other wildlife.

#### **8.b. Local Residents**

*Objective 8.b(1):* Within 5 years of plan approval, at least 50 percent of regularly sampled local residents will be able to recognize the location of the refuge and will understand the importance of the refuge to migratory birds, threatened and endangered species, and other wildlife.

### **Visitor Services Goal 9: Build Volunteer Programs**

*A sufficient number of skilled and trained volunteers will be available to support the refuge in meeting its mission and purposes.*

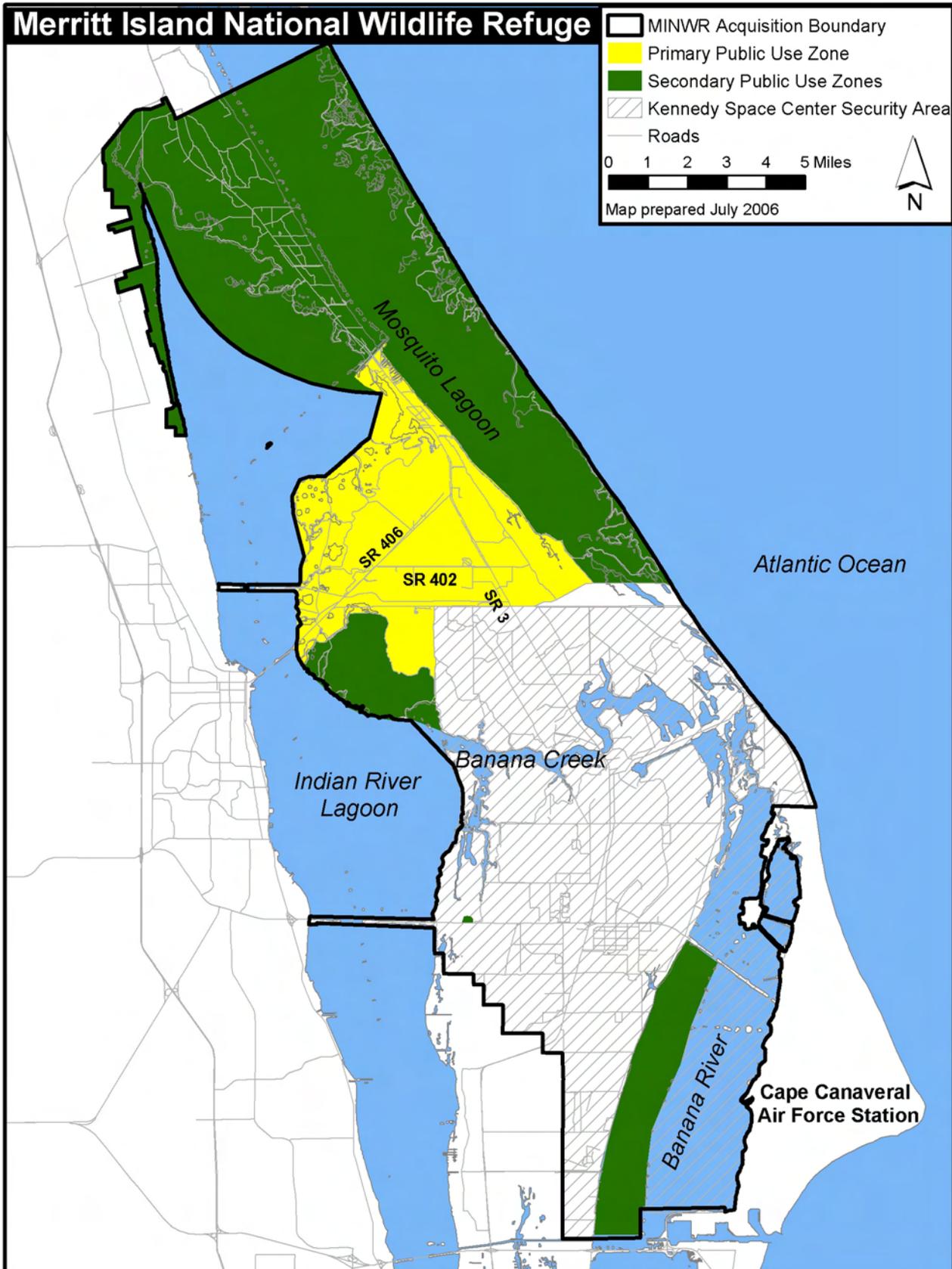
#### **9.a. Volunteer Training**

*Objective 9.a(1):* Within 5 years of plan approval, at least 75 percent of needed volunteer positions will be filled and each individual will receive adequate training to proficiently perform assigned duties with minimal supervision.

#### **9.b. Volunteer Job Satisfaction**

*Objective 9.b(1):* Within five years of plan approval, at least 75 percent of volunteers will annually report that they are highly satisfied with their positions.

Figure 26. Proposed Public Use Zones



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**Visitor Services Goal 10: Build Support of Friends Group**

*The Merritt Island Wildlife Association will be an advocate for the refuge, supporting all refuge goals and objectives and providing financial and in-kind support of refuge programs.*

**10.a. Merritt Island Wildlife Association Membership**

*Objective 10.a(1):* Over the 15-year life of the plan, the refuge will continue to maintain a close working relationship with the Merritt Island Wildlife Association, assisting in promoting the growth in membership and financial revenues, providing input on refuge needs, and working to align interests.

**10.b. Merritt Island Wildlife Association Employment**

*Objective 10.b(1):* Over the 15-year life of the plan, encourage the Merritt Island Wildlife Association in its hiring practices to hire employees who will assist the refuge in running the Visitor Center and the Visitor Services Program by assisting with visitor information and orientation, interpretive activities, and environmental education programs.

**10.c. Merritt Island Wildlife Association Outreach**

*Objective 10.c(1):* Over the 15-year life of the plan, encourage the Merritt Island Wildlife Association to become proactive in assisting the refuge in reaching new visitors and expanding the Visitor Services Program.

**Visitor Services Goal 11: Law Enforcement**

*The refuge will have a sufficient law enforcement staff to protect the visiting public, refuge facilities, and wildlife resources and all officers will have adequate training and equipment to perform their duties.*

**11.a. Law Enforcement**

*Objective 11.a(1):* Within 5 years of plan approval and through random annual surveys, at least 90 percent of visitors will report that they feel safe and can affirm that law enforcement personnel and refuge regulations are adequately protecting visitors and wildlife.

*Objective 11.a(2):* Within five years of plan approval, law enforcement officers will contact 10 percent of visitors participating in consumptive recreation activities (i.e., hunting and fishing).

*Objective 11.a(3):* Within two years of plan approval, law enforcement officers will spend at least 75 percent of their work time in the field.

*Objective 11.a(4):* Within five years of plan approval, there will be a 50 percent reduction over 2004 levels in the number of reported boat-related manatee deaths or injuries in and around the refuge.

*Objective 11.a(5):* Within 10 years of plan approval, there will be a 50 percent reduction over 2004 levels in reported drug violations, vehicle break-ins, and illicit sexual offenses in the primary public use zone of the refuge.

*Objective 11.a(6):* Within 15 years of plan approval, the Refuge Manager, other law enforcement agencies, and the public will be able to contact a refuge Law Enforcement Officer 24 hours a day, seven days a week to respond to law enforcement emergencies, search and rescue operations, and other law enforcement situations.

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**Visitor Services Goal 12: Concession Operations**

*The refuge will evaluate a concession agreement to improve visitor services and streamline administration operations.*

**12.a. Concession**

*Objective 12.a(1):* Within the 15-year life of the plan, prepare a written evaluation regarding the establishment of a concession operation to bring all commercial operations under a single point of contact.

**Visitor Services Goal 13: Fee Program**

*The refuge will implement a fee program to enhance visitor services and the visitor experience.*

*Discussion:* Fees are needed to help maintain refuge visitor facilities and to offset some portion of the operating costs for various programs. Fees are proposed for three programs: quota hunts, sports fishing permits, and Black Point Wildlife Drive. The fee for quota hunts would be increased from \$12.50 to \$15.00 and the new permit would be good for only one day, instead of for the weekend. The fee for the sports fishing permit and Black Point Wildlife Drive would be \$5 for a weekly permit or \$20 for the annual permit.

In addition to visitor fees, the refuge works in cooperation with Canaveral National Seashore in managing commercial guide permits. The cost of guide permits has been increased from \$250 for a two-year permit (in 2005) to \$250 per year (starting January 1, 2006). These commercial permits would be capped at 2005 levels (as of September 30, 2005) and no new permits would be issued, unless a current permit holder fails to renew his/her permit. Thereafter, guide fishing permits would be capped at approximately 70 permits.

**13.a. Quota Hunt Permits**

*Objective 13.a(1):* Within two years of plan approval, the refuge will charge fees for quota hunt permits sufficient to defray administrative and maintenance costs to operate the program.

**13.b. Sports Fishing Permits**

*Objective 13.b(1):* Within two years of plan approval, the refuge will implement an annual fee for sports fishing permits sufficient to defray administrative and maintenance costs to operate the program.

**13.c. Black Point Wildlife Drive**

*Objective 13.c(1):* Within two years of plan approval, the refuge will implement a fee for Black Point Wildlife Drive to help defray the administrative and maintenance costs.

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### 13.d. Commercial Guide Permits

*Objective 13.d(1):* Within five years of plan approval, commercial guide permits will be capped at no more than 70 permits and the fees will be sufficient to defray the program costs.

### Visitor Services Goal 14: Improve Refuge Appearance

The landscape of the refuge will be free of litter and visitors will report how clean the refuge appears.

#### 14.a. Litter

*Objective 14.a(1):* Decrease litter on the refuge by 50 percent within five years of plan approval and by 75 percent within ten years of plan approval through a phased approach to address litter problems and to change user behavior.

### REFUGE ADMINISTRATION

General refuge administration goals and objectives address staff, volunteers, facilities, and equipment, as well as unwanted wildland fire.

### Refuge Administration Goal 1: Refuge Management

*Provide sufficient staff, volunteers, facilities, and equipment to implement a comprehensive refuge management program to protect and manage the natural and cultural values of the refuge's east central Florida coastal barrier island system.*

#### 1.a. Unwanted Wildland Fire

*Objective 1.a(1):* Continue to suppress 95 percent of all unwanted wildland fires occurring on the refuge within the first 24 hours to protect refuge and NASA resources and facilities and to provide for health and safety of refuge staff, NASA staff, and visitors.

*Discussion:* Unwanted wildland fire (wildfires) could be an important impediment to both refuge and Space Center operations. More importantly, they present a real danger to visitors and employees of both organizations. In 1981, two refuge employees were killed during wildfire suppression activities. It is of the utmost importance that the refuge maintains a fire management staff that is well-trained, well-equipped, and sufficient to suppress wildland fires in a timely and safe manner.

**Causes of Unwanted Wildland Fire:** The vast majority of wildfires on the refuge result from lightning. Studies at Kennedy Space Center show that there is an average of one cloud to ground lightning strike per square mile per month. This works out to 1,500 lightning strikes per year on the burnable vegetation of the refuge. In addition to the lightning fires, a small number of human- and equipment-caused ignitions occur each year.

**Number and Size of Wildland Fires:** Between 1981, when accurate recording of fire activity was started, and 2005, the refuge averaged slightly over 18 wildfires per year. The number of ignitions and the amount of acreage burned varies greatly. In 1981, 42 wildfires burned over 16,000 acres. The period between 1988 and 2001 was also active with a total of 91 wildfires. The largest of these, the Ransom Road Fire in 1998, was over 4,000 acres. This fire shut down Kennedy Parkway (State Route 3) several times and smoke hampered Space Center operations for over a week. On the other hand, the wet period between 2002 and 2005 averaged only 6 wildfires per year, where most of these were smaller than one acre in size.

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Fire Preparedness - Personnel: After the fatalities in 1981, a substantial effort was made to properly train refuge personnel for wildland fire suppression. Most of the staff members who were physically capable of doing wildland fire fighting received sufficient training to qualify at least as a Firefighter Type 2. Through additional training and/or the hiring of qualified people, the refuge obtained personnel qualified in other key fireline positions, such as Helicopter Manager, Tractor Plow Operator, Engine Operator, and Incident Commander. Training has continued over the years and additional specialized fire qualifications have been added.

Fire Preparedness - Equipment: The fire situation in 1981 also brought the realization that refuge fire fighting equipment was inadequate. Surplus military vehicles that served as engines were replaced with four-wheel drive trucks with slide-in pump units. These, in turn, were replaced with increasingly more sophisticated equipment. At the present time, the refuge has four fully equipped Type 6 Wildland Engines.

Two Caterpillar D-6 dozers with six disk plows, along with appropriate transport vehicles, were acquired shortly after 1981. Over the years the refuge has upgraded the D-6s and purchased new tractor trailers upon which to move them. Two smaller crawler tractors are available for fire operations and share a two-disk plow. Early on, a large marsh buggy was used for fire operations in the wetland areas of the refuge. In recent years, an M-3 Marshmaster amphibious tracked vehicle has been obtained and fitted with fire suppression equipment to better serve this need.

Highly trained firefighters using the ground based firefighting equipment previously discussed cannot alone achieve the refuge's fire suppression objective. The fuels present on the refuge have been shown to be able to support fires that could quickly overwhelm engines and tractor plow units. In addition, the ridge and swale topography of the refuge lands could slow or prevent access to fires. The use of helicopters to provide quick and efficient initial attack was begun on the refuge in 1981. Beginning in that year, the refuge contracted for an exclusive use fire suppression helicopter. This ended in 2000.

For a while, the refuge had an agreement with Kennedy Space Center to utilize NASA helicopters for fire operations. This was marginally successful. Problems with availability and fire knowledge plagued this arrangement. After September 11, 2001, security demands on the NASA ships increased and the agreement was eventually discontinued. At the present time the Service helicopter is stationed in Titusville, and the refuge uses it as much as possible. However, this arrangement does not provide refuge fire operations with a helicopter that is consistently available for initial attack. The Service aircraft has other missions and is frequently on assignments out of the area for extended periods of time. If a fire helicopter is needed while the Service ship is unavailable, refuge Incident Commanders must depend on being able to borrow a carded aircraft from another refuge or to rent one.

Fuels Management: Many of the vegetation types on the refuge are fire maintained (Adrian 2003). Without periodic fire, fuel loading in these types quickly becomes extremely heavy. The accumulation of excess fuels was one of the major factors in the fatalities in 1981. Reducing fuel levels could reduce the intensity of wildfires and reduce the risk involved in suppressing them. Two methods of fuels reduction are used on the refuge.

Mechanical Treatment: Mechanical treatment could be done in either the overstory in timbered areas or the shrub layer in many vegetation types. When working in the pine forests and woodlands, timber removal is usually done through a commercial timber harvest (see Chapter V, Habitat Management Plan, in Appendix F). The purpose of these harvesting operations is to reduce the stand density, thereby reducing the chance of crown fires. In some cases, commercial operators would remove

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snags in addition to live timber. Commercial operators have also been used to remove cabbage palms along firelines, but this is usually done by refuge employees. Both the snags and the palms contribute to spotting during fire operations.

Manipulating the shrub layer could be done by several methods: shearing, chopping, or rotary cutting (see Chapters IV and V, Habitat Management Plan, in Appendix F). This technique is useful in reducing the height of stands of scrub oak and palmetto. These lower fuels could then be prescribed burned under moderate conditions.

Prescribed Fire: Mechanical treatments leave large amounts of dead and down materials. These activity fuels could create an increase in fire danger themselves. For this reason, most mechanical operations are followed by a prescribed fire. Not only does the fire consume the biomass, but it also releases nutrients. Without the use of fire, it would take many years for this to happen during the decomposition process. Prescribed fire is also used to meet resource management goals and objectives. In the case of the flatwoods and scrub vegetation, two of the most common fire maintained vegetation types, the need for fuels reduction burns coincides very well with the need to burn for habitat management.

*Strategies:*

- Continue to train firefighting staff to meet operational needs in accordance with interagency standards.
- Use fire assignments to meet task book training needs and to keep firefighters' qualifications current.
- Aggressively pursue a contract for an initial attack helicopter.
- Continue to upgrade firefighting equipment.
- Add an additional storage space for firefighting equipment.

### **1.b. Administrative Facilities**

*Objective 1.b(1):* Within one year of plan approval, site and develop an administrative office facility.

*Discussion:* The refuge's offices are clustered at the Visitor Center and at the Maintenance Compound. Offices in the Visitor Center include the public use and law enforcement programs and an office for the Merritt Island Wildlife Association (the refuge's friends group). The Maintenance Compound includes administrative offices in the administrative trailer, fire offices in the Fire Building and Fire Cache, and maintenance offices in the Shop Building, as well as a warehouse facility, pole barns, equipment storage garages, gas pumps, and other facilities.

During 2003, a surplus triple-wide trailer was acquired from NASA to serve as a temporary administrative office for the refuge. Before 2003, the existing combination office/Visitor Center was deemed insufficient to handle the support structure of a cooperating association, sales outlet, numerous volunteers, and 60,000 annual visitors to the building, while also supporting the refuge's daily administrative functions. The triple-wide trailer was established within the maintenance compound due to the ease of utility hookup. Hurricanes of 2004 and 2005 caused some roof damage to the trailer and required an evacuation of critical records during each event. Subsequent storm damage funding was made available to replace the office trailer. NASA agreed to design and contract the construction of a 2,800 square foot block building to serve as the refuge's office. The new office building is to be located along the entrance road to the maintenance compound. Utilities would be shared with the Maintenance Compound. The triple-wide trailer would be utilized as support for the biological and fire programs on an interim basis for as long as it remains structurally sound.

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The existing Fire Management Building has served the program well with one exception: the briefing room (18 feet by 24 feet) is not large enough to accommodate fire briefings and training requirements. The building should be expanded to double the size of this room.

*Objective 1.b(2):* Within five years of plan approval, work within Kennedy Space Center's utility systems to upgrade refuge water, sewer, telephone, fax, and computer utilities.

*Discussion:* The refuge headquarters compound is dependent upon on-site wells and septic tanks and upon Space Center utilities for telephone, fax, and computer communications. The well water is declared unfit for human consumption by the Space Center due to concerns for contamination by a nearby polluted Space Center site. Bottled water is made available for consumption. Well water is used for other non-consumptive activities. The refuge has two septic systems serving its offices, one at the Visitor Center and another at the Maintenance Compound. The Space Center has both sewer connections and water lines located at the Shuttle Landing Facility, which is located near the refuge's headquarters. Connecting to this facility would require installation of sewer and water lines for approximately two miles.

Over the years, the refuge has utilized nearly all of the available communication capacity. In addition, some of the lines are dedicated to supporting Canaveral National Seashore's entrance facilities. Upgrade of the system is needed to keep up with the information and communication demands of today.

*Strategies:*

- Work with NASA to pipe Cocoa municipal water to the refuge's headquarters.
- Connect to the Space Center's sewer system at the Shuttle Landing Facility to serve the refuge's offices.
- Work with NASA to expand the capacity for telephone, fax, and computer lines.

*Objective 1.b(3):* Within three years of plan approval, construct a dormitory facility and recreational vehicle pad facilities within the refuge headquarters compound for researchers, interns, volunteers, and temporary firefighters to replace the existing BioLab dormitory facility .

*Discussion:* A major asset to the refuge for research support is the BioLab facility, which is a NASA building used by the refuge (and formally by Canaveral National Seashore) to house researchers and volunteers. The almost pristine conditions of the Mosquito Lagoon and the outstanding condition of the estuarine waters relative to the Indian River Lagoon make the refuge a highly desirable location for estuarine research. The availability of the BioLab facility to researchers offsets research costs considerably when compared to the cost of having to rent motel rooms and/or apartments. Between June 1997 and April 2002, 75 individuals from 11 different universities and/or government agencies used the facility. Researchers and students were involved in 17 different projects during this time. The facility offers researchers, students, and volunteers on-site housing during their courses of study. This is a valuable asset to provide in-kind support to attract needed researchers to do projects on the refuge.

Beyond researchers, interns provide an essential component of the public use program for visitors on the refuge. Interns support Visitor Center operations, assist with interpretive and educational programs, and disseminate information. Interns are provided a small stipend, but free housing in the BioLab facility is a key component to making this program successful. Located about 8 miles north of the refuge's headquarters, the BioLab is approximately 40 years old and has been used for various purposes over the years. It was retrofitted to living quarters and laboratory space in the early 1990s.

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Fresh water supply problems and building deterioration brought the building close to being closed. In 2004 a new well was installed which alleviated the water problem. In 2005 a new roof was installed to prevent further water damage. Working with Merritt Island Wildlife Association and NASA, further repairs would be made to ensure that the building would be available for a few more years. The long-term solution to the need for housing interns, volunteers, researchers, and temporary firefighters is to construct a dormitory within the refuge's headquarters compound. This facility would be connected to the support systems (i.e., water, electric, telephone, and septic) of the compound. In addition the building would be better controlled and secured than the isolated BioLab. An additional feature would be the construction of recreational vehicle hookups and concrete pads. Some interns and volunteers would take advantage of the recreational vehicle pad option, especially those who are retired.

### **1.c. State Route 406**

*Objective 1.c(1):* Within 2 years of plan approval, repave State Route 406 from State Route 402 to State Route 3 to meet highway standards.

*Discussion:* The portion of State Route 406 located between State Routes 402 and 3 is the only access for visitors to reach Black Point Wildlife Drive and is the primary artery for visitor access to Haulover Canal. In 1996 one inch of asphalt was added to the roadway. Before then, the roadway had started to fail with numerous potholes. The one inch of asphalt has held the roadway in fair condition; however, strict weight limits have restricted heavy traffic. During the road work project on Black Point Wildlife Drive in 2003, two additional inches of asphalt was added to one end of State Route 406 to enable trucks to access the Wildlife Drive to conduct needed repairs. The State Route 406 roadway is now beginning to crack and fail and must be resurfaced to enable visitors to have a safe route to travel. Planning and completion of this effort would be a joint project between the Service and the Federal Highway Administration.

### **1.d. Refuge Staffing**

*Objective 1.d(1):* Within the 15-year life of the plan, provide a full complement of 61.5 (61 full-time and 1 half-time) permanent staff to protect and manage the natural and cultural resources of the refuge, while providing opportunities for appropriate and compatible public use.

*Discussion:* To serve the purposes of the refuge and to accomplish the outlined goals and objectives of the comprehensive conservation plan, additional staff and volunteers would be required. Along with additional staff, additional support equipment and facilities would be needed (e.g., office space, computers, and vehicles). See Figure 27 for the overall staffing chart. See Appendix I for the staffing charts for each of the refuge program areas [i.e., Office Administration (five staff); Biological Program (nine staff); Law Enforcement Program (four staff); Public Use Program (5.5 staff); Exotic, Invasive, and Nuisance Species Program (four staff); Fire Program (14 staff); and Maintenance Program (11 staff)]. The refuge would emphasize recruiting and retaining staff, supporting applicable training and certification programs. Spanning several refuge programs (including management, biology, law enforcement, public use, exotics, and fire), one desired skill set for refuge staff would involve geographic information systems (GIS), including digitizing skills, using global positioning systems (GPS), developing and maintaining GIS databases, managing and manipulating GIS databases, and analyzing and mapping GIS data. New hires in some program areas would include a job description requirement to have expertise with GIS or would be trained to use GIS to facilitate refuge management and decision-making.

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## 1.e. Refuge Signs

*Objective 1.e(1):* Maintain an effective network of signs meeting the National Wildlife Refuge System's standards to notify the public of refuge boundaries, public use areas, and closed areas by annually re-posting, replacing, and/or maintaining 20 percent of the refuge signs.

*Discussion:* The refuge maintains signs in accordance with Service standards. In addition, highway signs are administered in accordance with the Uniform Code of Traffic Standards. The network of signs informs the public of refuge boundaries, closed areas, public facilities, sensitive wildlife areas and rules and regulations designed to protect the public and the natural resources.

### **Refuge Administration Goal 2: Intergovernmental Coordination**

*Foster a strong and effective working relationship with existing partners and new partners for the purposes of accomplishing refuge management goals and protecting the natural and cultural resources of the refuge's coastal and estuarine habitats.*

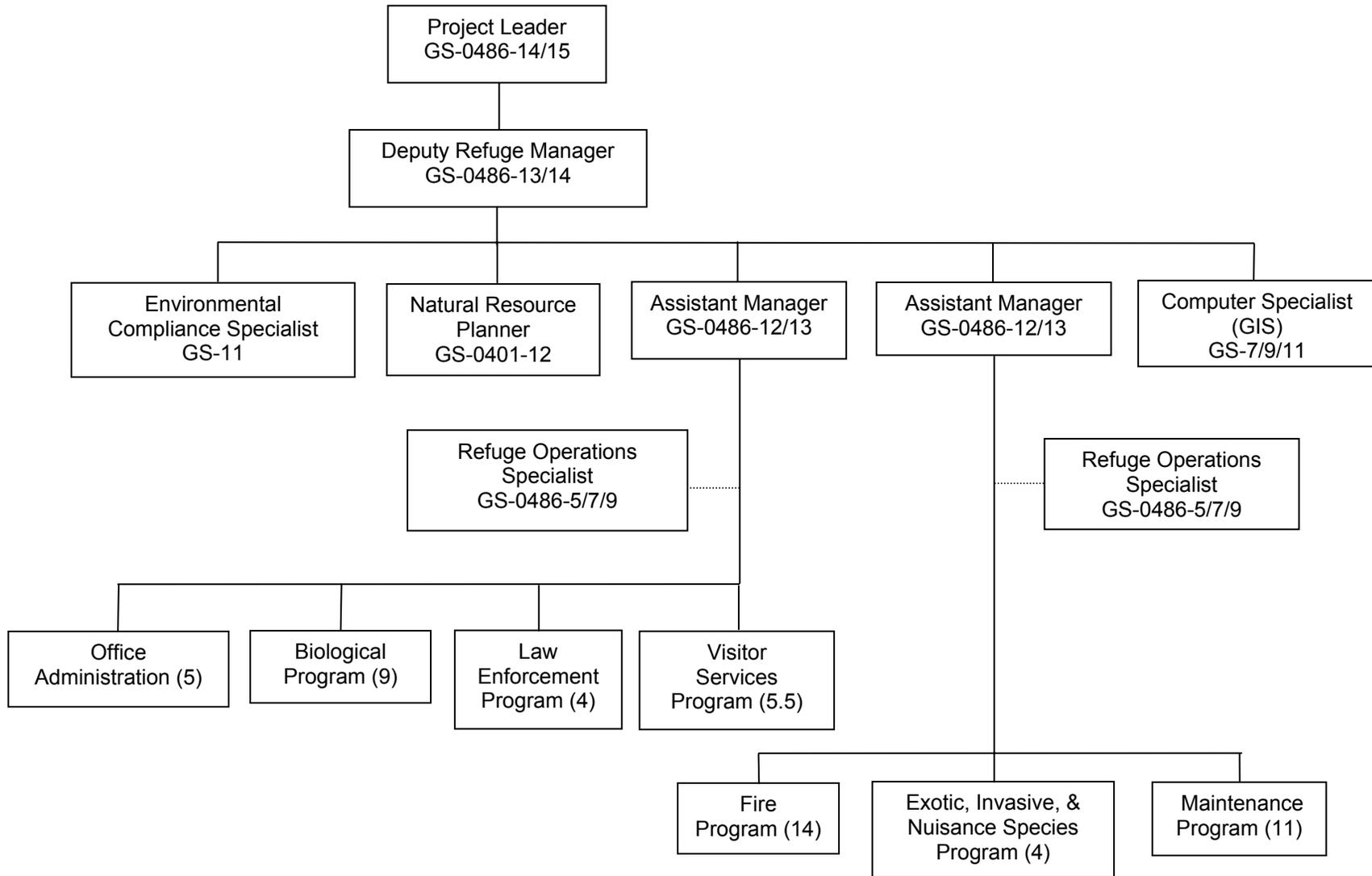
*Discussion:* Government is required to reinvent itself based on the economic conditions, shifting national priorities, national defense, and hurricane recovery. The public has an expectation that more of the Service's goals be accomplished through partnerships and that government must become more efficient. The Director of the Service has stated that the Service must emphasize working cooperatively with others; develop a more integrated approach to problem solving and share resources to get the job done; and make choices and find efficiencies in both resource and business management practices. This focus reinvigorates the refuge's current intergovernmental coordination efforts. Numerous federal, state, and local agencies could be considered partners for the refuge. However, more could be done to inform and educate the partners of the value of the refuge and the refuge's goals. In the same vein, the Service is willing to help other agencies with issues, such as fire management, nuisance wildlife, exotic plant control, and specific wildlife conservation issues. Much of this coordination could be accomplished by regular meetings and by developing personal relationships with individuals within other agencies.

## 2.a. Existing Partners

*Objective 2.a(1):* Improve refuge coordination with NASA in order to make refuge goals and objectives an important component in the planning and implementation of NASA's operations at Kennedy Space Center.

*Discussion:* Since the refuge is an overlay of the Kennedy Space Center, the most important relationship for the refuge is a positive interactive relationship with both NASA and the Space Center. This relationship also includes the various contractors on site. As the Space Center transitions into a new era with space exploration and growing relationships with non-governmental partners, it is critical that the management objectives of the refuge be included in any planning initiatives. Space Center employees and contractors need to understand the role of the refuge and hopefully come to place a high value on the resources it protects. In addition, they should come to understand that they play an integral role in the protection and management of the resources.

**Figure 27. Proposed Organizational Chart**



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*Strategies:*

- Brief the Kennedy Space Center Director and senior staff annually on current and future refuge plans.
- Meet regularly with Space Center environmental staff to better communicate on research, monitoring activities, potential new development projects, and opportunities to improve habitat.
- Continue to respond appropriately to NASA requests for technical support in dealing with wildlife issues or controversies at the Space Center.
- Build personal relationships with staff in various programs, including law enforcement, maintenance, master planning, environmental management, Internet technology, weather, payload processing, and National Test Directors.
- Invite site managers and other NASA officials to periodic demonstrations and viewings of actual refuge operations. Include social events where appropriate.
- Participate in special Space Center events sponsored by NASA (e.g., the Energy and Environmental Awareness celebration).

*Objective 2.a(2):* Improve refuge coordination with the U.S. Air Force in order to make refuge goals and objectives an important component in the planning and implementation of operations at Cape Canaveral Air Force Station.

*Discussion:* With Cape Canaveral Air Force Station located adjacent to Kennedy Space Center and the refuge and with overlapping management concerns (e.g., scrub-jays and sea turtles), the Service must improve coordination with the Air Force Station.

*Strategies:*

- Revise the agreement between the U.S. Air Force and the Service as it applies to Cape Canaveral Air Force Station. Resolve issues, such as fire suppression and technical support.
- Brief the Cape Commander and senior staff annually on current and future refuge plans.
- Meet regularly with the Cape environmental staff to better communicate on issues such as sea turtle nest predation and lighting, monitoring of wildlife, habitat restoration, and prescribed burning.
- Invite site managers and other U.S. Air Force officials to periodic demonstrations and viewings of actual refuge operations. Include social events where appropriate.
- Participate in special events sponsored by the Air Force Station.

*Objective 2.a(3):* Improve refuge coordination with the National Park Service in order to make refuge goals and objectives an important component in the planning and implementation of operations at Canaveral National Seashore.

*Discussion:* Since the Seashore and refuge are both part of the U.S. Department of the Interior, since a portion of the Seashore is an overlay of the refuge, since the two share land and water boundaries, and since the two have shared resource protection goals and objectives, it is imperative that the Seashore and refuge continue and improve coordination efforts.

*Strategies:*

- Meet regularly with the Park Superintendent and senior staff to ensure that both agencies are aware of current and future plans. In addition seek ways to resolve issues and discover ways to

- 
- be more efficient in management.
  - Meet regularly with the Seashore environmental staff to better communicate on research, monitoring, and habitat management.
  - Meet annually with the Park Superintendent and senior staff to review commercial and public use regulations to ensure consistency.
  - Continue to co-sponsor the biennial Mosquito Lagoon Symposium
  - Invite Seashore staff to social events where appropriate.
  - Participate in special events sponsored by the National Park Service at Canaveral National Seashore.
  - Coordinate to strive for consistency between laws and regulations for activities in Mosquito Lagoon.

*Objective 2.a(4):* Improve refuge coordination with the Florida Fish and Wildlife Conservation Commission as it applies to programs of mutual interest, including public use activities, research, law enforcement, wildlife, and habitat management.

*Strategies:*

- Sponsor an annual meeting with the Regional Director of Florida Fish and Wildlife Conservation Commission and the Park Superintendent of the Seashore to ensure consistency between laws and regulations applied to Mosquito Lagoon.
- Invite Florida Fish and Wildlife Conservation Commission staff to visit the refuge for an orientation and to social events where appropriate.
- Participate in appropriate special events sponsored by the Commission.

*Objective 2.a(5):* Improve refuge coordination with the St. Johns River Water Management District as it applies to programs of mutual interest, including the refuge's Wetland Management Plan, the Water Management District's Surface Water Improvement and Management Plan, and the Indian River Lagoon National Estuary Program.

*Strategies:*

- Continue to participate in the Indian River Lagoon National Estuary Program Advisory Board.
- Meet regularly with the Water Management District's staff to seek habitat restoration projects on the refuge that accomplish objectives of the refuge and that also meet the criteria under its Surface Water Improvement and Management Plan.
- Invite Water Management District staff to social events where appropriate.
- Participate in appropriate special events sponsored by the Water Management District.

*Objective 2.a(6):* To further goals and objectives in programs of mutual interest, continue to work with local governmental partners, such as Brevard County (including Mosquito Control District, Environmentally Endangered Lands Program, Parks and Recreation, County Commissioners, and Sheriffs Department), the Brevard County Tourist Development Council, and the city of Titusville.

*Strategies:*

- Continue to seek input and encourage these entities to be involved and informed of refuge activities and plans.
- Meet annually with the Brevard Mosquito Control District to ensure that water management objectives for impoundments are coordinated.
- Maintain mutual aid agreements in the event of emergencies or disasters.

- 
- Work with Canaveral National Seashore and local partners to support the development of an alternative transportation connection between the city of Titusville and the Atlantic Ocean (i.e., bicycle path).
  - Work with the Brevard County Environmentally Endangered Lands program to assist with management of Kaboord Sanctuary.

*Objective 2.a(7):* Continue to work with non-governmental partners, such as Ducks Unlimited, United Waterfowlers Association, Audubon Society, Wild Birds Unlimited, Florida Conservation Association, Fish and Wildlife Foundation, and Mosquito Lagoon Outfitters to discover areas of mutual interest.

*Strategy:*

- Maintain a dialogue with these groups to keep them informed of refuge activities and seek opportunities for grants or other funding.

## **2.b. New Partners**

*Objective 2.b(1):* Seek new partnerships, some of which may not be the conventional partners of the refuge.

*Strategies:*

- Identify and maintain a list of problems, issues, and opportunities with which the refuge could use partnership involvement.
- Take advantage of networking to seek partners.

## **Refuge Administration Goal 3: Commercial Harvesting**

*Limit the impacts to the natural resources of the northern Indian River lagoon system from commercial harvesting activities to current levels until these activities can be phased out from the refuge.*

### **3.a. Commercial Fishing Permits**

*Objective 3.a(1):* Upon plan implementation, limit commercial fishing permits to those users holding permits for 2004/2005.

*Discussion:* The refuge works in cooperation with Canaveral National Seashore to administer commercial harvest permits. Commercial harvest permits cover commercial fishing activities such as, but limited to, netting, hook and line fishing, crabbing, clamming, shrimping, and bait fishing. These commercial fishing activities have occurred in these waters since the refuge was established. Fish and Wildlife Service policy guidelines require these activities to be eliminated.

With the adoption of this plan, the refuge policy would be to issue commercial harvest permits only to those individuals who have a current permit. Approximately 70 permit holders currently exist. If the permit is not renewed, it would expire and cannot be renewed in future years. If an individual elected to not renew the permit, the permit may be passed to other members of the immediate family, such as: father, mother, sons, or daughters. Through attrition, commercial harvesting would be slowly eliminated, but would not cause economic hardship to families that depend upon this industry for their livelihoods. The commercial fishing program will sunset in 2018 and all permits will end by October 1, 2018.

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### 3.b. Beekeeping Permits

*Objective 3.b(1):* Upon plan implementation, limit beekeeping operations only to those users holding permits in 2004/2005.

*Discussion:* Historically, beekeeping on refuge lands supported the cultivation of citrus. When the refuge was established, beekeeping was permitted to continue in support of citrus growing, in accord with the Service's agreement with NASA. Beekeepers are awarded apiary sites on the basis of highest monetary bid in a sealed bid process. Beekeepers are limited to a maximum of 10 apiary sites and sites are awarded under permit in five-year cycles with the permit renewed annually. Each year beekeepers must pay for all the sites they are awarded. If a beekeeper does not pay for his sites, his/her permit is cancelled and those sites are re-bid for award to other beekeepers.

Since citrus management is scheduled to be eliminated over time and since beekeeping does not support the refuge's purposes or mission, it is the intent of the refuge to phase out beekeeping, but not to cause financial hardship to the beekeepers that currently have apiary sites on the refuge. To do this, future beekeeping operations would be limited to the ten beekeepers holding permits in 2004 and to the 53 apiary sites existing in 2004. Apiary permits would not be transferable from one beekeeper to another beekeeper. If a beekeeper gives up or fails to pay for his/her apiary sites, his/her permit would be permanently cancelled. As permits are cancelled, those apiary sites would be opened to bid by other 2004 beekeepers under the maximum of 10 sites per beekeeper limit. If bids are not received for an apiary site, that site would be dropped from the program. Over time, beekeeping on the refuge would be reduced and eventually eliminated through the attrition of beekeepers and by the elimination of unwanted apiary sites. The beekeeping program will sunset in 2018 with the removal of all apiary sites and the end of all permits by October 1, 2018.



# V. Plan Implementation

## INTRODUCTION

As required by the National Wildlife Refuge System Improvement Act of 1997, the Service will manage all refuges in accordance with an approved comprehensive conservation plan, which, when implemented, will achieve refuge purposes; help fulfill the Refuge System mission; maintain and, where appropriate, restore the biological integrity, diversity, and environmental health of the refuge; help achieve the goals of the National Wilderness Preservation System; and meet other mandates.

## FUNDING NEEDS AND PERSONNEL

This plan recommends funding that is substantially above current budget allocations and subject to congressional allocations on an annual basis. The recommended staffing outlined is not a commitment from Congress or the Service for staff, operational, maintenance, and/or project increases, but represents a future management framework to meet the goals, objectives, and strategies identified in this plan. Other possible funding sources include grants, entrance fee receipts, mitigation funds, donations, and partners. See Table 11 for the current refuge staff of 26 permanent positions, as well as the annual costs associated with these positions. Temporary and term positions are utilized when funding from sources other than base operation is available. See Figure 15 for the existing staffing chart.

**Table 11. The current staff of 26 and costs are shown**

Position	Estimated Annual Recurring Cost (Thousands)	Position	Estimated Annual Recurring Cost (Thousands)
Refuge Manager (Project Leader)	\$121	Equipment Operator	\$67
Deputy Refuge Manager	\$102	Equipment Operator	\$67
Refuge Operations Specialist (Assistant Manager)	\$55	Equipment Operator	\$67
Administrative Officer (Budget Office Assistant)	\$65	Equipment Operator	\$58
Natural Resource Planner	\$87	Maintenance Worker	\$59
Forester	\$74	Tractor Operator	\$51
Fire Management Specialist (Wildland Urban Interface Specialist)	\$73	Supervisory Fire Management Officer/Fire Control Officer	\$74
Supervisory Wildlife Biologist	\$91	Forestry Technician	\$58
Refuge Operation Specialist (Visitor Services)	\$87	Forestry Technician	\$43

Position	Estimated Annual Recurring Cost (Thousands)	Position	Estimated Annual Recurring Cost (Thousands)
Park Ranger (Visitor Center Manager)	\$67	Forestry Technician	\$43
Park Ranger (Refuge Law Enforcement Officer)	\$72	Forestry Technician	\$43
Park Ranger (Refuge Law Enforcement Officer)	\$83	Forestry Technician	\$43
Supervisory Equipment Operator (Maintenance Leader)	\$76	Fire Program Assistant	\$43
<b>TOTAL</b>			<b>\$1,769,000</b>

The Refuge System currently faces a backlog of project, operational, maintenance, and equipment needs. The current Refuge Operating Needs (RONS) system provides a list of proposed projects for the refuge, over and above the base operating budget of the refuge, which was \$2,018,000 in fiscal year 2005. The refuge's RONS and Service Asset and Maintenance Management (SAMMS) needs will continue under this plan. Once this plan is approved, the RONS and SAMMS databases will be updated to reflect the needs outlined in the plan.

To achieve the goals, objectives, and strategies outlined in Chapter IV of the proposed plan, additional personnel, operations, maintenance, facilities, and funds are needed. See Table 12 for the proposed staff and associated costs for 61.5 full-time employees (FTE), which would replace the existing staff of 26 (see Figure 27 for the proposed staffing chart).

**Table 12. The proposed staff of 61.5 and costs are outlined**

Proposed Position	Estimated Annual Recurring Cost (Thousands)
<b>Refuge Management (9 FTE)</b>	
Project Leader	\$152
Deputy Refuge Manager	\$129
Assistant Manager	\$109
Assistant Manager	\$109
Environmental Compliance Specialist	\$77
Computer Specialist (GIS)	\$63
Natural Resource Planner	\$92
Refuge Operations Specialist	\$52
Refuge Operations Specialist	\$52
<b>Office Administration (5 FTE)</b>	
Office Manager/IT Specialist	\$92
Office Assistant	\$52
Office Assistant (Property, personnel)	\$52
Office Assistant (Budget)	\$52
Automated Office Clerk (Reception)	\$52

<b>Proposed Position</b>	<b>Estimated Annual Recurring Cost (Thousands)</b>
<b>Biological Program (9 FTE)</b>	
Supervisory Refuge Biologist	\$109
Biologist (Uplands/Fire Ecologist)	\$77
Biologist (Wetlands)	\$77
Biologist (Marine)	\$77
Forestry Technician	\$52
Biological Science Technician	\$52
Biological Science Technician	\$52
Biological Science Technician	\$52
Biological Science Technician	\$52
<b>Law Enforcement Program (4 FTE)</b>	
Lead Law Enforcement Officer	\$77
Law Enforcement Officer	\$63
Law Enforcement Officer	\$63
Law Enforcement Officer (Marine)	\$63
<b>Visitor Services Program (5.5 FTE)</b>	
Supervisory Refuge Ranger	\$92
Refuge Ranger (Visitor Center, Volunteers)	\$77
Refuge Ranger (Environmental Education)	\$63
Refuge Ranger (Outreach)	\$63
Refuge Ranger (Interpreter)	\$63
Refuge Ranger (0.5 FTE Fee Collector)	\$21
<b>Exotic, Invasive, and Nuisance Species Program (4 FTE)</b>	
Biological Science Technician	\$52
Laborer	\$41
Laborer	\$41
Laborer	\$41
<b>Fire Program (14 FTE)</b>	
District Fire Management Officer	\$92
Assistant Fire Management Officer	\$77
Wildland and Urban Interface Specialist	\$77
GIS Specialist	\$63
Fire Program Assistant/Dispatcher	\$52
Wildfire Specialist	\$63
Prescribed Fire Specialist	\$63
Equipment Operator (Firefighter)	\$59
Equipment Operator (Firefighter)	\$59
Aviation Manager	\$63
Forestry Technician (Engine Captain)	\$47
<b>Maintenance Program (11 FTE)</b>	
Maintenance Supervisor	\$79
Maintenance Mechanic	\$69

<b>Proposed Position</b>	<b>Estimated Annual Recurring Cost (Thousands)</b>
Equipment Operator	\$69
Maintenance Worker	\$55
Maintenance Worker (Public Use, Mower)	\$52
Laborer (Trails)	\$44
Laborer (Posting)	\$44
Laborer (Trash)	\$44
Equipment Operator	\$63
Equipment Operator	\$63
Tractor Operator	\$52
<b>Total</b>	<b>\$4045.00</b>

## RESEARCH

In addition to ongoing projects, a variety of needed research projects exist today. These research projects cover a wide variety of issues and have a focused priority on management-oriented projects, including those listed.

- Address threats and impacts to refuge wildlife and habitat from exotic species.
- Address listed species recovery and management efforts.
- Address species of management concern (e.g., reddish egret or gopher tortoise).
- Address estuarine fisheries, wildlife disturbance, and public use.
- Address wildlife diseases (e. g., sea turtle fibropapilloma and avian viral disease monitoring).
- Address the impacts of reduced water quality, contaminants, and pollution on estuarine aquatic flora and fauna.
- Conduct research into integrated fisheries and wildlife in managed wetlands systems.
- Continue to encourage NASA support contracts of long-term monitoring programs that directly support refuge operations and management.
- Identify and encourage research projects that have substantial benefits to the refuge and species conservation and management (e.g., abiotic factors, sea turtle monitoring, endangered species research, public use, seagrass mapping, and others).
- Encourage research to document historical, ecological landscape features and demonstrate the changes that have occurred relative to habitat and species restoration.
- Develop a research and monitoring program for the American alligator to determine hormonal concentrations and bioaccumulation of contaminants, and to determine population dynamics in conjunction with proposed hunting programs.

In addition to research, there are many basic monitoring and inventory needs including:

- Monitor other native and endemic wildlife to determine wildlife guilds and habitat associations.
- Develop and maintain a species inventory for Merritt Island Refuge.
- Encourage community characterization studies for invertebrates, amphibians, reptiles, mammals and birds, and their management priority status among listed species and species of special concern.
- Develop GIS databases.
- Develop an inventory of historical maps and photography.
- Monitoring programs to track progress in the refuge's efforts for recovery of listed species should be developed.
- Additionally, adaptive management programs could monitor changes in wildlife populations associated with upland and wetland management programs.

- Encourage monitoring of bird rookeries, estuarine fisheries, seagrass beds, juvenile sea turtles, manatee habitat, rafting waterfowl, and other waterbirds using the system.
- Monitor the impacts of wildlife diseases on refuge populations. Encourage independent monitoring of wildlife diseases to receive recommendations on impacts to local populations and management issues (e.g., upper respiratory tract disease impacts on gopher tortoise populations, West Nile virus impacts on scrub-jay populations).
- Develop a monitoring or research program to determine the connection of the refuge beach and nearshore fisheries community, with special focus on any unique features that promote use by sharks, drums, and sea turtles (or other important fisheries species).
- Determine the role and function of the refuge nearshore habitats for the conservation of marine fisheries populations (e. g., nursery habitat, feeding area, and sanctuary area).
- Develop or encourage a monitoring program to evaluate the fisheries population dynamics in the Mosquito Lagoon by working with the Fish and Wildlife Conservation Commission and other partners.

## **PARTNERSHIPS**

The refuge would maintain and continue an aggressive approach to work with others to conserve, protect, and enhance fish and wildlife and their habitats. The Service is fully committed to maintaining and expanding joint endeavors and cooperation with educational institutions, researchers, local governments, state government, and other federal agencies, as well as organizations, schools, volunteers, and conservation organizations. To this end, the refuge would maintain and enhance existing partnerships, which include those listed partners, as well as the residents and business owners of the area.

Potential new partnerships for the refuge include business owners; commercial tour operators; additional local elementary, middle, and high schools; hunting and fishing organizations; new and retired residents; additional research centers and universities; and National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

## **STEP-DOWN MANAGEMENT PLANS**

The Service would prepare step-down management plans to provide strategies and implementation schedules for meeting goals and objectives identified in this comprehensive conservation plan. Since the Habitat Management Plan and Visitor Services Plan were prepared during the planning process of the comprehensive conservation plan, only five plans would need to be updated during the 15-year life of the plan: Law Enforcement, Hunting, Inventorying and Monitoring, Fire Management, and Hurricane and Disaster Preparedness. Table 13 lists these plans and their proposed completion schedules.

**Table 13. The step-down management plans to be updated during the 15-year life of the comprehensive conservation plan are listed**

<b>Step-down Management Plans to be Updated</b>	<b>Completion Schedule (2008-2023)</b>
Law Enforcement	By 2023
Hunting	By 2008
Inventorying and Monitoring	By 2023
Fire Management (updated every 5 years)	2008, 2013
Hurricane and Disaster Preparedness (updated annually)	annually

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## **MONITORING AND ADAPTIVE MANAGEMENT**

Monitoring the Service's performance, while implementing this comprehensive conservation plan, is critical to successful implementation of the plan. Monitoring and evaluation allows the Service, other government agencies, the public, and the partners to measure and evaluate progress. Following approval of the comprehensive conservation plan and public notification of the decision, the Service will begin implementing the objectives and strategies identified in the plan. The Service will monitor, evaluate, and determine whether or not progress is being made towards achieving the refuge's purposes, vision, and goals. Monitoring will address habitat or population objectives and the effects of management activities. Through adaptive management and evaluation of monitoring and research, results may indicate the need to modify refuge objectives and/or strategies.

## **PLAN REVIEW AND REVISION**

The Service will review this plan annually to decide if it requires any revisions. The plan will be modified along with associated management activities whenever this review or other monitoring and evaluation determine that changes are needed to achieve planning unit purpose(s), vision, and goals. The Service will revise this plan when significant new information becomes available, ecological conditions change, major refuge expansion occurs, or when the Service identifies the need to do so during plan review. At a minimum, plan revision will occur every 15 years. All plan revisions will follow the procedures outlined in current policy and will require compliance with the National Environmental Policy Act. The Service will conduct ongoing public involvement and continue informing and involving the public regarding management of this refuge.

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## SECTION B: ENVIRONMENTAL ASSESSMENT

### *I. Background*

#### INTRODUCTION

The Fish and Wildlife Service prepared this Environmental Assessment for Merritt Island National Wildlife Refuge in compliance with the National Environmental Policy Act and the National Wildlife Refuge System Improvement Act. The National Wildlife Refuge System Improvement Act requires the development of comprehensive conservation plans for all refuges. Following a public review and comment period on the draft plan, a final decision will be made by the Fish and Wildlife Service that will guide Merritt Island Refuge management actions and decisions over the next 15 years, provide understanding about the refuge and management activities, and incorporate information and suggestions from the public and refuge partners.

The draft plan proposes a management direction, which is described in detail through a set of goals, objectives, and strategies. The draft plan addresses current management issues, provides long-term management direction and guidance for the refuge, and satisfies the legislative mandates of the National Wildlife Refuge System Improvement Act of 1997. While the plan provides general management direction, subsequent step-down plans will provide more detailed management direction and actions.

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

Although several step-down management plans exist for the refuge, they are outdated and are insufficient to address the needs, concerns, and issues of the refuge over the next 15 years. Further, the refuge and the resources it protects face the spread of exotic, invasive, and nuisance species; the threats to threatened, endangered, and other imperiled species; the threats and impacts associated with an increasing human population and the demand for public use activities; and the decline in migratory birds and their habitats. This plan is needed to address current management issues, to provide long-term management direction for the refuge, and to satisfy the legislative mandates of the National Wildlife Refuge System Improvement Act of 1997, which requires the preparation of a comprehensive conservation plan for all national wildlife refuges.

#### PURPOSE AND NEED

The purpose of developing a comprehensive conservation plan is to ensure that Merritt Island National Wildlife Refuge serves as an inviolate sanctuary for migratory birds; protects a variety of habitats to support native diversity; sustains an abundance of waterfowl and other migratory birds; conserves rare, threatened, endangered, and other imperiled species; controls and eliminates exotic,

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invasive, and nuisance species; sustains the lagoonal fishery; provides opportunities for enjoyment of appropriate and compatible, wildlife-dependent recreation; promotes awareness and appreciation of natural resources; promotes support for refuge management activities; coordinates with a wide variety of governmental and non-governmental partners; protects and preserves archaeological and historical resources; protects outstanding natural, scenic, and ecologic values; and provides for appropriate and compatible scientific research.

This environmental assessment addresses the need to adopt a 15-year management plan for Merritt Island National Wildlife Refuge that provides guidance for future refuge management and that meets the requirements of the National Wildlife Refuge System Improvement Act.

## **DECISION FRAMEWORK**

Based on the assessment described in this document, the Fish and Wildlife Service will: (1) select an alternative that best serves the purposes of the refuge and the mission of the National Wildlife Refuge System, and (2) determine if the selected alternative is a major federal action significantly negatively affecting the quality of the environment, thus requiring preparation of an Environmental Impact Statement. The Service identified issues, concerns, and needs through discussions with the public; organizations; agency managers; conservation partners; local, state, and federal government agencies; and others. The Service's planning team identified priority issues, developed a range of alternatives, evaluated the possible consequences of implementing each of the alternatives, and recommended Alternative C as the proposed action. The draft plan was developed for implementation based on this recommendation.

## **PLANNING STUDY AREA**

Merritt Island National Wildlife Refuge is located along central Florida's eastern coastline in Brevard County, generally east of the city of Titusville, south of Canaveral National Seashore and New Smyrna Beach, and north of Cocoa Beach (see Section A, Figure 1). More than 40,000 people call the city of Titusville home, which is just across the Intracoastal Waterway from the refuge, while Brevard County has a population of over 475,000 (U.S. Census Bureau 2000b). The planning study area includes lands and waters identified within the refuge's current acquisition boundary (Figure 1).

## **AUTHORITIES, LEGAL COMPLIANCE, AND COMPATIBILITY**

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

## **PLANNING PROCESS AND ISSUE IDENTIFICATION**

During the preplanning and public scoping phases of the Merritt Island National Wildlife Refuge Comprehensive Conservation Plan, a myriad of issues and concerns surfaced. While some of these issues and concerns are important to the future of the refuge, many are not within the sole jurisdiction of the refuge and some are completely outside of its control. Many of the issues and concerns raised represent opportunities for increased coordination with existing and potential partners.

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For more detailed information about the planning process and the identification of issues, see Section A, Chapter III, Plan Development.



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## *II. Affected Environment*

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



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## *III. Alternatives*

### **INTRODUCTION**

Alternatives are different approaches or combinations of management actions and activities designed to achieve the refuge's purposes, vision, and goals; the mission of the National Wildlife Refuge System; and the mission of the Fish and Wildlife Service. Alternatives are formulated to address the priority issues, concerns, and problems identified by the Service, the public, and the governmental partners during public scoping and throughout the development of the draft plan.

The four alternatives identified and evaluated represent different approaches to provide permanent protection and restoration of 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 the management of lands to facilitate a physical and biological connection of habitats and to restore the function and habitat diversity once found in this area. In particular, the fish and wildlife communities found in the aquatic, transitional, and terrestrial habitats on the refuge serve as migration corridors and stop-over habitats for many migratory birds and other trust species. Refuge managers assessed biological conditions and analyzed external relationships affecting the refuge. This information contributed to the development of alternatives. As a result, each alternative presents different approaches to meeting long-term goals. Each alternative was evaluated based on how much progress it will make and how it will address core habitat issues, problems, and wildlife threats.

Problems and threats provide important perspectives and guidance in developing alternatives. Where data was available, trends in habitat and wildlife uses were evaluated, as was the capability of refuge habitat to support these uses. Overall, the greatest risk to fish, wildlife, plants, and associated habitats in the North Florida Ecosystem and the Indian River lagoon system is characterized by the permanent loss of habitats and connectivity. Thus, the Service has prioritized protecting, restoring, and connecting the remaining habitats.

All of the alternatives incorporate several concepts and management techniques intended to achieve the goals for management programs and activities conducted on the refuge, including management goals for: wildlife and habitat management, resource protection, visitor services, and refuge administration. Four alternatives were evaluated: Alternative A (No Action or Current Management), Alternative B (Threatened and Endangered Species), Alternative C (Migratory Birds), and Alternative D (Wildlife and Habitat Diversity). The No Action alternative (i.e., Alternative A) is a description of ongoing refuge management activities and may not, in all cases, meet all the goals. The No Action alternative is described as a basis of comparison for the action alternatives (i.e., Alternatives B, C, and D).

### **MANAGEMENT COMMON TO ALL ALTERNATIVES**

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

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## COMPATIBLE 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 long into the future. Before activities or uses are allowed on a national wildlife refuge, those uses must be found to be appropriate and compatible. A compatible use is one that will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge [§668ee(1) USC]. “Wildlife-dependent recreational uses may be authorized on a refuge when they are compatible and not inconsistent with public safety” [§668dd(d)(3)(A)(iii) USC]. The Service completed draft compatibility determinations for: waterfowl hunting, upland game hunting, fishing, wildlife observation and photography, environmental education and interpretation, bicycling, commercial services, commercial fishing, beekeeping, research, astronomy, organized group camping, non-commercial plant collection, interim management of citrus groves, feral hog control, and forest management – commercial timber harvest (see Appendix E). These compatibility determinations outline stipulations with which a particular use must comply in order to be approved to occur on the refuge.

## DESCRIPTION OF ALTERNATIVES

Alternative A (i.e., the No Action Alternative) continues current management activities similar to recent activities and levels on the refuge. Alternative B focuses refuge management actions on the needs of threatened and endangered species. Alternative C focuses refuge management actions on the needs of migratory birds. Alternative D focuses refuge management actions on maintaining and enhancing wildlife and habitat diversity. The four alternative management approaches take into consideration the listed criteria developed as a result of issue identification and organized under four broad management categories.

### Wildlife and Habitat Management

- Protect threatened and endangered species, migratory birds, and native wildlife diversity.
- Control exotic, invasive, and nuisance species.

### Resource Protection

- Acquire or otherwise manage key lands and waters.
- Coordinate protection of the archaeological and historical resources of the refuge.

### Visitor Services

- Provide opportunities for quality, appropriate, and compatible wildlife-dependent public use activities.
- Communicate key issues with Kennedy Space Center workers and area residents.
- Enhance refuge staff and programs through the use of trained volunteers.
- Increase the law enforcement presence.
- Control litter on the refuge.

### Refuge Administration

- Address staffing and support to meet refuge goals.
- Enhance intergovernmental coordination.
- Remove commercial harvesting activities from the refuge.

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## *ALTERNATIVE A – CURRENT MANAGEMENT (NO ACTION ALTERNATIVE)*

Alternative A continues refuge management activities and programs at levels similar to past management.

### **Wildlife and Habitat Management**

Wildlife and habitat management activities would continue at programs and levels similar to past management. Regarding threatened and endangered species, the refuge would maintain 550 Florida scrub-jay family groups across 15,000 acres, 11-13 nesting pairs of bald eagles, 6.3 miles of sea turtle nesting beaches, <10 percent sea turtle nest depredation rates, and the Banana River No Motor Zone as a manatee sanctuary. For migratory birds, the refuge would maintain 15,000-16,000 acres in impounded wetlands with a waterfowl management focus, ~2,500 acres of impounded wetlands with a shorebird management focus, and ~1,500 acres of impounded wetlands with a wading bird management focus. Further, the refuge would continue to maintain ~4,500 acres in impounded wetlands with a fisheries management focus. The refuge would continue to pursue grants from the State of Florida to control exotic plants and it would continue to annually remove 2,000-2,500 feral hogs from the refuge through trapping. Under an existing agreement, the refuge would continue to manage ~700 acres of citrus groves.

### **Resource Protection**

No active management currently addresses resource protection issues. The Service is not currently actively pursuing land acquisition. The Tank Island lease only covers to mean high water. The Seashore is the lead on cultural resources in the overlap area, while NASA is the lead in the overlay between NASA and the refuge. The extent of cultural resources is unknown in the Turnbull Creek area. Occasional law enforcement patrols respond to cultural resource issues as they arise.

### **Visitor Services**

Visitor services would continue similar to past refuge management activities. The visitation in 2003 was: 60,000 to the refuge's Visitor Center, over 550,000 direct refuge visits, and nearly 350,000 visits to the refuge's exhibit and tours at Kennedy Space Center. The refuge would continue to operate two information kiosks, the Visitor Center, two observation towers, Black Point Wildlife Drive, five trails, the manatee observation deck, and 113 miles of publicly accessible dikes and trails (where ~21 miles are seasonally closed from November through mid-February). About 36,000 acres would continue to be open to hunting three days per week under the state season in two quota and two open hunt areas. Fishing activities would continue with no active management. The refuge would continue to host two annual festivals and conduct about 50 interpretive programs. Limited outreach would continue to occur to Space Center workers and to area residents. About 70 active volunteers would continue to support refuge management activities, projects, and programs. Control of trash and litter would continue to be minimally effective.

### **Refuge Administration**

Refuge administration would continue similar to past management with about 25 full-time employees. Refuge offices would continue to be housed at the Visitor Center, Fire Building and Fire Cache, Shop, and administrative trailer. The refuge would continue to rely on existing utilities, which are currently at or near maximum capacity. And, the refuge would continue to use NASA's BioLab facility to house researchers and interns. The refuge would attempt to maintain refuge boundary signs and signs supporting visitor services. Regular intergovernmental coordination would continue with NASA. Sporadic coordination would continue with the Cape Canaveral Air Force Station. And, minimal coordination would continue with other governmental partners, including Canaveral National Seashore, Florida Fish and Wildlife Conservation Commission, and St. Johns River Water Management District. Commercial harvesting activities would continue on the refuge with about 10

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beekeeping permits for 53 apiary sites active in 2004 and with about 70 commercial crabbing, clamming, bait fishing, and hook and line fishing permits active in 2004.

### *ALTERNATIVE B – THREATENED AND ENDANGERED SPECIES*

Alternative B focuses refuge management actions on the needs of threatened and endangered species.

#### **Wildlife and Habitat Management**

Existing refuge management activities related to threatened and endangered species would be expanded under this alternative. The refuge would aggressively manage for Florida scrub-jays, restoring and maintaining 19,000 to 22,000 acres in optimal condition to support 900 family groups. Marginal habitats would also be actively managed for scrub-jay benefits. Some sites would see the reintroduction of scrub-jays. The refuge would work with the partners to enhance scrub-jay habitats on nearby lands, develop a predator control program, and develop an active research program with intensive monitoring. Habitat management activities would support the number of nesting pairs of bald eagles to expand to about 20, with increased protection of nest sites, development of artificial nesting platforms, and increased cultivation of future nest areas and nesting trees. Depredation rates for sea turtle nests would be decreased to less than five percent. The refuge would institute active lighting controls related to Cape Canaveral Air Force Station and Kennedy Space Center facilities, increased beach cleanups, increased research (especially into fibropapilloma and human impacts to sea turtles in the Lagoon system), beach restoration activities, and increased coordination with partners. The refuge would actively manage for the southeastern beach mouse by actively managing habitat, increasing surveys and monitoring activities, developing a research program, developing a predator control program, and directly opposing Kennedy Space Center and Cape Canaveral Air Force Station development in beach and dune habitats. Further, the Service would use the refuge's population of beach mice as a source population for re-introduction to other sites. The refuge would also actively manage for the West Indian manatee by reducing the size, speed, and horsepower of outboard motors allowed on the refuge; by regularly conducting law enforcement patrols; by limiting Kennedy Space Center and Cape Canaveral Air Force Station operations in estuarine waters; by implementing slow speed zones in north Banana River and Banana Creek; and by considering slow speed zones for the north Indian River Lagoon, for the Banana River (outside of the no motor zone), and in Mosquito Lagoon. The refuge would increase public awareness and understanding of issues related to manatees, as well as increase Space Center and Air Force Station awareness and understanding. The refuge would conduct several management actions, including increasing the prey base, developing artificial nest structures, conducting regular rookery and wetland surveys, and actively managing two to three impoundments specifically for wood storks to support the re-establishment of wood stork nesting on the refuge. The refuge would institute active management for the eastern indigo snake by working with the Space Center to change the shift changes away from dawn and dusk, increasing law enforcement and patrol on roadways, closing State Route 406 from State Routes 3 to 402 from dusk to dawn, reducing speed limits on roadways, decreasing illegal poaching activities, developing a research program, and implementing a survey and monitoring program.

Several altered habitats would be restored to native habitats to serve threatened and endangered species, including citrus groves and freshwater wetlands. Seagrass bed protection would be increased with prop scarring levels decreased to levels at or below the Florida Fish and Wildlife Conservation Commission's definition of light scarring.

Other existing programs would be decreased under this alternative. The refuge would manage less than 14,000 acres of impounded wetlands for waterfowl, focusing on waterfowl as a food base for

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bald eagles. No active refuge management would focus on shorebirds. All wading bird management activities would be focused on wood storks. The number of acres available for neotropical migratory birds would be decreased, since some of these habitats would be managed for scrub-jays.

Control of exotic, invasive, and nuisance species would increase under this alternative. Exotic plant control activities would focus on controlling target plants in habitats serving threatened and endangered species. Feral hog removal efforts would be increased to remove over 4,000 feral hogs annually from habitats serving threatened and endangered species. Several predator control programs would occur in habitats serving threatened and endangered species.

### **Resource Protection**

The refuge would focus resource protection activities on those habitats serving threatened and endangered species. The Service would pursue ownership and management of Bill's Hill. The Seashore would continue to be the lead on cultural resources in the overlap area, while NASA would continue to be the lead in the overlay between NASA and the refuge. The extent of cultural resources would continue to be unknown in the Turnbull Creek area. Occasional law enforcement patrols would respond to cultural resource issues as they arise.

### **Visitor Services**

All visitor services programs would be focused on threatened and endangered species. Visitation to the refuge and its Visitor Center would increase with the increasing population. The visitor experience would be more vicarious in nature. Waterfowl hunting activities would be decreased (e.g., the number of days and/or the number of acres available). The refuge would consider restrictions on estuarine fishing activities to limit the impacts to sea turtles, manatees, and seagrasses (e.g., closed areas and horsepower limits). Opportunities for recreational activities would be eliminated from all areas serving threatened and endangered species (e.g., Scrub Ridge Trail, Black Point Wildlife Drive, and wood stork impoundments). Visitor facilities would be limited to the Visitor Center, manatee observation deck, three trails (i.e., Visitor Center, Oak Hammock, and Palm Hammock trails), and ~60 miles of public roads and dikes (i.e., the refuge would close ~50 miles of dikes and roads to the public). Birding tours would be eliminated. The number of interpretive programs at the Visitor Center would be increased. Environmental education and interpretive programs and messages would focus on threatened and endangered species. The refuge would sponsor one annual festival, focusing on threatened and endangered species. The refuge would eliminate all public use activities which conflict with or in any way impact threatened and endangered species. Bank fishing and crabbing would be eliminated. Trash and litter removal activities would be increased.

### **Refuge Administration**

Refuge administration activities would be expanded, focusing on threatened and endangered species. Offices would be located at the Visitor Center, Fire Building and Fire Cache, Shop, Trailer, and a new administrative office building. Utilities would be upgraded. As part of the maintenance complex, a dorm facility and recreational vehicle pad facilities would be developed to support researchers, interns, and volunteers. Refuge staff would be increased to at least 60, focused on threatened and endangered species. The refuge would annually re-post or maintain boundary signs and visitor services' signs on 20 percent of the refuge. With an emphasis on threatened and endangered species, outreach and coordination efforts would be increased with Kennedy Space Center, Cape Canaveral Air Force Station, Canaveral National Seashore, Florida Fish and Wildlife Conservation Commission, and the St. Johns River Water Management District. All commercial harvesting activities would be eliminated, including commercial crabbing, clamming, bait fishing, hook and line fishing, and beekeeping.

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## ALTERNATIVE C – MIGRATORY BIRDS

Alternative C focuses refuge management actions on the needs of migratory birds.

### **Wildlife and Habitat Management**

Wildlife and habitat management activities would focus on migratory birds. Management for threatened and endangered species would remain the same or would be decreased. The refuge would maintain 583 family groups of Florida scrub-jays (meeting recovery goals for the refuge) across 13,000 acres, 11-13 nesting pairs of bald eagles, 6.3 miles of sea turtle nesting beaches, <20 percent sea turtle nest depredation rates, and the Banana River No Motor Zone as a manatee sanctuary. The refuge would manage intensively for waterfowl, increasing the acres of impounded wetlands managed to over 16,000 acres and annually supporting targets of 250 breeding pairs of mottled duck, 60,000 lesser scaup, 25,000 dabbling ducks, and 38,000 other diving ducks. The refuge would also manage intensively for shorebirds, increasing to over 5,000 acres managed in impounded wetlands for shorebirds, conducting monthly surveys, coordinating with national and regional shorebird plans, and evaluating the potential of additional habitats to be managed to support overwintering and migrating shorebirds. Over 3,300 acres of impounded wetlands would be managed with a wading bird focus. The refuge would increase the number of acres managed for neotropical migratory birds by increasing the acres in mixed hardwood and by increasing survey, research, and monitoring activities. Focusing management efforts in core habitats serving migratory birds, the refuge would continue to pursue grants from the State of Florida to control exotic plants and it would continue to annually remove 2,000-2,500 feral hogs from the refuge through trapping. To support migratory birds, the refuge would restore six islands to sand/shell substrate, restore six islands to grassy cover, and establish closed area buffers for all nesting and roosting islands. The refuge would focus on restoring as many citrus groves to hammock habitats as possible, resisting Kennedy Space Center development of citrus groves with soils that would support hammocks. And, the refuge would restore about 1,000 acres of interior freshwater wetlands. Further, the ridge and trough topography would be managed to maintain a mix of woody and grassy swales to serve the needs of migratory birds. The refuge would work with the partners to reduce the impacts of roadways and vehicles collisions on migratory birds (e.g., reduce speed limits in key areas used by migratory birds).

### **Resource Protection**

The refuge would focus resource protection activities on those habitats serving migratory birds. The Service would not pursue ownership and management of Bill's Hill. The Service would seek to amend the lease with the State of Florida to expand a closed area buffer out to 450 feet around Tank Island. The Seashore would continue to be the lead on cultural resources in the overlap area, while NASA would continue to be the lead in the overlay between NASA and the refuge. The extent of cultural resources would continue to be unknown in the Turnbull Creek area. Occasional law enforcement patrols would respond to cultural resource issues as they arise.

### **Visitor Services**

All visitor services and programs would be focused on migratory birds. Visitation to the refuge and its Visitor Center would increase with the increasing population. The refuge would eliminate waterfowl hunting on the refuge. The refuge would decrease disturbance to overwintering migratory birds by implementing closed areas throughout the refuge's estuarine waters from November through March of each year (e.g., close Mosquito Lagoon south of Haulover Canal from November to March). The refuge would decrease disturbance to migratory birds in public use areas by modifying or eliminating uses (e.g., the refuge would eliminate motorcycle riding, hiking, jogging, bicycling, and towing boat trailers on Black Point Wildlife Drive). Public use facilities would include the Visitor Center, manatee observation deck, Black Point Wildlife Drive, five trails, two observation towers, and 113 miles of public dikes and roads (where ~61 miles of dikes and roads would be closed seasonally from

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November through March). Environmental education and interpretation programs and messages would focus on migratory birds. The refuge would host one annual festival and would participate in the annual Spacecoast Flyway Festival. The refuge would eliminate all public use activities which conflict with or in any way impact migratory birds. Bank fishing and crabbing would be eliminated. Trash and litter removal activities would be increased.

### **Refuge Administration**

Refuge administration activities would be expanded, focusing on migratory birds. Offices would be located at the Visitor Center, Fire Building and Fire Cache, Shop, Trailer, and a new administrative office building. Utilities would be upgraded to support the maintenance complex. As part of the maintenance complex, a dorm facility and RV pad facilities would be developed to support researchers, interns, and volunteers. Refuge staff would be increased to at least 54, focused on migratory birds. The refuge would annually re-post or maintain boundary signs and visitor services' signs on 20 percent of the refuge. With an emphasis on migratory birds, outreach and coordination efforts would be increased with Kennedy Space Center, Cape Canaveral Air Force Station, Canaveral National Seashore, Florida Fish and Wildlife Conservation Commission, and the St. Johns River Water Management District. The potential exists for coordination with the Water Management District to degrade with increased conflicts due to differences in agency objectives. All commercial harvesting activities would be eliminated, including commercial crabbing, clamming, bait fishing, hook and line fishing, and beekeeping.

### *ALTERNATIVE D – WILDLIFE DIVERSITY (PROPOSED ACTION)*

Alternative D takes a more landscape view of the refuge and its resources, focusing refuge management on wildlife and habitat diversity.

### **Wildlife and Habitat Management**

The wildlife and habitat management actions would balance threatened and endangered species, migratory birds, and wildlife and habitat diversity. The refuge would annually support 500-650 Florida scrub-jay family groups with 350-500 territories in optimal conditions across 15,000-16,000 acres, as well as increase habitat and population monitoring. By actively managing the pine flatwoods and creating and conserving future potential eagle nest tree stands, the refuge would support 11-15 nesting pairs of bald eagles. The refuge would maintain 6.3 miles of sea turtle nesting beaches with a nest depredation rate of less than 10 percent; seasonally conduct nest surveys; rescue cold stunned, stranded, and injured sea turtles; and increase coordination with Kennedy Space Center and Cape Canaveral Air Force Station, especially on lighting issues. The refuge would maintain 100 acres of habitat for southeastern beach mouse, enhancing and restoring beach, dune, and transitional scrub habitat; facilitating research and monitoring; determining population numbers and status; and using the refuge's population as a source population for re-introduction to other sites. The refuge would also actively manage for the West Indian manatee by regularly conducting law enforcement patrols; limiting Kennedy Space Center and Cape Canaveral Air Force Station operations in estuarine waters; developing a mandatory manatee safety training program for refuge, Kennedy Space Center, Cape Canaveral Air Force Station, contractors, and researchers using the estuarine waters; maintaining the No Motor Zone in the Banana River; and maintaining four slow speed zones. The refuge would increase public awareness and understanding of issues related to manatees, as well as increase Kennedy Space Center and Cape Canaveral Air Force Station awareness and understanding. The refuge would conduct several management actions, including increasing the prey base, developing artificial nest structures, conducting regular rookery and wetland surveys, and actively managing two to three impoundments specifically for wood storks to support the re-establishment of wood stork nesting on the refuge.

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The refuge would enhance management for migratory birds. The refuge would manage 15,000-16,000 acres in impounded wetlands with a waterfowl focus for overwintering birds and for summer nesting birds. The refuge would manage waterfowl habitats to support targets of 250 breeding pairs of mottled duck, 60,000 lesser scaup, 25,000 dabbling ducks, and 38,000 other diving ducks. Further, the refuge would evaluate and minimize public use impacts to waterfowl populations using the refuge. The refuge would maintain over 2,500 acres of impounded wetlands with a shorebird focus and over 1,500 acres of impounded wetlands with a wading bird focus. For neotropical migratory birds, the refuge would conduct habitat enhancements and would support research to determine their usage and habitat requirements on the refuge. Further, the refuge would develop baseline information and regular inventories every five years for refuge fisheries. Every three years the refuge would monitor five percent of the refuge for changes in population dynamics for herpetological species.

In managing for wildlife and habitat diversity, the refuge would restore and enhance various habitats. The refuge would restore seven altered natural islands, restore three islands to sand/shell substrate, and restore two or three islands to grassy cover to support bird nesting. And, the refuge would establish closed area buffers for key nesting and roosting islands. Working with the partners, the refuge would work to decrease prop scarring to levels at or below Florida Fish and Wildlife Conservation Commission's definition of light scarring. Restoring 200 acres of citrus to native vegetation, the refuge would also evaluate 1,100 acres of groves for restoration or for Kennedy Space Center development. The refuge would restore 1,200 acres across 10 targeted impoundments, it would evaluate the restoration of an additional 3,100 acres across 11 impoundments, and it would restore dredge impacted wetlands. Further, the refuge would evaluate and restore the remaining altered freshwater wetlands to mimic natural hydrology for a diversity of wildlife.

The refuge would increase management actions regarding controlling and eliminating exotic, invasive, and nuisance species. The refuge would continue to pursue grants from the State of Florida to control exotic plants and would also conduct exotic plant surveys and maintain an exotic plant database. The refuge would annually control exotic plants on 30 percent of the refuge and would eliminate target exotic plants. Feral hog removal efforts would be increased to at least 4,000 per year.

To limit wildlife impacts from roadways and collisions, the refuge would increase law enforcement and patrol on the roadways, close State Route 406 from State Routes 3 to 402 from dusk to dawn, work with the partners to reduce the speed limits on key roadways, remove road kill to protect bald eagles and other wildlife, and develop education and outreach programs (e.g., for Kennedy Space Center employees).

### **Resource Protection**

The refuge would expand resource protection activities. The Service would pursue ownership and management of Bill's Hill. And, the Service would seek to amend the lease with the State of Florida to expand a closed area buffer out to 450 feet around Tank Island. The Seashore would continue to be the lead on cultural resources in the overlap area, while NASA would continue to be the lead in the overlay between NASA and the refuge. The refuge would identify any cultural resource sites within the owned and managed portions of the Turnbull Creek area. Regular law enforcement patrols would respond to cultural resource issues as they arise.

### **Visitor Services**

Visitor services programs and messages would be focused on wildlife and habitat diversity, while also including threatened and endangered species and migratory birds. Visitation to the refuge and its

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Visitor Center and to the refuge's exhibit and tours at Kennedy Space Center's Visitor Center would increase with the increasing population. The refuge would continue to operate two information kiosks, the Visitor Center, two observation towers, Black Point Wildlife Drive, five trails, the manatee observation deck, and 131 miles of publicly accessible dikes and roads (where ~21 miles would be seasonally closed from November through March), while adding four observation towers, two 10-person observation blinds, Americans with Disabilities Act-approved restrooms on Black Point Wildlife Drive, six canoe/kayak trails, a rookery viewing complex, and three bicycle trails. About 36,000 acres would continue to be open to hunting three days per week under the state season. The refuge would develop a deer and feral hog hunting program and it would evaluate the feasibility of an alligator hunting program. An estuarine fishing program would be developed with pole/troll zones, ethical flats fishing outreach materials, partnerships, and regular law enforcement patrols. The refuge would develop a freshwater fishing program with one or more partners in five borrow pit ponds. To help limit wildlife and habitat disturbance, the refuge would develop materials and programs to increase awareness and understanding to change the behaviors of users. Jogging would be eliminated from the refuge. Bicycling would be eliminated from marsh areas and would be restricted to designated trails.

The refuge would increase environmental education, interpretation, and outreach activities and programs. The refuge would develop an active environmental education program, annually targeting 30 percent of north Brevard County students in grades four to eight through four curriculum-based education programs: lagoonal waters, wetlands, scrub, and pine flatwoods. The Visitor Center, brochures, and outreach materials would include wildlife diversity messages. To accommodate increased visitation, the Visitor Center parking lot would be expanded to 40 spaces. And, the refuge would improve outreach at Kennedy Space Center's Visitor Center with maps and brochures and through training for all Space Center tour bus operators. Outreach would be increased to Space Center employees and to local residents to increase awareness and understanding.

Through staff, interns, and volunteers, the refuge would develop support for the increased visitation and the increased programs and activities. The refuge would work to increase the number of active volunteers, would fill at least 75 percent of needed volunteer positions, and would increase training for volunteers. And, the refuge would evaluate the establishment of a concession operation to bring all the commercial guides (e.g., fishing guides, boat tour guides, and bus tour guides) under a single point of contact. Commercial guides would be capped at 70 permits. Refuge fees would include: incidental business permit fee, quota hunt fee, upland game fee, sports fishing permit fee, and Black Point Wildlife Drive fee. Incidental business permit fees would be increased to \$500 for two years.

The refuge would work to decrease trash and litter on the refuge by 50 percent within five years and by 75 percent within 10 years. Volunteers and staff would be used to clean up the worst areas. Some areas would be closed due to high levels of trash.

### **Refuge Administration**

Refuge administration activities would be expanded, focusing on balancing threatened and endangered species, migratory birds, and wildlife and habitat diversity. Offices would be located at the Visitor Center, Fire Building and Fire Cache, Shop, Trailer, and a new administrative office building. Utilities would be upgraded. As part of the maintenance complex, a dorm facility and recreational vehicle pad facilities would be developed to support researchers, interns, and volunteers. Refuge staff would be increased to 61.5 full-time employees. The refuge would annually re-post or maintain refuge boundary signs and visitor services' signs on 20 percent of the refuge. With an emphasis on wildlife and habitat diversity, outreach and coordination efforts would be increased with Kennedy Space Center, Cape Canaveral Air Force Station, Canaveral National Seashore, Florida Fish and Wildlife Conservation Commission, and the St. Johns River Water Management District.

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Over time and by limiting the number of permits, the refuge would phase out all commercial harvesting activities, including commercial crabbing, clamming, bait fishing, hook and line fishing, and beekeeping.

## **COMPARISON OF ALTERNATIVES**

Each alternative is different in the type and level of land management and protection it would offer to achieve long-term wildlife and habitat goals. However, each is similar in its approach to managing the refuge. Each alternative would pursue the goals outlined in the comprehensive conservation plan; would acquire, protect, and enhance a diverse assemblage of habitat; and would pursue the recovery plans for those threatened and endangered species occurring on the refuge. Each alternative would be consistent with the purposes of the refuge and with the mission and goals of the National Wildlife Refuge System.

Table 14 identifies and compares the management actions under each alternative as a means of responding to the issues raised by Service managers, the public, and governmental partners. These management actions were summarized under the four alternatives previously described to accomplish the Refuge System mission and the purposes, vision, and goals of the refuge and to address the priority threats and issues raised by governmental agencies, private citizens, local businesses, and interested organizations.

**Table 14. The management alternatives are compared**

KEY TOPICS	Alternatives			
	Alternative A: Current Mgmt (No Action Alternative)	Alternative B: Threatened and Endangered Species	Alternative C: Migratory Birds	Alternative D: Wildlife and Habitat Diversity (Proposed Action)
<b>Wildlife and Habitat Management</b>				
<b>RARE, THREATENED, AND ENDANGERED SPECIES</b>				
Florida Scrub-jay – Scrub Habitats	Maintain 550 family groups across 15,000 acres. Conduct annual population survey. Utilize Kennedy Space Center’s scrub-jay research.	Expand Alternative A. Aggressively manage refuge habitats for scrub-jays. Restore and maintain 19,000-22,000 acres in optimal conditions to support 900 family groups. More aggressively manage marginal habitats (e.g., hammock and forest edges) for scrub-jays. Re-introduce scrub-jays to restored sites. Develop predator control program. Work with partners and adjacent landowners to enhance scrub-jay habitats near the refuge. Develop and implement adaptive management, research, and intensive monitoring program for scrub-jay habitat. Enhance the overall landscape of the shrub-scrub area to improve scrub-jay habitat. Investigate the	Decrease Alternative A. Maintain refuge’s portion of minimum population as described in recovery plan, estimated to be 583 family groups across 13,000 acres. (Allow hammock to grow up in scrub to support neotropical migratory birds.)	Expand Alternative A. Maintain 500-650 family groups with 350-500 territories in optimal conditions across 15,000 to 16,000 acres. Increase habitat and population monitoring. Develop and implement adaptive management program for scrub-jay habitat. Enhance the overall landscape of the shrub-scrub area to improve scrub-jay habitat.

<i>KEY TOPICS</i>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
		relationship between scrub-jay habitat and bald eagle nesting. Aggressively seek funding to restore citrus groves on former scrub sites to scrub habitats. Refuge would non-concur with Space Center development in scrub habitats.		
Bald Eagle – Flatwood and Scrub Habitats	Maintain 11-13 nesting pairs. Conduct annual nest survey. Protect nest sites during prescribed fire.	Expand Alternative A. Increase nesting to ~20 nesting pairs. Conduct intensive forest management. Actively manage pine flatwood and mixed pine hardwood forests to create and preserve future potential eagle nest tree stands. Conduct annual nest survey. Protect nest sites during prescribed fire. Develop artificial nesting platforms. Investigate the relationship between scrub-jay habitat and bald eagle nesting. Aggressively seek funding to restore citrus	Expand Alternative A. Maintain 11-13 nesting pairs. Conduct annual nest survey. Protect nest sites during prescribed fire. Focus flatwood management for neotropical migratory birds.	Expand Alternative A. Maintain 11-15 nesting pairs. Actively manage pine flatwoods forests to create and conserve future potential eagle nest tree stands. Conduct annual nest survey. Protect nest sites during prescribed fire.

<i>KEY TOPICS</i>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
		groves on former mesic sites to support pine communities.		
Sea Turtles – Beach and Estuary Habitats	Maintain 6.3 miles. Maintain nest depredation rates <10%. Conduct seasonal nest surveys. Rescue cold stunned, stranded, and injured sea turtles.	Expand Alternative A. Maintain nest depredation rates <5%. Institute active lighting control (related to Space Center and Cape Canaveral Air Force Station facilities and operations). Increase beach cleanup activities. Increase research into fibropapilloma and human impacts to turtles in lagoon system. Severely limit beach traffic (e.g., NASA Security and researchers). Restore and maintain dunes at higher elevations to create beach shadow. Consider beach and dune renourishment activities to enhance long term sea turtle nesting. Rescue cold stunned, stranded, and injured sea turtles. Increase coordination with Space Center and	Decrease Alternative A. Decrease monitoring and patrols. Maintain nest depredation rates <20%.	Expand Alternative A. Maintain 6.3 miles. Maintain nest depredation rates <10%. Conduct seasonal nest surveys. Rescue cold stunned, stranded, and injured sea turtles. Increase coordination with Space Center and Cape Canaveral Air Force Station, especially on lighting issues.

<i>KEY TOPICS</i>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
		Air Force Station.		
Southeastern Beach Mouse – Beach and Dune Habitats	Facilitate research and monitoring.	Expand Alternative A. Use refuge’s population as a source for re-introduction to other sites. Increase surveys of refuge populations and habitats. Increase research activities into habitat needs and predators. Develop predator control program, if needed. Convert woody swales and marginal habitats to dune and beach grass habitats. Investigate use of other habitats by beach mice. Evaluate implementation of a burn program. Refuge would non-concur with Space Center development in beach and dune habitats.	Same as Alternative A.	Expand Alternative A. Maintain 100 acres. Enhance and restore beach, dune, and transitional scrub habitat. Facilitate research and monitoring. Determine population numbers, population status, and available habitat. Use population as a source for reintroduction to other sites.
West Indian Manatee – Estuary Habitats	Actively manage ~12,000 acres of Banana River as a no motor zone. Maintain four idle or slow speed zones. Conduct regular law enforcement patrols for	Expand Alternative A. To reduce the size and speed of boats, limit the horsepower of outboard motors. Conduct regular law enforcement patrols for compliance. Severely limit Space	Same as Alternative A.	Expand Alternative A. Actively manage ~12,000 acres of Banana River as a no motor zone. Maintain four idle or slow speed zones. Conduct regular law enforcement patrols

<i>KEY TOPICS</i>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
	compliance.	Center and Cape Canaveral Air Force Station operations in estuarine waters. Implement slow speed zones in north Banana River and Banana Creek. Consider additional slow speed zones in the north Indian River Lagoon, south and west of the no motor zone in Banana River, and Mosquito Lagoon. Increase public outreach activities, especially for off-refuge boat ramps where boaters access the refuge. Develop and implement mandatory manatee safety training for refuge, KSC, CCAFS, contractors, and researchers using the estuarine waters of the refuge. Create a closed area buffer around the Manatee Observation Deck. Investigate the opportunity to provide freshwater in locations like Buck Creek. Investigate the		for compliance. Increase public outreach activities, especially for off-refuge boat ramps where boaters access the refuge. Develop and implement mandatory manatee safety training for refuge, Space Center, Cape Canaveral Air Force Station, contractors, and researchers using the estuarine waters of the refuge. Create a closed area buffer around the Manatee Observation Deck.

<i>KEY TOPICS</i>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
		opportunity to create deeper water holes to enhance manatee use.		
Wood Stork	Manage impoundments for multiple species, including for wood stork foraging. Conduct rookery and wetland surveys. No active nesting on refuge.	Expand Alternative A. Re-establish wood stork nesting. Conduct rookery and wetland surveys. Increase prey base. Provide artificial nest structures. Conduct research. Manage two to three target impoundments for wood stork foraging by augmenting freshwater and using active pumping to regulate water levels (e.g., M Pond, Shiloh impoundments, Duck Roost, Moore Creek, T-24-D, Gator Creek impoundments, C-21/36, and/or Picnic Island).	Same as Alternative A.	Expand Alternative A. Re-establish wood stork nesting. Manage impoundments for multiple species, including wood stork foraging. Conduct rookery and wetland surveys. Provide artificial nest structures.
Eastern Indigo Snake	No active management.	Decrease road kill by working with KSC to change shift change traffic to other than dawn and dusk hours and by increasing law enforcement and patrol on roadways. Decrease illegal poaching and	Same as Alternative A.	Same as Alternative A.

KEY TOPICS	Alternatives			
	Alternative A: Current Mgmt (No Action Alternative)	Alternative B: Threatened and Endangered Species	Alternative C: Migratory Birds	Alternative D: Wildlife and Habitat Diversity (Proposed Action)
		collecting. Investigate factors limiting indigo populations. Investigate habitat requirements and use throughout lifespan. Conduct research, inventory, and monitoring activities.		
<b>MIGRATORY BIRDS</b>				
Waterfowl	Manage 15,000-16,000 acres in impounded wetlands with a waterfowl management focus for overwintering and summer nesting. Conduct annual and monthly surveys.	Decrease Alternative A. Refocus management efforts on threatened and endangered species. Manage ≤14,000 acres in impounded wetlands for waterfowl as a food base for bald eagles.	Increase Alternative A. Manage intensively for waterfowl. Increase acres in impounded wetlands with a waterfowl focus to >16,000 acres, due to less restoration and reconnection. Support targets of 250 breeding pairs of mottled duck, 60,000 lesser scaup, 25,000 dabbling ducks, and 38,000 other diving ducks. Evaluate public use impacts to waterfowl populations. Conduct annual and monthly surveys.	Expand Alternative A. Manage 15,000-16,000 acres in impounded wetlands with a waterfowl management focus for overwintering and summer nesting. Support targets of 250 breeding pairs of mottled duck, 60,000 lesser scaup, 25,000 dabbling ducks, and 38,000 other diving ducks. Evaluate public use impacts to waterfowl populations. Conduct annual and monthly surveys.
Shorebirds	Maintain ≥2,500 acres of impounded wetlands with a shorebird focus. Conduct monthly surveys.	Decrease Alternative A. Refocus management efforts on threatened and endangered species. Manage 0	Increase Alternative A. Manage intensively for shorebirds. Increase acres in impounded wetlands with a	Expand Alternative A. Maintain ≥2,500 acres of impounded wetlands with a shorebird focus. Conduct monthly

KEY TOPICS	Alternatives			
	Alternative A: Current Mgmt (No Action Alternative)	Alternative B: Threatened and Endangered Species	Alternative C: Migratory Birds	Alternative D: Wildlife and Habitat Diversity (Proposed Action)
		acres with a shorebird focus.	shorebird focus >5,000 acres due to less restoration and reconnection. Conduct monthly surveys. Coordinate with national and regional shorebird management plans. Evaluate the habitat acreage potential of the refuge to support overwintering and fall migrating shorebirds.	surveys. Coordinate with national and regional shorebird management plans.
Wading Birds	Maintain $\geq 1,500$ acres of impounded wetlands with a focus on wading birds. Conduct monthly surveys.	Increase Alternative A. Refocus management efforts on threatened and endangered species. Increase the number of acres managed with a wading bird focus, since additional acres would be managed for wood storks.	Expand Alternative A. Increase acres in impounded wetlands with a wading bird focus >3,300 acres due to less restoration and reconnection.	Expand Alternative A. Maintain $\geq 1,500$ acres of impounded wetlands with a focus on wading birds. Conduct monthly surveys. Coordinate with national and regional wading bird management plans.
Neotropical Migratory Birds	No active management.	Decrease Alternative A. Decrease the acres of habitat available to neotropical migratory birds. Refocus management efforts on threatened and endangered species.	Expand Alternative A. Increase the number of acres managed for neotropical migratory birds. Increase the acres in mixed hardwood forest. Manage and enhance forests and shrublands	Expand Alternative A. Initiate research to determine usage and habitat requirements of neotropical migratory birds. Enhance habitat.

KEY TOPICS	Alternatives			
	Alternative A: Current Mgmt (No Action Alternative)	Alternative B: Threatened and Endangered Species	Alternative C: Migratory Birds	Alternative D: Wildlife and Habitat Diversity (Proposed Action)
			for neotropical migratory birds. Conduct surveys, research, and monitoring.	
<b>EXOTIC, INVASIVE, AND NUISANCE SPECIES</b>				
Control of Exotic Plants	Continue to pursue grants from State of Florida. Intermittently spray dikes, roads, and public use areas.	Expand Alternative A. Refocus management of exotic plants to habitats serving threatened and endangered species. Conduct surveys, develop database, control on 30% of refuge, and eliminate target exotic plants in habitats serving threatened and endangered species.	Expand Alternative A. Refocus management of exotic plants away from existing public use areas to core habitat areas serving migratory birds.	Expand Alternative A. Continue to pursue grants from State of Florida. Conduct surveys, develop database, control plants on 30% of refuge annually, and eliminate target exotic plants.
Control of Feral Hogs	Continue hog permits to remove 2,000-2,500 individuals per year.	Expand Alternative A. Increase efforts to remove $\geq 4,000$ hogs per year and focus removal efforts in habitats serving threatened and endangered species.	Same as Alternative A.	Expand Alternative A. Increase efforts to remove a target of 4,000 hogs per year.
<b>WILDLIFE AND HABITAT DIVERSITY</b>				
Natural and Spoil Islands	No active management.	Expand Alternative A. Manage for wood stork nesting.	Expand Alternative A. Evaluate and characterize all refuge islands with the potential to serve migratory birds. Restore 6 islands to	Expand Alternative A. Evaluate and characterize. Restore 7 altered natural islands. Restore 3 islands to sand/shell. Restore 2-3 islands to grassy cover.

KEY TOPICS	Alternatives			
	Alternative A: Current Mgmt (No Action Alternative)	Alternative B: Threatened and Endangered Species	Alternative C: Migratory Birds	Alternative D: Wildlife and Habitat Diversity (Proposed Action)
			sand/shell. Restore 6 islands to grassy cover. Establish buffers for all nesting and roosting islands serving migratory birds.	Establish buffers for targeted nesting and roosting islands.
Seagrass Beds	No active management.	Expand Alternative A. Work with partners to maintain or increase current level (~27,000 acres). Decrease prop scarring to levels at or below Florida Fish and Wildlife Conservation Commission's definition of light scarring.	Same as Alternative B.	Expand Alternative A. Work with partners to maintain current level (~27,000 acres). Decrease prop scarring to levels at or below Florida Fish and Wildlife Conservation Commission's definition of light scarring.
Restoration of Citrus Groves to Native Habitat	Agreement to actively manage ~700 acres in citrus groves. Began restoration of ~500 acres to hardwood and pine plantation. Restored 10 acres to scrub habitat with marginal success.	Expand Alternative A. Implement additional restoration to scrub habitat or pine communities based on soils and historic habitat types to benefit threatened and endangered species. Evaluate 1,300 acres for suitability for restoration to habitats serving threatened and endangered species. Aggressively seek funding for restoration.	Expand Alternative A. Implement additional restoration to hammock habitats. Resist Space Center development on soils that would support hammocks. Accelerated the restoration process.	Expand Alternative A. Restore 200 acres to approximate native vegetation. Evaluate 1,100 acres for suitability for restoration or Space Center development. Continue to manage farmable groves until restoration is possible.
Restoration of Estuarine	Restored over 550	Expand Alternative A.	Expand Alternative A.	Expand Alternative A.

<i>KEY TOPICS</i>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
Impounded Wetlands to Mimic Natural-like Conditions	acres. Actively pursuing additional restoration opportunities.	Evaluate impoundments for their roles related to eastern indigo snakes and wood storks. Potential increase in the number of acres restored from alternatives A and D.	Evaluate the role of impoundments and restored impoundments for migratory birds. Restore 600 acres of impounded wetlands. Actively manage all remaining impoundments.	Restore 1,200 acres across 10 targeted impoundments. Evaluate restoration of an additional 3,100 acres across 11 targeted impoundments. Restore dredge impacted wetlands.
Interior Freshwater Wetlands	Restored ~100 acres of overgrown swales by removing woody vegetation to enhance scrub landscape.	Expand Alternative A. Remove woody vegetation from swales in scrub landscape. Expand inventory and monitoring activities in wetlands related to threatened and endangered species.	Expand Alternative A. Maintain mix of woody and grassy swales reflecting the natural ridge and trough topography to serve migratory birds. Restore ~1,000 acres. Expand inventory and monitoring activities in wetlands related to migratory birds.	Expand Alternative A. Maintain ~100 acres of restored wetlands. Evaluate and restore remaining altered freshwater wetlands for a diversity of species. Mimic natural hydrologic function. Restore overgrown swales to enhance scrub-jay habitat.
Wildlife Impacts from Vehicle Collisions	Occasional law enforcement patrols to regulate speeds. Remove road kill from roadways to protect bald eagles. Control feral hog population.	Expand Alternative A. Reduce impacts and mortality to threatened and endangered species from vehicles. Remove road kill from roadways to protect bald eagles. Close State Route 406 from State Routes 3 to 402 from dusk to dawn. Develop baseline roadway mortality data.	Expand Alternative A. Reduce impacts and mortality to migratory birds from vehicles. Remove road kill from roadways to protect bald eagles. Develop baseline roadway mortality data. Develop active outreach and education programs. Increase law	Expand Alternative A. Routine law enforcement patrols to regulate speeds. Remove road kill from roadways to protect bald eagles. Control feral hog population. Close State Route 406 from State Routes 3 to 402 from dusk to dawn. Develop baseline roadway

KEY TOPICS	Alternatives			
	Alternative A: Current Mgmt (No Action Alternative)	Alternative B: Threatened and Endangered Species	Alternative C: Migratory Birds	Alternative D: Wildlife and Habitat Diversity (Proposed Action)
		Develop active outreach and education programs. Increase law enforcement efforts. Work with partners to reduce speed limits on roadways. Investigate habitat alterations to protect species.	enforcement efforts. Work with partners to reduce speed limits on roadways. Investigate habitat alterations to protect species.	mortality data. Develop outreach and education programs. Work with partners to reduce speed limits on roadways. Investigate habitat alterations to protect species.
Fish Populations in Estuary and Impounded Wetlands	~4,500 acres of impoundments are primarily managed and ~513 acres were restored to enhance fisheries. A total of 7,175 acres of impoundments have a fisheries component.	Expand Alternative A. Stock two to three impoundments for wood storks.	Expand Alternative A. Intensively manage impoundments (e.g., aeration, rotary ditching, in-migration fish ladders, and pumps) to enhance fisheries as food source for migratory birds.	Expand Alternative A. ~4,500 acres of impoundments are primarily managed and ~513 acres were restored to enhance fisheries. A total of 7,175 acres of impoundments have a fisheries component. Develop baseline inventory. Re-inventory every 5 years. Evaluate management necessary to maintain population levels.
Herpetological Species (e.g. frogs, toads, snakes, and lizards)	No active management.	Same as Alternative A.	Expand Alternative A. Increase herpetological species as food source for migratory birds. Increase freshwater wetlands.	Expand Alternative A. Every 3 years monitor 5% of refuge for changes in population dynamics.
<b>Resource Protection</b>				
<b>ACQUISITION BOUNDARY</b>				

<i>KEY TOPICS</i>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
Acquire Inholdings in Turnbull Creek Area	No active acquisitions.	Same as Alternative A.	Same as Alternative A.	Expand Alternative A. Purchase from willing sellers as funding is available. Prioritize acquisition key inholdings. Increase partnership opportunities.
Transfer Bill's Hill from CNS to Refuge	No active management. Assist Canaveral National Seashore with prescribed burning, wildfire control, and habitat management.	Expand Alternative A. Expand the acquisition boundary to encompass Bill's Hill and the adjacent federal estuarine waters. Obtain management authority or fee title ownership.	Same as Alternative A.	Same as Alternative B.
<b>LEASE/MANAGEMENT AGREEMENTS</b>				
Rookery Covered by Tank Island Lease	Lease includes Island only to mean high water.	Expand Alternative A. Amend the lease agreement to develop a 450-foot protective closed area buffer.	Same as Alternative B.	Same as Alternative B.
<b>ARCHAEOLOGICAL AND HISTORICAL RESOURCES</b>				
Kennedy Space Center	Seashore is lead on those resources in the overlap area. Respond as issues arise. Occasional law enforcement patrols.	Same as Alternative A.	Same as Alternative A.	Expand Alternative A. Seashore is lead on those resources in the overlap area. Respond as issues arise. Occasional law enforcement patrols. Locate all known cultural resource sites within Kennedy Space Center.

KEY TOPICS	Alternatives			
	Alternative A: Current Mgmt (No Action Alternative)	Alternative B: Threatened and Endangered Species	Alternative C: Migratory Birds	Alternative D: Wildlife and Habitat Diversity (Proposed Action)
Turnbull Creek	Extent of cultural resources is unknown.	Same as Alternative A.	Same as Alternative A.	Expand Alternative A. Identify any sites. Add them to the protection program.
Protection	Respond as issues arise. Occasional law enforcement patrols.	Same as Alternative A.	Same as Alternative A.	Expand Alternative A. Develop a protection program. Develop a regular patrol and enforcement program.
<b>Visitor Services</b>				
<b>WELCOME AND ORIENT VISITORS</b>				
Providing Information to the Public	Provide information at one refuge kiosk. Maintain web site. Provide information at Visitor Center through volunteers, exhibits, and movie. Provide refuge brochures and maps.	Expand Alternative A. Provide information at one refuge kiosk. Maintain web site. Provide information at Visitor Center through volunteers, exhibits, and movie. Provide refuge brochures and maps. Expand Visitor Center.	Same as Alternative A.	Expand Alternative A. Provide information at three refuge kiosks. Maintain web site. Provide information at Visitor Center through volunteers, exhibits, and movie. Provide refuge brochures and maps.
<b>HUNTING</b>				
Waterfowl Hunting Opportunities	~36,000 acres open to hunting 3 days per week during the state hunt season with 2 quota areas and 2 open hunt areas. Conduct regular law enforcement patrols. Monitor hunter success and harvest through check stations.	Decrease Alternative A. Decrease waterfowl hunting activities (e.g., number of days and/or acres available).	Decrease Alternative A. Eliminate waterfowl hunting program.	Expand Alternative A. Add the Turnbull marshes to the waterfowl hunt program.

KEY TOPICS	Alternatives			
	Alternative A: Current Mgmt (No Action Alternative)	Alternative B: Threatened and Endangered Species	Alternative C: Migratory Birds	Alternative D: Wildlife and Habitat Diversity (Proposed Action)
Upland Game Hunting Opportunities	No active management. No upland game hunting.	Same as Alternative A.	Same as Alternative A.	Expand Alternative A. Develop feral hog and deer hunt program.
Alligator Hunting Opportunities	No active management. No alligator hunting.	Same as Alternative A.	Same as Alternative A.	Expand Alternative A. Evaluate the feasibility for an alligator hunt.
<b>FISHING</b>				
Estuarine Fishing Opportunities	No active management. Occasional law enforcement patrols. Conducted two creel surveys and two aerial surveys.	Expand Alternative A. Investigate the impacts of flats fishing on sea turtles and manatees. Implement any necessary management actions to limit any impacts (e.g., closed areas and horsepower limits).	Expand Alternative A. Decrease disturbance by implementing closed areas for overwintering birds from November through March (e.g., close Mosquito Lagoon south of Haulover Canal).	Expand Alternative A. Develop flats fishing program. Develop pole/troll zones. Develop ethical flats fishing outreach materials. Develop partnerships with stakeholders to monitor compliance and to educate other users. Regular law enforcement patrols.
Freshwater Fishing Opportunities	No active management. One mercury survey conducted.	Same as Alternative A.	Same as Alternative A.	Expand Alternative A. Develop partnership(s) to expand freshwater fishing program to several borrow pit ponds.
<b>WILDLIFE OBSERVATION AND PHOTOGRAPHY</b>				
Wildlife Viewing and Photography Opportunities	Facilities include Visitor Center, Black Point Wildlife Drive, Manatee Observation	Decrease Alternative A. Eliminate wildlife viewing and photography in habitats serving	Similar to Alternative A. Facilities include Visitor Center, Manatee Observation Deck,	Expand Alternative A. Facilities include Visitor Center, Black Point Wildlife Drive, Manatee

KEY TOPICS	Alternatives			
	Alternative A: Current Mgmt (No Action Alternative)	Alternative B: Threatened and Endangered Species	Alternative C: Migratory Birds	Alternative D: Wildlife and Habitat Diversity (Proposed Action)
	Deck, five trails, two observation tower, and 113 miles of public roads and dike roads. ~21 miles of dike roads are seasonally closed from November to mid February.	threatened and endangered species (e.g., close Scrub Ridge Trail, Black Point Wildlife Drive, and wood stork impoundments). Visitor facilities include Visitor Center, Manatee Observation Deck, three trails, and ~60 miles of public roads and dike roads (~50 miles of dike roads to be closed).	Black Point Wildlife Drive, five trails, two observation tower, and 113 miles of public roads and dike roads. ~61 miles of dike roads along marshes would be seasonally closed from November through March.	Observation Deck, eleven upland trails, six observation towers, two 10-person observation blinds with spotting scopes, Americans with Disabilities Act-approved restrooms on Black Point Wildlife Drive, six canoe/kayak trails, rookery viewing complex, and 131 miles of public roads and dike roads. ~21 miles of dike roads to be seasonally closed from November through March.
<b>ENVIRONMENTAL EDUCATION</b>				
Environmental Education Opportunities	Historically, the refuge responded to requests for environmental education programs. Conduct one annual college program. Continue Canaveral National Seashore an environmental education partnership. Occasional teacher workshops.	Expand Alternative A. Focus educational messages on threatened and endangered species. Continue Canaveral National Seashore environmental education partnership. Develop an environmental education program where at least 30% of north Brevard County grades 4-8 would annually participate in environmental education	Expand Alternative A. Focus educational messages on migratory bird. Continue Canaveral National Seashore environmental education partnership. Develop an environmental education program where at least 30% of north Brevard County grades 4-8 would annually participate in	Expand Alternative A. Continue Canaveral National Seashore environmental education partnership. Develop an environmental education program where at least 30% of north Brevard County grades 4-8 would annually participate in environmental education programs of the refuge. Recruit and train 5-10 volunteers to assist teachers with these

<i>KEY TOPICS</i>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
		programs of the refuge. Recruit and train 5-10 volunteers to assist teachers with these programs. Develop curriculum-based education programs based on habitats serving threatened and endangered species. Conduct at least two workshops per year.	environmental education programs of the refuge. Recruit and train 5-10 volunteers to assist teachers with these programs. Develop curriculum-based education programs based on habitats serving migratory birds. Conduct at least two workshops per year.	programs. Develop four curriculum-based education programs: lagoonal waters, wetlands, scrub, and pine flatwoods. Conduct at least two workshops per year.
Visitor Center Visitation	Opened in 1984. 2,600 square feet. Serve >60,000 annual visitors. Annually host two festivals. Periodic update of exhibits.	Expand Alternative A. Refocus messages to threatened and endangered species. Develop a vicarious experience for refuge visitors (since in the field experiences are limited). Increase visitation to Visitor Center and expand the square footage of the Visitor Center. Increase movies, interpretive presentations, and exhibits, including interactive exhibits. Annually host one festival, focusing on threatened and	Similar to Alternative A. Refocus messages to migratory birds. Continue to host the Welcome Back Songbird Festival and participate in the Spacecoast Flyway Festival.	Expand Alternative A. Maintain wildlife diversity messages. Opened in 1984. 5,200 square feet. Annually host two festivals. Periodic update of exhibits. Expand parking lot to 40 spaces. Increase visitation.

KEY TOPICS	Alternatives			
	Alternative A: Current Mgmt (No Action Alternative)	Alternative B: Threatened and Endangered Species	Alternative C: Migratory Birds	Alternative D: Wildlife and Habitat Diversity (Proposed Action)
		endangered species.		
Interpretive Programs	Annually conduct ~50 interpretative programs. From November-March the refuge offers volunteer guided birding tours twice weekly.	Expand Alternative A. Refocus interpretive programs to threatened and endangered species. Most interpretive programs would occur at the Visitor Center. Eliminate birding tours. Increase the numbers of interpretive presentations.	Same as Alternative A.	Expand Alternative A. Increase the number of annual programs by 25% to ~63. From November-March the refuge offers volunteer guided birding tours twice weekly.
Number of Interpretive Trails	Four trails with limited interpretive signs.	Decrease Alternative A. Eliminate Scrub Ridge Trail. Maintain three trails on the refuge: Visitor Center, Oak Hammock, and Palm Hammock.	Same as Alternative A.	Expand Alternative A. Add interpretive trails. Improve interpretive signs along existing trails.
Manatee Observation Deck	Interpretive volunteer occasionally on site. Two interpretive signs.	Expand Alternative A. Increase interpretive opportunities and staffing on site.	Same as Alternative A.	Expand Alternative A. Increase interpretive opportunities and staffing on site.
Kennedy Space Center Visitor Center	Joint Seashore and refuge exhibit at Kennedy Space Center's Visitor Center. No on site staff.	Decrease Alternative A. Remove exhibit from Kennedy Space Center's Visitor Center.	Same as Alternative B.	Expand Alternative A. Improve outreach at Kennedy Space Center's Visitor Center. Provide refuge brochures and maps. Provide training to all Space Center tour bus operators.

KEY TOPICS	Alternatives			
	Alternative A: Current Mgmt (No Action Alternative)	Alternative B: Threatened and Endangered Species	Alternative C: Migratory Birds	Alternative D: Wildlife and Habitat Diversity (Proposed Action)
<b>OUTREACH</b>				
Kennedy Space Center Workers	Minimal outreach through staff meetings, wildlife call responses, and operational meetings. Participate in Space Center's annual Energy and Environmental Awareness Day. Occasional articles in Space Center's Bulletin newsletter.	Expand Alternative A. Focus all messages on threatened and endangered species. Increase participation in Space Center's monthly newsletter, especially regarding impacts to threatened and endangered species.	Expand Alternative A. Focus all messages on migratory birds. Increase participation in Space Center's monthly newsletter, especially regarding impacts to migratory birds.	Expand Alternative A. Increase outreach to Space Center staff in key positions. Increase participation in Space Center's monthly newsletter. Increase participation in Space Center events. Increase Space Center worker participation in refuge activities (e.g., beach cleanups).
Local Residents	Occasional programs provided on request to local organizations. Partner for one local festival.	Same as Alternative A.	Same as Alternative A.	Expand Alternative A. Increase outreach to local residents such that 50% sampled would recognize the location and importance of the refuge.
<b>VOLUNTEERS</b>				
Volunteers	~70 active volunteers. >165 total volunteers. Average 6,500 annual hours of volunteer service. Conduct volunteer orientation, an annual refresher, and informal on the job training.	Expand Alternative A. Increase the number of volunteers to serve the Visitor Center, monitor impacts, and conduct surveys. Focus messages on threatened and endangered species. Conduct volunteer orientation, an annual refresher, and	Expand Alternative A. Increase the number of volunteers to serve the Visitor Center, monitor impacts, and conduct surveys. Focus messages on migratory birds. Conduct volunteer orientation, an annual refresher, and informal on the job	Expand Alternative A. Increase number of active volunteers. Fill at least 75% of needed volunteer positions. Focus messages on wildlife diversity. Conduct volunteer orientation, an annual refresher, and informal on the job training.

KEY TOPICS	Alternatives			
	Alternative A: Current Mgmt (No Action Alternative)	Alternative B: Threatened and Endangered Species	Alternative C: Migratory Birds	Alternative D: Wildlife and Habitat Diversity (Proposed Action)
		informal on the job training. Increase training for volunteers. Survey volunteers to determine satisfaction levels. Increase satisfaction such that over 75% of volunteers are highly satisfied.	training. Increase training for volunteers. Survey volunteers to determine satisfaction levels. Increase satisfaction such that over 75% of volunteers are highly satisfied.	Increase training for volunteers. Survey volunteers to determine satisfaction levels. Increase satisfaction such that over 75% of volunteers are highly satisfied.
<b>FRIENDS GROUP</b>				
Merritt Island Wildlife Association	>900 Merritt Island Wildlife Association members (in 2004). Current projects include the Sandler Education Outpost and wildlife viewing enhancements (e.g., blinds and a trail) at Black Point Wildlife Drive.	Expand Alternative A. Support Merritt Island Wildlife Association to promote growth in membership and financial revenues. Work to align refuge's and Association's interests. Encourage Association to hire employees who support the refuge. Encourage Association to reach new visitors.	Same as Alternative B.	Same as Alternative B.
<b>CONCESSION OPERATIONS</b>				
Concession Operations	No concession operations.	Same as Alternative A.	Same as Alternative A.	Expand Alternative A. Evaluate the establishment of a concession operation to bring all commercial guides under a single point of contact.

KEY TOPICS	Alternatives			
	Alternative A: Current Mgmt (No Action Alternative)	Alternative B: Threatened and Endangered Species	Alternative C: Migratory Birds	Alternative D: Wildlife and Habitat Diversity (Proposed Action)
<b>FEE PROGRAM</b>				
Fees	Waterfowl quota hunt fee of \$12.50 per permit. Incidental business permit fee of \$250/2 years.	Expand Alternative A. Increase the fees. Collect fees for waterfowl hunting and incidental business permits. Eliminate commercial fishing guides. Evaluate other commercial uses for impacts.	Expand Alternative A. Increase the fees. Collect fees for incidental business permits. Eliminate commercial fishing guides. Evaluate other commercial uses for impacts.	Expand Alternative A. Implement waterfowl quota hunt fee, upland game fee, sports fishing permit fee, and Black Point Wildlife Drive fee sufficient to cover administrative and maintenance costs. Increase incidental business permit fees to \$500/2 years. Cap commercial guides at 50 permits.
<b>LITTER</b>				
Control of Trash and Litter	Use volunteers and staff to clean worst areas. Close some areas to use due to trash. Agreement with Canaveral National Seashore to empty trash cans at Haulover Canal. Control of trash and litter is minimally effective.	Expand Alternative A. Eliminate bank fishing and crabbing. Eliminate alcoholic beverages and glass containers. Use volunteers and staff to clean worst areas. Agreement with Canaveral National Seashore to empty trash cans at Haulover Canal.	Expand Alternative A. Seasonal dike closures would eliminate bank fishing and crabbing seasonally. Eliminate alcoholic beverages and glass containers. Use volunteers and staff to clean worst areas. Agreement with Canaveral National Seashore to empty trash cans at Haulover Canal.	Expand Alternative A. Decrease trash on refuge by 50% within 5 years and 75% within 10 years from current levels. Use volunteers and staff to clean worst areas. Close some areas to use due to trash. Agreement with Canaveral National Seashore to empty trash cans at Haulover Canal.

KEY TOPICS	Alternatives			
	Alternative A: Current Mgmt (No Action Alternative)	Alternative B: Threatened and Endangered Species	Alternative C: Migratory Birds	Alternative D: Wildlife and Habitat Diversity (Proposed Action)
<b>Refuge Administration</b>				
<b>REFUGE MANAGEMENT</b>				
Administrative Facilities, Utilities, Dorm Facility, and Signs	Offices located at Visitor Center, Fire Office, Shop, Fire Cache, and Administrative Trailer. Continue to use NASA's utilities and BioLab research facility. Attempt to maintain boundary signs. Maintain visitor services signs.	Offices located at Visitor Center, Fire Office, Shop, Fire Cache, and Administrative Trailer. Develop an administrative office building near existing facilities. Upgrade water, sewer, phone, fax, and computer utilities. Locate a dorm facility and recreational vehicle pad facilities for researchers, interns, and volunteers adjacent to the existing and planned administrative facilities. Annually re-post or maintain boundary and visitor services signs on 20% of the refuge.	Same as Alternative B.	Same as Alternative B.
Staff	Average 29 full-time and 6 term/temporary staff.	Expand Alternative A. >60 staff.	Expand Alternative A. >54 staff.	Expand Alternative A. 61.5 staff.
<b>INTERGOVERNMENTAL COORDINATION</b>				
Relationship with Kennedy Space Center, NASA	Operate under updated management agreement. Minimal outreach activities. Coordinate with Kennedy Space Center	Expand Alternative A. Increase outreach and coordination efforts with an emphasis on threatened and endangered species.	Expand Alternative A. Increase outreach and coordination efforts with an emphasis on migratory birds.	Expand Alternative A. Increase outreach and coordination efforts with an emphasis on wildlife and habitat diversity.

<i>KEY TOPICS</i>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
	on facility siting, mitigation, fire, law enforcement, nuisance wildlife, and security.			
Relationship with Cape Canaveral Air Force Station, U.S. Air Force	Sporadic coordination. Coordination is predominantly related to fire and smoke management.	Expand Alternative A. Increase coordination with an emphasis on threatened and endangered species. Formalize an agreement related to fire and habitat management on Cape Canaveral Air Force to benefit scrub-jays.	Expand Alternative A. Increase coordination with an emphasis on migratory birds.	Expand Alternative A. Institute routine coordination meetings to influence planning and implementation at Cape Canaveral Air Force Station.
Relationship with Canaveral National Seashore, National Park Service	Minimal coordination.	Expand Alternative A. Increase coordination efforts active management support with an emphasis on threatened and endangered species.	Expand Alternative A. Increase coordination efforts with an emphasis on migratory birds.	Expand Alternative A. Foster team approach and increase efficiencies.
Relationship with Florida Fish and Wildlife Conservation Commission, State of Florida	Minimal coordination.	Expand Alternative A. Increase coordination with an emphasis on threatened and endangered species.	Expand Alternative A. Increase coordination efforts with an emphasis on migratory birds.	Expand Alternative A. Increase coordination efforts on programs of mutual interest.
Relationship with St. Johns River Water Management District, State of Florida	Minimal coordination related to regulatory activities. Conflict exists between agency management philosophies.	Expand Alternative A. Increase refuge's influence and the importance of threatened and endangered species in projects funded under the Surface Water	Increase coordination efforts due to differences in institutional objectives. Potential for coordination to degrade below levels in	Expand Alternative A. Increase coordination efforts on programs of mutual interest.

KEY TOPICS	Alternatives			
	Alternative A: Current Mgmt (No Action Alternative)	Alternative B: Threatened and Endangered Species	Alternative C: Migratory Birds	Alternative D: Wildlife and Habitat Diversity (Proposed Action)
		Improvement Management Plan.	Alternative A. Potential to increase conflicts.	
<b>COMMERCIAL HARVESTING</b>				
Number of Permits for Commercial Crabbing, Clamming, Bait Fishing, and Hook and Line Fishing	~50 active permits. No cap on the number of permits that could be issued.	Decrease Alternative A. Eliminate all commercial harvesting permits.	Same as Alternative B.	Decrease Alternative A. Limit these permits to current permit holders (~70). Phase out use over time.
Number of Permits for Apiary Sites	10 permits issued in 2004 for 53 sites.	Decrease Alternative A. Eliminate all beekeeping permits.	Same as Alternative B.	Decrease Alternative A. Limit these permits only to those users holding permits in 2004. Cap maximum number of sites at 53. Phase out over time.

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## *IV. Environmental Consequences*

### **OVERVIEW**

The Service assessed the environmental impacts of implementing the alternatives on the biological, physical, social, economical, cultural, and historical resources of the refuge. Specific environmental and social impacts of implementing each alternative are discussed in the Table 15 under four broad management categories: wildlife and habitat management; resource protection; visitor services; and refuge administration. Outlined are the anticipated impacts over the 15-year life of the CCP that could result from the implementation of the actions described in alternatives A, B, C, and D. Implementation of any of the action alternatives (i.e., Alternatives B, C, and D) is anticipated to have positive impacts to area land values, related employment and income, and outdoor recreational and environmental education opportunities.

Parks (and, by extension, refuges) provide numerous benefits, including a sense of community, improved quality of life, shared environment in which people can connect and interact, and a channel for positive community participation by getting diverse people to work together towards a shared vision (Francis 2002), as well as provide for increased property values and municipal revenues, attraction and retention of affluent retirees, attraction of knowledge workers and talent, and attraction of home buyers (Lewis 2002).

### **EFFECTS COMMON TO ALL ALTERNATIVES**

A few potential effects would be similar under each of the alternatives.

### *CULTURAL RESOURCES*

The Fish and Wildlife Service is responsible for managing archaeological and historical sites found on refuge lands. Since cultural resource surveys on the refuge have been limited, additional surveys would be conducted prior to any new construction or excavation on refuge lands in order to fully satisfy provisions of the National Environmental Policy Act of 1969 and all applicable cultural resource laws and policies. Potentially negative impacts from construction of trails or facilities would require the review by the Service's Regional Archaeologist and consultation with the Florida State Historic Preservation Office. Determining whether a particular management action has the potential to affect cultural resources is an on-going process that would occur during the detailed planning stages of every project. Service acquisition of land with known or potential archaeological or historical sites provides three major types of protection for these resources – protection from private development (e.g., into single-family homes), protection from damage by federal activities, and protection from vandalism or theft. Service policy is to preserve these resources in the public trust, avoiding impacts whenever possible. Minimal or no negative impacts are anticipated for any particular cultural resources of the refuge under any of the alternatives. As a whole, positive impacts are expected to the cultural resources due to management and protection of these resources under all of the alternatives. However, the level of positive impacts to cultural resources varies by alternative.

### *ENVIRONMENTAL JUSTICE*

None of the management alternatives described in this environmental assessment would disproportionately place any adverse environmental, economical, social, or health impacts on minority

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or low-income populations. Implementation of any action alternative that includes public use and environmental education is anticipated to benefit minority and low-income citizens living in the vicinity of Merritt Island National Wildlife Refuge.

### *CLIMATE CHANGE*

The U.S. Department of the Interior requires agencies under its direction to consider potential climate change impacts as part of long-range planning. The increase of carbon within the earth's atmosphere has been linked to the gradual rise in surface temperature commonly referred to as global warming. In relation to comprehensive conservation planning for national wildlife refuges, carbon sequestration constitutes the primary climate-related impact to be considered in planning. The U.S. Department of Energy defines carbon sequestration as "...the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere" (U.S. Department of Energy 1999). The land is a tremendous force in carbon sequestration. Terrestrial biomes of all sorts (e.g., grasslands, wetlands, and forests) are effective in both preventing carbon emission and acting as a biological scrubber of atmospheric carbon monoxide. The Department of Energy report's conclusions noted that ecosystem protection is important to carbon sequestration and may reduce or prevent loss of carbon currently stored in the terrestrial biosphere.

Conserving natural habitat for fish and wildlife is the heart of any long-range plan for national wildlife refuges. The actions proposed in this plan and environmental assessment would conserve or restore land and water, and would thus enhance carbon sequestration. This in turn contributes positively to efforts to mitigate human-induced global climate changes.

### *SOILS*

All alternatives are anticipated to positively impact soil formation processes on lands the refuge acquires. Some disturbances to surface soils and topography would occur at those locations selected for administrative, maintenance, and visitor facilities, as well as in areas targeted for exotic and invasive species removal and eradication. However, these limited impacts would be at discrete sites.

### *WATER QUALITY, WETLANDS, AND FLOOD PLAINS*

All alternatives are anticipated to positively impact water quality. Positive impacts are anticipated from protecting groundwater recharge, preventing runoff, retaining sediment, and minimizing non-point source pollution and boating in select areas. The proposed management alternatives are not anticipated to have any adverse effects on the area's wetland and flood plains, pursuant to Executive Orders 11990 and 11988. Further, the refuge provides protection to lands and waters that would otherwise be developed into commercial and residential uses in the near future.

### *AESTHETICS*

Each alternative would protect the aesthetic characteristics associated with natural habitats. Minor, short-term, discrete negative aesthetic impacts may result from habitat management, restoration, and facility development activities, but these are short-lived and are offset by refuge management and resultant native habitats.

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## *VISITOR SERVICES*

Under any of the alternatives, the Service would consult with local and state officials and the public during detailed planning for and construction of any new facilities.

## *SOCIOECONOMIC ENVIRONMENT*

Each of the alternatives is anticipated to positively impact socioeconomic factors of the community. Although the refuge does occupy lands that might provide income to the local tax base (if NASA left and if the lands were developed), those lost tax revenues are offset by enhanced property values on adjacent lands and improved aesthetics related to conservation lands and open space. Further, the refuge does provide Volusia County with Refuge Revenue Sharing Act payments in lieu of property tax income. (When and if the Service acquired lands in Brevard County, revenue sharing payments would then also be made to Brevard County.) And, conservation lands require less expenditure of local taxes to fund infrastructure and other services than required by developed lands.

## *PUBLIC HEALTH AND SAFETY*

Based on the nature of each alternative, the location of the refuge, and current land use, all alternatives are not anticipated to have any significant negative impacts on the quality of the human environment, including public health and safety.

## **SUMMARY OF EFFECTS OF ALTERNATIVES**

Each of the alternatives is anticipated to result in net positive environmental benefits. Impacts under each alternative are summarized for soils; air quality; hydrology and water quality; and biological resources.

### *ALTERNATIVE A – CURRENT MANAGEMENT (NO ACTION ALTERNATIVE)*

Implementation of Alternative A is anticipated to result in net positive environmental benefits.

The management activities outlined under Alternative A are anticipated to have net neutral to positive impacts on soils.

The management activities outlined under Alternative A would help to improve air quality. Minor, short-term negative air quality impacts could be experienced during controlled burns or wildfires. However, these impacts are offset by the positive impacts of the resultant higher quality native habitats.

The management activities outlined under Alternative A are anticipated to have net positive impacts to hydrology and water quality. Minor restoration activities of citrus groves, impounded wetlands, and interior freshwater wetlands are anticipated to positively impact hydrology and water quality. Positive impacts would also result from the acquisition, protection, and management of additional lands.

The management activities outlined under Alternative A are anticipated to have net positive impacts to biological resources. Habitat management activities would result in high-quality habitats supporting native wildlife and wildlife diversity.

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## *ALTERNATIVE B – THREATENED AND ENDANGERED SPECIES*

Implementation of Alternative B is anticipated to result in net positive environmental benefits.

The management activities outlined under Alternative B are anticipated to have net positive impacts on soils. Restoring citrus groves and impounded wetlands and managing habitats would positively impact soils and soil formation processes.

The management activities outlined under Alternative B would help to improve air quality. Minor, short-term negative air quality impacts could be experienced during controlled burns or wildfires. However, these impacts are offset by the positive impacts of the resultant higher quality native habitats.

The management activities outlined under Alternative B are anticipated to have net positive impacts to hydrology and water quality. Restoration activities of citrus groves, impounded wetlands, and interior freshwater wetlands are anticipated to positively impact hydrology and water quality. The maintenance and spread of seagrasses and the decreased prop scarring would also result in positive hydrology and water quality impacts. And positive hydrology and water quality impacts would result from the acquisition, protection, and management of additional lands.

The management activities outlined under Alternative B are anticipated to have net positive impacts to biological resources. Habitat management activities would result in high-quality habitats supporting increased numbers of threatened and endangered species and native wildlife and wildlife diversity.

## *ALTERNATIVE C – MIGRATORY BIRDS*

Implementation of Alternative C is anticipated to result in net positive environmental benefits.

The management activities outlined under Alternative C are anticipated to have net positive impacts on soils. Restoring citrus groves, managing habitats, restoring impounded wetlands, and restoring natural islands would positively impact soils and soil formation processes.

The management activities outlined under Alternative C would help to improve air quality. Minor, short-term negative air quality impacts could be experienced during controlled burns or wildfires. However, these impacts are offset by the positive impacts of the resultant higher quality native habitats.

The management activities outlined under Alternative C are anticipated to have net positive impacts to hydrology and water quality. Restoration activities of citrus groves, impounded wetlands, and interior freshwater wetlands are anticipated to positively impact hydrology and water quality. The maintenance and spread of seagrasses and the decreased prop scarring would also result in positive hydrology and water quality impacts. And positive hydrology and water quality impacts would result from the acquisition, protection, and management of additional lands.

The management activities outlined under Alternative C are anticipated to have net positive impacts to biological resources. Habitat management activities would result in high-quality habitats supporting increased numbers of migratory birds and native wildlife and wildlife diversity.

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## *ALTERNATIVE D – WILDLIFE DIVERSITY (PROPOSED ACTION)*

Implementation of Alternative D is anticipated to result in net positive environmental benefits.

The management activities outlined under Alternative D are anticipated to have net positive impacts on soils. Restoring citrus groves, managing habitats, restoring impounded wetlands, and restoring natural islands would positively impact soils and soil formation processes.

The management activities outlined under Alternative D would help to improve air quality. Minor, short-term negative air quality impacts could be experienced during controlled burns or wildfires. However, these impacts are offset by the positive impacts of the resultant higher quality native habitats.

The management activities outlined under Alternative D are anticipated to have net positive impacts to hydrology and water quality. Restoration activities of citrus groves, impounded wetlands, and interior freshwater wetlands are anticipated to positively impact hydrology and water quality. The maintenance of seagrasses and the decreased prop scarring would also result in positive hydrology and water quality impacts. And positive hydrology and water quality impacts would result from the acquisition, protection, and management of additional lands.

The management activities outlined under Alternative D are anticipated to have net positive impacts to biological resources. Habitat management activities would result in high-quality habitats supporting native wildlife and wildlife diversity.

## **COMPARISON OF EFFECTS FROM IMPLEMENTING ALTERNATIVES**

While the four alternatives share similarities, their differences result in varying types and levels of impacts. None of the proposed management activities would lead to a violation of federal, state, or local laws imposed for the protection of the environment. Alternative A does not propose any change in the present management direction. As such, Alternative A serves as the baseline for comparing the other alternatives. Without funding and staffing to support needed programs and to provide protection for the resources, Alternative A provides the least support for long-term productivity and sustainability of the refuge. Alternative D provides the most benefits to the refuge, the natural resources supported by the refuge, and the local community, supporting long-term productivity and sustainability of the refuge.

Adaptive management is a key component of each alternative. As such, the actions outlined would not establish a precedent for future actions with significant effects nor represent a decision in principle about future considerations. Refuge management activities are constantly adapted as new research, data, and information become available.

See Table 15 for a comparison of the environmental consequences under four categories: wildlife and habitat management, resource protection, visitor services, and refuge administration.

**Table 15. The environmental consequences of implementing the management alternatives are compared**

<b>KEY TOPICS</b>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
<b>Wildlife and Habitat Management</b>				
<b>RARE, THREATENED, AND EDANGERED SPECIES</b>				
Florida Scrub-jay – Scrub Habitats	Neutral No change in scrub-jay habitat resulting in stable populations.	Positive Increased scrub-jay populations. Increased number of family groups. Increased scrub acres in optimal condition.	Neutral to Negative Decreased number of scrub acres in optimal condition.	Positive Slightly increased numbers of scrub-jays, family groups, and scrub acres.
Bald Eagle – Flatwood and Scrub Habitats	Neutral to Negative No change in eagle habitat to support stable to decreased populations.	Positive Increased work to improve nesting habitat in flatwoods to support increased bald eagle population. May also include some restoration of groves to pine.	Neutral to wintering population Neutral to Negative to nesting pairs Decreased management of pine flatwoods for eagle habitat.	Positive Emphasis on forest management to improve eagle nesting habitat to support increased bald eagle population.
Sea Turtles – Beach and Estuary Habitats	Neutral No change in sea turtle habitat to support stable populations.	Positive Increased management to support increased sea turtle populations.	Neutral to Negative Decreased management activities may result in stable to decreased sea turtle populations.	Neutral to Positive Increased management to support stable to increased sea turtle populations.
Southeastern Beach Mouse – Beach and Dune Habitats	Neutral to Negative No active management. Stable to decreased beach mouse populations.	Positive Active management to support increased beach mouse populations. Increased information. Enhanced habitat and habitat quality.	Neutral to Negative No active management. Stable to decreased beach mouse populations.	Positive Increased management to support increased beach mouse populations. Increased information. Enhanced habitat and habitat quality.

<b>KEY TOPICS</b>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
West Indian Manatee – Estuary Habitats	Neutral No change in manatee habitat to support stable populations.	Positive Active management to support increased manatee population. Decreased disturbance.	Neutral No change in manatee habitat to support stable populations.	Positive Increased management to support increased manatee populations. Decreased disturbance.
Wood Stork	Neutral No active nesting by wood storks. No change in wood stork habitat to support stable population.	Positive Active management to support nesting and increased wood stork populations.	Neutral to Positive No active nesting by wood storks. No change in wood stork habitat to support stable population.	Positive Increased management to support nesting and increased wood stork populations.
Eastern Indigo Snake	Neutral No active management. (Scrub management for scrub-jay benefits indigo snake.)	Positive Active management to support increased indigo snake populations. Increased information.	Neutral No active management. (Scrub management for scrub-jay benefits indigo snake.)	Neutral No active management. (Scrub management for scrub-jay benefits indigo snake.)
<b>MIGRATORY BIRDS</b>				
Waterfowl	Neutral No change in waterfowl habitats to support stable waterfowl populations.	Negative Manage waterfowl as food base for bald eagles. Decreased habitat to support stable to slightly decreased waterfowl populations.	Positive Increased habitat and habitat quality to support increased waterfowl populations. Decreased disturbance.	Positive Decreased disturbance.
Shorebirds	Neutral No change in shorebird habitat to support stable populations.	Neutral to Negative No acres managed for shorebirds to support decreased shorebird populations.	Positive Active management to support increased habitat and shorebird populations. Increased information.	Neutral to Positive Increased information to support stable to increased shorebird populations.

<b>KEY TOPICS</b>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
Wading Birds	Neutral to Positive No change in wading bird habitat to support stable to increasing populations.	Neutral to Positive Increased management for wood storks to support stable to increased populations of wading birds.	Positive Increased management and wading bird habitat to support increased populations.	Neutral to Positive Increased information to support stable to increased wading bird populations.
Neotropical Migratory Birds	Neutral to Negative No active management.	Negative Decreased neotropical migratory bird habitat to support decreased populations.	Positive Increased neotropical migratory bird management, habitat, and habitat quality to support increased populations. Increased information.	Positive Increased neotropical migratory bird management and habitat quality to support increased populations. Increased information.
<b>EXOTIC, INVASIVE, AND NUISANCE SPECIES</b>				
Control of Exotic Plants	Neutral to Negative Limited management, based on outside funding. While some exotic plants are being controlled, others continue to spread.	Positive Increased management. Decreased exotic plants in habitats serving threatened and endangered species.	Positive Increased management. Decreased exotic plants in habitats serving migratory birds.	Positive Increased management. Decreased levels of exotic plants, with the elimination of target exotic plants.
Control of Feral Hogs	Neutral to Negative Stable to increased populations.	Positive Stable to decreased populations.	Neutral to Negative Stable to increased populations.	Positive Stable to decreased populations.

<b>KEY TOPICS</b>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
<b>WILDLIFE AND HABITAT DIVERSITY</b>				
Natural and Spoil Islands	Negative No active management.	Negative to Neutral Increased management for wood storks.	Positive Increased management and restoration to increase habitat quality of natural and spoil islands. Increased shorebird and water bird nesting.	Positive Increased management and restoration to increase habitat quality of natural and spoil islands. Increased shorebird and water bird nesting.
Seagrass Beds	Negative No active management.	Positive Decreased prop scarring and increased seagrass habitat and habitat quality.	Positive Decreased prop scarring and increased seagrass habitat and habitat quality.	Positive Decreased prop scarring and increased habitat quality.
Restoration of Citrus Groves to Native Habitat	Neutral to Positive Stable to decreased acres in groves.	Positive Decreased acres in groves. More effort to restore groves with soils that support scrub species.	Positive Decreased acres in groves. More efforts to restore groves with soils that would support mesic hammocks, which would increase habitat for neo-tropical migratory birds.	Positive Decreased acres in groves. Groves would be restored in both scrub and mesic hammock areas.
Restoration of Estuarine Impounded Wetlands to Mimic Natural-like Conditions	Positive Actively pursuing restoration opportunities.	Neutral to Positive Potential for stable to increased acres restored. Increased information.	Positive Stable to increased acres restored. Increased information.	Positive Stable to increased acres restored. Increased information.
Interior Freshwater Wetlands	Neutral to Negative to historic wetland conditions No active management.	Positive Increased wetland habitat quality. Increased information.	Positive Increased wetland habitats and habitat quality. Increased information.	Positive Increased wetland habitats and habitat quality. Increased information.

<b>KEY TOPICS</b>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
Wildlife Impacts from Vehicle Collisions	Negative Road kill includes feral hogs, bald eagles, scrub-jays, vultures, otters, armadillos, raccoons, various snakes, turtles, gopher tortoises, and other wildlife.	Positive Decreased road kill. Increased information. Increased awareness and understanding.	Positive Decreased road kill. Increased information. Increased awareness and understanding.	Positive Decreased road kill. Increased information. Increased awareness and understanding.
Fish Populations in Estuary and Impounded Wetlands	Neutral to Negative No active management.	Neutral to Negative Increased fisheries management to support wood storks.	Negative Active management of fisheries to provide food source for migratory birds.	Positive Increased fisheries management and information.
Herpetological Species (e.g., frogs, toads, snakes, and lizards)	Neutral to Negative No active management.	Neutral to Negative No active management.	Neutral to Positive Increased habitats to support increased herpetological populations.	Neutral to Positive Increased information.
<b>Resource Protection</b>				
<b>ACQUISITION BOUNDARY</b>				
Acquire Inholdings in Turnbull Creek Area	Neutral to Negative Potential for increased habitat protection and quality. Potential for private development.	Neutral to Negative Potential for increased habitat protection and quality. Potential for private development.	Neutral to Negative Potential for increased habitat protection and quality. Potential for private development.	Positive Increased habitat protection and quality.
Transfer Bill's Hill from CNS to Refuge	Neutral to Positive Continue refuge-assisted management.	Positive Increased protection of wildlife and habitat. Increased habitat quality.	Neutral to Positive Continue refuge-assisted management.	Positive Increased protection of wildlife and habitat. Increased habitat quality.

<b>KEY TOPICS</b>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
<b>LEASE/MANAGEMENT AGREEMENTS</b>				
Rookery Covered by Tank Island Lease	Neutral to Negative Increased wildlife and habitat disturbance.	Positive Decreased wildlife and habitat disturbance to support increased nesting.	Positive Decreased wildlife and habitat disturbance to support increased nesting.	Positive Decreased wildlife and habitat disturbance to support increased nesting.
<b>ARCHAEOLOGICAL AND HISTORICAL RESOURCES</b>				
Kennedy Space Center	Neutral to Negative Potential for damage, theft, and vandalism.	Neutral to Negative Potential for damage, theft, and vandalism.	Neutral to Negative Potential for damage, theft, and vandalism.	Positive Increased information and protection.
Turnbull Creek	Neutral to Negative Potential for damage, theft, vandalism, and development. No information.	Neutral to Negative Potential for damage, theft, vandalism, and development. No information.	Neutral to Negative Potential for damage, theft, vandalism, and development. No information.	Positive Increased information and protection.
Protection	Neutral to Negative Potential for damage, theft, and vandalism.	Neutral to Negative Potential for damage, theft, and vandalism.	Neutral to Negative Potential for damage, theft, and vandalism.	Positive Increased information and protection.
<b>Visitor Services</b>				
<b>WELCOME AND ORIENT VISITORS</b>				
Providing Information to the Public	Neutral No change to existing program.	Positive Increased amount of information. Expanded Visitor Center.	Neutral No change to amount of existing information. Change messages to migratory birds.	Positive Increased number of kiosks and increased information.
<b>HUNTING</b>				
Waterfowl Hunting Opportunities	Neutral No change to existing program. Stable harvest of waterfowl.	Negative Decreased waterfowl hunting. Decreased harvest of waterfowl.	Negative Waterfowl hunting eliminated. No harvest of waterfowl.	Positive Waterfowl hunting expanded to include Turnbull marshes. Increased harvest of waterfowl.

<b>KEY TOPICS</b>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
Upland Game Hunting Opportunities	Neutral No upland game hunting. No harvest of deer.	Neutral No upland game hunting. No harvest of deer.	Neutral No upland game hunting. No harvest of deer.	Positive Develop an upland game hunt program to help control feral hog and deer populations. Increased harvest of deer and feral hogs.
Alligator Hunting Opportunities	Neutral No alligator hunting. No harvest of alligators (only nuisance alligators are destroyed).	Neutral No alligator hunting. No harvest of alligators (only nuisance alligators are destroyed).	Neutral No alligator hunting. No harvest of alligators (only nuisance alligators are destroyed).	Neutral to Positive The potential exists for decreased alligator populations due to increased harvest.
<b>FISHING</b>				
Estuarine Fishing Opportunities	Neutral to Negative No active management. Decreasing quality of estuarine fishing.	Neutral to Negative Potential for decreased acres available for flats fishing.	Negative Decreased acres available for flats fishing (e.g., through seasonal closures and rookery closed area buffers).	Positive Increased management (e.g., increased law enforcement and development of pole/troll zones). Improved quality of estuarine fishing.
Freshwater Fishing Opportunities	Neutral No active management.	Neutral No active management.	Neutral No active management.	Positive Development of freshwater fishing program.
<b>WILDLIFE OBSERVATION AND PHOTOGRAPHY</b>				
Wildlife Viewing and Photography Opportunities	Neutral Stable opportunities and facilities for wildlife viewing and photography.	Negative Decreased wildlife viewing and photography opportunities and facilities.	Neutral to Negative Stable facilities. Seasonally decreased wildlife viewing and photography opportunities.	Positive Increased wildlife viewing and photography opportunities and facilities.

<b>KEY TOPICS</b>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
<b>ENVIRONMENTAL EDUCATION</b>				
Environmental Education Opportunities	Neutral Limited program.	Positive Increased environmental education programs and participation.	Positive Increased environmental education programs and participation.	Positive Increased environmental education programs and participation.
Visitor Center Visitation	Neutral >60,000 annual visitors to the Visitor Center. In 2003, over 550,000 direct refuge visits and over 350,000 refuge visits through refuge's exhibit and tours at Space Center's Visitor Center.	Neutral to Positive Increased visitation to Visitor Center and refuge. Decreased (to 0) visitation to refuge exhibit and tours at Space Center's Visitor Center. Expanded Visitor Center, exhibits, and programs.	Neutral to Positive Increased visitation to Visitor Center and refuge. Decreased (to 0) visitation to refuge exhibit and tours at Space Center's Visitor Center.	Positive Increased visitation to Visitor Center, refuge, and refuge's exhibits and tours at Space Center's Visitor Center. Expanded Visitor Center and programs.
Interpretive Programs	Negative Stable interpretive programs, but increased visitation.	Neutral to Positive Stable to increasing interpretive programs.	Negative Stable interpretive programs, but increased visitation.	Positive Expanded interpretive programs.
Number of Interpretive Trails	Neutral Stable interpretive trails.	Negative Decreased number of trails.	Neutral Stable interpretive trails.	Positive Increased number of trails and interpretive maps, brochures, and signs.
Manatee Observation Deck	Neutral Stable interpretive programs.	Positive Increased interpretive opportunities.	Neutral Stable interpretive programs.	Positive Increased interpretive opportunities.
Kennedy Space Center Visitor Center	Neutral to Negative Static exhibit does not reflect agency mission or refuge purposes and goals.	Negative Remove exhibit.	Negative Remove exhibit.	Positive Improve exhibit and outreach at exhibit and for Space Center tours.

<b>KEY TOPICS</b>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
<b>OUTREACH</b>				
Kennedy Space Center Workers	Negative Minimal management and outreach.	Positive Increased management and outreach.	Positive Increased management and outreach.	Positive Increased management and outreach.
Local Residents	Neutral to Negative Minimal management and outreach.	Neutral to Negative Minimal management and outreach.	Neutral to Negative Minimal management and outreach.	Positive Increased management and outreach. Increased awareness and understanding.
<b>VOLUNTEERS</b>				
Volunteers	Neutral Stable volunteer work force.	Positive Expanded volunteer work force.	Positive Expanded volunteer work force.	Positive Expanded volunteer work force.
<b>FRIENDS GROUP</b>				
MIWA	Positive Increased membership.	Positive Increased membership. Increased support of refuge management and operations.	Positive Increased membership. Increased support of refuge management and operations.	Positive Increased membership. Increased support of refuge management and operations.
<b>CONCESSION OPERATIONS</b>				
Concession Operations	Neutral No active management. No concession operations.	Neutral No active management. No concession operations.	Neutral No active management. No concession operations.	Neutral to Positive. Potential for the development of a concession operation.
<b>FEE PROGRAM</b>				
Amount of Revenue Generated by Fees (80% Spent at Refuge)	Neutral Stable fee program.	Negative Decreased uses resulting in decreased total fees. Increased individual fee amounts.	Negative Decreased uses resulting in decreased fees. Increased individual fee amounts.	Positive Increased total and individual fees.

<b>KEY TOPICS</b>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
<b>LITTER</b>				
Control of Trash and Litter	Negative Increased trash and litter.	Positive Decreased trash and litter.	Positive Decreased trash and litter.	Positive Decreased trash and litter.
<b>Refuge Administration</b>				
<b>REFUGE MANAGEMENT</b>				
Administrative Facilities, Utilities, Dorm Facility, and Sign Network	Neutral No change in the levels of operations and maintenance of existing facilities and equipment.	Positive Increased facilities and equipment. Enhanced utilities. Increased dorm facilities and support to refuge programs. Enhanced information and habitat management. Enhanced sign network. Increased maintenance of signs.	Positive Increased facilities and equipment. Enhanced utilities. Increased dorm facilities and support to refuge programs. Enhanced information and habitat management. Enhanced sign network. Increased maintenance of signs.	Positive Increased facilities and equipment. Enhanced utilities. Increased dorm facilities and support to refuge programs. Enhanced information and habitat management. Enhanced sign network. Increased maintenance of signs.
Staff	Neutral No change in the levels of biological support and wildlife and habitat protection.	Positive Increased staff in all refuge programs. Enhanced information and habitat management.	Positive Increased staff in all refuge programs. Enhanced information and habitat management.	Positive Increased staff in all refuge programs. Enhanced information and habitat management.
<b>INTERGOVERNMENTAL COORDINATION</b>				
Relationship with Kennedy Space Center, NASA	Neutral No change.	Neutral to Negative Increased coordination, but increased conflicts.	Positive Increased coordination.	Positive Increased coordination.
Relationship with Cape Canaveral Air Force Station, U.S. Air Force	Neutral No change.	Neutral to Negative Increased coordination, but increased conflicts.	Positive Increased coordination.	Positive Increased coordination.

<b>KEY TOPICS</b>	<b>Alternatives</b>			
	<b>Alternative A: Current Mgmt (No Action Alternative)</b>	<b>Alternative B: Threatened and Endangered Species</b>	<b>Alternative C: Migratory Birds</b>	<b>Alternative D: Wildlife and Habitat Diversity (Proposed Action)</b>
Relationship with Canaveral National Seashore, National Park Service	Neutral No change.	Positive Increased coordination.	Positive Increased coordination.	Positive Increased coordination.
Relationship with Florida Fish and Wildlife Conservation Commission, State of Florida	Neutral No change.	Positive Increased coordination.	Neutral to Negative Increased coordination, but increased conflicts.	Positive Increased coordination.
Relationship with St. Johns River Water Management District, State of Florida	Neutral No change.	Positive Increased coordination.	Neutral to Negative Increased coordination, but increased conflicts.	Positive Increased coordination.
<b>COMMERCIAL HARVESTING</b>				
Number of Permits for Commercial Crabbing, Clamming, Bait Fishing, and Hook and Line Fishing	Neutral Increasing numbers of users.	Negative Decreased numbers of users (to 0).	Negative Decreased numbers of users (to 0).	Neutral to Negative Decreased numbers of users over time.
Number of Permits for Apiary Sites	Neutral No change to the number of permits.	Negative Decreased numbers of permits (to 0).	Negative Decreased numbers of permits (to 0).	Neutral to Negative Decreased numbers of permits over time.

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## V. Consultation and Coordination

### INTRODUCTION

The Merritt Island National Wildlife Refuge comprehensive conservation planning process involved a wide variety of participants: federal, state, and local governments; universities and other researchers; private non-profit groups; and the friends of the refuge, Merritt Island Wildlife Association, as well as a wide variety of local residents, local businesses, concerned citizens from all over the country, local schools, universities, and state and national organizations. Outreach efforts by the refuge and news coverage by the media have spread across the country. The list of participants, beyond those individuals and organizations providing comments during the public scoping process, includes the Core Planning Team, the Wildlife and Habitat Management Review Team, the Public Use Review Team, the Wilderness Review Team, the Intergovernmental Coordination Planning Team, and other parties.

### CORE PLANNING TEAM

The Core Planning Team included representatives from the Service (i.e., from the refuge and Ecological Services) and the Florida Fish and Wildlife Conservation Commission. The team met as a whole to review all of the issues, determine the priority issues, and identify potential solutions or approaches. A subset of the Core Planning Team, consisting of the refuge's staff, developed the draft plan and environmental assessment, based on the information and direction provided by the Core Planning Team.

Merritt Island National Wildlife Refuge, Fish and Wildlife Service

- Fred Adrian, Forester
- Cheri M. Ehrhardt, AICP, Natural Resource Planner
- Marc Epstein, Refuge Biologist
- Ron Hight, Project Leader
- Ralph Lloyd, Deputy Refuge Manager
- James Lyon, Biological Science Technician
- Dorn Whitmore, Supervisory Refuge Ranger

North Florida Ecosystem Field Office, Ecological Services, Fish and Wildlife Service

- John Kasbohm, former Fish and Wildlife Biologist

Florida Fish and Wildlife Conservation Commission

- Dennis David, Regional Director
- Richard Paperno, Research Biologist, Florida Marine Research Institute
- Steve Rockwood, Waterfowl Biologist

### WILDLIFE AND HABITAT MANAGEMENT REVIEW TEAM

Organized by staff at the Merritt Island National Wildlife Refuge Complex, the Wildlife and Habitat Management Review Team included a core group of Service staff with invited participants. The invited participants included local and regional experts, researchers, and individuals with intimate knowledge of and expertise of the resources of the refuge. These participants included representatives from: the Service, Kennedy Space Center (NASA), Canaveral National Seashore (NPS), National Marine Fisheries Service (NOAA), U.S. Geologic Survey, Florida Fish and Wildlife Conservation Commission, St. Johns River Water Management District, Brevard County, Brevard

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Mosquito Control District, Marine Resources Council, and several universities. The Wildlife and Habitat Management review was conducted in two parts during July and September of 2001.

Core Group – Merritt Island National Wildlife Refuge, Fish and Wildlife Service

- Fred Adrian, Forester
- Lisa Earnest, former Biological Science Technician
- Sandy Edmondson, former Cooperative Fish and Wildlife Student
- Cheri M. Ehrhardt, AICP, Natural Resource Planner
- Marc Epstein, Refuge Biologist
- Ron Hight, Project Leader
- Ralph Lloyd, Deputy Refuge Manager
- Gary Popotnik, former Biological Science Technician
- Dorn Whitmore, Supervisory Refuge Ranger

Invited Participants - Uplands

- Roger Boykin, Fire and Law Enforcement Coordinator, Southeast Regional Office, Fish and Wildlife Service
- Laura Brandt, Senior Refuge Biologist, ARM Loxahatchee National Wildlife Refuge, Fish and Wildlife Service
- Tim Breen, Regional Non-game Biologist, Florida Fish and Wildlife Conservation Commission
- Mickey Heitmeyer, Gaylord Memorial Laboratory, University of Missouri
- Chuck Hunter, Non-game Migratory Bird Biologist, Division of Migratory Birds, Southeast Regional Office, U.S. Fish and Wildlife Service
- Mike Legare, Wildlife Biologist, Dynamac Corporation/Kennedy Space Center
- Paul Schmalzer, Plant Ecologist, Dynamac Corporation/Kennedy Space Center
- Keith Watson, Non-game Migratory Bird Biologist, Division of Migratory Birds, Southeast Regional Office, Fish and Wildlife Service

Invited Participants - Beach, Wetlands, and Estuarine Systems

- James Bohnsack, Research Biologist, Southeast Fisheries Science Center, National Marine Fisheries Service
- Frank Bowers, Chief, Division of Migratory Birds, Southeast Regional Office, Fish and Wildlife Service
- Ron Brockmeyer, Environmental Specialist, St. Johns River Water Management District
- Jaime Collazo, Assistant Unit Leader, North Carolina State University, Fish and Wildlife Cooperative Research Unit, U.S. Geologic Survey
- Robert Day, Indian River Lagoon Program, St. Johns River Water Management District
- Jim Egan, Executive Director, Marine Resources Council
- Lew Ehrhart, Professor, University of Central Florida
- Leigh Fredrickson, Professor, Gaylord Memorial Laboratory, University of Missouri
- Grant Gilmore, Research Scientist, Dynamac Corporation/Kennedy Space Center
- Carlton Hall, Dynamac Corporation/Kennedy Space Center
- Garth Herring, Graduate Research Assistant, North Carolina State University
- Wilson Laney, Coordinator, South Atlantic Fisheries Management Council, Fish and Wildlife Service
- Mike Legare, Wildlife Biologist, Dynamac Corporation/Kennedy Space Center
- Rich Paperno, Research Biologist, Florida Marine Research Institute, Florida Fish and Wildlife Conservation Commission
- Steve Rockwood, Waterfowl Biologist, Florida Fish and Wildlife Conservation Commission
- Philip Stevens, Fisheries Biologist, U.S. Geological Survey, University of Florida
- John Stiner, Resource Specialist, Canaveral National Seashore, National Park Service

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- Eric Stolen, Wildlife Biologist, Dynamac Corporation/Kennedy Space Center
  - Scott Taylor, Biologist, Brevard Mosquito Control District
  - Robert Virnstein, Environmental Scientist, St. Johns River Water Management District
  - Keith Watson, Non-game Migratory Bird Biologist, Division of Migratory Birds, Southeast Regional Office, Fish and Wildlife Service
  - Conrad White, Supervisor, Natural Resources Management Office, Brevard County Florida
  - Blair Witherington, PhD, Sea Turtle Beach Nesting Index Coordinator, Florida Marine Research Institute, Florida Fish and Wildlife Conservation Commission

### **VISITOR SERVICES REVIEW TEAM**

The Visitor Services Review Team consisted of Service staff from the Southeast Regional Office and other refuges, as well as staff from the National Park Service and the Florida Fish and Wildlife Conservation Commission. The Public Use Review for the refuge was conducted in March 2002.

#### **Fish and Wildlife Service**

- Tom Comish, Refuge Manager, Sunkhaze Meadows National Wildlife Refuge
- Cheri M. Ehrhardt, AICP, Natural Resource Planner, Merritt Island National Wildlife Refuge Complex
- Ron Hight, Project Leader, Merritt Island National Wildlife Refuge Complex
- Richard Mattison, Architect, Division of Refuges, Southeast Regional Office
- Kay McCutcheon, Park Ranger, Santee National Wildlife Refuge
- Ray Paterra, Public Use Specialist, White River National Wildlife Refuge
- Garry Tucker, Acting Chief, Division of Visitor Services and Outreach, Southeast Regional Office
- Dorn Whitmore, Supervisory Refuge Ranger, Merritt Island National Wildlife Refuge Complex

#### **National Park Service**

- Norah Martinez, former Chief Ranger, Canaveral National Seashore

#### **Florida Fish and Wildlife Conservation Commission**

- Joni Ellis, former Conservation Education Specialist

### **WILDERNESS REVIEW TEAM**

The Wilderness Review Team involved staff from the Merritt Island National Wildlife Refuge Complex.

#### **Merritt Island National Wildlife Refuge, Fish and Wildlife Service**

- Cheri M. Ehrhardt, AICP, Natural Resource Planner
- Ron Hight, Project Leader
- Gary Popotnik, former Biological Science Technician

### **INTERGOVERNMENTAL COORDINATION PLANNING TEAM**

The Intergovernmental Coordination Planning Team participants included local, state, and federal governmental field staff representatives involved with the resources at the local and regional levels, including representatives from Fish and Wildlife Service, National Aeronautical and Space Administration, National Park Service (Canaveral National Seashore), National Oceanic and Atmospheric Administration (National Marine Fisheries Service), U.S. Air Force (Cape Canaveral Air Force Station), Florida Fish and Wildlife Conservation Commission, Florida Department of Environmental Protection, Florida Division of Forestry, St. Johns River Water Management District,

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Brevard County, Brevard Mosquito Control District, and city of Titusville.

Although they did not generally attend the meetings of the Intergovernmental Coordination Team, a variety of other governmental representatives were kept informed throughout the process and provided input to the team, including the Miccosukee Tribe, National Aeronautical and Space Administration, U.S. Air Force, National Oceanic and Atmospheric Administration, U.S. Army Corps of Engineers, Florida Fish and Wildlife Conservation Commission, Florida Division of State, Florida Division of Forestry, Florida Department of Community Affairs, Florida Department of Environmental Protection, Florida Inland Navigation District, St. Johns River Water Management District, Brevard County, Volusia County, and cities of Titusville, Oak Hill, and New Smyrna Beach.

#### Fish and Wildlife Service

- Fred Adrian, Forester, Merritt Island National Wildlife Refuge Complex
- Cheri M. Ehrhardt, AICP, Natural Resource Planner, Merritt Island National Wildlife Refuge Complex
- Marc Epstein, Refuge Biologist, Merritt Island National Wildlife Refuge Complex
- Ron Hight, Project Leader, Merritt Island National Wildlife Refuge Complex
- Steve Johnson, former Refuge Operations Specialist, Merritt Island National Wildlife Refuge Complex
- John Kasbohm, former Fish and Wildlife Biologist, North Florida Ecosystem Field Office, Ecological Services
- Ralph Lloyd, Deputy Refuge Manager, Merritt Island National Wildlife Refuge Complex
- Richard Meyers, former Refuge Operations Specialist, Merritt Island National Wildlife Refuge Complex
- Gary Popotnik, former Biological Science Technician, Merritt Island National Wildlife Refuge Complex
- Glen Stratton, Forestry Technician, Merritt Island National Wildlife Refuge Complex
- Dorn Whitmore, Supervisor, Refuge Ranger, Merritt Island National Wildlife Refuge Complex

#### National Aeronautical and Space Administration

- Mario Busacca, Environmental Management, Kennedy Space Center
- Chris Fairey, former Spaceport Services Director, Kennedy Space Center
- Sue Gaines, Lead, Master Planning, Kennedy Space Center
- John Halsema, Director, External Affairs, Kennedy Space Center
- Scott Kerr, Director of Spaceport Services, Kennedy Space Center
- Bill Knott, PhD, Chief Scientist, Kennedy Space Center
- Pete Nicolenko, National Test Director, Kennedy Space Center
- Renee Ponik, Planner, Master Planning, Kennedy Space Center
- Burton Summerfield, Occupational Health and Environmental Division Director, Kennedy Space Center
- Leila Taylor, Real Property Officer, Kennedy Space Center
- Joel Wells, External Affairs, Kennedy Space Center
- Spencer Woodward, NASA Test Director, Launch and Landing, Kennedy Space Center

#### National Park Service

- Timothy Morgan, former Chief Park Ranger, Canaveral National Seashore
- Bob Newkirk, former Superintendent, Canaveral National Seashore
- John Stiner, Resource Specialist, Canaveral National Seashore

#### National Oceanic and Atmospheric Administration

- George Getsinger, Ecologist, National Marine Fisheries Service

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U.S. Air Force

- Jack Gibson, Deputy Range/Base Engineer, Cape Canaveral Air Force Station
- Robin Sutherland, Cape Canaveral Air Force Station

Miccosukee Tribe

- F.K. Jones, Wildlife Director

Florida Fish and Wildlife Conservation Commission

- Dennis David, Regional Director
- Richard Paperno, Research Biologist, Florida Marine Research Institute
- Steve Rockwood, Waterfowl Biologist
- Blair Witherington, PhD, Sea Turtle Beach Nesting Index Coordinator, Florida Marine Research Institute

Florida Department of Environmental Protection

- Keith Fisher, Manager, St. Sebastian River Buffer Preserve
- Steve Williams, Environmental Specialist, St. Sebastian River Buffer Preserve

Florida Division of Forestry

- John Koehler, Orlando District Manager
- Mike Kuypers, District Manager, Bunnell District
- Bill Scaramellino, Forest Area Supervisor

St. Johns River Water Management District

- Ron Brockmeyer, Environmental Specialist
- Robert Day, Environmental Scientist, Indian River Lagoon National Estuary Program
- Peter Henn, Land Manager
- Michelle Reiber, Supervising Regulatory Scientist
- Troy Rice, Director, Indian River Lagoon National Estuary Program
- Robert Virnstein, Environmental Scientist

Brevard County

- Anne Birch, Manager, Environmentally Endangered Lands Program
- Marsha Cantrell, Manager, Park Support Services
- Ray Mojica, Environmentally Endangered Lands Program
- Donna Oddy, Natural Resources
- Cheryl Paige, Parks and Recreation
- Betty Salter, Parks and Recreation

Brevard Mosquito Control District

- Jim Hunt, Director
- Chris Richmond

City of Titusville

- Wes Hoaglund, Planner
- Dean Pettit, Chairman, Titusville Environmental Commission



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## SECTION C. APPENDICES

### A. Glossary

**ACE (or USACE)** - US Army Corps of Engineers.

**adaptive ecosystem management** - Use of the findings of ecology to manage natural resources, not for maximum commodity production (a traditional industrial forest), or for preservation of current conditions (a traditional reserve), but for the perpetuation of patterns and processes that allow the ecosystem to persist. This management style stresses experimentation, collaboration, and re-evaluation.

**adaptive management** - responding to changing ecological conditions so as to not exceed productivity limits of a specific place.

**alternative** - a reasonable way to fix the identified problem or satisfy the stated need (40 CFR 1500.2).

**amphidromous fish** - fish that can migrate from fresh water to the sea, or vice versa, not for the purpose of breeding, but at other times during the life cycle of the fish.

**anadromous** - fish that spend a large proportion of their life cycle in the ocean and return to freshwater to breed.

**appropriate use** - according to draft policy, an appropriate use is an existing or a proposed use that meets at least one of three criteria. (1) A use is appropriate if it is a priority public use or is necessary for the safe, practical, and effective conduct of a priority public use on the refuge. (2) A use is appropriate if it contributes to fulfilling the System mission, or the refuge purposes, goals, or objectives as described in a refuge management plan approved after October 9, 1997, the date the National Wildlife Refuge System Improvement Act of 1997 was passed. (3) A use is appropriate if the Refuge Manager documents in writing reasons why the use should be considered appropriate and obtains concurrence from the Refuge Supervisor.

**aquatic** - growing in, living in, or dependent upon water.

**BCC** - Bird of Conservation Concern, FWS.

**biogeography** - the science that studies the geographic distribution of organisms.

**biological integrity** - biotic composition, structure, and function at the genetic, organism, and community levels consistent with natural conditions, and the biological processes that shape genomes, organisms, and communities.

**biological or natural diversity (also biodiversity)** - the abundance, variety, and genetic constitution of animals and plants in nature; the total variety of life and its processes, including the variety of living organisms and the genetic differences between them and the communities and ecosystems in which they occur.

**biota** - the plants and animals of an area.

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**biotic community** - biological community or association, ecological community; an assemblage of species living in a prescribed area or physical habitat.

**BLM** - Bureau of Land Management.

**BMCD** - Brevard Mosquito Control District.

**breeding habitat** - habitat used by migratory birds or other animals during the breeding season.

**buffer zones** - protective land borders around critical habitats or water bodies that reduce runoff and non-point source pollution loading; areas created or sustained to lessen the negative effects of land development on animals and plants and their habitats.

**candidate species** - those species for which the Service has sufficient information on biological vulnerability and threats to propose them for listing.

**carrying capacity** - the size of the population that can be sustained by a given environment.

**catadromous fish** - fish that spend most of their lives in fresh water but migrate to sea to reproduce.

**Categorical Exclusion** - 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 (40 CFR 1508.4).

**CCAFS** - Cape Canaveral Air Force Station, U.S. Air Force.

**CCP** - Comprehensive Conservation Plan.

**CE** - Commercially Exploited, State of Florida.

**CFR** - Code of Federal Regulations.

**Challenge Cost Share Program** - a grant program administered by the US Fish and Wildlife Service providing matching funds for projects supporting natural resource education, management, restoration and protection on Service lands, other public lands and on private lands.

**community type** - a particular assemblage of plants and animals, named for the characteristic plants.

**compatibility determination** - the process required before any public use is allowed to occur on a refuge. A compatible use is one which, in the sound professional judgment of the Refuge Manager, will not materially interfere with or detract from fulfillment of the Refuge System Mission or refuge purpose(s). The 1997 National Wildlife Refuge System Improvement Act requires that a compatibility determination must be made by FWS before any use may be allowed on a refuge.

**compatible use** - an allowed use that will not materially interfere with, or detract from, the purposes for which the unit was established (Service Manual 602 FW 1.4). A compatible use is one that has been determined to be so through the compatibility determination process.

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**Comprehensive Conservation Plan (CCP)** - a document that describes the desired future conditions of a refuge or planning unit and provides long-range guidance and management direction to achieve the purposes of the refuge, help fulfill the mission of the System, maintain and, where appropriate, restore the biological integrity, diversity, and environmental health of each refuge and the System, and meet other mandates.

**conservation** - the management of natural resources to prevent loss or waste. Management actions may include preservation, restoration, and enhancement.

**conservation agreements** - written agreements reached among two or more parties for the purpose of ensuring the survival and welfare of native species of fish and wildlife and/or their habitats, or to achieve other specified conservation goals. Participants voluntarily commit to implementing specific actions that will remove or reduce the threats to these species.

**conservation easement** - a legal agreement between a landowner and a land trust (a private, nonprofit conservation organization) or government agency that permanently limits a property's uses in order to protect its conservation values.

**cooperative agreement** - the legal instrument used when the principal purpose of the transaction is the transfer of money, property, services or anything of value to a recipient in order to accomplish a public purpose authorized by federal statute and substantial involvement between the Service and the recipient is anticipated.

**CNS** - Canaveral National Seashore.

**cultural resource** - evidence of historic or prehistoric human activity, such as buildings, artifacts, archaeological sites, documents, or oral or written history. Cultural resources include historically, archaeologically, and/or architecturally significant resources.

**cultural resource inventory** - a professionally conducted study designed to locate and evaluate evidence of cultural resources present within a defined geographic area. Inventories may involve various levels, including background literature search, comprehensive field examination to identify all exposed physical manifestations of cultural resources, or sample inventory to project site distribution and density over a larger area. Evaluation of identified cultural resources to determine eligibility for the National Register follows the criteria found in 36 CFR 60.4 (Service Manual 614 FW 1.7).

**cultural resource overview** - a comprehensive document prepared for a field office that discusses, among other things, its prehistory and cultural history, the nature and extent of known cultural resources, previous research, management objectives, resource management conflicts or issues, and a general statement on how program objectives should be met and conflicts resolved. An overview should reference or incorporate information from a field office's background or literature search described in Section VIII. of the Cultural Resource Management Handbook (Service Manual 614 FW 1.7).

**database** - a collection of data arranged for ease and speed of analysis and retrieval, usually computerized.

**diadromous** - fish that migrate from freshwater to saltwater or the reverse: a generic term that includes anadromous, catadromous and amphidromous fishes.

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**digitizing** - the process of converting information from paper maps into geographically referenced electronic files for a geographic information system (GIS).

**dispersal** - the movement of organisms away from a location, such as point of origin.

**easement** - an agreement by which a landowner gives up or sells one of the rights on his/her property. For example, a landowner may donate a right-of-way across his/her property to allow access.

**ecological integrity** - the integration of biological integrity, natural biological diversity, and environmental health; the replication of natural conditions (Part 601, Chapter 3, FWS Manual).

**ecology** - the branch of science that studies the distribution and abundance of organisms and the relationship between organisms and their environment.

**ecosystem** - a biological community together with its environment, functioning as a unit. For administrative purposes, the Service has designated 53 ecosystems covering the United States and its possessions. These ecosystems generally correspond with watershed boundaries and vary in their sizes and ecological complexity.

**ecosystem approach** - a way of looking at socio-economic and environmental information based on ecosystem boundaries, rather than town, city, or county boundaries.

**ecosystem-based management** - an approach to making decisions based on the characteristics of the ecosystem in which a person or thing belongs. This concept takes into consideration interactions between the plants, animals, and physical characteristics of the environment when making decisions about land use or living resource issues.

**ecotourism** - a type of tourism that maintains and preserves natural resources as a basis for promoting economic growth and development resulting from visitation to an area.

**emergent wetland** - wetlands dominated by erect, rooted, herbaceous plants.

**Endangered Species Act** - adopted in 1973 to provide protection for species in danger of becoming extinct.

§4 - outlines procedures and criteria for (1) identifying and listing threatened and endangered species; (2) identifying, designating, and revising critical habitat; (3) developing and revising recovery plans; and (4) monitoring species removed from the list of threatened and endangered species.

§7 - outlines procedures for interagency cooperation to conserve federally listed species and designated habitat.

§9 - prohibits the taking of endangered species of fish and wildlife, as well as most threatened species of fish and wildlife.

§10 - provides exceptions to the §9 prohibitions, with the most relevant exceptions being scientific take permits (to enable scientific research or to enhance propagation or survival of a listed species) and incidental permits (as part of an otherwise legal activity).

**endangered species (E), federally** - a federally protected species which is in danger of extinction throughout all or a significant portion of its range.

**endemic** - native to and restricted to a particular geographical region.

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**environment** - the complex of climatic, geologic, hydrologic, soils, and biotic factors acting upon organisms.

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

**environmental education** - education aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution (Stapp et al 1969).

**environmental health** - Abiotic composition, structure, and functioning of the environment consistent with natural conditions, including the natural abiotic processes that shape the environment.

**Environmental Impact Statement (EIS)** - A detailed written statement required by section 102(2)(C) of the National Environmental Policy Act, analyzing the environmental impacts of a proposed action, adverse effects of the project that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources (40 CFR 1508.11).

**EPA** - Environmental Protection Agency.

**estuaries** - deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land.

**estuarine wetlands** - "The Estuarine system consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land." (Cowardin et al 1979)

**exemplary community type** - an outstanding example of a particular community type.

**extinction** - dying out, usually global, of a species for any reason.

**extirpated** - no longer occurring in a given geographic area; the removal, elimination, or disappearance of a species or subspecies from a part of its range.

**fauna** - the collection of wildlife in a particular region.

**FCREPA** - Florida Committee on Rare and Endangered Plants and Animals.

**FCT** - Florida Communities Trust.

**FDACS** - Florida Department of Agriculture and Consumer Affairs.

**FDCA** - Florida Department of Community Affairs.

**FDEP** - Florida Department of Environmental Protection.

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**FDOF** – Florida Division of Forestry

**federal land** - public land owned by the federal government, including lands such as national forests, national parks and national wildlife refuges.

**federally endangered species** - any species which is in danger of extinction throughout all or a significant portion of its range.

**federally listed species** - a species listed under the federal Endangered Species Act of 1973, as amended, either as endangered, threatened or species at risk (formerly candidate species).

**federally threatened species** - any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

**FWC or FFWCCC** - Florida Fish and Wildlife Conservation Commission.

**FIND** - Florida Inland Navigation District.

**Finding of No Significant Impact (FONSI)** - A document prepared in compliance with the National Environmental Policy Act, supported by an environmental assessment, that briefly presents why a federal action will have no significant effect on the human environment and for which an environmental impact statement, therefore, will not be prepared (40 CFR 1508.13).

**Fire behavior** - the manner in which a fire reacts to fuel, weather and topography.

**FIT** - Florida Institute of Technology.

**flora** - the collection of plants in a particular region.

**Florida Natural Areas Inventory (FNAI) Global Rank** - a ranking of a species, natural community, bird rookery, spring, sinkhole, cave, or other ecological feature based on the world-wide status of that element.

G1	critically imperiled globally because of extreme rarity (5 or fewer occurrences or less than 1,000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor
G2	imperiled globally because of rarity (6-20 occurrences or less than 3,000 individuals) or because of vulnerability to extinction due to some natural or man-made factor
G3	either very rare and local throughout its range (21-100 occurrences or less than 10,000 individuals) or found locally in restricted range or vulnerable to extinction from other factors
G4	apparently secure globally (may be rare in parts of range)
G5	demonstrably secure globally
T1	G1 equivalent for subspecies or varieties
T2	G2 equivalent for subspecies or varieties

T3	G3 equivalent for subspecies or varieties
T4	G4 equivalent for subspecies or varieties
T5	G5 equivalent for subspecies or varieties

**Florida Natural Areas Inventory (FNAI) State Rank** - a ranking of a species, natural community, bird rookery, spring, sinkhole, cave, or other ecological feature based on the status of that element in Florida.

S1	critically imperiled in Florida because of extreme rarity (5 or fewer occurrences or less than 1,000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor
S2	imperiled in Florida because of rarity (6-20 occurrences or less than 3,000 individuals) or because of vulnerability to extinction due to some natural or man-made factor
S3	either very rare and local throughout its range (21-100 occurrences or less than 10,000 individuals) or found locally in restricted range or vulnerable to extinction from other factors
S4	apparently secure in Florida (may be rare in parts of range)
S5	demonstrably secure in Florida
SU	due to lack of information, no rank or range can yet be assigned

**FNAI** - Florida Natural Areas Inventory.

**Fuels management** - any manipulation or removal of wildland fuels to reduce the likelihood of ignition or to lessen potential damage from fire or to reduce resistance to control and suppression.

**FWS (or USFWS or Service)** - US Fish and Wildlife Service.

**geographic information system (GIS)** - a computerized system used to compile, store, analyze and display geographically referenced information.

**goal** - descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units.

**grant agreement** - the legal instrument used when the principal purpose of the transaction is the transfer of money, property, services or anything of value to a recipient in order to accomplish a public purpose of support or stimulation authorized by federal statute and substantial involvement between the Service and the recipient is not anticipated.

**grassroots conservation organization** - any group of concerned citizens who come together to actively address a conservation need.

**habitat** - the place where a particular type of plant or animal lives. An organism's habitat must provide all of the basic requirements/components for life and should be free of harmful contaminants.

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**habitat conservation** - the protection of an animal or plant's habitat to ensure that the use of that habitat by the animal or plant is not altered or reduced.

**habitat degradation** - the process of transitioning from a higher quality to a lower quality wildlife habitat.

**habitat fragmentation** - breaking up of a specific habitat into smaller unconnected areas. A habitat area that is too small may not provide enough space to maintain a breeding population of the species in question.

**HBOI** - Harbor Branch Oceanographic Institute

**herbicide** - a chemical agent used to kill plants or inhibit plant growth.

**HMP** - Habitat Management Plan.

**HSWRI** - Hubbs-Sea World Research Institute

**hydric** - wet.

**hydrologic or flow regime** - characteristic fluctuations in river flows.

**hydrology** - the scientific studies of the properties, distribution, and effects of water in the atmosphere, on the earth's surface, and in soil and rocks.

**indicator species** - a species which, in the context of the surrounding landscape or in comparison with related communities, seems to be most indicative of the particular community.

**Integrated Pest Management (IPM)** - sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks.

**interjurisdictional fish** - populations of fish that are managed by two or more states or national or tribal governments because of the scope of their geographic distributions or migrations.

**interpretive facilities** - structures that provide information about an event, place or thing by a variety of means including printed materials, audiovisuals or multimedia materials. Examples of these would be kiosks which offer printed materials and audiovisuals, signs and trailheads.

**interpretive materials** - any tool used to provide or clarify information, explain events or things, or serve to increase awareness and understanding of the events or things. Examples of these would be: (1) printed materials such as brochures, maps or curriculum materials; (2) audio/visual materials such as videotapes, films, slides, or audio tapes; and (3) interactive multimedia materials, such as CD ROM and other computer technology.

**introduction** - a plant or animal moved from one place to another by man.

**invasive exotic species** - non-native species which have been introduced into an ecosystem, and, because of their aggressive growth habits and lack of natural predators, displace native species.

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**issue** - any unsettled matter that requires a management decision; e.g., a Service initiative, an opportunity, a management problem, a threat to the resources of the unit, a conflict in uses, a public concerns, or the presence of an undesirable resource condition. Issues should be documented, described, and analyzed in the CCP even if resolution cannot be accomplished during the planning process (Service Manual 602 FW 1.4).

**KSC** - John F. Kennedy Space Center, NASA.

**land trusts** - organizations dedicated to conserving land by purchasing land, receiving donations of lands, or accepting conservation easements from landowners.

**LAPS** - Land Acquisition Priority System (of the US Fish and Wildlife Service)

**limiting factor** - an environmental limitation that prevents further population growth.

**littoral zone** - the shore zone from the high water mark to a depth where light is barely sufficient for rooted aquatic plants to grow.

**local community** - the area or locality in which a group of people resides and shares the same government.

**management alternative** - a set of objectives and the strategies needed to accomplish each objective (Service Manual 602 FW 1.4).

**management plan** - a plan that guides future land management practices on a tract of land. In the context of this environmental impact statement, management plans would be designed to produce additional wildlife habitat along with the primary products, such as timber or agricultural crops.

**management strategy** - a general approach to meet unit objectives. A strategy may be broad, or it may be detailed enough to guide implementation through specific actions, tasks, and projects (Service Manual 602 FW 1.4).

**marginal habitat** - a habitat with low species diversity due to adverse physical or other conditions.

**mesic** - moderately moist or requiring moderate amounts of moisture, as in plants.

**mitigation** - actions taken to compensate for the negative effects of a particular project or action. Wetland mitigation usually takes the form of restoration or enhancement of a previously damaged wetland or creation of a new wetland.

**MIWA** - Merritt Island Wildlife Association, the friends' group of the Refuge.

**MIPCRU** - Merritt Island Primary Core Recovery Unit.

**MPA** - Marine Protected Area.

**mosaic** - a variety of different habitats intermixed in a relatively small area; several successional stages intermixed within a vegetation type.

**MRC** - Marine Resources Council.

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**NABCI** - North American Bird Conservation Initiative.

**NASA** - National Aeronautics and Space Administration.

**National Environmental Policy Act of 1969 (NEPA)** – requires all agencies, including the Service, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decision making (from 40 CFR 1500).

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

**native** - the plant and animal species, habitats, or communities that originated in a particular region or area, or those that have established in a particular region or area without human influence.

**native plant** - a plant that has grown in the region since the last glaciation and occurred before European settlement.

**natural conditions** - conditions thought to exist from the end of the Medieval Warm Period to the advent of the industrial era (approximately 950 AD to 1800 AD), based upon scientific study and sound professional judgment.

**NAWMP** - North American Waterfowl Management Plan.

**NEPA** - National Environmental Policy Act.

**niche** - the ecological role of a species in a community.

**NMFS** - National Marine Fisheries Service.

**NOAA** - National Oceanic and Atmospheric Association.

**non-point source pollution** - nutrients or toxic substances that enter water from dispersed and uncontrolled sites.

**Notice of Intent (NOI)** - a notice that environmental documents (e.g., an environmental impact statement) will be prepared and considered (40 CFR 1508.22). Published in the Federal Register.

**NPS** - National Park Service.

**NRCS** - Natural Resources Conservation Service.

**NWR** - National Wildlife Refuge.

**NWRA** - National Wildlife Refuge Association.

**NWRS** - National Wildlife Refuge System.

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**NVCS** - National Vegetation Classification System.

**objective** - a concise statement of what we want to achieve, how much we want to achieve, when and where we want to achieve it, and who is responsible for the work. Objectives derive from goals and provide the basis for determining strategies, monitoring refuge accomplishments, and evaluating the success of strategies. Objectives are attainable, time-specific, and measurable.

**occurrence site** - a discrete area where a population of a rare species lives or a rare plant community type grows.

**organochlorine pesticides** - chemicals made primarily of hydrogen, carbon and chlorine that persist for a long time in the environment.

**PAC** - Polycyclic Aromatic Hydrocarbons.

**PAMS** - Permanent Air Monitoring System.

**Partners for Wildlife Program** - a voluntary habitat restoration program undertaken by the Fish and Wildlife Service in cooperation with other governmental agencies, public and private organizations, and private landowners to improve and protect fish and wildlife habitat on private lands while leaving the land in private ownership.

**partnership** - a contract or agreement entered into by two or more individuals, groups of individuals, organizations or agencies in which each agrees to furnish a part of the capital or some in-kind service, i.e., labor, for a mutually beneficial enterprise.

**PCRU** - Primary Core Reserve Unit.

**PIF** - Partners in Flight.

**phosphorite** - a rock containing a high concentration of phosphorous.

**polycyclic aromatic hydrocarbons (PAHs)** - fused ring aromatic compounds, ubiquitous pollutants in the atmosphere and relatively resistant to biodegradation.

**population monitoring** - assessments of the characteristics of populations to ascertain their status and establish trends related to their abundance, condition, distribution, or other characteristics.

**prescribed fire** - the intentional application of fire to wildland fuels to achieve identified land use objectives (Service Manual 621 FW 1.7).

**Primary Core Recovery Units** - populations of the Florida scrub-jay that must be kept viable for the species to be considered fully recovered.

**priority public uses** - hunting, fishing, participating in environmental education, participating in environmental interpretation, observing wildlife, and photographing wildlife. These six priority public uses are outlined in the 1997 National Wildlife Refuge System Improvement Act.

**private land** - land that is owned by a private individual, group of individuals, or non-governmental organization.

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**private landowner** - any individual, group of individuals or non-governmental organization that owns land.

**private organization (or NGO)** - any non-governmental organization.

**protection** - mechanisms such as fee title acquisition, conservation easements or binding agreements with landowners that ensure land use and land management practices will remain compatible with maintenance of the species population at the site.

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

**public land** - land that is owned or otherwise managed as public land by the local, state, or federal government.

**Record of Decision (ROD)** - a concise public record of decision prepared by the Federal agency, pursuant to NEPA, that contains a statement of the decision, identification of all alternatives considered, identification of the environmentally preferable alternative, a statement as to whether all practical means to avoid or minimize environmental harm from the alternative selected have been adopted (and if not, why they were not), and a summary of monitoring and enforcement where applicable for any mitigation (CFR 1505.2).

**recovery** - improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in §4(a)(1) of the Endangered Species Act; the process by which species' ecosystems are restored so they can support self-sustaining and self-regulating populations of the listed species as persistent members of native biotic communities.

**refuge goals** - descriptive, open-ended and often broad statements of desired future conditions that convey a purpose but do not define measurable units (Writing Refuge Management Goals and Objectives: A Handbook).

**refuge purposes** - the purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, a refuge unit, or refuge subunit, and any subsequent modification of the original establishing authority for additional conservation purposes (Service Manual 602 FW 1.4).

**refuge lands and waters** - those lands and waters in which the Service holds full interest in fee title, or partial interest, such as agreement or easements.

**Refuge Operating Needs System (RONS)** - the Refuge Operating Needs System is a national database which contains the unfunded operational needs of each refuge. We include projects required to implement approved plans, and meet goals, objectives, and legal mandates.

**reintroduction** - the process of relocating a plant or animal species to a location where it historically occurred.

**restoration** - management actions that return a vegetative community or ecosystem to its original, natural condition or to something close to its natural state.

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**RH** - Relative Humidity.

**RIM** - Rotational Impoundment Management.

**RMIS** - Refuge Management Information System, FWS; includes RONS and SAMMS.

**RONS** - Refuge Operating Needs System, FWS.

**runoff** - water from rain, melted snow, or agricultural or landscape irrigation that flows over the land surface into a water body.

**SAMMS** - Service Asset Maintenance Management System, FWS.

**SAV** - Submerged Aquatic Vegetation.

**scoping** - a process utilized to determine the scope of issues to be addressed.

**Service (or FWS or USFWS)** - US Fish and Wildlife Service.

**Service presence** - the existence of the Service through its programs and facilities which it directs or shares with other organizations; the public awareness of the Service as a sole or cooperative provider of programs and facilities.

**SJRWMD** - St. Johns River Water Management District.

**soil association** - a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil

**species** - a distinctive kind of plant or animal having distinguishable characteristics that can interbreed and produce viable young; a category of biological classification.

**species abundance** - the relative distribution of the number of individuals of each species in a community.

**species diversity** - either the absolute number of species or a measure of both the number of species and their relative abundance.

**species of management concern** - species present in the watershed for which the Refuge has a special management interest. A list of such species would include a mix of federally listed threatened and endangered species; migratory bird, especially declining species, neotropical migrants, colonial waterbirds, shorebirds, and waterfowl; marine mammals; sea turtles; interjurisdictional fish; state-listed threatened, endangered, special concern, and commercially exploited species; Audubon Watch List species for Florida; species on the Florida Natural Areas Inventory list; species listed by the Florida Committee on Rare and Endangered Plants and Animals; and key indicator species.

**spodic horizon** - a mineral soil horizon or layer characterized by the alluvial accumulation of amorphous material composed of aluminum and organic carbon with or without iron.

**SRU** - Scrub Reserve Unit.

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**SSC** - Species of Special Concern, State of Florida.

**state land** - public land owned by a state such as state parks or state wildlife management areas.

**step-down management plans** - step-down management plans describe management strategies and implementation schedules. Step-down management plans are a series of plans dealing with specific management subjects (e.g., croplands, wilderness, and fire) (Service Manual 602 FW 1.4).

**stopover habitat** - habitat used during bird migration for rest and feeding.

**strategy** – a specific action, tool, technique, or combination of actions, tools, and techniques used to meet unit objectives.

**succession** - a natural sequence of changes in plant species and community structure over time, leading to a hypothesized stable climax community.

**surficial aquifer** - shallow beds of shells and sand that lie less than 100 feet underground. They are separated from the Floridan aquifer from a confining bed of soil

**take** - to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to collect to engage in any such conduct.

**TCF** - The Conservation Fund.

**threatened species (T), federally** - a federally protected species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

**TNC** - The Nature Conservancy.

**TPL** - Trust for Public Land.

**trust resource** - one that through law or administrative act is held in trust for the people by the government. A federal trust resource is one for which trust responsibility is given in part to the federal government through federal legislation or administrative act. Generally, federal trust resources are those considered to be of national or international importance no matter where they occur, such as endangered species and species such as migratory birds and fish that regularly move across state lines. In addition to species, trust resources include cultural resources protected through federal historic preservation laws, nationally important and threatened habitats, notably wetlands, navigable waters, and public lands such as state parks and National Wildlife Refuges.

**UCF** - University of Central Florida.

**UF** - University of Florida.

**unfragmented habitat** - large blocks of unbroken habitat of a particular type.

**unwanted wildland fire** - any fire burning in wildland areas that does not meet management objectives. In other words a wildfire.

**upland** - dry ground; other than wetlands.

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**USACE (or ACE)** - US Army Corps of Engineers.

**USC** – U.S. Code.

**USFWS (or FWS or Service)** - US Fish and Wildlife Service.

**USGS** - US Geologic Survey.

**vegetation** - plants in general or the sum total of the plant life in an area.

**vegetation type** - a plant community with distinguishable characteristics.

**viable population** - a population that will continue to occur in the area for the foreseeable future. In population modeling, minimum viable population (MVP) is the smallest number of individuals that are needed to maintain a species population in the long term.

**visitor center** - a permanently staffed building offering exhibits and interpretive information to the visiting public. Some visitor centers are co-located with refuge offices, others include additional facilities, such as classrooms or wildlife viewing areas.

**visitor contact station** - compared to a visitor center, a contact station is a smaller facility which may not be permanently staffed.

**VSP** - Visitor Services Plan.

**watershed** - the geographic area within which water drains into a particular river, stream or body of water. A watershed includes both the land and the body of water into which the land drains.

**WCS** - Water Control Structure.

**wetlands** - The U.S. Fish and Wildlife Service's definition of wetlands states that "Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water" (Cowardin et al 1979).

**wildland** - land other than that dedicated for other uses such as agriculture, urban, mining or parks.

**wildland fire** - a fire burning in the wildland areas.

**wildlife** - the mix of living organisms; includes plants and animals.

**wildlife-dependent recreational use** - "A use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation." These are the six priority public uses of the System as established in the National Wildlife Refuge System Administration Act, as amended. Wildlife-dependent recreational uses, other than the six priority public uses, are those that depend on the presence of wildlife. We also will consider these other uses in the preparation of refuge CCPs, however, the six priority public uses always will take precedence.

**wildlife diversity** - a measure of the number and relative abundance of wildlife species in an area.

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**wildlife management** - the practice of manipulating wildlife populations, either directly through regulating the numbers, ages, and sex ratios harvested, or indirectly by providing favorable habitat conditions and alleviating limiting factors.

**xeric** - dry or desert-like conditions.

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## C. *Relevant Legal Mandates*

Several procedural and substantive requirements of federal and applicable state and local laws and regulations affect refuges. The key laws, treaties, conventions, and executive orders are listed.

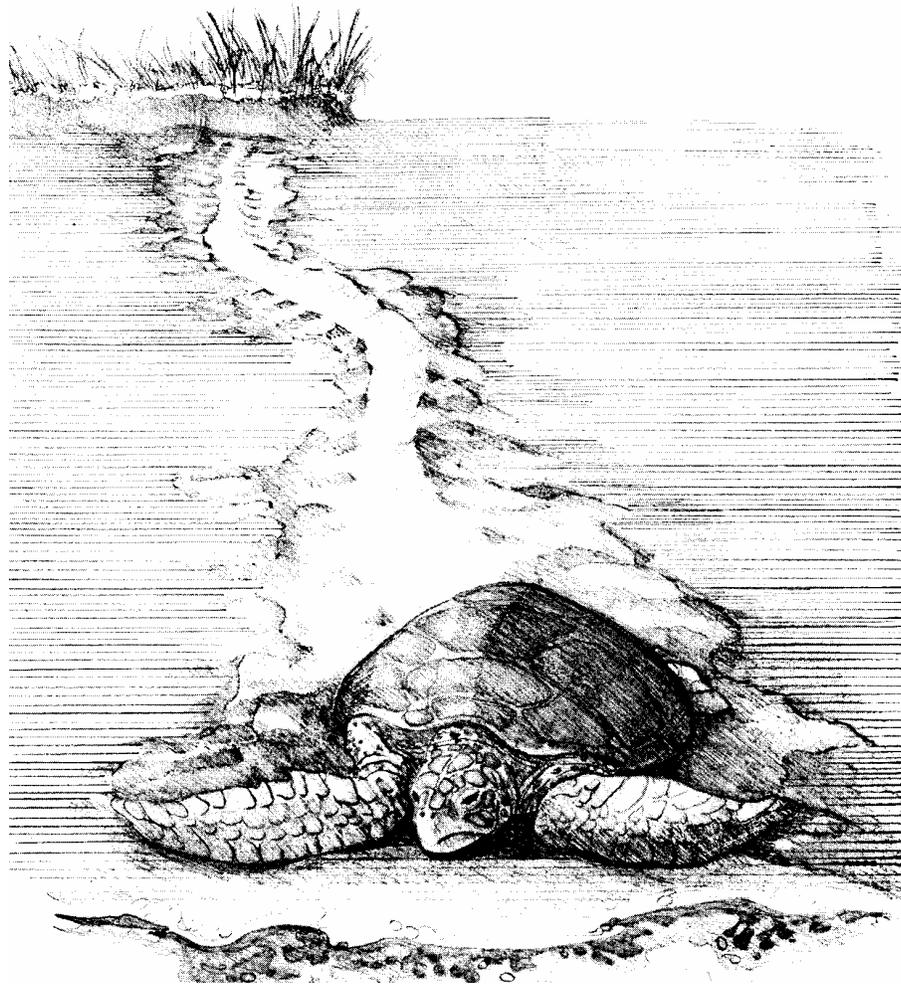
- Lacey Act (1900), as amended
- Antiquities Act (1906)
- Weeks-McLean Law (1913)
- Canadian United States Migratory Bird Treaty (Convention between the United States and Great Britain for Canada for the Protection of Migratory Birds) (1916)
- Migratory Bird Treaty Act (1918 and 1978)
- Migratory Bird Conservation Act (1929), as amended
- Migratory Bird Hunting and Conservation Stamp Act (1934)
- Fish and Wildlife Coordination Act (1934), as amended
- Historic Sites Act (1935)
- Refuge Revenue Sharing Act (1935), as amended
- Convention between the United States of America and the Mexican States for the Protection of Migratory Birds and Game Animals (1936)
- Federal Aid in Wildlife Restoration Act, as amended (1937)
- Bald and Golden Eagle Protection Act (1940), as amended
- Convention of Nature Protection and Wildlife Preservation in the Western Hemisphere (1940)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (1943)
- Flood Control Act (1944), as amended
- Transfer of Certain Real Property for Wildlife Conservation Purposes Act (1948)
- Refuge Trespass Act (1948)
- Federal Property and Administrative Services Act (1949), as amended
- Federal Aid in Fish Restoration Act (1950)
- Fish and Wildlife Act (1956), as amended
- Waterfowl Depredations Prevention Act, as amended (1956)
- Fish and Wildlife Coordination Act (1958)
- Cooperative Research and Training Units Act (1960)
- Wetlands Loan Act (1961)
- Refuge Recreation Act (1962), as amended
- Water Resources Planning Act (1962), as amended
- Refuge Revenue Sharing Act (1964), as amended
- Wilderness Act (1964)
- Land and Water Conservation Fund Act (1965), as amended
- National Wildlife Refuge System Administrative Act (1966)
- National Historic Preservation Act (1966)
- Freedom of Information Act (1967)
- Architectural Barriers Act (1968)
- National Trails System Act (1968)
- Wild and Scenic Rivers Act (1968)
- National Environmental Policy Act (1969)
- Executive Order 11514 - Protection and Enhancement of Environmental Quality (1970)
- Executive Order 11593 - Protection and Enhancement of the Cultural Environment (1971)
- Clean Water Act (1972)

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- Convention on Wetlands of International Importance (1972)
  - Executive Order 11644 - Use of Off-road Vehicles on Public Lands (1972), as amended (Executive Order 11989, 1977)
  - Federal Environmental Pesticide Control Act (1972), as amended
  - Federal Water Pollution Control Act Amendments (1972), as amended
  - Endangered Species Act (1973), as amended
  - Rehabilitation Act (1973)
  - Archaeological and Historic Preservation Act (1974)
  - Environmental Education Act (1975)
  - Federal Land Policy Management Act (1976)
  - Clean Air Act (1977), as amended
  - Clean Water Act (1977)
  - Executive Order 11988 - Floodplain Management and Wetlands Preservation (1977)
  - Executive Order 11989 - Use of Off-road Vehicles on Public Lands (1977)
  - Executive Order 11990 - Protection of Wetlands (1977)
  - Fish and Wildlife Improvement Act (1978)
  - American Indian Religious Freedom Act (1978)
  - Archaeological Resources Protection Act (1979)
  - Administrative Procedures Act (1979)
  - Fish and Wildlife Conservation Act (1980)
  - Executive Order 12372 - Intergovernmental Review of Federal Programs (1982)
  - The Food Security Act (1985)
  - Emergency Wetlands Resources Act (1986)
  - North American Wetlands Conservation Act (1989)
  - Federal Noxious Weed Act (1990)
  - Native American Graves Protection and Repatriation Act (1990)
  - Americans with Disabilities Act (1992)
  - Wild Bird Conservation Act (1992)
  - Executive Order 12898 - Environmental Justice in Minority Populations and Low-income Populations (1994)
  - Secretarial Order 3127 (602 DM 2) - Contaminants and Hazardous Waste Determination (1995)
  - Executive Order 12996 - Management and General Public Use of the National Wildlife Refuge System (1996)
  - Executive Order 13007 - Indian Sacred Sites (1996)
  - National Refuge System Improvement Act (1997) (and subsequent policies)
  - Executive Order 13084 - Consultation and Coordination with Indian Tribal Governments (1998)

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*D. Biota*

**LISTED SPECIES OF THE  
MERRITT ISLAND  
NATIONAL WILDLIFE REFUGE**



***Compiled by:  
Marc Epstein and Boyd Blihovde  
US Fish and Wildlife Service  
Merritt Island National Wildlife Refuge  
February 2006***

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# LISTED SPECIES OF THE MERRITT ISLAND NATIONAL WILDLIFE REFUGE

Listed species are plants or animals that have been listed by a state and/or federal agency with special protection or conservation designations. Included on this list are species designated by non-governmental agencies that do not provide regulatory protection (see below). Those species with regulatory protection are protected by law, such as state and federal endangered and threatened species. State Species of Special Concern (SSC) and Commercially Exploited are afforded special protection, recognition, or consideration (Florida Administrative Code 39-1.004 and Chapter 5B-40). Birds of Conservation Concern are those migratory and non-migratory bird species (not already listed as federally Threatened or Endangered) with the highest conservation priority (USFWS 2002). Brief explanations of species designations are listed below. Definitions of species designations and status are listed in Appendix 1.

## Types of Designations Used in this List:

### Agencies and Organizations Listing Species

Florida Fish and Wildlife Conservation Commission (**FWC**)  
Florida Department of Agriculture and Consumer Services (**FDA**)  
US Fish & Wildlife Service (**FWS**)  
Florida Natural Areas Inventory (**FNAI**)  
Florida Committee on Rare and Endangered Plants and Animals (**FCREPA**)

### Listing Designation

**Similarity of Appearance T(S/A)** means the species is similar in appearance to a threatened taxon. The American alligator in this case with the American crocodile, but the alligator is not a threatened species under the meaning or intent of the threatened designation.

**Endangered (E) means** “without special management efforts, these species are considered rare enough to become extinct.” (Federal and State)

**Threatened (T) means** “without special management efforts, these species are likely to become endangered in the foreseeable future.” (Federal and State)

**Species of Special Concern (SSC)** means that the species warrants special protection because of concern that it could become threatened. (State; see Sullivan 2004))

**Birds of Conservation Concern (BCC)** replaced the Nongame Birds of Management Concern (SMC). These birds have the highest conservation concern for the US Fish and Wildlife Service (other than the birds listed as federally Threatened or Endangered) (Federal; see USFWS 2002).

**Rare (R)** means the species is considered rare by the Florida Committee on Rare and Endangered Plants and Animals (non-government).

**Commercially Exploited (C)** means plants that are protect due to Commercial Exploitation.

**Rare (R)** means the species is considered rare by the Florida Committee on Rare and Endangered Plants and Animals (non-government).

**FNAI** means that the species has been ranked by the Florida Natural Areas Inventory (non-government).

**FCREPA** means the species is listed by Florida Committee on Rare and Endangered Plants and Animals (non-government).

This list is based on species with a federal, state, or non-government designation; it is not a comprehensive list of species for the refuge. There are 124 unique species included under this list: 1 amphibian, 10 reptiles, 69 birds, 6 mammals, and 38 plants. There may be species in Florida that are protected but not listed here because the species either has not been confirmed or has been extirpated from the refuge. This list includes species that are considered rare and do not occur on the refuge every year or there have been incidental reports (see Literature Cited section). The total number of listed species presently known to exist or regularly occur on the refuge is categorized (Tables 1 and 2).

Among the 124 species listed here, 50 are listed as state or federal threatened or endangered plants and animals (21 animals and 28 plants) and 5 are plants that are listed by the state as Commercially Exploited (Table 3). There are no known federally listed plants on the refuge and all listing for plant are state designations. Of the total listed animal species, 17 are federally listed. However, 7 of these species (American alligator, Kemp's ridley sea turtle, Hawksbill sea turtle, Atlantic salt marsh snake, snail kite, Audubon's crested caracara, and roseate tern) either have a special listing (i.e., alligator) or have rarely been recorded on the refuge. This brings the actual number of state or federally-listed species that presently occur on the refuge to 41; 10 federal and 31 state species (excludes alligator; includes 28 plant species) (Table 2). There are 10 federally and 3 state listed animal species (13 total state or federal) that presently occur on the refuge. A total of 93 species that presently occur on the refuge have a federal or state designation (i.e., T, E, BCC, SSC, or C). Annotated species records of rare sightings (16 species) are included on this list, however, these rare species may not actually be a functional component of the wildlife community on the refuge and may only be the results of incidental sightings. Additionally, rare non-federally listed species, such as the Florida black bear, Limpkin, Roseate tern, and others are also listed but may have limited distribution or activity on the refuge. Species that are rare or have only had incidental sightings are footnoted to this effect. They are removed from the final calculation.

There are 55 animal species designated as species of Special Concern by state or federal agencies (designated BCC or SSC). There are 33 plant species listed by the state as Threatened, Endangered, or Commercially Exploited. Included in the list are 22 additional plant species that have special designations (e.g., UR, FNAI, CITES, or FCREPA). Some plant species may have both a state and special designation.

Table 1. State or federally designated plants and animals that have been recorded on Merritt Island National Wildlife Refuge.

Species	Federal			State			Commercially Exploited Plants
	E	T	BCC	E	T	SSC	
Fishes	0	0	0	0	0	0	0
Amphibians	0	0	0	0	0	1	0
Reptiles	4	4	0	5	2	3	0
Birds	2	5	42	3	8	12	0
Mammals	1	1	0	1	2	1	0
Plants	0	0	0	17	11	0	5
<b>Total Recorded</b>	<b>7</b>	<b>10</b>	<b>42</b>	<b>26</b>	<b>23</b>	<b>17</b>	<b>5</b>

Table 2. Number state and federally threatened and endangered species that presently occur on the refuge.

T & E Species Presently Occurring	Fish	Amphibians	Reptiles	Birds	Mammals	Plants	TOTAL
Number of Federal	0	0	4	4	2	0	10
Number of State and Federal	0	0	4	7	2	28	41

Table 3. Listed species of the Merritt Island National Wildlife Refuge.

Scientific Names	Common Names	Agency Status			
		FWC	FWS	FCREPA	FNAI
<b>Amphibians (1)</b>					
<i>Rana capito</i>	Gopher frog	SSC	*	T	G3G4S3

Scientific Names	Common Names	Agency Status			
		FWC	FWS	FCREPA	FNAI
<b>Reptiles (10)</b>					
<i>Alligator Mississippiensis</i>	American alligator <sup>1</sup>	SSC	T(S/A)	*	G5S4
<i>Caretta caretta</i>	Loggerhead	E	T	T	S3
<i>Chelonia mydas</i>	Green turtle	E	E	E	S2
<i>Dermochelys coriacea</i>	Leatherback	E	E	R	S2
<i>Lepidochelys kempii</i>	Kemp's ridley <sup>3, 5</sup>	E	E	E	S1
<i>Eretmochelys imbricata</i>	Hawksbill <sup>3, 5</sup>	E	E	E	S1
<i>Gopherus polyphemus</i>	Gopher tortoise	SSC	*	T	S3
<i>Pituophis melanoleucus mugitus</i>	Florida pine snake <sup>4</sup>	SSC	*	SSC	G5T3S3
<i>Nerodia clarkii taeniata</i>	Atlantic saltmarsh snake <sup>2, 5</sup>	T	T	E	G4T1S1
<i>Drymarchon couperi</i>	Eastern indigo snake	T	T	SSC	G4T3S3

Scientific Names	Common Names	Agency Status			
		FWC	FWS	FCREPA	FNAI
<b>Birds <sup>6, 7</sup> (69)</b>					
<i>Spizella pusilla</i>	Field sparrow	*	BCC	*	*
<i>Ammodramus henslowii</i>	Henslow's sparrow <sup>5</sup>	*	BCC	*	*
<i>Aimophila aestivalis</i>	Bachman's sparrow	*	BCC	*	G3S3
<i>Passerina ciris</i>	Painted bunting	*	BCC	*	G5S3
<i>Sturnella magna</i>	Eastern meadowlark	*	BCC	*	*
<i>Dolichonyx oryzivorus</i>	Bobolink	*	BCC	*	*

Scientific Names	Common Names	Agency Status			
		FWC	FWS	FCREPA	FNAI
<b>Birds <sup>6,7</sup> (69)</b>					
<i>Dendroica discolor</i>	Prairie warbler	*	BCC	*	G5T3S3
<i>Dendroica pensylvanica</i>	Chestnut-sided warbler	*	BCC	*	*
<i>Lymnophylis swainsonii</i>	Swainson's warbler <sup>5</sup>	*	BCC	*	*
<i>Vireo altiloquus</i>	Black-whiskered vireo	*	BCC	R	G5S3
<i>Lanius ludovicianus</i>	Loggerhead shrike	*	BCC	*	*
<i>Cistothorus platenis</i>	Sedge wren	*	BCC	*	*
<i>Hylocichla mustelina</i>	Wood thrush	*	BCC	*	*
<i>Catharus fuscescens</i>	Veery	*	BCC	*	*
<i>Colaptes auratus</i>	Northern flicker	*	BCC	*	*
<i>Aphelocoma coerulescens</i>	Florida scrub-jay	T	T	T	G2S2
<i>Aramus guarauna</i>	Limpkin <sup>5</sup>	SSC	BCC	SSC	G5S3
<i>Charadrius melodus</i>	Piping plover	T	T	E	G3S2
<i>Botaurus lentiginosus</i>	American bittern	*	BCC	*	*
<i>Ixobrychus exilis</i>	Least bittern	*	BCC	SSC	G5S4
<i>Egretta caerulea</i>	Little blue heron	SSC	*	SSC	G5S4
<i>Egretta rufescens</i>	Reddish egret	SSC	BCC	R	G4S2
<i>Egretta thula</i>	Snowy egret	SSC	*	SSC	G5S3
<i>Egretta tricolor</i>	Tricolored heron	SSC	*	SSC	G5S4
<i>Eudocimus albus</i>	White ibis	SSC	*	SSC	G5S4
<i>Polyborus plancus audubonii</i>	Audubon's crested caracara <sup>5,7</sup>	T	T	T	G5S2LTLT
<i>Falco peregrinus</i>	Peregrine falcon	E	*	E	G4S2
<i>Rosthrhamus sociabilis</i>	Snail kite <sup>5,7</sup>	E	E	E	G4G5T2S2
<i>Elanoides forficatus</i>	Swallow-tailed kite	*	BCC	T	G5S2
<i>Circus cyaneus</i>	Northern harrier	*	BCC	*	*
<i>Grus canadensis pratensis</i>	Florida sandhill crane	T	*	T	G5T2T3S2S3
<i>Haematopus palliatus</i>	American oystercatcher	SSC	*	T	G5S2
<i>Mycteria Americana</i>	Wood stork	E	E	E	G4S2
<i>Gavia immer</i>	Common loon	*	BCC	*	*
<i>Pelecanus occidentalis</i>	Brown pelican	SSC	BCC	T	G4S3
<i>Laterallus jamaicensis</i>	Black rail	*	BCC	R	G4S2
<i>Rynchops niger</i>	Black skimmer	SSC	*	SSC	G5S3
<i>Sterna antillarum</i>	Least tern	T	BCC	T	G4S3
<i>Sterna dougallii</i>	Roseate tern <sup>5</sup>	T	T	T	G4S1
<i>Chilidonias niger</i>	Black tern	*	BCC	*	*
<i>Tyto alba</i>	Barn owl	*	BCC	*	*

Scientific Names	Common Names	Agency Status			
		FWC	FWS	FCREPA	FNAI
<b>Birds <sup>6,7</sup> (69)</b>					
<i>Asio flammeus</i>	Short-eared owl	*	BCC	*	*
<i>Haliaeetus leucocephalus</i>	Bald eagle	T	T	T	G4S3
<i>Caprimulgus carolinensis</i>	Chuck-will's-widow	*	BCC	*	*
<i>Puffinus lherminieri</i>	Audubon's shearwater <sup>5</sup>	*	BCC	*	*
<i>Fregata magnificens</i>	Magnificent frigatebird <sup>5</sup>	*	BCC	T	G5S1
<i>Melanerpes erythrocephalus</i>	Red-headed woodpecker	*	BCC	*	*
<i>Falco sparverius paulus</i>	Southeastern American kestrel <sup>5</sup>	T	BCC	T	G5T4S3
<i>Dendroica petechia (only gundlachi sub spp.)</i>	Yellow warbler	*	BCC	R	G5T4S3
<i>Dendroica dominica</i>	Yellow-throated warbler	*	BCC	*	*
<i>Numenius phaeopus</i>	Whimbrel	*	BCC	*	*
<i>Ammodramus maritimus</i>	Seaside sparrow	SSC	BCC	SSC	G4TS
<i>Calidris canutus</i>	Red knot	*	BCC	*	*
<i>Calidris pusilla</i>	Semipalmated sandpiper	*	BCC	*	*
<i>Limnodromus griseus</i>	Short-billed dowitcher	*	BCC	*	*
<i>Sterna nilotica</i>	Gull-billed tern	*	BCC	*	G5S2
<i>Sterna hirundo</i>	Common tern	*	BCC	*	*
<i>Casmerodius albus</i>	Great egret	*	*	SSC	*
<i>Nycticorax nycticorax</i>	Black-crowned night-heron	*	*	SSC	*
<i>Nycticorax violacea</i>	Yellow-crowned night-heron	*	*	SSC	*
<i>Plegadis falcinellus</i>	Glossy ibis	SSC	*	SSC	*
<i>Accipiter cooperii</i>	Cooper's hawk	*	*	SSC	*
<i>Recurvirostra americana</i>	American avocet	*	*	SSC	*
<i>Sterna fuscata</i>	Sooty tern <sup>5</sup>	*	*	SSC	*
<i>Sterna maxima</i>	Royal tern	*	*	SSC	*
<i>Sterna sandvicensis</i>	Sandwich tern	*	*	SSC	*
<i>Sterna caspia</i>	Caspian tern	*	*	SSC	*
<i>Picoides villosus</i>	Hairy woodpecker <sup>5</sup>	*	*	SSC	*
<i>Cictothorus palustris</i>	Marsh wren	SSC	*	SSC	*

Scientific Names	Common Names	Agency Status			
		FWC	FWS	FCREPA	FNAI
<b>Mammals (6)</b>					
<i>Peromyscus polionotus niveiventris</i>	Southeastern beach mouse	T	T	T	G5T1S1
<i>Podomys floridanus</i>	Florida mouse	SSC	*	T	G3S3
<i>Trichechus manatus</i>	West Indian manatee	E	E	E	G2S2
<i>Ursus americanus floridanus</i>	Florida black bear <sup>5</sup>	T	*	T	G5T2S2
<i>Neofiber alleni</i>	Round-tailed muskrat	*	*	SSC	*
<i>Mustela frenata peninsulæ</i>	Florida weasel <sup>5</sup>	*	*	R	*

Scientific Names	Common Names	Agency Status			
		USFWS	FDA	FCREPA	FNAI
<b>Plants <sup>8</sup> (38)</b>					
<i>Asclepias curtissii</i>	Curtiss milkweed	*	E	*	G3, S3
<i>Avicennia germinans</i>	Black mangrove	*	*	SSC	*
<i>Calamovilfa curtissii</i>	Curtiss reedgrass	*	T	*	G1G2,S1S2
<i>Calopogon multiflorus</i>	Many-flowered grass pink	*	E	*	*
<i>Chamaesyce cumulicola</i>	Sand dune spurge	*	E	*	G2,S2
<i>Chrysophyllum oliviforme</i>	Satinleaf	*	T	*	*
<i>Encyclia tampensis</i>	Butterfly orchid	*	C	*	*
<i>Epidendrum canopseum</i>	Greenfly orchid	*	C	*	*
<i>Harrisella filiformis</i>	Threadroot orchid	*	T	*	*
<i>Hexalectris spicata</i>	Crested coralroot	*	E	*	*
<i>Lantana depressa</i> var. <i>floridana</i>	East coast lantana	*	E	*	G2T2, S2
<i>Lechea cernua</i>	Nodding pinweed	*	T	*	G3, S3
<i>Lechea divaricata</i>	Pine pinweed	*	E	*	G2, S2
<i>Lilium catesbaei</i>	Catesby lily	*	T	*	G4, S3
<i>Myrcianthes fragrans</i>	Nakedwood	*	T	*	G4T3, S3
<i>Nemastylis floridana</i>	Celestial lily	*	E	*	G2, S2
<i>Ophioglossum palmatum</i> (= <i>Cheiroglossa palmata</i> )	Hand fern	*	E	E	G5, S2
<i>Opuntia stricta</i>	Shell mound prickly-pear	*	T	*	*
<i>Osmunda</i>	Cinnamon fern	*	C	*	*

Scientific Names	Common Names	Agency Status			
		USFWS	FDA	FCREPA	FNAI
<b>Plants<sup>8</sup> (38)</b>					
<i>cinnamomea</i>					
<i>Osmunda regalis</i> var. <i>spectabilis</i>	Royal fern	*	C	*	*
<i>Pavonia spinifex</i>	Yellow hibiscus	*	*	*	G4G5, S2S3
<i>Peclumula plumula</i> (= <i>Polypodium plumula</i> )	Plume polypody				
		*	E	*	*
<i>Peperomia humilis</i>	Peperomia	*	E	*	G5, S2
<i>Peperomia obtusifolia</i>	Florida peperomia	*	E	*	G5, S2
<i>Persea borbonia</i> var. <i>humilis</i>	Scrub bay	*	*	*	G3, S3
<i>Pogonia ophioglossoides</i>	Rose pogonia	*	T	*	*
<i>Pteroglossaspis ecristata</i> (= <i>Eulophia ecristata</i> )	False coco				
		*	T	*	G2G3, S2
<i>Remirea maritima</i> (= <i>Cyperus pedunculatus</i> )	Beach-star				
		*	E	*	*
<i>Rhizophora mangle</i>	Red mangrove	*	*	SSC	*
<i>Scaevola plumieri</i>	Scaevola	*	T	*	*
<i>Sophora tomentosa</i>	Necklace pod	*		*	G4, S3
<i>Spiranthes laciniata</i>	Lace-lip ladies'-tresses	*	T	*	*
<i>Tephrosia angustissima</i> var. <i>curtissii</i>	Narrow-leaved hoary pea; coastal hoary pea	*	E	*	G1T1, S1
<i>Tillandsia fasciculata</i>	Common pine	*	E	*	*
<i>Tillandsia utriculata</i>	Giant wild pine; giant air plant	*	E	*	*
<i>Verbena maritima</i> (= <i>Glandularia maritima</i> )	Coastal vervain	*	E	*	G2, S2
<i>Verbena tampensis</i> (= <i>Glandularia tampensis</i> )	Tampa vervain	*	E	*	G1, S1
<i>Zamia umbrosa</i> (= <i>Zamia pumila</i> )	East coast coontie	*	C	T	*

1 (S/A) means species was listed due to similarity of appearance with the American crocodile. The species is not listed in regards to regulatory actions of Section 7 of the Endangered Species Act and is not in danger of becoming extinct (D. Palmer, FWS, personal communication)

2 Within species home range area, not officially recorded on the Refuge (Moler 1992, Blihovde 1996, Seigel and Seigel 2000).

3 see Ehrhart (1983)

4 R. Seigel (personal communication)

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- 5 *Species which have been recorded on the Refuge but are rarely seen. These species may not be a functional component of the vertebrate wildlife on the refuge*
  - 6 *US Fish and Wildlife Service, 2002*
  - 7 *Merritt Island NWR, unpublished data*
  - 8 *Plants list after Schmalzer et al 2002*
  - 9 *Florida Natural Area Inventory. 2002*

## **Appendix 1: FNAI - Florida Natural Areas Inventory Ranking and Status Definitions** **UPDATED OCTOBER 2002**

Florida Resources and Environmental Analysis Center  
1018 Thomasville Road, Suite 200-C  
Tallahassee, Florida 32303  
Phone: (850) 224-8207    <http://www.fnai.org/data.cfm>

### **FNAI GLOBAL RANK DEFINITIONS**

**G1** = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor.

**G2** = Imperiled globally because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or man-made factor.

**G3** = Either very rare and local throughout its range (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction from other factors.

**G4** = Apparently secure globally (may be rare in parts of range)

**G5** = Demonstrably secure globally

**GH** = Of historical occurrence throughout its range, may be rediscovered (e.g., ivory-billed woodpecker)

**GX** = Believed to be extinct throughout range

**GXC** = Extirpated from the wild but still known from captivity or cultivation

**G#?** = Tentative rank (e.g., G2?)

**G#G#** = Range of rank; insufficient data to assign specific global rank (e.g., G2G3)

**G#T#** = Rank of a taxonomic subgroup such as a subspecies or variety; the G portion of the rank refers to the entire species and the T portion refers to the specific subgroup; numbers have same definition as above (e.g., G3T1)

**G#Q** = Rank of questionable species - ranked as species but questionable whether it is species or subspecies; numbers have same definition as above (e.g., G2Q)

**G#T#Q** = Same as above, but validity as subspecies or variety is questioned.

**GU** = Due to lack of information, no rank or range can be assigned (e.g., GUT2).

**G?** = Not yet ranked (temporary)

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## **FNAI STATE RANK DEFINITIONS**

**S1** = Critically imperiled in Florida because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor.

**S2** = Imperiled in Florida because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or man-made factor.

**S3** = Either very rare and local throughout its range (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction from other factors.

**S4** = Apparently secure in Florida (may be rare in parts of range)

**S5** = Demonstrably secure in Florida

**SH** = Of historical occurrence throughout its range, may be rediscovered (e.g., ivory-billed woodpecker)

**SX** = Believed to be extinct throughout range

**SA** = Accidental in Florida, i.e., not part of the established biota

**SE** = An exotic species established in Florida may be native elsewhere in North America

**SN** = Regularly occurring, but widely and unreliably distributed; sites for conservation hard to determine

## **FEDERAL LEGAL STATUS**

Provided by FNAI for information only.

For official definitions and lists of protected species, consult the relevant federal agency.

Definitions derived from U.S. Endangered Species Act of 1973, Sec. 3. Note that the federal status given by FNAI refers only to Florida populations and that federal status may differ elsewhere.

**LE** Endangered: species in danger of extinction throughout all or a significant portion of its range.

**LT** Threatened: species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

**E(S/A)** Endangered due to similarity of appearance to a species which is federally listed such that enforcement personnel have difficulty in attempting to differentiate between the listed and unlisted species.

**T(S/A)** Threatened due to similarity of appearance (see above).

**PE** Proposed for listing as endangered species.

**PT** Proposed for listing as threatened species.

**C** Candidate species for which federal listing agencies have sufficient information on biological vulnerability and threats to support proposing to list the species as endangered or threatened.

**XN** Non-essential experimental population.

**MC** Not currently listed, but of management concern to U.S. FWS.

**N** Not currently listed, nor currently being considered for listing as endangered or threatened.

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## STATE LEGAL STATUS

Provided by FNAI for information only.

For official definitions and lists of protected species, consult the relevant agency.

**Animals:** Definitions derived from “Florida’s Endangered Species and Species of Special Concern, Official Lists” published by Florida Fish and Wildlife Conservation Commission, 1 August 1997, and subsequent updates.

**LE** Endangered: species, subspecies, or isolated population so few or depleted in number or so restricted in range that it is in imminent danger of extinction.

**LT** Threatened: species, subspecies, or isolated population facing a very high risk of extinction in the future.

**LS** Species of Special Concern is a species, subspecies, or isolated population which is facing a moderate risk of extinction in the future.

**PE** Proposed for listing as endangered.

**PT** Proposed for listing as threatened.

**PS** Proposed for listing as species of special concern.

**N** Not currently listed, nor currently being considered for listing.

**Plants:** Definitions derived from Sections 581.011 and 581.185(2), Florida Statutes, and the Preservation of Native Flora of Florida Act, 5B-40.001. FNAI does not track all state-regulated plant species; for a complete list of state-regulated plant species, call Florida Division of Plant Industry, 352-372-3505 or see:

<http://www.doacs.state.fl.us>.

**LE** Endangered: species of plants native to Florida that are in imminent danger of extinction within the state, the survival of which is unlikely if the causes of a decline in the number of plants continue; includes all species determined to be endangered or threatened pursuant to the U.S. Endangered Species Act.

**LT** Threatened: species native to the state that are in rapid decline in the number of plants within the state, but which have not so decreased in number as to cause them to be endangered.

**PE** Proposed for listing as endangered.

**PT** Proposed for listing as threatened.

**C** Commercially Exploited

**N** Not currently listed, nor currently being considered for listing.

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<sup>9</sup> Explanations and definitions to the ranking system were copied from the Florida Natural Areas Inventory (FNAI) website. For additional information on FNAI species status and ranking, please contact FNAI or see <http://www.fnai.org/data.cfm>.

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**ACKNOWLEDGEMENTS:** We thank Jim Lyons (FWS), Becky Smith (Dynamac Corp.), Paul Schmalzer (Dynamac Corp.), and Cheri Ehrhardt (FWS) for making helpful comments to the draft document.

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## *E. Draft Compatibility Determinations and Appropriate Use Forms*

### **Introduction:**

The Fish and Wildlife Service reviewed several uses for compatibility during the comprehensive conservation planning process for Merritt Island National Wildlife Refuge. Descriptions and anticipated impacts of each of these uses are addressed separately. However, the Uses through the Other Applicable Laws, Regulations, and Policies sections, the Literature Cited section, the Public Review and Comment section, and the Approval of Compatibility Determinations section apply to each use. If one of these uses is considered outside of the Comprehensive Conservation Plan for Merritt Island National Wildlife Refuge, then those sections become part of that compatibility determination.

### **Uses:**

Several uses were evaluated to determine their compatibility with the mission of the Refuge System and the purposes of the refuge: 1) waterfowl hunting, 2) upland game hunting, 3) fishing, 4) wildlife observation and photography, 5) environmental education and interpretation, 6) bicycling, 7) commercial services, 8) commercial fishing, 9) beekeeping, 10) research, 11) astronomy, 12) organized group camping, 13) non-commercial plant collection, 14) interim management of citrus groves, 15) feral hog control, 16) and forest management – commercial timber harvest.

### **Refuge Name:**

Merritt Island National Wildlife Refuge

### **Establishing and Acquisition Authorities:**

Migratory Bird Conservation Act  
North American Wetlands Conservation Act

### **Refuge Purposes:**

Due to its nature as an overlap of Kennedy Space Center, National Aeronautics and Space Administration and its unique location and resources, the refuge has two traditional purposes, as well as an additional purpose stemming from legislation that created a unit of the National Park Service. Recognizing the high migratory bird benefits served by the lands and waters of the refuge, the Service administratively designated Merritt Island Refuge in 1963 under the Migratory Bird Conservation Act, outlining a primary purpose of these lands and waters:

"...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."

16 USC §715d (Migratory Bird Conservation Act)

Further reading of the Migratory Bird Conservation Act also recognizes benefits to other species, including those designated threatened or endangered:

"...to conserve and protect migratory birds...and other species of wildlife that are listed...as endangered species or threatened species and to restore or develop adequate wildlife habitat."

16 USC §715i (Migratory Bird Conservation Act)

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The refuge's primary purpose applies to all lands and waters managed by the refuge, regardless of when they were added to the refuge. Since the refuge has management agreements with NASA and the State of Florida, lands and waters under those management agreements are also subject to the conditions of those agreements.

In 1995, the refuge and its partners began purchasing additional lands and waters in the northwest corner of the refuge, the Turnbull area:

“(1) to protect, enhance, restore, and manage an appropriate distribution and diversity of wetland ecosystems and other habitats for migratory birds and other fish and wildlife in North America; (2) to maintain current or improved distributions of migratory bird populations; and (3) to sustain an abundance of waterfowl and other migratory birds consistent with the goals of the North American Waterfowl Management Plan and the international obligations contained in the migratory bird treaties and conventions and other agreements with Canada, Mexico, and other countries.”

16 USC §4401(2)(b) (North American Wetlands Conservation Act)

This secondary purpose applies only to those lands and waters of the Turnbull Creek area of the refuge. However, the primary purpose also applies to the lands and waters of the Turnbull Creek area. Again, since the refuge has management agreements with the State of Florida for lands and waters in the Turnbull Creek area, those lands and waters are also subject to the conditions of those agreements.

Congruent to the discussion of the traditional purposes of the refuge is the congressional enabling legislation in 1975 that established Canaveral National Seashore as a unit of the National Park Service. Congress established the Seashore partially on new lands and waters and partially as an overlay of NASA's Kennedy Space Center on lands and waters that were already being managed as part of Merritt Island National Wildlife Refuge. In the legislation, Congress outlined that the majority of the overlay portion of the Seashore would be managed as a refuge. The overlay area encompasses approximately 34,345 acres and includes southern Mosquito Lagoon. The Seashore was established "...to preserve and protect the outstanding natural, scenic, scientific, ecologic, and historic values...and to provide for public outdoor recreation use and enjoyment of the same...the Secretary shall retain such lands in their natural and primitive condition, shall prohibit vehicular traffic on the beach except for administrative purposes, and shall develop only those facilities which he deems essential for public health and safety" [16 USC 459(j)]. This language applies much as a Wilderness designation might apply, making this a secondary purpose for the 34,345 acres in the overlap area.

**National Wildlife Refuge System Mission:**

As outlined in the 1997 National Wildlife Refuge System Improvement Act, 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.

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**Description of Use:*****Waterfowl Hunting***

Waterfowl hunting has been identified as a priority wildlife-dependent activity under the National Wildlife Refuge System Improvement Act and is a traditional use at Merritt Island National Wildlife Refuge. The initial interagency agreement between NASA and the Service named waterfowl hunting as an activity that would continue as a condition of the agreement. This wildlife-dependent recreational use is supported by boating; therefore, boating impacts which are associated with the waterfowl hunting program are also considered in this review.

Waterfowl hunting is permitted on approximately 36,000 acres of the refuge's over 140,000 acres. Waterfowl hunting is being proposed in the Turnbull Creek area marshes. The remainder of the refuge is closed to hunting to protect other migratory birds, non-game birds, and endangered species; provide opportunities for non-consumptive recreational uses, such as wildlife viewing and photography; and provide a sanctuary for waterfowl. Hunting areas include the open waters of Mosquito Lagoon and the Indian River Lagoon, as well as 25 of the refuge's 76 impoundments. The 2,945-acre Pole and Troll zones in Mosquito Lagoon will alter historic waterfowl hunter access in part of one hunt area, but will help benefit waterfowl and other migratory birds and lessen impacts to submerged aquatic plants from prop scarring.

Waterfowl hunting is allowed in four areas of the refuge (i.e., hunt areas 1-4) in accordance with state regulations and seasons. In addition to state regulations, several refuge regulations apply, which are paraphrased in this list.

- Hunting is allowed only three days per week (i.e., Wednesday, Saturday, and Sunday) from one half hour before sunrise until 1:00 p.m.
- Entry into the refuge cannot begin earlier than 4:00 a.m.
- A general Merritt Island Refuge Hunt Permit for Ducks and Coots is required.
- A quota permit is required for hunt areas 1 and 4 during the months of November and December. A fee is charged for the quota permit.
- Hunters are required to have completed a state-certified hunter safety course and to carry proof of completion on their person while hunting.
- Hunting is not allowed within 15 feet of any dike.
- Airboats and jet skies are not permitted.

Quota permits are issued through a telephone call-in reservation system prior to the beginning of the waterfowl hunt season. Hunters may pay for the permits by mail or in person. Leftover and unclaimed quota permits are available to walk-in customers. The quota permit program is designed to maintain high quality hunting conditions, providing for limits to the number of hunting parties in each impoundment of the quota areas. The quota limits were developed by providing one hunting party per 40 acres in those quota areas. Further, each hunting party is limited to no more than four hunters per group.

Access to the hunting areas is primarily by boat, since access is limited and only a few areas allow foot access. Currently, the refuge has no restrictions on the type of boat, horsepower, or motor type. Depending on the hunt area, size of impoundment, or water conditions, hunters generally access the hunting areas with non-powered boats, such as canoes, or with motorized boats, such as small (i.e., 8-16-foot) flat-bottom boats with outboard motors, or go-devils. The open waters of Mosquito Lagoon can be hazardous during windy weather conditions and for safety reasons, most hunters in Hunt Area 3 use slightly larger flat-bottom boats, up to 18 feet, to access this area.

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The best hunting is usually found in the impoundments. The refuge has made efforts to provide launch sites into each impoundment open to waterfowl hunting. This is not only convenient to the hunter, but helps prevent damage to the dike's bank and vegetation. Hunt Area 3 is the exception to this rule, and hunters who hunt in the beach impoundments on the east side of Mosquito Lagoon must pull over the dike.

Water level management in the impoundments is an important aspect of refuge management. The strategy is to begin holding water in the impoundments designated for waterfowl management in late summer for the production of desirable waterfowl aquatic plants. As the season progresses, the refuge has some ability to hold water to create the proper balance to fulfill the dual requirements for waterfowl and hunters. Achieving optimum water level conditions for the diverse range of wildlife species that utilize the impoundments and visitors engaged in priority recreational activities constitute one of the greatest management challenges for the refuge. Each user group, it seems, prefer different water level conditions and, on occasion, vandals pull riser boards, which drain the impoundments. To prevent visitors from tampering with the riser boards, the refuge has designed a locking mechanism aimed at preventing unwanted removal of riser boards.

**Availability of Resources:** Operation and maintenance funds to support waterfowl hunting are taken from the refuge's annual budget, which is adequate to sustain the program at the current level. Funds are needed annually to mow, grade, and fix roads open to waterfowl access; replace gravel on hunter access roads; paint, repair, and replace signs; develop and print brochures; and issue permits. One Refuge Ranger, one Refuge Biologist, one Biological Science Technician, one Administrative Assistant, and two law enforcement officers spend at least one month a year managing the waterfowl hunt. These salaries come out of the refuge's operating budget and are adequate to sustain the program at current levels.

**Anticipated Impacts of Use:** Anticipated impacts were identified and evaluated based on best professional judgment and published scientific papers, as well as by analyzing 30 years of refuge hunt data. Numerous studies have documented the inverse relationship between the number of waterfowl using an area and hunting intensity (Reichholf 1973, Arctander et al 1984, Madsen et al 1992 as cited by Fox and Madsen 1997, Wolder 1993). Boating, walking, and shooting undoubtedly impact the distribution of and use by bald eagles, but waterfowl carcasses that become available during the hunting season may be beneficial for bald eagles and other scavenging species. The greatest potential adverse impact related to waterfowl hunting may be from boating impacts. Boating has been shown to alter distribution, reduce use of particular habitats by waterfowl and other birds, alter feeding behavior, and cause premature departure from areas. Impacts of boating can occur even at low densities, given the ability of powerboats to cover extensive areas in a short amount of time, the noise they produce, and their speed (Sterling and Dzubin 1967, Bergman 1973, Speight 1973, Skagen 1980, Korschgen et al 1985, Kahl 1991, Bauer et al 1992, Dahlgren and Korschgen 1992).

Feeding patterns and the nutritional status of waterfowl has also been shown to be impacted by hunting. Hunting can cause birds to change feeding locations (Cronan 1957, Thornburg 1973, Madsen 1995), feed more at night (Thornburg 1973, Morton et al 1989a, Morton et al 1989b), reduce the amount of time spent feeding (Cronan 1957, Thompson 1973, Thornburg 1973, Paulus 1984, Korschgen et al 1985, Morton et al 1989a), and feed in lower quality habitat (Kahl 1991). Other factors, including road access, hunter densities, and distribution and amount of high quality sanctuary, can impact waterfowl and non-target species (Skagen 1980, Bauer et al 1992). Thirty years of data at the refuge generally support these findings.

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The literature suggests that the main impact of waterfowl hunting on wildlife and the wetlands of the refuge is not the direct mortality of waterfowl from hunters, but is the associated impacts related to boating. Boating impacts wildlife due to noise and speed, and significantly increases access to more parts of the marsh (i.e., hunters accessing by boat can disturb more birds than walk-in hunters).

As a strategy to reduce motor boat impacts, the refuge has taken several actions. Perhaps the biggest factor and one over which the refuge has no control is that about half of the refuge is within the restricted area of Kennedy Space Center and is closed to motorized boating. This area serves as a sanctuary for migratory birds and other species. The only portion of the south half of the refuge that is open to the public is the Banana River and most of it is a no motor zone and is not open to hunting. Within the hunting area, a portion of Hunt Area 3 is designated as a Pole and Troll Zone. This is a management strategy to improve the quality of fishing and to reduce prop scarring. Although not specifically aimed at reducing waterfowl hunting impacts, this action could benefit waterfowl by reducing disturbance to waterfowl, while also reducing impacts to submerged aquatic grasses. These actions will be monitored to determine their effectiveness in maintaining waterfowl and other wildlife populations.

Disturbance by hunters to other recreational activities is not considered a problem due to the limited number of days and hours during which the refuge is open to hunting. This, coupled with the availability of quality wildlife viewing areas outside of the hunting area, indicates that visitors engaged in non-consumptive wildlife recreation are generally not impacted by waterfowl hunting. Wildlife viewing and photography areas, such as Black Point Wildlife Drive, serve as additional sanctuaries from hunting. Hunting may actually improve wildlife viewing on the Wildlife Drive, since hunting pressure in surrounding marshes probably shifts waterfowl to the sanctuary found along the Wildlife Drive.

The refuge has taken numerous actions to reduce hunting pressure. Implementing quota hunt permits, limiting the number of days that the refuge is open to hunting, closing roads from November through March annually, and implementing the Pole and Troll zones are all actions taken to help sustain migratory bird populations. If waterfowl populations begin declining or other wildlife impacts occur, additional actions can be taken, such as implementing additional closed areas, increasing the size of the pole and troll zones, or adding other motor boat restrictions.

**Determination (check one below):**

	Use is Not Compatible
X	Use is Compatible, with the Listed Stipulations

**Stipulations Necessary to Ensure Compatibility:** To ensure compatibility of hunting activities on the refuge, several stipulations are necessary in addition to state regulations, as listed.

- Hunting is allowed only three days per week (i.e., Wednesday, Saturday, and Sunday) from one half hour before sunrise until 1:00 p.m.
- Entry into the refuge cannot begin earlier than 4:00 a.m.
- A general Merritt Island Refuge Hunt Permit for Ducks and Coots is required.
- A quota permit is required for hunt areas 1 and 4 during the months of November and December. A fee is charged for the quota permit.
- Hunters are required to have completed a state-certified hunter safety course and to carry proof of completion on their person while hunting.

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- Hunting is not allowed within 15 feet of any dike.
  - Airboats and jet skies are not permitted.

As necessary, the Service will implement additional regulations to address waterfowl hunting. In the future, it may be necessary to focus additional management actions to maintain high quality waterfowl habitat in the sanctuary as a strategy to help sustain waterfowl populations. Other strategies such as restricting motor boat use in some impoundments for hunting or scouting, establishing additional seasonal sanctuaries, implementing quotas in non-quota hunt areas, extending the requirement for quota permits into January, reducing the number of days open to hunting, implementing noise or speed restrictions on boats, are additional measures the refuge could use to sustain waterfowl populations.

**Justification:** Hunting is a priority wildlife-dependent use under the National Wildlife Refuge System Improvement Act. Waterfowl hunting, as described, was determined to be compatible, in view of the potential impacts that hunting and the supporting activities (e.g., boating) can have on the Service's ability to achieve the purposes and goals of the refuge, because: (1) hunter densities and use levels are relatively low during most days the refuge is open to hunting, (2) sufficient restrictions have been established to ensure that an adequate amount of high-quality feeding and resting habitat would be available to accommodate the needs of waterfowl and other wetland birds using the refuge, and (3) sufficient opportunities are available for other priority wildlife-dependent recreation during the waterfowl season.

#### **Mandatory 15-Year Re-evaluation Date:**

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#### **Description of Use:**

##### *Upland Hunting*

Hunting has been identified as a priority wildlife-dependent activity under the National Wildlife Refuge System Improvement Act. With the implementation of the comprehensive conservation plan, the Service will take the steps necessary (e.g., develop needed regulations and publish the appropriate Federal Register notice) to open the refuge to upland hunting for deer and feral hogs in a portion of the refuge's upland habitat in cooperation with the state. This will provide additional opportunities for a priority recreational activity and help to reduce the feral hog population on the refuge. Implementing the upland hunt will first require preparing a hunt plan; posting appropriate notice in the Federal Register; and establishing regulations in Title 50, Code of Federal Regulations.

Upland hunting for white-tailed deer and feral hogs will be designated in the area north of Haulover Canal on approximately 6,083 acres of the refuge's over 140,000 acres. A quota will be established for the number of hunters. The remainder of the refuge will remain closed to upland hunting to minimize conflicts with other priority uses and for Kennedy Space Center security reasons. The area north of Haulover has the highest deer population. The upland game hunt will be conducted in cooperation with the Florida Fish and Wildlife Conservation Commission.

**Availability of Resources:** The details for administering the program have not been determined. It is assumed that a quota permit will be charged for the hunting opportunity to cover the costs of managing the program. Funds would be needed annually to mow, grade, and fix roads and parking areas open to hunter access; maintain signs; and print leaflets. The selection process for permits will likely be processed through the existing state system. Management of the program has a biological, administrative, maintenance, and law enforcement component. Partnering with the state will help provide the needed components.

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**Anticipated Impacts of Use:** Anticipated impacts were identified and evaluated based on best professional judgment and published scientific papers. Many of the impacts associated with upland hunting are similar to those considered for other public use activities, such as waterfowl hunting and wildlife viewing and photography, with the exception of direct mortality to game species, short-term changes in the distribution and abundance of game species, and unrestricted travel through the hunt area. Direct mortality can impact isolated, resident game species populations by reducing breeding populations to a point where the isolated population can no longer be sustained. This can result in localized extirpation of isolated populations.

The hunt would be conducted in upland habitats therefore minimal disturbance to migratory birds is anticipated. Use of lead shot could be allowed for deer and feral hogs, but considering the separation between the upland hunt and wetland habitat, the ingestion of lead shot by migratory birds should be minimal. The walk-in hunters would use existing fire breaks and roads for access. No soil compaction or vegetation disturbance is expected. Parking would occur in temporary sites designated along existing fire lines. Hunting would not occur within 1,500 feet of any active eagle nest.

The refuge has an active hog removal program where the permittees trap and remove feral hogs in four geographic areas of the refuge. The area proposed for the upland hunt would be located in the northern geographic hog trapping zone. The primary intentions of feral hog hunts would be to increase pressure on this population and assist in the population control of this unwanted species. Upland hunting for feral hogs would help reduce the hog population in this area, while also reducing the availability of hogs for the feral hog trapping permittee. This activity would assist the refuge in the control of this species.

**Determination (check one below):**

	Use is Not Compatible
X	Use is Compatible, with the Listed Stipulations

**Stipulations Necessary to Ensure Compatibility:** Several stipulations will be necessary to ensure compatibility of this use. Additional stipulations may be added, as the program is developed with the state. Known stipulations are listed.

- The hunt will be conducted in accordance with state regulations and seasons.
- The methods of hunting to be considered include primitive weapons, archery, and shotguns.
- Only white-tailed deer and feral hogs will be hunted in the designated area.
- Quota hunt permits will be issued.
- Hunting densities no greater than one hunting party per 100 acres will be allowed.
- The number of deer permitted to be taken will be based on annual population estimates.
- Check stations will be used to collect hunt data and to monitor the quality of the hunt.
- Vehicle access and parking will be limited and confined to existing fire lanes and unimproved roads.
- Climbing spikes and permanent stands will not be permitted.
- Off road vehicles or ATVs will not be permitted.
- Liberal bag limits or extended seasons may be established for feral hogs as part of a wider effort to eliminate this non-native species.
- No flagging or trail marking will be permitted.

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Upland hunting would have little impact on other visitor activities. The Pine Flatwoods Trail is proposed in the area north of Haulover Canal. Two boat ramps and several waterfowl hunter and fishing access roads also traverse through the area proposed for upland hunting. A closed area for hunters will be established to provide at a safe buffer distance around all public use facilities.

**Justification:** Hunting is a priority wildlife-dependent use under the National Wildlife Refuge System Improvement Act. Upland hunting, as described, was determined to be compatible, in view of the potential impacts that hunting can have on the Service's ability to achieve purposes and goals of the refuge, because: (1) hunter densities and use levels will be relatively low during days the refuge is open to hunting, (2) sufficient restrictions have been established to ensure that an adequate amount of high-quality habitat would be available to accommodate the needs of deer and other wildlife using the refuge, and (3) sufficient opportunities are available for other priority wildlife-dependent recreation during the upland hunt season.

### **Mandatory 15-Year Re-evaluation Date:**

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### **Description of Use:**

#### *Fishing*

Fishing has been identified as a priority wildlife-dependent activity under the National Wildlife Refuge System Improvement Act and is a traditional use at the refuge. The initial interagency agreement between NASA and the refuge named fishing as an activity that would continue. This wildlife-dependent recreational use is supported by boating; therefore, boating impacts which are associated with fishing are also considered in this review.

Fishing is permitted on approximately 46,000 acres of the refuge's 140,000 acres. The remainder of the refuge is contained within the restricted area of the Kennedy Space Center and is closed to fishing. This large closed area serves as a sanctuary from fishing activities to protect fish, along with other wildlife. Fishing areas include the open waters of Mosquito Lagoon, the Indian River Lagoon, and Banana River, as well as 32 of the refuge's 76 impoundments and several freshwater borrow pits.

Fishing is allowed in accordance with state regulations. Additionally, the refuge has implemented refuge-specific fishing regulations which can be update annually in Title 50 Code of Federal Regulations. The listed items are a summary of refuge-specific fishing regulations.

- A refuge sports fishing permit is required.
- Fishing is allowed only during daylight hours.
- Night fishing from boats is allowed under a valid special Sports Fishing Permit in the open waters of the refuge (i.e., Mosquito Lagoon, Indian River Lagoon, and the Banana River) and night boat launching is permitted from Bair's Cove, Beacon 42, and the BioLab boat ramps.
- Fishing, crabbing, and boat/canoe/kayak launching is not permitted from Black Point Wildlife Drive or from any side road or dike connected to Black Point Wildlife Drive, except L Pond Road.
- Motorized vessels are not permitted in the Banana River within the posted No Motor

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Zone. This includes any vessel having an attached or non-attached internal combustion or electric trolling motor capable of use.

- Vessels may not operate internal combustion engines in either of two Pole and Troll zones, except in the posted channels. Vessels drafting more than 12 inches at rest may not enter a Pole and Troll Zone.
- Airboats, personal watercraft, or hovercraft are not allowed.
- Harvesting of horseshoe crabs is prohibited.
- Fisherman and crabbers must attend their lines.

Both saltwater and freshwater fishing is available, but the estuarine fishing opportunities in Mosquito Lagoon, Indian River Lagoon, and Banana River are by far the largest component of the fishing program. Because of the associated wildlife and habitat impacts of boats, regulations have been developed to reduce impacts from boats. In addition to the regulations listed above, slow speed and no wake zones have been established in several locations, in addition to the No Motor Zone in Banana River, for the protection of manatees.

With the advent of tunnel-hull flatboats, jack-plate, and jet-foot devices, outboard-powered boats, and jet boats, many boats can now operate at fast speeds in shallow water. With these developments, fishing boats now present the potential to disturb foraging and loafing water birds in shallow water habitats. Outboard-powered boats also have the potential to cause impacts to the soft lagoon bottom and the submerged aquatic plants. Over the last 20 years these impacts have been increasing, along with the number of anglers utilizing the lagoon waters of the refuge. Over the last 20 years the number of sports fisherman has increased from 25,000 to 151,000 annual visitors. The combination of increased anglers and improved boat designs has increased impacts in the shallow water flats of the estuary, impacting the quality of the fishing experience. The development of the Pole and Troll zones in two of the most severely impacted shallow water flats in Mosquito Lagoon is an adaptive strategy to allow a quality priority wildlife-dependent use to continue, as well as to help reduce wildlife disturbance and submerged aquatic plant impacts.

Fishing by boat represents the largest percentage of fisherman, but bank fishing opportunities are available from Haulover Canal and from numerous other locations where anglers fish from the bank or fish by wading in the water. Several freshwater borrow pits and drainage ditches provide limited freshwater fishing opportunities. A common issue associated with bank fishing is litter.

**Availability of Resources:** Operation and maintenance funds to support fishing are taken from the refuge's annual budget, which is adequate to sustain the program at the current level. Funds are needed annually to mow, grade, and fix roads, parking lots, and boat ramps open to fishing; replace gravel on roads leading to boat ramps; paint, repair, and replace signs; and develop and print brochures. One ranger, two law enforcement officers and several maintenance workers spend up to two months a year managing the fishing program. These salaries come out of the refuge's operating budget, which is adequate to sustain the existing program.

Funding for the improvements outlined in the comprehensive conservation plan is not currently available. For example, the cost to post the two Pole and Troll zones is about \$60,000. If the Pole and Troll zones were expanded, additional funding would be necessary. Funding would also be need for road and parking improvements, restrooms, bank fishing improvements, and freshwater fishing improvements. With the implementation of the comprehensive conservation plan, a fee will be charged for a sports fishing permit (e.g., \$5 weekly or \$20 annually in 2007), which is projected to generate approximately \$193,000 per year. Eighty percent of this revenue source will remain at the refuge and will be used to fund sports fishing improvements identified in the comprehensive conservation plan.

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**Anticipated Impacts of Use:** Anticipated impacts were identified and evaluated based on best professional judgment and published scientific papers, as well as by analyzing 30 years of refuge fishing data. Overfishing has been known to cause ecological extinction of certain fish species and precedes all other human disturbance (Jackson et al 2001). In recent history, overfishing in Florida has led to the decline of certain species such as redfish and sea trout. But, today the state monitors fish populations and has set seasons, slot and size limits, and total bag limits for most sports fish, making the likelihood of overfishing depleting fish stocks minimal. The closed areas of the refuge also serve to recharge local waters. Stevenson and Sulak (2001) tagged 3,358 estuarine sport fish in the restricted area of the refuge and documented adult sport fish movement to surrounding waters. Collectively, the state fishing regulations and the extensive fishery recharge afforded by the Kennedy Space Center restricted area should minimize the likelihood of fish stocks declining on the refuge.

Wildlife responds differently to boats based on their size, speed, the amount of noise they make, and how close the crafts get to wildlife. Boats increase the access of visitors to areas not open to most other visitors, thus having a greater potential to cause wildlife disturbance if not managed properly. The speed and manner in which a boat approaches wildlife can influence wildlife responses. Rapid movement directly toward wildlife frightens them, while movement away from or at an oblique angle to the animal is less disturbing (Knight and Cole 1995). Dahlgren and Korschgen (1992) categorized human activities in order of decreasing disturbance to waterfowl:

1. rapid over water movement and loud noise (e.g., power-boating, water skiing, and aircraft),
2. over water movement with little noise (e.g., sailing, wind surfing, rowing, and canoeing),
3. little over water movement or noise (e.g., wading and swimming), and
4. activities along shorelines (e.g., fishing, birdwatching, hiking, and traffic).

Hume (1976 as cited by Dahlgren and Korschgen 1992) observed a similar differential response of waterfowl to human activities. Common goldeneyes often flew when people on the shore approached within 100 or 200 meters, but settled elsewhere on the water. A single sailing dingy was sufficient to cause more than 60 common goldeneyes to take flight and for most to leave the vicinity within a few minutes. Remaining birds then flew up each time the boat approached to within 300 to 400 meters and generally left the area within an hour. The appearance of a powerboat caused instantaneous flight by most birds. If the boat traversed the length of the reservoir, all remaining birds left within minutes. Hume reported that waterfowl abundance decreased over time as a result of the increased frequency of boating.

In Germany, Bauer et al (1992) concluded that boating pressure on wintering waterfowl had reached such a high level that it was necessary to establish larger sanctuaries and stop water sports and angling from October to March. Likewise, on numerous occasions Thornburg (1973) observed boaters causing mass flights of diving ducks on the Mississippi River. He believed that increased boating could pose a serious threat to the continued use of the area by great numbers of migratory waterfowl. Thornburg (1973) concluded that eventually restrictions on boating activity may be necessary and that establishing a sanctuary should be considered.

Rodgers and Schwikert (2002) compared flushing distance of three species of birds in response to a slow versus fast approach using the same outboard-powered boat. A fast approach resulted in significantly larger flush distances for brown pelicans, anhingas, and great egrets. They concluded that water bird staging areas along migratory corridors and frequently used foraging sites of resident birds merit protection from human activity. In another study Rodgers and Smith (1997) recommended that the establishment of 150-meter buffer zones around colonial bird rookeries would help minimize disturbance. Increasing the predictability of boating patterns to help wildlife habituate to non-

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threatening human disturbance can also be accomplished by establishing well-marked routes of travel.

Boating has been shown to alter distribution, reduce use of particular habitats by waterfowl and other birds, alter feeding behavior, and cause premature departure from areas. Impacts of boating can occur even at low densities, given the ability of powerboats to cover extensive areas in a short amount of time, the noise they produce, and their speed (Sterling and Dzubin 1967, Bergman 1973, Speight 1973, Skagen 1980, Korschgen et al 1985, Kahl 1991, Bauer et al 1992, Dahlgren and Korschgen 1992).

Because the quality of fishing is better within the refuge, tournament fishermen originating from a tournament outside the refuge travel into refuge waters. Tournaments have become big businesses and can substantially increase the level of fishing activity in the refuge. This can have negative impacts on other sports fishermen, wildlife, and habitat.

**Determination (check one below):**

	Use is Not Compatible
X	Use is Compatible, with the Listed Stipulations

**Stipulations Necessary to Ensure Compatibility:** Fishing is allowed on the refuge in accordance with state regulations. In addition the refuge has the listed sports fishing regulations, which are paraphrased.

- A refuge sports fishing permit is required
- Fishing is allowed only during daylight hours.
- Night fishing from boats is allowed under a valid special Sports Fishing Permit in the open waters of the refuge (i.e., Mosquito Lagoon, Indian River Lagoon, and the Banana River) and night boat launching is permitted from Bair’s Cove, Beacon 42, and the BioLab boat ramps.
- Fishing, crabbing, and boat/canoe/kayak launching is not permitted from Black Point Wildlife Drive or from any side road or dike connected to Black Point Wildlife Drive, except L Pond Road.
- Motorized vessels are not permitted in the Banana River within the posted No Motor Zone. This includes any vessel having an attached or non-attached internal combustion or electric trolling motor capable of use.
- Vessels may not operate internal combustion engines in either of two Pole and Troll zones, except in the posted channels. Vessels drafting more than 12 inches at rest may not enter a Pole and Troll Zone.
- Airboats, personal watercraft, or hovercraft are not allowed.
- Harvesting of horseshoe crabs is prohibited.
- Fisherman and crabbers must attend their lines.

Boating impacts wildlife due to noise and speed, as well as from increased access to more parts of the lagoon (i.e., boats can disturb more birds than bank fishing). Most of the southern half of the refuge (except for a portion of the Banana River) is closed to the public and serves as a sanctuary. Most of the portion of the Banana River open to the public is restricted to non-motorized boats. Within the 21,000 acre Mosquito Lagoon, the refuge has established two Pole and Troll zones as a management strategy to improve the quality of fishing and to reduce prop scarring. If the Pole and

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Troll zones prove to be effective, additional zones may be expanded to other shallow water habitats of the refuge. This action is anticipated to benefit waterfowl and other shallow water foraging and loafing birds by reducing the disturbance from powerboats. Channels are embedded within the Pole and Troll zones which provide a predictable route of travel for motorized boat travel and should reduce wildlife impacts. Closed areas buffers are posted around colonial bird rookeries as an additional protection to sensitive wildlife areas. Manatee speed zones have been established in Mosquito Lagoon north of Haulover Canal. The area west of the Intracoastal Waterway channel is a Slow Speed/No Wake zone and the area east of the Intracoastal Waterway is posted for 35 mph daytime and 25 mph nighttime speed limits. Haulover Canal is designated as a Slow Speed/Minimum Wake zone. Monitoring will help the Service to determine the effectiveness of refuge management actions in maintaining migratory birds, endangered species, and other wildlife populations on the refuge.

The refuge has little control over fishing tournaments which originate off the refuge. However, the staff will work with the organizers of these events to educate them to the impacts boating can have on wildlife, discuss limiting the size of the tournament, and brief them on refuge regulations.

It is anticipated that Kennedy Space Center's restricted area (which serves as a sanctuary); the 10,000-acre No Motor Zone; the 2,945 acres of Pole and Troll zones, which include posted running channels; and the Slow Speed/Minimum Wake, Idle Speed, and posted speed zones designed to protect manatees will be adequate to sustain migratory bird and endangered species populations and adequate stocks of fish, and provide for a quality fishing experience which has little impact on other visitors. If wildlife populations suffer as a result of fishing activities, the quality of fishing declines, or other wildlife impacts occur, additional Pole and Troll zones or manatee zones may be established and/or additional motor boat restrictions may be implemented. The refuge will modify or eliminate any use with unacceptable impacts.

**Justification:** Fishing is a priority wildlife-dependent use under the National Wildlife Refuge System Improvement Act. Fishing, as described, was determined to be compatible, in view of the potential impacts that fishing and supporting activities (e.g., boating) can have on the Service's ability to achieve purposes and goals of the refuge, because: (1) fishing densities and use levels are relatively low during most days; (2) sufficient restrictions have been established to ensure the protection of manatees and that an adequate amount of high-quality feeding and resting habitat would be available to accommodate the needs of waterfowl, migratory birds, and other resident birds using the refuge; and (3) sufficient opportunities are available for other priority wildlife-dependent recreation.

#### **Mandatory 15-Year Re-evaluation Date:**

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#### **Description of Uses:**

##### *Wildlife Observation and Photography*

Wildlife observation and photography are considered simultaneously in this compatibility determination. Wildlife observation and photography have been identified in the National Wildlife Refuge System Improvement Act of 1997 as priority wildlife-dependent recreational uses provided they are compatible with the purposes of the refuge. This compatibility determination applies only to personal photography. Commercial photography or videography, if allowed, would be covered under the Commercial Services compatibility determination and would require a special use permit by the refuge with specific restrictions.

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Wildlife observation and photography may occur during daylight hours throughout all open areas of the refuge and on Kennedy Space Center bus tours within restricted portions of the Space Center. Posted with closed area signs, certain portions of the refuge are closed to protect wildlife, while other areas are closed to support Space Center operations. Wildlife viewing and photography improvements have been made at Black Point Wildlife Drive, the manatee observation deck, along hiking trails, and at other locations to provide exposure to different refuge habitat types and diverse flora and fauna. In addition, numerous refuge dikes and roads are open year-round or seasonally to provide different wetland or upland habitats for wildlife viewing. Although no photography blinds currently exist on the refuge, two wildlife viewing blinds are planned for Black Point Wildlife Drive. Restrooms and other improvements are planned on the Wildlife Drive to support wildlife observation and photography.

Approved forms of access for wildlife viewing and photography include driving licensed vehicles, hiking, and motorized and non-motorized boats. Certain areas may be closed to specific forms of transportation. Motor boat restrictions zones are in place in several locations to provide protection for manatees, to increase the quality of fishing opportunities, and/or to limit prop damage. Bicycles are not allowed on hiking trails and will be allowed only on designated routes.

Refuge brochures and maps will provide the public with the locations of visitor facilities.

**Availability of Resources:** Operation and maintenance funds to support wildlife viewing and photography are taken from the refuge's annual budget, which is adequate to sustain the program at the current level. Funds are needed annually to mow, grade, and fix roads open to the public; replace gravel on the Wildlife Drive and other public roads; fix, repair, and replace boardwalks and trails; paint, repair, and replace signs; and develop and print brochures. Up to three equipment operators, two ranger and two law enforcement officers spend up to one month managing this program (7 staff months).

Funding is not currently available to fully support all the planned wildlife observation and photography improvements identified in the comprehensive conservation plan. To support the program and make improvements, the Merritt Island Wildlife Association, in cooperation with other partners, has currently pledged \$76,455 and is pursuing additional fund raising opportunities. In addition a fee will be established on Black Point Wildlife Drive and is projected to generate approximately \$200,000 per year. These funds will help offset program costs. Other refuge staff, volunteers, and the Merritt Island Wildlife Association also support these uses.

**Anticipate Impacts of Uses:** This section is to critically and objectively evaluate the potential effects that wildlife observation and photography could have on the wildlife, habitat and other public use activities based on available information and best professional judgment. Each activity has the potential to have impacts, but the focus is to minimize impacts to within acceptable limits. This is based on the impacts at the existing and projected level of use.

*Short-term Impacts:* Impacts associated with wildlife observation activities can be divided into two categories, based on whether the activity occurs within or outside of a vehicle. In general, activities that occur outside of vehicles tend to increase disturbance potential for most wildlife species (Klein 1993, Gabrielson and Smith 1995, Burger 1981, Pease et al 2005). Wildlife observation trails and pullouts along the Black Point Wildlife Drive have a greater potential for disturbing wildlife species. Among wetland habitats, out-of-vehicle approaches can reduce time spent foraging and can cause water birds to avoid foraging habitats adjacent to the out-of-vehicle disturbance (Klein 1993). One possible reason for this result is that vehicle activity is usually brief, while walking requires a longer period of time to cover the same distance. Similarly, walking on wildlife observation trails tends to

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displace birds and can cause localized declines in the richness and abundance of wildlife species (Riffell et al 1996). Bicycling and people walking causes more disturbances to waterfowl than vehicles (Pease et al 2005).

Wildlife photographers tend to have the largest disturbance impacts (Klein 1993, Morton 1995, Dobb 1998). While wildlife observers frequently stop their vehicles to view wildlife, wildlife photographers are much more likely to leave their vehicles and approach wildlife on foot (Klein 1993). Even slow approach by wildlife photographers tends to have behavioral consequences to wildlife (Klein 1993). Other impacts include the potential for some photographers to remain close to wildlife for extended periods of time (Dobb 1998) and the tendency of casual photographers with low power lenses to get much closer to their subject than other activities would require (Morton 1995).

Boating impacts on wildlife can be classified based on the form of boating activity (Korschgen and Dahlgren 1992, Knight and Cole 1995) the season of use (Burger 1995) and species tolerance to the activity (Jahn and Hunt 1964). For example, motorboat activity likely has more disturbances on wildlife than non-motorized boat travel because motorboats produce a combination of movement and noise ((Knight and Cole 1995). Even canoes can cause disturbance based on the ability to access shallower areas of the marsh (Speight 1973). However compared to motorboats and airboats, canoe travel appears to have the least disturbance (Jahn and Hunt 1964).

*Long-term Impacts:* Considering the high level of use and variety of activities occurring at the refuge, appropriate solutions to minimize impacts need to be developed and monitored. For example, during the fall migration and over-wintering season, wildlife observation, photography, environmental education, interpretation, and waterfowl hunting are all occurring simultaneously and are at the highest levels of the year. Techniques to limit disturbance must be evaluated, implemented, and monitored. This stems from the hypothesis that prolonged and extensive disturbance may cause migratory birds to abandon the wetlands most disturbed by humans and winter elsewhere. Current public use may not be at a level to cause this shift, but anticipated increases relative to the expansion of the population and growth of visitor opportunities could result in seasonal shifts in migratory bird use of the refuge's wetland habitats.

**Determination (check one below):**

	Use is Not Compatible
X	Use is Compatible, with the Listed Stipulations

**Stipulations Necessary to Ensure Compatibility:** By design wildlife observation and photography should have minimal wildlife and habitat impacts. However, as use increases, wildlife impacts are more likely to occur. Evaluation of the sites and programs will be conducted annually to assess if objectives are being met, if habitat impacts are minimized, and if wildlife populations are not being adversely affected. If evidence of unacceptable impacts begins to appear, it will be necessary to change the activity or the program, move the activity or program, or eliminate the program.

Stipulations that may be employed include those listed.

- Establishing buffer zones that minimize disturbance around sensitive areas and establishing additional no-entry zones.
- Vegetation that effectively conceals visitors and provides cover for birds can help minimize impacts of people in busy areas like Black Point Wildlife Drive.
- Impacts from wildlife viewing and photography can be reduced by providing observation blinds.

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- The establishment of stay in your vehicle zones could further reduce disturbance on the Wildlife Drive.
  - Re-routing, modifying, or eliminating activities which have demonstrated direct wildlife impacts should also be employed.
  - Education is critical for making visitors aware that their actions can have negative impacts on birds.
  - Establishing well-marked trails where human use is more predictable will lessen wildlife impacts.

**Justification:** Wildlife observation and photography are priority public uses of the National Wildlife Refuge System. Providing quality, appropriate, and compatible opportunities for these activities contributes toward fulfilling provisions of the National Wildlife Refuge System Improvement Act. Wildlife observation and photography would provide excellent forums for promoting increased awareness, understanding, and support of refuge resources and programs and of the Service. The stipulations outlined above should minimize potential impacts relative to wildlife/human interactions. At the current level of visitation, these wildlife-dependent uses would not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

#### **Mandatory 15-Year Re-evaluation Date:**

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#### **Description of Uses:**

##### *Environmental Education and Interpretation*

Environmental education and interpretation consist primarily of youth and adult education and interpretation of the natural resources of the refuge. Activities include on-site staff-led or teacher-led environmental education programs; off-site teacher-led classroom programs; teacher workshops; and interpretation of wildlife, habitat, other natural features, and/or management activities occurring on the refuge. These activities seek to increase the public's knowledge and understanding of wildlife and their habitats and to contribute to wildlife conservation and support of the refuge. Environmental education and interpretation have been identified in the National Wildlife Refuge System Improvement Act as priority public use activities, provided they are appropriate and compatible with the purposes for which the refuge was established.

The comprehensive conservation plan identifies an expansion of the environmental education program to a curriculum-based program that focuses on habitat diversity. Over time the program would grow to provide a diverse range of on-site staff-led education programs. The programs will explore various habitats of the refuge (i.e., lagoon waters, wetlands, scrub, and pine flatwoods), leading to a better understanding of the value of these habitats to fish and wildlife resources, the human influence on the ecosystem, and the importance of these resources to society. The refuge has developed facilities to support the program and will be developing curricula that allow students to explore and experience these habitats firsthand.

The proposed interpretation program strives to increase awareness and understanding of the refuge's natural features, habitat diversity, wildlife, human history, and refuge management activities. The comprehensive conservation plan calls for minor changes, such as adding new signs, revising brochures, and developing new interpretive panels and kiosks. The plan also calls for more extensive improvements such as developing the pine flatwoods trail and the Huntington Road trail, making improvements at the manatee observation deck, developing an interpretive wildlife viewing area near the Kennedy Space Center Visitor Center, and adding a guided tram-type tour.

Except for the improvements near the Space Center, proposed changes in the environmental education and interpretive program are planned for areas currently open to the public. Current interpretive sites include the Visitor Center, Black Point Wildlife Drive, Oak and Palm Hammock trails, Cruickshank Trail, Scrub Ridge Trail, and the manatee observation deck. The refuge utilizes the Sandler Educational Outpost as the focal point for education programs. New educational programs will utilize several sites in the vicinity of the Outpost, including various lagoon waters, marshes, scrub, and pine sites. Supervised activities will encourage the exploration of the environment but efforts will be made to return any collected item to the habitat from which it came in an unharmed condition.

**Availability of Resources:** Annual refuge operation and maintenance funds support the Visitor Service program and activities. The development of proposed facilities is contingent upon successfully locating a funding source. Costs for improvements identified in the comprehensive conservation plan will typically come from the Merritt Island Wildlife Association, Fish and Wildlife Foundation, other grants or endowments, and refuge budget increases under the Refuge Operating Needs System. The Merritt Island Wildlife Association is annually supplementing the environmental education program and interpretive programs by \$10,000. A portion of the proposed fee money generated from Black Point Wildlife Drive, approximately \$100,000 annually, can also be used for improvements in the interpretive and educational programs. Refuge staff, such as interpretive rangers, volunteers, and the Merritt Island Wildlife Association, provides the staffing for these uses.

**Anticipated Impacts of Uses:** Environmental education primarily occurs at the Sandler Education Outpost and surrounding areas. The expansion of the program, as proposed, would increase disturbance in several new sites, however, impacts would be considered short-term and discrete due to the low anticipated frequency of use and ability to move sites to a new area if the habitat showed signs of impacts. Vegetation trampling, altering structure and species composition, and temporal wildlife impacts to species would be at a minimal level. This unavoidable impact associated with running the environmental educational program is acceptable.

Impacts associated with interpretive activities generally occur at developed facilities such as the Visitor Center, trails, boardwalks, Wildlife Drive, manatee deck, or other improved facilities. Adding the new interpretive sites will have some wildlife or habitat impacts. The pine flatwoods trail would utilize an existing fire break and only minimal clearing will be required for a parking lot (about one tenth of an acre). The preferred route for the tram tours would utilize an existing railroad track and about two tenths of an acre of clearing would be required for a parking lot. The planned observation tower for visitors at the Kennedy Space Center would be located adjacent to State Route 405 and most improvements (e.g., parking lots and a kiosk) would be located in a previously cleared and disturbed area. The tower and tower trail would be located near some wetlands, but the footprint of the tower and trail will be in uplands where impacts are minimal.

**Determination (check one below):**

	Use is Not Compatible
X	Use is Compatible, with the Listed Stipulations

**Stipulations Necessary to Ensure Compatibility:** While anticipated impacts are anticipated to be minimal, stipulations are required to ensure that wildlife resources are adequately protected. The environmental education program activities will avoid sensitive sites and sensitive wildlife populations. Built into all curriculums will be a section on wildlife etiquette. Environmental education programs and activities will be held at or near established facilities where impacts may be minimized. Evaluations of

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sites and programs should be conducted annually to assess if objectives are being met and that the natural resources are not being adversely impacted.

Impacts associated with interpretive programs are also anticipated to be minimal. One overarching aspect of the interpretive program is to build understanding and appreciation for the refuge and its natural resources. As use increases, wildlife disturbances are unavoidable, but through interpretive material (e.g., brochures, signs, and kiosk panels) proper wildlife etiquette will be stressed. Education is critical for making visitors aware that their actions can have negative impacts on wildlife. Interpretive activities and programs will be conducted at developed sites where impacts can be minimized. Wildlife impacts on Black Point Wildlife Drive will be carefully monitored. If impacts are detected, adaptive strategies will be developed, such as stay in your vehicle zones, to lessen wildlife disturbance. Annual evaluations will be conducted to assess if objectives are being met and that the natural resources are not being adversely affected.

The refuge will modify or eliminate any use that results in unacceptable impacts.

**Justification:** Environmental education and interpretation represent two priority wildlife-dependent recreational activities listed under the National Wildlife Refuge System Improvement Act. Environmental education and interpretation are used to encourage all citizens to act responsibly in protecting natural resources. They are tools the refuge can use to build understanding, appreciation, and support for the refuge and the National Wildlife Refuge System. Resources required to run the programs is minimal and is built into the refuge operation and maintenance budget. Identified improvements will not be developed until adequate staff and budget are available to develop and operate them. As long as stipulations to ensure compatibility are followed, the programs should remain compatible with the purposes of the refuge. At such time that the monitoring program identifies unacceptable wildlife impacts are occurring, the refuge will modify the activity to minimize or eliminate the impacts.

Both programs allow the education of the public of the missions of the Service and Refuge System and refuge purposes. They highlight the areas which are most in line with the refuge's management philosophy proposed under the comprehensive conservation plan. Considering the minimal anticipated impacts through implementation of the environmental education and interpretation programs and the benefits that should arise through public education, participation, and involvement, the program is deemed compatible.

#### **Mandatory 15-Year Re-evaluation Date:**

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#### **Description of Use:**

##### *Bicycling*

While not one of the six priority wildlife-dependent recreational uses listed in the National Wildlife Refuge System Administration Act, bicycling is a mode of transportation currently used to facilitate wildlife observation. Bike riding is also included in the Compatibility Determination for Wildlife Observation and Photography. This compatibility determination provides additional guidance on this specific use. As proposed, bike riding would occur only on designated roads and trails. This use occurs all year.

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**Availability of Resources:** Operation and maintenance funds to support wildlife viewing are taken from the refuge's annual budget, which is adequate to sustain the program at the current level. Funds are needed annually to mow, grade, and fix roads open to the public; replace gravel on the Wildlife Drive and other public roads; fix, repair, and replace boardwalks and trails; paint, repair, and replace signs; and develop and print brochures. The refuge will seek outside funding, grants, and partnerships to fund the development of the bicycle paths planned in the comprehensive conservation plan.

**Anticipate Impacts of Use:** A critical and objective evaluation of the potential effects that bicycles could have on the wildlife, habitat, and other public use activities is based on available information and best professional judgment. Although bicycling has the potential to have impacts, the focus is to minimize impacts. This is based on the impacts at the existing and projected level of use.

Bicycling may be an appropriate form of transportation to view wildlife and has been approved in specific locations. However, bicycle riding takes several forms. For example, mountain biking, according to the International Mountain Bicycling Association is the sport of riding bicycles off paved roads. It requires endurance and bike handling skills and is performed on dirt roads, fire breaks, access roads, and public trails. According to the Association, the sport is broken down into several categories: cross country, downhill, street, dirt jumping, and free riding. Several aspects of mountain biking are more similar to trail running than to regular bicycling (Wikipedia 2005).

Although wildlife viewing may be an incidental aspect of the mountain biking activity, it is not considered the main purpose or intent. Mountain bikers, joggers, and all-terrain vehicle riders may enjoy the outdoor setting found at the refuge, but the activity may conflict with other wildlife-dependent recreation activities, may disturb migratory birds, and is not specifically aimed at viewing wildlife. Therefore, mountain biking, along with other similar sport activities, such as jogging, is not permitted.

Other forms of bike riding may be appropriate. The intent of some bike riders is wildlife viewing and several bicycle trails are planned in the comprehensive conservation plan. Bicycle riders are not permitted to ride on refuge hiking trails. This activity disturbs other trail users and will be eliminated from hiking trails and eventually from the Wildlife Drive.

*Short-term Impacts:* Wildlife disturbance relative to bicycle riding has been poorly studied with most references using other activities such as walking, hiking, and operating vehicles and their impacts on wildlife; therefore, bicycle impacts are inferred (unless noted). As noted in the Wildlife Observation and Photography compatibility determination, impacts associated with wildlife observation activities can be divided into two categories, based on whether the activity occurs within or outside of a vehicle. In general, activities that occur outside of vehicles (including bicycling) tend to increase the disturbance potential for most wildlife species (Klein 1993, Gabrielson and Smith 1995, Burger 1981, Pease et al 2005). Out of vehicle activities along wildlife observation trails and pullouts along the Black Point Wildlife Drive have the greatest potential for disturbing wildlife species. Among wetland habitats, out of vehicle approaches can reduce time spent foraging and can cause water birds to avoid foraging habitats adjacent to the out of vehicle disturbance (Klein 1993). One possible reason for this result is that vehicle activity is usually brief; while out of vehicle activities such as walking require longer periods of time to cover the same distance. Similarly, walking on wildlife observation trails tends to displace birds and can cause localized declines in species richness and abundance (Riffell et al 1996).

A study conducted at Back Bay National Wildlife Refuge indicated that jogging and bike riding in an open habitat, such as marshes where the activity is highly visible to wading birds, shorebirds, and

waterfowl, is disruptive. As a result, marsh birds in open areas flee from joggers and bike riders (Laskowski 1999). Wildlife may receive different cues from different modes of transportation, since wildlife do not flee as readily from cars, perhaps because the person is hidden in the vehicle and not perceived as a threat (Klein 1983). A 2005 study at Back Bay National Wildlife Refuge (Pease, et al 2005) compared five different human activities (i.e., motorized tram, slow moving truck, fast moving truck, bicyclist, and pedestrian) in relation to waterfowl disturbance. The study found that people walking and biking disturbed waterfowl more than vehicles.

*Long-term Impacts:* Considering the high level of use and variety of activities occurring at the refuge, appropriate solutions to minimize impacts need to be developed. For example, during the fall migration and over-wintering season wildlife observation, photography, environmental education, interpretation, and waterfowl hunting are all occurring simultaneously and are at the highest levels of the year. Techniques to limit disturbance must be evaluated, and implemented and monitored. This stems from the hypothesis that prolonged and extensive disturbance may cause migratory birds to abandon the wetlands most disturbed by humans and winter elsewhere. Current use may not be at a level to cause this shift, but anticipated increases relative to the expansion of the population and the growth of visitor opportunities could result in seasonal shifts in migratory bird use of the refuge wetland habitat. Bicycling would add to the level of disturbance, especially in wetland habitats and strategies need to be implemented to limit wildlife impacts.

**Determination (check one below):**

	Use is Not Compatible
X	Use is Compatible, with the Listed Stipulations

**Stipulations Necessary to Ensure Compatibility:** All forms of wildlife observation should have minimal wildlife and habitat impacts. However, bicycling can cause wildlife impacts in open wetland areas, can increase wildlife impacts, and can disrupt other individuals viewing wildlife. Bicycles will not be permitted on established hiking trails. Bicycling on Black Point Wildlife Drive has not reached a level where disturbance is occurring to wildlife or other individuals participating in wildlife observation. However, as use on Black Point Wildlife Drive increases, bicycling could become a greater disruption to wildlife or other visitors. Three bike paths are proposed in the comprehensive conservation plan, and as soon as the first bike path is developed, bicycling will be discontinued on Black Point Wildlife Drive. Evaluation of bike riding on bike paths and other roads open to biking will be conducted annually to assess if objectives are being met, if habitat impacts are within a tolerable range, and if wildlife populations are not being adversely affected. If evidence of unacceptable impacts begins to appear, it may be necessary to change the activity or the program, move the activity or program or eliminate the program.

Stipulations that might be employed include those listed.

- Establishing buffer zones that minimize disturbance around sensitive areas and establishing additional no entry zones.
- Vegetation that effectively conceals visitors and provides cover for birds can help minimize impacts of people.
- Impacts from wildlife viewing can be reduced by providing observation blinds.
- The establishment of stay in your vehicle zones could further reduce disturbance on the Wildlife Drive.
- Techniques specific to bicycling will include: re-routing, modifying, or eliminating bicycle riding activities which have demonstrated direct wildlife impacts in open wetland habitats.

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- Education is critical for making bicycle riders aware that their actions can have negative impacts on birds.
  - Establishing well-marked bike trails where this use is allowed and contained.

**Justification:** Bicycling to observe wildlife facilitates priority public uses of the National Wildlife Refuge System. Providing opportunities for these activities contributes toward fulfilling provisions of the National Wildlife Refuge System Improvement Act. Wildlife observation from bicycles in areas where there are few impacts to wildlife would provide an appropriate mode of transportation for promoting increased awareness, understanding, and support of refuge resources and programs. The stipulations outlined above should minimize potential impacts relative to wildlife/human interactions. At the current level of visitation, bicycling does not seem to conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

### **Mandatory 10-Year Re-evaluation Date:**

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#### **Description of Use:** *Commercial Services*

While not one of the six priority wildlife-dependent recreational uses named in the National Wildlife Refuge System Administration Act, commercial services support wildlife viewing, interpretation, hunting, and fishing and they assist the refuge in providing quality wildlife-dependent recreational activities. The refuge authorizes commercial services through the issuance of special use permits. For the purpose of this document, the term, commercial, is defined as a permittee that charges a client a fee for a program or service to generate a profit. This does not include individuals who perform these services for no fee, not-for-profit groups, schools, colleges, or other governmental agencies.

This activity provides recreational and educational opportunities for the public who desire a quality wildlife-dependent experience, but who may lack the necessary equipment, skills, knowledge, ability, or resources to obtain it themselves. Commercial services on the refuge include: motor vehicle tours; boat, canoe and kayak tours; and guided sports fishing and hunting trips. Except for the fee charged to the customer by the commercial provider, the impacts associated with these activities are no different than other activities, which are already occurring on the refuge. The named activities covered by this compatibility determination are similar to the activities covered by the interpretation, wildlife observation, waterfowl hunting, and fishing determinations, but this compatibility determination provides additional guidance specific to commercial services.

As proposed most commercial services would be permitted in the open areas of the refuge under a special use permit. If the activity occurs in Mosquito Lagoon or north of State Route 402 and east of State Route 3, the permit is administered through an Incidental Business Permit with Canaveral National Seashore. Mosquito Lagoon is an area which is contained within the boundary of both the Seashore and the refuge. The arrangements for the incidental business permits have been developed to avoid the need for redundant permits from the Seashore and the refuge and to maintain uniformity of regulations, procedures, and guidelines between the two Department of Interior agencies. Interpretive training and further guidelines may be developed and required in the future. No administrative facilities for the providers of these commercial services will be located on the refuge.

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**Availability of Resources:** This program cost to refuge operations includes, but is not limited to: development and review of policy and procedure, administration of annual permits (e.g., addressing inquires, screening applicants, checking on insurance, and issuing permits), and enforcement and monitoring of permit holders. However, the size and scope of the program and number of permits issued will have to be balanced with the permit fee. One factor is that Canaveral National Seashore currently administers the Commercial Fishing Guide program, which is the largest component of commercial services. Existing facilities, such as boat ramps and other infrastructure, are adequate to accommodate this use at existing levels.

**Anticipated Impacts of Use:** To date, the largest single component of the commercial services program is guided fishing trips. Sports fishing from boats is a use that has increased dramatically over the last 20 years. Boating, especially power boating, has been shown to cause numerous wildlife impacts (see the Fishing and Waterfowl Hunting compatibility determinations). With the popularity and growth of sports fishing, commercial fishing guides obtaining permits in the refuge have shown a similar level of growth (0 fishing guide permits in 1985 to over 70 in 2005). The main difference between most sports fishermen and fishing guides is the level of fishing activity. Although data is unavailable to support this, informal observations at boat ramps and contact by refuge law enforcement officers indicate that many commercial fishing guides provide guide services on the refuge several times per week compared to most individual sports fisherman who are seen much less frequently. This infers that a relatively small number of commercial fishing guides have the potential to cause much more wildlife disturbance or impact other individuals engaged in priority recreation activities than the same number of sports fisherman. The refuge cannot separate the impacts of fishing guides from recreational fishermen on wildlife, sports fishing, or other users.

Currently no permits are issued to hunting guides. Although only one permit is currently issued to a kayak outfitter, over the past five years, there have been several other permits issued to kayak guides and to one motorboat tour operator. Each year the refuge issues several permits to motor vehicle tour guides.

Guided tour activities may conflict with other refuge visitors. For example, commercial tours will use the same areas as other visitors engaged in wildlife observation, kayaking, hunting, and angling. Unregulated, commercial operations could adversely affect the safety of other visitors and the quality of their experience, and could contribute to wildlife disturbance.

**Determination (check one below):**

	Use is Not Compatible
X	Use is Compatible, with the Listed Stipulations

**Stipulations Necessary to Make the Use Compatible:** Commercial operators shall be permitted only in the areas open to the public. Seasonal or permanent closures in certain areas may be imposed on commercial operators if the level of use becomes excessive, conflicts occur with other users engaged in priority wildlife-dependent recreation, or wildlife impacts occur. In the future, interpretive training and other stipulations may be required of commercial operators to help the refuge achieve its outreach and educational objectives.

The refuge is implementing a number of strategies to address the quality of sports fishing and impacts from boaters in the shallow waters of Mosquito Lagoon. Included are strategies to cap commercial fishing guides at current levels. For planning purposes the current level is defined as any guide who holds a permit between October 1, 2003 and September 30, 2005. There are

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approximately 70 permit holders currently. With the completion of the comprehensive conservation plan, no additional new permits will be issued to commercial fishing guides unless a current permit holder fails to renew.

Fees charged for special use permits are based on the duration of the permit. A one-time permit (good for one visit) is \$50. The fee for annual commercial use permits is \$250. *The permit structure changed in January 2006 when the permit changed from a two-year permit for \$250 to an annual permit issued in January for \$250.* These fees are anticipated to be increased as the cost for administering the program increases.

Commercial service providers follow all refuge regulations along with additional special conditions stipulated in their permits. The listed special conditions are common to most commercial service providers.

- The permittee will provide proof of general liability insurance in the amount of \$300,000.
- The permittee will provide proof of a state charter license and/or Coast Guard Captain's license.
- The provider will supply the refuge with his/her fee schedule charged per client.
- The provider will supply the refuge with the number of trips provided per year (this will include the number of clients).
- The vessels used by fishing guides will be required to bear the annual guide permit decal.

All conditions of special use permits must be met. A special use permit may be revoked for failure to comply with the conditions or for repeat violations of refuge regulations.

Motor vehicle tours are allowed on all public roads throughout the refuge, except that busses are not allowed on dikes such as Black Point Wildlife Drive. Participants of tours may use the Visitor Center and auditorium, but this use must be scheduled in advance. Additional fees may be charged for the use of the Sandler Educational Outpost pavilion or restroom and prior approval is required to use these facilities.

Boat, canoe, and kayak tours may use all designated launch sites. Tour routes will be approved in the permit.

Guide fishing trips may fish in the waters of Mosquito Lagoon, Indian River Lagoon, and Banana River in accordance with refuge and state regulations. Commercial fishing guides will be capped at current levels.

Guide hunting trips may utilize existing hunt areas. All refuge hunting regulations and quota permit requirements apply.

**Justification:** Commercial operations support wildlife observation, interpretation, fishing, and waterfowl hunting. They provide recreational and educational opportunities for the public who desire a quality wildlife-dependent experience, but who may lack the necessary equipment, skills, knowledge, ability or resources to obtain it themselves. Providing opportunities for these activities would contribute toward fulfilling provisions of the National Wildlife Refuge System Improvement Act. The stipulations outlined above should minimize potential impacts relative to wildlife/human interactions. At the current level of visitation, commercial operations would not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

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**Mandatory 10-Year Re-evaluation Date:**

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**Description of Use:***Commercial Fishing*

Harvesting commercial resources from the marine environment has been a historic use on the refuge well before the refuge was established. The activity included fishing with large nets and net boats. That activity was banned in the early 1990s by a state referendum. The commercial fishing activities that remain on the refuge include crabbing using crab pots, clamming using rakes, fishing using hook and line, fishing using throw nets, and bait fishing using throw nets. Currently these activities are allowed under a commercial harvest permit. Approximately 70 individuals are currently under permit. Due to the proximity of Canaveral National Seashore and its regulatory responsibility, it was determined in 1999 that a joint permit was the most appropriate means to administer the program.

**Availability of Resources:** The permitting process requires the review of boat registration, saltwater products license, and photo identification to renew each permit. The permits expire on September 30 of each year. Administrative oversight is required to process the permits and handle the fees collected. In addition catch-logs must be maintained by the permittee and are subject to review. Law enforcement officers are required to ensure that permittees adhere to their special permit conditions. For instance, water areas are closed seasonally to commercial harvest. Currently the refuge has sufficient funds from the permits to support the program. However, resources are not sufficient to monitor the specific environmental impacts.

**Anticipated Impacts of Use:** Inherent impacts result from the operation of motorized boats in the marine environment, which include motor exhaust, disturbance to wildlife, turbidity of the water, and alteration of the marine bottoms. More specific impacts include the by-catch in crab pots of diamond-backed terrapins and other organisms. In addition, derelict traps that have been abandoned or moved by storms continue to catch and kill many organisms. Manatees have also become entangled in the float lines of the pots and suffered loss of appendages or death. Clamming with rakes or tongs can disturb or destroy marine grasses if conducted in the wrong area. Raking also adds to the turbidity of the water, which can impact seagrass growth. The level of recreational fishing from the shore and from boats is steadily increasing. At some point, direct competition will occur between the recreational and commercial fishing efforts.

**Determination (check one below):**

	Use is Not Compatible
X	Use is Compatible, with the Listed Stipulations

**Stipulations Necessary to Ensure Compatibility:** The number of permits issued for commercial fishing will be capped at the current level and the commercial fishing program will sunset in 2018 with the end of all permits by October 1, 2018. For planning purposes the current level is defined as any valid permit issued between October 1, 2003 and September 30, 2005. In addition the permits will not be sold or transferred to anyone other than an immediate family member (i.e., father, son, daughter, mother, brother, or sister). Through attrition the number of permits will decline over time. Based on on-going research by state and federal manatee recovery teams on the design of crab pots

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with escape mechanisms for manatee, crabbers will be required to implement new designs or modifications. They will also be required to recover more derelict traps. More water areas with shallow water and sensitive bottoms may be closed to commercial fishing. Special conditions in the permits will help minimize impacts from these uses. Fees are anticipated to increase to ensure the costs associated with the program are covered.

**Justification:** The refuge recognizes the family dependence on being waterman over the history of this local area. In order to allow a long transition of family businesses and to not place undo hardship on these families and their business, this phased approach is fair and equitable. The families will be required to adhere to more and more special conditions of the permits and permit cost increases.

**Mandatory 10-Year Re-evaluation Date:**

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**Description of Use:**

*Beekeeping*

Beekeeping is a use which historically supported the growing of citrus crops on refuge lands both before and after establishment of the refuge. As the acreage of citrus on the refuge has declined, beekeeping has continued and beekeepers now rely not only on citrus, but also on palmetto, maple, Brazilian pepper, and other plants for their honey crops. Beekeeping is currently allowed under special use permit. Beekeepers are selected by competitive bid with each beekeeper restricted to a maximum of 10 apiary sites. Permits are for five years and are renewed annually. If a beekeeper fails to pay for his sites, the sites are re-bid and awarded to other beekeepers. There currently are 10 permitted beekeepers and 53 apiary sites on the refuge.

**Availability of Resources:** The competitive bidding process requires the solicitation and collection of bids and a public drawing to award apiary sites. On an annual basis, permits are issued, funds are collected, and NASA badges are obtained for permittees with apiary sites within Kennedy Space Center's security area. If a permittee does not pay for his sites, refuge staff administers a new competitive bidding process for the available apiary sites. During the life of the permits, refuge staff occasionally inspects apiary sites and addresses access issues. Currently there are sufficient funds in the refuge's operations budget to administer the beekeeping program. Resources are not sufficient to monitor the specific environmental impacts of beekeeping activities.

**Anticipated Impacts of Use:** Approximately 13 acres of habitat are maintained as cleared apiary sites. There is probably some minor disturbance to wildlife caused by work at the apiary sites, but this is minimal because beekeepers visit the sites on an infrequent basis. Bees from the apiary sites pollinate exotic plants (e.g., Brazilian pepper), which may enhance the spread of these exotics on the refuge.

**Determination (check one below):**

	Use is Not Compatible
X	Use is Compatible, with the Listed Stipulations

**Stipulations Necessary to Ensure Compatibility:** The number of permits issued for beekeeping and the number of apiary sites will be capped at the current level and the beekeeping program will

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sunset in 2018 with the removal of all apiary sites and the end of all permits by October 1, 2018. For planning purposes, the current level is defined as permit holders and apiary sites in effect from January 2005 through December 2005. Permits will not be issued to anyone other than the 10 current permit holders and permits will not be transferable. If a current permit holder fails to pay for his sites, the sites will be made available through the bidding process to the remaining current permit holders under the maximum of 10 sites per permittee stipulation. Any site not receiving bids will be eliminated from the program. Once a current permit holder is dropped from the program due to non-payment, he will not be allowed to reenter the program at a future date. All sites will be re-bid in 2006 for a new 5-year permit period starting in January 2007 and ending December 2011. After 2011, permits will again be issued in 2016, as long as current beekeepers and apiary sites remain in the program.

Beekeepers will also be required to adhere to special conditions outlined in special use permits. These conditions address payment of fees, responsibility for apiary equipment, NASA security clearances, restrictions due to NASA operations, refuge fire operations, apiary site maintenance, apiary site conditions, and protection of listed species.

**Justification:** Beekeeping is a commercial use which does not contribute to the achievement of the refuge purposes or the mission of the National Wildlife Refuge System. Southeast Region guidance indicates that beekeeping typically will not be allowed on refuges, the only exception being the use of bees as sentinels for wildlife or public health reasons. In light of this, the refuge intends to eliminate beekeeping. However, the refuge recognizes the investment beekeepers have in their businesses. The refuge also recognizes the dependence current beekeepers have on the refuge apiary sites and acknowledges that, for many beekeepers, other suitable sites are not available within a reasonable driving distance. In order not to place undo hardship on these beekeepers and their businesses, the phased approach to eliminating beekeeping outlined in the Stipulations section above was selected as fair and equitable.

#### **Mandatory 10-Year Re-evaluation Date:**

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#### **Description of Use:**

##### *Research*

Research is the planned, organized, and systematic gathering of data to discover or verify facts. In principle, research conducted on the refuge by universities, co-op units, non-profit organizations, and other research entities furthers refuge management and serves the purposes, vision, and goals of the refuge. The refuge hosts research from a variety of research institutions, including NASA and its contractors. All research activities, whether conducted by governmental agencies, public research entities, universities, private research groups, or any other entity, shall be required to obtain special use permits from the refuge. All research activities will be overseen by the refuge biologist and refuge manager. The refuge has established a Refuge Research Policy (Number 9, dated July 19, 2005) that provides guidance for the refuge's research program.

**Availability of Resources:** The refuge currently supports an eight room dorm building on-site to support researchers and students. As resources become available, the comprehensive conservation plan outlines the addition of an updated dorm facility and recreational vehicle pads in the maintenance compound area. The refuge maintains geographic information system databases and a library of pertinent biological texts, published scientific and biological papers, reports, and reprints.

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Other than the administration of associated special use permits, no refuge resources are generally required for this use.

**Anticipated Impacts of the Use:** Generally, adverse impacts from research are minimal. Occasionally, slight or temporary wildlife or habitat disturbances may occur (e.g., minor trampling of vegetation may occur when researchers access monitoring plots). However, these impacts are not significant, nor are they permanent. Also, a small number of individual plants or animals might be collected for further scientific study, but these collections are anticipated to have minimal impact on the populations from which they came. All collections will adhere to the Service's specimen collection policy (Director's Order 109, dated March 28, 2005). Projects that are fish and wildlife management-oriented, which will provide needed information to refuge operation and management, will receive priority consideration and will even be solicited.

**Determination (check one below):**

	Use is Not Compatible
X	Use is Compatible, with the Listed Stipulations

**Stipulations Necessary to Ensure Compatibility:** All research conducted on the refuge must further the purposes of the refuge and the mission of the National Wildlife Refuge System. All research will adhere to established refuge policy on research and policy on collecting specimens (Directors Order Number 109). To ensure that research activities are compatible, the refuge requires that a special use permit be obtained before any research activity may occur. Research proposals and/or research special use permit applications must be submitted in advance of the activity to allow for review by refuge staff to ensure minimal impacts to the resources, staff, and programs of the refuge. Each special use permit may contain conditions under which the research will be conducted. Each special use permit holder will submit annual reports to the refuge updating the refuge on research activities, progress, findings, and other information. Further, each special use permit holder will provide copies of findings, final reports, publications, and/or other documentation at the end of each project. The refuge will deny permits for research proposals that are determined to not serve the purposes of the refuge and the mission of the National Wildlife Refuge System. The refuge will also deny permits for research proposals that are determined to negatively impact resources or that materially interfere with or detract from the purposes of the refuge. All research activities are subject to the conditions of their permits.

**Justification:** Research activities provide important benefits to the refuge and to the natural resources supported by the refuge. Supporting management, research conducted on the refuge can lead to new discoveries, new facts, verified information, and increased knowledge and understanding of resource management, as well as track current trends in fish and wildlife habitat and populations to enable better management decisions. Research has the potential to further the purposes of the refuge and the mission of the National Wildlife Refuge System.

**Mandatory 10-Year Re-evaluation Date:**

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**Description of Use:***Astronomy*

To support the Kennedy Space Center work force, the Service has allowed a group of amateur astronomers to utilize a site on the north end of the refuge on certain nights for astronomy purposes. The group simply sets up telescopes in a designated site to view the skies. The group uses the site approximately eight nights a year. The group size is limited to 25 individuals. Applicants must obtain a special use permit from the refuge before commencement of this activity.

**Availability of Resources:** The activity is conducted under a special use permit issued biannually. There is no current charge for the permit. No facilities are required, nor are any alterations of habitat required for this activity. Each event requires notification to the refuge. Since the area is closed to public use at night, notification of the use must be coordinated with refuge and Space Center law enforcement. Staff involvement is limited to permit processing and monitoring.

**Anticipated Impacts of Use:** There are no long-term measurable impacts from this activity. The designated site is in an upland community, away from any concentrated bird activity. The site already has some human use since it contains a fenced cemetery. Some minor short-lived soil compaction may occur.

**Determination (check one below):**

	Use is Not Compatible
X	Use is Compatible, with the Listed Stipulations

**Stipulations Necessary to Ensure Compatibility:** Participants must obtain a special use permit from the refuge. The special use permit will contain specific conditions of approval. A special use permit may be revoked at any time for non-compliance or for any violations. The group size is limited to 25 individuals and no fires are permitted. The frequency of eight nights per year is an acceptable level of use. If a dramatic increase in use is requested, or if multiple organizations request to use the site, a reevaluation will be necessary.

**Justification:** Kennedy Space Center is the primary launch site for spacecraft in this country. As such, Space Center administration attempts to nurture individual employee interest in the exploration of space. In addition, providing a variety of recreational opportunities is also part of the total employee experience at the Space Center. As an overlay of the Space Center, the refuge cooperates with this effort. No long-term impacts are anticipated from this activity.

**Mandatory 10-Year Re-evaluation Date:**

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**Description of Use:***Organized Group Camping*

The refuge has provided an unimproved camping site for the Boy Scouts of America and the Girl Scouts of America for many years. This opportunity is provided as support for a 1985 national cooperative agreement with the Boy Scouts. Each camping event is covered by a special use permit.

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An average of 23 troops representing 550 individuals uses the site annually. Most of the use avoids the hot summer months. The refuge coordinates the placement of portable restrooms for each event. In recent years the Merritt Island Wildlife Association has funded the construction of an open pavilion and permanent restrooms at the site. These actions were in support of the refuge environmental education program. The pavilion is utilized by the scouts at no cost. If they desire to use the permanent restrooms a \$25 cleaning fee is required. The troops are required to accomplish conservation projects, such as litter pickup, during their stay on the refuge.

Other organized groups outside of the scouts have requested the use of the camping area. The refuge has resisted expansion of the opportunity due to logistical and monitoring workload requirements.

**Availability of Resources:** Operation and maintenance costs for this program are taken from the 1262 maintenance account, the 1263 visitor services account, and 1264 law enforcement account of the refuge's budget. Maintenance workers mow the site periodically. They also trim trees and brush. Refuge rangers coordinate the special use permit, order the portable restrooms, monitor compliance, notify Kennedy Space Center security, and ensure the conservation project is accomplished. The refuge's operating budget is adequate to sustain this program at the current level of use.

**Anticipated Impacts of Use:** The camping site is not located in an area of intensive bird use. It is an upland site with no impacts to wetlands. Some minor soil compaction and vegetation trampling do occur associated with the use. No impact to gopher tortoises or their burrows is expected. Fires are restricted to an approved fire pit.

**Determination (check one below):**

	Use is Not Compatible
X	Use is Compatible, with the Listed Stipulations

**Stipulations Necessary to Ensure Compatibility:** Applicants must obtain a special use permit from the refuge. This use must have a conservation basis supporting the missions of the Service and Refuge System, the purposes and goals of the refuge, and the six priority wildlife-dependent recreational uses of the Refuge System. A conservation project assisting the refuge must be a part of the requirements. A sanitary system must be in place to support the activity.

**Justification:** Boy Scouts and Girl Scouts have a conservation unit within their programs. Few places are available for a truly wild, but safe camping experience. The Service has a broad national agreement to work with these scouting groups, therefore, as long as the impacts are minimized and the refuge has adequate funds and staff to support this activity, it could continue.

**Mandatory 10-year Re-evaluation Date:**

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**Description of Use:***Non-commercial Plant Collection*

Plant collection for non-commercial purposes involves collecting, gathering, or using plant materials from refuge lands for individual, non-commercial, personal purposes that is incidental and non-destructive in nature. All plant collection (i.e., plant material, dead or alive, exotic or native) activities must be covered under a special use permit. Activities for incidental plant collection includes small amounts of materials that may be used by hunters for the building of temporary blinds; small amounts of already downed or previously cut trees for firewood; or small amounts of plant material used for personal, individual purposes. Each request for the collection of plant materials will be evaluated independently. Request for collections or actions to collect plants that will adversely impact any state or federally protected species will not be allowed. Similarly, no collections will be allowed in areas that will disrupt fish and wildlife or their habitats, and/or in areas that will adversely impact public use or public use facilities. All plant collection requests and collection activities will be overseen by the refuge ranger, refuge biologist, and refuge manager.

**Availability of Resources:** Other than the administration of associated special use permits, no refuge resources are required for this use.

**Anticipated Impacts of the Use:** Generally, adverse impacts from plant collections are minimal. Occasionally, slight or temporary disturbances may occur (e.g., minor noise associated with cutting of firewood). However, these impacts are not significant, they are not permanent, and they are far less upsetting than ordinary refuge operations (e. g., mowing of roads, controlling exotic plant species, and cutting trees to clear roads). All plant collections will adhere to the Service's specimen collection policy (Director's Order 109, dated March 28, 2005).

**Determination (check one below):**

	Use is Not Compatible
X	Use is Compatible, with the Listed Stipulations

**Stipulations Necessary to Ensure Compatibility:** To ensure that plant collection activities are compatible, the refuge requires that a special use permit be obtained before any collection activity may occur. All plant collections will adhere to established refuge and Service policies on collecting specimens (Director's Order Number 109) and stipulations from Director's Order Number 109 will be inserted as a special condition in all special use permits. All plant collection requests must be submitted in advance of the activity to allow for review by refuge staff to ensure minimal impacts to the resources, staff, and programs of the refuge. Each special use permit will contain conditions under which the collections must be conducted. The refuge will deny permits for plant collections that are determined to be detrimental to the resource or to be in conflict with the purposes of the refuge and the mission of the National Wildlife Refuge System. The refuge will deny permits for plant collections that are determined to negatively impact protected species or that interfere with or detract other refuge programs. All plant collection activities are subject to the conditions of their permits and may be revoked at any time for any violations.

**Justification:** Some plant collection activities may benefit the refuge by removing exotic species or unwanted downed material that may be obstructing access or that may be inconsequential to refuge operations. Allowing limited and supervised plant collection or removal within the scope of this determination may support some refuge projects and partnerships. Otherwise, plant collection activities at current levels are few and have minimal impacts.

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**Mandatory 10-Year Re-evaluation Date:**

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**Description of Use:***Interim Management of Citrus Groves*

When NASA acquired the land that is now the refuge, approximately 2,000 acres of citrus groves existed. Under the refuge's agreement with the Kennedy Space Center, the refuge is responsible for citrus grove management. At first, the owners previous to NASA were allowed to continue to farm the groves. After several years, the groves were leased to commercial citrus interests. To facilitate administration of the citrus contracts, the groves were divided in groups between 250 and 350 acres in size. In the late 1980s, the refuge entered into a Memorandum of Understanding (MOU) with the Kerr Center for Sustainable Agriculture in an attempt to find ways of growing citrus with less chemical inputs than is the normal practice. The Kerr Center worked with the citrus contractors to reduce the amounts of pesticides and to find more efficient ways of applying fertilizer. The contractors paid for this work through what was know as Clean Up and Improvement funds, a contract obligation. This continued until the mid 1990s when economic conditions forced the contractors to give up their operations.

NASA took over most of the grove operations for two years while the Kerr Center, under a modified MOU, operated one of the grove groups. NASA eventually returned all of the groves to the refuge. At that time the refuge again revamped the MOU with the Kerr Center. The Kerr Center, which soon became the Florida Research Center, was to farm as many of the groves as they deemed economical. They were to use the revenue from these groves to continue to develop an environmentally friendly citrus culture program that would be economically viable. The knowledge thus gained would then be exported to other citrus growers along the east coast of Florida. Hopefully, these growers would use these new techniques, thereby reducing the citrus industry's contribution to non-point source pollution in the Indian River Lagoon system.

As a part of the now renamed Florida Research Center's grove management program, the less economically desirable blocks of citrus were allowed to go fallow. The abandoned groves were those on poor soil, with low value juice oranges and some grapefruit. The fallow groves soon became overgrown with Brazilian pepper and other exotics.

The overall goal for citrus on the refuge as described in the refuge's comprehensive conservation plan is to eventually eliminate groves on the refuge. Under the plan, some of the land occupied by the groves would be restored to native habitat. Several restoration projects have been proposed in the comprehensive conservation plan and the habitat management plan. Other lands are designated to be returned to NASA as sites for future facilities. The Florida Center for Research will continue to farm a portion of the remainder of the groves until final disposition of these groves is decided. The fate of the uneconomical groves is undecided.

**Availability of Resources:** All of the citrus field and research operations are performed by the Florida Research Center. At the present time a portion of the time of one staff member is dedicated to overseeing the grove operations. Other staff members are involved in obtaining security clearance from NASA for workers in the groves inside the Kennedy Space Center security zone. The comprehensive conservation plan does not specifically identify an individual position to oversee the management of the citrus groves, but this could be a collateral duty for one of the biological staff.

**Anticipated Impacts of the Use:** Citrus farming has the potential to spread exotic plants and to contribute to nutrient and pesticide pollution to the Indian River Lagoon system and other waters in

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and around the refuge. However, the MOU with the Florida Research Center tasks it with developing citrus culture methods that reduce these very risks. The Florida Research Center monitors the water coming off the grove areas, where practically no contamination has been detected under their program.

The Florida Research Center also controls exotic plants in the farmed groves and along their perimeters. If the groves are left unmanaged until they can be restored, these areas would have a greater potential for negative impacts on refuge habitats and wildlife than they would if management of them was continued by the Florida Research Center or a similar organization. This use is a short term, interim use in anticipation of future native habitat restoration activities.

**Determination (check one below):**

	Use is Not Compatible
X	Use is Compatible, with the Listed Stipulations

**Stipulations Necessary to Ensure Compatibility:** The farming of the citrus groves should be continued under a MOU similar to the one now in force. Farming practices should minimize the used of pesticides and use innovative methods of fertilization, such as foliar feeding. Pesticides will be applied only when a Pesticide Use Proposal has been approved for that chemical. Pesticide Use Proposals will be developed annually in accordance with current Service policy. Monitoring of the runoff from the groves should be continued to track possible contamination of surface water from chemical applications. Frequent communication between the grove operator and the refuge must be done to ensure that sustainable agricultural practices are being used, that new technology is being employed where feasible, and that impacts are minimized.

**Justification:** As conducted under the MOU, interim citrus farming does not detract from or materially interfere with the purposes of the refuge. As an interim practice, citrus farming serves refuge goals in that invasive exotic plants are controlled on over 700 acres with little or no cost to the refuge. And, the potential exists for wider ranging environmental benefits from citrus research conducted on the refuge. If the sustainable citrus culture techniques being developed on the refuge can be exported to citrus growers along the east coast of Florida, then the reduction of overall runoff pollution in the Indian River Lagoon system can be reduced. Left fallow and with little or no funding to support restoration to native habitats, citrus groves on the refuge would serve to grow and spread exotic plants on the refuge.

**Mandatory 10-Year Re-evaluation Date:**

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**Description of Use:**

*Feral Hog Control*

Feral hogs are one of the most abundant exotic animals on the refuge. They are present in nearly all refuge habitats. Feral hogs cause considerable damage and impacts to native wildlife and habitats. The refuge has historically utilized trappers to annually remove about 2,500 feral hogs from the refuge. Under the current feral hog control program, four trapping units are assigned to four agent trappers and their helpers under special use permits. Trappers are permitted to remove feral hogs from the refuge through the use of live traps and trail dogs.

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The feral hog control program supplements other refuge activities to control hogs, including the proposed upland deer and feral hog hunt program, which is outlined in the comprehensive conservation plan and in the Upland Game Hunting compatibility determination. Under the sea turtle protection program, refuge staff and permittees focus special attention on removing hogs from the beach and dune system to limit hog predation of sea turtle nests.

The comprehensive conservation plan outlines increasing the removal of feral hogs to 4,000 animals annually for three years, evaluating the feral hog population after this time, and adjusting the target take accordingly to reduce the feral hog population on the refuge and to limit impacts to native wildlife and habitats.

**Availability of Resources:**

The current level of refuge funding is adequate to support the feral hog removal program as it is described in the refuge’s comprehensive conservation plan and habitat management plan. Funding is utilized for staff time and, occasionally, to purchase shelled corn for baiting traps. Staffing at the current level is also adequate to administer the feral hog removal program. Management staff administers permits and checks for permit compliance. Administrative staff prepares pass cards for trappers and obtains NASA security badges as needed. Law enforcement officers monitor permit compliance and compliance with applicable laws and regulations.

**Anticipated Impacts of Use:**

Minor, short-term, and discrete increased disturbance to native wildlife may be caused by trapping and trail dog activities. Native wildlife such as raccoons, opossums, and wild turkey may occasionally feed on corn used for bait at trap sites. The potential for disturbance to the visiting public does exist, however, most trapping and trail dog activities take place in areas closed to the public or at night to limit disturbance.

**Determination (check one below):**

	Use is Not Compatible
X	Use is Compatible, with the Listed Stipulations

**Stipulations Necessary to Ensure Compatibility:**

Feral hog removal permits will be issued for five years and renewed annual subject to successful performance during the prior year by the agent trapper.

Agent trappers will furnish all labor, equipment, and supplies required to accomplish the effective capture and removal of hogs from the refuge.

Possession of firearms is prohibited.

All captured hogs will become the property of the trapper and will be disposed of in accordance with local, state, and federal laws. All hogs must be removed from the refuge alive.

Period of use, time of entry, route of travel, and techniques used are subject to approval by the refuge manager.

Hog trapping and capture will be restricted during daylight hours in the vicinity of Black Point Wildlife Drive, Oak Hammock and Scrub Jay trails, and other public use areas.

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All agent trappers and helper trappers will be required to pass a refuge background check. Individuals with wildlife violations, felony violations, trespass violations, a pattern of repeated misdemeanor violations, and other similar violations will not be permitted.

Agent trappers will be required to operate a specified number of traps for at least nine days each month from October through April.

Agent trappers will be required to submit reports each month outlining the number of hogs captured and the number of traps operated each month.

Agent trappers must provide the refuge with detailed personal information for each helper trapper and must provide detailed information on all vehicles to be used for feral hog removal.

Trappers required to work in Kennedy Space Center's security area will be required to meet and maintain security requirements for NASA badging.

**Justification:** Feral hog removal and the resulting reduction of the refuge feral hog population help reduce habitat disturbance, competition between feral hogs and native wildlife for food resources, native wildlife mortality, safety hazards due to hog and car collisions, and property destruction caused by rooting activities. Without this feral hog removal program, an unrealistic amount of refuge staff time would be required to reduce the feral hog population to the level achieved by the current removal program.

#### **Mandatory 10-Year Re-evaluation Date:**

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#### **Description of Use:**

##### *Forest Management – Commercial Timber Harvest*

Merritt Island National Wildlife Refuge has used commercial timber harvesting to support its forest and woodland management program for twenty years under the refuge's Upland Habitat Management Plan (Adrian et al 1982) and the Forest and Upland Habitat Management Plan (Adrian 1991). Under the refuge's comprehensive conservation plan, timber harvesting will continue to be used in forest and woodland stands where the trees are merchantable.

Timber harvesting will be used to help achieve several of the goals and objectives outlined in the comprehensive conservation plan. Included in these are the provision of nesting substrate for the bald eagle (*Haliaeetus leucocephalus*), the improvement of habitat for the Florida scrub-jay (*Aphelocoma coerulescens*), the creation of diversity in the landscape, and the maintenance of ecological integrity. The strategies and techniques for each of these are discussed in detail in the current habitat management plan which was developed as a step-down plan of the comprehensive conservation plan.

Periodically, timbered areas of the refuge will be assessed as to their ability to meet habitat requirements. When it is necessary to remove part or all of a stand of trees, a prospectus will be prepared and the sale offered to commercial harvesting operations. Two general methods of choosing the trees will be used. The first is to mark the individual trees that are to be removed. This method is usually used where the purpose of the harvest is to create a range of stand densities

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throughout the forest. In this case a relatively small portion of the stand is removed and is most applicable where the objective is to create eagle nesting habitat or where more diversity in the forest is desired. The other method of choosing trees to be harvested is logger selection, which can be used when it is necessary to remove either the entire stand or the majority of it. With the logger selection method, the commercial operator is given the number of stems per acre that are to be left on the site, along with some size and form parameters. He is then allowed to select the trees that are cut as he works through the stand. The most likely use of this method is to reduce trees in areas where the shrub layer would provide habitat for the Florida scrub-jay. Although this method reduces the amount of pre-harvest work by eliminating marking, it requires closer monitoring of the logging operation.

Commercial timber harvesting may also be used to protect the health of the forests and woodlands. In this scenario, pockets of trees infested with insects or disease would be removed to prevent the spread of these pathogens throughout the area.

**Availability of Resources:** In order to effectively use timber harvesting to achieve refuge goals and objectives, personnel on the refuge's staff need to be knowledgeable in forest ecology. They must also have an awareness of the capabilities and limitations of timber harvesting operations. At the present time, such staffing is available. The comprehensive conservation plan provides for staffing at both the technical and professional level to meet this requirement in the future

**Anticipated Impacts of the Use:** Harvesting operations can have a major impact on the shrub layer of forests. The equipment used in these endeavors crushes and breaks many of the plants as trees are felled and skidded to the loading docks. However, the understory quickly recovers. Within a year, much of the shrub layer has grown back. The removal of some of the stems opens up the understory and allows easier access by the wildlife that lives there. Often times, the herbaceous layer responds positively to the removal of the overstory and portions of the shrub layer. This can create important foraging opportunities although they are short lived.

Soil compaction and disruption of local drainage can also be an important negative side effect of logging operations. These can be mitigated by selecting proper sites for loading areas, varying skid trails and avoiding operations during wet periods.

Noise level of the equipment and chainsaws will cause some minor disruption or displacement of wildlife.

**Determination (Check one below):**

	Use is Not Compatible
X	Use is Compatible, with the Listed Stipulations

**Stipulations Necessary to Ensure Compatibility:** All commercial timber harvesting operations will be carried out under a special use permit. Conditions of the sale will be specified in the permit and will depend on the purpose of the harvest, the characteristics of the site, current policy, and safety of refuge and Kennedy Space Center employees and visitors. The permit should also address any specific requirements of the Space Center.

While checking on harvest operations, refuge staff will be aware of present and forecasted weather conditions. Should soil moisture reach a point where excessive damage is being done to the site operations will be shut down until conditions improve. Refuge staff will also check for damage to the residual stand and will make operators aware of any problems as soon as they are detected.

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**Justification:** The forest management actions, proposed in the comprehensive conservation plan and described in the habitat management plan, are in accordance with Service guidelines for the protection, management, and enhancement of wildlife populations and habitats on the refuge. The habitat for the bald eagle and the Florida scrub-jay, both federally threatened species, will require periodic manipulation if recovery goals are to be met. The timber harvest will also help meet goals of maintaining upland habitat diversity and will help maintain the ecological integrity of the refuge landscape.

**Mandatory 10-Year Re-evaluation Date:**

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**Public Review and Comment:** Following the initial gathering of information, a notice of intent to prepare a comprehensive conservation plan for the refuge was published in the Federal Register on August 26, 2002. The Service also placed ads in local newspapers, posted information on the refuge's web site regarding upcoming meetings and how to submit comments, posted meeting information in the local community (e.g., at local shops, at the refuge's Visitor Center, and at the local libraries), and sent out flyers announcing the public meetings. An open house at the refuge's Visitor Center kicked off the public scoping phase on September 21, 2002. Over 180 people attended the open house which was followed by three public scoping meetings: October 23, 2002 in south Merritt Island with 31 attendees; October 28, 2002 in New Smyrna Beach with 17 attendees; and October 29, 2002 in Titusville with 55 attendees. During September and October 2002, 10 CCP related

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articles appeared in three local papers: Florida Today, Orlando Sentinel, and Press Tribune. One article appeared in November 2002 to review the wide range of plan comments submitted to the Service. During public scoping, over 1,600 written comments were submitted by individuals and organizations spanning 49 states and 11 countries. Two planning updates kept the public informed of the progress of the plan. Follow up meetings were scheduled in 2004 to address the public's concerns specific to Mosquito Lagoon: April 29, 2004 in Titusville with 65 attendees; May 12, 2004 in New Smyrna Beach with 25 attendees; November 8, 2004 in Titusville with 7 attendees; and November 22, 2004 in New Smyrna Beach with 32 attendees. To date, over 1,500 people are on the refuge's comprehensive conservation plan mailing list. Verbal and written comments were recorded regarding a variety of subjects, including uses of the refuge. Further, during the public comment and review period, opportunity was provided to the public to submit comments during a 60-day review period.

**Approval of Compatibility Determinations:**

The signature of approval covers all the compatibility determinations considered within the Comprehensive Conservation Plan for Merritt Island National Wildlife Refuge. If one of the descriptive uses is considered for compatibility outside of the plan, the approval signature becomes part of that determination.

**Signature:**

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Refuge Manager

Date

**Review:**

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Regional Compatibility Coordinator

Date

**Review:**

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Refuge Supervisor

Date

**Concurrence:**

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Regional Chief  
National Wildlife Refuge System  
Southeast Region

Date

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Merritt Island National Wildlife Refuge

Use: Bicycling

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies.      Yes  No

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate

Appropriate

Refuge Manager: \_\_\_\_\_

Date: \_\_\_\_\_

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Merritt Island National Wildlife Refuge

Use: Commercial Services

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies.      **Yes**  **No**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate**

**Appropriate**

Refuge Manager: \_\_\_\_\_

Date: \_\_\_\_\_

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Merritt Island National Wildlife Refuge

Use: Commercial Fishing (phase out use)

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies.      **Yes**  **No**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate**

**Appropriate**

Refuge Manager: \_\_\_\_\_

Date: \_\_\_\_\_

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Merritt Island National Wildlife Refuge

Use: Beekeeping (phase out use)

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies.      **Yes** ✓ **No** \_\_\_

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** \_\_\_\_\_

**Appropriate** ✓ \_\_\_\_\_

Refuge Manager: \_\_\_\_\_

Date: \_\_\_\_\_

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Merritt Island National Wildlife Refuge

Use: Research

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies.      **Yes** ✓    **No** \_\_\_

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** \_\_\_\_\_

**Appropriate** ✓

Refuge Manager: \_\_\_\_\_

Date: \_\_\_\_\_

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Merritt Island National Wildlife Refuge

Use: Astronomy

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✓
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies.      **Yes**  **No**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate**

**Appropriate**

Refuge Manager: \_\_\_\_\_

Date: \_\_\_\_\_

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Merritt Island National Wildlife Refuge

Use: Organized Group Camping

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✓
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies.      **Yes** ✓    **No** \_\_\_

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** \_\_\_\_\_

**Appropriate** ✓

Refuge Manager: \_\_\_\_\_

Date: \_\_\_\_\_

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Merritt Island National Wildlife Refuge

Use: Non-commercial Plant Collection

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies.      **Yes** ✓ **No** \_\_\_

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** \_\_\_\_\_

**Appropriate** ✓

Refuge Manager: \_\_\_\_\_

Date: \_\_\_\_\_

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Merritt Island National Wildlife Refuge

Use: Interim Management of Citrus Groves

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies.      **Yes** ✓    **No** \_\_\_

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** \_\_\_\_\_

**Appropriate** ✓

Refuge Manager: \_\_\_\_\_

Date: \_\_\_\_\_

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Merritt Island National Wildlife Refuge

Use: Feral Hog Control

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies.      **Yes**  **No**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate**

**Appropriate**

Refuge Manager: \_\_\_\_\_

Date: \_\_\_\_\_

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Merritt Island National Wildlife Refuge

Use: Forest Management – Commercial Timber Harvest

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies.      **Yes** ✓    **No** \_\_\_

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** \_\_\_

**Appropriate** ✓

Refuge Manager: \_\_\_\_\_

Date: \_\_\_\_\_

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Merritt Island National Wildlife Refuge

Use: All-terrain Vehicles

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?		✓
(c) Is the use consistent with applicable executive orders and Department and Service policies?		✓
(d) Is the use consistent with public safety?		✓
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✓
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✓
(g) Is the use manageable within available budget and staff?		✓
(h) Will this be manageable in the future within existing resources?		✓
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✓
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		✓

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies.      **Yes**  **No**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate**

**Appropriate**

Refuge Manager: \_\_\_\_\_

Date: \_\_\_\_\_

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Merritt Island National Wildlife Refuge

Use: Boating (Airboats and Personal Watercraft)

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?		✓
(c) Is the use consistent with applicable executive orders and Department and Service policies?		✓
(d) Is the use consistent with public safety?		✓
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✓
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✓
(g) Is the use manageable within available budget and staff?		✓
(h) Will this be manageable in the future within existing resources?		✓
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✓
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		✓

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies.      **Yes** ✓    **No** \_\_\_

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** ✓

**Appropriate** \_\_\_\_\_

Refuge Manager: \_\_\_\_\_

Date: \_\_\_\_\_

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Merritt Island National Wildlife Refuge

Use: Horseback Riding

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?		✓
(c) Is the use consistent with applicable executive orders and Department and Service policies?		✓
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✓
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✓
(g) Is the use manageable within available budget and staff?		✓
(h) Will this be manageable in the future within existing resources?		✓
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✓
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		✓

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies.      **Yes**  **No**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate**

**Appropriate**

Refuge Manager: \_\_\_\_\_

Date: \_\_\_\_\_

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Merritt Island National Wildlife Refuge

Use: Jogging

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✓
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✓
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		✓

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies.      **Yes** ✓    **No** \_\_\_

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** ✓

**Appropriate** \_\_\_\_\_

Refuge Manager: \_\_\_\_\_

Date: \_\_\_\_\_

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Merritt Island National Wildlife Refuge

Use: Model Airplanes

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?		✓
(c) Is the use consistent with applicable executive orders and Department and Service policies?		✓
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✓
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?		✓
(h) Will this be manageable in the future within existing resources?		✓
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✓
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		✓

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies.      **Yes**  **No**

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate**

**Appropriate**

Refuge Manager: \_\_\_\_\_

Date: \_\_\_\_\_

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**

## FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Merritt Island National Wildlife Refuge

Use: Segways

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?		✓
(c) Is the use consistent with applicable executive orders and Department and Service policies?		✓
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?		✓
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?		✓
(h) Will this be manageable in the future within existing resources?		✓
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?		✓
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?		✓

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies.      **Yes** ✓    **No** \_\_\_

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** ✓

**Appropriate** \_\_\_\_\_

Refuge Manager: \_\_\_\_\_

Date: \_\_\_\_\_

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use. If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence. If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

**A compatibility determination is required before the use may be allowed.**



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## *F. Habitat Management Plan*

For a copy of the Habitat Management Plan for Merritt Island National Wildlife Refuge, please contact the refuge at 321.861.0667; or [MerrittIslandCCP@fws.gov](mailto:MerrittIslandCCP@fws.gov); or PO Box 6504, Titusville, FL 32782-6504. Or to view or print a copy, please visit: <http://www.fws.gov/southeast/planning/>, select Draft Documents, and scroll down to Merritt Island National Wildlife Refuge.



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## *G. Visitor Services Plan*

For a copy of the Visitor Services Plan for Merritt Island National Wildlife Refuge, please contact the refuge at 321.861.0667; or [MerrittIslandCCP@fws.gov](mailto:MerrittIslandCCP@fws.gov); or PO Box 6504, Titusville, FL 32782-6504. Or to view or print a copy, please visit: <http://www.fws.gov/southeast/planning/>, select Draft Documents, and scroll down to Merritt Island National Wildlife Refuge.



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## *H. List of Preparers*

Merritt Island National Wildlife Refuge, Fish and Wildlife Service

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- Cheri M. Ehrhardt, AICP, Natural Resource Planner
- Marc Epstein, Refuge Biologist
- Ron Hight, Project Leader
- Ralph Lloyd, Deputy Refuge Manager
- James Lyon, Biological Science Technician
- Dorn Whitmore, Supervisory Refuge Ranger