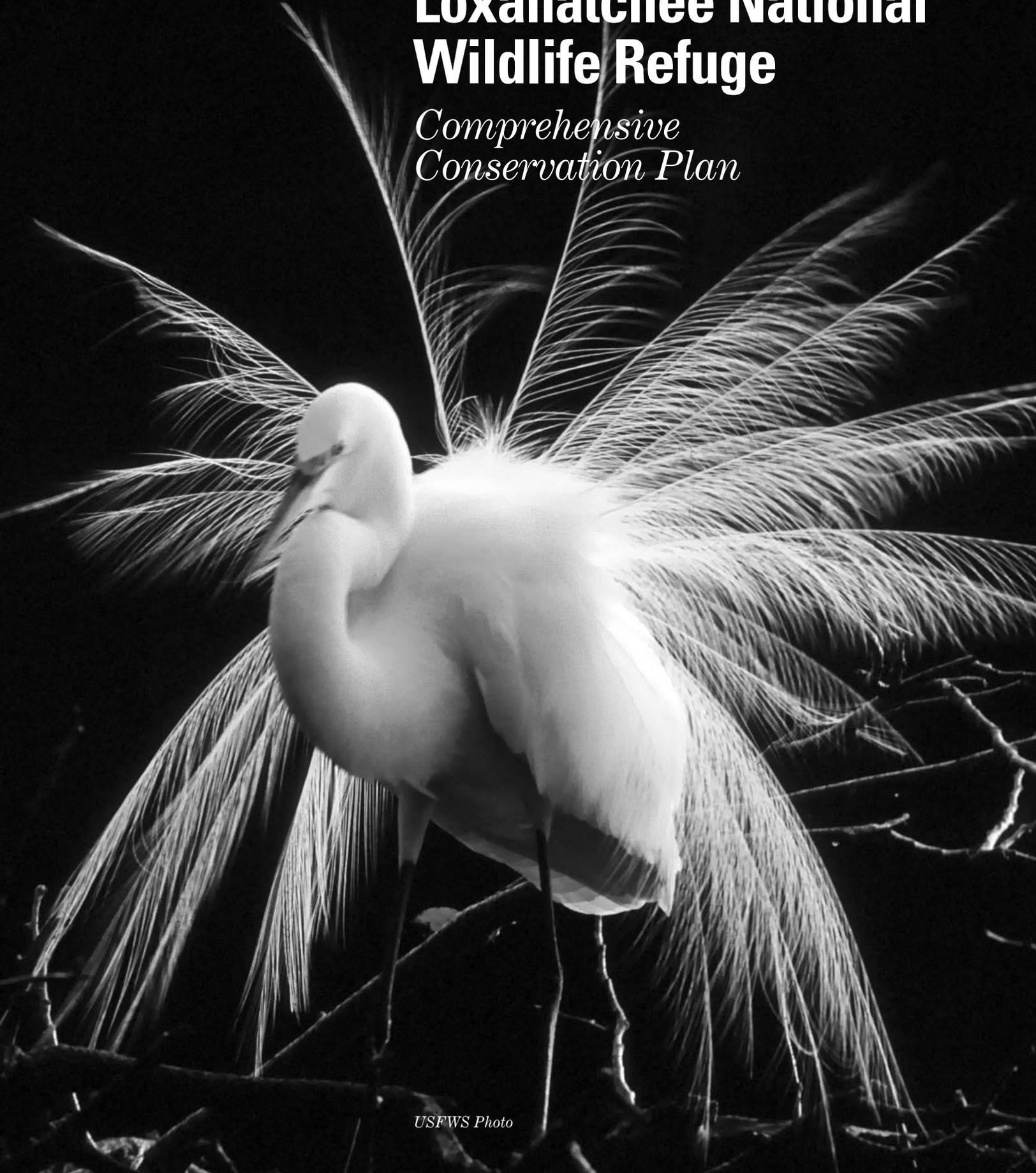


U.S. Fish & Wildlife Service

# Arthur R. Marshall Loxahatchee National Wildlife Refuge

*Comprehensive  
Conservation Plan*



USFWS Photo

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## *Guiding Principals of the National Wildlife Refuge System*

We are land stewards, guided by Aldo Leopold's teachings that land is a community of life and that love and respect for the land is an extension of ethics. We seek to reflect that land ethic in our stewardship and to instill it in others.

Wild lands and the perpetuation of diverse and abundant wildlife are essential to the quality of the American life.

We are public servants. We owe our employers, the American people, hard work, integrity, fairness, and a voice in the protection of their trust resources.

Management, training from preservation to active manipulation of habitats and populations, is necessary to achieve the missions of the National Wildlife Refuge System and the U.S. Fish and Wildlife Service.

Wildlife-dependent uses involving hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation, when compatible, are legitimate and appropriate uses of the National Wildlife Refuge System.

Partnerships with those who want to help us meet our mission are welcome and indeed essential.

Employees are our most valuable resource. They are respected and deserve an empowering, mentoring, and caring work environment.

We respect the rights, beliefs, and opinions of our neighbors.





# I. Background



Immature Kites  
Photo © Betty Wargo

## Introduction

The U.S. Fish and Wildlife Service is developing a Draft Comprehensive Conservation Plan to guide refuge management and resource use at A.R.M. Loxahatchee National Wildlife Refuge in southeastern Florida. Contained in this draft plan is a description of the planning process, general background on the refuge, desired future conditions, refuge vision and goals, and the management actions necessary to achieve these conditions.

Guiding the development of the plan is Part 602 (National Wildlife Refuge System Planning) of the Fish and Wildlife Service Manual and the National Wildlife Refuge System Improvement Act of 1997. An overriding consideration reflected in the proposed plan is that fish and wildlife conservation has first priority in refuge management; public uses are allowed and encouraged as long as they are compatible with, or do not detract from, this priority mission and the purposes for which the refuge was established.

The major issues addressed in the plan include exotic species; biological diversity; water quality and quantity; land use changes; habitat and wildlife protection; recreational opportunities and access; and environmental education and partnerships. Based on these issues, a range of alternatives was identified that could be implemented within the next 15 years. From these alternatives, the Service has tentatively selected a preferred alternative, which is described in the following pages.

This plan supports the National Wetlands Priority Conservation Plan; the North American Waterfowl Management Plan; the Partners-in-Flight Initiative; the Multi-Species Recovery Plan for South Florida; the South Florida Ecosystem Plan, and the Comprehensive Everglades Restoration Plan.

## Purpose of and Need for the Plan

The purpose of the plan is to identify the role the refuge will play in support of the mission of the National Wildlife Refuge System and to provide guidance in refuge management and public use activities. The plan articulates the Service's management direction (goals, objectives, and strategies) for the next 15 years (2000-2015).

### *The plan is needed to:*

- provide a clear statement regarding the future management of the refuge;
- provide refuge neighbors, visitors, the public, and government officials with an understanding of the Service's management actions on and around the refuge;
- ensure that the refuge's management actions are consistent with the mandates of the National Wildlife Refuge System;
- provide long-term guidance and continuity for refuge management;
- provide a basis for the development of budget requests on the refuge's operational, maintenance, and capital improvement needs; and
- address the issues regarding the refuge's license agreement with the South Florida Water Management District, including issues relating to modification of the agreement and management capabilities and responsibilities.

**Planning Process**

A Draft Comprehensive Conservation Plan/Environmental Assessment was prepared in compliance with the National Wildlife Refuge System Improvement Act of 1997, and the National Environmental Policy Act of 1969. The Refuge System Improvement Act requires the Service to actively seek public involvement in environmental planning such as the preparation of environmental assessments and environmental impact statements. It also requires the Service to seriously consider all reasonable alternatives, including a “no action” alternative. These alternatives are described in the Environmental Assessment (*Appendix A*).

*In developing the refuge plan, the Service completed a 3-step planning process, as follows:*

- (1) Established and organized a planning team for the purpose of developing a refuge comprehensive conservation plan;
- (2) Held a public meeting to identify the important issues, concerns, and opportunities relating to the future management of the refuge; and
- (3) Prepared a draft plan for public review and comment.

On July 14-15, 1998, the Service assembled a planning team at the refuge headquarters to begin developing a draft plan for the refuge. The team developed a vision statement for the refuge and identified a number of issues and concerns that were likely to affect the management of the refuge. The planning team also identified several goals for the future direction of the refuge and planned the agenda for the first public scoping meeting.

The public scoping meeting was held in Boynton Beach, Florida, on August 17, 1998. This meeting identified a variety of issues, concerns, and opportunities concerning the management of the refuge. In addition, the Service distributed comment sheets and evaluated responses from persons who attended the public meeting as well as from those who could not attend the meeting. The comments from the public scoping meeting and those expressed on the comment sheets are summarized in Appendices G and I, respectively. These comments and each alternative and response are reflected in summary statements identified in Table 18.

Following the identification of the issues and opportunities, the planning team began the process of preparing the draft plan and environmental assessment. Information concerning the refuge’s physical, biological, and socioeconomic environment was compiled and is described in Section III, Refuge Environment.

At subsequent planning team meetings, the alternatives for the management of the refuge were identified. Each alternative was described as a set of objectives or management actions (*Appendix A*). The potential impacts of each alternative on the physical, biological, cultural and historic, and socioeconomic environments are also described in Appendix A.

The draft plan was distributed to officials of federal, state, and local government agencies, private organizations, and the general public for review and comment. A public meeting was held to present each alternative and obtain verbal comments from the public. In addition, a public meeting was held to present the draft plan. Comments were collected for a period of 40 days. Those comments were integrated into the final management plan (Section IV).

## The U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service is the primary federal agency responsible for conserving, protecting, and enhancing the Nation's fish and wildlife populations and their habitats. Although the Service shares this responsibility with other federal, state, tribal, local, and private entities, it has specific trustee responsibilities for migratory birds, threatened and endangered species, anadromous fish, and certain marine mammals, as well as for lands and waters administered by the Service for the management and protection of these resources.



Tricolored Heron  
USFWS Photo by Evelyn McGraw.

As part of its mission, the Service operates more than 520 national wildlife refuges covering more than 92 million acres. These areas comprise the National Wildlife Refuge System, the world's largest collection of lands specifically managed for fish and wildlife. The majority of these lands, 77 million acres, is in Alaska, with the remaining 15 million acres spread across the other 49 states and several island territories.

### The National Wildlife Refuge System

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

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

The Act establishes wildlife conservation as the primary mission of the National Wildlife Refuge System. Refuges will be managed to fulfill the mission of the National Wildlife Refuge System, fulfill the individual purpose of each refuge, and maintain the biological integrity, diversity, and environmental health of the system.

While wildlife will have first priority in refuge management, wildlife-dependent recreation uses or other uses may be allowed after they have been determined, by the Refuge Manager, to be appropriate and compatible uses. Further, wildlife-dependent recreation uses, namely hunting, fishing, wildlife observation, wildlife photography, environmental education and interpretation are legitimate and priority public uses, are dependent upon healthy fish and wildlife populations and are to receive enhanced consideration over other public uses in planning and management.

National wildlife refuges provide important habitat for native plants, mammals, birds, fish, amphibians, reptiles, insects, and invertebrates. They also play a vital role in preserving threatened and endangered species. Refuges offer a wide variety of wildlife-dependent recreational opportunities, and many have visitor centers, wildlife trails, and environmental education programs. In 1995, 24.9 million people visited national wildlife refuges to hunt, fish, observe and photograph wildlife, and participate in educational and interpretive activities (U.S. Fish and Wildlife Service, 1997a). As visitation increases, significant economic benefits are generated to local communities. On a national basis, refuge visitors contribute more than \$400 million each year to local economies.

## A.R.M. Loxahatchee National Wildlife Refuge

### *History*

A.R.M. Loxahatchee National Wildlife Refuge, located 7 miles west of the city of Boynton Beach, is the only remnant of the northern Everglades in Palm Beach County, Florida (*Figure 1*). Unlike the name of many national wildlife refuges, Loxahatchee's name was changed in 1986 to include a noted local conservationist Arthur R. Marshall. Most of the 147,392-acre refuge is encompassed by Water Conservation Area 1, which is owned by the State of Florida and is licensed to the Service.



White ibis colony  
USFWS Photo by F. Broerman

To the northwest of the refuge is the Everglades Agricultural Area which includes sugar cane farms, winter vegetable and sod farms, and cattle ranches. The land east of the refuge is predominantly urban with the exception of the agricultural lands of the East Coast Buffer area. To the south and southwest of the refuge lie Water Conservation Areas 2 and 3, and Everglades National Park--the only other remaining portions of the Everglades fresh water marsh.

Beginning with the Swampland Act of 1845, and later the 1907 Everglades Drainage Act, excessive drainage activities occurred in the Everglades to pave the way for agriculture and development. To meet the ever-increasing water needs of agriculture and population expansion, three water storage areas called Water Conservation Areas 1, 2, and 3 (*Figure 1*), were constructed by the U.S. Army Corps of Engineers in the 1940s. Bounded by levees and connected by a series of canals, these areas were placed under the jurisdiction of what is now the South Florida Water Management District, an agency of the State of Florida.

In 1951, a license agreement (*Appendix N*) between the South Florida Water Management District and the Service, under the Migratory Bird Conservation Act, enabled the establishment of the 143,238-acre Loxahatchee National Wildlife Refuge at Water Conservation Area 1. This "refuge interior" land, as it is called, is owned by the State of Florida, but managed by the Service. The license agreement was later amended to include the 1604-acre Strazzulla Marsh, which lies adjacent to Water Conservation Area 1 (*Figure 2*).

In addition to the lands licensed from the District, the Fish and Wildlife Service owns 2,550 acres to the east and west of the refuge interior. This acreage is sub-divided into four management compartments--A, B, C, D, and the Cypress Swamp. In total, the refuge currently includes 147,392 acres of northern Everglades habitat.

The refuge is currently managed by a staff of 20 permanent and 4 temporary/seasonal personnel. The permanent personnel include a project leader, deputy project leader, a refuge operation specialist, 2 Everglades Program Team members, 2 administrative staff, 3 law enforcement staff, 4 biological staff, 4 maintenance/operations staff, and 2 public use staff. In fiscal year 1999, the refuge operated with a budget of \$1,451,000 for payroll and operation needs and received \$357,000 in special funding authorized by Congress to address the maintenance backlog. For fiscal year 2000, the refuge was allocated \$1,520,700 for payroll and operation needs and also received \$144,100 for projects authorized by Congress.

The refuge Headquarters Area is the main entrance for refuge administration, education, and public access. It contains an entrance fee booth, administration building, a visitor center, four permanent residences, the Everglades Program Team office building, a vehicle storage building, four sheds, and a maintenance complex. In addition to these administrative facilities, the area contains three boat ramps, a floating boat house, seven parking lots, a boardwalk, an observation tower, observation platform, and a fishing platform. The Hillsboro Recreation Area, located at the southernmost point on the refuge, contains a parking area and boat ramps.

Figure 1. Regional perspective for A.R.M. Loxahatchee National Wildlife Refuge

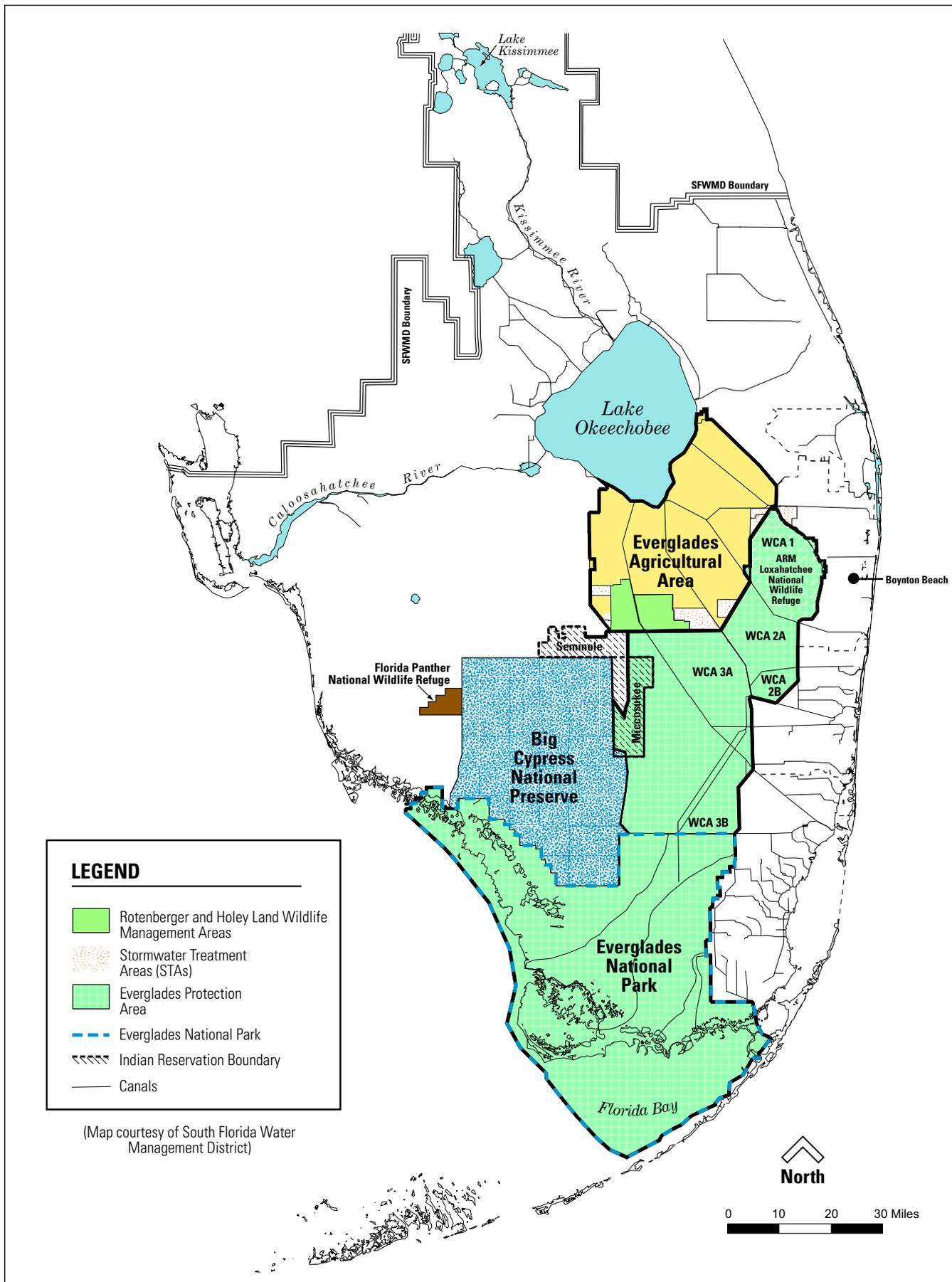
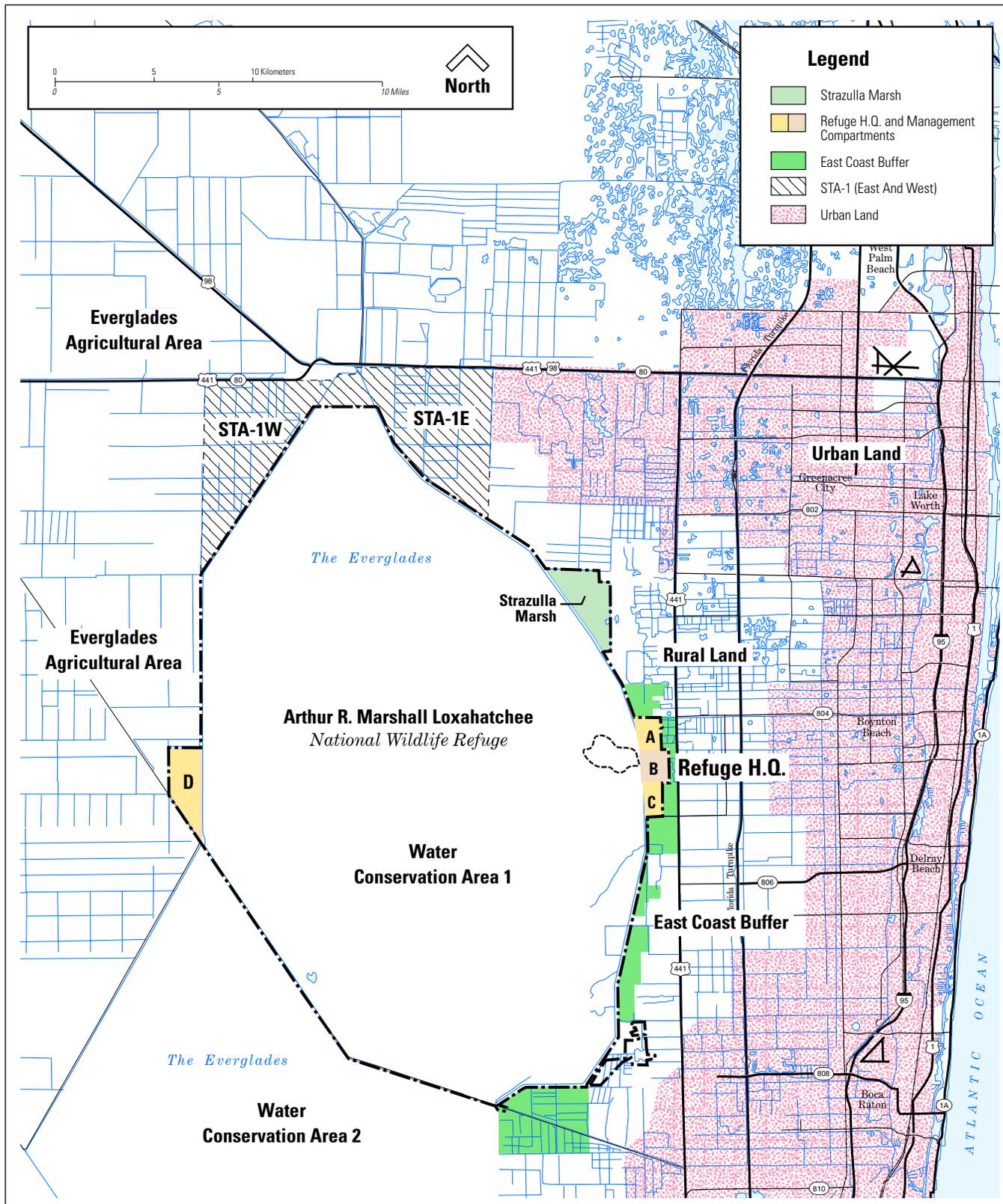


Figure 2. Boundaries and potential buffer lands at A.R.M. Loxahatchee National Wildlife Refuge



### *Purpose*

The Migratory Bird Conservation Act of February 18, 1929, 45 Stat. 1222, the Act of June 30, 1948, 62 Stat. 1171, 1176, authorizing the construction of the Central and Southern Florida Flood Control Project and the Fish and Wildlife Coordination Act of March 10, 1934, 48 Stat. 401, amended by the Act of August 14, 1946, 60 Stat. 1080, authorized the establishment of Loxahatchee National Wildlife Refuge on January 1, 1951.

The refuge was created by two agreements entered into by the Department of the Interior. The first agreement is a General Plan with the Florida Game and Fresh Water Fish Commission (now the Florida Fish and Wildlife Conservation Commission) which permitted Water Conservation Area 1 to be used by the Fish and Wildlife Service for the national migratory bird management program. The second agreement is a long term License from the Central and Southern Florida Flood Control District (now the South Florida Water Management District) which provided for the use of Water Conservation Area 1 by the Service “as a Wildlife Management Area, to promote the conservation of wildlife, fish, and game, and for other purposes embodying the principles and objective of planned multiple land use.”

According to the Fish and Wildlife Coordination Act, this refuge

*“...shall be administered by him (Secretary of the Interior) directly or in accordance with cooperative agreements... and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon....”*  
(16 USC § 664).

The Migratory Bird Conservation Act of 1929 states that the refuge is to be “...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds.” (16 USC. § 715d). This purpose and the mission of the National Wildlife Refuge System is fundamental to determining the compatibility of proposed uses of the refuge. The compatibility of these uses is discussed in Appendix D.

### *Ecosystem and North American Context*

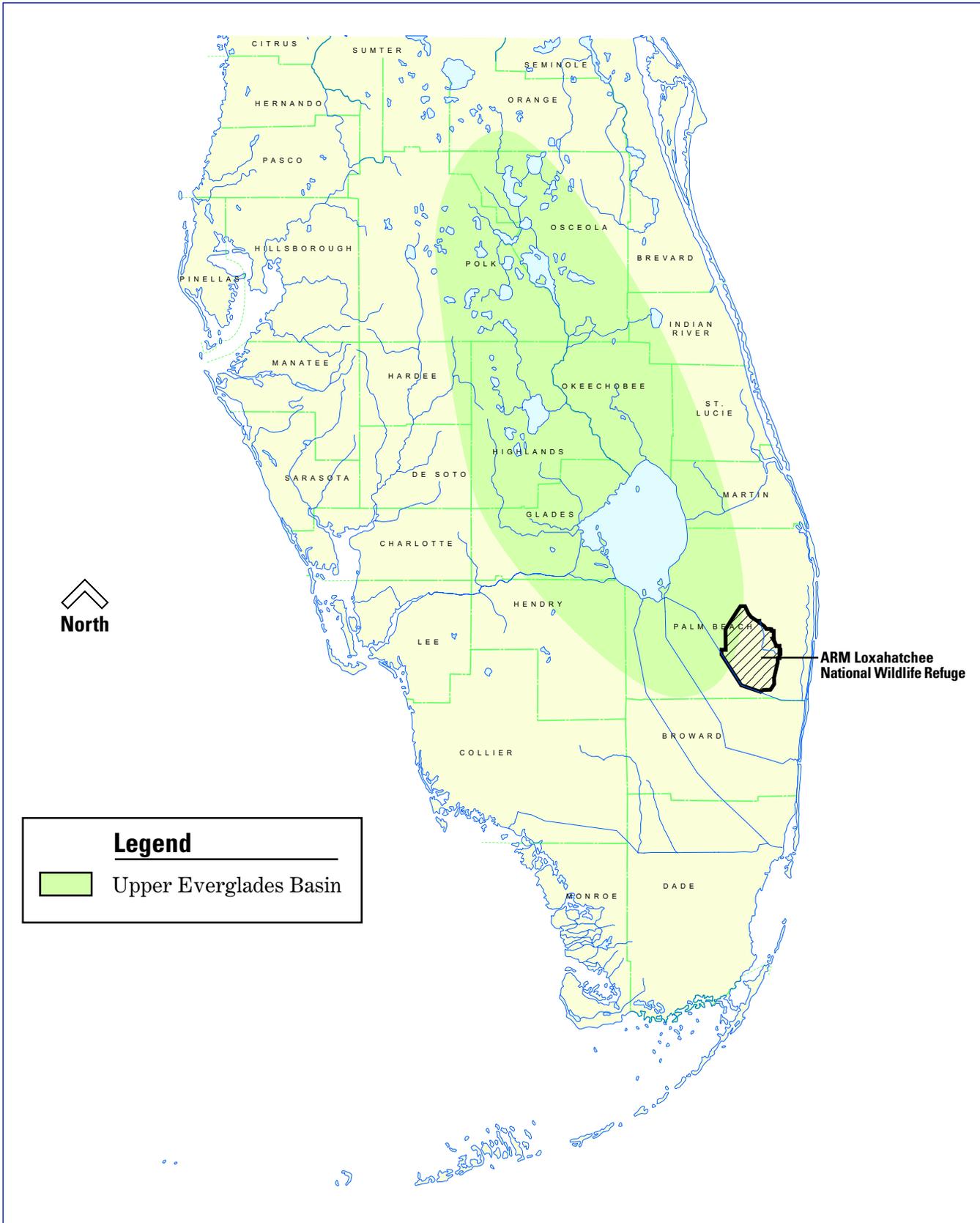
Role of Refuge in South Florida Ecosystem Plan:

In response to the complexity of the South Florida and Everglades Ecosystems, a South Florida Ecosystem Plan was completed by the Service’s South Florida Ecosystem Team. This plan identified the goals, objectives, and strategies for this ecosystem and the major issues associated with eight ecosystem sub-regions. The refuge, located in the Florida Everglades ecosystem subregion (*Figure 4*), will make a significant contribution to achieving the objectives of this plan. Consistent with the South Florida Ecosystem Plan, the refuge will reduce exotic species; manage water quality and quantity through partnerships; inventory and monitor wildlife and habitat; enforce laws to protect refuge resources; promote public awareness about the ecosystem; provide wildlife-compatible recreation; and maintain facilities and equipment at or above Service standards.

The Refuge Manager attends and participates in monthly working group meetings of the South Florida Ecosystem Team, which is comprised of Service field stations in an area from Ft. Myers to Vero Beach and south to the Keys. This team works together to accomplish Service priorities which include protection and management of federal trust species and combating the ever increasing problem of exotic invasives.

During the past two years the refuge has taken an active role in partnership efforts to protect and enhance habitats and wildlife both on and off refuge. Staff members have participated on water preserve area study teams designed to provide buffer lands east of the Everglades that will provide short hydro-period wetlands, enable ground water recharge, and capture water for storage and delivery to east coast populations. Staff

Figure 3. Upper Everglades Basin of importance to central Florida wintering waterfowl, breeding mottled ducks and wood ducks



are also working closely with county and state efforts to provide wildlife corridors and greenways connecting several of the large land management areas. In addition, the refuge is an active participant in Palm-Net, a network of federal, state, and county agencies and private organizations working together to provide interpretation and environmental education opportunities to the public.

#### Role of Refuge in Everglades Restoration:

The refuge is an important part of the overall Everglades ecosystem. The refuge receives water flowing south from Lake Okeechobee (S5-A Pump Station) and the Everglades Agricultural Area (S6 Pump Station). Discussions of re-plumbing the Everglades have included decompartmentalization including removal of the levees surrounding the refuge. However, removing the western and southern levees would allow water to flow south to Water Conservation Areas 2,3 and Everglades National Park, but would result in less control over maintaining water in the northern part of the system. In addition, because of land subsidence north and west of the refuge, if the levees were removed, water would flow north and west instead of the historic southerly direction and drain the refuge. Model runs of decompartmentalization show a decrease in Lake Okeechobee levels and a decrease in overall water supply leading to the conclusion that at this time, removal of the levees would not be beneficial to water supply or ecological values of the system or to the refuge. However, as part of the restoration, agricultural drainage water that comes through the S6 Pump Station would soon stop and it will be re-routed through the new Stormwater Treatment Area 2, and into Water Conservation Area 2.

The construction of canals throughout the Everglades ecosystem, as a whole, has changed historic sheet-flow patterns. Comparisons of newly shot aerial photos to historical aerial photos show elongate tree islands appear to be losing their overall appearance of a teardrop or a strand shape. Studies indicate that loss of a consistent north to south water flow over the refuge is one of the factors contributing to this landscape change (Brandt 2000).

The refuge's water regulation schedule, revised May 1995, has provided a mechanism to keep water levels in the refuge from dropping below 14 ft. NGVD. This schedule keeps the refuge from completely drying out every year. Though periodic dry outs are part of the natural cycle, yearly dry outs can reduce fish populations (prey for many species including wading birds), reduce the number of apple snails available for snail kites, provide additional areas for the germination and spread of exotic vegetation, and increase fire risks. Since the adoption of the regulation schedule in 1995, no major fires have occurred in the refuge, and the refuge experienced a record year for wading bird nesting in 1999. Stormwater Treatment Areas 1 East and 1 West will assist hydro patterns by providing a ready reservoir of low nutrient water that the refuge can draw from when needed.

Water quality and water quantity issues will continue to be major concerns in the protection of the resource. Until there are assurances that water entering the refuge is clean, options that put more (greater than recent levels) dirty water into the refuge are not considered ecologically beneficial. The existing water regulation schedules appear to be benefitting the ecological system within the refuge. Protecting the resources in the refuge contributes to overall Everglades restoration in that it helps to maintain the spatial extent and heterogeneity of historic habitats. This will contribute to the overall maintenance of system biological diversity.

The refuge is working cooperatively with the Corps of Engineers and South Florida Water Management District to better manage water resources in the context of multiple uses (needs for the environment, urban, and agricultural uses), including the use of long term forecasting and rainfall driven operations. Refuge personnel have, in the past and more recently,

increased participation in discussions of restudy and restoration alternatives by participating in various committees and advisory groups including:

- Alternative Evaluation Team coordinated by the Corps of Engineers (disbanded 1999)
- Restoration Coordination and Verification and subteams (i.e., Adaptive Assessment Team, Regional Evaluation Team) coordinated by the Corps of Engineers
- Water Preserve Area
- Technical Oversight Committee
- Everglades Technical Advisory Committee

#### Partners-In-Flight Program:

Recent documentation of plummeting bird numbers, especially of migrant passerines (Hagen and Johnston 1989, Finch and Stengel 1992) stimulated the formation of Partners-In-Flight, an international organization to address the needs of non-game migratory birds. The Service is one member of the Partners-In-Flight Program that includes coordination between federal, state and non-governmental agencies, industry, and conservation groups to promote research, land protection, and education about migratory birds.

The refuge is in the Atlantic Flyway, one of the primary migratory routes of bird species that breed in temperate North America and winter in the tropics of the Caribbean and South America. More than 116 species of neotropical migrants have been recorded passing through the south Florida ecosystem. More than 129 bird species migrate to the south Florida ecosystem to overwinter, and another 132 species breed in the ecosystem. Because this ecosystem is located near Cuba and the West Indies, it draws Caribbean species that rarely appear elsewhere in North America.

In 1995, the Service prepared a list of migratory non-game birds of management concern in the United States to stimulate a coordinated effort by federal, state, and private agencies to develop and implement comprehensive and integrated approaches for the management of selected species (*Tables 22 and 29*). The south Florida ecosystem supports many of these species (*Appendix L*).

#### Western Hemisphere Shorebird Reserve Network:

The refuge is also an important stopover location for many species of migratory shorebirds and a nesting location for some shorebirds. Although the refuge is not designated as a strategic migrational site by the Western Hemisphere Shorebird Reserve Network, it does provide important foraging habitat for these species and contributes survey data to the network.

#### North American Waterfowl Management Plan:

Since the first settlers arrived, more than 50 percent of the United States' original 220 million acres of wetlands, upon which waterfowl depend, have been destroyed often causing dramatic declines in numerous waterfowl populations.

Although some populations have declined, waterfowl remain an economically important group of migratory birds on the North American continent. According to the 1996 National Survey of Fishing, Hunting and Wildlife Associated Recreation, approximately 1.8 million people spent \$740 million annually to hunt ducks, both on and off national wildlife refuges. About 18.6 million people spent \$2 billion observing, photographing, and otherwise appreciating waterfowl throughout the United States, not just on refuges (Fish and Wildlife Service, Division of Federal Aid).

Recognizing the importance of waterfowl and wetlands to North America and the need for international cooperation to promote their well-being, the Canadian and United States governments developed a strategy to restore



Mottled Ducks  
USFWS Photo by B. Thomas, Jr

waterfowl populations to the levels of the 1970s through habitat protection, restoration and enhancement. The strategy was documented in the North American Waterfowl Management Plan, which was signed in 1986 by the Canadian Minister of the Environment and the United States' Secretary of the Interior. This plan identified important waterfowl habitat areas, established habitat and population goals, and established interstate/international partnerships, called joint ventures, to implement plan goals.

In 1997, the Atlantic Coast Joint Venture continued to build upon its firm foundation as Florida became its 17th state partner. Mid-winter data indicate that 17 to 26 percent of the Atlantic Flyway's January censused duck population winter in north and central Florida--an incidence greater than in any other state in the flyway.

A small portion of the refuge lies within the Upper Everglades Basin, which provides winter waterfowl habitat for scaup, ring-necked ducks, redheads, blue- and green-winged teal, wigeon and fulvous-whistling ducks, which are the most abundant species of waterfowl wintering in all of Florida (*Figure 3*). It also provides breeding habitat for mottled and wood ducks. Thus, the refuge has the potential of providing habitat for a portion of the North American wintering population, especially for ring-necked ducks. Management activities contribute towards meeting numerous goals of the North American Waterfowl Management Plan.

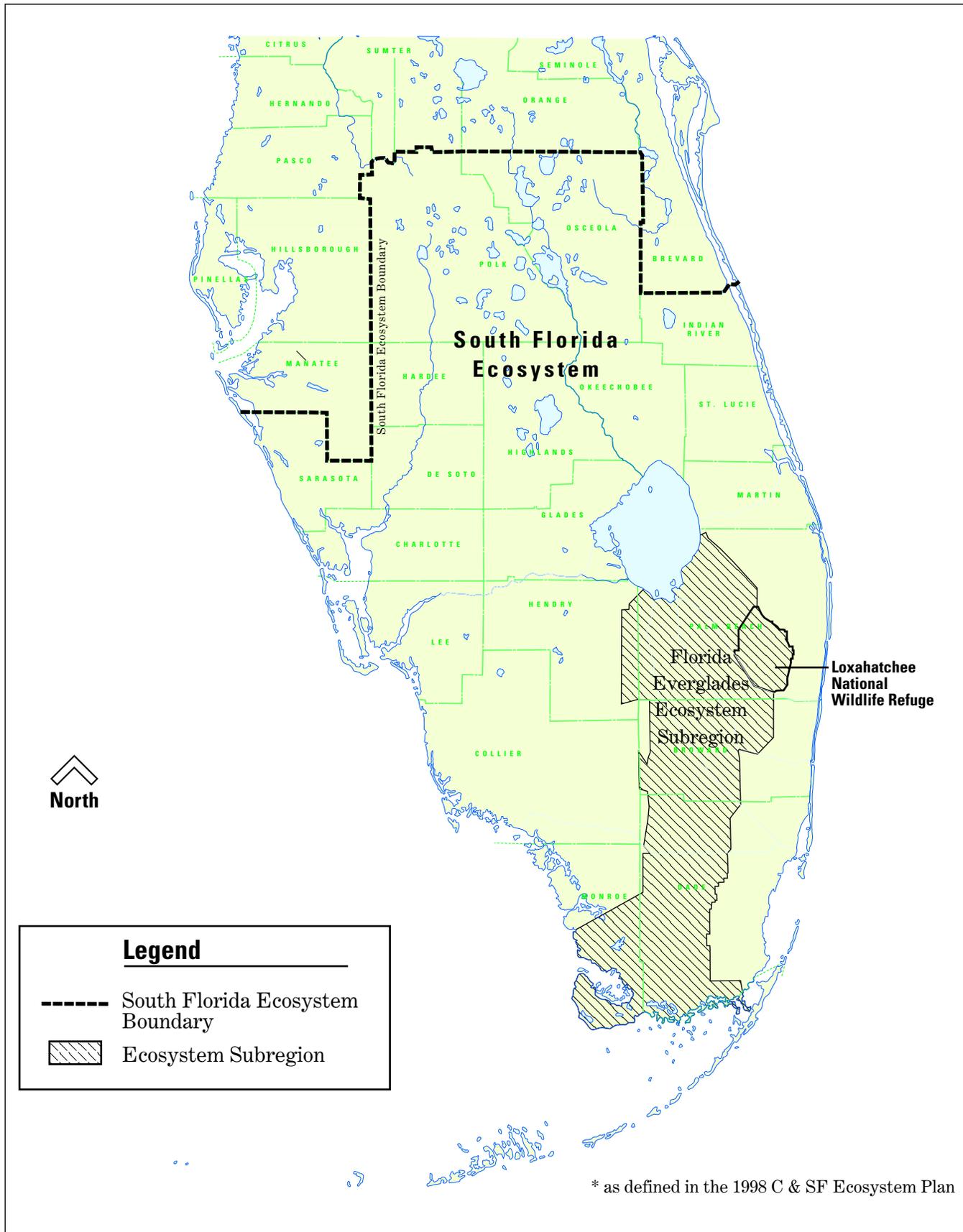
The issue of high mercury levels found in resident fish and alligator body burdens raises concerns about resident waterfowl. Population monitoring and heavy metal testing is needed for mottled and wood ducks including determining if a health advisory is needed regarding these locally harvested species. It is assumed that because they are not fish-eating birds the levels are within tolerance levels, however testing would be prudent.

### *Legal Context*

In addition to the refuge's authorizing legislation and the National Wildlife Refuge System Improvement Act of 1997, the legal and policy guidance for the operation of national wildlife refuges is contained in the documents or acts listed below. For a description of the key legislation and policies, see Appendix F.

- Executive Order 1312- Invasive Species (2/3/99)
- National Wildlife Refuge System Administration Act of 1966 (16 USC 668dd-668ee)
- Refuge Recreation Act of 1962 (16 USC 460k-460k-4)
- Title 50 of the Code of Federal Regulations, Subchapters B and C
- The Refuge Manual
- Fish and Wildlife Service Manual
- Endangered Species Act of 1973 (16 USC 1531-1543)
- Migratory Bird Hunting and Conservation Stamp Act (16 USC 718-718h)
- Migratory Bird Treaty Act of 1918 (16 USC 703-712)
- National Environmental Policy Act of 1969 (PL 91-190, 42 USC 4321-4347)
- Bald Eagle Protection Act of 1940 (16 USC 668-668d)
- American Indian Religious Freedom Act (P.L. 95-341, [1978], 92 Stat. 42 USC 1996)
- Antiquities Act (P.L. 59-209, approved 6/8/1906, 34 Stat. 225, 16 USC 431-433)
- Archaeological Resources Protection Act (P.L. 96-95 [10/31/1979], as amended by P.L. 100-555 [10/18/1988] and P.L. 100-588 [11/3/1988], 93 Stat. 721, 16 USC 470 aa et seq.)
- Archaeological and Historic Preservation Act (P.L. 93-291 [1974, 88 Stat. 1974], amending Reservoir Salvage Act, 16 USC 469)
- Executive Order 13007 - Sacred Sites (5/24/1996)
- National Historic Preservation Act (P.L. 89-665 [1966], 80 Stat. 95, as amended by P.L. 96-515 [1980], 94 Stat. 2987; P.O. 102-575 Title 40 (1992), 106 Stat. 4600)
- Native American Grave Protection and Repatriation Act (P.L. 101-601 (1990), 104 Stat. 3048, 25 USC 3000-3013, 18 USC 1170)

Figure 4. Florida Everglades Ecosystem Subregion\* within the South Florida Ecosystem



## II. Planning Issues and Opportunities



Boat-tailed grackle  
USFWS Photo by Evelyn McGraw

### Introduction

Early in the development of this plan, the planning team developed a list of issues and concerns that was likely to be associated with the management of the refuge. This list was derived from team knowledge of the area, a public scoping meeting, and written comments submitted by the public.

The scoping meeting, held on August 17, 1998, provided the public with an opportunity to identify issues and concerns. Approximately 60 persons attended the meeting. After a 15-minute presentation on the values of the refuge, the meeting participants were divided into small groups, with the group discussions facilitated by a consultant and planning team members. The comments of each group, following a structured format, were recorded on flip charts. These comments are summarized in Appendix G. Responses from comment sheets, distributed at the scoping meeting and at the refuge, and handwritten letters or postcards also provided information on issues and concerns of importance to the public. The comment packet and a summary of the comments are found in Appendix H and I, respectively.

Using the above sources, the planning team developed an abbreviated list of statements reflecting the major issues and concerns. While the summary statements, presented below, may not be identical to the original statements given by the public, the statements accurately reflect the intended meaning of the comments received. The responsiveness of the alternatives to these issues and concerns is summarized in Appendix A, Table 18.

### Summary Statements

#### *Wildlife Habitat Management*

- The increasing number of exotic and invasive plant and animal species is negatively impacting the refuge's native wildlife and habitat.

Many local citizens were concerned about the threat exotic plants and animals pose to the ecosystem and to the water supply. The public mentioned such threats as melaleuca, Old World climbing fern, Brazilian pepper, Australian pine, walking catfish, armored catfish, the bromeliad weevil, and the Asian fresh-water marsh eel. It is their desire that the refuge staff increase its efforts to protect native plants and wildlife from these threats.

- There is a need to improve the management of species and habitats to enhance the native biodiversity and integrity of the refuge.

Many citizens stated that it is imperative that the refuge manage the remaining portion of the Everglades to improve habitats and wildlife populations. Some people believe that past refuge administration allowed wildlife and habitats to decline and they wish that the land had been better managed. Many people expressed frustration at the poor condition of the impoundments and wondered why there was not more wildlife available to observe on a year-round basis.

- The degraded water quality and past water management practices (e.g., water quantities and schedules) are negatively impacting the refuge's ecosystem.

Many people stated the need for better water quality and an adequate water quantity for the refuge. Other people, however, expressed concern about having sufficient water for agriculture and the urban areas, particularly if the refuge takes what it needs.

### *Refuge Protection*

- The refuge is threatened by rapid development of residences, planned communities, strip malls, or golf courses near its boundaries.

Many people recognize the threat of impending development and its impact on the natural land base in the south Florida region, and they wish to protect lands around the refuge from development. Some people would like to see the current agricultural land use adjoining the refuge perpetuated or more land set aside for natural areas. Many people appeared to understand the fragility of the Everglades ecosystem and support restoring adjacent lands to a native state.

- The wildlife and habitats are not protected enough.

Many comments were written supporting greater protection of refuge wildlife and habitats, especially for threatened and endangered species. Many people expressed a desire to see the whole biological system protected. Others believe that providing protection to wildlife and habitat is especially important even if it means limiting public access.

### *Public Use*

- There are not enough opportunities to observe wildlife and its habitat in a quiet, natural, non-developed environment.

Many people expressed their appreciation for the refuge, its relatively quiet environment and its undeveloped nature. Since much of the land in south Florida has been developed (in their view), the refuge needs to stay relatively unsullied and quiet--a sanctuary for the public as well as for wildlife. Some people wished that more areas of the refuge (e.g., Strazzulla Marsh or the perimeter levee) were open so they could participate in more passive wildlife observation. Many people said that they don't want any activity that will disrupt wildlife populations or damage wildlife habitat.

- There is a need for increased access to the refuge for active recreational uses such as hiking, camping, bicycling, horseback riding, canoeing and airboating.

A number of people would like to bicycle, horseback ride, ride all-terrain vehicles, camp, hike, or airboat on the refuge. Many people believe that many kinds of recreation have not been offered to the public and should be. Due to the loss of natural lands in south Florida, people said they want to be able to enjoy green space in ways other than walking.

- There is a need to provide increased access to the refuge for hunting waterfowl, deer, alligator, turkey, bear and frogs. The habitat needs better management for fishing and hunting activities.

- Some people expressed frustration that the refuge provides a limited amount of access for hunting; further, they wished that the refuge allowed the use of airboats, especially for that purpose. Others desired a greater number of species to hunt. A number of individuals expressed frustration with what they perceive to be poor management of hunting and fishing habitat, especially with regard to the dense cattail growth at the south end of the refuge.

- Don't allow airboating.

A number of people wrote comments and stated at the public meeting that the refuge should not be opened to private airboating.

- There is a need to provide access and improve/provide public use facilities at the Hillsboro Recreation Area and at Strazzulla Marsh.

Many people expressed a desire for improved facilities and support services at the Hillsboro area, located at the south end of the refuge. The desired facilities and services should include a concession (with interpretive tours, boat rentals, educational experiences), usable boat ramps, telephones and restrooms. In addition, some people wished to have access to Strazzulla Marsh. Many people were concerned about the poor maintenance of the canoe trail and lack of additional access to the refuge interior. A few people desired an access point at the north end of the refuge to replace the closed “20-Mile Bend” access point.

- There is a need to expand environmental education and interpretation, highlighting the Everglades ecosystem.

Many people want to experience a greater number and variety of environmental education programs on the refuge. Further, they want their children to learn about the Everglades through the refuge. Some people said that new exhibits are needed, which can be rotated, and that facilities needed to be upgraded. Some citizens wished that the refuge would provide more educational tours for school and senior citizen groups, and summer camps.

### *Partnerships*

- There is a need for the refuge to develop partnerships with state, county and community agencies, universities and educational institutions, natural resource based organizations and other entities.

People think the refuge should work more closely with other natural resource agencies and user groups. To enhance management, some people believe there is a need to share equipment and knowledge between agencies.

- Take the refuge from the Fish and Wildlife Service and give it back to the State (Florida Fish and Wildlife Conservation Commission).

Some people do not want the Service to manage Water Conservation Area 1. Currently, a license agreement with the South Florida Water Management District gives authority to the Service to manage wildlife in keeping with its mission and establishing legislation, but the Water Management District retains the authority to manage water for flood control and water supply. These citizens feel the Agreement has been violated regarding wildlife and habitat management and by public access.

- Many of the public wish the refuge to develop ecotourism connections with the business community.

Citizens recognize that the refuge is a tourist attraction and they hope that it can continue to be beneficial to the local economy. Some citizens wish the refuge would join the Chamber of Commerce and create connections between hotels, recreational sport organizations and businesses.

### Significant Resource Problems

Water quality, quantity and timing, invasive and exotic plants and animals, and urban growth are three major factors affecting the welfare of fish, wildlife, and plants on the refuge and the surrounding ecosystem.

The defining element of the refuge and the whole of the Everglades is water, its quality, delivery timing and amount. This unique ecosystem has had a very low nutrient base for thousands of years and is comprised of species that have evolved to thrive under low nutrient conditions. Human activities adjacent to the refuge have introduced nutrients, primarily



*Melaleuca*  
USFWS photo by M.D. Mattei

fertilizers, which enhance the growth of many non-indigenous and invasive species to the detriment of native species. Increased nutrients change bacteria and algae, the most basic level of the system. This moves through the system until it is visible as the vast unnatural acreages of cattail. Replacing the natural Everglades marsh vegetation, these nuisance species create monotypic stands that are far less productive for wildlife and lacks the visual appeal of a diverse natural Everglades.

The reduction of nutrients entering the refuge has been and will continue to be a major issue.

The Everglades Nutrient Removal Project was completed in October 1993 (South Florida Water Management District 1997). This

serves three primary purposes: (1) to reduce phosphorus loads entering the refuge and help minimize imbalances in Everglades flora and fauna; (2) to develop the design, construction, operations, and maintenance experience necessary for large scale application of flow-way treatment technology; and (3) to implement optimal nutrient removal technology.

Currently the Everglades Nutrient Removal Project is in the last stages of conversion to Stormwater Treatment Area 1-W. Stormwater Treatment Area 1-E, through which surficial water will also be filtered, will be built adjacent to the northeast portion of the refuge. The Everglades Nutrient Removal Project, combined with best management farming practices, has already achieved phosphorous levels below the original goal of 50 PPB. However, a numeric standard still needs to be set for the amount of phosphorus that no longer causes an imbalance to flora and fauna. To reach this standard will require design and implementation of new technology. The standard will not only provide a basis for assessing the financial resources required to achieve water quality, but also a basis for monitoring.

Because the Everglades is no longer a free-flowing system that relies on temporal weather patterns to sustain it, humans must now attempt to provide water when and where the system can most benefit. The system evolved under variation, not constant annual schedules. Unfortunately, the water delivery system in place often exhibits its inadequacies in the form of extended droughts or floods. Technology must be developed and implemented to allow water managers to be more responsive to the natural system's needs and still meet the demands for water supply and flood control.

Exotic plants and animals are a tremendous threat to the ecosystem and to its water supply. The refuge has the worst invasive exotic plant problem in all of south Florida, and among the worst in National Wildlife Refuge System, with more than 96,000 acres infested to varying degrees. The amount of funding needed to control exotic plants is great, especially considering the insufficient funding nationwide for national wildlife refuges. A greater awareness is needed to maintain the refuge's biological integrity (See Refuge Environment, Exotic Plants).

Species such as melaleuca, Old World climbing fern, Brazilian pepper, Australian pine, walking catfish, and now the South American armored catfish, bromeliad weevil, and Asian fresh-water marsh eel are threats that are currently visible. New "exotics" will undoubtedly appear as the refuge struggles to find controls for established species. Exotics are not just costly threats to the natural environment, but also to agriculture, land development, business, and human health as well.

To meet the demands of a growing urban population, there is a continuous stream of land use proposals for lands surrounding the refuge. These proposed land use changes are often detrimental to the natural environment and the aesthetics of the area. For example, power transmission lines and high speed rail have been proposed to extend through the refuge natural and public use areas. Solid waste disposal sites have been proposed to abut the refuge boundary, which will bring unsightly mountains of waste adjacent to public use areas and adversely affect wildlife and water quality. However, the most likely immediate threat is from the rapidly escalating speed with which strip malls and housing developments are being built, especially adjacent to the refuge borders.



## III. Refuge Environment

### Physical Environment

#### *Climate*

Located in the subtropical region of south Florida, the refuge's climate is hot and humid most of the year and the winters are mild. In general, there are two seasons--wet and dry. The wet season occurs from late May to late October. The refuge receives some of the highest amounts of rainfall in south Florida (Gleason et al., 1975). While annual rainfall ranges from 40 to 83 inches, about 60 inches is typical. More than one-half of the rainfall for the year occurs between June and September in the form of thunderstorms. Only one hurricane (Irene in 1999) has made a direct hit on the refuge since it was established, however, numerous hurricanes

and tropical storms have skirted it, and these have caused large rainfall events primarily during the months of August to November. During the dry season, November to May, rain falls during the cold fronts which average about seven per month from December through March, but the amount is significantly less than during the wet season.



USFWS Photo by S.D. Jewell

Winds prevail out of the southeast and the average relative humidity is 75 percent. While air temperatures at the refuge have ranged from 20°F to 101°F, the mean summer temperature and the mean winter temperature are 89°F and 56°F, respectively. The combination of humidity and temperature causes heat indices to range from 105°-110°F in the summer. Since the eastern edge of the refuge is located

within 12 miles of the Atlantic Ocean, temperatures are moderated. The temperatures also are moderated by the surface water of the Everglades.

#### *Physiography, Soils, and Geology*

The refuge is composed of 147,392 acres of Everglades habitat. The refuge is part of a large fresh water storage area connected by a series of canals and levees, which were completed by the Corps of Engineers in 1960. The underlying aquifer provides water into nearby coastal communities.

Underlying the refuge is a depression in the Fort Thompson Formation, a limestone bedrock, which results in greater water depth than the surrounding Everglades. Unlike other areas of the Everglades, where there are only shallow layers of soil overlying the bedrock, soil depths in the refuge range from 3.6 - 14.0 feet (Silveira 1996). The soil is primarily Loxahatchee Peat which forms from the roots, rootlets, and rhizomes of white water lily, and is an indication of a historic slough community. The peat is lightly colored, fibrous and spongy, reflective of high organic content. The low ash content of the soil is an indication of infrequent burns in the area.

Loxahatchee Peat is found only in two areas in the Everglades--in the refuge and Water Conservation Area 2, and in the western portions of Water Conservation Area 3 and Shark Slough. Loxahatchee Peat is slightly more acidic and has lower mineral content than other peats. The oldest peat on the refuge has been dated at 4,800 years. Everglades Peat (formed primarily from sawgrass) and Gandy Peat (formed from woody material, especially associated with tree islands) also are present on the refuge.

The refuge is on a gradual north to south slope which results in slowly moving surface water sheet flow. The topography undulates throughout the refuge, creating mounds and depressions that are covered by varying depths of water. In addition, the refuge contains thousands of tree islands which form when a layer of peat dislodges itself from the substrate and floats to the surface. During periods of low water, tree islands become rooted to the substrate. Plant succession occurs rapidly, and within about three years, woody vegetation is established.

### *Hydroperiod and Hydropattern*

Water flowing from the Everglades is vital to supplying surface water for south Florida, replenishing the Florida and Biscayne aquifers, carrying essential nutrients and clean, fresh water to estuaries, and supporting an extremely rich and diverse assemblage of wildlife and plants. Changes in the hydroperiods (the duration that an area is inundated) and hydropatterns (the depth, timing, flow, and location of surface water) have altered these vital wetland functions in the south Florida ecosystem.

Historically, surface water originating from rainfall and natural springs flowed from the Kissimmee basin of central Florida. The spring fed creeks formed rivers and filled Lake Okeechobee. From that point, water overflowed the south end of the lake and began its southward sheet flow to the southern tip of Florida. Historically, the precipitation that fell on the Everglades could spread out over the entire area (>2,317 square miles). To prevent flooding and provide agricultural and developmental land use, the Corps of Engineers started the massive and historic effort of controlling Everglades waters through construction of hundreds of miles of levees and canals. This construction has not only constricted sheet flow, but also has removed excess Everglades water to the ocean. As the levees and canals were completed, water ceased its natural flow through the Everglades; rather, it was channeled through what is now the refuge. In contrast to the past, water now enters the refuge from rainfall and three access points of controlled surface flow.

Construction of the levees has had significant effects on the hydrology, vegetation, and wildlife in the refuge. The shallow shorter hydroperiod marshes that once surrounded the refuge have been replaced by deep-water habitats along the canals. Lost is the mosaic of habitats that provided, in the same year, the availability of deeper water slough habitats for foraging snail kites and shallower marshes for foraging wading birds (e.g., wood storks). Changes in the natural timing of water levels affect wading bird feeding patterns, apple snail reproductive output, and alligator nesting. In addition, changes in the patterns of water depth have resulted in changes in aquatic vegetation and tree islands. In areas that have become wetter, particularly along the rim canal, tree islands have decreased in size and number (Brandt 2000), and more aquatic communities have developed (Hagenbuck et al., 1974). In drier areas, particularly the northern portion of the refuge, woody vegetation has become more abundant (Hagenbuck et al., 1974). Lower water levels, particularly during the dry season, increase the potential for fire and for fires to burn hotter, resulting in more damage to vegetation and soils.

Another consequence of impoundment has been the reduction of water flow through the refuge. A reduction in flow rates has changed the patterns of nutrient transport, seed dispersal, soil accretion, or loss. Brandt(2000) provided some evidence that changes in flow as well as hydroperiods and depths have contributed to the changes in the patterns of tree islands in the refuge. The importance of flow as a structuring process, as well as hydroperiods, should be considered for the maintenance of the ecological integrity of the refuge and the Everglades.

Timing and volume of water releases from the refuge also have influenced lands and waterways east and south of the refuge. By sending water to the eastern urban areas, water flowing southward through the Everglades ecosystem is greatly reduced, resulting in increased salinity in Florida and Biscayne Bays. Prior to June, in preparation for the hurricane season, the Corps of Engineers releases a large volume of fresh water from the refuge into the Atlantic Ocean. This heavy pulse of fresh water into the nearby Atlantic Ocean dilutes the saline environment, creating negative affects on fish and marine life. Because this water is released near the refuge, the water cannot complete its historical sheet flow to the tip of south Florida. The loss of fresh water to Florida Bay has created hyper-saline conditions, which have negatively impacted the estuarine and bay production and the entire fishing industry.

### *Overview of Water Regulation*

#### Purpose:

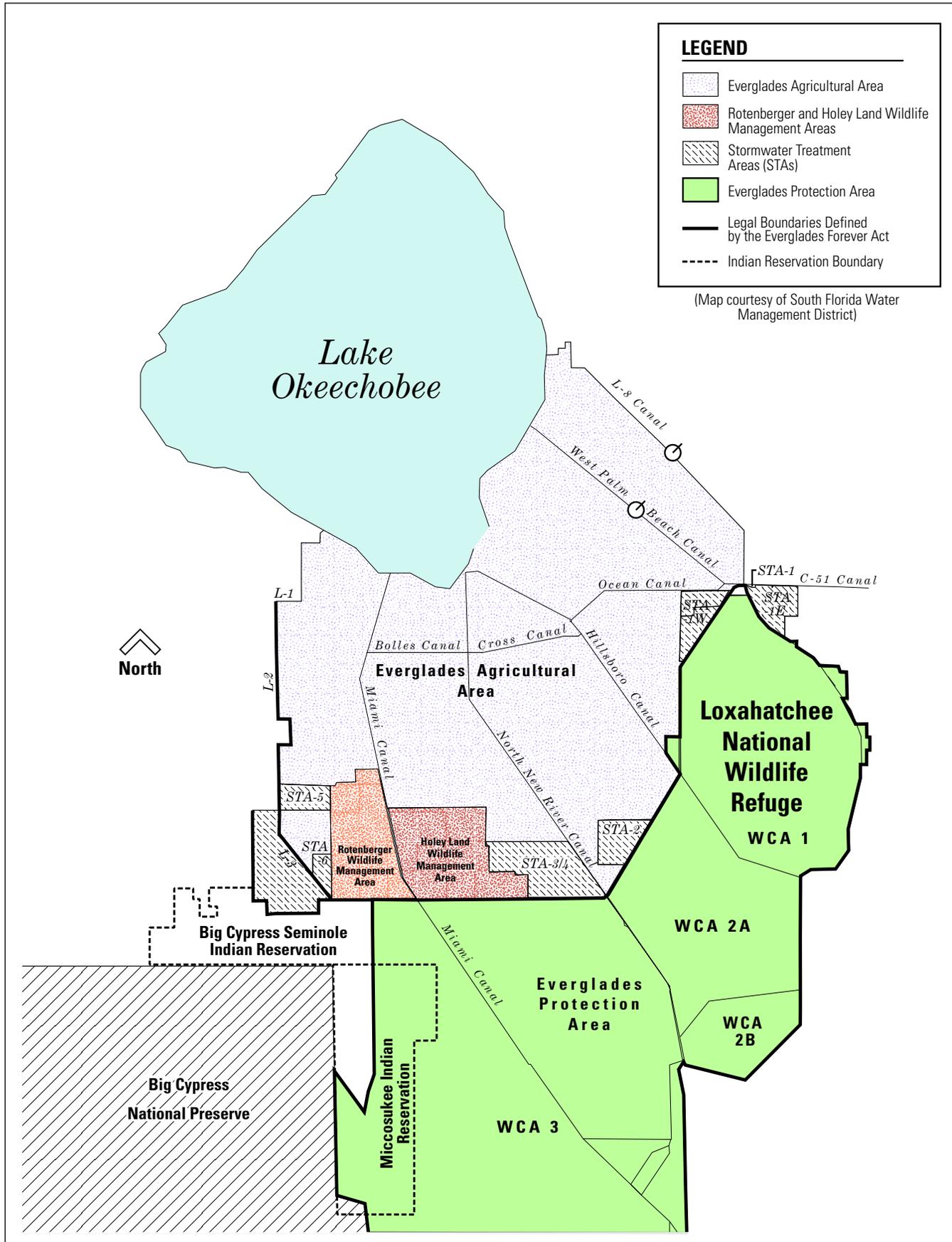
A.R.M. Loxahatchee National Wildlife Refuge, also known as Water Conservation Area 1, is part of the Corps of Engineers' Central and Southern Florida Project for Flood Control and other purposes (*Figure 5*). Water levels in Water Conservation Area 1 are regulated by a schedule to produce optimum benefits among competing interests. These interests are flood control, water supply (agricultural, municipal, and industrial), fish and wildlife enhancement, prevention of saltwater intrusion, and water supply to Water Conservation Areas 2 and 3 and Everglades National Park. To produce these benefits, the water level (elevation) in the refuge is adjusted as the year progresses, either by a release of water from Water Conservation Area 1, an intake of water from Lake Okeechobee, or by a combination of water release and intake.

#### Water Intake:

The current major sources of water for the refuge are rainfall (56 percent), the S-5A, G-251, G-310, and S-6 pump stations (40 percent), and ACME 1 and 2 pump stations (4 percent). These stations are located at the north, west and east sides of the refuge (*Figure 6*). The S-5A station pumps water from the West Palm Beach Canal; the G-251 and G-310 stations pump water from the Stormwater Treatment Area 1-W; the S-6 station currently pumps water to the Hillsboro Canal, but will soon be diverting all of this water into STA-2; and the ACME 1 and 2 pump stations discharge water from Basin B in the Village of Wellington area. The amount of water that comes in from S-6 is approximately 155,000-acre feet per year of water or 30 percent of the water that comes in through structures. This water loss will be made up by increased flows through the S-5A station and Stormwater Treatment Area 1-E and/or reduction in outflows from the refuge. Without this compensation the refuge will be greatly impacted. Occasionally, the refuge receives water by gravity from S-5A(S), a two-bay gated spillway.

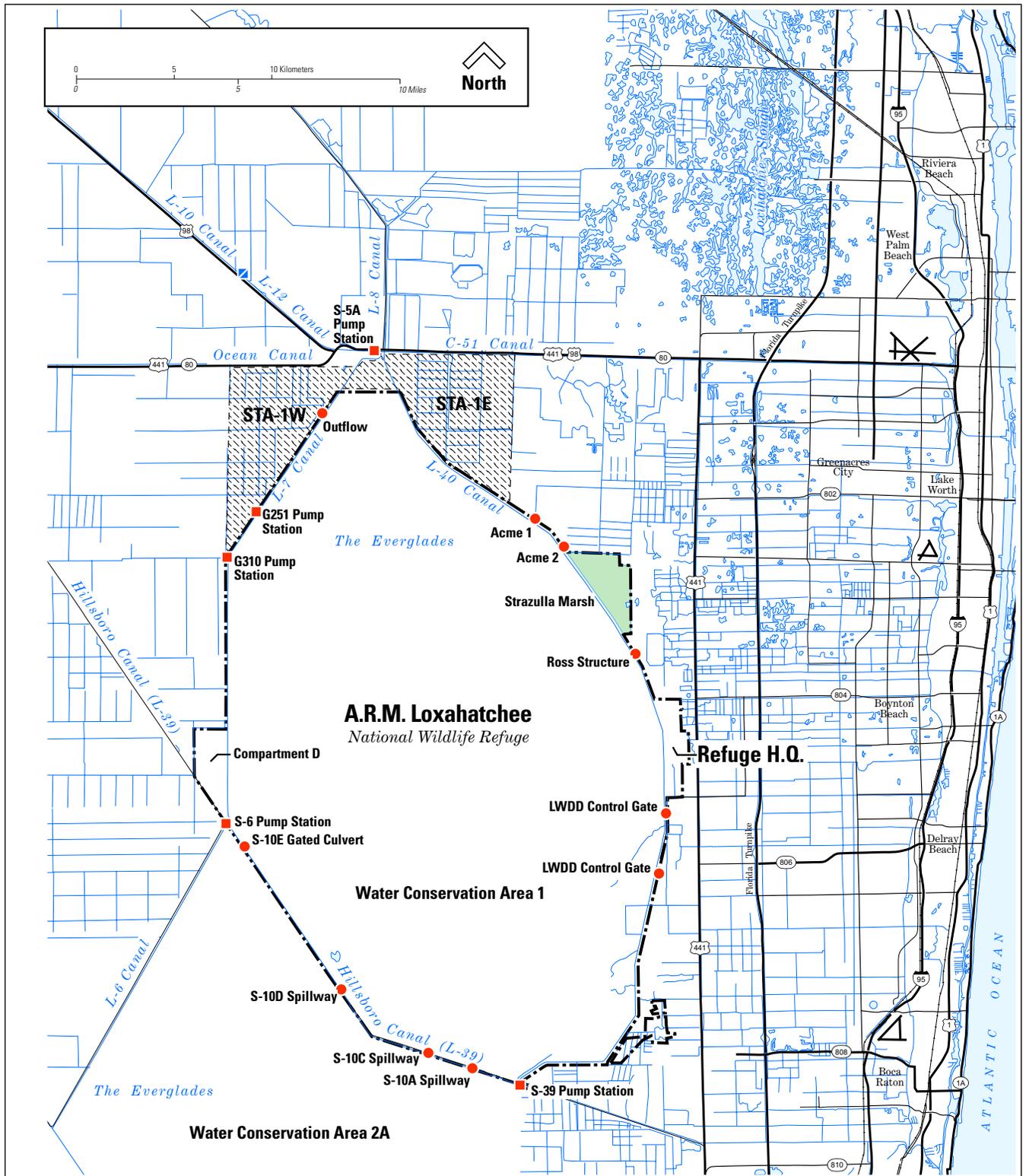
Of all the water coming into the refuge, 44 percent is artificially pumped and the remaining 56 percent is natural rainfall. Approximately 91 percent of the pumped water is drained from agricultural lands north and west of the refuge, while the remainder, 9 percent, is from agricultural and developed lands located east of the refuge through the ACME Stations (*Figure 6*). The pumping stations remove an average of 3/4 of an inch of agricultural area runoff per day from their respective drainage areas in the Everglades Agricultural Area.

**Figure 5. Major canals of the Central and South Florida Project which affect water flow in and out of A.R.M. Loxahatchee National Wildlife Refuge and the rest of the Everglades Ecosystem**



(Map courtesy of South Florida Water Management District)

Figure 6. The location of pump stations and spillways at A.R.M. Loxahatchee National Wildlife Refuge



Water Release:

Water outlets from the refuge are the Lake Worth Drainage District and ACME Stations on the east side of the refuge and the S-10 and S-39 spillways on the west side. Serving as a flood control gate, the S-10 consists of three spillways--S-10A, S-10C, and S-10D. In addition, the South Florida Water Management District operates S-10E, which consists of three 6-foot diameter gated culverts, as an additional outlet from Water Conservation Area 1 into Area 2A.

The primary purpose of the S-39 spillway is to make releases from the refuge to supply water needs to the Hillsboro Canal during the dry season. It also can be used to discharge excess water to the ocean when capacity is available in the Hillsboro Canal and when the water is not needed in Water Conservation Area 2 or 3. Water may also be released from the refuge through S-5A north for irrigation in the Everglades Agricultural Area when stages in canals in the C-51, L-10, L-12 or L-8 basins are low.

It is important to point out that both pumping in or release of water at a maximum volume is usually detrimental to breeding wildlife populations. Rapid changes in water depths do not allow some types of animals to reproduce successfully. For example, the primary food source for the

endangered Everglades snail kite is the apple snail. This invertebrate crawls out of the water and lays eggs on herbaceous plant stems. If water rapidly rises, the eggs are submerged and they die. Thus a season's worth of food supply will be lost for limpkins, alligators and other wildlife including the Everglades snail kite. If water levels fall too rapidly, fish populations may not be able to find sloughs or deeper water areas. The fish get stranded and die; a major component of the marsh food web is reduced and large populations of wildlife have insufficient food supplies.

Refuge Water Regulation Schedule  
As indicated earlier, the water level in Water Conservation Area 1 is regulated to produce maximum

benefits among the various interests--flood control, water supply, fish and wildlife, and prevention of salt water intrusion. To produce these benefits, the water level in the refuge is adjusted as the year progresses, either by a release of water from Water Conservation Area 1, an intake of water from Lake Okeechobee, or by a combination of water release and intake. The particular action taken to release, intake, or retain water is dependent upon the water elevation in a given month. Water elevations, grouped into four zones--A1 (Flood Control); A2, B (Water Supply); and C (Inactive) across time, comprise the water regulation schedule (*Figure 7*).

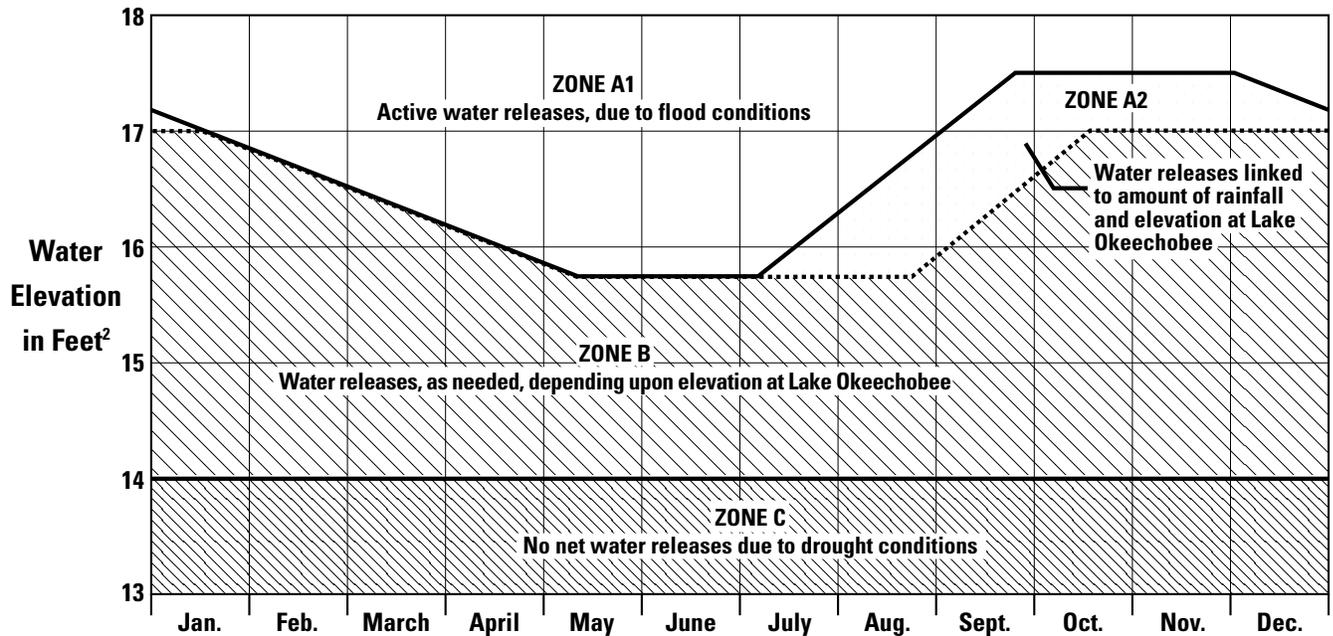
Zone A1 is the flood control zone from January through June. When water levels enter this zone, active water releases will be made due to flood conditions. If, for example, the water level reached 17.5 feet in January, water would be released through the S-10 spillway to achieve an elevation of 17.2 feet or lower.

From July through December, attempts are made to maintain water levels within Zone A2. In this zone, water levels in Water Conservation Area 1, which are linked with rainfall amounts and the water level at Lake Okeechobee, are permitted to reach a maximum of 17.5 feet; "excess" water



Water management at Compartment D  
USFWS Photo by B. Thomas Jr.

Figure 7. Water regulation schedule for Water Conservation Area 1, A.R.M. Loxatchee National Wildlife Refuge<sup>1</sup>



<sup>1</sup> Established in May, 1995, the water regulation schedule is administered by the U.S. Army Corps of Engineers  
<sup>2</sup> National Geodetic Vertical Datum; Surface water elevation above sea level

is released from the S-10 and S-39 spillways. When additional water is needed for Water Conservation Area 2A or other areas, it is released from Area 1, depending on relative water level at Lake Okeechobee.

Zone B, the water supply zone, ranges from a minimum of 14.0 to 17.5 feet during the year. This is the zone targeted to be most beneficial to fish and wildlife on the refuge. When Area 1 water levels are within this zone, water supply releases are made from Area 1 as needed, in relation to the water level at Lake Okeechobee.

For Zone C, when water levels drop to 14.0 feet or less, there would be no net release of water from Area 1. Any water supply releases would be preceded by an equivalent volume of inflow from the lake.

There have been temporary deviations from the regulation schedule during excessive rainfall events that occurred in 1995, during the El Niño event that occurred during the dry season, January through mid-May 1998, and after Hurricane Irene in the fall of 1999. This allowed water to be stored in Water Conservation Area 1, as well as A2.

**Benefits of Water Regulation Schedule:**

The refuge water regulation schedule is designed to generate the following benefits to fish and wildlife and their habitats:

- Increased water depth during the wet years in the northern portion of the refuge;
- Increased hydroperiod of interior marshes to avoid annual dryout;
- Increased area of interior marsh which serves as nursery areas for aquatic organisms;
- Improvement in timing of winter stage drawdown to benefit wading birds;
- Restoration of deep water habitats suitable for nesting Everglades snail kites;
- Greater water storage within the central and southern Florida project system during wet and normal rainfall years;

### *Water Quality*

Due to human activities during the last century, nutrients and toxic substances are ubiquitous and an ever-increasing problem in the south Florida environment. Nutrients and toxic substances from urban and agricultural lands have degraded the relatively pristine lakes, streams, estuaries, and bays of the region (McPherson and Halley 1997).

#### Nutrients:

##### Impacts on the Everglades

Fertilizers are widely used in south Florida to maintain high levels of agricultural productivity. From July 1990 through June 1991, fertilizers sold in south Florida contained 140,000 tons of inorganic nitrogen and 56,000 tons of phosphate (McPherson and Halley 1997). Nutrient loading from urban areas and the Everglades Agricultural Area has significantly increased nutrient concentrations, particularly phosphorus, in the water conservation areas (Stober et al., 1996). Historically, the Everglades has been deficient in nutrients with phosphorus concentrations averaging 10 parts per billion (Lodge 1994); if phosphorus exceeds 50 parts per billion in the water conservation areas, there is a good chance that eutrophication will occur.

Researchers have documented a variety of negative effects from increased nutrients such as increased soil phosphorus content; changed periphyton communities; loss of native sawgrass communities; increased organic matter in water; reduced dissolved oxygen; conversion of wet prairie plant communities to cattails; and loss of important habitats for wading birds (Stober et al., 1996).

As indicated earlier, approximately 91 percent of the water pumped into the refuge is drained from agricultural lands and developed lands east of the refuge. High nutrient runoff (specifically phosphorus) from agricultural lands is one of the most serious issues facing the refuge; this runoff causes proliferation of cattails and other undesirable plant species that negatively affect the ecosystem's balance. Areas in the western, southwestern, southern, and southeastern portions of the refuge continue to be eutrophied by the influx of nutrients (Fish and Wildlife Service 1996a).

The refuge is unique in that most of the high nutrient water received remains in the canals which surround the conservation area, instead of flowing directly through the refuge itself. Some high nutrient water does move into the refuge, but evidence indicates that it moves slowly and affects only a limited distance of Everglades habitat near the canals (McCormick, 1999). Much of the interior refuge water comes from rainfall. Portions of Water Conservation Areas 2 and 3, and even Everglades National Park, have been directly impacted through runoff entering into the central portions of these areas.

The refuge's water quality contrasts sharply with other Everglades habitats. Using data from the Everglades Consolidated Report, the refuge water quality differs (is lower) considerably from Water Conservation Area 2 with regard to the following: alkalinity (by a factor of 5), specific conductivity (by a factor of 5), ammonia (by 63 percent), nitrate (by more than 50 percent), calcium (by a factor of 5), magnesium (by a factor of 6), sodium (by 478 percent), sulfate (by a factor of 16), chloride (by a factor of 5), and dissolved organic carbon (by 200 percent). However, the refuge has more than twice the amount of iron as Water Conservation Area 2, and this was listed as a concern in the report.

**Comparison of phosphorus and nitrogen loadings (metric tons) as a percentage from water years 1990-1999 (South Florida Water Management District 2000).**

Area	Mean Phosphorus Load	Mean Nitrogen Load
Refuge	35 %	28 %
Water Conservation Area 2	23 %	21 %
Water Conservation Area 3	37 %	33 %
Everglades National Park	5 %	18 %

When comparing the sizes of the refuge with Water Conservation Area 3 and the Everglades National Park, the refuge takes in much more phosphorus and nitrogen per acre.

Extensive cattail marshes are associated with chemical and hydrologic imbalances derived from agriculture, or other impacted runoff waters (Gleason et al., 1975). While cattails are not described in historical accounts, or identified on early maps of the Everglades, cattails currently occupy at least 6,000 acres of the refuge (Richardson et al., 1990); they are also a persistent noxious weed in compartments, impoundments, and borrow canals. The water used to regulate these areas originates from the L-40 canal and is nutrient-rich, thereby contributing to the spread of cattail. Thick stands of cattail obstruct wildlife use of these wetlands and preclude wildlife-dependent recreation such as birding and photography.

**Legal Action**

In view of the adverse effects of nutrients on the Everglades, in 1988 the U.S. Attorney for South Florida filed a lawsuit on behalf of the refuge and Everglades National Park. The suit alleged that the State of Florida, by neglecting to enforce its water quality standards, allowed high nutrient runoff to enter Class III waters. In 1991, the State of Florida and the Federal Government signed a Settlement Agreement which mandated the development of a constructed wetland Everglades Nutrient Removal project and six stormwater treatment areas to filter nutrient-rich water, the application of Best Management Practices by farmers to reduce the amount of nutrients originating from their lands, and the research and development of supplemental technologies to enable water to meet the Class III standard.

As indicated earlier, historic phosphorous loading in the northern Everglades is believed to have averaged about 10 parts per billion over time. To attain interim and long-term phosphorus targets, the South Florida Water Management District constructed in 1994, as a test method of removing phosphorous loads, a 3,700-acre wetland known as the Everglades Nutrient Removal Project. This project achieved its performance objectives based on 57 months of operational data (August 94-April 99) All 12-month rolling, flow weighted total phosphorus concentrations at the outflow were well below 50 PPB (Chimney et al., 2000) This project makes an important contribution toward water quality and the stormwater treatment areas are based on this project.

Thus far, two of the six stormwater treatment areas have been completed. The Everglades Nutrient Removal Project is being incorporated into the footprint of a larger Stormwater Treatment Area (1W) for a total treatment area of 6,700 acres. Stormwater Treatment Area 1E, being constructed by the Corps of Engineers, will be 5,350 acres. Together, the stormwater treatment areas will straddle the north end of the refuge filtering water being pumped from the S5A station. These two filtering marshes, along with agricultural best management practices, will reduce phosphorous values to an interim value less than 50 PPB. Long-term values to be set by the Florida Environmental Regulatory Commission will be accomplished through a combination of Best Management Practices, optimization of the stormwater treatment areas, and appropriate new technologies. The successful construction, maintenance, and operation of stormwater treatment areas will be critical to ensuring water quality and quantity to the refuge.

**Toxic Materials:****Pesticides and Herbicides**

Pesticides have been widely used in south Florida's agricultural and urban areas to control insects, fungi, and other undesirable organisms. Since Florida has year-round warm temperatures and a moist climate, vigorous pest control is a necessity. Pesticide use per acre is ranked among the top five in the nation; at the same time, agricultural production only ranks 30th in the nation.

Pesticides vary in their toxicity, transport, and persistence. While persistent pesticides (e.g., DDT, chlordane, dieldrin, and aldrin) have been banned from Florida, their residues often become widely distributed and are potentially hazardous to non-target biota (McPherson and Halley 1997). By far the most frequently detected insecticides in both surface waters and bottom sediments are the chlorinated hydrocarbons (Shahane 1994). Since the late 1960s, persistent organochlorine pesticides have been detected in fish, which are part of the Everglades food chain (Kolipinski and Higer 1969, McPherson 1973, Haag and McPherson 1997).

Chlorinated chemicals, such as polychlorinated biphenyls, dioxins, and furans, which are used primarily in urban and industrial areas, pose a serious threat not only to fish and wildlife but also to human populations (Colborn et al., 1993). Although most uses of polychlorinated biphenyls have been banned since the late 1970s, these persistent chemicals are still found in the environment. In recent years, many organochlorine pesticides and polychlorinated biphenyls have been linked to hormone disruption and reproductive problems in aquatic invertebrates, fishes, birds, and mammals (Colborn et al., 1993).

Herbicides, including atrazine, bromocil, simazine, 2-4-D, ametryn, hexazinone, and diuron, which have the highest rate of application, are among the most frequently detected herbicides in Florida's surface waters (Shahane 1994).

While the refuge shares the same challenges regarding some pesticides with other Water Conservation Areas and Everglades National Park, those pesticides of potential concern mainly for the refuge include endosulfan, diuron, endosulfan sulfate, and 2, 4-D. Three metals of concern for the refuge include beryllium, iron, and mercury.

**Mercury**

Evidence of mercury contamination in fish and wildlife in south Florida fresh water ecosystems is extensive. High mercury levels have been detected in the endangered wood stork and other birds (Sundlof et al., 1994). Scientists suspect that increased mercury exposure may partially explain the 50-year decline in wading bird numbers. Fish and alligators sampled in the Everglades have high mercury levels in their tissues (Ware et al., 1990, Eisler 1987). In 1989, after discovering the extent and severity of mercury in fish, the Florida State Health Officer advised fishermen to avoid consumption of several species of fish in more than 1,000,000 acres of the Everglades. The health advisory for the refuge is as follows:

*“The Florida Department of Health and Rehabilitative Services has issued a health advisory urging limited consumption of largemouth bass and warmouth caught in certain portions of the Everglades due to excessive accumulation of the element mercury. Fish caught in Water Conservation Area 1 should not be eaten more than once per week by adults and not more than once per month by children under 15 and pregnant women, and fish caught in Water Conservation Areas 2 and 3 should not be eaten at all.”*

**Air Quality**

Air quality is not perceived to be as critical a concern as water quality. However, research shows that some of the mercury in the Everglades, generated from incinerators or power plants, is transported there atmospherically.

## Biological Environment

### *Native Vegetation*

#### Vegetative Communities

The native vegetative communities of the Everglades ecosystem found on the refuge include sloughs, wet prairies, sawgrass, tree islands, cattail, and Cypress swamp. Based on 1989 satellite imagery for the refuge interior, these communities have been grouped into four groups, namely, marsh, shrubs, tree islands, and cattail (*Figure 8*). These communities evolved in a watery system that naturally had low nutrients. Numerous algae species or periphyton growing on the submerged vegetation are the basis for all aquatic life, providing food for a host of micro and macro invertebrates and grazing fish species (Lodge 1994).

#### Sloughs

Sloughs are the deepest natural marsh communities in the Everglades. During the rainy season, water depth in sloughs may exceed 3 feet, with the annual average depth about 1 foot. The dominant vegetation includes white water lily, floating heart, and spatterdock (Lodge 1994). Submergent plants such as bladderwort, fanwort or chara are abundant (Fish and Wildlife Service 1997c). Underlying sloughs is peat soil, which support fish species and aquatic invertebrates.

#### Wet Prairies

In contrast to sloughs, wet prairies have shallower water levels and are characterized by short emergent plants such as beakrushes, spike rushes and red-root (Chapman, pers. comm.). Wet prairies are the most prevalent vegetative community (approximately 50 percent land coverage) in much of the central and eastern portions of the refuge, and are generally found between sawgrass marshes and sloughs. This important vegetative community provides prey for wading birds and the Everglades snail kite in the form of fish, aquatic invertebrates and apple snails (Lodge 1994).

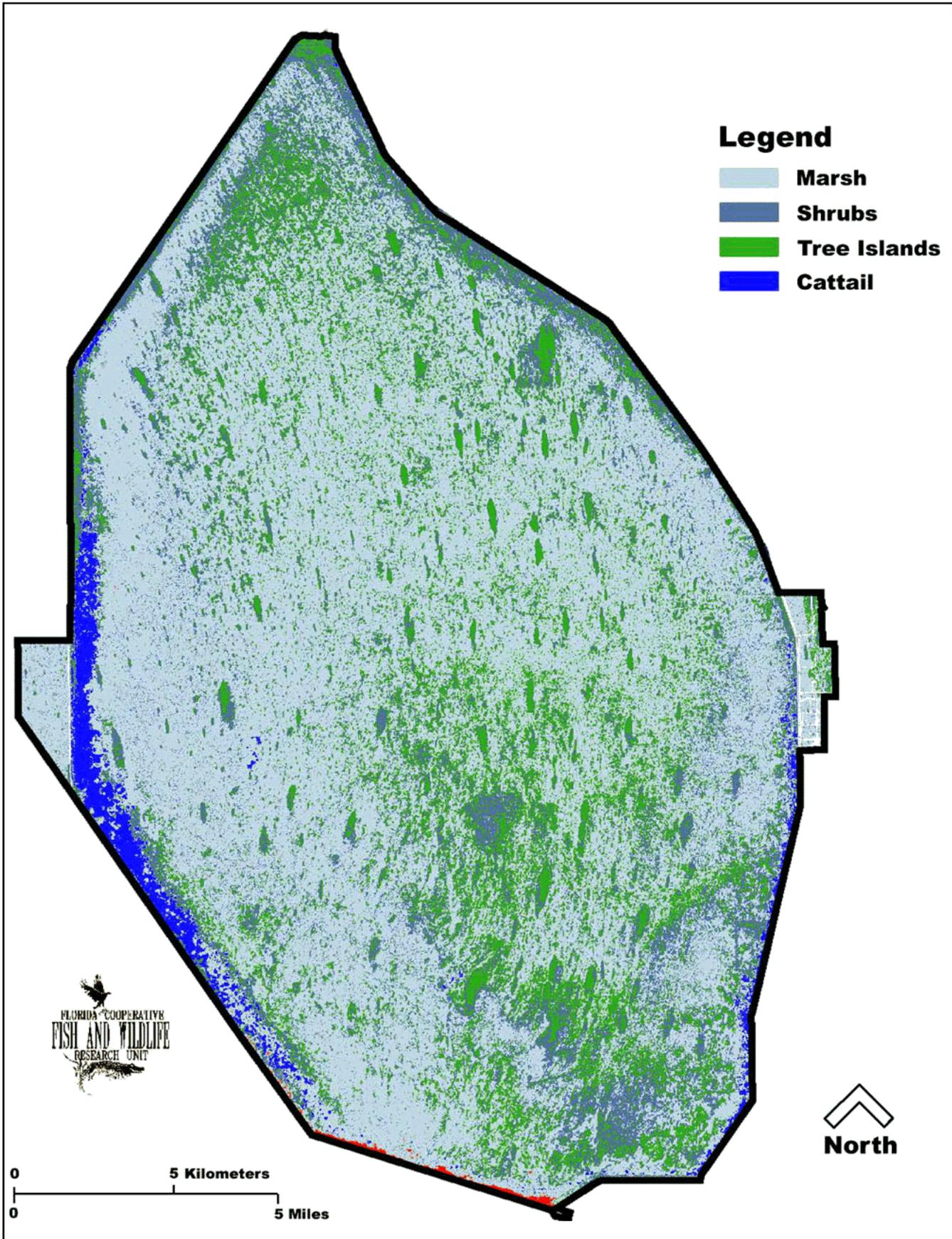
#### Sawgrass

The sawgrass community (25 percent land coverage) is characterized by the saw-edged sedge that dominates this type of habitat. Sawgrass may grow in solid stands, mosaics or interspersed with other species such as wax myrtle and dahoon holly. Sawgrass areas often border tree islands, separating them from the wet prairie (Lodge 1994).

#### Tree Islands

The northern portion of the refuge is characterized with thousands of tree islands that range from less than 1 acre to more than 300 acres. There is approximately 20 percent of the refuge interior covered with tree islands. They are typically composed of an overstory of redbay and dahoon holly with wax myrtle, buttonbush and cocoplum comprising a dense midstory and numerous ferns in the understory. Tree islands form when submerged peat patches rise to the water's surface and small plants become established followed by shrubs and trees. During drought conditions, alligators wallow out a circular deep water refugia, called "alligator holes." Wind blown herbaceous seeds germinate on the exposed peat and eventually woody vegetation grows on the edges and creates a tree island with a "doughnut shape." Alligator holes are very important aquatic refugia during the dry season and are sources for fish and other aquatic organisms' population reestablishment after summer rain rehydrates the ecosystem (Lodge 1994). A vast number of tree islands have been impacted by invasive exotic plants.

**Figure 8. Vegetative communities of A.R.M. Loxahatchee National Wildlife Refuge**  
(Adapted from Richardson et al., 1990)



### Cypress Swamp

On the eastern edge of the refuge is a 400-acre cypress swamp community which is composed of pond cypress trees, pond apple, myrsine, lichens and ferns such as giant leather, sword, shield, strap, royal, resurrection and swamp ferns. The moist microclimate of the cypress swamp also provides for a profusion of epiphytes (air plants), such as cardinal, giant, reflexed and twisted wild pine and Spanish moss. This cypress swamp is the largest remaining remnant of a community on the east side of the Everglades whose former range extended from Lake Okeechobee through Palm Beach and northern Broward counties, south to Fort Lauderdale (Lodge 1994). The cypress swamp includes 20 species of trees and shrubs, 20 herbs, 9 vines, 1 sedge, 14 ferns, 7 bromeliads and 2 lichens (Fish and Wildlife Service 1987b). (*See Appendix K*).

### Cattail

Two native species of cattail grow on the refuge. Naturally growing cattails can be found surrounding wading bird colonies, roost tree islands, and alligator holes. The cattail growth is dependent upon the intense pulse of nutrients deposited by the concentration of nesting birds. After a tree island is abandoned by nesting birds, cattails often die back because of the loss of nutrients (Fish and Wildlife Service 1998c). In response to years of artificially high levels of nutrients (phosphorous) in the water, a dense stand of cattails has been established along the perimeter canal. Near the S-6 water structure, monotypic stands of cattail growth are approximately ½ mile deep. This water, received from the S-5A and S-6 pump stations, originates from the agricultural fields to the north and west of the refuge. Attempts to reduce the nutrient load in water and lessen the negative impacts to the refuge are on-going (*see Part II, Significant Resource Problems and Part III, Water Quality*).

### Wildflowers

At least 50 wildflower species (exotic and native) can be found in marsh areas of the refuge (Fish and Wildlife Service 1987). Common types found are Spanish needle, arrowhead, buttonbush, string and spider lilies, elderberry, lizard's tail and scorpiontail, pickerelweed and primrose willow.

### *Exotic Plants*

Invasive exotic plants, such as Brazilian pepper, melaleuca, and Old World climbing fern, pose a serious threat to the whole south Florida ecosystem, to native plant communities, wildlife habitats, threatened and endangered species, and species of special concern on the refuge. Floating exotic plants, such as water lettuce and water hyacinth, threaten to clog refuge canals restricting navigation, water flow, and water drainage. These alien plants, lacking natural predators and insects to keep them in check, rapidly expand forming dense, monotypic forests and thickets which are undesirable to humans and wildlife. This degraded habitat has been proven to support less species diversity than native plant habitats. Generally, exotic plants in south Florida tend to establish in "disturbed" areas such as abandoned farm fields, along roadways, canals, and drainage ditches, and in wetlands which have been altered or stressed due to hydroperiod changes (Ferriter 1998). Melaleuca and Old World climbing fern are, however, not restricted to areas of disturbance. Since the climate and conditions of south Florida are similar to conditions for melaleuca and Old World climbing fern in their native countries, these plants have rapidly become established in pristine areas. Management of invasive pest plants is one of the priorities established by the South Florida Ecosystem Restoration Task Force. As a result of these priorities, the task force and working group have authorized and funded the Noxious Exotic Weed Task Team to develop the comprehensive strategic plan for the management of exotic pest plants in Florida (with emphasis on south Florida). The team members are managers and scientists from key federal, state, and local agencies that deal directly with exotic pest plants (Doren 1998). The State of Florida Everglades Forever Act of 1994, requires the South Florida Water

Management District to coordinate with other state, local, and federal government entities to manage exotic pest plants with emphasis in the Everglades Protection Area (all areas from the Everglades Agricultural Area south to the Everglades National Park). The Florida Chapter of Exotic Pest Plant Council, established in 1982, documents the spread of exotic pest plants and unifies the exchange of information between land management agencies, research scientists, industry and other interest groups who are concerned with the impacts of exotic plants in natural areas (Laroche 1994). Category I plants are species that are currently invading and disrupting native plant communities in Florida. The refuge has 21 Category I plants (Table 24). Category II plants are species that have shown a potential to disrupt native plant communities, and the refuge has at least nine of these (Table 25).

Refuge staff will remain actively involved with organizations such as the Florida Exotic Pest Plant Council, Southeast Florida Exotic Pest Plant Council, and the South Florida Invasive Plant Working Group and adopt the strategies for exotic plant management recommended by these organizations. The refuge will update its melaleuca management plan by 2002 to incorporate the methods and strategies of the South Florida Water Management District's melaleuca management plan originally drafted in 1990. By following the strategies of this plan, the South Florida Water Management District has almost completed initial treatments of melaleuca on all their lands and surveys have indicated a 26 percent decrease in melaleuca populations particularly in the water conservation areas and Lake Okeechobee from a high of 488,000 acres in 1993, to 361,000 acres in 1999.

#### Melaleuca

Melaleuca, a native of Australia, was originally introduced in southeast and southwest Florida in 1906 (Meskimen 1962) as an ornamental plant. At one time, people believed the tree could assist in draining water from the Everglades because water is rapidly taken up, used in photosynthesis and released into the air as a vapor (transpiration). It is thought that the area that became the refuge and Ft. Meyers on Florida's west coast were heavily

seeded by airplane. In the 1930s and 1940s, trees were planted along the rim canal of Lake Okeechobee and at the Monroe station, Big Cypress National Preserve (Laroche 1994). Although the greatest concentrations are found in areas of historical introductions, the refuge has one of the highest concentrations of melaleuca in all of the south Florida ecosystem.

In Strazzulla Marsh, melaleuca has invaded the cypress swamp and domes, sawgrass, and wet prairies; nearly 50 percent of this area has been affected. In the refuge interior, melaleuca has invaded native tree islands, sawgrass, sloughs, and wet prairies. The most recent aerial survey in 1995, estimated that 49 percent (71,000 acres) of the refuge interior was moderately to heavily

infested. Using 1992 data as a comparison, melaleuca is calculated to be expanding at the rate of 10 acres per day. The history of melaleuca throughout the Everglades ecosystem, including the refuge, is one of "an explosion in slow motion" (Laroche 1994). From the 1960s to the early 1980s, melaleuca grew at an exponential rate. Areas occupied by a single, isolated "pioneer" tree soon developed into acres of dense "heads" and



Melaleuca "hack and squirt"  
Photo © John and Karen Hollingsworth

Figure 9. 1992 Melaleuca Aerial Survey Results

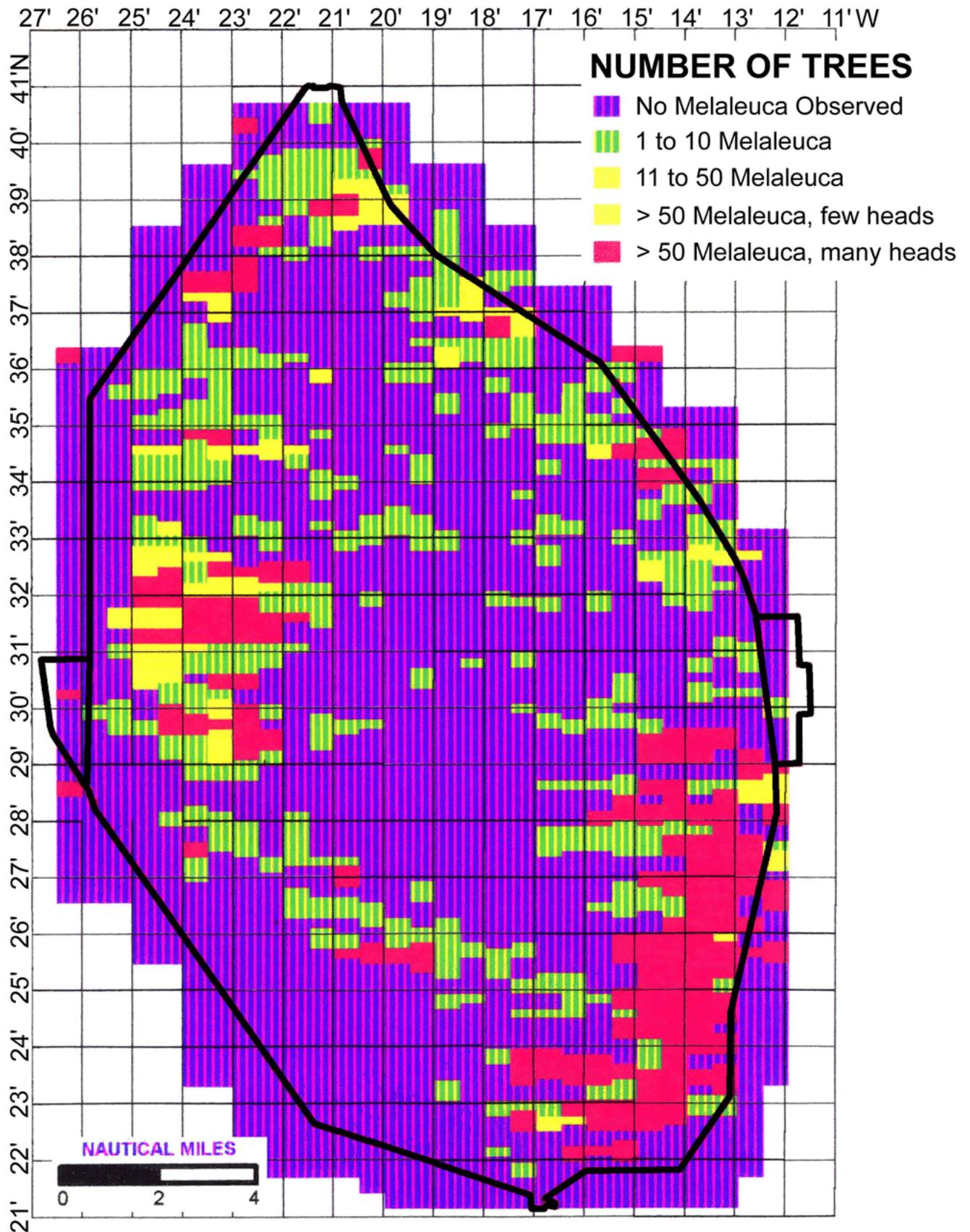
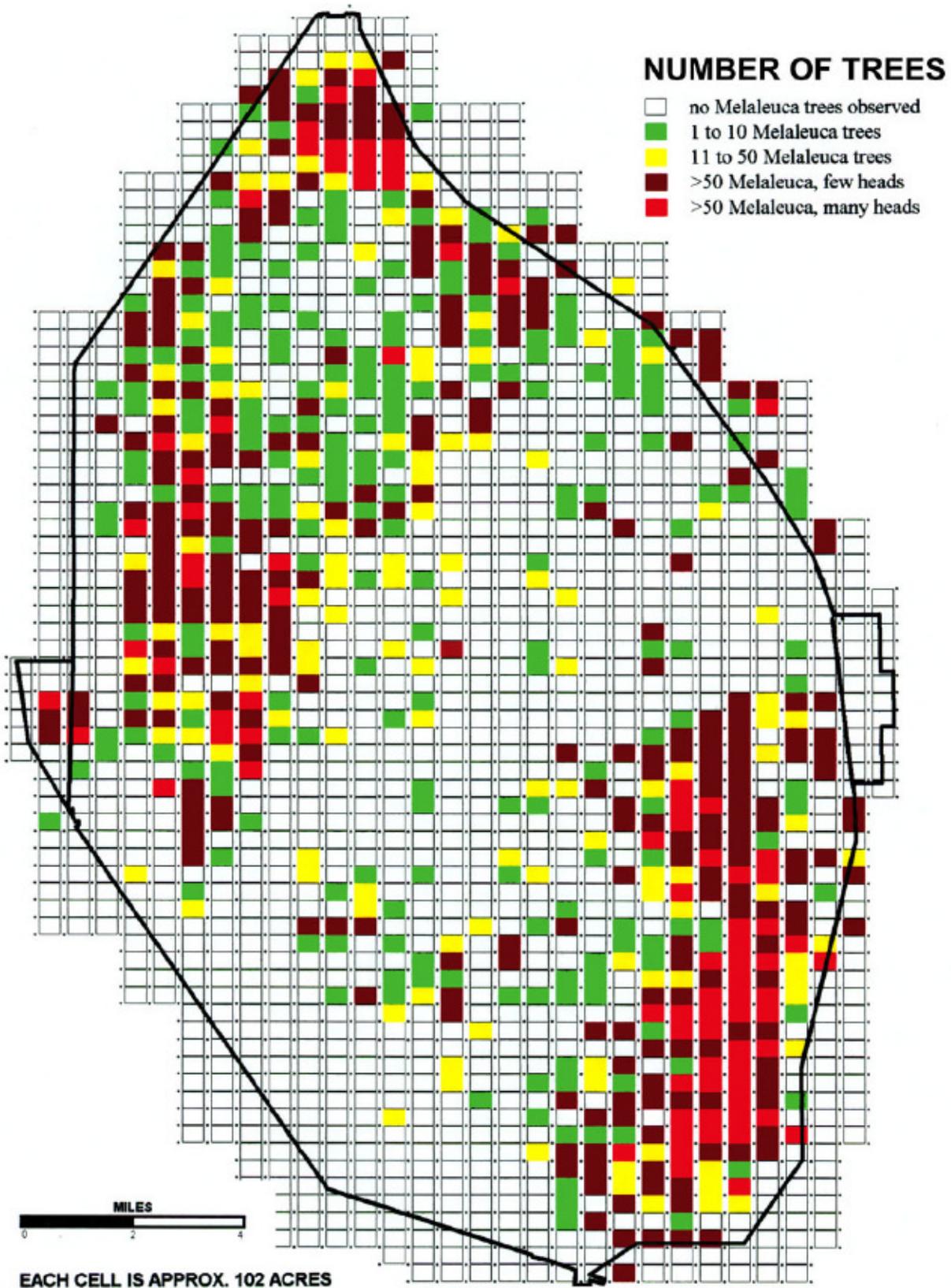


Figure 10. 1995 Melaleuca Aerial Survey Results



monotypic forests. By the mid- to late-1970s, melaleuca had spread to all areas of the refuge. It was the Refuge Manager's opinion that if an effective treatment technique could not be found, melaleuca would certainly take over the refuge.

With no natural enemies in south Florida, such as disease or insects to control its spread, and an ideal growing climate, melaleuca now threatens to permanently replace and eliminate native Everglades flora and fauna. As indicated above, melaleuca primarily invades disturbed areas but is particularly prevalent in Florida wetlands; i.e., the refuge, where hydroperiods have been artificially shortened or altered. In addition to the above effects, live melaleuca inhibits the use of prescribed fire as a management tool since the volatile oils in melaleuca leaves would produce intense, uncontrollable fires. Furthermore, the use of fire would generate a massive seedfall which would allow the tree to become quickly established in adjacent areas. The raging wildfire during the drought of 1989-90, certainly contributed to the exponential spread of melaleuca in the refuge interior. The primary management tool used at the refuge for the control of melaleuca is herbicides. At the present time, the chief treatment method involves felling mature trees using chainsaws followed by treatment with 50 percent Arsenal® diluted in water. Follow-up visits are necessary to prevent reinfestation. Since an intensive herbicide program was established in 1992, refuge staff have eradicated more than 2,209,000 of these trees on refuge lands at an annual cost exceeding \$200,000, funded by the Service and the District. An estimated 6,400 acres have been cleared of melaleuca. Unfortunately, refuge staff can only treat about ½- to 1-acre-per-day, which is having a limited effect on the 10-acre-per-day advance of melaleuca on the refuge. Since herbicidal treatments are labor intensive and costly and melaleuca can easily re-infest cleared areas, biological control offers an alternative (Center et al., 1998).

In 1999, the refuge switched to using private contractors for exotic plant control for both melaleuca and Old World climbing fern after refuge staff consulted with the National Park Service, the Department of Environmental Protection, the South Florida Water Management District, and other local agencies and made the determination that using private contractors was the most cost effective means to eradicate exotic plants. To better incorporate the philosophy of an integrated pest management approach, the refuge has increased its role and effort concerning public outreach and awareness by identifying the dangers and risks associated with the introduction of exotic plants. Programs by individuals directly involved with exotic plant management are scheduled as part of the "Calendar of Events" at the visitor center and these presentations are free to the general public. Refuge staff schedule programs and slide presentations for environmental education groups and for local chapters of national organizations such as the Audubon Society.

The refuge will continue to push for more exotic plant control funding, a limiting factor to successful exotic plant management. This will be done by keeping this issue a high priority and informing all levels of the Service about resource impacts and budget needs. Several key refuge personnel serve as members on regional invasive species teams and ecosystem restoration task forces where key exotic plant issues are addressed. The refuge's exotic plant problems are frequently addressed in local and national newspapers, magazines and on national and Service web sites.

Within the past few years, U.S. Department of Agriculture research scientists have begun to research insects from Australia as possible controls of melaleuca. The snout beetle, was released on the refuge and other parts of south Florida in the spring of 1997. Unfortunately the beetle cannot survive and reproduce in the wet habitat of the refuge. A second biological control, the defoliating sawfly, is scheduled for release in 2000. Shipments were sent to the quarantine facility in 1992-1993. The Environmental Assessment is currently being reviewed pending approval

by the Service's Washington Office. This sawfly offers the best hope for melaleuca control. Both adults and larvae feed voraciously on foliage of the tree eventually causing complete de-foliage. The insects entire life cycle occurs on the melaleuca tree, above ground. Larva pupate within the bark of the tree. Researchers have been reluctant to release this insect due to its noticeable damage as many people still have melaleuca growing in their yards as ornamentals. Additionally, its release has been delayed because the larvae have proven to be toxic, when consumed in large quantities, by some wildlife and domestic animals. Studies and research into this matter are continuing at this time. Evidently the larvae store a toxic chemical in their system as they feed (Lophrytonin) and it becomes more concentrated as they age.

Alternative methods for exotic plant control on the refuge other than chemical, physical, and biological controls are currently limited. Mechanical control using heavy equipment is limited to impoundment levees where the primary target is Brazilian pepper. No heavy equipment can be used in sensitive areas such as the marsh interior or in Strazzulla Marsh due to the soft substrate and irreparable damage this machinery would cause to native vegetation. As funding permits the refuge will use aerial treatment as a control method on some of the larger monotypic melaleuca heads. This application technique has proven effective by the South Florida Water Management District in the water conservation areas and on Lake Okeechobee. The refuge would rank at the top of the list for funding from the District and Florida Department of Environmental Protection programs due to its designation as a water conservation area and its close association with the District.

Public use volunteers, environmental education groups, and college students currently assist refuge staff in the removal of Brazilian pepper, willow, and cattail in refuge compartments, along the trails and levees, and around the visitor center. Groups of college students have, in the past, assisted refuge crews by pulling melaleuca seedlings. The logistics involved with the transport of large numbers of individuals into the marsh interior for exotic plant control is not effective given current refuge staffing levels and available equipment. All funding has focused on exotic plant control contracts.

Ultimate control of melaleuca at the refuge will depend on an integrated management approach using both chemical and biological methods (e.g., defoliating sawfly and melaleuca snout beetle). In combination, these efforts will certainly slow the establishment of additional areas of infestation. Without continued management, the refuge and its unique northern Everglades habitat will surely be lost to melaleuca.

#### Old World Climbing Fern

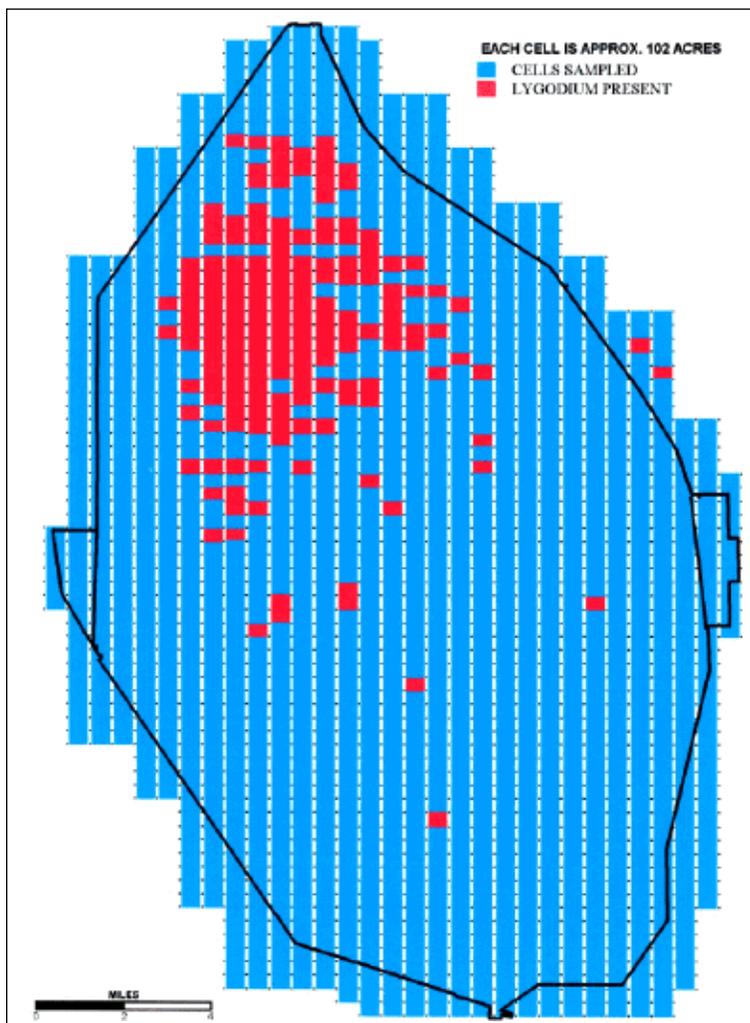
Old World climbing fern, a native of Asia, was first found in Martin County in the late 1950s (Beckner 1968). This species prefers wet sites and grows particularly well along the ecotone between wet and dry habitats. It also appears to be growing particularly well in areas where native tree islands were damaged, or killed by a refuge fire during 1989-1990. Ascending tree canopies, it smothers Everglades tree islands, invades pinelands and cypress swamps, and also spreads across open wetland marshes (Ferriter 1998). Evidently, extended hydroperiods have no noticeable impacts on the growth or spread of the fern.

On the refuge, Old World climbing fern is overrunning native tree islands in the interior and is commonly found in the Cypress Swamp. In a number of locations, "fern ladders" can be seen ascending to the top of cypress trees. Its presence on trees and their canopies prohibits the use of prescribed fire as a management tool in the cypress swamp and on interior tree islands, where a crown fire would be particularly destructive. A 1995 aerial survey by the South Florida Water Management District revealed that 17,500 acres (12 percent) of the refuge were infested by climbing fern.



Refuge volunteers working to control exotic plants  
USFWS Photo by L. Chapman

**Figure 11. 1992 Old World Climbing Fern (*Lygodium*) Survey Results**



By 1997, it had infested an estimated 21,000 acres. Some areas are heavily impacted and others are moderately to lightly impacted. However, since small areas of fern infestation are not visible in aerial surveys, the estimate is considered conservative.

Unfortunately, no standard control programs currently exist for the treatment of Old World climbing fern throughout south Florida. Refuge staff have been hand pulling small clumps of climbing fern from the Cypress Swamp and along the Marsh Trail. In collaboration with the South Florida Water Management District, test plots have been established in the refuge interior to monitor the spread of the fern. The U.S. Department of Agriculture and Geological Survey have begun research to find safe and effective biocontrols.

The Southeast Florida Exotic Plant Task Force and Florida Department of Environmental Protection have joined the refuge in an effort to control exotic plants in south Florida. In 1999, a contractor began the first ever treatment of Old World climbing fern and was able to treat 300 acres in the refuge interior. This work signifies the first effort to control this invasive exotic plant on the refuge.

Exotic plant populations, size, and distribution will continue to be monitored using systematic aerial surveillance and reconnaissance flights at a minimum of every three years. The last survey was conducted in 1995, for melaleuca and Old World climbing fern populations. Similar surveys were conducted in 1990 and 1992. Data collected during these flights will be used to create distribution maps, and refuge biologists will be able to calculate expansion rates and document infestation levels of exotic plants. These surveys will also help to determine the effectiveness of the melaleuca and Old World climbing fern herbicide treatment programs. A surveillance and reconnaissance flight survey is scheduled for September 2000. Individual management

plans for melaleuca and Old World climbing fern will be completed or updated by 2002, and incorporated into an overall Integrated Pest Management Plan.

Without extensive chemical treatment or biocontrols, Old World climbing fern will continue to spread across the refuge, engulfing native tree islands and cypress trees.

**Brazilian Pepper**

Brazilian pepper was introduced in the late 1800s as an ornamental shrub. This widely adaptable and aggressive shrubby tree rapidly invades disturbed sites such as fencerows, roadsides, canal banks, levee berms, and abandoned farmland. It also invades pine flatwoods, sand-pine scrub, cypress swamps, fresh water marshes, and mangroves. Growth and seed production is stimulated by normal hydroperiods. A tremendous number of seeds are dispersed by fruit-eating birds such as the cedar waxwing, American robin, and European starling, as well as opossums and raccoons. Once established, Brazilian pepper out-competes the slower growing native vegetation, eventually forming monotypic forests. A 1993 aerial

survey revealed that Brazilian pepper infested an estimated 550,000 acres of central and south Florida. By 1997, the acreage infested had grown to 660,000 acres (Ferriter 1998).

Currently, Brazilian pepper ranks as the third most invasive plant found on the refuge. The greatest concentrations of Brazilian pepper are found along compartment levees, roadways, in the Cypress Swamp, and on tree islands in the northern interior where water levels fluctuate. With the exception of the drier interior tree islands, it does not grow well in the refuge interior due to the extended hydroperiod (deep water). Little is known about the extent of Brazilian pepper on the refuge.

Brazilian pepper is currently controlled with herbicides or by mechanical means. Trees located in high visibility or public use areas are targeted first, such as those along the Marsh Trail or around the visitor center. Trees are typically treated using the “cut stump” technique followed by the application of undiluted Rodeo® or 50 percent Arsenal®. Large trees along levee berms and roadways are uprooted mechanically using a backhoe or bulldozer. Post-treatments are necessary to control resprouting from uncut stems. Seedlings are removed by hand. Where permitted, fire can be effective in controlling seedlings. From 1992-1998, refuge staff and volunteers eliminated an estimated 41,000 trees. Without active management, Brazilian pepper will form dense thickets. These thickets will eventually obstruct vehicular and human traffic.

#### Australian Pine

Australian pine was introduced in the 1890s as a potential lumber source. Later, it was planted around farm fields as windbreaks and along canals to stabilize banks, helping to prevent soil erosion. By the early 1900s, it had already begun to invade natural habitats (Small 1927). By 1993, Australian pine invaded more than 365,000 acres in south Florida (Simberloff et al., 1997). Like Brazilian pepper, Australian pine aggressively invades disturbed areas such as abandoned farm fields and vacant lots, and along roadways and canals. Rapid growth produces dense forests which shade out native plants. According to Ken Langeland of the University of Florida, the accumulated litter (needles) under a dense forest prevents the growth of desirable vegetation. On the refuge, Australian pine is most frequently encountered along the perimeter levee which surrounds the refuge.

As a part of melaleuca control operations, Australian pine is cut and the stump and cambium are treated with a 50 percent solution of Arsenal®. Over a 6-year period from 1992-1998, 90 Australian pines have been eliminated in the refuge interior. Australian pine will continue to be treated when encountered during normal melaleuca eradication efforts. No biological controls have been released for the control of this aggressive tree. The high water level in the refuge interior should help prevent the spread of this tree but drier sites along perimeter levees will have to be monitored closely.

#### Floating Exotic Plants

Floating exotic plants, such as water hyacinth and water lettuce, form dense mats which clog canals impeding navigation, water drainage, and recreational use. In addition, heavy infestations may retard the growth of desirable submersed plants; lower dissolved oxygen levels; increase the frequency of fish kills; increase sedimentation; increase flooding and water temperatures; and destroy and smother fish and wildlife habitat (Schmitz et al., 1993).

Water hyacinth presents a greater problem than water lettuce. Originally introduced as an aquatic ornamental in the 1880s and as potential cattle fodder, water hyacinth quickly spread throughout Florida's waterways. By the 1950s, it had infested more than 118,000 acres of these waterways (Simberloff et al., 1997). By the 1960s, water hyacinth infested an estimated 125,000 acres (U.S. Congress 1965). Intensive management reduced this acreage to around 3,900 by 1988 (Schardt and Ludlow 1993).



Water hyacinth  
Photo © John and Karen Hollingsworth

On the refuge, the acreage of water hyacinth and water lettuce ranges from 250 to 300 acres, depending upon control efforts and time of year. Infestations are restricted to the perimeter canals (L-40, L-39, and L-7) of the refuge interior and borrow canals surrounding refuge compartments and impoundments. Maintenance of the perimeter canals is currently performed by the South Florida Water Management District. Approximately 100 to 200 acres of water hyacinth and water lettuce are treated annually. Using airboats and johnboats for access, herbicides (e.g., Reward® and

Rodeo®) are applied with portable spray units. When infestations impede navigation, water flow and drainage, spraying is applied with helicopters. While the perimeter is maintained by the Water Management District, refuge staff maintain the borrow canals surrounding refuge impoundments, the center canal which serves to drain and fill Compartment C, and the Canoe Trail.

Several insect biocontrols that have proven to be highly effective in reducing the rate of expansion are the water hyacinth weevils (Center 1982), and the water hyacinth moth (Center and Durden 1981). The South American weevil has caused dramatic declines in the water lettuce populations (Dray and Center 1992). The Asian water lettuce moth has yet to become established.

### *Fish and Wildlife*

The refuge contains nearly 150,000 acres of wetlands which provide important feeding, roosting and nesting habitats for many birds, mammals, reptiles and amphibians. These wildlife are described below.

#### Birds

In any given year, as many as 257 species of birds may use the diverse wetland habitats of the refuge--the sloughs, wet prairies, sawgrass, tree islands, cattail, and cypress swamp. Of those birds, approximately 93 species are considered to be common or abundant during certain seasons (Table 21). For the Everglades snail kite, limpkin, smooth-billed ani, roseate spoonbill, wood stork, American swallowtail kite, short-tailed hawk, Florida sandhill crane, purple gallinule, black-necked stilt and the Arctic peregrine falcon, the refuge provides important habitat for both nesting and migration. In its position in the North American Continent, Florida is a "natural funnel" for neotropical migratory birds (e.g., songbirds, raptors, shorebirds), which depend on the refuge and other areas for resting and feeding prior to their long flight to Central and South America. Through the Partners-in-Flight program, federal, state, and private agencies are developing and implementing a comprehensive approach for managing selected species of migratory nongame birds (Tables 28 and 29). In an attempt to prevent the listing of most of



Great horned owl  
USFWS Photo

these birds as threatened or endangered species, these trust species are given higher priority than general wildlife species in management methods and judging potential impacts. The refuge currently conducts migratory passerine surveys in the woodlands near the visitor center and on the tree islands of the interior.

Waterfowl

A variety of duck species such as the ring-neck, mottled, fulvous-whistling, wood, and ruddy duck, as well as blue-winged teal, green-winged teal, lesser scaup, northern pintail, American widgeon, northern shoveler, hooded merganser, and gadwall may be found on the refuge when water levels are appropriate and adequate habitat is available. However, the mottled and wood ducks are the only ones nesting in the area. Waterfowl counts taken between 1975 and 1982, revealed that the average peak wintering duck population was more than 21,000 birds. More recently (1989-1997), however, the general trends in waterfowl numbers appear to be lower and there is a great deal of within-seasonal and year-to-year variation in waterfowl numbers (*Table 1*). These results are based on total counts taken each month from September-March. Only the lowest and highest counts taken during this period are shown. This decline in waterfowl numbers can be partially explained by the encroachment of cattail, as indicated earlier (see section on water quality), by the increased availability and quality of habitat further north and by mild winters in the north. If the birds do not have to expend the energy, they will not fly as far south as the refuge. The refuge is at the southernmost point of the waterfowl migration area (*Figure 3*). Approximately 20 percent of the refuge is available for waterfowl hunting during season, leaving 80 percent of the refuge for waterfowl to forage and rest.

There are no health advisories for consuming waterfowl collected in the Everglades, and there are no known studies of mercury levels conducted on waterfowl collected at the refuge.

**Table 1. Number of waterfowl observed during surveys in the refuge interior from September to March 1989 to 1998**

Count	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Low	39	3089	97	no data	6	35	48	369	9	212
High	16,000	35,817	15,520	20,000	405	1,201	1,901	1,318	927	1,104

Wading Birds

The wading bird breeding populations of the Everglades ecosystem have declined 90 percent as a result of a more than 50 percent reduction in habitat due to urbanization, agricultural conversion, altered water flows, and the associated reduction in fish and food items. Of the 15 species of waders that breed in the south Florida ecosystem and the refuge, the wood stork, great egret, snowy egret, tricolored heron, and white ibis have declined by an estimated 75 to 80 percent between the 1930s and late 1970s (Ogden 1994). Wading birds foraging on the refuge include the wood stork, little blue heron, tricolored heron, great blue heron, great egret, snowy egret, cattle egret, roseate spoonbill, black-crowned and yellow-crowned night-herons, glossy ibis, and white ibis. Based on annual nesting bird surveys using air boats, there appears to be a slight decline in the number

of nests from 1992 to 1998 (*Table 2*). Generally, wading birds need water levels high enough to sustain fish (prey populations) but low enough to allow them to forage effectively. In 1999, lack of spring rains gradually lowered the refuge interior water levels during breeding season to create excellent nesting conditions. Coupled with a more comprehensive survey method, 1999 resulted in the highest number of nests in recent memory. However, heavy rains caused the water levels to rapidly rise at the time when the chicks fledged, creating difficult foraging conditions for the young birds. Fluctuating water levels strongly influence the nesting success of all birds each year.

**Table 2. Wading bird nest estimates on the A.R.M. Loxahatchee National Wildlife Refuge, 1992-1999**

<i>Species</i>	<i>1992</i>	<i>1993*</i>	<i>1994</i>	<i>1995</i>	<i>1996</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>
Little blue heron	938	673	1,333	1,153	1,372	1,311	1,036	1,592
Tri-colored heron	520	173	103	343	197	254	352	489
Great blue heron	87	73	73	82	118	95	123	217
Great egret	239	328	396	610	837	516	828	2,037
Snowy egret	97	4	21	59	28	73	15	470
Cattle egret	1,408	728	1,051	729	2,403	1,028	1,682	831
White ibis	2,761	218	1,849	2,249	800	1,095	873	5,780
Total nests	6,050	2,575	4,826	5,225	5,755	4,372	4,909	11,416

*\*During 1993, approximately 378 unknown wading bird nests could not be identified.*

**Mammals**

There are 23 species of mammals known to occur on the refuge (Fish and Wildlife Service 1999), including the Mexican free-tailed bat, cotton mouse, grey squirrel, raccoon, bobcat, round-tailed muskrat, and the exotic nine-banded armadillo. At the present time, there are no surveys to monitor population levels for these species.

From 1982-1984, white-tailed deer counts were completed using a helicopter. During those years the number of deer observed ranged from 1 to 80, and the estimated population on the refuge was between 23 and 1540 animals. No recent helicopter surveys have been completed.

**Amphibians**

Very little is known about the status of various populations of amphibians on the refuge. There are a few known species of salamanders that may occur on the refuge. These are the two-toed amphiuma (or Congo eel), greater and lesser siren, everglades dwarf siren, peninsula newt, and dwarf salamander (Coppen 1997). Great blue herons have been observed eating the sirens or the amphiuma (Fish and Wildlife Service 1999a).

There are at least 11 species (exotic and native) of frogs and toads on the refuge. A few of the most common are the Florida cricket frog, green treefrog, pig frog, oak toad, and southern toad (Coppen 1997). The exotic Cuban tree frog is frequently heard around the headquarters office and visitor center and has been observed in Strazzulla Marsh (Fish and Wildlife Service 1999a).

## Reptiles

Approximately 10 species of turtles (exotic and native) use the refuge habitats, including the stinkpot, Florida redbelly, peninsula cooter, and Florida softshell turtles (Coppen 1997). Eight species of lizards (exotic and native) are found on the refuge, including the green anole, the Cuban brown anole, and the ground skink (Coppen 1997). Occasionally, exotics such as monitor lizards and green iguanas have been found on the refuge.

Up to 24 different snake species (exotic and native) have been found on the refuge, including garter snakes, racers, Florida cottonmouth and the dusky pygmy rattlesnake (Coppen 1997). Observed exotic snakes include boa constrictors and pythons.



*Everglades rat snake*  
USFWS Photo by B. Thomas Jr.

Alligators are considered umbrella or keystone species because of the important role they play in providing pockets of standing water during droughts and they are near the top of the food chain.

According to early refuge personnel, the refuge supported more and larger alligators per acre than most parts of the Everglades. During the early 1950s through 1965, there was some concern that alligator populations had decreased due to hunting and few large alligators were observed in the interior (Fish and Wildlife Service 1950-1965). In 1967, a night count around the perimeter canal resulted in the sighting of 1235 alligators in 55

miles (22 alligators/mile). Alligator surveys conducted on the refuge, on other water conservation areas, and on the national park by biologists from many agencies from 1979 to 1987, showed fluctuating numbers of alligators related to season and water level. Alligator numbers in the canals averaged 21 alligators/mile and ranged from 8 to 101 alligators/mile. In 1998, a series of regional alligator surveys, which included the refuge, were initiated by researchers at the University of Florida (Mazzotti et al., 1999). Surveys of the refuge interior and the L-40 canal showed that the refuge had higher densities of alligators along the survey routes than any of the other Water Conservation Areas. Sixteen and nine alligators/mile were observed during surveys of the L-40 canal on the refuge, and the interior respectively (compared to a maximum of eight and two alligators/mile in other canals and marshes). Alligators of all sizes were observed along both survey routes with more larger alligators observed in the canal survey. Many pods of young of several size classes were observed along the interior survey route indicating that alligator nesting is occurring on a regular basis in the interior. In addition, alligators in and around the refuge appear to be in good condition, unlike alligators in other locations in south Florida. It is unknown if the amphibians or reptiles on the refuge have been impacted adversely by environmental conditions as they have been in other areas of south Florida.

## Invertebrates

Approximately 40 species of butterflies can be found on the refuge during various times of the year (Coppen 1997). Most common are queens, soldiers, white peacocks, gulf fritillaries, julias, palmedes, and zebra butterflies (Table 20). The butterfly garden will continue to attract many species to the visitor center area. Annual butterfly surveys are being completed on the refuge as part of the North American Butterfly Count.

The Florida apple snail is an important tropical freshwater mollusk on the refuge as well as the entire Everglades. This species, as well as the exotic mystery snail and spike-topped snails are food sources for young alligators and numerous birds, including the limpkin and the Everglades snail kite (Lodge 1994). The refuge provides abundant aquatic habitat for dragonfly larvae (Lodge 1994). There are 23 species of dragonflies known to occur on the refuge. Common species include the scarlet skimmer, Halloween pennant, eastern pondhawk, and four-spotted pennant. These dragonflies feed on mosquitos, beetles, wasps, and other insects. Seven species of damselflies use the refuge habitats; among them are the duckweed firetail, Rambur's forktail, swamp spreadwing, and lilypad forktail (*Table 20*). In addition, a host of other important aquatic invertebrates such as spiders, crayfish, prawns, molluscs, snails and worms are important prey species in the marsh food web.

No formal surveys or research for apple snails, dragonflies, or damselflies, are currently being conducted on the refuge.

#### Fish

There are at least 46 species of temperate fresh water fish that occur regularly on the refuge including mosquitofish, topminnow, largemouth bass, gar, and bowfin (Loftus and Kushlan 1987). See Appendix K, Table 20, for a list of fish species occurring in the area.

Water level management greatly influences the range and survival of both invertebrates and fish on the refuge. Water levels can dictate vegetation, habitat structure, and vulnerability of aquatic species to predation. Structurally simple sloughs and canals are dominated by bass and other predatory fish (Loftus and Kushlan 1987). Prawns and crayfish tend to occur more often in densely vegetated wet prairies than in sloughs (Lowe 1986). Small fish and large arthropods manage to avoid large fish in sloughs but large arthropods feed on small fish in wet prairies and sawgrass stands. Prolonged high water with few droughts or drawdowns would likely result in more, larger largemouth bass, gar, and bowfin (Jordan 1996). No formal surveys regarding fish species are currently being conducted on the refuge.

#### *Exotic Animal Species*

Populations of non-indigenous aquatic animal species are increasing in Florida and this expansion, coupled with the introduction of new exotic species, poses a threat to biodiversity on par with habitat loss and degradation. Very little is known, however, about the precise nature of these threats to native species and the ecology of most of the non-indigenous aquatic animal species in Florida. Thirty-two exotic fish taxa (species, hybrids, and unidentified forms) have reproducing populations in Florida (Fuller et al., 1997). Possibly 13 species of cichlids such as the peacock cichlid, blue tilapia, and black-chinned tilapia could be found in refuge waters (Nico 1997). Giant canal shrimp can also be found at the Loxahatchee refuge, generally around water control structures.

Two recently discovered threats to the refuge and all of south Florida, an armored catfish and the swamp eel, are suspected to be causing significant disruptions in the population levels of native species. The South American armored catfish, known to achieve high population levels, feeds heavily on benthic invertebrates which are the basis for the food web in the Everglades. The swamp eel feeds voraciously on native fresh-water fish species such as sunfish and bass. It is believed that the Brazilian spike-topped apple snail is beginning to displace the native Florida apple snail, which is the primary food of the endangered Everglades snail kite (Warren 1997). Sportfish introductions to south Florida include oscars, blue tilapia, peacock cichlids, and Mayan cichlids.



*Green iguana (exotic species)*  
USFWS Photo by S. Rinker



Banding a young Snail kite  
USFWS Photo by M. Bailey

### *Threatened and Endangered Species*

There are at least 63 imperilled species known to occur or could occur on the refuge. These species are listed as either federal or state threatened and endangered species, species of special concern, species of management concern, or listed by the Convention of International Trade in Endangered Species (*Table 22*). The Service has primary responsibility for federally listed species. However, in many cases they occupy the same or similar habitat. By managing for federally listed species, state and other listed species benefit as well.

According to Appendix K, Tables 22, 28, and 29, 15 species of wading birds such as herons, storks, and ibises nest on the refuge and are considered ecological indicators because of their wide foraging ranges and relatively specific food and habitat requirements. The breeding success of these species reflects the health of the wetland and coastal habitats of the south Florida ecosystem, the Everglades ecosystem, and need to be monitored to reflect the success of the Everglades Restudy Project.

The wading bird breeding populations of the Everglades ecosystem have declined 90 percent as a result of a 50 percent reduction in habitat and the associated reduction in fish and food items (Ogden 1994). While the refuge is a viable breeding ground for wading birds, artificially controlled hydroperiods often fail to mimic the natural system and this failure has contributed to the decline in breeding and foraging success. In May 1995, a new water schedule was instituted which more closely mimics the natural system and the effects of this schedule on nesting success are being monitored. High numbers (up to 300 per day) of wood storks have been observed foraging on the refuge interior and impoundments when the water levels are very low. Wood storks have been recorded as nesting on the refuge twice; successfully in 1990, during an extreme drought (Fish and Wildlife Service 1990; Maffai and Jelks 1991) and unsuccessfully in the drought of 1999 (Fish and Wildlife Service 1999c). The refuge has appropriate nesting habitat for wood storks and some impoundments could be managed for optimal foraging year-round. Little blue and tricolored herons, white ibis, limpkins, and snowy egrets regularly forage, roost, and nest on the refuge. While the refuge has traditionally been a productive area for snowy egrets in south Florida, nesting success has declined in recent years.

The reddish egret has been rarely observed on the refuge. While it is not unusual to see immature roseate spoonbills in the impoundments during very low water levels, they are not known to nest on the refuge. One of the rare times (1999) they were observed nesting, the effort was unsuccessful. In the 1970s, Florida sandhill cranes were observed in good numbers in the refuge interior; however, they are now rarely observed and only two nests have been recently observed, one in 1996, and another in 1999.

The Everglades snail kite has had poor nesting success on the refuge with a total of only 7 nests observed from 1976 to 1997. However in 1998, 18 Everglades snail kite nests were found and approximately 1/3 of the nests were thought to be successful (Fish and Wildlife Service 1998). The bird is mobile, moving from one watershed (or conservation area) to another as foraging conditions change. With the change in the water regulation schedule in 1995 providing better habitat for its primary prey, the apple snail, it is hoped the nomadic Everglades snail kite will increase its nesting activities at the refuge.

Bald eagles are not seen often, but a couple are observed perched in trees on or near the refuge every two or three years. Arctic peregrine falcons are routinely observed foraging and resting in the refuge interior during the fall and spring migration. American kestrels are observed wintering on the refuge, however, they are not the Southeastern Kestrel.

The American alligator appears to be doing well on the refuge. In 1999, a long term survey was initiated to determine the abundance, nesting success, and health of this species. Alligators of all sizes were observed in both survey routes, with larger alligators observed in the canal survey. Many pods of young of several size classes were observed along the interior survey route indicating that alligator nesting is occurring on a regular basis in the interior. Nests were located, opened, and the eggs measured, counted, and evaluated for viability. Tending females were captured, marked, and measurements were taken. Early indications are that alligators in and around the refuge appear to be in good condition, unlike alligators in other locations in south Florida.



Nesting American alligator  
USFWS Photo by S. Jewell

Five reintroduced whooping cranes were briefly observed near the western edge of the refuge in 1998.

Occasional sightings of the Florida panther or an escaped captive mountain lion have been noted in the refuge's annual narratives and biological observations but never confirmed.

Tropical curly-grass fern was found in 1972 by Taylor Alexander on tree islands near the airboat trail, but its status is currently unknown. In 1998 two bromeliads, commonly found in the cypress swamp and on most tree islands, were listed by the State of Florida as endangered. This listing is in response to an exotic weevil which has begun devastating native bromeliad populations in south Florida. Additionally, a number of ferns has been listed in response to the rapid loss of wetlands in Florida.

#### *Research Natural Area*

The refuge features a 2,560-acre Research Natural Area, the center of which is located at 26° 34' North and 80° 22' West (*Figure 12*). This area is part of a system of Research Natural Areas located on federal lands. These areas "...preserve a representative array of all significant natural ecosystems and their inherent processes as baseline areas." (U.S. Department of Agriculture 1977.) Furthermore, these areas provide opportunities to obtain, through scientific research, "...information about natural system components, inherent processes, and comparisons with representative manipulated systems." Use of Research Natural Areas by responsible scientists is allowed as long as other areas of similar quality are available; little activity is encouraged. No baseline studies have been conducted or are currently underway on this area.

#### *Management of the Compartments*

As indicated earlier, the refuge has four sections (*Figure 14*), designated as Compartments A, B, C, and D. Each of the compartments is divided into a number of smaller impoundments. Currently Compartments A, B and C receive water from rainfall and Pump 1. This two-way pump is located at the northwest corner of Compartment A, adjacent to the L-40 canal. Each impoundment has a 36- or 48-inch culvert and water can be raised or lowered by gravity through flash board risers. Compartment D has a separate two-way pump and water structures associated with the perimeter canal.

Figure 12. Research Natural Area of A.R.M. Loxahatchee National Wildlife Refuge

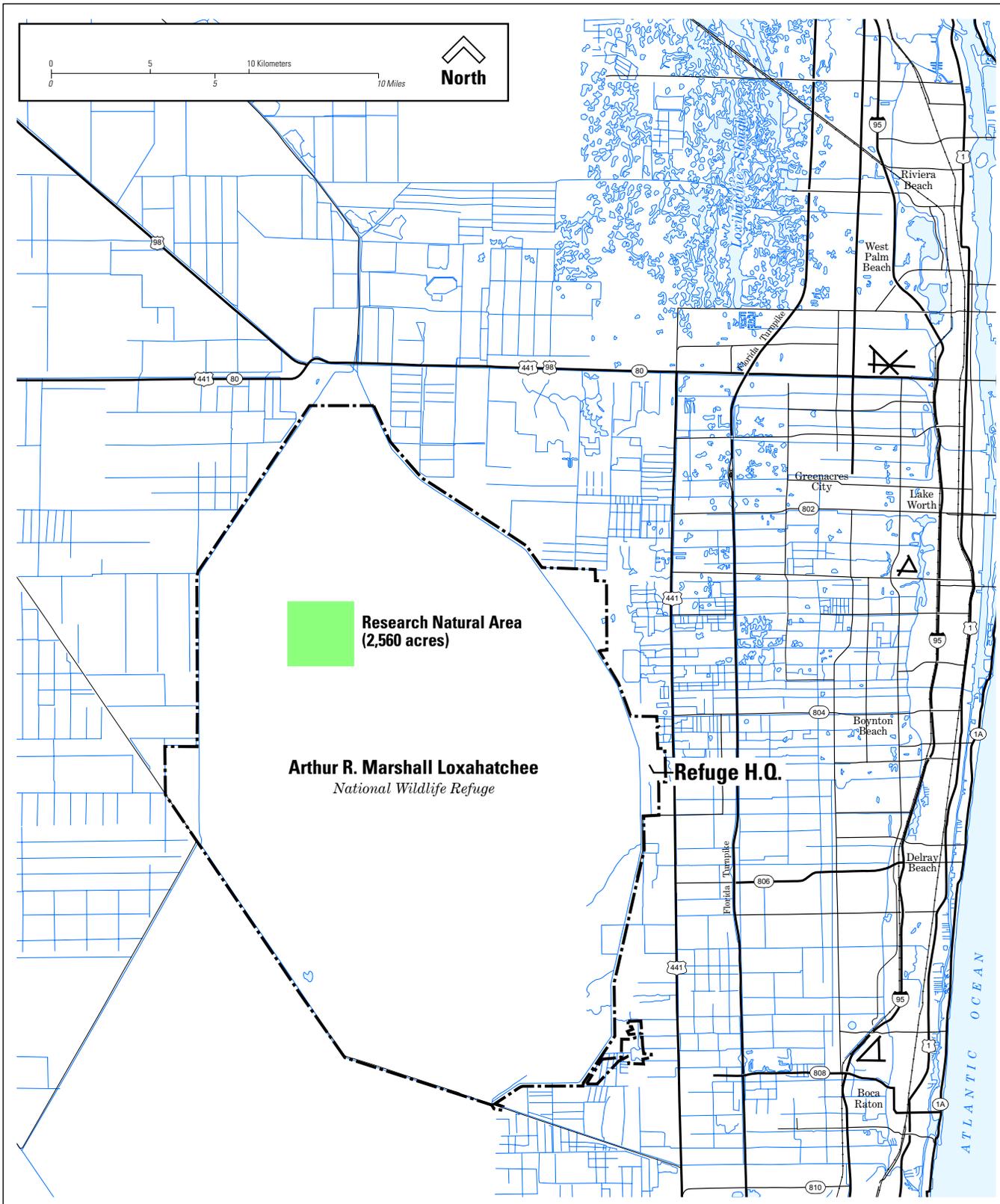
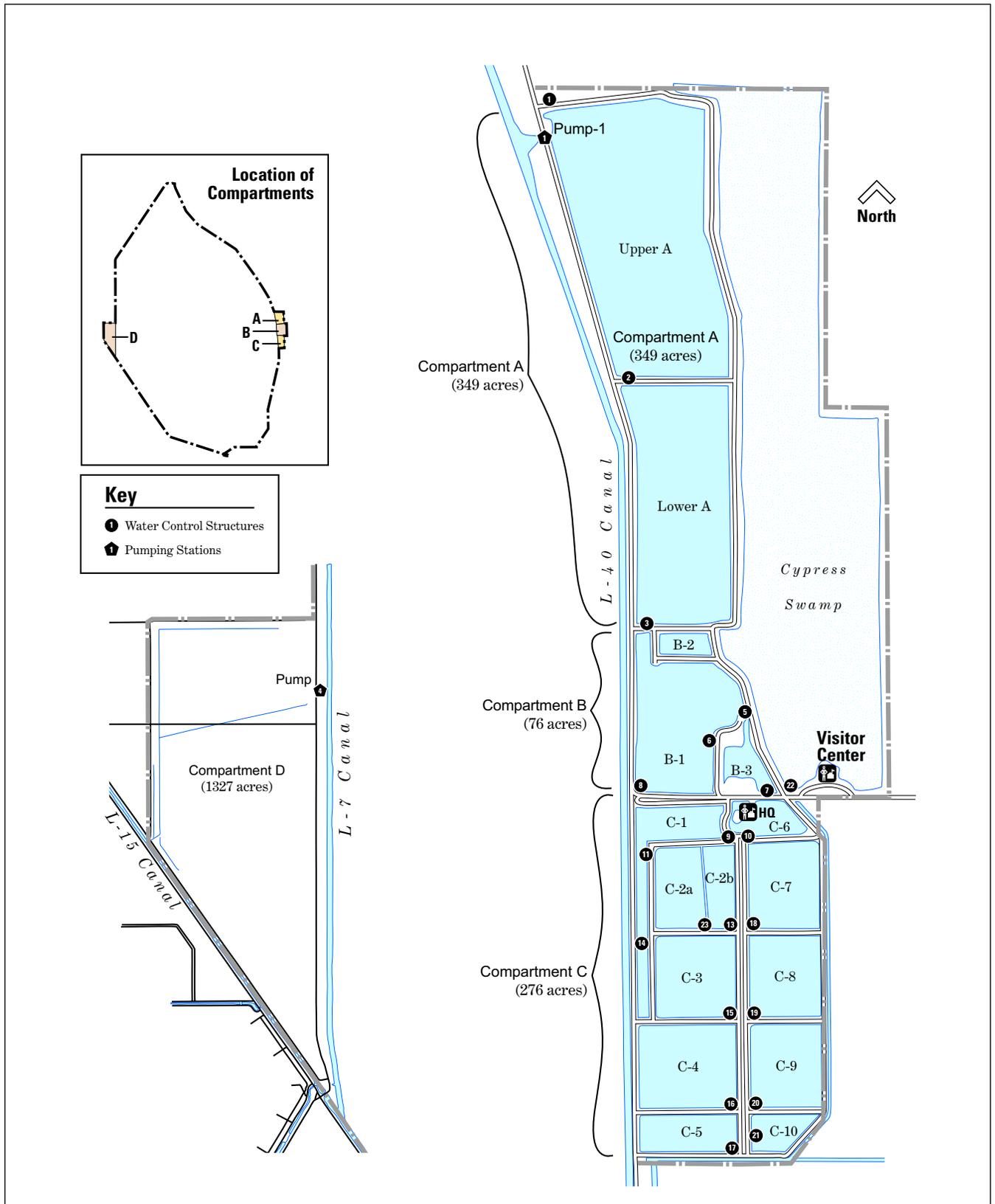


Figure 13. The location of water control structures and pumps used at A.R.M. Loxahatchee National Wildlife Refuge



Originally, Compartments A, B, and C were created to provide waterfowl habitat. In the 1960s, these compartments were managed using farming techniques. The individual impoundments were drained, dried, disced, plowed, fertilized, and replanted for the production of food (e.g., millet, rice, ryegrass) for wintering waterfowl. The use of fertilizers resulted in extensive growth of undesirable cattail, grasses, and other noxious plants. Large amounts of herbicides were used to control the unwanted vegetation.

In the 1970s, management goals of Compartment C were focused on production of apple snails as forage for the endangered Everglades snail kite. However, by 1980, farm management again was being used to control vegetation, and many impoundments were fertilized and planted with rice or millet. During this time, cattail and grasses grew extensively. In several impoundments a trail cutter was used to control the vegetation.

In the late 1980s to late 1990s, impoundment management philosophy shifted toward achieving a natural assemblage of aquatic plants, vertebrates and invertebrates, following the successional stages of the Everglades ecosystem (Fish and Wildlife Service 1992, 1998a, 1999b). In spite of these efforts, cattail and exotic grasses expanded to dominate large portions of the impoundments, due most likely to the residual effects of fertilizers applied earlier, high nutrient-laden water from the interior canal, and the effects of a closed system. The problems with invasive species in the compartments is evident as indicated below.

**Compartment A (350 acres):**

Portions of this compartment consist of cypress trees, sawgrass, willow, wax myrtle, and dahoon holly. However, cattail has invaded both Upper and Lower A impoundments to the point of excluding the sawgrass and overtaking the willow, myrtle, and holly.

**Compartment B (76 acres):**

This compartment, composed of three impoundments, B-1, B-2 and B-3, consists of spatterdock, water lily, eleocharis, and sawgrass found near the center, with abundant cattail along the edges.

**Compartment C (276 acres):**

This compartment is composed of eleven units (C1, 2a, 2b, and C3-10). While native plants such as sawgrass, eleocharis, spatterdock, water lily, string and spider lily, pickerelweed, and sagittaria are found in most units, cattail and exotic grasses dominate the edges and large portions of the impoundments (Fish and Wildlife Service 1995b, 1999a.). Of the units in Compartment C, only C-6 and C-7 (Marsh Trail) have been actively managed for the benefit of the visiting public for the last 18 years.

**Compartment D (1327 acres):**

This compartment, originally acquired to provide habitat for the listed Florida sandhill crane, is divided into two impoundments and has become overgrown with woody shrubs such as willow and myrtle and dense sawgrass. This compartment is plagued with seepage problems.

**Cypress Swamp (400 acres):**

The water in the cypress swamp is high in nutrients from pumped-in agricultural water, and results in dense covers of water spangles and duckweed. The understory of this pond cypress swamp is predominately fern (over nine species), herbaceous plants, dahoon holly, myrsine, red bay, buttonbush, and pond apple. This area is currently being invaded by exotic Brazilian pepper, guava, aquatic ipomoea, and Old World climbing fern.

With appropriate habitat management, the compartments have the potential of providing habitat for wildlife species found in the refuge interior. More than 25 state or federally listed species have been recorded using the compartments, including the Florida panther in the 1960s and 1980s (Fish and Wildlife Service 1996b, 1999, 1999a).

*Ecology and Role of Fire in Plant Communities*

## Fire Ecology:

The refuge has a variety of vegetation types which are either dependent upon fire, susceptible to fire, or spread fire. Sawgrass marsh is extremely combustible but well adapted to fire. Beakrush and spikerush wet prairies have insufficient fuel to carry a fire under high water levels. However, when prairies are dry, a well developed algal mat can burn, smolder, and spread over long distances. Maidencane wet prairies occur in drier sites and burn almost as well as sawgrass (Wade et al., 1980). Sloughs act as natural firebreaks, since the vegetation is sparse and wet most of the year. However, if the surface sediments dry out, “muck” fires may develop in the peat. The combustion literally burns up the peat and then the slough is created when water re-floods the area. At the southern end of the refuge, where dense stands of cattail have replaced sawgrass and slough communities, extensive amounts of dead material and litter burn readily during the dry season.

Tree islands, found interspersed among the sloughs and wet prairies, will rarely carry fire during the wet season. Since sloughs and wet prairies usually contain low fuel levels, these communities will not spread fire from island to island. However, when the water table drops below ground level, tree island communities are susceptible to destructive fires. At those times, adjacent wet prairies may also be sufficiently dry to spread fire to tree islands. Melaleuca and Old World climbing fern also contribute to the spread of fire. The volatile oils in the melaleuca leaves produce intensive crown fires and “fire-brands” which increase the chance of spotting. In tree island areas, vertical growth of the climbing fern creates a “ladder effect” and produces crown fires which kill supporting trees. Pieces of fern also break off and float in the thermals causing fire to spread a half-mile or more. Tremendous spore dispersion appears to result from fire in the fern. The 1995 fire is thought to be a major contributor to the spread of the fern on the north end of the refuge. Studies need to be conducted to determine if fire does spread Old World climbing fern.

Cypress swamps are one of the primary natural barriers to the spread of wildfire (Wade et al., 1980) if water levels are high enough to provide a saturated microclimate. The 400-acre swamp provides a barrier between the compartments and adjacent farmlands. However, the invasion of climbing fern in the cypress trees has increased its susceptibility to wildfire.

## Role of Fire in Everglades Plant Communities Over Time:

Lightning-caused wildfire played a continuing historical role in perpetuating the unique mosaic of plant communities in south Florida and on the refuge. This historical role is evidenced by ash layers embedded in Everglades peat (Cohen 1974), the high percentage (70 percent) of plant species which occur in communities that are maintained by fire (Robertson 1953), and the high incidence of lightning. There are more days with lightning recorded in south Florida than anywhere else in the United States (Wade et al., 1980). Many low growing plants such as sawgrass require sub-climax habitats to remain constant, and lightning fires have been a major force in interrupting plant succession in the Everglades.

During the early 1900s, Everglades ecology began to change in part because human-caused fires became much more frequent and destructive as the marsh was drained. Human-caused fires are more destructive, burn more acreage, and occur mostly in dry season (January through May) when low water levels allow tree islands and peat to be consumed. A naturally started fire usually occurs in the rainy season (May through August) from lightning strikes burning a mosaic pattern governed by existing water and patchy vegetation, and is extinguished with abundant rainfall.

During the period 1910-1960, while boundary levees were being constructed throughout south Florida to contain the Everglades, it is believed that fires were intentionally set on the refuge. These fires

destroyed many tree islands in the south end of the refuge; numerous burned-out cypress stumps on the south end give validity to this observation. Since the refuge was established in 1951, wildfires have been sporadically recorded in annual refuge narratives.

**Fire Risk and Suppression:**

The refuge is rated as a “low consequence” refuge based on fire occurrence, history, fuel type, severity indices, and local conditions. Fires will normally be limited in scope due to the presence of many natural firebreaks and high moisture retention in the vegetation and soils. Only during severe droughts will damaging fires likely occur. Even in these circumstances (e.g., the drought of 1981-1982), the scope of the fire may be constrained by habitat and environment and may be beneficial to wildlife. Since access to the refuge is limited to two locations, it would be relatively easy to close the refuge to public use, if necessary, to ensure public safety.

In the past, wildfire suppression has been aggressive to contain wildfire on the refuge when it is needed to protect adjacent private lands and structures. The Florida Division of Forestry is the primary agency in Florida to control wildfires, and would be the primary agency to assist with a wildfire on the refuge. Not all fires would be curtailed; rather, there are only a few circumstances when wildfires would be suppressed in the refuge interior. These include: 1) muck fires in severe drought conditions; 2) fires that produce excessive smoke on adjacent roadways or in nearby communities; and 3) fires that threaten to spread to adjacent lands. The Division of Forestry may be asked for assistance in suppressing a refuge fire, if necessary.

**Socioeconomic Environment**

*Demographics*

The population in Palm Beach County has grown 68 percent from 1980-1995 (Table 3). Population density in this same period has increased 60 percent. Like many counties in south Florida, Palm Beach County’s population has become more diverse. Data for the period between 1980 and 1990, shows that the proportion of Caucasian and African American populations is decreasing, while the Hispanic and Asian populations are growing. The Native American population has remained a small but stable proportion. The county education levels are slightly higher than the state average. Median and per capita incomes for Palm Beach County in 1990, were much higher than the state averages (\$32,212 and \$22,135 respectively).

**Table 3. Socioeconomic profile of Palm Beach County, Florida, 1980 - 1990**

<i>Characteristic</i>	<i>1980</i>	<i>1990</i>
Population (number)	576,758	863,503
Population Density (pop./sq. mile)	289	433
<b>Race/ethnicity (%)</b>		
Caucasian	84.5%	79.3%
African American	13.4%	11.9%
Hispanic	1.6%	7.6%
Native American	0.2%	0.2%
Asian	0.3%	1.0%
<b>Education</b>		
% Population over 25 with HS degree	71.0%	78.8%
% Population over 25 with College degree	17.1%	22.1%
Median Family Income	\$19,817	\$38,539
Per capita Income (\$)	\$12,820	\$29,103

Poverty levels for the county have decreased slightly for both families and individuals, and are lower than the state averages (9 percent for families and 11 percent for individuals for the state). The income and poverty statistics suggest that the county residents are more affluent than residents in most other counties in Florida.

*Land Use*

Most of the agricultural production is in the western portion of Palm Beach County and in the Everglades Agricultural Area, which coincidentally encircles the refuge. The important agricultural products in the county include sugarcane, vegetables, melons, ornamental crops, and to a lesser extent, citrus.

As the population of Palm Beach County grew by 50 percent between 1980 and 1990, a large portion of the agricultural lands was lost to urbanization. Interestingly, the number of farms has increased within the county (15.5 percent), while the average farm size has decreased by more than 15 percent (*Table 4*). The estimated market value of land and buildings (average per acre) in 1992 was \$3,576. Due to explosive development since then, land prices have escalated.

**Table 4. Agricultural summary highlights of Palm Beach County, Florida**

<i>Characteristic</i>	<i>% change 1982-1992</i>	<i>1992</i>	<i>1987</i>	<i>1982</i>
Farms (number)	15.5%	924	975	800
Land in farms (acres)	-4.4%	637,934	659,438	667,817
Average size of farm (acres)	-17.4%	690	676	835
Estimated market value of property (land and buildings average \$/acre)	47.5%	\$3,576	\$3,233	\$2,424

*Recreation Use*

National and Regional Context:

The 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation indicated that in Florida, there were 2.9 million participants in fishing, 29,000 participants in hunting, 1.8 million wildlife watchers, with 3.6 million participants completing this survey (many respondents participated in more than one activity). Since 1991, Florida statistical trends indicate about a 30 percent decline in participation in hunting and nonconsumptive wildlife watching, while participation in fishing has remained about the same.

In the 4-county (Palm Beach, Martin, St. Lucie, Indian River) state planning region, where the refuge is located, of 62 million participants in outdoor recreation (1992), 47 percent were tourists, 39 percent were residents of the region, and 14 percent were Florida residents located outside of the region. The most popular outdoor recreational activities were saltwater beach activities, bicycle riding, fishing, hiking, picnicking, and nature study. The activities with the highest projected facility needs for the year 2000, include fresh water and saltwater non-boat fishing, hiking, bicycling, and horseback riding trails.

**Table 5. Highest Recreational Use at A.R.M. Loxahatchee National Wildlife Refuge, FY98**

<i>Type of Use</i>	<i>Estimates</i>
Total Visitors	110,642
Visitor Center	64,930
Nature Trails - Foot Trails	91,147
Fishing	20,346

**Refuge Recreation Use:**

The visitation to the refuge was estimated at 110,000 visitors per year since 1994. Visitation varies by season. Approximately 17,000 visits occur monthly during February-March, and 4,000-6,000 per month in September-October. Of the total visitation, interpretation, nature observation, and fishing comprise most of the recreation uses on the refuge. In FY 1998, nearly 65,000 persons visited the visitor center and/or nearby boardwalk, about 91,000 walked the nature trails, 20,346 fished and approximately 264 people hunted on the refuge (*Table 5*).

**Access**

The Headquarters Area is located on Lee Road, which originates from State Highway 441. This area provides refuge administration, interpretation/education, and public access (*Figure 14*). Visitors will pass an entrance fee station which is staffed during peak hours and is run on the honor system the remaining time.

The Headquarters Area is located in and around Compartment C (*Figure 14*), one of 4 compartments (A- D). Compartment C contains an observation tower, bridge, and 10 impoundments, approximately 25 acres each, which are contained by 6 miles of levees. A 1/4-mile interpretive boardwalk circles through the Cypress Swamp. Located in the area are three boat ramps, an observation platform, and a concrete fishing platform (both wheelchair accessible).

The interior of the refuge is currently allocated into three management zones: Closed to Public Use; Open to Public Use except no waterfowl hunting; and Open to Public Use, waterfowl hunting by permit only (*Figure 14*).

In addition to the Headquarters Area, visitors can access facilities at the Hillsboro Recreation Area. This area, located in the southern part of the refuge, contains a gravel parking lot and 4 boat ramps. Only 2 ramps are usable at the present time.

Another traditional entrance to the refuge, 20-Mile Bend Recreational Area, located at the northern end of the refuge, has been closed for development of the Everglades Stormwater Treatment Areas.

**Wildlife Observation and Photography**

Wildlife observation and photography, notably of birds and alligators, occur at any location where access is allowed. Land-based observation occurs along the Cypress Swamp Boardwalk, Marsh Trail (C-7 Impoundment) throughout Compartment C, and along the perimeter levee. As indicated above, the C-7 Impoundment can provide some special opportunities to observe wildlife. In the refuge interior, water-based observation from boats or canoes occurs along the Everglades Canoe Trail and in the Public Use Area, located in the southeastern area of the refuge.

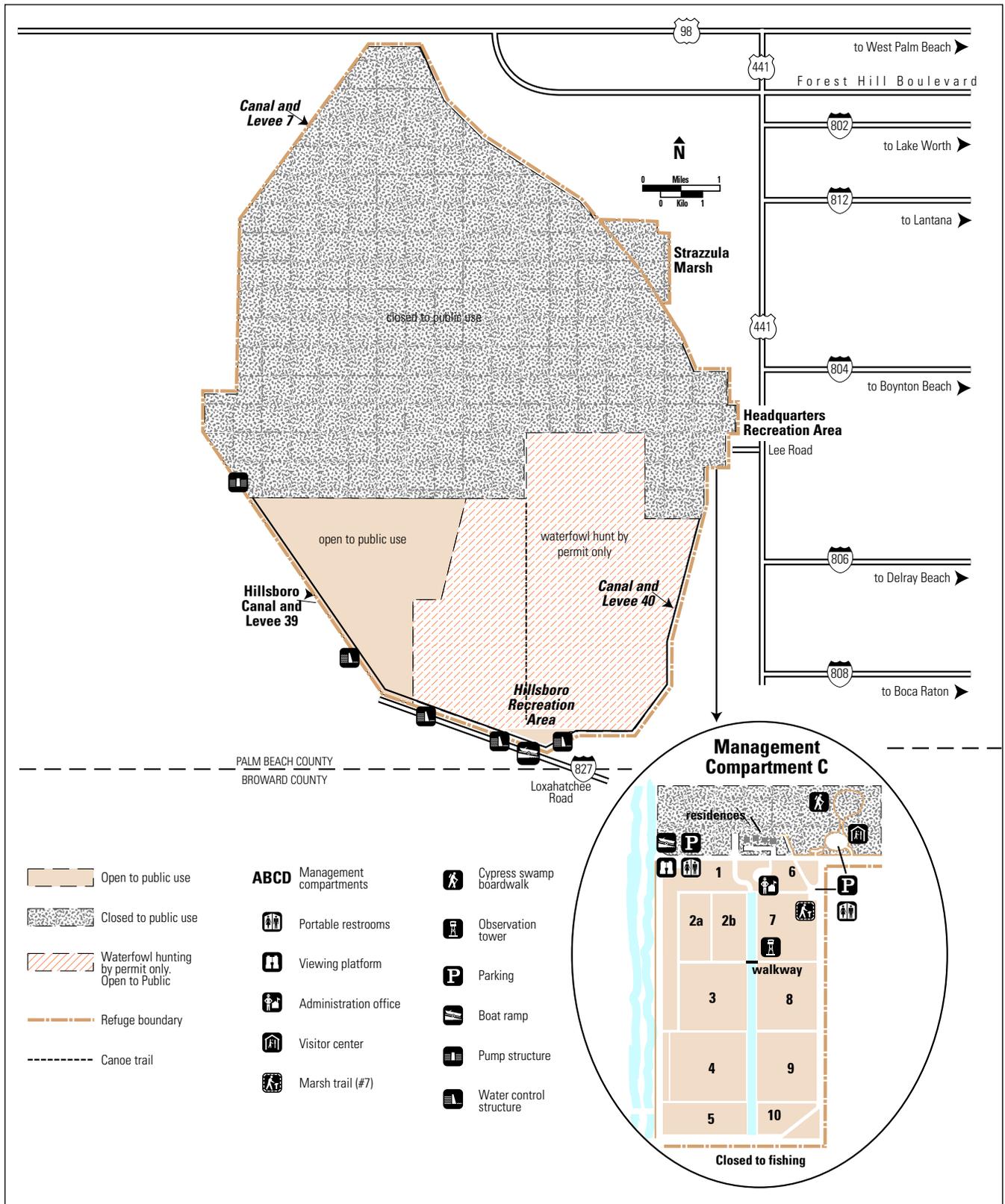
**Interpretive Programs**

The visitor center provides exhibits, seasonal talks, and slide programs. Field guides, nature books, and other materials can be purchased here. The Loxahatchee Natural History Association produces a visitor guide to the refuge and holds an annual art contest and photo contest. Guided tours, audiovisual and guest lecture programs are offered throughout the year.

**Walking/Hiking/Bicycling**

Walking and hiking is available in the following areas: the Cypress Swamp Boardwalk (0.4 mile); Marsh Trail (0.8 mile); the perimeter of Compartment C (6 miles); and the levee between the ACME 2 Station (northern edge of Strazzulla Marsh) to the Hillsboro Recreation Area (12 miles), and up to the S-6 water structure at Compartment D (*Figure 14*). Bicycling is allowed on the perimeter levee from the Headquarters Area to Hillsboro.

**Figure 14. Current Location of Compartments A,B,C,and D, Headquarters Area, Strazzulla Marsh and Hillsboro Recreation Area at A.R.M. Loxahatchee National Wildlife Refuge**





Canoe trail  
USFWS Photo by B. Thomas

#### Fishing

Boat-based sport fishing occurs in the perimeter canals and open public use areas, and bank fishing occurs at the Hillsboro Recreation Area and the headquarters canal area (*Figure 14*). The primary species caught include large mouth bass, redear sunfish, bluegill, warmouth sunfish, and tilapia.

#### Canoeing/Kayaking/Boating

Canoeing, kayaking, and motorboating are permitted in the Public Use Area and in the 57-mile perimeter canal, providing sufficient water is available. In some parts of the canal, weed growth may prevent boat or canoe passage. Canoeing and kayaking is also available on the 5.5 mile canoe trail, located near the refuge headquarters and parking area (*Figure 14*). One platform toilet is located along the trail.

The majority of the boating occurs along the L-39 canal, located on the southwest perimeter. Boat access is available at two of the four boat ramps located at the Hillsboro Recreation Area and three ramps at the Headquarters Area.

#### Hunting

Waterfowl hunting is permissible in a designated area in the southeast corner of the refuge (*Figure 14*). A refuge permit, federal duck stamp, and state hunting license are required. The refuge operates special restrictions over and above state regulations during the November to January hunt. During 1995-1997, less than 1 percent of refuge visitors participated in hunting activities.

Recreation Economics:

A 1995 study, using the National Park Service’s Money Generation Model, shows the extent of the refuge’s contribution to the local economy (*Table 6*). This model estimated that the refuge produces 12,533 visitor days of use, and this level of visitation resulted in more than \$350,000 in direct sales and nearly \$700,000 in total economic benefits. The refuge was also estimated to produce \$41,124 in increased sales tax revenues and that 28 jobs were created in the community by refuge-related tourism.

**Table 6. Economic impacts of A.R.M. Loxahatchee National Wildlife Refuge, 1995. (Correia 1995)**

<i>Impact Factors</i>	<i>Amount</i>
Visitor days	12,533
Estimated direct sales to visitors	\$351,484
Estimated sales benefits from tourists	\$685,394
Increased sales tax revenues	\$41,124
Estimated new jobs created by refuge-related tourism	28

Data concerning average recreational expenditures per visitor day by specific activities for the Southeast Region shows that non-consumptive activities (such as birdwatching, photography, and hiking) and fresh water fishing, which are major refuge recreational activities, contribute to Palm Beach County’s economy (*Table 7*). Each visitor day of non-consumptive activities, on average, produces about \$12 in spending for local residents, and nearly \$36 spending for non-residents (1992 dollars). Fresh water fishing produced significantly higher spending averages for non-residents (\$44), but less for residents (\$11). Refuge visitation and the accompanying

spending by visitors undoubtedly contribute to the economy of both Palm Beach and Broward counties.

**Table 7. Southeast Region Recreation Expenditures per person, per day by activity (1992 dollars) (Laughland and Caudill 1997)**

<i>Sector</i>	<i>Non-consumptive</i>		<i>Fresh-water Fishing</i>	
	<i>Resident</i>	<i>Non-resident</i>	<i>Resident</i>	<i>Non-resident</i>
<i>Lodging</i>	\$0.0	\$6.75	\$0.0	\$7.78
<i>Food/drink</i>	\$6.56	\$15.08	\$5.62	\$17.34
<i>Transportation</i>	\$5.14	\$13.11	\$3.71	\$6.30
<i>Other</i>	\$0.38	\$0.63	\$1.61	\$3.17
<i>Total</i>	\$12.08	\$35.57	\$10.94	\$44.59

## Cultural Environment

### *Prehistoric Background*

Archaeologists suspect that prehistoric occupation did not occur on the refuge because of little dry land on which to live. Even tree islands, which are thought to have formed recently, would have been unsuitable for prehistoric occupation (Griffin et al., 1979). Three sites show evidence of the Glades tradition within close proximity to the refuge (Griffin et al., 1979). The sites mentioned include the Cagles Hammock site (Mower and Williams 1974), the Markham Park site (Williams and Mowers 1977), and the Peace Camp site (Mowers and Williams 1972).

### *Belle Glade (Okeechobee) Area*

Griffin et al., (1979) have hypothesized that the refuge may have been used by the Belle Glade People to travel east toward the Atlantic. Once there, the Belle Glade People could have traded with the groups there, or harvested the marine goods recovered at Fort Center (Griffin et al., 1979).

The closest Belle Glade site to the refuge (according to Griffin et al., 1979) is the Boynton Mound Complex located within ½ mile of the eastern boundary.

### *Historic Period*

By the time European explorers stepped foot on the Florida peninsula, there were five tribal groups associated with the east coast of Florida. These groups were the Timicua to the North, the Ais, the Guacata, the Jeaga, and the Tequesta to the south. All tribes were known to collect shellfish and other marine and aquatic resources, which resulted in large shell and bone middens near the villages (Andrews and Andrews 1985). There is evidence that these middens/mounds were used as safe-havens of dry land when coastal flooding occurred (Andrews and Andrews 1985).

Tribal groups most associated with the refuge area were the Guacata, the Jeaga and the Tequesta (Griffin et al., 1979). It appears that the Guacata occupied a territory in a band north of the refuge which included the eastern shore of Lake Okeechobee and the coast near St. Lucie. Other groups such as the Jeaga and perhaps even the Tequesta would be located south of what is now the refuge.

By the 1800s, Native Americans from Georgia, Alabama, and South Carolina began filtering down into the Florida peninsula. These people became more cohesive through time as they fought together against the encroaching Europeans in the Second Seminole War of 1835-1842 (Neill 1956). The war's end could be nothing but a loss for the Seminoles as they were forcibly moved west. Those that chose to remain made their way into the Everglades inhabiting a land that the newer Americans did not seem to want (Griffin et al., 1979).

With improved transportation, more settlers began to move into the area. Small communities, most of which were short lived, sprang up near the refuge. These consisted of Belle Glade c. 1913; Glade Crest c. 1914, on the Hillsboro Canal; Shawano c. 1924, on the Hillsboro Canal; 20 Mile Bend at the juncture of the Hillsboro and West Palm Beach Canals, Gladeview on Hillsboro Canal, and Loxahatchee c. 1913, on West Palm Beach Canal (Will 1964:180; Will 1968:33) (Griffin et al., 1979). The new settlements, with associated road construction, managed to bypass the refuge due to the inhospitable environment.



*Aerial view of refuge canoe trail  
USFWS Photo by S. Jewell*

## *IV. Management Direction*

### **Introduction**

Described below are a vision statement, goals, and the plan for managing the refuge over the next 15 years. Contained in the plan are the goals, objectives, and strategies for achieving the refuge vision.

The planning team evaluated four alternatives for managing the refuge, and chose the Ecosystem Emphasis alternative as the preferred alternative. The other alternatives evaluated were Maintain Current Management, Biological Emphasis, and Public Use Emphasis. These alternatives are described in the Alternatives section of Appendix A.

In essence, the preferred alternative will result in increased invasive exotic plant eradication and control, improved water quality, delivery and timing, increased protection of trust species, protection of migratory songbird stopover sites, restoration of wetland impoundments, enhanced resident wildlife populations, and improved long-term opportunities for appropriate and compatible wildlife-dependent recreation, environmental education and interpretation.

A common thread through this plan is that wildlife conservation assumes first priority in refuge management. Public uses are allowed if they are appropriate and compatible with wildlife and habitat conservation. Specifically, wildlife-dependent recreation uses (hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation) will be emphasized.

### **Refuge Vision**

The planning team, in consideration of input through public meetings and draft reviews of this plan, has developed the following vision for the A.R.M. Loxahatchee National Wildlife Refuge to guide its present and future management direction:

*To serve as an outstanding showcase for ecosystem management that restores, protects and enhances a portion of the unique northern Everglades biological community. This public asset provides for the enjoyment and enhanced quality of life for present and future generations.*

## Refuge Goals

The following four goals were developed in keeping with refuge vision and purpose:

- Restore and conserve the natural diversity, abundance, and ecological function of refuge flora and fauna.
- Conserve natural and cultural resources through partnerships, protection, and land acquisition from willing sellers.
- Develop and implement appropriate and compatible wildlife-dependent recreation and environmental education and interpretation programs that lead to enjoyable experiences and greater understanding of the Everglades and south Florida ecosystems.
- Continue a partnership with the South Florida Water Management District, including renewal of the license agreement for Water Conservation Area 1. Continue the development of an effective and productive staff to achieve the vision, goals, and objectives of this plan.

## Management Plan

### *Summary Statement*

This management plan was derived from Alternative 2 and amended to reflect the comments from the public, non-governmental organizations' and agencies' review of the draft plan. The refuge will be managed using an ecosystem management approach to maintain natural processes or to mimic those processes such as fire and water regimes. In doing so, the refuge will be managed to meet the needs of the resources and allow greater public access for hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation. Oral comments made during public meetings and written comments conveyed both a desire for increased public access and recreation and a desire to preserve the solitude and natural environment of the refuge. The decisions to allow or to prohibit certain uses were dependent upon whether the proposed uses would have an adverse effect on the natural resources of the refuge (see Table 17; Appendix D; and Appendix J) and upon the professional judgement of the refuge staff and planning team.

The management plan outlines how wildlife and habitats will be enhanced by the refuge over the next 15 years. The goals, objectives, and strategies are a recognition that the refuge is a portion of the much larger Everglades ecosystem. The actions considered and taken in implementing this plan will affect the remaining Everglades ecosystem south of the refuge, the natural areas southwest of the refuge, and nearby municipalities and landowners.

A crucial element of this plan is controlling exotic and invasive plants and pursuing funding to eliminate these refuge threats. Also, appropriate water quantity, timing, delivery, and high quality water are critical to achieve refuge objectives and those of the Everglades ecosystem, of which the refuge is a part. Water management, the movement of water into and out of the refuge with appropriate timing and amounts relative to habitat and wildlife needs, will rely upon developing progressive partnerships with the South Florida Water Management District and the U.S. Army Corps of Engineers. This plan also enhances biological and research programs including extensive inventorying, Geographic Information System mapping, and monitoring of the wildlife and habitat resources at the refuge. Prescribed fire will be used as an important tool for managing wildlife habitat. All of the compartments (2,550 acres) will be actively managed to enhance wildlife habitat. Restoration of Compartment A to cypress swamp will begin with cypress planting and relevant levee removal.

The environmental education and outreach program will be enhanced to showcase the northern Everglades ecology and human influence on the southeast Florida ecosystem. A wide range of partnering opportunities will be actively pursued and fostered to share in the protection of natural and cultural resources. A visitor contact station with interpretive exhibits and a concession will be developed at the Hillsboro Area to enhance

appropriate and compatible wildlife-dependent recreation. This plan will increase hunting accessibility by increasing the effective hunting acreage and the number of huntable species. The previously closed Strazzulla Marsh will be opened to the public on a limited basis and new facilities will be developed to include an interpretive trail, a boardwalk, an observation tower and possibly a poleboat trail. Parking access will be potentially developed through partnership with the Village of Wellington and the ACME Drainage District. Facilities at the Headquarters Area will be expanded or upgraded.

### *Goals, Objectives, and Strategies*

The goals, objectives, and strategies presented below are the Service's response to the issues and concerns expressed by the planning team, by the public at open meetings (two), and by comments submitted by the public. Those issues addressed, but not accepted, are discussed in Appendix J. The goals, objectives, and strategies are presented in hierarchical format. Following each goal is a list of objectives, and under each objective is a listing of strategies which are indicated as bulleted items. The goals are equally important in the plan. The Plan Implementation section shows the support projects for the goals in priority order.

These objectives and strategies reflect the Service's commitment to achieve the mandates of the National Wildlife Refuge System Improvement Act of 1997, and its stated mission, of the National Wildlife Refuge System, the Endangered Species Act, the Comprehensive Everglades Restoration Plan (formerly the Restudy). The purpose gives guidance to the vision and goals for the refuge. With adequate staffing and funding, outlined in the Plan Implementation section, the Service intends to accomplish these goals, objectives, and strategies during the next 15 years.

### *Goal 1. Wildlife Habitat and Population Management*

Restore and conserve the natural diversity, abundance, and ecological function of refuge flora and fauna.

#### Discussion:

Water is the lifeblood of the Everglades and every effort will be made to monitor water quantity, timing and delivery as well as water quality. Water hydropattern management includes regulating the amount of water released into or taken out of the refuge, the timing of water delivery or removal, length of time water is retained and the seasonal importance of water in the refuge and surrounding areas. The refuge will rely upon developing progressive partnerships with the South Florida Water Management District and the U.S. Army Corps of Engineers relating to water delivery, timing, and amount. Also, tests will be conducted for pesticides, fertilizers, and elemental contaminants in waters and underlying soils of the compartments, cypress swamp, and Strazzulla Marsh, as well as below the major inflow water structures and other pertinent locations. Exotic and invasive plants are a major threat to the whole Everglades ecosystem and especially to the refuge. An Integrated Pest Management Plan will be developed to attack this extensive problem. Approximately 71,000 acres infested with varying densities of melaleuca and 25,000 acres infested with Old World climbing fern will be reduced to a maintenance control level. The Everglades ecosystem evolved under the influences of fire and the refuge will implement a fire management program that enhances native plant communities. Prescribed fire will also be used to remove treated, dead, exotic and invasive plant biomass and to control new exotic and invasive plant growth in treated areas. All of the compartments (2,550 acres) will be actively managed to enhance wildlife habitat. To be enhanced are the biological and research programs, including extensive inventorying, Geographic Information System mapping, and monitoring of wildlife and habitat. The emphasis of the biological program will be to protect, maintain, and enhance wildlife populations, native habitats and vegetative communities on the refuge. A comprehensive step-down management plan will be developed to detail these methods.

Objectives:

1. Continue to partner with the South Florida Water Management District and the Army Corps of Engineers to restore and maintain healthy water regimes and appropriate hydropatterns for 143,238 acres (Water Conservation Area 1) of the refuge as part of the northern Everglades.
  - Evaluate and monitor hydrologic conditions on the refuge.
  - Review and improve the existing hydrologic model for the refuge to more closely predict wildlife population and vegetative community responses to changes in water levels and water delivery.
  - Assess the impacts of the previous, current, and future water regulation schedules regarding quality, quantity, delivery, and timing of water on native and exotic and invasive species and habitats.
  
2. Expand water quality monitoring to include pesticides, fertilizers, and elemental contaminant levels in the cypress swamp, compartments, Strazzulla Marsh, below the inflow water structures, and other pertinent locations.
  - Work with state and federal agencies, universities, and other parties associated with the Comprehensive Everglades Restoration Plan.
  - Continue to monitor nutrient levels and add new monitoring sites at all water inflows of the refuge not currently being monitored.
  - Improve the water quality in the cypress swamp.
  - Develop a Water Quality Monitoring Plan by 2002.
  
3. Reduce exotic melaleuca and Old World climbing fern to a maintenance control level in 15 years and restore treated areas with native plants as needed.
  - Aggressively pursue funding for the removal of exotic plants.
  - Develop an Integrated Pest Management Plan by 2002.
  - Inventory and map the distributions of invasive and exotic plant species, and using Geographic Information Systems, map all exotic and treatment areas.
  - Develop eradication and control programs for invasive and exotic species.
  - Develop restoration programs for native habitats.
  - Review and update the existing Melaleuca Management Plan by 2002.
  - Develop a complete Lygodium Management Plan in conjunction with other natural resource agencies and researchers by 2002.
  - Foster partnerships with organizations and agencies addressing common issues, including those that are developing bio-control agents.
  
4. Monitor, control, or eradicate exotic or invasive animal threats.
  - Develop an Integrated Pest Management Plan by 2002.
  - Inventory and map the distributions of invasive and exotic animal species, and using Geographic Information Systems, map all exotic and treatment areas.
  - Develop control programs for invasive and exotic animal species.
  - Develop a complete Exotic Animal Management Plan by 2002.
  - Aggressively pursue funding for the removal of exotic animals.
  - Foster partnerships with organizations and agencies addressing common issues, including those that are developing bio-control agents.

5. Implement a fire management program to simulate the historical Everglades ecosystem fire regime where appropriate, enhancing native plants and deterring invasive and exotic plant spread by January 2004.
  - Revise the Fire Management Plan to manage appropriate refuge habitats by 2002.
  - Update the Fire Management Plan at 5-year intervals.
  - Monitor and evaluate prescribed burning effects to assist in determining future burn plans.
  - Partner with other natural resource agencies and organizations to implement burn prescriptions.
  
6. Inventory, map, and monitor wildlife and habitats of the northern Everglades. Compile, collect, and analyze these data to guide refuge management and to contribute to Everglades restoration evaluations.
  - Compile historic data and establish a continuous data collection and analysis effort.
  - Develop computerized databases to facilitate data storage and retrieval, including Geographic Information System capabilities. These databases will be compatible with Service standards.
  - Through inventory and monitoring, establish trends of sensitive habitats, trust species, focal species and biological indicators (Everglades snail kites, wading birds, and alligators) in conjunction with the Science Subgroup on Everglades Restoration.
  - To promote biological diversity on the refuge, develop a program to monitor tree islands so that the effects of management can be assessed.
  - Formulate a Biological Inventory/Monitoring Plan by 2003.
  
7. Manage the compartments, cypress swamp, and Strazzulla Marsh to enhance habitat for trust species such as neotropical migrants, shorebirds, waterfowl, wading birds, and alligators.
  - Ensure that equipment needs are met to fulfill this objective, and develop partnerships with local landowners and agencies.
  - Increase partnerships with the Everglades Agricultural Area landowners and other surrounding landowners.
  - Develop a Moist Soil/Water Management Plan for the compartments, cypress swamp, and Strazzulla Marsh by 2002.
  - Restore Compartment A to cypress swamp.
  
8. Manage and maintain diverse native habitats and viable wildlife populations consistent with sound biological principles and other objectives of this plan.
  - Identify habitat needs through data collection and analyses.
  - Maintain or enhance the habitat of trust species such as threatened and endangered species, species of concern, and migratory birds.
  - Enhance trust species nesting success by providing cover and stop-over sites for migratory birds by reducing human disturbance, and by providing or creating nesting, roosting, and foraging habitat.
  - Support and implement listed species recovery plans.
  - Provide data and analysis to contribute to updating the Multi-Species Recovery Plan for south Florida.
  - Map native plant communities and incorporate data into a Geographic Information System.
  - Monitor changes and trends in wildlife, fish, and habitat.
  - Support Partners-In-Flight initiatives with habitat management, outreach, and staff networking.
  - Support Partners In Amphibian and Reptile Conservation with habitat management, outreach, and staff networking.
  - Formulate a Biological Inventory/Monitoring Plan by 2003.

*Goal 2. Resource Protection*

Conserve natural and cultural resources through partnerships, protection, and land acquisition from willing sellers.

## Discussion:

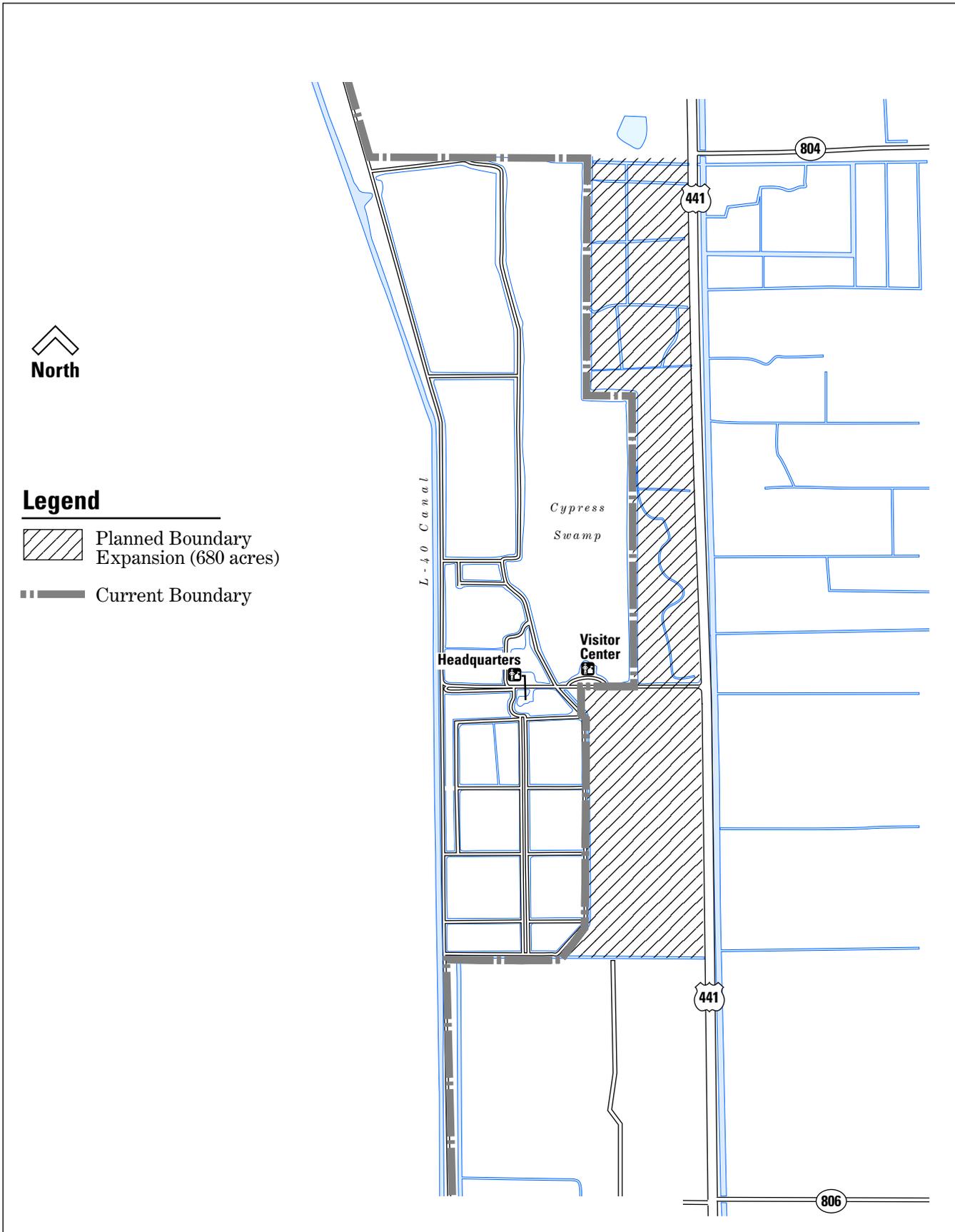
Developing and cultivating active partnerships with a wide-ranging group of interested parties is imperative to fully protect and manage refuge resources and to achieve the vision of this plan. The refuge is currently threatened by impending business and residential development on the eastern refuge border. The refuge will realign the acquisition boundary to include the lands immediately east of the Headquarters Area (approximately 680 acres, see Figure 12). The refuge recognizes the lands east of the refuge up to U.S. Highway 441/State Road 7 as “Areas of Concern” or “Buffer Lands.” A wide range of partnering opportunities will be actively pursued and fostered to protect natural and cultural resources.

## Objectives:

1. Protect water resources and develop partnerships to ensure an appropriate water regulation schedule (quantity, delivery, and timing), as well as ensuring proper water quality for the benefit of wildlife and habitats of the northern Everglades.
  - Partner with Corps of Engineers, Florida Department of Environmental Protection, South Florida Water Management District, local drainage districts and universities to ensure Class III water quality on the refuge.
  - Partner with Corps of Engineers and South Florida Water Management District to implement the water schedule and be in contact on a frequent basis or better.
  
2. Protect other natural biological resources on or near the refuge by encouraging communication and developing partnerships with interest groups, landowners, and with the law enforcement division of resource agencies.
  - Work with adjacent landowners to establish an exotic free “buffer zone” and wildlife corridors.
  - Develop partnerships for research, control, and monitoring of exotic and invasive species with entities such as the Florida Exotic Pest Plant Council, Southeast Florida Invasive Plant Working Group and the South Florida Water Management District.
  - Develop new and continue existing partnerships for research and monitoring of biological resources with universities, conservation organizations (e.g., Ducks Unlimited, Waterfowl USA, Partners-In-Flight), and agencies (e.g., South Florida Water Management District, Florida Department of Environmental Protection, and Florida Fish and Wildlife Conservation Commission).
  
3. Realign the refuge acquisition boundary “Area of Concern” and recognize “Buffer Lands” along the eastern side of the refuge.
  - The refuge recognizes the lands along the east side of U.S. Highway 441/State Road 7 and in front of the refuge headquarters entrance as a new acquisition boundary (*Figure 15*).
  - The refuge considers the land east of U.S. Highway 441/State Road 7 and to the south of the refuge to be a potential buffer zone (*Figure 2*).
  - Develop collaborative relationships with federal, state, and county land offices, agencies, organizations, and landowners to ensure the “Areas of Concern” remain as agricultural or natural lands.
  - Work with federal, state, and county land offices to protect approximately 680 acres directly in front of the Headquarters Area and restore them to cypress swamp or wetlands.

4. Protect species from exposure to contaminants by following applicable regulations.
  - Implement Integrated Pest Management Plan
  - Comply with current contaminant response plans.
  - Continue partnerships with agencies testing for mercury levels in fish.
  - Through education and outreach, encourage the use of integrated pest management by Everglades Agricultural Area landowners and other surrounding landowners.
  
5. Protect refuge resources (147,392 acres), facilities associated with three visitor use areas, and the visiting public through appropriate law enforcement.
  - Refuge law enforcement officers will keep informed of refuge programs and will be engaged in educational contacts with the public.
  - Update and enhance the refuge's Law Enforcement Plan by 2002 and establish partnerships with other law enforcement agencies.
  
6. Develop and implement a cultural resource protection plan in accordance with federal and state historic preservation legislation.
  - Pursue funding for a comprehensive archaeological survey of the refuge.
  - Consult with the State Historic Preservation Office and the Keeper's Office to determine eligibility of each identified site for listing on the National Register of Historic Places.
  - Using survey information, develop a Geographic Information System layer for the refuge's archaeological and historic sites by 2003.
  - Develop a Cultural Resource Protection Plan by 2003.
  
7. Diminish the looting and vandalism of known or newly discovered archaeological sites.
  - Each refuge law enforcement officer will complete the Archaeological Resources Protection Act training course within 2 years of arriving at the refuge.
  - Pertinent refuge staff will complete the Section 106/Cultural Resources for Managers training course within 2 years of arriving at the refuge.
  - Work with the State Historic Preservation Office to ensure confidentiality of cultural resource data within the refuge and the State of Florida.
  
8. Encourage partnerships to protect cultural resources.
  - Work with the pertinent federal and state agencies, the State Historic Preservation Office, professional archaeologists, Native American communities, and the public.
  - Develop Memorandums of Understanding with pertinent federal and state agencies (e.g., the Florida Department of Environmental Protection) to enhance law enforcement of the Archaeological Resources Protection Act, the Native American Grave Protection and Repatriation Act, and applicable portions of Section 50, Code of Federal Regulations.
  - Facilitate investigations of the Archaeological Resources Protection Act violations and illegal artifact collections on the refuge.
  - Through the efforts of the Regional Archaeologist, obtain information on and input into the management of significant cultural and sacred sites from Miccosukee and Seminole Tribes.

Figure 15. Proposed boundary expansion near the Headquarters of A.R.M. Loxahatchee National Wildlife Refuge



*Goal 3. Public Use*

Develop and implement appropriate and compatible wildlife-dependent environmental education and interpretation programs and recreation opportunities that lead to enjoyable experiences and greater understanding of the Everglades and south Florida ecosystems.

## Discussion:

As identified in the National Wildlife Refuge System Improvement Act, there are six high priority wildlife-dependent recreation uses. These are hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation. Fundamental to the provision 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. The compatibility of refuge uses is addressed in Appendix D.

To ensure a quality wildlife-dependent recreational experience, while achieving a “wildlife first” mandate, the number of refuge users and conflicts among users may be limited by (1) permitted uses; (2) designating trails, levees, and sites for specific kinds of wildlife-dependent recreation use; and (3) permitting uses at certain times of the year.

There are a number of situations where future refuge closures or restrictions may be warranted. Examples of these situations include, but are not limited to, specific designated use areas; the protection of endangered species; protection of colonial bird nesting colonies or roost sites; establishment of sanctuary areas for waterfowl; restriction of hunting to certain days of the week; closing a hunt season due to population decline; establishment of hunter quota systems to provide for a high quality hunting experience or to achieve specific wildlife population objectives; minimizing conflicts with other refuge management or public use programs; safety considerations; and/or inadequate funds or staff to administer the activities.

## Objectives:

1. Expand appropriate and compatible wildlife-dependent recreational opportunities at the Headquarters Area (*Figure 16*).
  - Update the existing Public Use Management Plan by 2002, and host appropriate events such as Everglades Day, International Migratory Bird Day, National Wildlife Refuge Week, and seasonal “Calendar of Events” programming.
  - Repair existing trails at the Headquarters Area and meet or exceed the Americans with Disabilities Act code.
  - Enhance the cypress swamp boardwalk by constructing a tree canopy observation tower.
  - Rehabilitate and elevate the existing observation platform at the boat launch area.
  - Rebuild the boardwalk into the C-8 Impoundment and build a photo blind by 2001 through partnerships with our various refuge support groups and other volunteers.
  - Improve visitor services such as enhanced informational and educational signage and additional benches throughout Compartment C trails
  - Extend the existing canoe trail at the Headquarters Area and include one or two overnight camping platforms.
2. Provide public access to the Strazzulla Marsh (*Figure 17*).
  - Develop two short boardwalks, an observation tower, photo blinds, and interpretive signage.
  - Create a poleboat trail in the refuge interior, with access from Strazzulla Marsh (depending on water quality improvement in the perimeter canal.)

Figure 16. Expanded public use opportunities at the Headquarters Area, A.R.M. Loxahatchee National Wildlife Refuge.

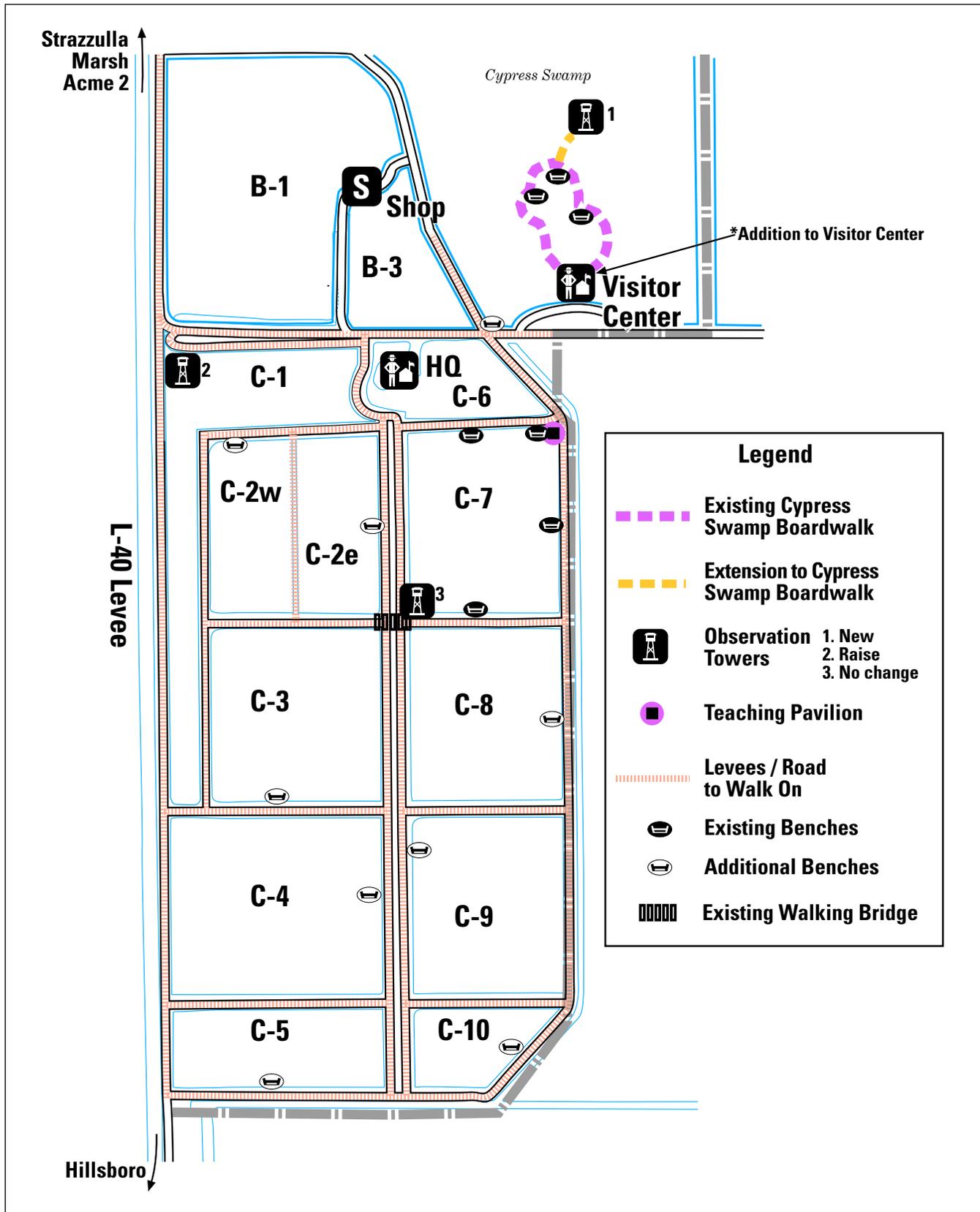
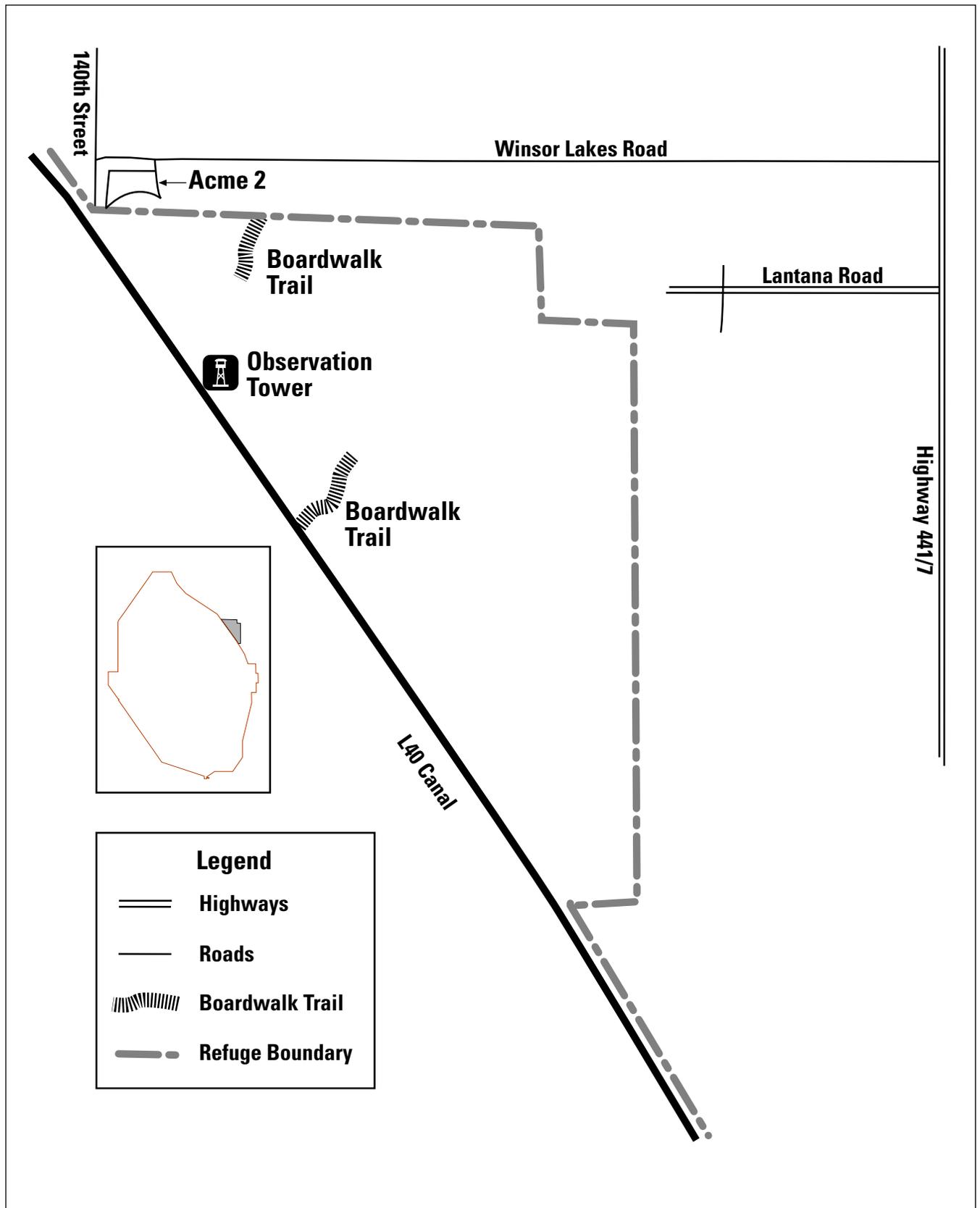


Figure 17. Expanded public use opportunities at Strazzulla Marsh, A.R.M. Loxahatchee National Wildlife Refuge.



3. Develop a hiking and bicycling trail on the existing main levee.
  - Continue the newly opened bicycle use of the perimeter levee from the Headquarters Area to Hillsboro Area (*Figure 18*).
  - Permit hiking use of the main levee from Hillsboro Area northwest to the S-6 Pump. Hiking is also allowed from Hillsboro Area to the ACME 1 Pump Station which is northeast of Strazzulla Marsh (*Figure 18*). Parking access may be developed in partnership with the Village of Wellington and the ACME Drainage District.
  
4. In cooperation with state and county natural resource agencies, develop a Contact Station and Interpretive Center at the Hillsboro Area. Also, a limited concession contract will be awarded to expand appropriate and compatible wildlife-dependent recreational opportunities at the Hillsboro Area.
  - The Contact Station and Interpretive Center will provide a refuge presence at the Hillsboro Area, and give interpretation to the differences between Water Conservation Areas 1, 2, and 3 and nearby Wildlife Management Areas. The building would provide offices, public telephones, and restroom facilities.
  - The concession contract may include a limited number of motorboat, canoe, kayak and bicycle rentals, fishing gear, and a seasonal pontoon boat shuttle service with interpretive guides between Hillsboro, Headquarters and the Strazzulla Marsh Areas.
  
5. The refuge will provide appropriate, compatible, wildlife-dependent fishing and hunting opportunities (*Figure 19*).
  - Develop a Hunt Plan for Alligators and Feral Hogs and update the Waterfowl and Fishing Plans by 2002.
  - Permit up to four small fishing tournaments per year.
  - Redefine the boundaries of the waterfowl hunt area to make it more accessible.
  - Eventually increase waterfowl hunt area accessibility by developing paths through the invasive cattail area on the east side of the refuge interior (depending on water quality improvement in the perimeter canal).
  
6. Develop an environmental education curriculum by 2002, for use on and off the refuge that centers on providing an understanding and appreciation of the Everglades, the refuge's ecology, and the human influence on ecosystems of southeast Florida. This plan will follow guidelines from the National Outreach Strategy and be part of a strategy to reach key community leaders such as teachers, school board members, elected officials, and the news media.
  - Update Environmental Education and Interpretation Plan by 2002.
  - Increase educational opportunities with an enhanced and expanded environmental education/visitor center and a teaching pavilion near the Marsh Trail in the Headquarters Area.
  - Expand educational topics to include water quality and exotic and invasive plant impacts on the natural environment.
  - Update the environmental education manual to include the Strazzulla Marsh and Hillsboro Area.
  - Initiate teacher in-service training using the refuge as an outdoor classroom.
  - Make the most effective use of Service resources (for example, teaching teachers). Support specific Service resource priorities as outlined in the Outreach Strategy.
  - To assist visiting teachers and promote a 'leave no trace' ethic, increase liaisons with county and private school boards to implement a volunteer education and guide program.

- Coordinate satellite downlinks with the Service and area schools, and create a downlink site when a refuge classroom is available.
- Create and maintain an interactive web site.
- With the assistance of the regional archaeologist and local Native American communities, develop an education program highlighting Native American cultural heritage as it pertains to the refuge.

7. Upgrade and expand the interpretive program, portraying the significance of the refuge and threats affecting the refuge and the south Florida ecosystem. The interpretive program will be updated using the guidelines from the Fish and Wildlife Service National Outreach Strategy.

- Enhance refuge literature, ensuring updated information about the Service and National Wildlife Refuge System missions.
- Provide multi-lingual brochures and other handouts.
- Promote and expand interpreted tours.
- Enhance and enlarge the Volunteer Speakers Bureau.
- Explore opportunities of greater public investment in the refuge such as a lifetime pass and an “Adopt-a-Refuge” program.
- Repair, replace, and improve interpretive signs.
- Create interpretive signs or kiosks to explain the impoundment management regime at the Headquarters Area and to explain the natural areas of Hillsboro and Strazzulla Marsh.
- Enhance the current media and elected officials outreach program.

#### *Goal 4. Administration*

Continue a partnership with the South Florida Water Management District, including renewal of the license agreement for Water Conservation Area 1. Continue the development of an effective and productive staff to achieve the vision, goals, and objectives of this plan.

##### Discussion:

Successful negotiations with the South Florida Water Management District that lead to signing a new license agreement are fundamental to the implementation of this plan. The license agreement will allow the Service to continue managing the wildlife and associated habitats in Water Conservation Area 1 as the A.R.M. Loxahatchee National Wildlife Refuge for years to come. Also important to the successful management of the refuge is the continued development of an effective staff.

##### Objectives:

1. Work with the South Florida Water Management District to sign a new license agreement.
2. Expand current staff to accomplish additional priority refuge operations and maintenance.
3. Continue developing internal Service and external partnerships to share equipment and manpower.

Figure 18. Public use opportunities and land use zones on the L-40 and L-39 Levees, A.R.M. Loxahatchee National Wildlife Refuge.

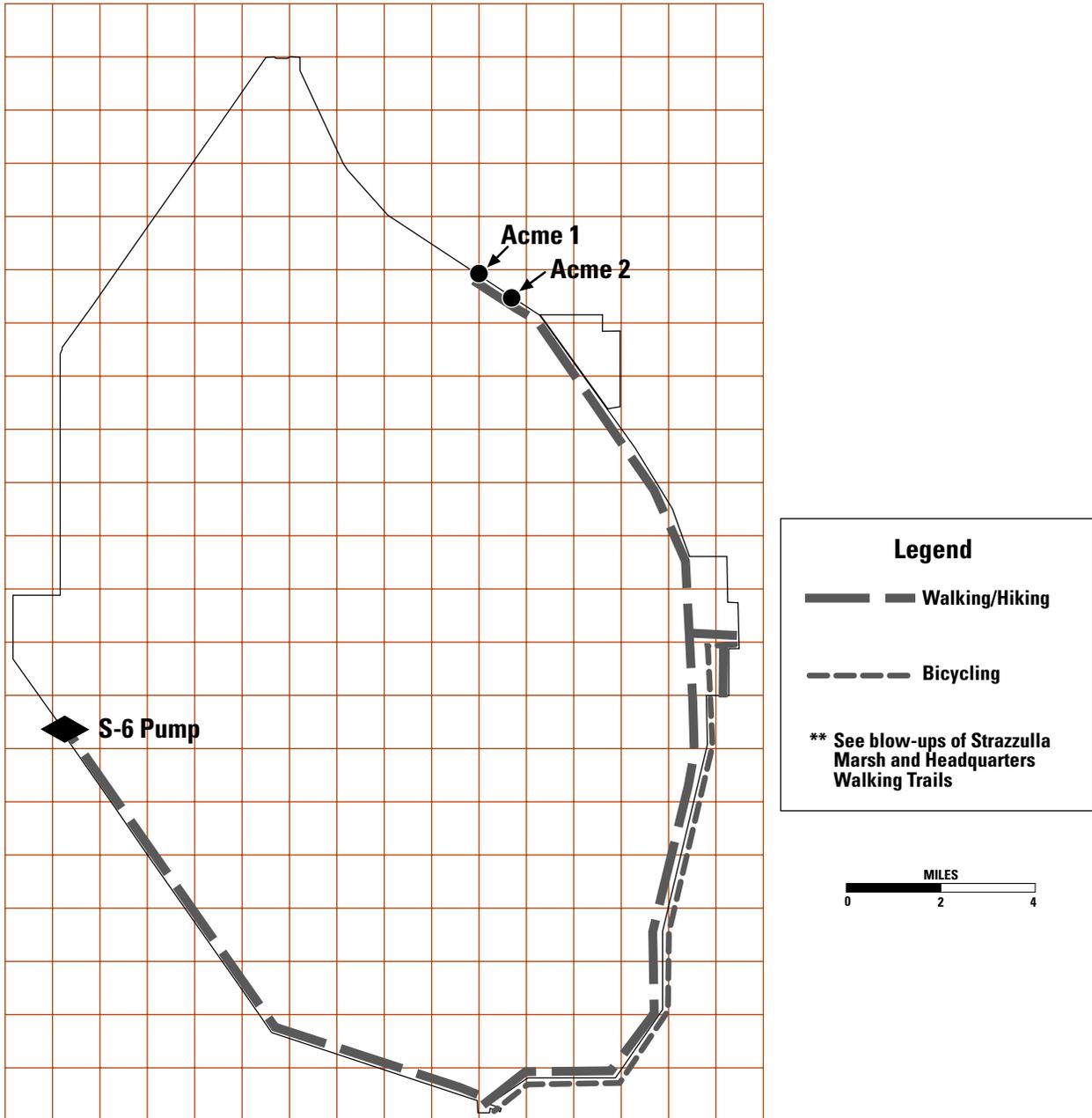
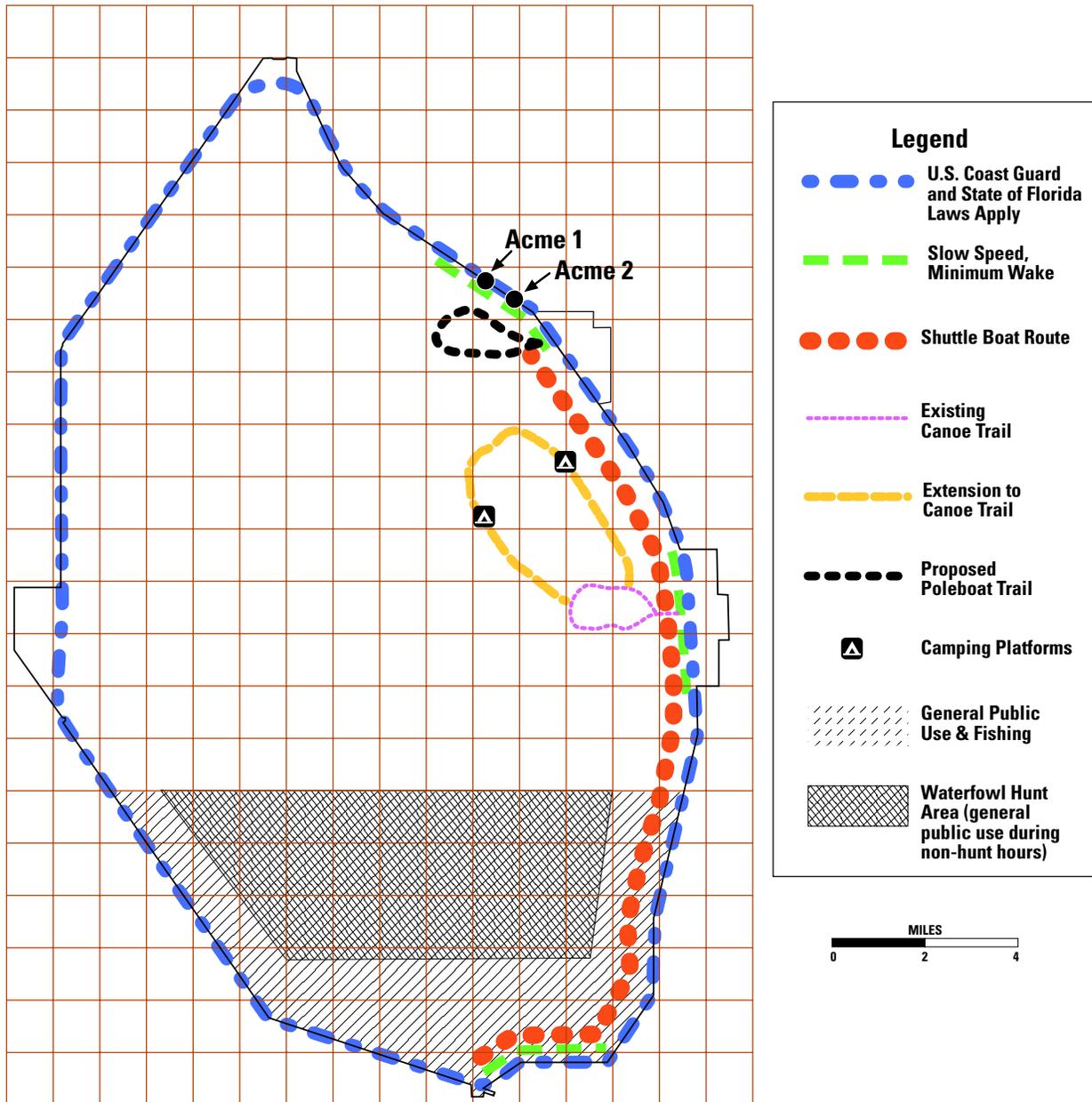


Figure 19. Expanded public use opportunities and waterway zones, A.R.M. Loxahatchee National Wildlife Refuge.





## V. Plan Implementation

The future of this and most national wildlife refuges is dependent upon a public constituency that is knowledgeable of refuge resources and mandates, as well as environmental issues, and is willing to work toward resolving them. To build and maintain this needed constituency, this plan not only provides actions to protect, restore, and conserve wildlife habitat, but also to expanded educational and appropriate, compatible, wildlife-dependent recreational opportunities. Developing partnerships among our



*Nesting Great blue herons*  
USFWS Photo

constituencies is the common thread to implementing these actions and opportunities. Promoting the refuge as an asset of Palm Beach County will enhance the refuge's image and help expand local support. To achieve the management plan for the refuge, this section identifies projects, staff development and equipment needs, staffing and funding needs, partnership opportunities, step-down management plans, and a biological monitoring and evaluation plan.

### Project Summaries

Listed below is a prioritized list of project summaries and their associated costs for biological baseline data collection, habitat restoration and management, environmental education and interpretation, invasive exotic plant

and animal control, expanded wildlife-compatible recreational opportunities, land acquisition, and facility development and maintenance over the next 15 years. While this project list is not intended to be all inclusive, it does reflect the basic needs identified by the public (two comment periods), planning team members, and refuge staff based upon available information. These projects were generated for the purpose of achieving refuge objectives and strategies, and the primary linkages of these projects to those planning elements are identified in each summary. Additionally, these projects are the basis for funding requests from the U.S. Congress, which must be approved by the Fish and Wildlife Service, the Department of the Interior and the President's Office of Management and Budget, before being forwarded to Congress. The following project descriptions are listed in order of priority, and derived mostly from public comments and comments from government and non-government agencies in response to the Draft Comprehensive Conservation Plan for A.R.M. Loxahatchee National Wildlife Refuge.

### *Wildlife Habitat and Population Management*

#### *Project 1. Invasive Exotic Species Control*

##### 1a. Invasive Exotic Plant Species Control (melaleuca and Old World climbing fern only)

The invasive exotic plant species of melaleuca and Old World climbing fern presently infest nearly 100,000 acres of the refuge and are expanding at a rate of more than 4,000 acres per year. These plants are out-competing native vegetation and are altering the Everglades ecosystem. Since past research and control efforts have not kept up with the rate of spread of these species, a significant increase in funding for aerial and ground controls is needed. Most recent contracts for ground control cost in excess of \$200 per acre for melaleuca; aerial application \$300-\$400 per acre. In

addition to control efforts, funding is also needed for research related to biological controls in partnership with U.S. Department of Agriculture's research and quarantine facilities. The encouraging news, as least as it relates to melaleuca, is that there are several promising insects that feed specifically on this species that may be used as bio-controls. Unfortunately, there are no known bio-controls for Old World climbing fern, and labor intensive control is approximately \$500 per acre. To effectively tackle this significant threat to refuge habitats, \$3,000,000 will be needed for at least 5 years to tackle the bulk of the infestation while bio-controls are tested on melaleuca and discovered for Old World climbing fern. Lesser amounts of funding will be needed for maintenance control of the new growth. An ecologist, knowledgeable in exotic plants and animals, will be needed (\$61,300). In addition, mapping is needed to understand existing conditions, to plan control strategies, to evaluate habitat conditions; and to provide long-term monitoring. A one-time mapping contract would cost \$280,000 and would need to be updated every 5 years. The hope is that 5 years of significant funding towards mechanical and herbicidal control will allow enough time for research efforts to produce bio-controls that will work effectively. Obviously, if bio-controls can be introduced earlier, funding could be reduced. After 5 years, funding would still be needed to enable maintenance control of existing invasive exotics and to be pro-active in response to new threats. The subtropical environment of south Florida is conducive to the growth and establishment of exotic plant species. Close monitoring and action is needed to prevent future exotic threats from reaching epidemic proportions. The estimated cost of this project is \$3,340,000 for the first year and \$3,000,000 for the next 5 years until the bulk of the infestation can be reduced to maintenance control levels. The recurring base or annual funding for maintenance control should be around \$500,000 per year by current estimates (Linkage: Goal 1, Objectives 1, 3,5,8).

#### 1b. Other Invasive Exotic Plant Species Control

Beyond the daunting melaleuca and Old World climbing fern problems, there are other invasive exotic plant infestations that negatively impact natural refuge habitats. Water lettuce and water hyacinth clog waterways on the refuge, and hydrilla and other invasive exotic plants impact management in other areas. Brazilian pepper, wild guava, bishopwood, earleaf acacia and other species infest wetlands and dike areas. The extent of these impacts is not well known. This project would survey these invasive exotic plants at a cost \$10,000, with updates needed every 5 years. The survey would assist the refuge in focusing treatment and controlling these other exotic plants. The estimated cost for this project is \$10,000 with recurring costs of \$1,500 per year (Linkage: Goal 1, Objective 8).

#### 1c. Invasive Exotic Animal Species Control

Very little is known about the ecology, range, or abundance of most of the 89 species of Florida's non-indigenous aquatic animals, including those that inhabit the refuge. Walking catfish, oscar, tilapia, black acara, and others have infested the refuge waters for years (*Table 23*). Exotic fish species are discovered each year and it is thought that these species pose a threat to biodiversity on par with habitat loss and degradation. Serious new threats include the Asian swamp eel, a South American armored catfish, and a bromeliad weevil which are poised to infiltrate the refuge waters and vegetation. This survey would need to be updated every 5 years. In addition, mapping is needed to understand existing conditions, plan control strategies, evaluate habitat conditions, and provide long-term monitoring for these exotic animals. The estimated cost for this project is \$10,000 with recurring costs of \$1,500 a year (Linkage: Goal 1, Objectives 4, 8).

### *Project 2. Water Quantity, Timing, Delivery, and Quality Monitoring*

A hydrological computer model is needed to predict the potential impacts to wildlife and habitats under the new Everglades hydrologic regime. This model would enable managers to recommend changes in the regime that would minimize impacts and provide critical data to evaluate long term impacts to the refuge under different restoration alternatives (\$200,000 per year for five years). Increased water quality monitoring is needed for pesticides, herbicides, fertilizers, heavy metals in canal inflows, exotic plant treatment areas, cypress swamp inflows, and in the compartments. This will include analyzing water and soils as well as body burdens in fish, amphibians, and waterfowl (\$75,000). The total estimated cost for this project is \$275,000, with recurring costs of \$200,000 per year (Linkage: Goal 1, Objectives 2,6; Goal 2, Objective 1; Goal 3, Objective 6).

### *Project 3. Base Maintenance*

With the expanded operations and facilities benefitting resource and public use programs via this Comprehensive Conservation Plan, there is a need to develop an effective, pro-active maintenance program. Additional funding is needed to maintain existing refuge facilities, infrastructure, equipment and vehicles as well as expand and maintain the refuge's water and sewage treatment plants. A minimum level of parts and supplies needs to be available for immediate use. Comprehensive inspections of all buildings, vehicles, and equipment need to be implemented to enable long-term use. Costs for this additional support will be \$100,000 per year (Linkage: Goal 4, Objectives 2,3).

### *4. Expand Environmental Education and Outreach*

To accommodate the increasing interest in environmental education by the expanding school systems in south Florida, a new curriculum, developed for use by educators on and off the refuge, will center on conveying the importance of the Everglades and refuge habitats as well as the impacts of human development. An open air pavilion will be constructed near the marsh trail for teaching visiting school classes. Outreach opportunities will be expanded and enhanced through public service materials, brochures, and a web site to reach 6 million (and growing) south Florida residents, as well as the million more tourists who visit annually. Costs for construction and start-up will be \$150,000, with recurring costs of \$10,000 per year (Linkage: Goal 3, Objectives 6, 7).

### *5. Fire Management Program*

Fire has historically been a natural part of the Everglades ecosystem. Due to the burgeoning population on the southeast Florida coast and air quality standards, it is difficult to use prescribed fire. However, it is a preferred management tool. Research is needed to better understand different aspects of the natural role of fire in the unique northern Everglades system, the effect of fire on tree islands, and the potential effects of increased loads of phosphorous to topsoil released by fire. Another unique research need is to understand the effect of fire in spreading exotic plants such as Old World Climbing fern and melaleuca and conversely how fire can be used to retard the spread of these exotics. In addition, studies are needed to implement safe and effective prescribed fires, and to design burn units (areas to be burned) and frequency models (determine how often to burn, what the plant communities and wildlife responses would be to fire at different times of the year and under various water depths). The studies would be contracted to a university, the U.S. Geological Survey's Biological Resources Division, or another research partner at \$100,000 per year.

To implement an effective fire management program, a fire management officer (or a prescribed fire specialist) (\$61,300 per year for salary/benefits) is needed with an understanding of the role of fire in the Everglades ecosystem, the constraints exotics place on the system, and the benefits of prescribed burning in restoration of wildlife habitat. A fire technician to assist in this complex program would also be needed (\$33,500 per year

for salary/benefits). Refuge impoundments within Compartments B and C would be burned on a rotational basis to reduce undesirable vegetation and provide quality wildlife habitat. Specific areas of the refuge interior would be burned to reduce the biomass of treated melaleuca and rank cattail vegetation. The initial cost for this project is \$200,000 with recurring costs of \$200,000 per year (Linkage: Goal 1, Objectives 3,5,8; Goal 3, Objective 1).

### *6. Everglades Restoration Monitoring*

The recovery and maintenance of healthy populations of threatened, endangered, keystone/indicator species, and habitats are important goals of the National Wildlife Refuge System and Everglades restoration. All biological data collected on the refuge from its inception would be compiled and entered into a computerized database. Studies would be initiated to gather data on the life histories and habitat uses of key species such as snail kite, alligator, migratory birds, resident wading birds, and fish. Collection of these data will permit the refuge to evaluate the overall success of restoration efforts and guide future management decisions. A biologist would be hired to assist with surveys, data collection and entry, and analysis. Estimated costs include \$120,000 for start-up costs for a biologist and equipment, with recurring costs of \$50,000 per year (Linkage: Goal 1, Objectives 1,2,6,8; Goal 2, Objective 2).

### *7. Monitor Vegetation Patterns and GIS Database Development*

#### 7a. Geographic Information System Database

Geographic Information System technology enables better mapping, evaluation, and presentation of the diverse and dynamic northern Everglades habitats of which the refuge is a part. A Geographic Information System workstation would be acquired to enable staff, researchers, and partners to evaluate multi-layered spatial data including habitat, wildlife, exotic species, and results of management decisions. A Geographic Information System staff position is needed to manage the system and data (\$50,800). Estimated costs are \$90,000 for the first year, with recurring costs of \$60,000 per year (Linkage: Goal 1, Objectives 2,3,4,5,6,7,8; Goal 2, Objective 3).

#### 7b. Monitor Dynamic Northern Everglades Vegetation Patterns

The imperiled northern Everglades is a dynamic system resulting in continuous changes in vegetation patterns in response to hydrology, fire, elevation, and soils. This project will compile data from all past studies on vegetation change in the refuge and re-sample 1-square-mile photo plots. Several studies, conducted on the refuge since the 1940s, can serve as the foundation for future studies. This project, estimated to cost \$60,000 would enable the refuge to gain a greater understanding of ecosystem processes and would assist in making future management decisions. This project would be re-done every 5 years at an estimated cost of \$25,000 to evaluate refuge management as outlined in the Comprehensive Conservation Plan and the Comprehensive Everglades Restoration Plan (Linkage: Goal 1, Objectives 2,3,4,5,6,7,8; Goal 2, Objective 2).

### *8. Actively Manage Compartments and Impoundments*

Management Compartments A, B, C, and D comprise 2,550 acres of habitat available for more intensive management. One of the least represented components of the historic system is forested wetlands. Compartments A and possibly B could be replanted in cypress, pond apple, red maple, and other trees native to the appropriate plant community (\$70,000). A mosaic of habitats will be created in other areas through active water manipulation and prescribed burning to provide foraging needs of migrating shorebirds, nesting wading birds, waterfowl, and raptors. Thirteen impoundments totaling 725 acres need to have several water control structures replaced or repaired (\$70,000). New pumps are needed at both the north and south ends (\$325,000) and all perimeter canals need to be rehabilitated (\$170,000) to improve water delivery. A seepage pump with automatic settings is needed at Compartment D to facilitate

water management and minimize seepage/flooding impacts to neighboring landowners. In order to effectively manage water and maintain water facilities, a maintenance position would be needed (\$43,300). Heavy equipment such as an excavator, bulldozer, and tractor need to be acquired (\$410,000). The estimated cost for this project is \$1,088,300 with recurring costs of \$110,000 per year. In addition, staff would provide technical assistance and help develop grants and partnerships with state, regional, county, and private landowners to enhance habitat management for trust species throughout Palm Beach County and the surrounding area (Linkage: Goal 1, Objectives 3,4,5,7,8; Goal 3, Objective 1).

### *9. Expand Hunting Opportunities*

Developing additional public hunting opportunities for alligator and feral hog will require additional administrative, biological, and law enforcement effort and overtime costs. Increasing accessibility at the south end of the refuge for waterfowl hunting will require establishing contracts for trail maintenance, but will not be done until water quality reaches acceptable levels on a consistent basis. The estimated cost of this project is \$50,000 with recurring costs of \$15,000 per year (Linkage: Goal 3, Objectives 4,5).

### *10. Boundary Line Survey*

Several portions of the refuge boundary have become overgrown with vegetation or impacted by adjoining developments. At least 20 miles of boundary would be marked and posted to clearly identify the refuge boundary. Estimated cost is \$75,000 (Linkage: Goal 2, Objectives 3,5,6,7).

### *11. Hillsboro; Develop a Contact Station and Interpretive Center*

This southernmost access point to the refuge is heavily used by residents from Palm Beach and Broward counties. While the parking lot has been graveled and existing boat ramps are scheduled for replacement, facilities are still limited. A new information center would be built for refuge staff, volunteers, and refuge support groups. This center would provide information about the refuge and would assist in increasing visitor security, reduce vandalism and decrease other illegal activities. Efforts would be made to partner with the Florida Fish and Wildlife Conservation Commission, South Florida Water Management District, and local agencies to convey the value of the Everglades and major restoration efforts, contrast the unique differences between Water Conservation Areas 1,2, and 3, and adjacent Wildlife Management Areas. A refuge ranger position (\$41,400) would be filled to provide environmental education, interpretation, and coordination. Projected start-up costs will total \$241,400, with recurring costs of \$50,000 per year (Linkage: Goal 3, Objectives 3,6,7).

### *12. Land Acquisition*

To protect the integrity of the refuge, it is necessary to acquire nearby lands from willing sellers or enter into management agreements with other government entities. Staff are particularly concerned about extending the refuge boundary to include a narrow strip of land (about 680 acres), or entering into a partnership to manage the lands just east of the visitor center and refuge impoundments. Such lands would buffer the effects of urban development adjacent to the refuge. While several efforts are underway to acquire lands along the eastern boundary, either as water preserve areas (as part of the Comprehensive Everglades Restoration Plan) or as environmentally sensitive lands (as part of Palm Beach County's Agricultural Reserve Program), there is always the possibility that this land may not be acquired under these programs. If this is the case, leases, easements, or management partnerships are the preferred choices to protect these lands. However, the refuge would still be interested in acquiring these lands from willing sellers. Land purchase estimates could range between \$2 - 6 million. Lands acquired could be managed as natural wetlands or replanted with trees to restore the forested wetland component of the Everglades (Linkage: Goal 2, Objective 3; Goal 1, Objective 8).

### *13. Develop Strazzulla Marsh Visitor Facilities*

Additional access and public use facilities are needed at the north end of the refuge to accommodate people residing to the north and the west of the refuge, particularly in the Village of Wellington and other nearby Palm Beach County communities. Facilities will be developed for compatible, wildlife-dependent recreation, including a disabled-accessible fishing pier, elevated observation tower and boardwalk, possibly a poleboat launch, interpretive panels, information and directional signing, and restrooms. This development will also serve as an access point for hiking use associated with the hiking trail. Public access and a vehicle parking lot may be developed in partnership with the Village of Wellington and the ACME Drainage District. A maintenance person would be hired for the upkeep and repair of this and other refuge facilities. Estimated costs would be \$275,000 for construction and start-up, with salary and maintenance costs running \$40,000 per year (Linkage: Goal 3, Objectives 2,5,7).

### *14. Expand Hillsboro Recreational Activity Facilities*

A contract would be awarded to establish a concession operation. This concession may provide a limited number of the following recreational opportunities: canoe and boat rentals, fishing equipment and guides, bicycle rentals, and interpretive pontoon boat trips up to the Headquarters and Strazzulla Marsh areas. The concessionaire, as the refuge develops the appropriate partnerships, may also supply equipment, rentals, and guides to support recreational opportunities in Water Conservation Area 2 which is adjacent the refuge and extensively accessed within 50 yards of the Hillsboro Area entrance. A law enforcement officer would be stationed at this site to ensure visitor safety and resource protection (\$46,200). Projected start-up costs will run \$108,600, with recurring costs of \$37,600 per year (Linkage: Goal 3, Objectives 3,4,5).

Data collection  
USFWS Photo by M. Bailey



*15. Expand Headquarters Visitor Facilities*

While the refuge has the second highest visitation among outdoor attractions in Palm Beach County, its visitor center is limited in its ability to provide interpretive exhibits and programs to a rapidly expanding nearby population of 6 million people. Construction of an additional building, to mirror the existing one, will double the space to 5,000 square feet and provide an expanded display area with interactive exhibits, classrooms, “wet labs,” larger auditorium, expanded cooperating association sales area, and additional office and storage space. The Service will contract for construction of the building (\$650,000) as well as new exhibits (\$400,000). Existing levees will be opened for wildlife observation and hiking in Compartment A and interpretive signs will be installed (\$25,000). A senior public use specialist (\$70,300 per year) is needed to coordinate outreach, planning, and interpretive programs for the refuge (as well as for its “satellite” refuge, Hobe Sound National Wildlife Refuge, which is administered by Loxahatchee refuge). In addition, a park guide (\$39,600) would be hired to assist with the expanded interpretive tours and programs. The existing canoe trail will be extended and two camping platforms (\$16,000 each) and two composting toilets (\$3,000 each) will be added to allow overnight platform camping. The canoe trail will need to be maintained at least three times per year (\$10,000) with a mechanical cutting machine and \$10,000 will cover overall program administrative costs. The cost of the canoe trail extension and camping platforms will be \$58,000. The total cost for this project is \$1,274,000 with recurring costs of \$160,000 per year (Linkage: Goal 3, Objectives 1,3,6,7).

**Table 8. Cost summary of the projects for the refuge**

The Initial Project Cost is the projected sum for getting the project started the first year. The Recurring Base Cost is the amount that will be incurred each year thereafter to continue the project.

<i>Projects</i>	<i>Initial Project Cost</i>	<i>Recurring Base Cost</i>
1. Invasive Exotic Species Control	\$3,340,000	\$3,000,000 *
2. Water Quantity, Timing, Delivery and Quality Monitoring	275,000	200,000
3. Base Maintenance	-----	100,000
4. Expand Environmental Education and Outreach	150,000	10,000
5. Fire Management Program	200,000	200,000
6. Everglades Restoration Monitoring	120,000	50,000
7. Monitor Vegetation Patterns/GIS Database Development	150,000	60,000
8. Actively Manage Compartments and Impoundments	1,088,300	110,000
9. Expand Hunting Opportunities	50,000	15,000
10. Boundary Line Survey	75,000	-----
11. Hillsboro; Develop a Contact Station and Interp.Center	241,400	50,000
12. Land Acquisition	2 to 6,000,000	-----
13. Develop Strazzulla Marsh Visitor Facilities	275,000	40,000
14. Expand Hillsboro Recreational Activity Facilities	108,600	37,600
15. Expand Headquarters Visitor Facilities	1,274,000	160,000
<i>Grand Total</i>	<i>\$7,347,300</i>	<i>\$4,032,600</i>
<i>without land acquisition</i>		<i>\$9,347,300</i>
<i>with land acquisition</i>		<i>\$13,347,300</i>

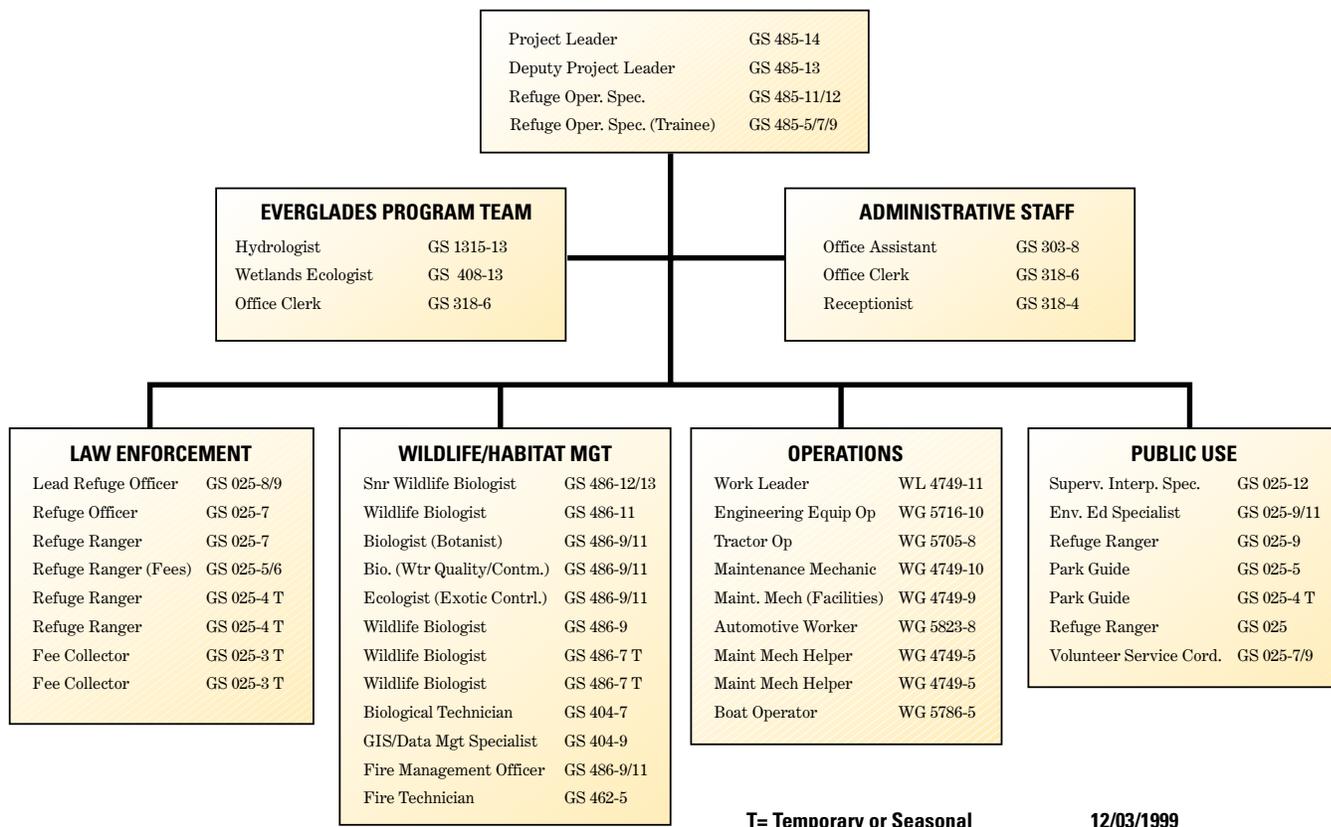
\* The Recurring Base Cost for Project 1 will diminish quickly over time as areas are “initially attacked” and as bio-controls are released and become more effective against melaleuca and Lygodium.

**Table 9. Annual cost of proposed staff positions for A.R.M. Loxahatchee National Wildlife Refuge**

\* Law enforcement enhanced pay, Salary including benefits (calculated at the highest potential wage possible, using FY-2000 wage scales).  
T- temporary or seasonal

<i>Management</i>	<i>Grade</i>	<i>Annual Cost*</i>
Project Leader	GS-0485-14	\$104,400
Deputy Project Leader	GS-0485-13	\$88,400
Refuge Operations Specialist	GS-0485-11/12	\$74,300
Refuge Operations Specialist (trainee)	GS-0485-5/7/9	\$51,200
<i>Everglades Program Team</i>		
Hydrologist	GS-1315-13	\$88,400
Wetlands Ecologist	GS-0408-13	\$88,400
Office Clerk (EP Team only)	GS-0318-6	\$37,700
<i>Administrative Staff</i>		
Office Assistant	GS-0303-8	\$46,400
Office Clerk	GS-0318-6	\$37,700
Receptionist	GS-0318-4	\$30,200
<i>Law Enforcement</i>		
Lead Refuge Officer	GS-0025-9/11*	\$62,000
Refuge Ranger	GS-0025-7*	\$46,200
Refuge Ranger	GS-0025-7	\$41,900
Refuge Ranger (Fees)	GS-0025-5/6	\$37,700
Refuge Ranger	GS-0025-4 T	\$13,200
Refuge Ranger	GS-0025-4 T	\$13,200
Fee Collector	GS-0025-3 T	\$11,800
Fee Collector	GS-0025-3 T	\$11,800
<i>Wildlife/Habitat Management</i>		
Senior Wildlife Biologist	GS-0486-12/13	\$88,400
Wildlife Biologist	GS-0486-11	\$62,000
Biologist (Botanist)	GS-0486-9/11	\$62,000
Biologist (Water Quality & Contaminants)	GS-0486-9/11	\$62,000
Ecologist (Exotic Control)	GS-0486-9/11	\$62,000
Wildlife Biologist	GS-0486-9	\$51,200
Wildlife Biologist	GS-0486-7 T	\$18,400
Wildlife Biologist	GS-0486-7 T	\$18,400
Biological Technician	GS-0404-7	\$41,900
GIS/Data Management Specialist	GS-0404-9	\$51,200
Fire Management Officer	GS-0486-9/11	\$62,000
Fire Technician	GS-0462-5	\$33,800
<i>Maintenance Operations</i>		
Wage Leader	WL-4749-11	\$52,700
Engineering Equipment Operator	WG-5716-10	\$45,100
Tractor Operator	WG-5716-8	\$39,600
Maintenance Mechanic	WG-4749-10	\$45,100
Maintenance Mechanic (Facilities)	WG-4749-9	\$42,300
Automotive Worker	WG-5823-8	\$39,600
Maintenance Mechanic Helper	WG-4749-5	\$31,200
Maintenance Mechanic Helper	WG-4749-5	\$31,200
Boat Operator	WG-5786-5	\$31,200
<i>Public Use</i>		
Supervisory Interpretive Specialist	GS-0025-12	\$74,300
Environmental Education Specialist	GS-0025-9/11	\$62,000
Refuge Ranger	GS-0025-9	\$51,200
Refuge Ranger	GS-0025-7	\$41,900
Park Guide	GS-0025-5	\$33,800
Park Guide	GS-0025-4 T	\$13,200
Volunteer Services Coordinator	GS-0025-7/9	\$51,200
Subtotal (annual staff costs)		\$2,183,800
Annual fixed costs (phone, gas, diesel, electric, travel, equipment repair, equipment and building maintenance, etc.)		\$185,000
<b>Total Annual Cost</b>		<b>\$2,368,800</b>

**Figure 20. Proposed staffing plan for A.R.M. Loxahatchee National Wildlife Refuge**



**Staffing and Funding**

Currently a staff of 23 permanent and 13 temporary/seasonal positions has been approved by the regional office for the refuge, but current funding covers only 20 permanent and 4 temporary/seasonal positions. In the recent past, most of the temporary/seasonal personnel have been used for melaleuca control or for the entrance fee program. Since the plan calls for contracting out exotic species control, and fee collection procedures and compliance monitoring have been improved, the number of “seasonals” was reduced to four positions.

To complete the extensive wildlife management and restoration projects and increase inventorying, monitoring, and mapping projects more permanent staff will be needed, including a refuge operational specialist, an office clerk, a receptionist, a law enforcement refuge ranger, a botanist, an ecologist, a wildlife biologist, a geographic information system specialist, a fire management officer, a fire technician, a wage leader for the maintenance staff, a tractor operator, a maintenance mechanic, a maintenance mechanic helper, a boat operator, an interpretive refuge ranger, a park guide, and a volunteer services coordinator. Additional seasonal positions are needed to expand the programs identified in the plan including a refuge ranger (law enforcement) and interpretive park guide during our heavy use periods and two wildlife biologists during critical census/inventory time periods. The staffing plan (Figure 20), at full development level, would achieve the plan objectives and strategies within a reasonable time period. The annual costs (salary, including benefits) of the staffing plan is shown in Table 9. The rate at which this refuge achieves its full potential of contributing locally, regionally, and nationally to wildlife conservation; appropriate, compatible wildlife-dependent recreation; and environmental education is totally dependent upon receiving adequate funding and staffing.

**Partnership Opportunities**

To achieve the goals and objectives of this plan, maintaining existing partnerships and developing new ones with a variety of resource agencies, organizations, and individuals is essential (for a list of existing and potential partners, see Appendix M). Partnerships will not only enable the refuge to fulfill plan objectives, but also minimize costs.

As reflected in the management objectives, Loxahatchee refuge is one of the key players in the restoration of the northern Everglades. Coordination with agencies, organizations, and individuals involved with Everglades restoration will ensure that refuge management remains consistent with ecosystem restoration objectives.

Effective management of water quality, quantity, and timing is critical to achieving wildlife habitat and population objectives in the refuge interior. To these ends, partnerships will be developed with adjacent landowners, South Florida Water Management District, Lake Worth Drainage District, Corps of Engineers, and the Florida Department of Environmental Protection. To maintain and enhance wildlife habitat outside of the refuge, the Service will focus its efforts on developing partnerships with the Village of Wellington and farmers in the Everglades Agricultural Area.

Effective management of exotic plants will depend on developing key partnerships with other local, state, and federal agencies and universities and conservation organizations. These partnerships will provide for an extensive base of knowledge and expertise to assist the refuge in organizing its exotic plant management efforts. The refuge works closely with the South Florida Water Management District, U.S. Department of Agriculture, National Park Service, Department of Environmental Protection, and University of Florida researchers and scientists concerning exotic plant research and monitoring, and exotic plant treatments for melaleuca, Old World climbing fern, and floating exotic plants. Research scientists from the U.S. Department of Agriculture and the University of Florida assist refuge staff to identify exotic plants, recommend herbicides and treatment methods, coordinate biological control releases and monitoring, and assist with research on the effects of exotic plants on native plants and wildlife. The refuge has just begun a partnership with the Lake Worth Drainage District on levee maintenance, native plantings, and chemical treatment of exotic floating plants. They have also assisted with the removal of Brazilian pepper using heavy equipment around refuge impoundments. The refuge hopes to develop partnerships with adjoining landowners and neighbors to establish “exotic free” buffers adjacent to the refuge.

Collaboration with colleges, universities, and conservation organizations will enable the refuge to carry out its extensive plans for research, monitoring, and education. To create awareness and expand environmental education efforts in the community, partnerships will be established with school systems and organizations. The refuge’s existing relationship with its cooperating association, the Loxahatchee Natural History Association, will be enhanced and similar partnerships will be pursued with other support groups to meet other refuge needs.

**Table 10. Step-Down Management Plans and completion dates, arranged by issue sequence in the goals and objectives portion of the plan.**

<i>Step-Down Plan</i>	<i>Completion Date</i>
Integrated Pest Management Plan	2002
Exotic Plant Control Plan	2002
Exotic Animal Control Plan	2002
Water Quality Monitoring Plan	2002
Biological Inventory/Monitoring Plan	2003
Moist Soil/Water Management Plan	2002
Fire Management Plan (Update)	2002
Law Enforcement Plan	2002
Cultural Resource Protection Plan (Update)	2003
Public Use Management: General Plan (Update)	2005
Public Use Management: Environmental Education Plan (Update)	2002
Public Use Management: Fishing Plan (Update)	2004
Public Use Management: Hunt Plan (Update)	2004
Alligator Hunt Plan	2004
Feral Hog Hunt Plan	2004
Waterfowl Hunt Plan (Update)	2004
Public Use Management: Signs (Update)	2004

### **Step-Down Management Planning**

A comprehensive conservation plan is a strategic plan that guides the future direction of the refuge. Before some of the strategies and projects can be implemented, detailed step-down plans will need to be prepared or updated. To assist in preparing and implementing the step-down plans, refuge staff will develop partnerships with local agencies and organizations. These plans, listed in Table 10 and described below, will be developed in accordance with the National Environmental Policy Act, which requires the identification and evaluation of alternatives and public involvement prior to their implementation.

#### *Integrated Pest Management Plan*

Draft Completion 2002

This plan will address the complex issue of bringing exotic plants and animals to a maintenance control level on the refuge. It will cover chemical herbicide use (aerial and ground level), mechanical eradication, and the use of bio-controls. The Exotic Plant and the Exotic Animal Control Plans will be sections within this plan.

#### *Exotic Plant Control Plan (Update)*

Completion 2002

This plan (as part of the Integrated Pest Management Plan) will bring exotic and invasive plants to a maintenance control level as soon as possible. It will identify current infestation levels of the major exotic or invasive plants on the refuge and outline methods for controlling and monitoring these plants. Survey and control methods will also be identified for non-major exotic and invasive exotic plants.

*Exotic Animal Control Plan*

Completion 2002

This plan (as part of the Integrated Pest Management Plan) will describe survey, removal and monitoring techniques for both terrestrial and aquatic invasive and exotic animals (vertebrate and invertebrates).

*Water Quality Monitoring Plan*

Completion 2002

This plan will address monitoring sites and stations targeted for ongoing research into how the quality of water changes over time. It will state how the various habitat types (cypress swamp, Strazzulla marsh, impoundments and refuge interior) and structures (Stormwater Treatment Area outflows, culverts leading into the cypress swamp, etc.), will be monitored for nutrients, pesticides, and other chemicals which may adversely affect those environments.

It will also include the stipulations set forth in the Consent Decree. This plan will help ensure that all refuge water quality meets the standards of the Department of Environmental Protection and the Environmental Protection Agency for Class III and Outstanding Florida Waters. It will address research and monitoring needs to meet these water quality standards and will more precisely identify the location of monitoring sites, list the frequency of monitoring, and describe the methods of evaluation.

*Biological Inventory/Monitoring Plan*

Completion 2003

This plan will describe inventory and monitoring techniques and time frames. All plant communities and associations in the refuge as well as all trust species (migratory birds including shorebirds, neotropical passerines, and waterfowl), listed species (federal and state threatened, endangered, and species of concern), and key species shall be inventoried, and population trends will be monitored. These data are essential to guide wildlife habitat management on the refuge.

*Moist Soil/Water Management Plan*

Completion 2002

This plan will identify the procedures for managing the compartments and the cypress swamp for optimal wildlife benefits, including methods, timing, and implementation.

*Fire Management Plan*

Completion 2002

Updating and implementing this plan will result in more aggressive wildlife habitat management in the refuge interior. This plan will also include fire management in other areas of the refuge, including all the compartments and Strazzulla Marsh.

*Law Enforcement Plan*

Completion 2002

Updating this plan will reflect objectives and strategies of the comprehensive conservation plan.

*Cultural Resource Protection Plan*

Completion 2003

This plan will identify and seek to protect archeological sites. Development of this plan, written by the Service's Regional Archaeologist, will involve consultation with federally recognized Native American Nations, the State Historic Preservation Office, and other professional archaeologists.



*Monitoring vegetation density  
USFWS Photo by M. Bailey*

#### *Public Use Management: General (Update)*

Completion 2005

This plan will address appropriate, compatible, and wildlife-dependent recreation issues including facility upgrades, handicapped accessibility, types of recreation, accessibility, and concession usage.

#### *Environmental Education Plan*

Completion 2002

This update will reflect the objectives and strategies of the comprehensive conservation plan and address environmental education guidelines following Sunshine State standards. As a part of this plan, an education manual will be created that follows the plan and Fish and Wildlife Service guidelines for environmental education.

#### *Hunt Plan and Fishing Plan*

Completion 2004

This updated plan will reflect the Comprehensive Conservation Plan's objectives and strategies regarding select species including alligators, feral hogs, and waterfowl. It will identify species to be hunted, seasons, limits (dependent upon biological survey findings), hunt areas, accessibility, hunt methods, and other regulations applicable to species hunting regulations. This update will address specific aspects of the refuge fishing program including boat speeds, fishing boundaries, needed facilities, and applicable fishing regulations.

#### *Sign Plan (Update)*

Completion 2004

In this plan, signs will be redesigned, incorporating Fish and Wildlife Service guidelines.

## Monitoring and Evaluation

Effective long-term management of the refuge will depend on baseline inventories and periodic monitoring and evaluation of refuge resources.

Data generated from inventory and monitoring efforts will enable refuge staff to determine the status and trends of key species and habitats. These data will be incorporated into a geographic information system, which will enable refuge staff to evaluate the effects of alternative habitat management techniques, exotic plant control methods, and changes in water quality on these species and habitats.

These efforts will enable the refuge to evaluate the achievement of the proposed objectives and strategies identified in the Comprehensive Conservation Plan, if necessary make adjustments in the plan, and test new management techniques. Thus, adaptive management, as it is called, is a flexible approach to the long-term management of resources that is guided by the results of ongoing inventory and monitoring activities.

The primary direction the biological inventorying and monitoring plan will follow is governed by the Service Refuge Manual and the “Fulfilling the Promises” and “Biological Needs Assessment” (internal management) documents. Issues such as the Everglades restoration and regional protection of listed, trust, and focal species are referenced in the South Florida Ecosystem Team’s Ecosystem Plan, South Florida Multi-Species Recovery Plan, and the Comprehensive Ecosystem Restoration Monitoring Plan. All these documents assist refuge management and the refuge biological program to focus inventory and monitoring plans with limited resources.

The following is a list of guidelines and steps refuges use to determine which habitats and species are inventoried and monitored. (Note: Inventory and monitoring projects are sometimes specific to the refuge, while others support regional, national, and international emphasis.)

- Those habitats or species listed in the Refuge Purpose (wildlife habitat and migratory birds)
- The habitats and species of critical management importance. Usually this means the primary trust species (federally listed threatened and endangered species, migratory birds, anadromous fish, and certain marine mammals) which reside on or are dependent upon the habitats found on the refuge (e.g., snail kite, wood stork)
- Secondary trust species (federally listed threatened and endangered species, migratory birds, anadromous fish, and certain marine mammals) which occasionally may use the refuge (e.g., bald eagle, crested caracara)
- State listed species (e.g., Florida sandhill crane, strap fern), Species of Management Concern (e.g., yellow rail, American bittern) and species listed under CITES (e.g., river otter, delicate ionopsis)
- Those habitats or species of concern in the South Florida Ecosystem Team’s Ecosystem Plan, South Florida Multi-Species Recovery Plan and the Comprehensive Ecosystem Restoration Monitoring Plan (e.g., tree islands, wading birds, alligators). These focal habitats and focal species were selected because they can provide information and indicate changes on larger communities and ecological processes.

Adjustments will be made to phase out less productive efforts and include methods providing sensitive indications of population dynamics. Although the refuge is quite large, it is not isolated. Rather, it is an important portion of the greater Everglades ecosystem and surveys will be closely tied to monitoring the restoration efforts.

A limited list of current inventory and monitoring surveys the refuge staff and researchers conduct may be found in Appendix O. The Comprehensive Inventorying and Monitoring Plan will show greater detail in deciding what and how sites or species are selected and how the monitoring will take place.

The Exotic Plant Control Plan includes monitoring and evaluations as well. An exotic plant monitoring program will be key to successful exotic plant management on the refuge. Several projects are currently in the development stage and hopefully will be implemented in 2001. Ten and twelve treated tree islands will be selected for long-term monitoring of Old World climbing fern and melaleuca respectively. Percent coverage of melaleuca, Old World climbing fern, and native plant species will be documented over time in 4 X 5 meter plots in the ground (0-1 meter), shrub (1-2 meters), and over story (>2 meters) vegetation layers. The study will help determine the effectiveness of herbicide treatments and help predict the optimal time for re-treatments. Regeneration of melaleuca, Old World climbing fern, and native vegetation in the various layers will also be documented. In addition, photo points will be established on the interior and exterior of the tree islands to document re-growth. Sites will be monitored quarterly.

Another study to monitor impacts of Old World climbing fern on the native vegetation of tree islands in the refuge was completed during 2000 (Brandt, L. and D. Black, South Florida Water Management District). This study examined species richness and percent cover in ground, shrub, and overstory vegetation layers in one 4 X 5 m plot on ten tree islands in refuge. Five tree islands were heavily infested and five islands had very low or no infestation. Species richness was similar between infested and non-infested islands; however, percent cover of native species was significantly reduced on heavily infested plots.

A herbicide efficacy monitoring program will be developed in the near future to document effectiveness of selected herbicides on Old World climbing fern and non-target damage to native vegetation. Similar studies have been conducted in the past by the Florida Park Service at J.D. State Park, by the South Florida Water Management District at Dupuis State Reserve, and by herbicide manufacturers at the Florida Power and Light Company-owned Baley Barber Swamp in Indiantown. Additional experiments of testing and comparing aerial versus ground application techniques for herbicides on melaleuca and Old World climbing fern may also be implemented but this is strictly dependent upon funding availability and increases.



## *I. Purpose of and Need for Action*

As directed by the National Wildlife Refuge System Improvement Act of 1997, Comprehensive Conservation Plans are to be developed for all National Wildlife Refuges by 2012. These plans will identify the role a refuge will play in support of the mission of the National Wildlife Refuge System, and provide guidance regarding its management direction and operations for the next fifteen years.

A Draft Comprehensive Conservation Plan has been developed for A.R.M. Loxahatchee National Wildlife Refuge to address important natural resource, compatible wildlife-dependent recreation, and administrative needs. To be specific, there is a need to restore and conserve the natural diversity, abundance, and function of flora and fauna; conserve natural and cultural resources through protection, partnerships, and acquisition of land from willing sellers; provide opportunities for appropriate, compatible, wildlife-dependent recreation and environmental education programs; and provide effective and efficient administration of the refuge. For background information relating to natural resource needs, refer to Section II of the Draft Comprehensive Conservation Plan.

Critical to meeting the above needs is the renewal of the U.S. Fish and Wildlife Service's license agreement with the South Florida Water Management District, which controls water flow into and out of Water Conservation Area 1, (also known as the refuge) and to the adjacent Strazzulla Marsh. These lands, while not owned by the Fish and Wildlife Service, are managed under the license agreement, the refuge's authorizing legislation and other federal laws.

*Purple gallinule*  
USFWS Photo by Bruce Flaig



## *II. Proposed Action*

Based on the environmental effects analysis of the proposed action (known as the 'preferred alternative' or the Ecosystem Emphasis Alternative 2) along with public comments concerning the significance of these effects, the Regional Director of the Fish and Wildlife Service must decide whether or not the proposed action would have a significant impact on the environment. If the proposed action is not significant, then a Finding of No Significant Impact will be issued, followed by the preparation of a Final Comprehensive Conservation Plan. If the proposed action is significant, then an Environmental Impact Statement will be prepared.

### *III. Issues and Concerns*

For a description of the issues and concerns, refer to Section II, Planning Issues and Opportunities, in the Draft Comprehensive Conservation Plan.

Following the guidelines of the National Environmental Policy Act, issues and concerns were identified by holding a public scoping meeting and by obtaining written comments from the public. The planning team identified a range of reasonable alternatives, evaluated the consequences of each alternative, and chose the alternative which, in the opinion of the Service and the team, is the best approach to guide the refuge's future direction. This planning effort and the refuge team's ongoing dialogue with various federal, state and county agencies, interest groups and individuals provided important elements in the synthesis of the proposed goals, objectives, and strategies found in the Draft Comprehensive Conservation Plan. Implementation of the plan will necessitate further coordination and cooperation with these entities.

## IV. Alternatives

### Description, Staffing Needs, and Costs

The planning team evaluated four alternatives for achieving the vision. These alternatives, consisting of goals and objectives, are: Alternative 1, Maintain Current Management; Alternative 2, Ecosystem Emphasis; Alternative 3, Biological Emphasis; and Alternative 4, Public Use Emphasis. The alternatives reflect the issues and concerns identified by the planning team, public scoping meeting comments (August 17, 1998, Boynton Beach, Florida), and written comments.

Alternative 2, Ecosystem Emphasis, is the Service's preferred alternative for managing the refuge. Regardless of which alternative is ultimately implemented, the Service will strive to accomplish the objectives set for the 15-year period, assuming that the necessary funding and staffing are obtained.

Described below is a summary of the alternatives and the goals and objectives for each alternative. A comparison of the alternatives by management objectives can be found in Table 15. The staffing, operational, and project costs for the alternatives are found in Table 16.

#### *Alternative 1. Maintain Current Management (No Action Alternative)*

Under this plan, hydrologic conditions (water quality, quantity, delivery, and timing) would continue to be monitored with existing programs. Water quality testing will continue in 4 Atmospheric Deposition stations and 16 helicopter stations in the refuge interior, and at the S5-A and Everglades Nutrient Removal Project outflow stations.

Water management will rely upon developing progressive partnerships with the South Florida Water Management District and the U.S. Army Corps of Engineers. A few of the refuge staff would continue to attend meetings and give necessary input on topics that may affect the refuge and other Everglades issues. Due to inadequate funding, the exotic plant control program would continue on a very limited basis through the use of refuge staff or by contract. Refuge personnel would continue to monitor a limited number of high profile wildlife species such as nesting wading birds, alligator nests, and neotropical migratory birds. Limited management around the Marsh Trail would continue resulting in one impoundment managed every other year. Law enforcement personnel and activity would continue to be a priority along with other programs such as exotic plant control and biological programs. Recreation and environmental education activities would continue but function at low levels. Public use programs would continue using inadequate existing facilities, and outdated brochures, educational information, and exhibits.

### Goal 1. Wildlife Habitat and Population Management

#### Objectives:

1. Protect 143,238 acres of refuge habitat (the interior) with the current water regulation schedule.
2. Continue to monitor refuge water quality through the 16 interior helicopter stations, the 4 atmospheric deposition stations, and the Everglades Nutrient Removal Project.
3. Control invasive and exotic plants by staff or by contractors on a limited basis as minimal funding allows.
4. Monitor a limited number of high profile wildlife species such as wading birds, waterfowl, and snail kites.
5. Conduct limited management in Compartment C, Impoundment C-7 (33 acres), and monitor other impoundments for wildlife use.

### Goal 2. Resource Protection

#### Objectives:

1. Protect water resources on the refuge by participating on committees associated with Everglades restoration and by providing input on water quality issues.
2. Protect wildlife and plant communities and minimize species exposure to contaminants by following applicable regulations. Follow current contaminant response plans.
3. Enforce refuge laws and regulations and protect resources, facilities, and the visiting public. Continue limited partnerships with other law enforcement agencies.
4. Develop and implement a cultural resource protection plan congruent with federal and state historic preservation mandates.

### Goal 3. Public Use

#### Objectives:

1. Provide an appropriate compatible, wildlife-dependent recreational experience by maintaining existing facilities. Continue to allow hunting, fishing, wildlife observation, canoeing opportunities, bicycling, and hiking on portions of the perimeter levee (*Figures 21 and 22*).
2. Continue limited environmental education and seasonal programs. Maintain existing interpretive trails and boardwalk.

### Goal 4. Administration

#### Objectives:

1. By October 1, 2000, work with South Florida Water Management District to sign a new license agreement.
2. Maintain current staffing levels to accomplish refuge operations and maintenance.

Figure 21. Alternative 1: Current public use accessibility, A.R.M. Loxahatchee National Wildlife Refuge.

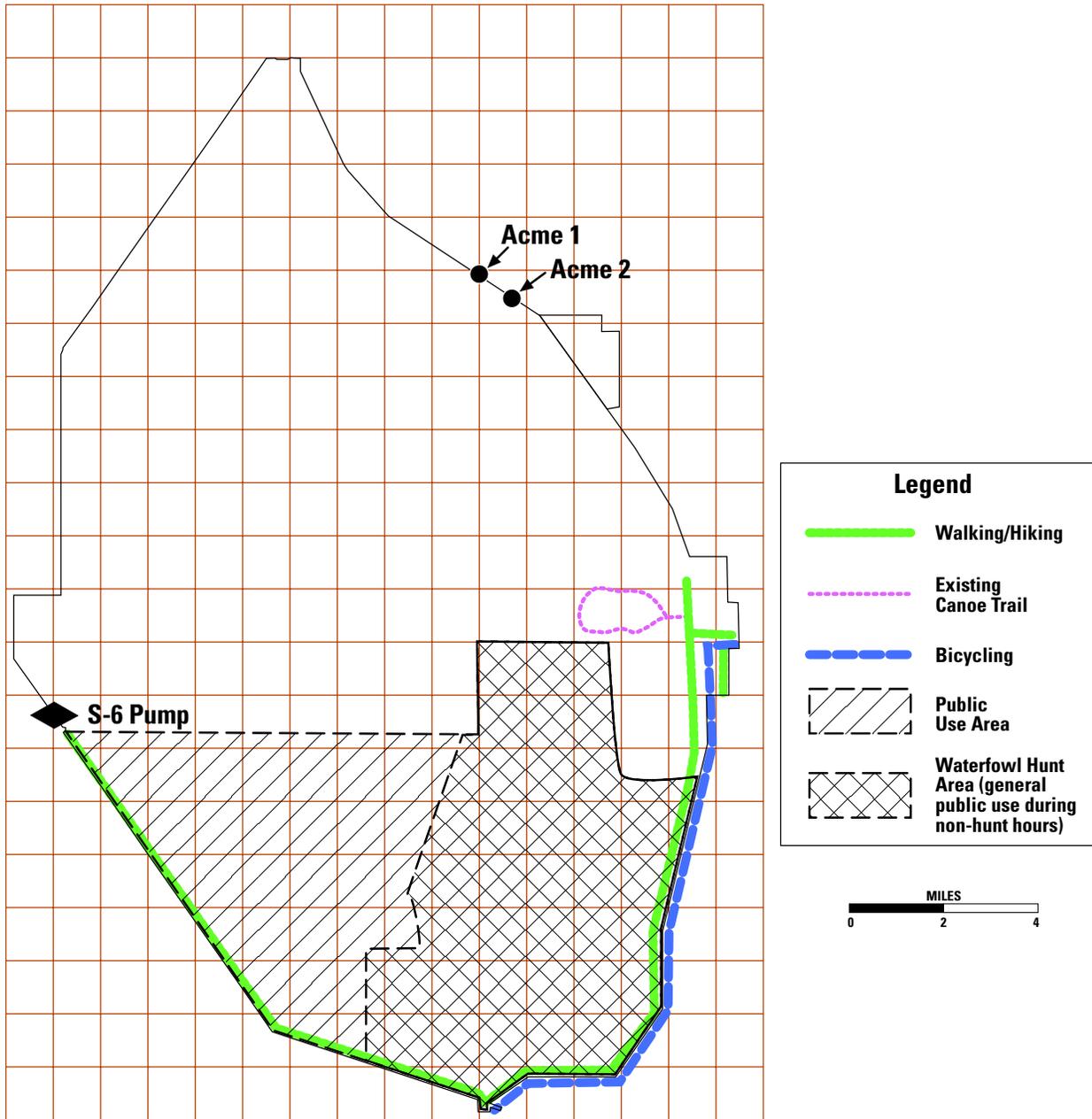
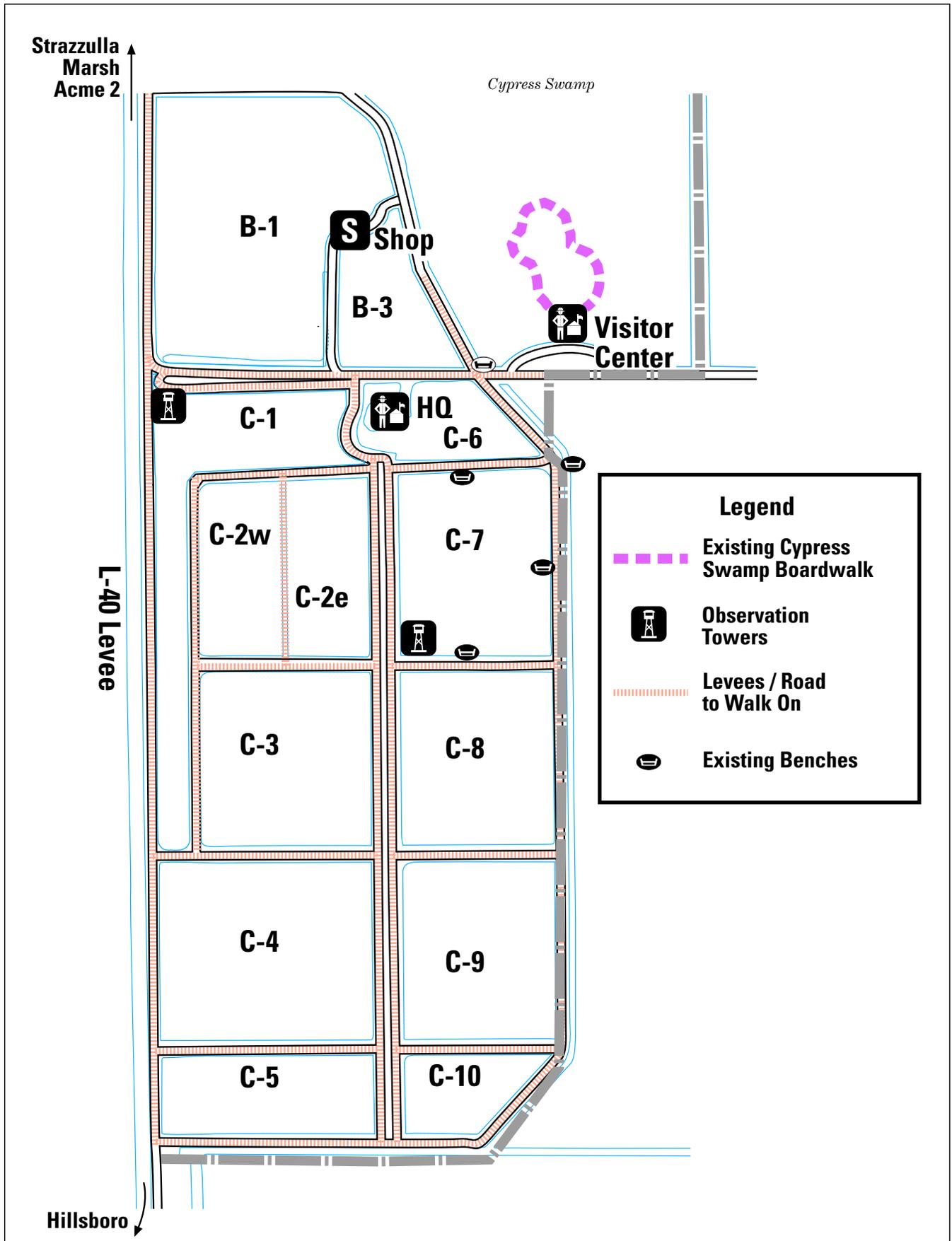


Figure 22. Alternative 1: Public use areas at Headquarters area, A.R.M. Loxahatchee National Wildlife Refuge.



**Table 11. Annual cost of staff positions for A.R.M. Loxahatchee National Wildlife Refuge under Alternative 1, "Maintain Current Management"**

<i>Management</i>	<i>Grade</i>	<i>Annual Cost*</i>
Project Leader	GS-0485-14	\$104,400
Deputy Project Leader	GS-0485-13	\$88,400
<i>Everglades Program Team</i>		
Hydrologist	GS-1315-13	\$88,400
Wetlands Ecologist	GS-0408-13	\$88,400
<i>Administrative Staff</i>		
Office Assistant	GS-0303-7	\$41,900
Office Clerk	GS-0318-5	\$33,800
<i>Law Enforcement</i>		
Lead Refuge Officer	GS-0025-8/9*	\$52,500
Refuge Ranger	GS-0025-7*	\$46,200
Refuge Ranger (Fees - Lead)	GS-0025-5/6	\$37,700
Refuge Ranger (Fees)	GS-0025-5 T	\$14,800
Fee Collector	GS-0025-3 T	\$ 11,800
Fee Collector	GS-0025-3 T	\$ 11,800
<i>Wildlife/Habitat Management</i>		
Wildlife Biologist	GS-0486-11/12	\$74,300
Wildlife Biologist	GS-0486-9	\$51,200
Biologist (Water Quality & Contaminants)	GS-0486-9	\$51,200
Biological Technician	GS-0486-6/7	\$41,900
<i>Maintenance Operations</i>		
Refuge Operations Specialist	GS-0485-5/7/9	\$51,200
Engineering Equipment Operator	WG-5716-10	\$45,100
Maintenance Mechanic (Facilities)	WG-4749-9	\$42,300
Automotive Worker	WG-5823-8	\$36,900
Maintenance Mechanic Helper	WG-4749-5	\$31,200
<i>Public Use</i>		
Supervisory Interpretive Specialist	GS-0025-9	\$51,200
Refuge Ranger	GS-0025-7	\$41,900
Park Guide	GS-0090-4 T	\$13,200
Subtotal (annual staff costs)		\$1,151,700
Annual fixed costs (phone, gas, diesel, electric, travel, equipment repair, equipment and building maintenance, etc.)		\$120,000
<b>Total Annual Cost</b>		<b>\$1,271,700</b>

\* Law enforcement enhanced pay (6c retirement), Salary including benefits (calculated at the highest potential wage possible, including for each position, using FY-2000 wage scales).

T- temporary or seasonal

Figure 23. Proposed boundary expansion near the headquarters of A.R.M. Loxahatchee National Wildlife Refuge

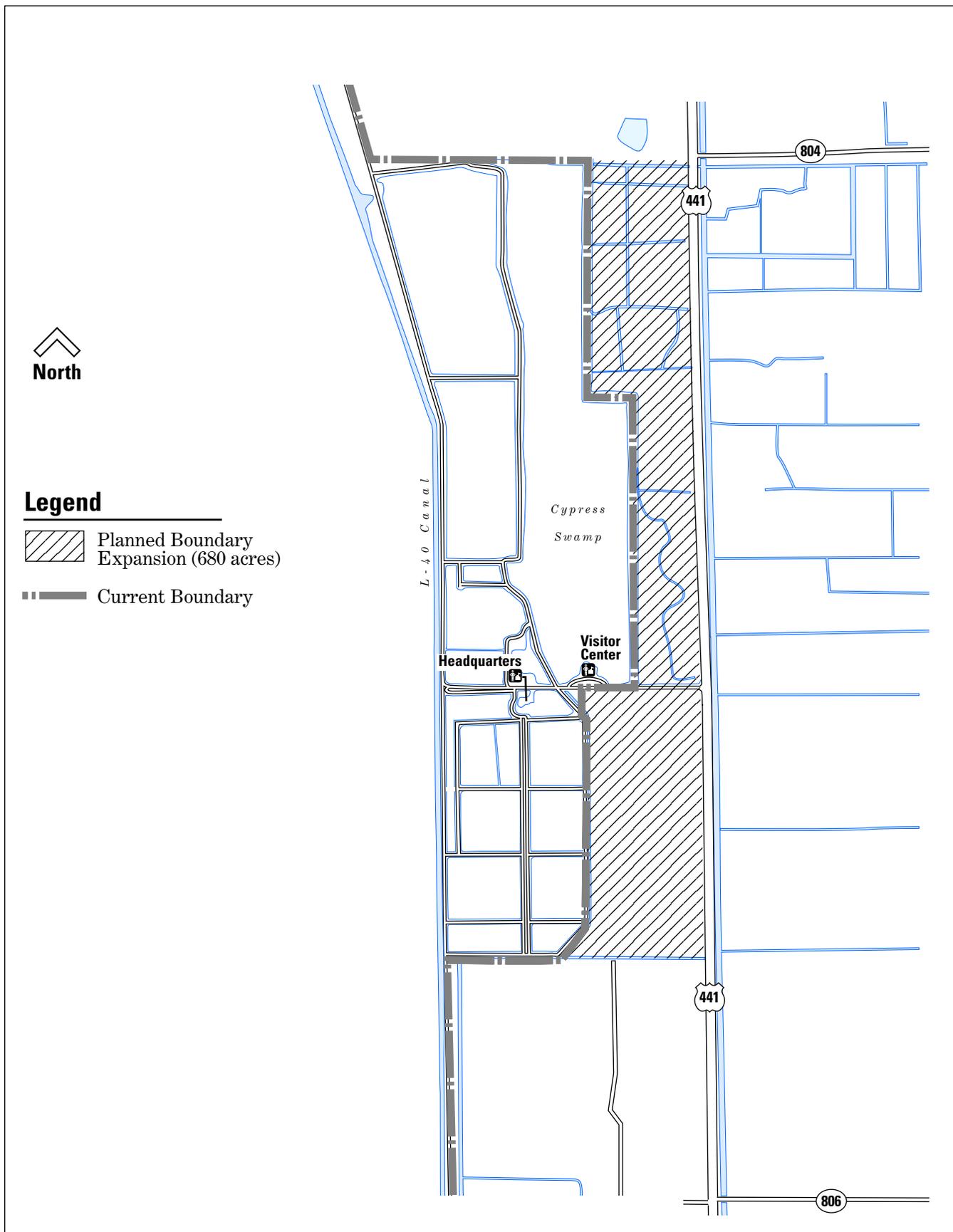


Figure 24. Alternatives 2 and 4: Expanded public use opportunities at the Headquarters Area, A.R.M. Loxahatchee National Wildlife Refuge.

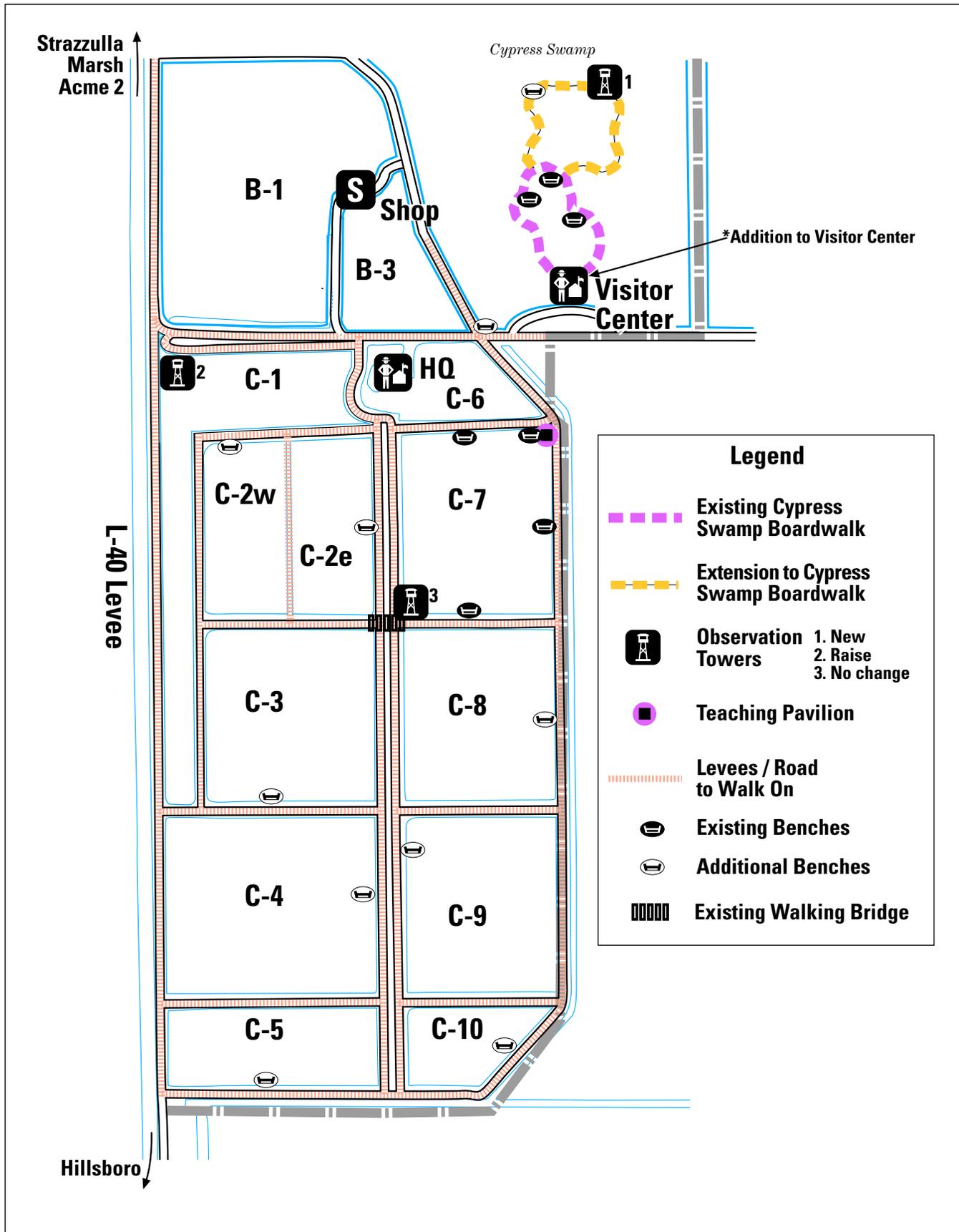


Figure 25. Alternatives 2 and 4: Expanded public use opportunities and waterway zones, A.R.M. Loxahatchee National Wildlife Refuge.

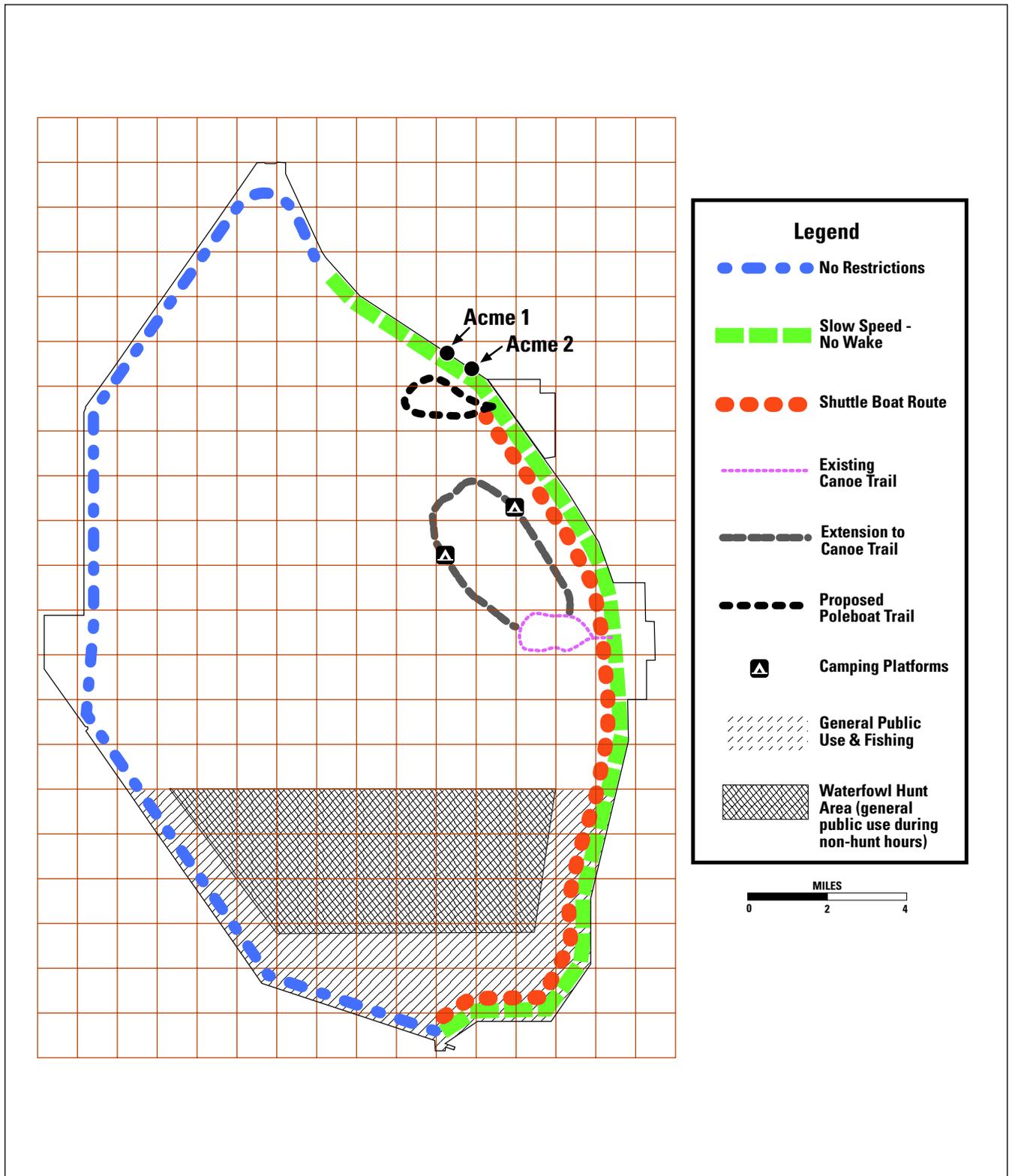


Figure 26. Alternatives 2 and 4: Expanded public use opportunities at Strazzulla Marsh, A.R.M. Loxahatchee National Wildlife Refuge.

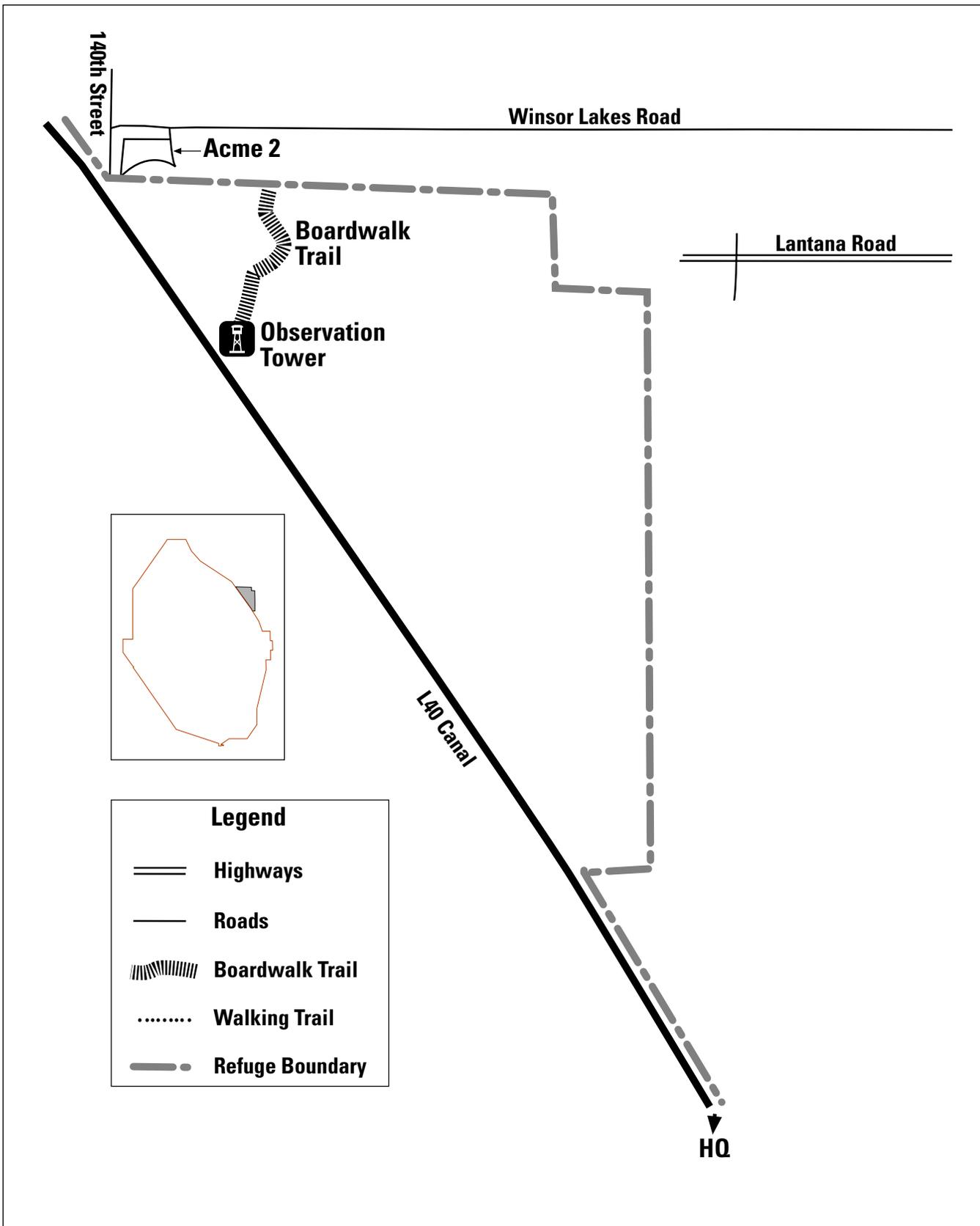
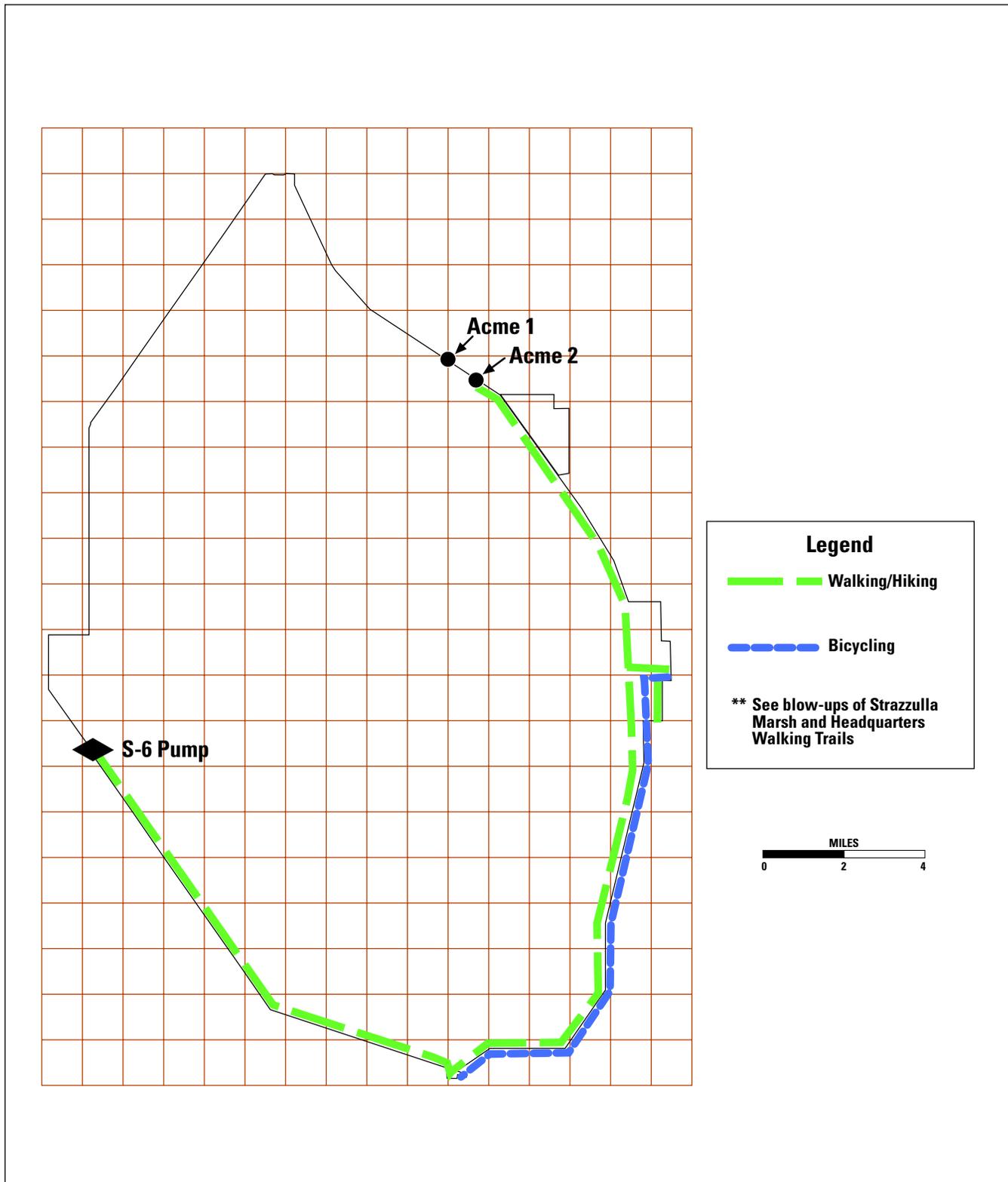


Figure 24. Alternatives 2 and 4: Public use opportunities and land use zones on the L-40 and L-39 Levees, A.R.M. Loxahatchee National Wildlife Refuge.



*Alternative 2. Ecosystem Emphasis (Preferred Alternative- This was the preferred alternative before public comment and input was incorporated.)*

Appropriate water quality, quantity, timing, and delivery are critical to achieve refuge objectives and Everglades ecosystem objectives. Water management will rely upon developing progressive partnerships with South Florida Water Management District and the Army Corps of Engineers. Another crucial element of this plan is controlling exotic and invasive plants and aggressively pursuing funding to eliminate these threats to the refuge (see Section V, Plan Implementation, Project Summaries, of the Draft Comprehensive Conservation Plan, and Table 8). An Integrated Pest Management Plan will be developed to attack this extensive problem. This alternative enhances biological and research programs, including extensive inventorying, Geographic Information System mapping, and monitoring of wildlife and habitat. Prescribed fire will be used to simulate the historical Everglades ecosystem and as an important tool for managing wildlife habitat and controlling exotic plant growth. All of the compartments (2,030 acres) will be actively managed to enhance wildlife habitat. The refuge will adjust the acquisition boundary to include the lands immediately east of the Headquarters Area to potentially buffer the refuge from development. A wide range of partnering opportunities will be actively pursued and fostered to protect natural and cultural resources.

The previously closed Strazzulla Marsh will be opened to the public on a limited basis. Visitor services will be enhanced or established at the Headquarters Area and Strazzulla Marsh and will include interpretive trails, a boardwalk (or extension), and observation towers. A new pole-boat trail across from Strazzulla Marsh (depending on water quality improvement in the perimeter canal) may be constructed. A concession will be developed at the Hillsboro Recreation Area to expand appropriate, compatible, wildlife-dependent recreational opportunities. The canoe trail will be extended and include overnight platforms (depending on logistics and administrative needs). This plan will increase hunting accessibility and the number of huntable species to include feral hog and alligator by limited permit (if periodic surveys are favorable for hunts). The environmental education program will be enhanced to showcase the northern Everglades ecology and human influence on the southeast Florida ecosystem.

#### Goal 1. Wildlife Habitat and Population Management

##### Objectives:

1. Continue to partner with the South Florida Water Management District and the Corps of Engineers to restore and maintain healthy water regimes for 143,238 acres of the refuge as part of the northern Everglades.
2. Expand water quality monitoring to include pesticide, herbicide, fertilizer, and elemental contaminant levels in the cypress swamp, all compartments, Strazzulla Marsh, and the refuge interior by 2005, with the Water Quality Monitoring Plan written by 2002.
3. Reduce exotic melaleuca and Old World climbing fern to a level that requires minimal maintenance in 15 years and restore treated areas with native plants as needed. Develop a Draft Integrated Pest Management Plan by 2002, incorporating the Exotic Plant Control Plan.
4. Monitor and eradicate other exotic or invasive animal threats by 2008. Complete writing the Exotic Animal Control Plan by 2002 and add to the Draft Integrated Pest Management Plan.
5. Implement a fire management program to simulate the historical Everglades ecosystem fire regime where appropriate, enhancing native plants and deterring invasive and exotic plant spread by January 2004. Re-write the Fire Management Plan by 2002.

6. Inventory, map, and monitor wildlife and habitats of the northern Everglades. Compile, collect, and analyze these data to guide refuge management and to contribute to Everglades restoration evaluations. Write the Biological Inventory/Monitoring Plan by 2003.
7. Manage the compartments (A,B,C and D), cypress swamp, and Strazzulla Marsh for trust species such as neotropical migrant landbirds, shorebirds, waterfowl, and wading birds.
8. Manage and maintain diverse native habitats and viable wildlife populations consistent with sound biological principles and other objectives of this plan.

#### Goal 2. Resource Protection

##### Objectives:

1. Protect water resources and develop partnerships to ensure an appropriate water regulation schedule (water quality, quantity, delivery, and timing) for the benefit of wildlife and wildlife habitat. Participate in committees associated with the Comprehensive Everglades Restoration Plan and Water Preserve Areas by providing input on water quality, quantity, and timing issues.
2. Protect other natural biological resources on or near the refuge by encouraging communication and developing partnerships with interest groups, landowners, and with the law enforcement division of other natural resource agencies.
3. Adjust the refuge acquisition boundary to include the lands immediately east of the Headquarters Area (approximately 680 acres; see Figure 23). The refuge recognizes the lands adjacent to the refuge and east to SR 441/7 as "Areas of Concern" or buffer lands.
4. Protect species from exposure to contaminants by following applicable regulations.
5. Protect refuge resources (147,392 acres), facilities associated with three visitor use areas, and the visiting public using law enforcement.
6. Develop and implement a cultural resource protection plan in accordance with federal and state historic preservation legislation by 2003.
7. Diminish the looting and vandalism of known or newly discovered archaeological sites.
8. Encourage partnerships to protect cultural resources.
9. Update the Law Enforcement Management Plan by 2002.

#### Goal 3. Public Use

##### Objectives:

1. Expand appropriate, compatible, wildlife-dependent recreational opportunities at the Headquarters Area by repairing trails, extending the boardwalk, creating an observation tower in the cypress swamp, raising an existing observation tower, creating a photo blind in Compartment C-8, and improving public support services (*Figure 24*). Extend the existing canoe trail at the Headquarters Area and include two overnight platforms (depending on logistics, administrative needs and funding). (*See Figure 25.*)
2. Provide public access into the Strazzulla Marsh and develop hiking trails, a boardwalk with an observation tower, photo blinds, and interpretive signage. Possibly create a poleboat trail across from Strazzulla Marsh (depending on water quality improvement in the perimeter canal). (*See Figure 26.*)

3. Develop a multi-use trail and waterway system. Continue bicycling and hiking access on the eastern perimeter canal levee (*Figure 27*). Bicyclists will use the levee from the Headquarters Area south to the Hillsboro Recreation Area only. Hiking will be allowed from the S-6 pump station on the western perimeter levee, through Hillsboro Recreation Area to ACME 2 pump station (just north of Strazzulla Marsh). A designated waterway system for motorboats will be implemented on refuge waterways (*Figure 25*).
4. In cooperation with state and county natural resource agencies, expand recreational opportunities at Hillsboro Recreation Area. Develop the use of a concession which may include motorboat, bicycle and fishing gear rentals, fishing guides, interpretive exhibits, and a seasonal pontoon boat shuttle between the Hillsboro Recreation Area, and Strazzulla Marsh and Headquarters Areas.
5. The refuge will provide appropriate, compatible, wildlife-dependent fishing and hunting opportunities. Feral hog and alligator hunting will be initiated. The waterfowl hunt area will be modified to create easier access and to include better habitat (*Figure 25*). Create access trails into the waterfowl hunt area from the east and southeast perimeter canal (depending on water quality improvement in the perimeter canal). Four fishing tournaments per year will continue to be allowed by permit. Hunt and Fishing Plans will be updated or written by 2004.
6. Develop an environmental education curriculum by 2002, for use on and off the refuge that centers on providing an understanding and appreciation of the Everglades, the refuge's ecology, and the human influence on ecosystems of southeast Florida. This plan will follow guidelines from the National Outreach Strategy (Fish and Wildlife Service 1997e), and be part of a strategy to reach key community leaders such as teachers, school board members, elected officials, as well as the news media (Fish and Wildlife Service 1997e). Upgrade the visitor center to include a larger auditorium/classroom with an adjoining wetlab. Build an outdoor teaching pavilion near the Marsh Trail. The Environmental Education Plan will be completed by 2002.
7. Upgrade and expand the interpretive program, portraying the significance of the refuge and threats affecting the refuge and the south Florida ecosystem. The interpretive program will be updated using the guidelines from the National Outreach Strategy. The General Public Use Plan and Sign Plan will be updated by 2005 and 2004 respectively.

#### Goal 4. Administration

##### Objectives:

1. By October 1, 2000, work with South Florida Water Management District to sign a new license agreement.
2. Expand current staff to accomplish additional priority refuge operations and maintenance.
3. Continue employee productivity through recognition and training.
4. Continue developing internal and external partnerships to share equipment and manpower.

**Table 12. Annual cost of proposed staff positions for A.R.M. Loxahatchee National Wildlife Refuge under Alternative 2, "Ecosystem emphasis"**

\* Law enforcement enhanced pay (6c retirement)

Salary including benefits (calculated at the highest potential wage possible, using FY-2000 wage scales).

T- temporary or seasonal

<i>Management</i>	<i>Grade</i>	<i>Annual Cost*</i>
Project Leader	GS-0485-14	\$104,400
Deputy Project Leader	GS-0485-13	\$88,400
Refuge Operations Specialist	GS-0485-11/12	\$74,300
Refuge Operations Specialist (trainee)	GS-0485-5/7/9	\$51,200
<i>Everglades Program Team</i>		
Hydrologist	GS-1315-13	\$88,400
Wetlands Ecologist	GS-0408-13	\$88,400
Office Clerk (EP Team only)	GS-0318-6	\$37,700
<i>Administrative Staff</i>		
Office Assistant	GS-0303-8	\$46,400
Office Clerk	GS-0318-6	\$37,700
Receptionist	GS-0318-4	\$30,200
<i>Law Enforcement</i>		
Lead Refuge Officer	GS-0025-9/11*	\$62,000
Refuge Officer	GS-0025-7*	\$46,200
Refuge Ranger	GS-0025-7	\$41,900
Refuge Ranger (Fees)	GS-0025-5/6	\$37,700
Refuge Ranger	GS-0025-4 T	\$13,200
Refuge Ranger	GS-0025-4 T	\$13,200
Fee Collector	GS-0025-3 T	\$ 11,800
Fee Collector	GS-0025-3 T	\$ 11,800
<i>Wildlife/Habitat Management</i>		
Senior Wildlife Biologist	GS-0486-12/13	\$88,400
Wildlife Biologist	GS-0486-11	\$62,000
Biologist (Botanist)	GS-0486-9/11	\$62,000
Biologist (Water Quality & Contaminants)	GS-0486-9/11	\$62,000
Ecologist (Exotic Control)	GS-0486-9/11	\$62,000
Wildlife Biologist	GS-0486-9	\$51,200
Wildlife Biologist	GS-0486-7 T	\$18,400
Wildlife Biologist	GS-0486-7 T	\$18,400
Biological Technician	GS-0404-7	\$41,900
GIS/Data Management Specialist	GS-0404-9	\$51,200
Fire Management Officer	GS-0486-9/11	\$62,000
Fire Technician	GS-0462-5	\$33,800
<i>Maintenance Operations</i>		
Wage Leader	WL-4749-11	\$52,700
Engineering Equipment Operator	WG-5716-10	\$45,100
Tractor Operator	WG-5716-8	\$39,600
Maintenance Mechanic	WG-4749-10	\$45,100
Maintenance Mechanic (Facilities)	WG-4749-9	\$42,300
Automotive Worker	WG-5823-8	\$39,600
Maintenance Mechanic Helper	WG-4749-5	\$31,200
Maintenance Mechanic Helper	WG-4749-5	\$31,200
Boat Operator	WG-5786-5	\$31,200
<i>Public Use</i>		
Supervisory Interpretive Specialist	GS-0025-12	\$74,300
Environmental Education Specialist	GS-0025-9/11	\$62,000
Refuge Ranger	GS-0025-9	\$51,200
Refuge Ranger	GS-0025-7	\$41,900
Park Guide	GS-0025-5	\$33,800
Park Guide	GS-0025-4 T	\$13,200
Volunteer Services Coordinator	GS-0025-7/9	\$51,200
Subtotal (annual staff costs)		\$2,183,800
Annual fixed costs (phone, gas, diesel, electric, travel, equipment repair, equipment and building maintenance, etc.)		\$185,000
<b>Total Annual Cost</b>		<b>\$2,368,800</b>

### *Alternative 3. Biological Emphasis*

Similar to Alternative 2, this alternative would provide emphasis on restoring and maintaining healthy water regimes, reducing all exotic plants and animals especially melaleuca and Old World climbing fern and extensive inventorying and monitoring of wildlife and habitats. Also similar to Alternative 2, the refuge will adjust the acquisition boundary to include the lands immediately east of the Headquarters Area. A wide range of partnering opportunities will be actively pursued and fostered to protect other natural and cultural resources.

A key feature of this alternative is the restoration of 1,100 acres to native cypress swamp and other appropriate habitats through the removal of the dikes between Compartments A, B and C and the cypress swamp. With the removal of the dikes, recreational opportunities and accessibility would be reduced in the Headquarters Area. Educational and interpretive opportunities at the headquarters visitor center would not be enhanced, Strazzulla Marsh would not be opened and no concession would be developed in Hillsboro Recreation Area. The level of service provided to the public would be the same level as Alternative 1. A public feral hog hunting program would be initiated to reduce the habitat damage caused by feral hogs at Strazzulla Marsh.

Another key feature is that a greater number of biologists would be hired and the public use staff would be reduced. The increased complexity of the biological program would contribute greater understanding of the ecosystem to management decisions.

#### Goal 1. Wildlife Habitat and Population Management

##### Objectives:

1. Restore and maintain healthy water regimes for 143,238 acres of the northern Everglades in partnership with South Florida Water Management District and the Army Corps of Engineers.
2. Expand water quality monitoring to include pesticide, herbicide, fertilizer, and elemental contaminant levels in the cypress swamp, all compartments, Strazzulla Marsh, and the refuge interior.
3. Reduce melaleuca and Old World climbing fern to a level that requires minimal maintenance within 15 years and restore treated areas with native plants where applicable. Other exotic plants will be controlled as they are encountered. Create a draft Integrated Pest Management Plan including Exotic Plant and Animal Management Plans.
4. Monitor and eradicate other exotic or invasive animal threats.
5. By January 2002, implement a fire management program to simulate the historical Everglades ecosystem fire regime where appropriate, enhancing native plants and deterring invasive and exotic plant spread.
6. Inventory, monitor, and map important representative taxa of most wildlife on the refuge.
7. Restore A, B, and C Impoundments to cypress swamp and other appropriate Everglades habitat according to historical occurrence. Restoration will be accomplished by removing levees, placing culverts, and re-planting native vegetation.
8. Manage and maintain viable populations of most wildlife and habitat, consistent with sound biological principles and other objectives of this alternative.
9. Actively manage Compartment D to provide habitat for Everglades habitat and species, given the physical constraints of this compartment.

## Goal 2. Resource Protection

### Objectives:

1. Protect water resources on the refuge by developing communication and partnerships to ensure an appropriate water regulation schedule (quality, quantity, delivery, and timing) for the benefit of wildlife and wildlife habitat of the Everglades ecosystem.
2. Protect other natural biological resources on the refuge by encouraging communication and developing partnerships with the law enforcement offices of other natural resource agencies, natural resource interest groups, and landowners.
3. The refuge recognizes the lands east of the refuge up to SR 441/7 as “Areas of Concern,” and as potential buffer zones. The refuge will adjust the acquisition boundary to include the lands immediately east of the Headquarters Area (approximately 680 acres, Figure 23).
4. Protect refuge resources, facilities, and the public using law enforcement.
5. Develop and implement a Cultural Resource Protection Plan in accordance with federal and state historic preservation legislation.

## Goal 3. Public Use

### Objectives:

1. Restoration of Compartments A, B, and C and the removal of connecting dikes will reduce wildlife observation opportunities at the Headquarters Area (Figure 28).
2. Continue walking and biking along the perimeter levee (Figure 29).
3. Reduce waterfowl hunting and accessibility by limiting the size of the hunting area and the number of hunting days (Figure 29).
4. Implement a feral hog hunting program in Strazzulla Marsh to reduce detrimental effects of hogs on wildlife habitat.
5. Continue to use the visitor center to maintain the refuge educational program.

## Goal 4. Administration

### Objectives:

1. By October 1, 2000, work with the South Florida Water Management District to sign a new license agreement.
2. Provide a full staff complement to accomplish refuge goals, operations, and maintenance with an emphasis on biological personnel.

### *Alternative 4. Public Use Emphasis*

Similar to Alternative 1, this Alternative would follow the current water regulation schedule used to protect the refuge interior, allow only limited inventorying and monitoring of high profile wildlife species, and minimal control of invasive and exotic plants would be carried out by staff, contractors, or volunteers as funding permits. A wide range of partnering opportunities will be actively pursued and fostered to protect natural and cultural resources.

The key element of this alternative would be to provide an increase in recreational opportunities that are constrained by the compatibility of these recreational uses with refuge purposes and the mission and goals of the National Wildlife Refuge System. All the described public use

Figure 28. Alternative 3: Public use opportunities with removal of levees, A.R.M. Loxahatchee National Wildlife Refuge.

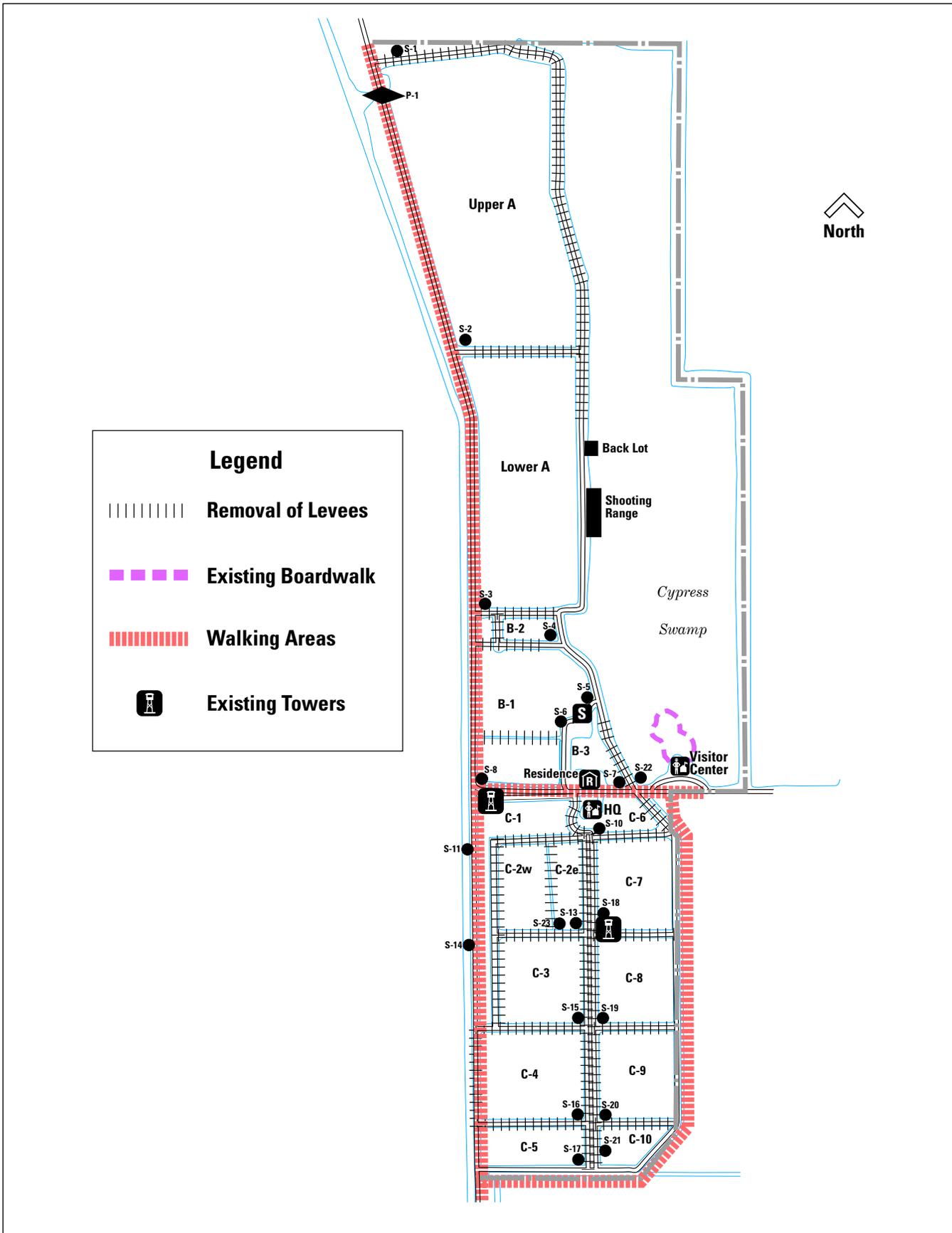
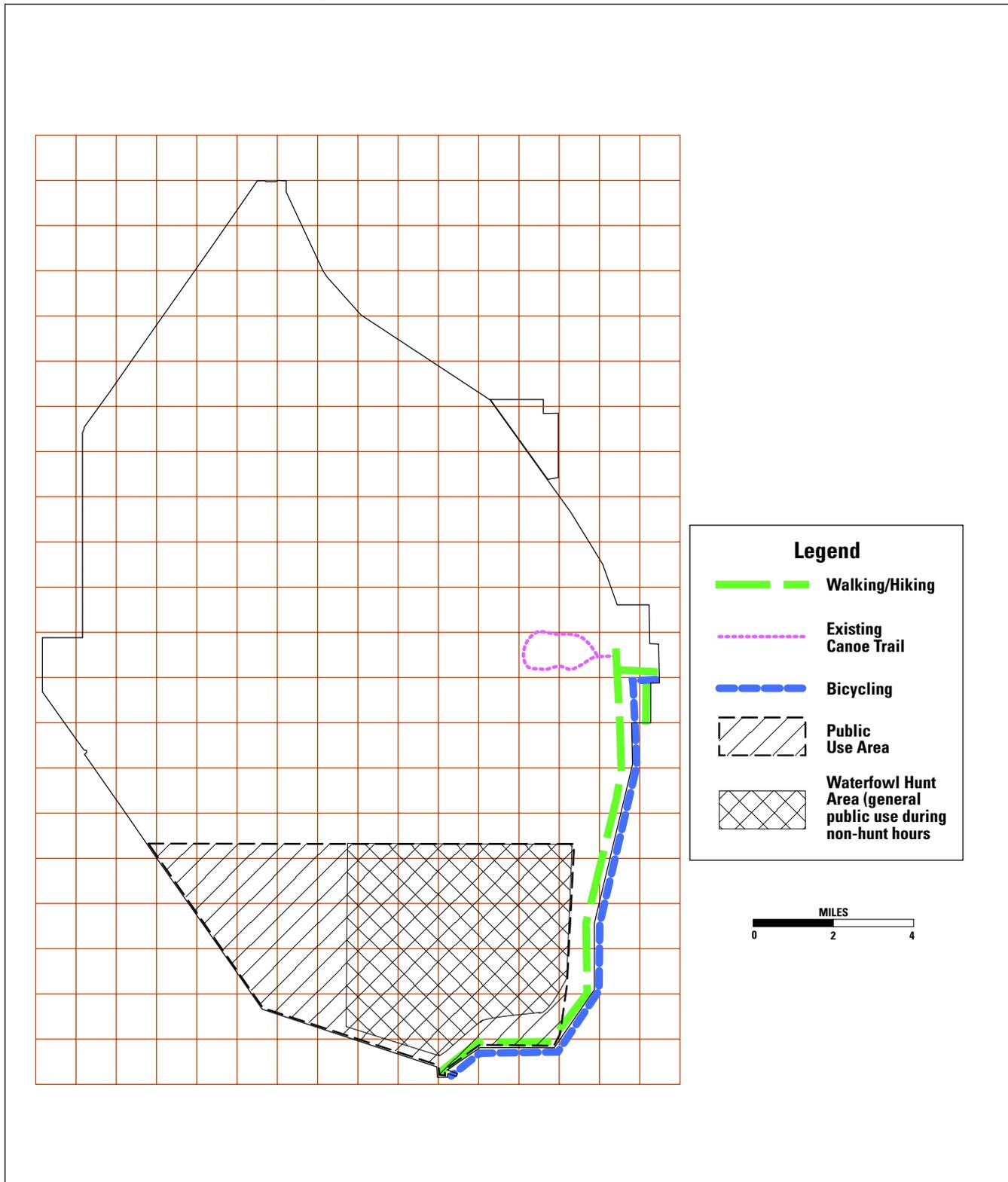


Figure 29. Alternative 3: Reduced public use access, A.R.M. Loxahatchee National Wildlife Refuge.



**Table 13. Annual cost of proposed staff positions for A.R.M. Loxahatchee National Wildlife Refuge under Alternative 3 "biological emphasis"**

<i>Management</i>	<i>Grade</i>	<i>Annual Cost*</i>
Project Leader	GS-0485-14	\$104,400
Deputy Project Leader	GS-0485-13	\$88,400
Refuge Operations Specialist	GS-0485-11/12	\$74,300
Refuge Operations Specialist (Trainee)	GS-0485-5/7/9	\$51,200
<i>Everglades Program Team</i>		
Hydrologist	GS-1315-13	\$88,400
Wetlands Ecologist	GS-0408-13	\$88,400
Office Clerk (EP Team only)	GS-0318-6	\$37,700
<i>Administrative Staff</i>		
Office Assistant	GS-0303-8	\$46,400
Office Clerk	GS-0318-6	\$37,700
Receptionist	GS-0318-4	\$30,200
<i>Law Enforcement</i>		
Refuge Officer (Lead)	GS-0025-9/11*	\$62,000
Refuge Officer	GS-0025-7*	\$46,200
<i>Wildlife/Habitat Management</i>		
Senior Wildlife Biologist	GS-0486-12/13	\$88,400
Wildlife Biologist	GS-0486-11	\$62,000
Biologist (Botanist)	GS-0486-9/11	\$62,000
Biologist (Water Quality & Contaminants)	GS-0486-9/11	\$62,000
Ecologist (Exotic Control)	GS-0486-9/11	\$62,000
Wildlife Biologist	GS-0486-9	\$51,200
Wildlife Biologist	GS-0486-7	\$41,900
Wildlife Biologist	GS-0486-7	\$41,900
Biological Technician	GS-0404-7	\$41,900
Biological Technician	GS-0404-7	\$41,900
GIS/Data Management Specialist	GS-0404-9	\$51,200
Fire Management Officer	GS-0486-9/11	\$62,000
Fire Technician	GS-0462-5	\$33,800
<i>Maintenance Operations</i>		
Engineering Equipment Operator	WG-5716-10	\$52,700
Maintenance Mechanic (Facilities)	WG-4749-9	\$51,200
Automotive Worker	WG-5823-8	\$39,600
Maintenance Mechanic Helper	WG-4749-5	\$31,200
Boat Operator	WG-5786-5	\$31,200
Laborer	WG-4749-3	\$25,600
<i>Public Use</i>		
Supervisory Interpretive Specialist	GS-0025-9	\$51,200
Refuge Ranger	GS-0025-7	\$41,900
Subtotal (annual staff costs)		\$1,677,700
Annual fixed costs (phone, gas, diesel, electric, travel, equipment repair, equipment and building maintenance, etc.)		\$153,000
Total Annual Cost		\$1,830,700

\* Law enforcement enhanced pay  
(6c retirement),

Salary including benefits (calculated at the highest potential wage possible, using FY-2000 wage scales).

T- temporary or seasonal

activities in Alternative 2 apply to this Alternative. More employees will be hired for public use activities and to assist with environmental education and the biological staff will be reduced. Volunteers will conduct most of the biological surveys.

#### Goal 1. Wildlife Habitat and Population Management

##### Objectives:

1. Protect 143,238 acres of refuge habitat with the current water regulation schedule.
2. Continue to monitor water quality in the refuge interior, as in Alternative 1.
3. Control invasive and exotic plants on a limited basis with staff, contractors, or volunteers as minimal funding allows.
4. Perform the limited biological inventory and monitoring program with volunteers (a biologist will oversee the program).
5. Manage the compartments, cypress swamp, and Strazzulla Marsh for public viewing.

#### Goal 2. Resource Protection

##### Objectives:

1. Conserve natural and cultural resources through partnerships and protection, and implement a cultural resource interpretive and educational program.
2. Protect water resources on the refuge by participating in committees associated with the Comprehensive Everglades Restoration Project and Water Preserve Areas by providing input on water quality, quantity, and timing issues.
3. Adjust the acquisition boundary to include the lands immediately east of the Headquarters Area (approximately 680 acres, see Figure 20). Lands east of the refuge up to SR 441/7 will be recognized as “Areas of Concern.” Develop partnerships to establish wildlife corridors and buffer lands in south Florida.
4. Develop partnerships for research and monitoring of biological and natural resources and control exotic and invasive species.
5. Protect wildlife and plant communities on the refuge and minimize species exposure to contaminants by following applicable regulations. Follow current contaminant response plans.
6. Enhance law enforcement to protect refuge resources.

#### Goal 3. Public Use

##### Objectives:

1. Expand appropriate, compatible, wildlife-dependent recreational opportunities at the Headquarters Area by improving trails, extending the cypress swamp boardwalk, adding a new observation tower and raising an existing one, creating a photo blind in Impoundment C-8, and improving public support services (*Figure 24*).
2. Allow limited public access into the Strazzulla Marsh and develop a hiking trail, a boardwalk with an observation tower over the sawgrass marsh, and photo blinds (*Figure 26*).
3. Extend the existing canoe trail at the Headquarters Area and include two overnight platforms depending on logistics, administrative needs, and funding. Possibly create a new pole-boat trail across from Strazzulla Marsh (depending on water quality improvement in the perimeter canal).

4. Continue bicycling and hiking on the perimeter levee (*Figure 27*). Bicyclists will use the levee from the Headquarters Area south to Hillsboro Recreation Area only. Hiking will be allowed on the levee from the S-6 pump station on the west side, through Hillsboro Recreation Area and north to the ACME 2 pump station.
5. Provide appropriate, compatible, wildlife-dependent fishing and hunting opportunities. Feral hog and alligator hunting will be initiated. The waterfowl hunt area will be modified to create easier access and to include better habitat (*Figure 25*). Eventually create access trails into the waterfowl hunt area from the east and southeast perimeter canal (depending on water quality improvement in the perimeter canal). Four fishing tournaments per year will continue to be allowed by permit.
6. Expand recreational opportunities at Hillsboro Recreation Area through the use of a concession. The concession could include motorboat, bicycle and fishing tackle rental, fishing and interpretive guides, interpretive exhibits, food and gift shop, and an interpretive pontoon boat shuttle between the Hillsboro Recreation Area, Strazzulla Marsh, and Headquarters Areas.
7. Expand the environmental education program, take the Everglades curriculum to sites off the refuge and improve outreach opportunities.
8. Build a covered shelter (teaching pavilion) near the Marsh Trail, expanding the environmental education program to reach more visitors and school groups.
9. Enlarge the visitor center to handle the projected increase in visitors to the refuge, the Everglades, and south Florida.

#### Goal 4. Administration

##### Objectives:

1. By October 1, 2000, work with South Florida Water Management District to sign a new license agreement.
2. Expand the staff to accomplish refuge goals, operation, and maintenance with an emphasis on public use personnel.

**Table 14. Annual cost of proposed staff positions for A.R.M. Loxahatchee National Wildlife Refuge under Alternative 4 “public use emphasis”**

	<i>Management</i>	<i>Grade</i>	<i>Annual Cost*</i>
	Project Leader	GS-0485-14	\$104,400
	Deputy Project Leader	GS-0485-13	\$88,400
	Refuge Operations Specialist	GS-0485-11/12	\$74,300
	Refuge Operations Specialist (Trainee)	GS-0485-5/7/9	\$51,200
	<i>Everglades Program Team</i>		
	Hydrologist	GS-1315-13	\$88,400
	Wetlands Ecologist	GS-0408-13	\$88,400
	Office Clerk (EP Team only)	GS-0318-6	\$37,700
	<i>Administrative Staff</i>		
	Office Assistant	GS-0303-8	\$46,400
	Office Clerk	GS-0318-6	\$37,700
	Receptionist	GS-0318-4	\$30,200
	<i>Law Enforcement</i>		
	Lead Refuge Officer	GS-0025-8/9*	\$52,500
	Refuge Officer	GS-0025-7*	\$46,200
	Refuge Ranger	GS-0025-7	\$41,900
	Refuge Ranger (Fees)	GS-0025-5/6	\$37,700
	Refuge Ranger	GS-0025-5	\$33,800
	Fee Collector	GS-0025-3 T	\$ 11,800
	Fee Collector	GS-0025-3 T	\$ 11,800
	<i>Wildlife/Habitat Management</i>		
	Senior Wildlife Biologist	GS-0486-12/13	\$88,700
	Wildlife Biologist	GS-0486-11	\$62,000
	Biologist (Water Quality & Contaminants)	GS-0486-9/11	\$62,000
	Ecologist (Exotic Control)	GS-0486-9/11	\$62,000
	Biological Technician	GS-0404-7	\$41,900
	Fire Technician	GS-0462-5	\$33,800
	<i>Maintenance Operations</i>		
	Wage Leader	WL-4749-11	\$52,700
	Engineering Equipment Operator	WG-5716-10	\$45,100
	Maintenance Mechanic	WG-4749-10	\$45,100
	Maintenance Mechanic (Facilities)	WG-4749-9	\$42,300
	Tractor Operator	WG-5716-8	\$36,900
	Automotive Worker	WG-5823-8	\$36,900
	Maintenance Mechanic Helper	WG-4749-5	\$31,200
	Maintenance Mechanic Helper	WG-4749-5	\$31,200
	Boat Operator	WG-5786-5	\$31,200
	<i>Public Use</i>		
	Supervisory Interpretive Specialist	GS-0025-12	\$74,300
	Environmental Education Specialist	GS-0025-9/11	\$62,000
	Refuge Ranger	GS-0025-9	\$51,200
	Refuge Ranger	GS-0025-7	\$46,200
	Park Guide	GS-0025-5	\$33,800
	Park Guide	GS-0025-5	\$33,800
	Park Guide	GS-0025-4 T	\$13,200
	Volunteer Service Coordinator	GS-0025-7/9	\$51,200
	Subtotal (annual staff costs)		\$1,956,900
	Annual fixed costs (phone, gas, diesel, electric, travel, equipment repair, equipment and building maintenance, etc.)		\$167,000
	<b>Total Annual Cost</b>		<b>\$2,123,900</b>

\* Law enforcement enhanced pay (6c retirement), Salary including benefits (calculated at the highest potential wage possible, including for each position, using FY-2000 wage scales).

T- temporary or seasonal

**Table 15. A comparison of alternatives by management goals**

*Goal 1. Wildlife Habitat and Population Management*

<i>Alternative 1.</i> <b>Maintain Current Management</b>	<i>Alternative 2.</i> <b>Ecosystem Emphasis</b>	<i>Alternative 3.</i> <b>Biological Emphasis</b>	<i>Alternative 4.</i> <b>Public Use Emphasis</b>
Protect 143,238 acres of the refuge interior under the current water regulation schedule and continue existing water quality monitoring activities in the interior.	Continue same water schedule, but improve communications on timing and delivery, expand monitoring to include contaminants and to include the cypress swamp and compartments.	Same as Alt. 2.	Same as Alt. 1
Control exotic plants as funding becomes available.	Aggressively pursue funding to remove exotic plants. Physically reduce exotic plants to a minimal maintenance level and control exotic animals.	Same as Alt. 2.	Same as Alt. 1.
No active fire management program, with no prescribed burning.	Implement a fire management program for all applicable areas of the refuge, including controlling invasive exotic plants.	Same as Alt. 2.	Same as Alt. 1.
Monitor high- profile species such as the Florida snail kite, wood stork and waterfowl.	Develop a comprehensive biological inventorying, monitoring and mapping program. This program would encompass plant communities to assess trends, wildlife and habitat responses to management techniques and Everglades restoration efforts, as well as trust species (listed, umbrella or keystone species).	The comprehensive biological program as described in Alt.2 will be fully implemented, but will also include most invertebrates, vertebrates, flowering and non-flowering plants, and algae in the refuge as well as trust species.	Same as Alt. 1 but surveys would be conducted by volunteers.
Continue limited wildlife/vegetation enhancement in Compartment C, (Impoundment C-7 only).	Actively and aggressively manage compartments for trust species. Use many different techniques, including prescribed burning to reduce accumulated biomass.	Restore Compartments A, B and C to cypress swamp. Remove most levees separating them from the existing cypress swamp and add culverts where necessary. Manage Compartment D for listed species.	Manage Compartment C, cypress swamp and Strazzulla Marsh for increased viewing of wildlife. Use prescribed burning to reduce accumulated biomass.

**Table 15. A comparison of alternatives by management goals (continued)**

*Goal 2. Resource Protection*

<i>Alternative 1.</i> <b>Maintain Current Management</b>	<i>Alternative 2.</i> <b>Ecosystem Emphasis</b>	<i>Alternative 3.</i> <b>Biological Emphasis</b>	<i>Alternative 4.</i> <b>Public Use Emphasis</b>
Continue participation on Everglades restoration committees.	Encourage communications and develop partnerships with natural resource agencies to ensure appropriate water scheduling, and continue to participate on a host of committees committed to Everglades restoration.	Same as Alt. 2.	Same as Alt. 2
Limited partnerships with groups listed in Alt. 2.	Develop and renew partnerships with interest groups, landowners, and law enforcement divisions of county, state and other agencies.	Same as Alt. 2	Same as Alt. 2
No changes to acquisition management boundary or participation in buffer lands project.	Adjust the refuge acquisition boundary to include approximately 680 acres east of Headquarters Area. Enter into management agreements with agencies that own nearby public lands. Participate in the East Coast Buffer Lands Effort and identify lands along SR 441/7 as “Areas of Concern.”	Same as Alt.2	Same as Alt.2
Use existing cultural resource management protection plan.	Update the cultural resource management protection plan.	Same as Alt. 2.	Same as Alt.2.
Follow minimal regulations to minimize wildlife/habitats to contaminant exposure.	Same as Alt. 1, plus begin contaminant monitoring in the cypress swamp, all compartments and the refuge interior as funds become available.	Same as Alt. 2.	Same as Alt. 1.

**Table 15. A comparison of alternatives by management goals (continued)**

*Goal 3. Public Use*

<i>Alternative 1. Maintain Current Management</i>	<i>Alternative 2. Ecosystem Emphasis</i>	<i>Alternative 3. Biological Emphasis</i>	<i>Alternative 4. Public Use Emphasis</i>
Maintain existing visitor facilities, interpretive exhibits and signage.	<p>Improve trails, extend cypress boardwalk and erect an observation tower, raise existing boat ramp observation tower and create a photo-blind.</p> <p>Update interpretive exhibits, interpretive signs and literature.</p>	Same as Alt. 1., with a reduction in areas to observe wildlife for the visiting public in Compartment C.	Same as Alt. 2.
Maintain existing levels of environmental education.	<p>Enlarge the visitor center with an auditorium/classroom and wet lab. Construct an open air teaching pavilion near the Marsh Trail for visiting school groups. Update and redesign the teaching curriculum. Update the outreach program.</p>	Same as Alt. 1	Same as Alt. 2.
No access to Strazzulla Marsh.	<p>Open portions of Strazzulla Marsh to visitors, provide a walking trail, a boardwalk with an observation tower and interpretive signs. A parking lot will be placed on nearby existing high ground pending partnership development.</p>	Same as Alt 1.	Same as Alt.2
No concession at Hillsboro Recreation Area.	<p>Build a concession building that includes office space and interpretive exhibits at Hillsboro Recreation Area.</p> <p>Develop a contract with a concessionaire who may provide motorboats, bicycles, fishing tackle rentals, fishing guides, and a seasonal interpretive pontoon shuttle between Hillsboro Recreation Area, Strazzulla Marsh and Headquarters Area.</p>	Same as Alt. 1.	Same as Alt. 2

**Table 15. A comparison of alternatives by management goals (continued)**

*Goal 3. Public Use (continued)*

<i>Alternative 1.</i> <b>Maintain Current Management</b>	<i>Alternative 2.</i> <b>Ecosystem Emphasis</b>	<i>Alternative 3.</i> <b>Biological Emphasis</b>	<i>Alternative 4.</i> <b>Public Use Emphasis</b>
Continue current canoe trail.	Improve canoe trail maintenance, expand the trail into the marsh and create two overnight platforms. Canoe and kayak access to all public use waters in the refuge.  Possibly develop a poleboat trail across from Strazzulla Marsh.	Same as Alt. 1.	Same as Alt. 2.
Continue hiking access on the perimeter levee from the S-6 pump station on the western perimeter levee, through Hillsboro Recreation Area north to ACME 2 pump station. Continue bicycling access from Hillsboro Recreation Area to the Headquarters Area.	Hiking and bicycling access are the same as Alt. 1.	Same as Alt. 1	Same as Alt. 2.
No change in motorboat boat access.	Motorboats will be limited to 'slow speed - minimum wake' in all waters of the refuge except in the perimeter canal northwest of Hillsboro Recreation Area.	Same as Alt. 2.	Same as Alt. 2.
Continue with existing hunting and fishing opportunities.	Redefine the waterfowl hunt area boundary to be more motorboat accessible and in better quality habitat. Allow a limited alligator hunt as well as a primitive arms feral hog hunt.	Reduce waterfowl hunt areas and hunt days. Allow primitive arms feral hog hunt in Strazzulla Marsh.	Same as Alt. 2.

**Table 15. A comparison of alternatives by management goals (continued)**

*Goal 4. Administration*

<i>Alternative 1. Maintain Current Management</i>	<i>Alternative 2. Ecosystem Emphasis</i>	<i>Alternative 3. Biological Emphasis</i>	<i>Alternative 4. Public Use Emphasis</i>
Sign a new license agreement with South Florida Water Management District.	Same as Alt. 1	Same as Alt. 1	Same as Alt. 1
Maintain current staff levels.	Expand the staff to accomplish refuge goals and objectives established in this plan.	Same as Alt. 2., with emphasis on expanding the biological staff and reducing the public use staff .	Same as Alt. 2. with emphasis on expanding the public use staff and reducing the biological staff.

**Table 16. A comparison of the annual cost of proposed staff positions, including operational and project costs, for A.R.M. Loxahatchee National Wildlife Refuge under four alternatives**

<b>General Administration Expenditures</b>	<i>Alternative 1. Maintain Current Management</i>	<i>Alternative 2. Ecosystem Emphasis</i>	<i>Alternative 3. Biological Emphasis</i>	<i>Alternative 4. Public Use Emphasis</i>
+ Annual Staff Costs	24 positions \$1,151,700	46 positions \$2,183,800	34 positions \$1,677,700	40 positions \$1,956,900
Annual Fixed Costs	\$120,000	\$185,000	\$153,000	\$167,000
* Annual Operating Costs	\$1,271,700	\$2,368,800	\$1,830,700	\$2,123,900
Recurring Base Project Costs	\$204,200	\$4,060,600	\$3,648,000	\$1,022,600
**Total Annual Costs	\$1,475,900	\$6,429,400	\$5,478,700	\$3,146,500
^ Initial Project Costs	\$144,100 without land acquisition	\$7,367,300 without land acquisition	\$5,268,300 without land acquisition	\$1,022,600 without land acquisition
Fleet	---	15 vehicles	10 vehicles	12 vehicles
Heavy Equipment	---	1 excavator 2 bulldozers 1 road grader 1 backhoe	1 bulldozer 1 backhoe	1 excavator 2 bulldozers 1 road grader
New Facilities	---	3 buildings 4 trails 1 obs. tower 3 pumps/wcs	1 pump/wcs	3 buildings 4 trails 1 obs. tower

+ Annual Staff Costs calculated at year 2000 federal scale rates including complete benefits (see Tables 11,12, 13 and 14 respectively).  
 \* Annual Staff Costs + Annual Fixed Costs = Total Annual Operating Costs  
 \*\* Total Annual Operating Costs + Recurring Base Project Costs = Total Annual Costs.  
 ^ Initial Project Costs are the beginning costs incurred to get specific projects underway (see Table 8).

### **Alternatives Considered but Rejected**

Based upon a review of the comments about issues/concerns expressed at the public scoping meeting and responses to the comment sheets, the planning team generated a list of ideas that reflected these issues/concerns. These ideas were grouped into eleven alternatives. Of these alternatives, four were evaluated; two were rejected because of a limited scope, but many of the ideas were incorporated into the final four alternatives; and five were rejected. The following alternatives were rejected: “No Public Refuge;” “Open as Much as Possible to Public Access or Completely Open;” “Function as a Wildlife Sanctuary, with Limited or No Public Access;” “Maximize Water Protection;” and “Purchase Remaining Conservation Lands in Palm Beach County.”

### **Responsiveness to Issues, Concerns, and Opportunities**

Following the guidelines of the National Environmental Policy Act, a planning team identified issues and concerns by holding a public scoping meeting and by fielding written comments from the public. Table 18 reflects how each of the alternatives addresses the major issues and concerns. In other words, “What actions does the Service plan to take in response to these issues and concerns?” As the reader will note, while most alternatives are responsive to the issues and concerns, others provide little improvement in the actions to address identified needs.

After considering the responsiveness of the alternatives to the issues and concerns, the environmental consequences of the alternatives, and legal mandates for managing national wildlife refuges, it is the opinion of the planning team and the Service that the preferred alternative (Ecosystem Emphasis) best balances wildlife and public use and meets the intent of the National Wildlife Refuge System Improvement Act.

**Table 17. Alternatives considered but rejected and the rationale for rejection**

<i>Alternatives Rejected</i>	<i>Rationale for Rejection</i>
<p><b>“No Public Refuge”</b> (private management, state management, don’t support Comprehensive Everglades Restoration Plan or the Water Preserve Areas)</p>	<p><i>Deviates from Legislative Mandates.</i> In keeping with the Refuge Improvement Act of 1997, the Service is charged with developing comprehensive conservation plans for all national wildlife refuges within 15 years.</p> <p>The Service desires to continue as an active partner in Everglades restoration and protection. The majority of lands are managed through a license agreement with the South Florida Water Management District and the Service and its legislative mandates. The return of the refuge interior to State management or to private management would require the dissolution of the agreement. The refuge is an important part of the Comprehensive Everglades Restoration Plan in that it protects some of the most pristine Everglades habitat left in the system and is an important area for wildlife use, especially while southern components are being restored.</p> <p>The Service response to other issues associated with access and recreation are addressed in Appendix J.</p>
<p><b>“Open as much as possible to public access or completely open”</b> (all sections-all hours).</p>	<p><i>Deviates from Service Policy.</i> The fundamental mission of the National Wildlife Refuge System is wildlife conservation: wildlife must come first in the management of refuges. The Service will allow and provide for public use of a refuge-- to the extent possible--as long as these uses are compatible with this mission and the purposes for which the refuge was established. In the development of public use opportunities, appropriate, compatible wildlife-dependant recreation uses will be emphasized. However, to open the entire refuge to public use would cause unreasonable harm to wildlife populations and habitat.</p> <p>The Service response to other issues associated with access and recreation are addressed in Appendix J.</p>
<p><b>“Function as a wildlife sanctuary, with limited or no public access”</b> (closed refuge to all public, no public use, ecosystem management with low impact by human interaction)</p>	<p><i>Deviates from Legislative Mandates.</i> The Refuge Improvement Act of 1997 recognizes the importance of a close connection between fish and wildlife and the American character, and of the need to preserve America’s wildlife for future generations to enjoy. In the planning and management of national wildlife refuges, appropriate, compatible wildlife-dependent recreational uses will be emphasized when it is determined that these uses are compatible with the mission of the National Wildlife Refuge System and refuge purposes.</p>
<p><b>Maximize water protection</b> (status quo on habitat management, fix water by 2006)</p>	<p><i>No Jurisdiction.</i> The State of Florida surface water quality standards have been or are being set by the Florida Department of Environmental Protection. Waters discharged into the refuge under permits issued to the South Florida Water Management District must meet the requirements established in the permits by the Department of Environmental Protection and as set out in the Consent Decree. The Service can review and comment on permit requirements and encourage the District to improve water quality but it has no legal jurisdiction over the District; rather, legal jurisdiction lies with the Department of Environmental Protection.</p>
<p><b>Purchase remaining conservation lands in Palm Beach County.</b></p>	<p><i>Not Feasible.</i> While the Service has the authority to acquire appropriate lands from willing sellers to fulfill its mission, those lands must support the Everglades Restoration effort or be lands used by federally threatened or endangered species. Although this refuge may wish to acquire more lands, and support the East Coast Buffer Initiative, Water Preserve Area, and Ag Reserve Initiatives, the refuge is one of more than 520 national refuges requesting funds from Congress for land purchases. It is not feasible to think funds would be allocated for the refuge to purchase the remaining lands in the county.</p>

**Table 18. Responsiveness of the alternatives to issues and concerns expressed at the public scoping meeting or through written comments**

Issue or Concern	<i>Alternative 1.</i> <b>Maintain Current Management</b>	<i>Alternative 2.</i> <b>Ecosystem Emphasis</b>	<i>Alternative 3.</i> <b>Biological Emphasis</b>	<i>Alternative 4.</i> <b>Public Use Emphasis</b>
<b>Wildlife and Habitat:</b> 1. The increasing number of exotic plant and animal species are negatively impacting the refuge's native wildlife and habitat.	Maintain a limited effort of exotic plant removal.	Aggressively bring exotic and invasive plants to a maintenance control level. Actively seek funding for plant removal. Create an Integrated Pest Management Plan which includes the exotic and invasive plant and animal removal plans. Use prescribed fire to remove biomass and to stunt exotic and invasive plant regrowth. Support public hunting opportunities to remove exotic animals. Support sound bio-control efforts.	Same as Alt. 2	Same as Alt. 1
2. There is a need to improve the management of species and habitats to enhance the native biodiversity and integrity of the refuge.	Continue to follow the consent decree regarding water regulation.	Implement a fire management plan to simulate the historical Everglades ecosystem. Extensive exotic plant control efforts will reduce exotics to minimal presence. Management efforts will include restoration of cleared land to cypress swamp, water level manipulation and fishery management to provide a mosaic of habitats to compliment the refuge interior. Intensely managing Compartments A,B,C and D and impoundments will provide good quality habitat for migratory, wintering and resident wildlife.	Same as Alt. 2 , however Compartments A,B and C will be re-joined and restored to native cypress swamp. Active management of Compartment D will provide good quality habitat for migratory, wintering and resident wildlife.	Same as Alt.1
3. The degraded water quality and past water management practices (e.g. water quantities and schedules) are negatively impacting the refuge's ecosystem.	Follow consent decree.	Follow consent decree. Increase monitoring of water quality and assess wildlife and habitat response to the 1995 water quantity, timing and delivery schedule. Administratively support the Comprehensive Everglades Restoration Plan and Water Preserve Areas. Increase public awareness on these projects through environmental education. See that state and federal water quality laws are followed in accordance with legal mandates.	Same as Alt. 2	Follow consent decree. Support the Comprehensive Everglades Restoration Plan with environmental education. Conduct minimal monitoring of water quality and assess wildlife and habitat response to the water quantity, timing and delivery. See that state and federal water quality laws are followed in accordance with legal mandates.

**Table 18. Responsiveness of the alternatives to issues and concerns expressed at the public scoping meeting or through written comments (continued)**

Issue or Concern	Alternative 1. Maintain Current Management	Alternative 2. Ecosystem Emphasis	Alternative 3. Biological Emphasis	Alternative 4. Public Use Emphasis
<b>Refuge Protection:</b>				
1. The refuge is threatened by rapid development of residences, planned communities, strip malls or golf courses near its boundary.	Little change will be made to augment the refuge boundaries.	Partnerships will be explored and developed to acquire additional lands or assist in the East Coast Buffer effort to protect undeveloped or agricultural areas around the refuge, especially along State Road #7/441 and Headquarters Area.	Same as Alt. 2	Same as Alt. 2
2. The wildlife and habitats are not protected enough.	The consent decree will be followed to improve water quality and therefore passively enhance habitat. Few species will be monitored.	A comprehensive biological program including extensive inventory, monitoring, research and GIS mapping of trust, key and umbrella species will be implemented. This information will assist management activities seeking to protect, maintain and enhance wildlife populations and native habitats on the refuge. Law enforcement effort will be increased to reduce poaching and harassment.	A comprehensive biological program as described in Alt.2 will be implemented, but will include most invertebrates, vertebrates, flowering and non-flowering plants, and algae in the refuge. This information will assist management activities seeking to protect, maintain and enhance wildlife populations and native habitats on the refuge. Law enforcement efforts will be increased and public accessibility reduced.	Same as Alt. 1
<b>Public Use:</b>				
1. There are not enough opportunities to observe wildlife and its habitat in a quiet, natural, non-developed environment.	Continue existing opportunities for passive recreation such as wildlife observation, painting and photography.	Expand or update the Headquarters Area visitor center, interpretive trails. Continue Alt. 1 activities. Open Strazzulla Marsh to the public with an interpretive trail, a boardwalk and an observation tower. Establish a concession for Hillsboro Recreation Area with an interpretive pontoon shuttle between main access points.	No new opportunities would be developed over Alt. 1. Levees between impoundments and the cypress swamp would be removed resulting in fewer walking trails at the Headquarters Area.	Same as Alt. 2
2. There is a need for increased access to the refuge for active recreational uses such as hiking, camping, bicycling, horseback riding, canoeing, and airboating.	Continue walking and bicycling access on the perimeter levee. Increase efforts to maintain the existing canoe trail effectively.	Continue Alt. 1 opportunities and extend existing canoe trail and provide overnight opportunities on the canoe trail. Consider creating a pole boat trail across from Strazzulla Marsh. Establish a concession for Hillsboro Recreation Area with motorboat, bicycle and fishing gear rentals. Assign areas of waterways by boat speed.	Same as Alt. 1.	Same as Alt. 2. Recreational airboating cannot be allowed because it is incompatible with primary refuge purposes of providing habitat for migratory birds.

**Table 18. Responsiveness of the alternatives to issues and concerns expressed at the public scoping meeting or through written comments (continued)**

Issue or Concern	<i>Alternative 1.</i> <b>Maintain Current Management</b>	<i>Alternative 2.</i> <b>Ecosystem Emphasis</b>	<i>Alternative 3.</i> <b>Biological Emphasis</b>	<i>Alternative 4.</i> <b>Public Use Emphasis</b>
<p><b>Public Use:</b></p> <p>3. There is a need to provide increased access to the refuge for hunting waterfowl, deer, alligator, turkey, bear and frogs.</p> <p>The habitat needs better management for fishing and hunting activities.</p>	<p>Continue existing hunting and fishing opportunities.</p>	<p>Redefine waterfowl hunt area to allow greater accessibility to motorboats by expanding existing interior hunt boundaries to the west.</p> <p>Prescribed burning will be used to open habitat and create waterfowl and coot loafing and foraging areas. Prescribed burning shall also open more area for fishing accessibility.</p> <p>Strazzulla Marsh will be opened to feral hog hunting at specified times. A limited alligator hunt will be instituted. Habitat improvements will be made (see Refuge Protection 2.)</p>	<p>Initiate feral hog hunting on Strazzulla marsh to reduce resource degradation. Reduce waterfowl hunting days and accessibility to hunt areas.</p>	<p>Same as Alt. 2.</p>
<p>4. Don't allow air boating/ allow airboating.</p>	<p>Recreational airboating will not be allowed, however, staff will use airboats for necessary biological operations, habitat management, research and law enforcement.</p>	<p>Same as Alt. 1</p>	<p>Same as Alt. 1</p>	<p>Same as Alt. 2. Recreational airboating can not be allowed because it is incompatible with primary refuge purposes of providing habitat for migratory birds</p>
<p>5. There is a need to improve access and improve/provide public use facilities at the Hillsboro Recreation Area and at Strazzulla Marsh.</p>	<p>No improvements will be made to the Hillsboro Recreation Area except upgrading the existing boat ramps.</p> <p>Strazzulla Marsh will remain closed to the public.</p>	<p>Partner with other agencies to award full concession contract, including establishment of buildings with interpretive displays, public restrooms and telephones, plus docks, improved boat ramps, rental motorboats and bicycles, fishing guides and pontoon boat tours at Hillsboro Recreation Area.</p> <p>Limited areas of Strazzulla Marsh will be opened to the public and feature a boardwalk, an observation tower and interpretive signs. A pole boat trail may be developed. A parking lot will be placed nearby on existing high ground.</p>	<p>Same as Alt. 1.</p>	<p>Same as Alt. 2.</p>

**Table 18. Responsiveness of the alternatives to issues and concerns expressed at the public scoping meeting or through written comments (continued)**

Issue or Concern	<i>Alternative 1.</i> <b>Maintain Current Management</b>	<i>Alternative 2.</i> <b>Ecosystem Emphasis</b>	<i>Alternative 3.</i> <b>Biological Emphasis</b>	<i>Alternative 4.</i> <b>Public Use Emphasis</b>
<b>Public Use:</b>				
6. There is a need to expand environmental education and interpretation, highlighting the Everglades ecosystem.	Environmental education will be minimally addressed. The current interpretive system will be maintained but not improved.	The visitors center area will be expanded with an additional building constructed for schools and college classes and in-service teacher education classes. An open-air teaching pavilion will be built near the marsh trail for field instruction. The current refuge curriculum will be expanded and improved. Interpretive exhibits and signs will be improved or added to all access points.	Environmental education will not be stressed. The current interpretive system will be amended to explain the rejoining of the compartments.	Same as Alt. 2.
<b>Partnerships:</b>				
1. There is a need for the refuge to develop partnerships with state, county and community agencies, universities and other educational institutions, natural resource based organizations and other entities.	Limited partnership efforts will continue.	Extensive efforts will be made to work with these groups. Efforts will be made to cooperate by sharing information, skill, manpower and equipment with partners.	Same as Alt. 2	Same as Alt.1
2. Give the refuge land back to the state.	Sign a new License Agreement with South Florida Water Management District and continue refuge operations.	Same as Alt 1., see Alternatives Considered but Rejected (Table 17).	Same as Alt 1, see Alternatives Considered but Rejected (Table 17).	Same as Alt 1, see Alternatives Considered but Rejected (Table 17).
3. Many of the public wish to develop ecotourism connections with the business community.	The refuge will continue to allow people to visit, and explore limited partnerships.	Support increasing partnerships and recognize that greater refuge awareness will enhance ecotourism and resource protection in the area.	Same as Alt. 2	Same as Alt. 2

## V. Affected Environment

See Section III, Refuge Environment, of the Draft Comprehensive Conservation Plan.

## VI. Environmental Consequences

Section IV described the four alternatives for achieving the vision for the refuge. These alternatives are Alternative 1, Maintain Current Management; Alternative 2, Ecosystem Emphasis; Alternative 3, Biological Emphasis; and Alternative 4, Public Use Emphasis. This section discusses the environmental impacts expected to occur from the implementation of each alternative. Alternative 1 (Maintain Current Management) is used as the baseline from which the other three alternatives are compared.

The planning team selected the following impact topics to analyze: (1) Physical Environment, (2) Biological Environment, (3) Cultural and Historic Resources, (4) Recreation, Environmental Education and Interpretation, (5) Socioeconomic Environment and (6) Unavoidable Impacts.

Direct, indirect, and cumulative impacts are described where applicable for each alternative. Direct impacts are those that occur immediately or occur at the same place and time. Indirect impacts are those that are foreseeable and occur later in time. Cumulative impacts are a series of individual, seemingly minor ones that may accumulate to create major problems over a period of time. The effects of the alternatives on the impact topics are summarized in Table 19.

### Effects on the Physical Environment

#### *Soils*

Under Alternatives 1, 2, 3 and 4, the soils of the interior would not be impacted differently by the current water management schedule initiated in May 1995. With the minimum water level measured at marsh station 1-8c set at 14 feet (National Geographic Vertical Datum), the refuge interior would not become dry and subside as readily as it has in the recent past. By keeping some water over the peat, mercury would not be activated as readily with the re-flooding of summer rains. Also the possibility of peat fires would not be as great a threat as it has been in the past.

Under Alternative 1, no active or intense wildlife habitat management would occur on any impoundment, except C-7. To provide habitat for wading birds, waterfowl and shorebirds, unwanted vegetation would be managed using moist soil management techniques (draining, rollerchopping, discing, re-flooding) and occasional applications of herbicides. These techniques would have a negative effect on the soils in C-7, since peat soils would compact and subside under drainage and compress under the weight of heavy equipment. Re-flooding could also re-activate mercury in the soil and cause contamination of wildlife foods.

Under Alternative 2, intensive wildlife habitat management would occur in all compartments (A, B, C and D). Instead of drainage and the use of heavy equipment, prescribed fire would be used to reduce unwanted vegetation. By limiting soil exposure to air for long periods and eliminating heavy equipment, subsidence should not be as pronounced and the potential for mercury contamination should be reduced. To determine if the proposed impoundment treatments would imperil wildlife, routine soil samples would be taken and tested for mercury and contaminants as part of the inventory/monitoring process.

Under Alternative 3, a select number of levees around Compartments A, B, and C would be removed. Dismantling the levees may, in the short run, have a negative impact on the peat marshes, but the habitat restoration to a cypress swamp would be beneficial to the soils and to wildlife in the long run.

Under Alternatives 2 and 4, actual construction of boardwalks, observation towers, and improving public support services at the Headquarters Area and Strazzulla Marsh would have negative, but minimal effects on soils and vegetation. However minimal wetland effects may be, they would be mitigated to comply with the requirements of Section 404 of the Clean Water Act and other applicable regulations. Turbidity during construction would be limited by silt screens or other methods to minimize potential runoff during construction. Parking areas would be constructed to allow storm water to percolate into the soil rather than allowing it to run directly into the adjacent wetlands. Short-term negative effects to air, noise quality, and soils within the project site would be expected, and measures to protect the environment would be taken.

Under Alternatives 2, 3 and 4, hunting of feral hogs would help alleviate soil disturbance and decrease exotic plant establishment in the Strazzulla Marsh.

In all of the alternatives, staff airboat use will cause limited soil erosion to the wetlands. (See Airboat Impacts.)

### *Hydrology*

Under Alternatives 1 and 4, there would be little change from the current conditions. However, under Alternatives 2 and 3, hydrologic conditions in the refuge interior should improve as greater efforts to enhance communications and partnerships between the refuge, South Florida Water Management and Army Corps of Engineers would result in better day-to-day water management.

Also under Alternatives 2 and 3, extensive monitoring and modeling would be conducted that would allow refuge staff to recommend changes to the current regulation schedule. This would result in a cumulative, long-term benefit to refuge habitats and wildlife. In addition, under Alternative 2, hydrologic conditions in the compartments would benefit targeted trust species such as wading birds, wood storks, shorebirds, and Florida snail kites. Non-targeted species may not benefit as much from specific management actions. While managing small impoundments such as Compartments A, B, or C, draining, burning, or discing can temporarily displace and cause minimal benefit to fish, small mammals, and invertebrates. However, the hydrologic conditions in a few impoundments would change on a rotational schedule, allowing the remaining 15+ impoundments to provide habitat for “non-target species.” Under Alternative 3, the hydrologic conditions in the impoundments would be returned to a more natural Everglades condition (by the removal of levees), and wetland-dependent species would benefit.

### *Water Quality*

Water issues such as quality, quantity, delivery, and timing, directly and cumulatively, affect the nesting and foraging success of many species. Because of the significant water issues affecting the refuge, staff would continue to monitor these issues and continue to dialogue with the South Florida Water Management District and the Army Corps of Engineers under all alternatives. Direct and indirect efforts to reduce nutrient loads (phosphorous) from agricultural and residential runoff into the refuge would also continue under all alternatives.

Because of actions outside of the refuge and specifications under the Consent Decree, water quality in the refuge should improve over the next 15 years. The difference in the alternatives would be seen in the extent of improvement above what is already mandated. Under Alternatives 1 and 4, a cumulative increase in the water quality in the interior of the refuge would be observed; however, with no additional monitoring, the identification of problem areas and their ultimate clean-up would not be accomplished.

Under Alternatives 2 and 3, water quality, quantity, delivery, and timing throughout the refuge would improve. Monitoring would be expanded to include pesticides, fertilizers, herbicides, and elemental contaminants in the refuge interior, all the compartments, and cypress swamp. The number of water quality monitoring stations would be increased so that problem sites could be identified. Subsequent clean-up of problem sites would be beneficial for most species. Water quality problems in the cypress swamp would be specifically addressed resulting in a positive cumulative impact on water quality. Increased communication and coordination with agencies such as the South Florida Water Management District and the Army Corps of Engineers regarding water quality monitoring would assist the refuge in comprehensive monitoring of its resources and would allow quicker responses to timing of water delivery or removal which is especially important to wildlife populations.

The cumulative effects of long-term herbicide use for exotic and invasive plant control under Alternatives 2 and 3 would diminish surface water quality in localized areas. Only wetland approved herbicides would be used. Leaching could cause chemicals used in refuge operations to enter the aquifer in a very dilute form. No health or safety concerns are expected; however, water quality testing would be used to keep contamination below allowable levels.

Improving water quality would directly improve the vegetation and habitat conditions within refuge impoundments. Most of the water currently received by the refuge and diverted into refuge impoundments is laden with nutrients, causing an explosion of noxious vegetation. The impoundments then become covered in dense vegetation and unsuitable for many species of wildlife that once used them. This also has a direct effect on the numbers of visitors who come to the refuge to view wildlife.

New facility construction of any of the structures in the alternatives would have little effect on water quality. Any or all fill operations would comply with the requirements of Section 404 of the Clean Water Act and other applicable regulations. Turbidity during construction would be limited by silt screens or other methods to minimize potential runoff during construction. Parking areas would be constructed to allow storm water to percolate into the soil rather than allowing it to run directly into the adjacent wetlands. Short-term negative effects to air, noise quality, and soils within the project site would be expected, and measures to protect the environment would be taken. (See section on Airboat Impacts regarding water quality issues.)

### *Air Quality*

Under Alternatives 1 and 4, no impacts are anticipated. Under Alternatives 2 and 3, sporadic times of air pollution would increase on a short-term basis, since fire would play a much larger role in refuge management than under the first alternative. For example, more than 100 acres of impoundments could be burned each year; a number of treated melaleuca sites could be burned each year; and portions of the interior could be treated with prescribed fire each year.

Smoke pollution generated by prescribed fire could effect, in the short term, vehicular traffic safety and respiratory problems in the urbanized areas east of the refuge. To minimize the amount of smoke, fire prescriptions would be conducted with predominately easterly winds.

### *Noise pollution*

The refuge strives to maintain the natural quiet and sounds associated with the refuge's environment. Artificial and mechanical noise has the potential to disturb wildlife and human visitation. As stated in an Environmental Assessment for Big Cypress National Preserve, artificial noise, specifically airboats, may cause resident, migratory, and wintering wildlife to flush from nests, dens, cover, foraging areas, or cause avoidance of habitat (Department of the Interior, National Park Service 1999a, 1999b). (*See Airboat Impacts and Appendix J.*)

Under Alternatives 1 and 4, a helicopter would be used two days a month to collect water samples by the staff of the refuge and South Florida Water Management District. Additional helicopter flights may be used to gather technical information on the refuge as well as inspect other areas (e.g., Everglades Nutrient Removal Project, Storm Water Treatment Areas, and Water Conservation Areas). To minimize negative impacts to wildlife, all flights must exceed 500 feet, unless in accordance with a special use permit. All aircraft flying below 500 feet would be investigated by refuge law enforcement.

Under Alternatives 1 and 4, very limited noise impacts are anticipated except at Hillsboro Recreation Area, where a nearby commercial airboat operator works out of Water Conservation Area 2.

Under Alternatives 2 and 3, additional wildlife or habitat research and inventory/monitoring surveys conducted with the use of helicopters, airplanes, or airboats would have the potential of increasing noise impacts. The cost of helicopter and airplane rental would limit their use to the most important trips over the refuge. All airboat use in the refuge interior would be based on specific project needs (*See Airboat Impacts*).

Under Alternatives 2 and 4, the concession at Hillsboro Recreation Area would generate more noise impacts than described in Alternatives 1 and 3, because of increased motorboat use, guided fishing tours, and potentially an interpretive pontoon boat tour (*See Airboat Impacts*).

With all the alternatives, gunfire associated with the hunting seasons would contribute to local noise pollution; however, this impact is thought to be minimal and distant from the most heavily visited section of the refuge.

Under Alternatives 2 and 4, there would be increased noise in the Headquarters Area from pumps, which move water in and out of the impoundments to enhance wildlife habitat. This periodic engine noise would negate the 'natural quiet' some visitors seek at the refuge.

### *Aesthetics*

The refuge is a scenic wonder, filled with outstanding Everglades marsh, tree island, and cypress swamp habitats. The managed impoundments can also be pleasing to the eye. Under Alternative 1, invasive cattail, floating exotic plants, exotic trees, and vines would continue to prevent a naturalist's appreciation of the refuge. There would be minimal attempt to place native plants around facilities and residences under Alternative 1.

Under Alternatives 2 and 3, a great effort would be made to control and manage the invasive and exotic plants on the refuge. Initially, the control efforts would not be pleasing to visitors. Treatments vary with kinds of exotic plants; melaleuca is cut down or pulled out and allowed to lay in the water to die; Old World climbing fern is sprayed, causing cascades of dead vine debris to hang from shrubs and trees; Brazilian pepper is cut or uprooted; and other exotic or invasive plants would be chemically treated and would remain on site to decompose. These treated areas may appear unsightly until native plants fill in the areas.

Fire would be used to reduce melaleuca biomass after treatment, where applicable. Further research is needed to know if burning treated Old World climbing fern is a safe and effective method to reduce biomass and not spread its spores. Under these alternatives, strict guidelines would be followed for planting site-appropriate native plants around facilities and residences.

Under Alternatives 2 and 3, prescribed fire would be used to enhance wildlife habitat in the interior. Fire would also be used in the impoundments under Alternatives 2 and 4. Some may consider this management tool to be aesthetically unpleasing, since these marsh areas would be temporarily blackened; however, new vegetative growth would rapidly become green.

Under Alternative 3, a short-term decrease in the aesthetics in the Headquarters Area would occur as numerous levees are removed and the impoundments are restored to cypress swamp and Everglades-type conditions.

Generally, under Alternatives 2 and 4, the increase in the number of access points and associated visitor use escalates the potential for litter. Litter would not only be unsightly, but also it may result in increased wildlife ingestion of plastics and entanglements in trash.

### *Facilities*

Under Alternatives 1 and 3, no new facilities would be created. Existing buildings would be maintained. No additional impacts are expected. Under Alternatives 2 and 4, a concession building would be constructed at the Hillsboro Recreation Area. It would be built on a former structure site that was prepared with fill so no archaeological restrictions would apply. A dock area may be built when the concession building is approved. Initial construction would directly impact the area. However, the proposed area is already heavily impacted from boat use and a dock would decrease the impact to banks and decrease erosion problems. Existing boat ramps would be replaced with little or no damage to the site. Under Alternatives 2 and 4, an additional building for classroom education/auditorium would be constructed near the present visitor center at the Headquarters Area and a teaching pavilion will be constructed near Impoundment C-7. Because the proposed sites for these additional structures are the edge of an existing filled area (parking lot or grassy area), no archaeological sites exist in this area, and no existing wetlands would be lost. Constructing the overnight platforms along the canoe trail would cause minimal direct negative impacts, but little other impacts would be expected. Parking facilities would be created on existing high ground near Strazzulla Marsh under Alternatives 2 and 4.

## Effects on the Biological Environment

### *Vegetation and Exotic Plants*

#### Sloughs and Wet Prairies:

Under Alternatives 1 and 4, wet prairies and possibly sloughs would continue to fill in with vegetation because of the loss of fire in the ecosystem. This would result in the possible loss of thousands of acres of native plant communities and diminish the biological heterogeneity of the northern Everglades. Under Alternatives 2 and 3, the use of prescribed fire would mimic the natural role of wildfire and continue to provide the open habitat, which would benefit many wildlife species.

#### Sawgrass:

Under Alternatives 1 and 4, sawgrass would continue to fill in open spaces especially in the south, southwestern, and western portion of the refuge. With the abnormally high nutrient content of the water, the sawgrass stands around the edges of the refuge have grown taller, more numerous, and more dense than historically. As the water quality improves, sawgrass would grow more slowly and less densely. However, the existing biomass would continue to convert wet prairies to sawgrass.

Under Alternatives 2 and 3, prescribed fire (*Fire Impacts section*) would be used to reduce the impinging sawgrass and recreate wet prairies. Fire would also assist in re-creating the rich mosaic of sawgrass and wet prairie which provides both cover and foraging opportunities for wildlife species. The effects of Alternatives 2 and 3 would be beneficial to wildlife.

#### Tree Islands and the Cypress Swamp:

Under Alternatives 1 and 4, wildfire would eventually destroy tree islands which are covered by Old World climbing fern; likely assist in spreading the exotic fern (although studies are needed to verify this); and assist in spreading exotic melaleuca seed. Without exotic plant treatment and control, the largest remaining cypress strand along the eastern edge of the Everglades would probably be lost to the infestation of exotics and/or wildfire.

Under Alternatives 2 and 3, control efforts would halt the spread of exotic and invasive plants and permit the restoration of these degraded habitats. Alternatives 2 and 3, would have some direct impacts on nearby non-targeted plants related to treatment techniques but would provide substantial positive effects on these native vegetative communities in the long run.

#### Cattail:

Much of the habitat found along the perimeter of the interior is reduced in value and serves no useful purpose to wildlife, as sawgrass marsh and wet prairies have been replaced by dense cattail. Under the current management program and Alternative 4, dense cattail would continue to expand from the refuge perimeter canals inward toward the more pristine interior. Under Alternatives 1 and 4, waterfowl and fish habitat would continue to decline as open portions of the refuge fill in with cattail in the south, southwest, and western portions of the refuge.

Generally, as water quality improves under all the alternatives, cattail in the perimeter canal is expected to decline very slowly as it loses its supply of high nutrients. However, the residual large area of biomass would still preclude wildlife use.

In Alternatives 2 and 3, prescribed fire in cattail would reduce biomass in the areas mentioned as well as other cattail-infested areas and provide better wildlife habitat.

**Exotic Plant Impacts to Native Vegetation:**

Vegetation components of the refuge would continue to exist under Alternatives 1 and 4, albeit in a different form than the original Everglades. Major portions of the refuge vegetation would continue to be replaced by invasive and exotic plants.

Under Alternatives 1 and 4, controlling invasive exotics such as melaleuca, Old World climbing fern, and Brazilian pepper would not receive the level of attention given in Alternatives 2 and 3; thus, there would be continued degradation of native habitats unique to the northern Everglades. Current levels of refuge funding for treatment of exotics, using temporary laborers and private contractors, would result in very limited control. Native habitats, including sawgrass, wet prairies, sloughs, and tree islands, would continue to be replaced by monotypic stands of melaleuca at the rate of 10 acres per day.

Under Alternative 1, an additional 25 percent of the refuge interior would be lost to melaleuca within 5 years. Similar habitats in Compartment D and Strazzulla Marsh would be subjected to the same fate. Without aggressive treatment, Old World climbing fern would continue to spread at the rate of approximately 5 acres per day. Brazilian pepper would continue to overrun levees and dikes, successfully crowding out native vegetation growing along the edge of impoundments. Constant seed release from exotic plants onto neighboring private lands would further accelerate the infestation of refuge lands. The refuge, in fact, would succumb to exotic plant invasion within 15 years and the integrity of the ecosystem would be lost forever. Under all the alternatives, floating invasive exotics such as water lettuce and water hyacinth would continue to impact the perimeter canals (L-40, L-39, and L-7); these exotics cause water flow and drainage problems, cause water control structures to clog, and impede recreational boating, fishing, and waterfowl hunting. Large mats of floating vegetation reduce available dissolved oxygen and contribute to fish kills. This loss of fish has a direct impact on large predators such as wading birds and alligators.

Under Alternatives 2 and 3, invasive exotic plants would be aggressively controlled and would become one of the refuge's highest priorities. Infestations of melaleuca, Old World climbing fern, and Brazilian pepper would be reduced to "maintenance control" levels within 15 years if adequate funding is made available. All other invasive upland and aquatic plants would be eradicated or actively controlled. Native Everglades habitats including wet prairies, tree islands, sawgrass communities, and sloughs would benefit directly and would recover naturally. Other Category I and II exotics would continue to be treated on a "when encountered" basis.

Under Alternatives 2 and 3, some damage to native vegetation would be expected due to an increase in exotic plant control efforts. Increased ground efforts and large-scale aerial treatments would be needed to attack large monotypic stands of melaleuca, and tree islands completely covered with Old World climbing fern. Because species-specific herbicides are not yet available, the herbicides currently used have the potential of killing the majority of the native vegetation present in the treatment area. Large scale aerial operations to attack Old World climbing fern-infested native tree islands would most likely result in the death of native trees, shrubs, and surrounding ground cover. However, some species such as buttonbush, cocoplum, wax myrtle, red bay, and dahoon holly may be resilient to many of these non-selective herbicides. Sawgrass and willow species generally take a longer time to recover. After approximately six months of dead vegetation decomposition, these tree islands would once again become germination sites for desirable native vegetation due to the presence of a natural seed source in the soil or from neighboring un-infested tree islands.

Service funds, coupled with potential partnerships and grants, would be used to conduct exotic plant surveys, map infestation areas, map treatment areas through the use of satellite imagery, as well as to directly treat invasive and exotic plants. This increased funding would allow for several invasive exotics to be targeted at various locations throughout the refuge. Additionally, the refuge, through the Service's Partners for Fish and Wildlife Program, would join with neighboring private (agriculture) landowners to treat invasive exotics so that an "exotics-free" buffer could be established between these private lands and the refuge. This would greatly reduce the seed fallout and prevent future exotic infestations. Refuge staff would continue to participate in exotic plant working groups to ensure future funding opportunities.

Additional benefits under Alternatives 2 and 3 would be the implementation of a fire management program to restore the native fire regime that once occurred in the northern Everglades ecosystem. This would greatly improve the quality of the habitat for all refuge wildlife and would further prevent the spread of invasive exotics, if performed under controlled situations.

Improving refuge water quality is a high priority under both Alternative 2 and 3. These improvements would have a moderate impact on controlling the spread of exotic plants such as water lettuce and water hyacinth, and would reduce the spread of noxious vegetation such as cattail, a plant which thrives under high nutrient conditions associated with poor water quality.

Under Alternative 4, increasing public use would require the construction of additional nature trails into areas that were previously closed to the visiting public such as Strazzulla Marsh. This would cause limited damage to native vegetation and may increase the potential for exotic infestation. A primary characteristic of invasive exotics is their ability to quickly establish and take space over disturbed areas. This would unfortunately lead to more maintenance and control, requiring additional funds and manpower.

#### *Wildlife and Protected Species*

Under Alternatives 1 and 4, loss of native habitats to exotic and invasive plants would have a severe impact on almost all bird species, especially threatened and endangered species such as the Florida snail kite, wood stork, and species of concern including most wading bird species. These species depend heavily on a mosaic of habitats found on the refuge, especially open areas, to survive. Neither the Florida snail kite nor the wood stork would be able to forage for their preferred foods; they would most likely abandon the refuge.

Migratory shorebirds, waterfowl, and resident wading birds (most of which are species of special concern) would experience a similar fate due to the loss of quality habitat, which would be replaced by dense, impenetrable stands of invasive exotics. As previously noted, Alternatives 2 and 3 management efforts would improve conditions in the Everglades marsh.

Under Alternatives 1 and 4, native tree islands, the cypress swamp, and Strazzulla Marsh would be directly impacted by Old World climbing fern and Brazilian pepper. Loss of these native vegetative communities would adversely affect both resident and neotropical song birds as well as listed species. Migratory songbirds (*Appendix K*) depend heavily on native vegetative communities to provide insects, fruit, and cover during migration. These communities also serve as important breeding, resting, and feeding areas for resident songbirds. On the other hand, Alternatives 2 and 3 would concentrate efforts to preserve or restore areas of exotic infestation and keep these communities viable for use by migratory passerines and resident songbirds.

Waterfowl habitat would not improve under Alternatives 1 and 4. However, under Alternatives 2 and 3, open areas would be created and vegetation density would be reduced. The open areas and resulting new vegetative growth would provide better habitat and foraging conditions for ducks and coots.

### *Research and Monitoring*

Under Alternatives 1 and 4, only high profile species such as the endangered wood stork and Florida snail kite would be monitored. This would result in spotty information, insufficient knowledge, and gaps with respect to most species on the refuge. This lack of comprehensive knowledge and the crucial role that it plays in formulating management policy, could prove detrimental to the natural ecosystem, native vegetation, and wildlife populations. Additionally, the refuge would not be able to assess the effects of the Comprehensive Everglades Restoration Plan or provide pertinent data to assess the Comprehensive Everglades Restoration Plan's adaptive management process.

Alternative 2 encompasses a comprehensive biological program to include inventory, monitoring, and GIS mapping of species on the refuge. Trust, keystone, and umbrella wildlife species and associated habitats would be evaluated; thus, this alternative is more inclusive and would be more helpful in assessing management activities than either Alternatives 1 or 4. Under Alternative 3, the biological program is more encompassing than Alternative 2, monitoring most forms of wildlife and associated habitats.

Both Alternatives 2 and 3, would have dramatic benefits for wildlife and their associated habitats. Because of the significant problems associated with key wildlife populations in the Everglades (wading birds and alligators), the proposed comprehensive biological programs and cooperative research projects would be of great importance to Water Conservation Areas, Everglades National Park, and adjoining management areas.

Under Alternatives 2 and 3, greater numbers of research projects would be allowed in the refuge than under Alternatives 1 and 4. The refuge is one of the last relatively pristine and un-impacted natural areas left in south Florida that can provide an appropriate setting for natural science research. Additionally, because a large portion of the refuge is managed for wildlife and closed to the public, expensive research equipment is relatively safe and project sites remain undisturbed-- which is a standard research requirement. The results of these projects would provide management information which can be used for all the Everglades ecosystem to improve wildlife populations and their habitats.

### *Wildlife in the Compartments*

In Alternative 1, only Impoundment C-7 would be managed for wildlife habitat and would provide 33 acres of benefit to wildlife, predominantly for waterfowl. Under this alternative, the remainder of the compartment system (1997 acres) would be minimally managed providing little benefit for wildlife populations.

In Alternative 2, all 2,030 acres of Compartments A, B, C, and D would be actively managed for many forms of wildlife including trust, keystone and umbrella species. The impoundments (via a step-down management plan) would be managed in a mosaic, so at least one or two different impoundments would provide optimal foraging habitat throughout the year for groups of wildlife such as wading birds, waterfowl or shorebirds, and species in between these groups. This alternative would result in numerous positive impacts, both direct and cumulative, for the imperiled species mentioned above.

Under Alternative 3, the 1,102 acres of Compartments A, B, and C, and the cypress marsh would be re-joined by removing levees. The area would be restored to its historic vegetative community. This should have a positive indirect and cumulative effect on trust species and most Everglades-adapted wildlife. Compartment D (1327 acres) would be actively managed for listed species found in the Everglades marsh.

Under Alternative 4, all of Compartment C (276 ac.) would be actively managed for many forms of wildlife including trust, keystone, and umbrella species. The result would have positive impacts for species using this area, and the public would see the results of sound wildlife management practices. The remaining 1,754 acres of compartments would be minimally managed, providing little benefit for wildlife.

### *Research Natural Area*

Under all the alternatives, the Research Natural Area portion of the refuge would not be intentionally impacted because access to it is virtually not allowed. In a sensitive marsh environment, the physical act of a person walking in the peat or airboating over the water causes changes to the substrate. The refuge staff prefers to have research occur outside this area if at all possible to retain the area's "pristine condition." Currently, the refuge offers enough non-impacted sites that the Research Natural Area does not need to be used for research. However, if research is allowed, this relatively untouched area would provide an excellent baseline to which impacted areas could be compared.

Under Alternatives 1 and 4, the exotic Old World climbing fern would not be controlled and would eventually overtake this area. As described in the Fire Impacts, Exotic Plant Control Section, the "ladder effect" would carry fire into and destroy tree islands in this area. Consequently, the Research Natural Area may be subjected to greater negative wildfire impacts and would not retain its "natural characteristics." Also, melaleuca would increase in this area without control treatment.

Under Alternatives 2 and 3, a significant effort would be made to prevent or control exotic plant invasion of this area. The removal or control of exotic plants would have a negative impact in the same way it would in other areas of the refuge (*see Exotic Plant Impacts to Native Vegetation*). However, major indirect and cumulative benefits would be realized. Without the removal or control effort, the area's plant community would eventually be lost to the detrimental effect of a wildfire.

### *Airboat Impacts*

Airboats have been used for transportation in the Everglades since approximately the 1930s. They have provided a motorized means of transportation that allows users to access areas for fishing, hunting, or other outdoor activities that otherwise would not be accessible due to low water or dense vegetation. They also are an invaluable tool for accessing research sites and conducting law enforcement activities. Because they are ideally suited for travel in the Everglades, airboats have become very popular. The popularity of airboats combined with an increase in the number of people participating in outdoor recreational activities has resulted in an increase of human-related disturbances to wildlife and natural areas. Some land managers are prohibiting the use of airboats and swamp buggies because of the disturbance factor and to protect wildlife. The refuge is mandated by the Refuge Improvement Act to minimize or eliminate disturbances to wildlife. The following is a summary of potential airboat impacts that have been identified by south Florida biologists from the National Audubon Society, South Florida Water Management District, Big Cypress National Preserve, Everglades National Park, U.S. Fish and Wildlife Service, Florida Fish and Wildlife Conservation Commission, and other scientists. Further information on airboat impacts is presented in Appendix J.

Airboats impact flora and fauna via noise and physical disturbance. In addition, airboats can impact visitors who desire a “wilderness experience.” Studies have shown that airboats can generate noise in excess of 120dB when accelerating and 63db to 75dB while cruising. This is above the acceptable noise levels for cars and motorcycles (Florida Vehicle Noise Prevention and Control Act of 1974, Section 316.293). Noise of this magnitude disturbs both people and wildlife. In addition, the noise from airboats carries for long distances (at least one to two miles) away from the source so impacts are general and not limited to the area in which the airboat is being operated.

Physical disturbances caused by airboats can include damage and destruction to habitats and wildlife. Damages can include leaf loss and stem breakage on individual plants; changes in vegetation community types due to soil disturbance; the spread of exotic plants; and injury or death to wildlife due to collisions with airboats, displacement from nests, or stress related to noise and the presence of a large rapidly moving vehicle.

Continuous airboat operation through sawgrass and wet prairie habitats creates airboat trails, which are open areas where vegetation no longer grows due to physical disturbance, soil erosion, and compaction. Though these trails can provide dry season refugia for many wildlife, they also can change drainage patterns and provide routes for the movement of exotic fish, exotic vegetation, and nutrients into more pristine wetland areas.

Research on the effects of human disturbance on wildlife has shown that a 14-foot airboat approaching colonial waterbirds will cause behavior disruption at a greater distance than an approach on foot or by a 14 foot johnboat. In another study, visual disturbance from the presence of an airboat was found to occur in areas that were used as foraging or roosting sites. These short-term disturbances (especially if they happen frequently) may adversely impact individuals by influencing where, when, and how long they are able to forage. In addition to being displaced from an area, wildlife may be injured or killed by airboats. This is of particular concern for secretive birds, such as bitterns and rails that may flush immediately in front of a boat, or species such as apple snails (the primary food source of the endangered Florida snail kite) that lay their eggs on emergent vegetation.

#### **Airboat Effects on Refuge Resources:**

Under Alternative 1, impacts from airboats would be minimal. Refuge biologists would continue to use airboats only to conduct minimal wildlife surveys and visit established data collection sites. A limited number of researchers and special use permittees would continue to be allowed to access the interior using airboats. All staff, researchers, and permit holders are instructed to minimize airboat impacts by avoiding visible wildlife and minimizing damage to vegetation. Law enforcement activities would generally be concentrated in the Hillsboro Recreation Area. Only a small percentage of motorboat users experiencing mechanical difficulty require airboat rescue.

For Alternatives 2 and 3, airboats would be used by refuge biologists for more intense efforts to survey wildlife and habitat, and conduct inventory and mapping activities. In these alternatives, a limited number of researchers and special use permittees would be allowed to access the interior using airboats. All staff, researcher and permit holders would continue to minimize airboat impacts by avoiding visible wildlife and minimizing damage to vegetation.

In Alternatives 2 and 3 additional efforts to bring exotic plants to a minimal maintenance level would require extensive airboat operation. The detrimental effects of the contractor's airboats would be minimized by requiring them to stay on airboat trails leading to designated work sites. Extraneous movement of the airboats would be strongly discouraged to minimize the dispersion of spores from exotic plants while in the work sites.

In Alternatives 2 and 4, refuge law enforcement personnel would use airboats more to monitor an expected increase in waterfowl and alligator hunting, and an increase in emergency rescues of lost canoeists and campers.

### *Fire Impacts*

#### Exotic Plant Control:

Fire has been a major factor in the development and perpetuation of the Everglades ecosystem. It is a frequent and widespread event which acts to interrupt plant succession. Sub-climax communities, which are characteristic of the Everglades, including sawgrass and wet prairies, depend on fire to establish and maintain their historical dominance. The abundant and diverse wildlife of the Everglades has evolved and thrived in a fire-adapted regime.

Unfortunately, at least two exotic plants found on the refuge can be spread by uncontrolled fire. Mature melaleuca trees burn readily but are resistant to fire because of the thick, water-laden, papery bark that protects the cambium. Mature trees release millions of seeds during a fire and those seeds fall on a fire-enriched muck that greatly increases the potential for successful germination. Another exotic, Old World climbing fern, rapidly grows into thick mats and up into the canopy of trees. It acts as a "flame ladder," introducing fire into tree canopies resulting in tree death. Furthermore, when Old World climbing fern burns, it floats off in small pieces, increasing the spread of fire, often devastatingly. Wildfire would rapidly spread untreated melaleuca and Old World climbing fern, stifling all control efforts.

Conversely, prescribed fire is the most successful method available to reduce the biomass of dead melaleuca trees and to enhance native plant recovery in treated areas. Without reducing dead melaleuca biomass, the restoration period for the site is greatly prolonged. Also, prescribed fire can kill immature melaleuca plants that are resprouting in treated areas or newly invading a relatively pristine area. Unfortunately, not enough scientific information is known regarding the fire effects on treated and dead Old World climbing fern. Studies need to be funded to identify weak points in this plant's life cycle. That information would assist managers in controlling the fern and learning if prescribed fire can be used to reduce the incredible biomass associated with this plant, without causing its spread.

Under Alternatives 1 and 4, there would be no intentionally introduced fire anywhere in the refuge interior. The "no action" proposed in these alternatives would not prohibit fire altogether because unplanned wildfire by lightning strike would result regardless of management desires. This would actually enhance the spread of untreated melaleuca and Old World climbing fern. If one waited for a random wildfire to encounter a treated melaleuca area, the most often result would be inadequate or no restoration of the area. However, a lightning strike fire in untreated exotic plant areas would surely increase the spread of their seeds or spores. Re-establishment of already treated exotic plants would occur because prescribed fire is not used under Alternative 1. Under Alternatives 2 and 3, fire would be intentionally introduced on the refuge. The natural ecosystem has been severely altered by exotic plants, and now requires the use of planned or prescribed fire to properly restore the Everglades. Because wildfire would have devastating negative effects on the exotic

plant removal programs for melaleuca and Old World climbing fern (as previously noted), prescribed fire as proposed in this alternative would only be used in areas where exotic plants have already been treated or where immature plants could be killed with no risk of spreading seeds. Prescribed fire, which accelerates habitat restoration, would be used to remove the large amounts of dead biomass and immature regrowth that results when melaleuca trees are cleared by staff or contractors. Costly exotic plant eradication efforts, and subsequent habitat restoration, would greatly benefit from a prescribed fire program under Alternatives 2 and 3. Prescribed fire would also be used to maintain healthier habitats such as areas not affected by exotic plants and overgrown, relatively pristine areas. In addition to restoring natural habitats as described above, prescribed fire would be used to minimize the chances of a more intense wildfire entering tree islands and other areas that are impacted by invasive species.

#### Invasive Plant Control (Cattail):

Under Alternatives 1 and 4, the perimeter of the refuge interior would continue to be rimmed by dense cattail growth. This native plant is considered an undesirable invasive species because of its explosive growth response to high nutrient laden water entering the refuge. Even when the water quality is improved, dead or reduced cattail biomass would remain and prevent native habitats from becoming reestablished. Lack of a prescribed burning program would continue to have an indirect and especially cumulative negative impact on wildlife and wildlife habitats. Under Alternatives 1 and 4, efforts to remove invasive cattail would greatly suffer from lack of a prescribed fire plan. Conversely, under Alternatives 2 and 3, the use of prescribed fire would greatly improve approximately 6,000 acres of waterfowl habitat and complement efforts to improve water quality. This action would speed up the efforts to restore the natural sawgrass stands when done in conjunction with water quality improvements.

#### Compartment Management:

Under Alternative 1, prescribed fire would not be used in compartment management of the refuge. The overgrown and invasive plants presently found in approximately 2,030 acres of wetland impoundments would remain and prevent optimal habitat utilization by wildlife. Under Alternative 1, only a rare wildfire would affect the impoundments, resulting in low habitat diversity and an abundance of invasive cattail. Under Alternative 2, prescribed fire would be used to help create and maintain a mosaic of habitats benefitting a wide array of migratory birds, including shorebirds, wading birds, and waterfowl. Because prescribed fire can be used in moist areas where effective water control and drainage are difficult to maintain, fire is a preferred management option for the impoundments. Where prescribed fire would be used to restore and maintain wildlife habitat, an educational effort would be made to inform the public of the benefits of prescribed burning.

Alternative 3 would not use prescribed fire as often as Alternative 2, because restoration of Compartments A, B, and C to cypress swamp is the management goal. However, fire would be used initially to remove the overriding vegetative biomass and open the wetlands up for replanting of native cypress.

Under Alternative 4, prescribed fire would not intentionally be used anywhere on the refuge except in the publicly accessible Compartment C (approximately 300 acres). The substantial negative ramifications associated with not using prescribed fire explained in Alternative 1 would also be felt in this alternative. In Compartment C, where prescribed fire would be used to restore and maintain wildlife habitat, an educational effort would be made to inform the public about the benefits of prescribed burning. Under Alternative 4, prescribed fire would enhance the habitats, thereby increasing visitor wildlife observation and photography activities.

### Catastrophic Wildfire:

Without a prescribed burning program, catastrophic wildfires would result due to high fuel load buildup. Fires burning through thick vegetation on the refuge have the potential to disrupt wading bird colonies, other nesting birds, and listed species. Most vegetative habitats can change because of an excessive fuel load. Some of these changes could include: 1) muck fires that destroy the soils resulting in deep sloughs; 2) tree islands (the unique feature of the refuge) burning completely and changing into wet prairie; 3) sawgrass marsh and its peat substrate being consumed

and turning into wet prairies or sloughs; and 4) cypress heads or cypress swamps being consumed and becoming willow or Brazilian pepper thickets.

Catastrophic wildfires produce direct negative impacts on human health and safety if smoke is carried to adjacent roadways or populated areas. Negative effects are associated with wildfires that burn huge tracts of land, spread to lands off of the refuge, and threaten residential areas and croplands. Under Alternatives 1 and 4, the refuge would not be able to control much of the negative effects of wildfire. Conversely, under Alternatives 2 and 3 (and 4, regarding only the C impoundments) the chances of a catastrophic wildfire are reduced

because regularly burned vegetation does not usually burn as rampantly or generate as much heat, flame height, or thermals because of reduced fuel availability. Breaking up vegetative fuels with prescribed fires would reduce the potential for such destructive fires. This reduced threat benefits all aspects of public safety, health, and property. There are less all-around negative effects associated with a prescribed burn program except for temporarily lessened air quality during the actual time of the burn.

### Costs of Fire Suppression:

Catastrophic fire suppression costs include the cost of firefighting personnel and the cost of equipment and supplies. The State of Florida, Division of Forestry, can provide suppression services in the refuge interior if needed. Even without major suppression, costs may still be incurred from the replacement of items lost in a fire. Property in the interior includes permanent and temporary research facilities, boundary signs, and restroom facilities along the canoe trail. Property in the Headquarters Area includes five residences, a vehicle storage building, an office, a visitor center, a shop maintenance building, and boat building with six airboats. There are three areas of above-ground fuel tanks (shop, Compartment D and the P-1 pump) and an oil storage building in the shop area that would pose considerable threat to personal safety, property, and natural resources in a wildfire. No wildfires have been documented around refuge buildings and only a few have been recorded in the impoundments around the Headquarters Area.



Prescribed burn  
USFWS Photo by C. Sewell

### Effects on Cultural and Historic Resources

Under all four alternatives, any known or found historic and archaeological sites would be protected under federal ownership as defined in the National Historic Preservation Act of 1966, as amended through 1992 (P.L. 89-665), the Archaeological Resources Protection Act of 1979 (P.L. 96-95), the Native American Graves Protection and Repatriation Act of 1990 (P.L. 101-601), and the implementing regulations authored by the Advisory Council on Historic Preservation, the Department of the Interior, and the National Park Service. However, the degree of protection as well as the opportunities to conduct scientific research and to interpret past cultures vary between each alternative.

Archaeological and related scientific investigations on the refuge have been limited to Griffin, Miller, and Fryman's 1979 project-specific archaeological survey. The lack of a comprehensive refuge-wide archaeological survey hampers the Service's ability to effectively meet its myriad cultural resource management responsibilities. Such a survey would provide a site predictive model based upon the region's cultural history, known site distribution, oral history interviews, historic documents, historic land use patterns, topography, geomorphology, soils, hydrology, and vegetative patterns.

Under Alternative 1, cultural resource management would be limited to those investigations required for compliance with Section 106 of the National Historic Preservation Act and Archaeological Resources Protection Act-related investigations of illicit looting and collecting. Data relating to the refuge's hydrological regime, geomorphology, changing vegetation patterns, and past cultural land use patterns would be garnered only through reviews of existing technical literature and not through focused scientific investigations. Other efforts, such as erosion control and interpretive and educational opportunities, would be virtually non-existent due to the lack of personnel, facilities, and funds.

A refuge-wide comprehensive archaeological survey would be conducted under Alternatives 2, 3, and 4. The rationale for such an investigation and use of its data, however, differ for these alternatives. A site predictive model would be generated from the survey. Critical variables include the region's cultural history, known site distribution, historic human land-use patterns, geomorphic processes, hydrological regimes, soils, and vegetative patterns. Alternative 2, Ecosystem Emphasis, would represent a balanced management approach to the refuge's natural and cultural resources. To accomplish the goals of this alternative, scientific investigations, such as plant and animal inventories, Geographic Information System mapping, archaeological investigations, and geomorphic studies, are necessary tools. The databases generated from these investigations would enhance the refuge's ability to monitor and protect cultural resources under their jurisdiction. The emphasis on environmental education can provide increased public awareness of the region's past cultural histories, the fragility of archaeological sites, and the nature of human-habitat interactions. Ties with the Miccosukee and Seminole Nations are further encouraged in Alternatives 2 and 4, particularly for input into the management of sites important to these groups as well as an opportunity to educate others about their history and use of resources present within the refuge. Partnerships with universities and other pertinent entities to conduct scientific archaeological research would be actively pursued and fostered.

Alternative 3 places a limit on public use and instead focuses on an intensive ecosystem management approach. Decisions would be made utilizing sound biological and wildlife principles, and past and ongoing investigations. This alternative provides an opportunity to conduct scientific archaeological investigations that incorporate a range of other disciplines. The objective would be to provide information regarding the refuge's habitats and changes due to human-habitat interactions.

Opportunities would decline for public education regarding issues of historic preservation, responsible site stewardship, and to introduce the region's past and current cultural histories. Protection for archaeological sites would improve due to active investigations as well as closure of large areas to the public.

Alternatives 2 and 4 are potentially the most destructive to cultural resources due to the construction of facilities, such as boardwalks, pavilions, docks, campsites, and restrooms that are needed to facilitate public use. Although increased visitation leads to opportunities for education about past cultures and habitats, it could also lead to an increased potential for site loss due to public use related activities, illicit looting, and un-permitted collecting. Educational opportunities should focus on responsible site stewardship that introduces the public to the region's rich cultural history via interpretive programs and panels at sites. To support increased public use, it is imperative that a comprehensive archaeological survey of the refuge be conducted. As in other alternatives, project-specific investigations and/or site assessment would still be required for the proposed construction of facilities and other management activities. The refuge's law enforcement capabilities and officer training would need to be upgraded so that recorded archaeological sites can be monitored for damage caused by looting and benign activities, such as hiking, camping, and boating, as well as to conduct Archaeological Resources Protection Act related investigations when necessary.

### **Effects on Recreation, Environmental Education, and Interpretation**

#### *Recreation*

Under Alternative 1, there would continue to be public recreation use of existing facilities including photography, wildlife observation via canoeing and kayaking on the existing canoe trail, in perimeter canals, or in the public use area of Hillsboro Recreation Area ; via walking and hiking along access roads, on the levees of Compartment C, on the perimeter levee from the S-6 pump station through Hillsboro Recreation Area to the ACME 2 station or on the boardwalk; via bicycling on the east side of the perimeter levee between Hillsboro Recreation Area and the Headquarters Area; fishing in perimeter canals and in the Hillsboro Recreation Area public use areas; and waterfowl hunting in a designated area. Existing levels of public benefits supporting wildlife observation while engaging in relaxation, family togetherness, interacting with nature, learning-discovery, escape from work-related pressures, and exercising would be sustained. Opportunities to have solitude, observe more abundant wildlife, and have a "semi-wilderness" type experience would be limited because public use is concentrated into a limited number of sites.

Under Alternatives 2 and 4, all public recreational uses conducted in Alternative 1, and their associated benefits, would be sustained. New and additional public use opportunities are being proposed to take advantage of existing roads/levees and trails that provide excellent opportunities to observe the many species of wildlife that use the refuge. The perimeter canal offers exceptional wildlife viewing and photographic opportunities for a myriad of wading birds, waterfowl, hawks, and alligators. Furthermore, the levee offers one of the highest vistas in the refuge enabling observation of the unique Everglades habitats. Strazzulla Marsh (formerly closed to the public) would be opened, under limited access, for wildlife observation, plant community appreciation, and "interpretation." A full concession contract would be established in the Hillsboro Recreation Area to allow visitors to experience the uniqueness of northern Everglades. A number of other enhancements in facilities would be added including two new observation towers, photo-blind(s), and new and extended boardwalks. Several new recreational activities would be facilitated including an extended canoe trail with two camping platforms, feral hog and alligator hunting, and the possibility of poleboating on the northeast portion of the perimeter levee.

Under Alternatives 2 and 4, the observation towers with interpretive signs and photo-blinds (one each at Strazzulla Marsh and the cypress swamp boardwalk at the Headquarters Area) would increase opportunities for wildlife observation/photography, ultimately leading to visitor education and appreciation of wildlife and its habitat. The height of an existing observation tower at the boat ramp in the Headquarters Area would be raised. This tower faces west and overlooks the vast acreage of the refuge interior. It would provide enhanced opportunities for observing and photographing sunsets over the refuge, thus enhancing an aesthetic appreciation of this remnant of the northern Everglades. The new boardwalk and limited trails at Strazzulla Marsh, and the extension to the existing boardwalk at the visitor center cypress swamp, would not only provide opportunities to observe wildlife in previously closed areas, but also increase opportunities to escape urban congestion and find solitude in a natural setting.

There are three major user groups that heavily use trails in the south Florida area for the opportunity to experience and enjoy the outdoors and observe nature and wildlife. They are hikers, bicyclists, and equestrian groups. The existing refuge perimeter levee is the highest vantage point in the area and for 30 feet on either side it is free of vegetation. The design of the levee, including the sharp slope and deep canals along each side preclude off trail use. Because of these constraints, the levee allows excellent opportunities for wildlife observation while limiting the impact or disturbance of human use.

Because of the narrow width of the perimeter levee (16 feet at the top), it is not suited to support all three users at the same time and in fact could pose a safety hazard. For this reason, portions of the eastern side of the levee have been set aside for specific uses to enable a variety of means, i.e., foot or bicycle, to be able to observe wildlife and experience a portion of the northern Everglades habitat.

Under Alternatives 2 and 4, the canoe trail extension and overnight platforms would provide benefits such as learning about the Everglades, the unique opportunity to observe nocturnal wildlife by sight and sound, observation of celestial phenomenon somewhat away from urban light pollution, and an opportunity to recognize the uniqueness of the Everglades ecosystem. The longer trail would enable maximum exposure to the most unique feature of the northern Everglades, the numerous tree islands, and the wildlife that use them, which are more prevalent deeper into the refuge.

Under Alternatives 2 and 4, access to the interior of the refuge is limited due to the shallow water, thick vegetation, and peat that make up the Everglades. Canoeing provides one of the quietest, easiest and least impacting method to experience this unique area. The existing trail increases in use each year. The proposed poleboat trail is another opportunity to experience a different portion of the refuge via a slightly different boat. Poleboating would lead to aesthetic appreciation of the refuge, would enable the visitor to observe wildlife and the habitats they use in a method that resembles the historic means of access into the northern Everglades, and provide interpretation of the cultural history of the refuge. Poleboats pose less impact to the wetlands than canoes, as they are pushed rather than paddled. A primitive route would be marked with small flags or signs only. The only maintenance required for this project would be to cut a short pass through the perimeter vegetation to access the interior marsh. However, this opening into the marsh would not occur until low phosphorous levels are consistently found in the perimeter canal near Strazzulla Marsh.

Under Alternatives 2 and 4, allowing primitive weapon feral hog hunts and alligator hunting provides additional opportunities and seasons for hunters. These hunts also provide additional incentives to spend time in the refuge and to enjoy the variety of visual, aesthetic and natural features surrounding them, improve upon marksmanship skills, obtain food and escape urban pressures.

Under Alternatives 2 and 4, other activities (bicycling, wildlife observation from a boat, hiking, photography, fishing and interpretive shuttle rides) would also likely increase. Motorboats, bicycles and fishing gear rentals, fishing guide services, and a pontoon shuttle between Hillsboro Recreation Area, the Headquarters Area and Strazzulla Marsh may be allowed by a concessionaire at Hillsboro Recreation Area. For individuals or groups who do not have outdoor recreation equipment, the rental and guide service would not only enable access to the refuge, but also enhance the normal human benefits provided by the refuge (e.g., excitement at seeing birds and wildlife, opportunities for families to spend time together in an interesting and inexpensive location, escaping urban pressures, learning about nature, and exercise).

Under Alternatives 2 and 4, however, the addition of recreational opportunities at Hillsboro Recreation Area, Strazzulla Marsh, and Headquarters Area could result in potential user conflicts, particularly on weekends (e.g., between fast moving motorboats, wildlife observers or canoeists), concerning perceptions of crowding, diminished solitude, and quieter moments at the refuge.

Alternative 3 would provide the same recreational opportunities as Alternative 1, with the exception of the differences described below. Several levees creating the compartments in the Headquarters Area would be removed and the area would be restored to a cypress swamp. Removal of the levees would decrease visitor ability to walk, observe wildlife, photograph wildlife, appreciate nature, escape urban pressures, and enjoy family comradery around Compartment C.

Under Alternative 3, waterfowl hunting opportunities would decrease as the size of the hunting area and the length of the hunting season is reduced. These cut backs in waterfowl hunting would diminish the benefits of hunting such as nature appreciation, comradery, improving marksmanship skills, obtaining food, and escaping urban pressures and likely would increase perceptions of crowding.

The feral hog hunting program initiated in Strazzulla Marsh would assist in the management of the tract but may provide only a modest increase in hunting opportunities. However, this opportunity provides access for hunters to this previously inaccessible area and opportunities to improve marksmanship, obtain food, and escape urban pressures.

### *Environmental Education and Interpretation*

For Alternative 1, current levels of interpretation and environmental education would continue at the visitor center, self-guided interpretive trails, and boardwalks. Although tremendous ecological changes have occurred in the northern Everglades ecosystem and agencies/organizations have responded to the challenge of restoring its hydrology, this information is not reflected in current interpretive exhibits, signs, photos, and brochures. Thus, the opportunities to educate the public about ecological changes, their causes, and restoration efforts would continue to be limited. Furthermore, interpretation provided by refuge staff would not occur, since all existing forms of interpretation are self-initiated and based on reading the text of signs or brochures. The opportunity to have questions answered is, for all practical purposes, provided by the volunteers at the visitor center.

For Alternatives 2 and 4, an auditorium/classroom building would be constructed adjacent to the existing visitor center at the Headquarters Area to assist with the planned expansion of the environmental education program and the development of a school outreach program. An open-air teaching pavilion, constructed near Impoundment C-7, would give visiting school teachers a place to conduct their lessons regarding the Everglades and the pavilion would encourage more teachers to bring their classes to the refuge. These additional facilities should provide increased opportunities for youth to experience classroom demonstrations, see videos, and ask questions.

Under Alternatives 2 and 4, a Hillsboro Recreation Area office, developed for staff members, the Natural History Association, and the concessionaire would also feature exhibits reflecting issues concerning the Everglades. Generally, interpretive resources (e.g., exhibits, signs, photos and brochures) would be revised to reflect ecological changes, their causes, and restoration efforts.

Under Alternatives 2 and 4, an improved environmental education program, developed by refuge staff for the local school system, would seek to convey the effects of human actions on the refuge and ecosystems of south Florida. It would promote low-impact strategies that recreationists could adopt to minimize their impact the ecosystem. This program would clearly increase the opportunities for learning about nature, the participant's role in the ecosystem, and the mission of the refuge system. Thus, these "hands-on" experiences with refuge staff would particularly enhance the effectiveness of the refuge's environmental education program.

Under Alternative 3, current levels of interpretation and environmental education would continue primarily at the visitor center, with limited and dated self-guided interpretive trails and boardwalks at the Headquarters Area. The ecological changes and restoration efforts in the Everglades ecosystem would not be reflected in current interpretive exhibits, signs, photos, and brochures. These interpretive resources would be updated more slowly as staff time permits and funds are available. A limited number of off-site environmental education programs, with dated and insufficient materials, would be conducted; the benefits of the programs have been described in Alternative 1.

## Effects on the Socioeconomic Environment

### *Ecotourism*

A survey on the economic impact of birding ecotourism on communities surrounding national wildlife refuges highlights the substantial benefits visitors bring to the local economy. In 1994, the economic impact on the communities surrounding each of the refuges in the nation ranged from over a half-million to several millions of dollars, which included lodging, meals, gasoline, and ancillary purchases. Generally, most birding visitors average 50 years of age, with income and education levels above the national average. More than half of the visitors cited refuges as their primary destination (Laughland and Caudhill 1997).

For Alternatives 1 and 3, little negative or positive impact would be seen in the economy. However, as the refuge visibility increases under Alternatives 2 and 4, there would be substantial benefits to the local economy because of their associated development of visitor facilities and recreational activities. The additional effort to increase awareness of the refuge under Alternatives 2 and 4, would positively impact the number of local individuals, school groups and vacationers to the refuge. No anticipated increase of visitation would occur under Alternatives 1 and 3, except for a rise in visitation by the anticipated local population growth. Alternative 3 could even show a short-term decline in visitation.

### *Property Values*

Research shows that "...a wildlife refuge in an increasingly urbanized and congested region can generate community benefits for regional inhabitants. This community amenity can be reflected in higher land values, particularly for properties nearby." (Kerlinger 1995). With the expected continual loss of natural areas in south Florida, the refuge becomes more important as a visitation site for the portion of the public wanting release from the urban environment. Hence in all alternatives, the continued presence of a national wildlife refuge would increase property values in the area, which would provide economic benefits to nearby communities.

### *Tax Revenue*

The Service owns 2,500 acres of land (Headquarters Area, cypress swamp, Compartments A, B, C and D), and the South Florida Water Management District owns the majority of the land (144,842 acres) managed by the refuge. Because Federal lands are not subject to state or local taxes or assessments under the Refuge Revenue Sharing Act, the Fish and Wildlife Service makes annual payments to Palm Beach County to offset the loss of property tax revenues. Refuge Revenue Sharing Act payments for owned and acquired lands are based upon the greatest of the following three formulas: 1) 3/4 of 1 percent of the appraised value; 2) 25 percent of the net receipts produced from the lands; or 3) 0.75 dollars per acre. The Refuge Revenue Sharing Act also requires that Service lands be appraised every five years to ensure that payments to local governments remain equitable. Although the lands owned by the refuge are not large, the payment will continue to Palm Beach County under all alternatives.

In addition to the Revenue Sharing Act proceeds under Alternative 1, there would be no change in the estimated \$40,000 in local sales taxes generated by visitors (1993). Alternatives 2 and 4, should produce moderate increases in sales tax impacts. In a relative sense, the local impact could be significant. Again, it is important to note that increased refuge visitation would likely come from local residents (estimated 80 percent), and residents do not spend as much in the local economy on a per visit basis as out-of-town visitors. Alternative 3, would have a minor negative impact on local sales tax.

### Unavoidable Impacts

Under Alternatives 1 and 4, exponential exotic plant growth would continue to threaten the overall integrity of the refuge. Additionally, the refuge would continue to be viewed as a seed source (and possibly for all of south Florida) for the establishment of additional exotic plants in nearby areas.

Under Alternatives 2 and 3, every effort would be made to preserve the native vegetation under and around Old World climbing fern while treating it, but some non-target plant damage would unavoidably occur. This negative impact would be heavily out-weighted by the benefit of this plant removal and by the restoration of affected areas by appropriate native plants. In the case of Old World climbing fern, a careful application of a chemical would minimize the effects to surrounding plants. Only a wetland-approved chemical would be used. The refuge staff would keep abreast of advancements in the areas of chemical control and use them as technology provides species-specific treatments. Techniques used to control exotics such as melaleuca, Brazilian pepper, and other, yet unidentified exotic or invasive plants also will be monitored to ensure that possible negative impacts do not outweigh the benefits. Specifically, a water quality monitoring program would be implemented to ensure that levels in the refuge do not exceed permitted amounts. The refuge staff would keep abreast of advancements in bio-controls for exotic plants and would use them, subject to federal and state permits, where applicable and effective.

Under Alternative 2, the projected increase of visitor numbers could possibly impact the foraging ability of wading birds in Compartment C of the Headquarters Area. This impact is thought to be insignificant due to the types of public use (e.g., wildlife observation, photography, and environmental interpretation allowed in this area). In addition, due to the number of impoundments in Compartments A, B, and C, access to certain impoundments could be closed if needed to benefit critical wildlife needs such as nesting.

Under Alternatives 2 and 3, direct short-term air pollution to nearby communities may be associated with the prescribed burn program. No major adverse impacts to the refuge resource or natural environment would result from the selection of Alternative 2.

Under Alternatives 2, 3, and 4, construction of boardwalks, towers, camping platforms, or buildings would cause an immediate impact to wildlife habitat around each work site. Standard conservative construction techniques would be used to minimize impacts and all construction areas would comply with the requirements of Section 404 of the Clean Water Act and other applicable regulations. Turbidity during construction would be limited by silt screens or other methods to minimize potential runoff during construction. Parking areas would be constructed to allow storm water to percolate into the soil rather than allowing it to run directly into the adjacent wetlands. Short-term negative effects to air, noise quality, and soils within the project site would be expected, and measures to protect the environment would be taken. Every effort would be made to use recycled materials and environmentally sensitive treated lumber in all projects.

## Effects Common to Alternatives

### *Health and Safety Effects*

The alternatives would not have a significant effect on health and safety. Under all alternatives, water resources are protected and water schedules are coordinated with other agencies. The only potential safety problems are perhaps use of watercraft in the refuge interior by staff, exotic plant control crews, or researchers; motorized vehicle accidents occurring on refuge roads; accidents occurring during the hunting season where other user groups might be affected; and the short-term presence of smoke from a prescribed burn. As indicated below in the mitigation section, time and space zoning has been used successfully on other refuges to minimize the possibility of potential conflicts between hunters and other user groups.

### *Regulatory Effects*

As indicated in the Background Section of the Draft Comprehensive Conservation Plan, the Service must comply with a number of federal laws, executive and administrative orders, and policy in the development and implementation of management actions and programs (*See Appendix E*). The alternatives would not lead to a violation of these laws and orders.

### *Effects on Surrounding Lands*

Land adjacent to natural areas can often provide critical habitat for wildlife species when the water conservation areas, including the refuge, have either too little or too much water. Although some areas seem insignificant to wildlife because they only appear to provide occasional foraging or roosting habitat, they are critical resting and foraging spots for wildlife. As urban expansion continues to convert agricultural and rural lands into housing tracts, malls, golf courses, or other developments, these critical wildlife habitats are lost. These losses accumulate over time and in the end, there is less land available for wildlife; thus, wildlife populations decline (Schortemeyer 1980). Only more active management of refuge lands and promotion of wildlife-compatible land uses adjacent to the refuge would maintain resources at current levels.

### *Uncertainty of and Future Action Effects*

Although land east of the refuge is currently predominantly farmland, several subdivisions exist. As the price of land escalates, extensive areas of farm land are being bought up and developed into subdivisions and strip malls at an alarming rate. Several existing plans, proposed by local government agencies, would create permanent “buffer lands” for most of the lands adjacent to the refuge’s eastern boundary. These plans are strongly supported by the refuge management staff in order to reduce disturbance to wildlife or decrease the impact to refuge habitats. However, there is no development moratorium in areas near the refuge to ensure lands remain rural until a large-scale buffer project is decided upon. Strip malls, condos, golf courses, and neighborhoods may end up being refuge neighbors despite these plans.

Among the proposed plans is the East Coast Buffer project. This plan would, in part, create water preserve areas for storing water or groundwater recharge. Lands to be acquired as a part of this project have been identified but not secured. Lands have also been identified along the eastern boundary as part of the Comprehensive Everglades Restoration Plan and the Water Preserve Area. Palm Beach County has appropriated \$100 million to purchase lands from willing sellers in an area east of the refuge known as the Agricultural Reserve. The Florida Park Service has expressed interest in establishing a state park adjacent to or near the refuge.

The refuge would partner with the agencies involved to support creation of these buffer lands and to minimize conflicts possibly created by differing agency missions. Because of uncertainties associated with these and possibly unforeseen changes, this plan may need to be amended at an earlier than anticipated date.

#### *Cumulative Effects*

Cumulative effects on the environment result from incremental effects of a proposed action when these are added to other past, present, and reasonably foreseeable future actions. While cumulative effects may result from individually minor actions, they may be viewed, as a whole, to be significant over time.

The implementation of the alternatives include actions relating to facility development, wildlife habitat and population management, resource protection, public use, and administrative programs on the refuge. These actions would have both direct and indirect effects (e.g., facility development results in increased public use, which increases littering, noise, and vehicular traffic); however, the cumulative effects of these actions over the 15-year planning period would not be significant. (See the *Environmental Consequences Section* for these effects.)

#### *Controversy Over Effects*

The Service recognizes that there are some aspects of the plan that may be controversial. These include all forms of hunting, recreational airboating, horseback riding, and water management (hydropatterns and quality). They have been addressed in the plan in the following sections: Plan Sections III - Refuge Environment; IV - Management Direction; V - Plan Implementation; Appendix J - Public Issues Addressed But Not Allowed, and Appendix R - Service Response to Public Comments, Service Response to Agency Comments.

Wood stork  
USFWS Photo by J. Kleen



**Table 19. A summary of the environmental consequences of all the alternatives**

Issue or Concern	Alternative 1. Maintain Current Management	Alternative 2. Ecosystem Emphasis	Alternative 3. Biological Emphasis	Alternative 4. Public Use Emphasis
<b>Effects on Physical Environment:</b> <i>Soils</i>	Drainage and use of heavy equipment would negatively impact soil in Impoundment C-7 due to compaction and subsidence of the peat soil.	Minimum drainage coupled with little heavy equipment use in all compartments would minimize soil subsidence.	Negative, but short-term impact to peat marshes from levee removal around A-C Compartments; however, long-term benefit to soils in the cypress swamp due to habitat restoration.	Same as Alternative 2
		Recreation facility developments at Headquarters Area and Strazzulla Marsh would have a negative but minimal effect on soils.		Same as Alternative 2
		Reduced soil disturbance from hog activity at Strazzulla Marsh due to feral hog hunting.	Same as Alternative 2	Same as Alternative 2
<i>Hydrology</i>	Minimal change from current conditions.			Same as Alternative 1
		Better water management due to improved communications and partnerships could positively impact hydrologic conditions.	Same as Alternative 2	
		Recommending changes to current regulation schedule based on monitoring and modeling would benefit refuge habitats.	Same as Alternative 2	
		Hydrologic conditions would benefit trust species, but may not benefit non-targeted species.	Returning impoundments to natural Everglades condition would benefit wetland-dependent species.	
<i>Water Quality</i>	Cumulative increase in water quality in the interior of the refuge due to consent decree.	Water quality, quantity, delivery and timing throughout the refuge would improve with better communication.	Same as Alternative 2	Same as Alternative 1
	With no additional monitoring, there would be no cleanup of additional problem sites.	Expanded monitoring and water test locations, allowing for identification and cleanup of problem sites, would have positive impacts for managing most species.	Same as Alternative 2	Same as Alternative 1
		Long-term herbicide use can potentially diminish surface water quality in exotic plant treatment areas.	Same as Alternative 2	

**Table 19. A summary of the environmental consequences of all the alternatives (continued)**

Issue or Concern	Alternative 1. Maintain Current Management	Alternative 2. Ecosystem Emphasis	Alternative 3. Biological Emphasis	Alternative 4. Public Use Emphasis
<b>Physical Environment:</b> <i>Water Quality</i>		No health or safety concerns are expected because water quality testing would keep contamination from refuge operations below allowable levels in the aquifer.	Same as Alternative 2	
		Addressing water quality problems in the cypress swamp would have positive impact on water quality.	Same as Alternative 2	
<i>Air Quality</i>	No impacts are anticipated.	Prescribed fire projects would occur with predominately easterly winds, reducing smoke impact to residential areas east of the refuge, but the fires would create temporary, short-term smoke pollution and affect nearby traffic safety and people suffering respiratory problems.	Same as Alternative 2	Same as Alternative 1
<i>Noise Pollution</i>	Helicopter flights for management purposes would be required to stay above 500 feet thereby causing minimum negative impacts to wildlife.	Additional research and surveys would result in slightly increased noise impacts from helicopters, airplanes and airboats.	Same as Alternative 2	Same as Alternative 1
	Commercial airboat operator in Water Conservation Area 2 would continue to cause noise impact at Hillsboro Recreation Area.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
		Increased motorboat use, guided fishing tours and potential pontoon boat tour would increase noise impacts.		Same as Alternative 2
		Pumps moving water in and out of impoundments at the Headquarters Area, while enhancing habitat, would have negative impact on “natural quiet” of the area.		Same as Alternative 2
<i>Aesthetics</i>	Aesthetics of invasive cattail and exotic plants, trees and vines would have negative impact on naturalist’s appreciation of refuge	Efforts to manage and control invasive and exotic plants would initially result in unsightly areas until native plants fill in the areas.	Same as Alternative 2	Same as Alternative 1
		The use of prescribed fire would initially produce aesthetically displeasing blackened areas until new vegetative growth produces positive aesthetics.	Same as Alternative 2	Same as Alternative 2, but only in Compartment C.

**Table 19. A summary of the environmental consequences of all the alternatives (continued)**

Issue or Concern	Alternative 1. Maintain Current Management	Alternative 2. Ecosystem Emphasis	Alternative 3. Biological Emphasis	Alternative 4. Public Use Emphasis
<b>Effects on Physical Environment:</b> <i>Aesthetics</i>			Removal of levees and restoration of impoundments in the Headquarters Area would cause short-term decrease in aesthetics.	
		Increase in access points and public use increases potential of unsightly litter which would also negatively impact biological environment as wildlife ingest plastic and become entangled in trash.		Same as Alternative 2
<i>Facilities</i>	Existing buildings would be maintained causing no additional impacts.	Recreational facility development would cause short term negative impacts to air, noise quality and soils during initial construction, but minimal direct negative impacts would occur after construction is completed.	Same as Alternative 1	Same as Alternative 2
<b>Effects on the Biological Environment:</b> <i>Sloughs and Wet Praries</i>	Thousands of acres of native plant communities would be lost as wet prairies and sloughs fill in with vegetation.	Prescribed fire would prevent wet prairies and sloughs from filling in with vegetation thus restoring natural heterogeneity and providing open habitat for many species of wildlife.	Same as Alternative 1	Same as Alternative 2
<i>Sawgrass</i>	Sawgrass would continue to fill in open spaces, potentially converting wet prairies into sawgrass.	Formation of a mosaic of sawgrass and wet prairie through prescribed burning would provide positive impacts for wildlife.	Same as Alternative 2	Same as Alternative 1
<i>Tree Islands and the Cypress Swamp</i>	Negative impacts caused by wildfire would destroy tree islands covered by Old World climbing fern, possibly cause spreading of the fern and would assist in spreading melaleuca seed.	Some direct negative impacts caused by control efforts to stop the spread of exotic and invasive plants, however, would provide substantial positive effects by restoring habitats.	Same as Alternative 2	Same as Alternative 1
	Loss of largest remaining cypress strand along the eastern edge of the Everglades due to infestation of exotics or to wildfire.			Same as Alternative 1
<i>Cattail</i>	Until water quality improves, growing expanses of cattail would decrease waterfowl habitat and exclude other wildlife uses.	Prescribed fire in cattail reduce the biomass and provide better habitat.	Same as Alternative 2	Same as Alternative 1

**Table 19. A summary of the environmental consequences of all the alternatives (continued)**

Issue or Concern	Alternative 1. Maintain Current Management	Alternative 2. Ecosystem Emphasis	Alternative 3. Biological Emphasis	Alternative 4. Public Use Emphasis
<b>Effects on the Biological Environment:</b> <i>Exotic Plant Impacts to Native Vegetation</i>	Floating invasive exotics would have a negative impact causing water flow and drainage problems, clogging water control structures, impeding recreational use and reducing dissolved oxygen resulting in fish kills that directly impact the top of the food web in the Everglades ecosystem.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
	Major portions of native habitats, including sawgrass, wet prairies, sloughs, and tree islands would continue to be replaced by invasive and exotic plants. Twenty five percent of the refuge interior would be lost to melaleuca within 5 years. The refuge would succumb to exotic plant invasion within 15 years.	Native Everglades habitats would benefit directly and recover naturally with the aggressive control of invasive exotics.	Same as Alternative 2	Same as Alternative 1
		Control efforts would cause some initial damage to native vegetation including death of native trees, shrubs and ground cover but, long term, these areas would become germination sites for desirable native vegetation.	Same as Alternative 2	
		Implementation of a fire management program would greatly improve the quality of habitat and would prevent the spread of invasive exotics.	Same as Alternative 2	
		Improved water quality would benefit native vegetation communities.	Same as Alternative 2	
				Increased public use would require construction of additional nature trails in areas such as Strazzulla Marsh which would cause limited damage to native vegetation and increase potential for exotic infestation.

**Table 19. A summary of the environmental consequences of all the alternatives (continued)**

Issue or Concern	Alternative 1. Maintain Current Management	Alternative 2. Ecosystem Emphasis	Alternative 3. Biological Emphasis	Alternative 4. Public Use Emphasis
<b>Effects on the Biological Environment: Wildlife and Protected Species</b>	Loss of native habitats due to exotic and invasive plants would have severe negative impacts on most bird species.	Improving Everglades marsh habitat through management efforts would benefit bird species.	Same as Alternative 2	Same as Alternative 1
	Loss of native habitats including native tree islands, the cypress swamp, and Strazzulla Marsh would have negative impacts on resident and neotropical songbirds.	Plant communities including native tree islands, the cypress swamp, and Strazzulla Marsh would remain viable for migratory and resident songbirds.	Same as Alternative 2	Same as Alternative 1
<b>Research and Monitoring</b>	There would be no improvement in waterfowl habitat which would continue to degrade.	Open areas through fire management and resulting new vegetative growth would provide better habitat and foraging conditions for waterfowl.	Same as Alternative 2	Same as Alternative 1
	Limited information gathering would have negative impact on management of wildlife and habitat.	Species and habitat response to management efforts would be used to 'fine tune' management activities.	Provides more information than Alternative 2.	Same as Alternative 1
<b>Wildlife in the Compartments</b>	Limited information would prevent refuge from assessing the effects of the Comprehensive Everglades Restoration Plan and providing data to assess Comprehensive Everglades Restoration Plan management process.	Comprehensive biological programs and cooperative research projects would have positive impact in assessing the Comprehensive Everglades Restoration Plan effort.	Same as Alternative 2	Same as Alternative 1
	Limited number of scientific research projects would not provide significant management information to be used in the Everglades ecosystem.	Greater number of research projects would provide significant management information that would have positive impact on the refuge and the whole Everglades ecosystem.	Same as Alternative 2	Same as Alternative 1
<b>Research Natural Area</b>	Managing Impoundment C-7 would occasionally provide 33 acres of beneficial marsh habitat, but the remaining 1997 acres in impoundments would provide minimal benefit to wildlife.	Impoundments A, B, and C would be managed so that 1-2 impoundments would provide optimal foraging habitat throughout the year resulting in large direct and cumulative positive impacts.	Removal of levees to rejoin Impoundments A, B, C and the cypress marsh would have positive, direct and cumulative impact on wildlife.	Management of Impoundment C would have positive impacts on wildlife there, however, the remaining acreage would be minimally managed, providing little benefit to wildlife.
	There would be negative impact because Old World climbing fern would not be controlled.	Removal or control of exotic and invasive plants would have a direct negative impact, however, major indirect and cumulative impacts would be realized.	Same as Alternative 2	Same as Alternative 1

**Table 19. A summary of the environmental consequences of all the alternatives (continued)**

Issue or Concern	<i>Alternative 1.</i> <b>Maintain Current Management</b>	<i>Alternative 2.</i> <b>Ecosystem Emphasis</b>	<i>Alternative 3.</i> <b>Biological Emphasis</b>	<i>Alternative 4.</i> <b>Public Use Emphasis</b>
<b>Effects on the Biological Environment:</b> <i>Airboat Impacts</i>	Airboat impacts would be minimal as the boats would be used only by staff and researchers.	Increase use of airboat by biologists, law enforcement and researchers would increase negative impacts, however avoiding visible wildlife and minimizing damage to vegetation would minimize overall impact.	Increased use of airboats by biologists and researchers would increase negative impacts, however avoiding visible wildlife and minimizing damage to vegetation would minimize overall impact.	Increased use of airboats by law enforcement would increase negative impacts, however, avoiding visible wildlife and minimizing damage to vegetation would minimize overall impact.
<b>Fire Impacts:</b> <i>Exotic Plant Control</i>	Unplanned wildfires would have much greater negative impact because prescribed fires would not be used to reduce the fuel load.	Prescribed fire program would have a positive impact on exotic plant control and subsequent habitat restoration as well as reduce the intensity of unplanned wildfires.	Same as Alternative 2	Same as Alternative 1
<i>Invasive Plant Control</i>	Lack of a prescribed burn would have an indirect and cumulative negative impact on wildlife and habitat.	Prescribed fire would greatly improve habitat and speed up efforts to restore the marsh.	Same as Alternative 2	Same as Alternative 1
<i>Compartment Management</i>	Lack of prescribed fire would have negative impact resulting in low habitat diversity and an abundance of cattail.	Prescribed fire would be used to create and maintain habitat diversity which would benefit resident and migratory birds, including shorebirds, wading birds and waterfowl.	Prescribed fire would be used less often but would be used initially to remove vegetation from Impoundments A, B and C opening the wetlands up for replanting of native cypress.	Prescribed fire would enhance the habitat in Impoundment C but would not be used on any other part of the refuge, resulting in low habitat diversity and rank vegetation.
<i>Catastrophic Wildfire</i>	Lack of prescribed fire to reduce fuel loads would result in catastrophic wildfires that would have negative impacts on vegetative habitats by destroying soils, tree islands, sawgrass marsh and cypress swamps.	Prescribed fire would reduce the chance of catastrophic wildfires thereby preventing negative impacts on vegetative habitats.	Same as Alternative 2	Same as Alternative 1
<i>Costs of Fire Suppression</i>	With no prescribed fire program to reduce catastrophic wildfires, costs would be incurred to replace facilities and equipment lost in a wildfire.	Prescribed fire programs would have a positive benefit on costs by reducing the chances of a catastrophic wildfire which would incur costs to replace facilities and equipment.	Same as Alternative 2	Same as Alternative 1
<b>Effects on Cultural and Historic Resources:</b>	Because data collection would be limited to review of existing documents, erosion control, interpretive and educational opportunities would be limited. Cultural resource management would be limited to investigations required by applicable laws.	Databases generated from a variety of investigative techniques, while working with multiple partners, would have a positive impact on the refuge's ability to monitor and protect cultural resources and increase public education opportunities.	Active investigations would provide information to be used for resource management, as well as improve protection of archaeological sites, however, public use activities would be limited due to closure of large areas to the public.	A variety of investigations, as well as multiple partnerships, would provide information on the cultural and archaeological resources of the refuge.

**Table 19. A summary of the environmental consequences of all the alternatives (continued)**

Issue or Concern	<i>Alternative 1.</i> <b>Maintain Current Management</b>	<i>Alternative 2.</i> <b>Ecosystem Emphasis</b>	<i>Alternative 3.</i> <b>Biological Emphasis</b>	<i>Alternative 4.</i> <b>Public Use Emphasis</b>
<b>Effects on Recreation, Environmental Education, and Interpretation:</b> <i>Recreation</i>	Existing levels of public benefits such as opportunities for relaxation, family togetherness, interacting with nature, learning-discovery, escape from work-related pressures and exercising would be sustained, however, opportunities for solitude, observing wildlife and “semi-wilderness” experiences would be limited, as public use is concentrated into a limited number of sites.	All public use in Alternative 1 would be sustained as well as an increase in public accessibility, an increase in aesthetic appreciation, and additional hunting opportunities. Additional areas would be opened to the public, new facilities constructed or enhancement of existing facilities and establishment of a concession contract in the Hillsboro Recreation Area provide greater public use opportunities. However, additional recreation opportunities would result in potential user conflicts.	The same recreational opportunities would be available as in Alternative 1 including a modest increase in feral hog hunting, however, there would be a decrease in visitor use around Impoundment C and a decrease in waterfowl hunting opportunities.	Same as Alternative 2
<i>Environmental Education and Interpretation</i>	Current levels of interpretation and environmental education would continue with limited opportunities to educate the public about refuge issues or to provide interpretation of refuge resources by the staff.	Effectiveness of the environmental education program to increase the opportunities for learning about nature, the participant’s role in the ecosystem, and the mission of the refuge system would be enhanced by expanding the environmental education program, developing a school outreach program and adding additional facilities.	Current levels of interpretation and environmental education would continue as interpretive resources are slowly updated and a limited number of off-site environmental education programs are conducted.	The environmental education and interpretive programs would be the same as Alternative 2.
<b>Effects on Socioeconomic Environment:</b> <i>Ecotourism</i>	There would be minimal impact on the economy.	An increase in visitation to the refuge caused by more visitor facilities and increased recreational activities would have a positive impact on the local economy.	There would be a short-term decline in visitation followed by no minimal positive or negative impact on the economy.	Same as Alternative 2
<i>Tax Revenue</i>	There would be no change in local sales tax generated by visitors.	Increase in visitation would cause a moderate increase in sales tax generated.	A short term decline in visitation would have a minor negative impact on local sales tax generated.	Same as Alternative 2

**Table 19. A summary of the environmental consequences of all the alternatives (continued)**

Issue or Concern	<i>Alternative 1.</i> <b>Maintain Current Management</b>	<i>Alternative 2.</i> <b>Ecosystem Emphasis</b>	<i>Alternative 3.</i> <b>Biological Emphasis</b>	<i>Alternative 4.</i> <b>Public Use Emphasis</b>
<b>Unavoidable Impacts:</b>	Exponential growth of exotic plants would continue to threaten the biological integrity of the refuge and the refuge would continue to be viewed as a seed source causing the establishment of exotic plants in uninfested nearby areas.	Removing and controlling exotic and invasive plants would have an unavoidable negative impact on some non-targeted species, however the positive benefits to the native vegetation would far outweigh the negative impacts.	Same as Alternative 2	Same as Alternative 1
		An increase in visitor numbers would have a minor negative impact on the foraging ability of wading birds in Compartment C, however this impact is insignificant due to the types of public use allowed and if warranted, areas of Compartment C can be easily closed to the public.		
		Short-term air pollution to nearby communities would be associated with the prescribed burn program, however no major adverse impacts to the refuge resource or natural environment would occur.	Short-term air pollution to nearby communities would be associated with the prescribed burn program.	Same as Alternative 2 on a very limited basis.
		Construction would cause an immediate negative impact to the habitat around each work site, however standard conservative construction techniques would be used to minimize impacts.	Same as Alternative 2	Same as Alternative 2

## Mitigation Measures

Described below are the measures used to mitigate and minimize potential adverse effects.

### *Wildlife Disturbance*

Disturbance to wildlife at some level is an unavoidable consequence of any public use program, regardless of the activity involved. Obviously some activities innately have the potential to be more disturbing than others. All preferred alternative public use activities contained in this document have been carefully planned to avoid unacceptable levels of impact.

As currently proposed, the known and anticipated level of disturbance of the preferred alternative is not considered significant and well within the tolerance level of known wildlife species and populations present in the area. All hunting activities (season lengths, bag limits, number of hunters) would be conducted within the constraints of sound biological principles and refuge-specific regulations established to restrict illegal or non-conforming activities. Providing fishing opportunities allows the use of a renewable natural resource without adversely impacting other resources.

Fishing activities are not thought to cause a disruption in the resource because most anglers use catch and release methods. High amounts of mercury associated with fish in south Florida and at the refuge necessitate catch and release. The sources of mercury deposition in the Everglades ecosystem and the resulting effects on wildlife, fish and soils are not well known and the refuge is a contributing member to the extensive multi-agency research effort.

General wildlife observation (photography, walking, bicycling, canoeing/kayaking) activities may result in minimal disturbance to wildlife. If visitors venture too close to foraging wading birds, alligators, or other wildlife, disruption of foraging or resting activities would result in a more severe disturbance. To mitigate potential disturbances, a greater number of volunteers, serving as naturalist rovers, would help educate visitors about the problems associated with their actions. If a visitor disregards the rovers instructions, refuge law enforcement officers would handle the situation. Also, areas may be closed to the public if disturbance is excessive.

There are three major user groups that heavily use trails in the south Florida area for the opportunity to experience and enjoy the outdoors and observe nature and wildlife. They are hikers, bicyclists, and equestrian groups. The existing refuge perimeter levee is the highest vantage point in the area and for 30 feet on either side it is free of vegetation. The design of the levee, including the sharp slope and deep canals along each side, precludes off trail use. Because of these constraints, the levee allows excellent opportunities for wildlife observation while limiting the impact or disturbance of human use.

Because of the narrow width of the perimeter levee (16 feet at the top), it is not suited to support all three users at the same time and in fact could pose a safety hazard. For this reason, portions of the eastern side of the levee have been set aside for specific uses to enable a variety of means; i.e., on foot, bicycle, to be able to observe wildlife and experience a portion of the northern Everglades habitat.

Initial disturbance to wildlife and habitat would occur during the construction of new facilities such as the teaching pavilion, visitor center extension, Strazzulla Marsh boardwalk, canoe trail camping platform, and

development of the canoe trail extension. However minimal the wetland effects may be, wetland impacts would be mitigated to comply with the requirements of Section 404 of the Clean Water Act and other applicable regulations. Turbidity during construction would be limited by silt screens or other methods to minimize potential runoff during construction. Parking areas would be constructed to allow storm water to percolate into the soil rather than allowing it to run directly into the adjacent wetlands. Short-term negative effects to air, noise quality, and soils within the project site will be expected, and measures to protect the environment would be taken. Allowing these non-consumptive recreational opportunities on the refuge would help to maintain and build public support for the refuge and the Everglades ecosystem.

Monitoring activities through wildlife inventories and assessments of public use levels and activities would be conducted, and public use programs would be adjusted as needed to limit disturbance to acceptable levels. No pets would be allowed on the refuge because of their potential to cause disturbance to wildlife (with the exception of retrievers in waterfowl hunting). No pet may be left in any vehicle on refuge because of the threat of the animal overheating.

The refuge recognizes the impacts airboats have on vegetation and wildlife. Refuge management would continue to limit staff and researchers to necessary airboat travel. All airboat operators would have attended an airboat safety course and would refrain from driving through vegetation if at all possible and from causing disturbances to wildlife.

An airboat was initially considered as the craft to use for the concession shuttle boat. Because of the airboat disturbance to wildlife and the visitor's inability to hear an interpreter or experience the sounds of the Everglades, the use of an airboat was abandoned. Instead, a quietly operating (possibly electric) pontoon boat with an interpretive guide would be the choice for the seasonal shuttle boat.

The extensive labor, airboat use, and chemicals it would take to bring the more than 90,000 acres infested with exotic plants to maintenance control levels may exceed some wildlife species tolerances for disturbance. However, the refuge and the Service (Executive Order 13112 on Invasive Species) believe that controlling exotic plants is critical to retain the ecology of the refuge and the Everglades ecosystem as a whole.

#### *Water Quality Disturbance*

An access point for a poleboat trail and access trails into the waterfowl hunt area are planned. Each of these projects have the potential to allow water into the refuge interior from the perimeter canal. If this occurs, cattail would begin growing where it had not been previously established. To prevent further damage to the refuge vegetation structure, these trails would not be created until nutrients in the perimeter canal water are shown to be sustained at acceptable levels (yet to be determined) in accordance with the Consent Decree.

#### *User Group Conflicts*

As public use levels expand across time, unanticipated conflicts between user groups may occur. Programs would be adjusted as needed to eliminate or minimize each problem and provide quality appropriate, compatible wildlife-dependent recreational opportunities. Experience has proven that time and space zoning, (e.g., establishment of separate use areas, use periods, and restricting numbers of users), if necessary, are effective tools in eliminating conflicts between user groups.

Under the preferred plan, hiking and biking areas on the perimeter levee are zoned and some uses are separated to avoid potential conflicts between user groups and to enhance the experience of each user group.

The perimeter canal would also be zoned by speed to enhance the experience and to prevent potential conflict between different user groups. While motorboats utilize most of the refuge waters, they shall operate at “slow speed, minimum wake” at all times to prevent swamping canoeists, kayakers, and shuttle boat patrons and to minimize noise level disturbances to other users (*Figure 19*).

#### *Effects on Adjacent Landowners*

Implementation of the proposed action would not impact adjacent landowners. Future land acquisition would occur on a willing seller basis only, including the “Areas of Concern” and at fair market values. At several locations in the comprehensive plan, reference is made to the need for conducting water quality sampling and monitoring activities to document current conditions and seek to improve quality, if necessary. The refuge would follow the Consent Decree and other guidelines to enhance the quality waters entering the refuge.

As the refuge eradicates its exotic plants, exotic seed dispersal from the refuge would diminish. Eventually, when the refuge exotic plants are at maintenance control levels, minimal seed dispersal would occur and the refuge would be a much better neighbor to local land owners.

#### *Land Ownership and Site Development*

Proposed land acquisition efforts by the Service would result in changes in land and recreational use patterns, since all uses on national wildlife refuges must meet compatibility standards. The lands identified in the proposed acquisition boundary are currently agricultural lands. The lands selected for acquisition would be returned to a wetland or cypress swamp.

Potential development of the buildings, trails, and other improvements could lead to minor short-term negative impacts on plants, soil, and some wildlife species. Efforts would be made to use recycled products and environmentally sensitive treated lumber when building the boardwalks and observation towers. The placement of the visitor center environmental classroom/auditorium and the separate teaching pavilion would occur on existing fill areas (parking lots or adjacent open, grassy areas). The construction of an office/concessionaire building would be over an existing shellrock fill area in the same location as a former concession structure. All operations would comply with the requirements of Section 404 of the Clean Water Act and other applicable regulations. Turbidity during construction would be limited by silt screens or other methods to minimize potential runoff during construction. If necessary, affected parking areas would be constructed to allow stormwater to percolate into the soil, rather than allowing it to run directly into adjacent wetlands.

As indicated earlier, one of the direct effects of site development is increased public use; this increased use may lead to increased littering, noise and vehicle traffic. While Service funding and personnel would be allocated to minimize these indirect effects, such allocations would make the resources unavailable for other programs.

### Short-term Uses versus Long-term Productivity

The proposed habitat protection and management program is dedicated to maintaining the long-term productivity of the refuge habitats. Short-term losses of visual aesthetics and visitor use after a prescribed burn would have long-term benefits for many wildlife trust species and reduce the probability of wildfire. While direct and immediate process of invasive exotic plant removal would produce unsightly results for a time, it would also provide long-term benefits to the refuge and to the surrounding natural areas. The construction of a wildlife trail and observation tower at the Strazzulla Marsh, towers at the Headquarters Area and a concession operation at Hillsboro Recreation Area would have short-term negative impacts on the marsh and swamp communities. Educational value and associated public support gained from the visitor experiences would have long-term benefits for the entire ecosystem.



Fire line  
USFWS Photo by R.I. Payton

## VII. Consultation and Coordination

A planning team composed of representatives from the Service, the South Florida Water Management District, the U.S. Army Corps of Engineers, Palm Beach County's Department of Environmental Resources Management, Florida Atlantic University's Department of Anthropology, the University of Florida's Department of Recreation, Parks and Tourism, and the University of Florida's Institute of Food and Agricultural Sciences, was formed to prepare the Draft Comprehensive Conservation Plan for the refuge.

The planning team met on five occasions (July 14-15, October 6-7 and November 4, 1998, January 12-13, 1999, and October 19, 1999) to develop a vision statement, goals, objectives, and strategies for the refuge. Specific team members were also involved in writing the various sections of the plan.

On August 17, 1998, the team conducted a public scoping meeting to determine the important issues and concerns (these issues and concerns are summarized in Chapter II of the Draft Comprehensive Conservation Plan). Based on the issues and concerns generated at this meeting and the team's knowledge of the refuge environment, a Draft Comprehensive Conservation Plan/Environmental Assessment was prepared for public review and consideration. Dr. Pat Bidol-Padva served as the facilitator for the planning team meetings and the public scoping meeting.

### *The planning team members were:*

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- Skye Wheeler, Graduate Student, Department of Anthropology, Florida Atlantic University, Boca Raton, Florida
- Dawn Whitehead, former Fisheries Resource Coordinator, Fish and Wildlife Service, Ecological Services Office, Vero Beach, Florida



# Glossary

- Accrete . . . . . To grow by being added to, such as an accumulation of peat, or sediment over a period of time.
- Alien Species . . . . . With respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem. Also known as an exotic species.
- Alternative . . . . . A set of objectives and strategies needed to achieve refuge goals and desired future conditions.
- Anadromous . . . . . Going from salt water to fresh water, such is said of salmon, shad, snook, or tarpon.
- Anthropogenic . . . . . Caused by man, such as air pollution.
- “Area of Concern” . . . . . Lands near the refuge boundary that the Service would prefer to stay undeveloped; remain agricultural or be restored to their natural state. The Service would assist in managing these lands for wildlife through developing partnerships or by entering into license agreements or boundary easements.
- Atmospheric Deposition Stations . . . . . Stations in refuge interior which sample particulates from air and rainwater; components consist of 4 - 3 ½ gallon buckets and a solar-powered lid tripped by a solenoid during a period of rain; established procedure for testing for atmospheric deposition of phosphorus as part of the consent decree.
- Bioaccumulation . . . . . The process in which industrial waste, toxic chemicals, or pesticides gradually accumulate in living tissue, or in the food web/chain.
- Biomagnification . . . . . See bioaccumulation.
- Biomass . . . . . The total mass, or amount of material in a particular area.
- Biological Diversity . . . . . The variety of life forms and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur.
- Biota . . . . . The plant and animal life of a region.
- Borrow Canal . . . . . A canal which was created when soil or rock was removed to construct a dike, levee, or unpaved road.
- Buffer . . . . . A multi-use transitional area designed and managed to protect core reserves and critical corridors from increased development and human activities that are incompatible with wildlife. In this document, agricultural lands are also considered buffer lands. “Areas of Concern” are also used to delineate buffer lands.
- Cacique . . . . . An Indian chief, or local political boss.
- Calusa . . . . . An Indian tribe of south Florida, now thought to be extinct.
- Catastrophic Wildfire . . . . . Fires which historically occurred in the Everglades prior to the 1900s usually once every decade during severe droughts; fires had potential, due to their intense nature, to physically alter a particular plant community. Fires reduced accumulated peat and perpetuated the long-hydroperiod marsh habitat.
- Category I . . . . . Florida Exotic Pest Plant Council has developed three ranking categories to classify the invasiveness and threat of exotic plants to the natural environment. Category I species are those species invading and disrupting native plant communities in Florida. This definition does not rely on the economic severity or geographic range of the problem, but on documented ecological damage.
- Category II . . . . . Species that have shown a potential to disrupt native plant communities. These species may become ranked as Category I, but have not yet demonstrated disruption of natural Florida plant communities.
- Category III . . . . . Plants to “watch out” for; only a few specimens have escaped to natural areas; unknown if planted as ornamentals by humans.

- Central and Southern Florida Project . . . This major project, first authorized by Congress in 1948, is a multi-purpose water resources project. The authorized purposes of the project include: flood control, regional water supply for agricultural and urban areas, prevention of salt water intrusion, water supply to Everglades National Park, preservation of fish and wildlife, recreation, and navigation. In short, this project resulted in the 1000s of miles of drainage canals across the historic range of Everglades and is what makes it possible for over five million people to now live and work in the 18,000 square mile area which extends from south of Orlando to Florida Bay.
- Central and South Florida Restudy . . . . The name that has officially been changed to the Comprehensive Everglades Restoration Plan. Please see this name in the glossary.
- Class III waters . . . . . Waters suitable for fish and wildlife.
- Compatible Use . . . . . An appropriate wildlife-dependent recreational use or any other use on a refuge that is within the mandates laid down in the Refuge Improvement Act of 1997; the intent of the Congress in the Act of 1997 or in the 'Final Internal Draft' document of appropriate uses on a National Wildlife Refuge. The Refuge Manager may also determine if an activity will that will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the refuge.
- Comprehensive Conservation Plan . . . . A document that describes the desired future conditions of a refuge and provides long-range guidance and management direction for the Refuge Manager to accomplish the purposes of the refuge, contribute to the mission of the system, and to meet other relevant mandates.
- Comprehensive Everglades Restoration Plan The purpose of the Comprehensive Everglades Restoration Plan is to develop modifications to the Central and Southern Florida Project to restore the Everglades and Florida Bay ecosystems while providing for the other water-related needs of the region. The Comprehensive Everglades Restoration Plan is currently in the feasibility phase of the study which is jointly funded by the Corps of Engineers and the South Florida Water Management District. The Comprehensive Everglades Restoration Plan is being accomplished by an interdisciplinary, multi-agency team from a number of Federal, State, Tribal, and local government agencies.
- Consent Decree . . . . . Settlement agreement in 1992 between federal and the state agencies to formulate a comprehensive plan to restore, preserve and protect the unique flora and fauna of the A.R.M. Loxahatchee National Wildlife Refuge and Everglades National Park, to maintain a cooperative relationship in accomplishing these goals, and to settle and resolve the disputes that have arisen between and among them without admitting or conceding liability.
- Everglades Agriculture Area . . . . . Agricultural area (700,000 acres) northwest of the refuge noted for its production of sugarcane, rice, sod and winter vegetables; created as the result of the Central and Southern Florida Project and drainage of historic Everglades habitat.
- Ecosystem . . . . . A dynamic and interrelated complex of plant and animal communities and their associated non-living environment.
- Ecosystem Approach . . . . . A strategy or plan to protect and restore the natural function, structure, and species composition of an ecosystem, recognizing that all components are interrelated.
- Ecosystem Management . . . . . Management of an ecosystem that includes all ecological, social, and economic components which make up the whole of the system.
- Ecotone . . . . . A transitional zone between two habitat types, or adjacent communities.
- Edge Effect . . . . . Theory in wildlife management that the area between two adjacent habitat types or along the edge of a particular habitat types supports and maintains a greater diversity and number of species.
- Elemental Contaminants . . . . . Elements such as phosphorus, mercury or selenium that occur in the environment naturally, or unnaturally as the result of man.
- Endangered Species . . . . . Any species of plant or animal defined through the Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range.
- Everglades Nutrient Removal Project. . A 3,700 acre man-made filtration marsh created in 1994; located between the Everglades Agriculture Area and the refuge designed to remove nutrients (phosphorus) from storm water.

## Appendix B - Glossary

Environmental Assessment . . . . .	A systematic analysis to determine if proposed actions would result in a significant effect on the quality of the environment.
Everglades Protection Area . . . . .	This includes all lands in the former Everglades ecosystem from the Everglades Agricultural Area south to Everglades National Park.
Epiphyte . . . . .	A plant that grows on another plant but is not parasitic and produces its own food by photosynthesis, such as orchids, air plants, lichens, and mosses.
Exotic Pest Plant Council . . . . .	Council of resource managers formed in 1984 to unify the exchange of information between federal, state, and local land managers, research scientists, and the plant industry that were concerned with the impacts of exotic plants in natural areas.
Estuarine . . . . .	Deposited in an estuary; an inlet or arm of the sea where salt water and fresh water meet.
Eutrophic . . . . .	A body of water rich in nutrients that causes the excessive growth of noxious plants.
Eutrophication . . . . .	The process by which a body of water becomes rich in nutrients over a period of time; can be accelerated by man as a result of runoff of fertilizers or by agricultural practices such as cattle or crop farming.
Evapotranspiration . . . . .	The total water loss from soil, including direct evaporation and that by transpiration from the leaf surface of plants.
Everglades Construction Project . . . . .	The cornerstone of Everglades restoration. Major objectives of this program are to clean up nutrient enriched stormwater runoff before it enters the Everglades system and to improve the timing, distribution and flow of water within the Everglades system. This project includes provisions for construction of more than 40,000 acres of water treatment marshes known as Stormwater Treatment Areas. These areas would remove phosphorus and other pollutants from Everglades Agricultural Area stormwater runoff.
Exotic Species . . . . .	A non-indigenous or alien species, or one introduced to this state, either purposefully (horticulture trade) or accidentally that escaped into the wild where it reproduces on its own, either sexually or asexually. Any introduced plant or animal species that is not native to the area and that may be considered a nuisance.
Feral . . . . .	A wild, free-roaming animal; may be a domestic escapee.
Species of Management Concern . . . . .	This is a category assigned to species for which information in the possession of the Service indicated that proposing to list as threatened or endangered was possibly appropriate, but for which sufficient data were not available to support proposed rules.
Geographic Information System . . . . .	A computer based system for the collection, processing, and managing of spatially referenced data. This system allows for the overlay of many data layers and provides a valuable tool for addressing resource management issues.
Goals . . . . .	Descriptive statements of desired future conditions.
Hydrologic . . . . .	Involving water flows or their distribution as related to evaporation, or flow to fresh water marshes, marshes, seas, estuaries, etc.
Hydrology . . . . .	The scientific study of the properties, distribution and effects of water in the atmosphere, on the earth's surface and in soil and rocks. A hydrologic model is a type of simulation which takes into account the known behavior of water in the form of mathematical formulas and computer models that allow one to mimic the movement of water in a known area.
Hydropattern . . . . .	A description of water movement change in depth, timing, flow, or location of surface water.
Hydroperiod . . . . .	A measure of the fluctuation and change of water levels and flow over time. The length of time an area is inundated.
Introduction . . . . .	The intentional, or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity.
Invasive species . . . . .	A native, or non-native plant that has flourished beyond its normal constraints, due to changes in its natural environment. It is a variable condition defined by the Florida Exotic Pest Control Council category to which the species is ranked.

## Appendix B - Glossary

- Issue** . . . . . Any unsettled matter that requires a management decision. For example, a resource management problem, concern, a threat to natural resources, a conflict in uses, or the presence of an undesirable resource condition.
- Keystone Species** . . . . . A species unique to, or dependent upon a specific habitat; that one of a number of associated parts, or things that support, or hold together the others, such as the periphyton found in the Everglades system or an American alligator.
- License Agreement** . . . . . A lease agreement initiated in 1951 between the South Florida Water Management District and the Fish and Wildlife Service that enables the Service to manage Water Conservation Area 1 as a portion of the A.R.M. Loxahatchee National Wildlife Refuge. After 50 years (ending in the year 2001) the agreement has three renewable 15-year periods.
- Listed Species** . . . . . Any species of fish, wildlife or plant which has been determined to be ‘at risk’ by a state or the federal government agency. In this document, at risk may include threatened, endangered, species of special concern, species of management concern or species included in the Convention of International Trade in Endangered Species
- Littoral Zone** . . . . . The intertidal ecological zone along the shore, or the area between the perimeter canals and the dense, cattail growth.
- Lygodium** . . . . . Genus for Old World climbing fern; an invasive vine from southeast Asia and Africa introduced in the 1950s, or earlier by the nursery trade as an ornamental vine; rapidly displacing native vegetation in the refuge and other areas of south Florida.
- Maintenance Control** . . . . . Appropriate methods of eradicating, suppressing, reducing, or managing invasive species populations, preventing spread of invasive species from areas where they are present, and taking steps such as restoration of native species and habitats to reduce long term effects of invasive species and to prevent further invasions. The reduction of exotic pest plant populations to an economically or ecologically acceptable level through mechanical, chemical or biological means.
- Management** . . . . . Any intentional or planned activity which has an effect on an existing natural community which has been degraded in some way. Management which attempts to restore natural community functions, structures and/or composition is termed restorative management.
- Melaleuca** . . . . . Invasive weed from Australia; introduced intentionally into the Everglades to “dry up” the vast wasteland for agricultural purposes; also known as the paper bark tree, or punk tree; extremely disruptive to natural habitats such as the Everglades.
- Money Generation Model** . . . . . National Park Service’s computer module that generates public usage/visitation estimates.
- Midden** . . . . . A slightly elevated mound composed of shell fragments and other debris left as waste by native Indians; shell mounds found throughout the Everglades ecosystem constructed by native Indians.
- Monotypic** . . . . . Consisting of one type or species, such as exotic vegetation. Examples include single crops (fields of sugar cane), the dense growth of cattail along the refuge perimeter canal, or melaleuca ‘heads’. Scientific studies have shown that monotypic stands of vegetation generally provide poor wildlife habitat.
- Multi-Species Recovery Plan** . . . . . A newly developed plan (1999) spear-headed by the Fish and Wildlife Service to address listed species and their habitat needs.
- Native** . . . . . A species already occurring in Florida at the time of European contact (1500 AD). With respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem.
- Naturalist Rover** . . . . . A refuge volunteer that has completed specific training in wildlife identification and habitat interpretation. These volunteers assist visitors and help to enhance visitor experience at the refuge.
- Neotropical Migratory Birds** . . . . . Birds that migrate from North America back and forth to South or Central America. These birds usually breed in North America and ‘winter’ in the Caribbean, South or Central America. Usually this term is inclusive of many passerines and shorebirds.
- National Geodetic Vertical Datum** . . . . U.S. Geological Survey term describing surface water elevation above sea level.

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Non-indigenous Species . . . . .	A plant, or animal which has been introduced to the state of Florida. A non-native, exotic or alien plant, or animal.
Objectives . . . . .	Actions to be accomplished to achieve a desired outcome
Old World Climbing Fern . . . . .	See Lygodium.
Organochlorines . . . . .	Toxic pesticides such as DDT, DDE, dieldrin, and chlordane banned in 1970 due to persistent harmful residual characteristics; implicated as cause of decline of numerous raptor species due to its causing thin eggshells; biomagnified in the food chain.
Paleoenvironments . . . . .	Involving or dealing with forms, conditions, phenomena, fossils, etc., of remote (esp. geologic) eras.
Parasitic . . . . .	Living at the expense of others; one organism or species gains to the detriment of the host organism or species.
Partnerships . . . . .	A mutually beneficial, joint relationship between two agencies or an agency and land owner, etc.
Passerine . . . . .	The largest bird group, composed of small perching birds. Examples include northern cardinals, blue jays, warblers, sparrows and wrens.
Polychlorinated biphenyls . . . . .	Residuals, or waste produced by urban industries which pose a risk to the environment, also known as PCBs.
Periphyton . . . . .	A complex association of several types of algae unique to the Everglades; the basis of the Everglades food chain.
Piscivorous . . . . .	Fish-eating.
Poleboat . . . . .	Traditional narrow, flat bottom wooden boat used by the first settlers, or “glades men” of the Everglades; a long stiff pole is used to propel the boat through vegetation in the selected direction.
Parts per billion . . . . .	Standard unit to measure concentrations of phosphorus.
Preferred alternative . . . . .	The Service’s selected alternative identified in the Draft Comprehensive Conservation Plan.
Prescribed fire . . . . .	A planned or intentional fire set by resource land managers to improve or restore wildlife habitat and reduce potentially dangerous fire fuel loads, also known as “controlled burn.”
Rachis . . . . .	The principal axis of an inflorescence, or of a compound leaf; a collection of stems, or vines as related to Lygodium.
Refugia . . . . .	A place of shelter, safety or protection from danger.
Research Natural Area . . . . .	Specific natural areas set aside in large refuges of the National Wildlife Refuge System that are protected and preserved from disruptive uses, active or manipulative management, encroachment and development. In this refuge, 2,560 acres of the interior have been set aside and are generally off-limits to all personnel. Potentially, these areas can be used for comparative studies by research scientists and staff.
Restore or restoration management . . . . .	Management actions to return a vegetative community or ecosystem to its original, natural condition. To bring a disturbed site or an area changed from its native state back to its historic structure, including water regimes, plant community and wildlife components. In this document, restoration can refer to exotic plant removal, planting native plants, and /or reintroductions of native plants or animals.
Restudy . . . . .	The name that has officially been changed to the Comprehensive Everglades Restoration Plan. Please see this name in the glossary.
Sawgrass . . . . .	The dominant plant, or sedge associated with Everglades habitats; the edge of the plant, or blade is extremely sharp and easily cuts human flesh.
Sawgrass Marsh . . . . .	A wetland area dominated by sawgrass such as the Everglades.
Scoping . . . . .	Process for determining the scope of issues to be addressed by a comprehensive conservation plan and for identifying the significant issues. Involved in the scoping process are federal, state, and local agencies, private organizations, and individuals.
Settlement Agreement . . . . .	See consent decree.

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Slough . . . . .	The deepest area of surface water covering the Everglades and the refuge. Usually contains white water lily and spatterdock as its dominate vegetative cover.
Species . . . . .	A group of organisms all of which have a high degree of physical and genetic similarity, generally interbreed only among themselves, and show persistent differences from members of allied groups of organisms.
Stormwater Treatment Areas . . . . .	A human-made marsh constructed to filter nutrients from agricultural runoff and stormwater. Two will be built on the northern boundaries of the refuge.
Stakeholders . . . . .	Individuals or groups that have an interest in a potential or current issue; could include federal, state, tribal, and local government agencies, academic institutions, the scientific community, non-governmental entities including environmental, agricultural, and conservation organizations, trade groups, commercial interests and private landowners.
Threatened species . . . . .	Those plant or animal species likely to become endangered species throughout all or a significant portion of their range within the foreseeable future. A plant or animal identified and defined in accordance with the 1973 Endangered Species Act.
Tree islands . . . . .	Areas of higher elevation within the Everglades ecosystem that characteristically support more upland type shrubs, trees, and woody vegetation, namely red and sweet bay, willow, wax myrtle, Dahoon holly, cocoplum, and buttonbush. Hundreds of tree islands are found in the refuge.
Trust species . . . . .	Specifically, species that are federal responsibility and include migratory birds, threatened and endangered species, anadromous fish, and certain marine mammals. The term is broadly used in this document to include federal, state and internationally listed species, including threatened, endangered, species of special concern and species of management concern. Also known as 'listed species'.
Umbrella species . . . . .	Species for which protection of its habitat will protect the habitat and life history requirements of a large number of other plants and animals such as the American alligator.
Water Conservation Area . . . . .	Man-made impounded wetlands, areas created by the Central and Southern Florida Project that were designed for water storage, water supply, flood protection, flood control, and outdoor recreation. Water Conservation Areas 2 and 3 are south of the refuge and are managed by the Florida Fish and Wildlife Conservation Commission. The refuge interior is 'laid over' Water Conservation Area 1.
Water Preserve Area . . . . .	A conceptual design of interconnected series of marsh lands, reservoirs and aquifer re-charge basins. The basins would hold water lost from the Everglades system during wet hydroperiods; reduce seepage from the system, capture stormwater run off, provide water to the urban and agricultural areas during dry hydroperiods and buffer between the existing Everglades ecosystem and an increasing urbanized east coast.
Watershed . . . . .	The entire land area that collects and drains water into a stream or stream system.
Wildlife diversity . . . . .	Measure of the number of wildlife species in an area and relative abundance.

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# Compatibility Determination

## Introduction

This Compatibility Determination describes the wildlife-dependent and other uses that may be included in the public use program under the preferred alternative (Alternative 2 - Ecosystem Emphasis) and determines whether these uses are compatible uses. This determination applies to lands (144,842 acres) under a license agreement with the South Florida Water Management District, lands (2,550 acres) owned by the Fish and Wildlife Service, and the lands (680 acres) included in the expanded acquisition boundary.

Under the National Wildlife Refuge System Administration Act of 1966, the Refuge Recreation Act of 1962, and the National Wildlife Refuge System Improvement Act of 1997, the Service may not permit recreational uses on a national wildlife refuge unless these uses are first determined to be compatible wildlife-dependent uses. The Improvement Act now requires that the needs of fish, wildlife, and plant resources on national wildlife refuges come first. All public uses must be compatible with these resources. Compatibility is determined if the activity does not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System Mission or the major purposes of the national wildlife refuge where the use is proposed. Furthermore, compatible activities which depend on healthy fish and wildlife populations will be recognized as priority general public uses. The 1997 law established the priority public uses as hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation.

## Refuge Uses

The compatibility determination applies to: 1) wildlife observation and photography; 2) walking/hiking/bicycling; 3) canoeing/kayaking/poleboating; 4) camping on the canoe trail; 5) concession operation; 6) hunting; 7) fishing; 8) environmental education and interpretation; and 9) research and Special Use Permits.

## Refuge Name

Arthur R. Marshall Loxahatchee National Wildlife Refuge

## Date Established

June 8, 1951

## Establishing and Acquisition Authority(ies)

A Cooperative and License Agreement between the Central and Southern Florida Flood Control District (precursor to the South Florida Water Management District) and the U.S. Fish and Wildlife Service with the Migratory Bird Conservation Act of 1929 authorized the establishment of Arthur R. Marshall Loxahatchee National Wildlife Refuge. In the initial License Agreement, 143,116 acres of wetlands, known as Water Conservation Area 1, were leased to the U.S. Fish and Wildlife Service by the State of Florida to be managed in accordance with the Agreement and legislative mandates. These mandates also apply to a subsequent amendment to the Agreement, which added the 1604-acre Strazzulla Marsh.

## Refuge Purpose

*This refuge was established*

*“...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds.”*

*(Migratory Bird Conservation Act of 1929. 16 U.S.C. Sec. 664).*

## Refuge Vision

The refuge vision, crafted by the Comprehensive Conservation Plan team members in 1998, is:

*“to serve as an outstanding showcase for ecosystem management that restores, protects, and enhances a portion of the unique northern Everglades biological community. This public asset provides for the enjoyment and enhanced quality of life for present and future generations.”*

## Mission of the National Wildlife Refuge System

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

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

## Description of Uses and Anticipated Biological Impacts

This compatibility determination relies on the best estimates of public use as compiled by the Department of Recreation, Parks and Tourism and the Institute of Food and Agricultural Sciences of the University of Florida. During the upcoming years, the Service would continue, as indicated in the Draft Comprehensive Conservation Plan, to conduct surveys to estimate wildlife populations and plant community diversity, gather definitive public use data, and assess public use impacts on wildlife resources. If adverse impacts to refuge resources associated with public use activities are identified in future years, modifications to that part of the program in question would be implemented to minimize that impact.

### *Wildlife Observation/Photography*

The refuge is known for its easily observed population of alligators. This species probably brings more out-of-town visitors to the refuge than any other species. The refuge is also known for its diversity and visibility of resident and wintering wading birds. Some of the Florida specialty birds that bring in birders from around the country include the Florida snail kite, swallow-tailed kite, short-tailed hawk, smooth-billed ani, wood stork, and limpkin. The compartment system at the Headquarters Area can provide forage areas for thousands of birds. Some waterbirds nest in this area, providing excellent opportunities for photography. Since the refuge is geographically positioned in the Atlantic Flyway, there is a good possibility to observe waterfowl and migratory shorebirds. The cypress swamp and the ecotone surrounding it are rewarding areas to see migratory neotropical passerines and many birders enjoy the seasonal show of colorful warblers and vireos. Butterflies, dragonflies, and damselflies grace the landscape of all refuge areas, providing some of the best photo opportunities in south Florida. Grey fox, raccoon, river otter, bobcat and the exotic armadillo are also commonly seen by the quiet observer.

Non-consumptive uses such as hiking, butterfly watching, birdwatching, nature photography and plant identification are enjoyed by approximately 304,000 people a year; and according to 1998 information, visitors come from as many as 38 foreign countries, the whole United States, as well as locally. An increase in non-consumptive uses is expected to grow quite rapidly due to increases in resident population growth, winter visitor population, and the awareness of the refuge's diverse habitats and the new/upgraded facilities for observing wildlife.

To accommodate the burgeoning visitor use to the refuge, more access areas are needed to help educate the public and interpret the Everglades ecosystem. Projects such as extending or creating a boardwalk, observation towers or photo blinds would be approached with great care to minimize damage to the resource. All efforts would be made to use conservative construction techniques (e.g., silt barriers), recycled materials, and environmentally sensitive treated lumber in each of these projects.

In most cases, wildlife observation/photography would result in minimal disturbance to wildlife. However, if visitors venture too close to foraging wading birds, alligators or other wildlife, foraging or resting activities would be disrupted. To minimize the chance of these disturbances, volunteer "rovers" would educate visitors about the problems associated with their actions. If a visitor disregards the rover's instructions, a refuge law enforcement officer would be called upon to handle the situation. Also, areas may be closed to the public if disturbance is excessive.

### *Walking/hiking/bicycling*

New and additional public use opportunities are being proposed to take advantage of existing roads/levees and trails that provide excellent opportunities to observe the many species of wildlife that use the refuge. The perimeter canal offers exceptional wildlife viewing and photographic opportunities for a myriad of wading birds, waterfowl, hawks, and alligators. Furthermore, the levee adjacent to the canal offers one of the highest vistas in the refuge enabling observation of the unique Everglades habitats. The existing refuge perimeter levee is the highest vantage point in the area and for 30 feet on either side it is free of vegetation. The design of the levee, including the sharp slope and deep canals along each side, precludes off trail use. Because of these constraints, the levee allows excellent opportunities for wildlife observation while limiting the impact or disturbance of human use.

There are three major user groups that heavily use trails in the south Florida area for the opportunity to experience and enjoy the outdoors and observe nature and wildlife. They are hikers, bicyclists, and equestrian groups.

Walking/hiking on the perimeter levee is allowed from Hillsboro Area northwest to the S-6 Pump. Hiking is also allowed from Hillsboro Area to the ACME 1 Pump Station which is northeast of Strazzulla Marsh. Bicycling is allowed on the perimeter levee from Hillsboro Recreation Area east-northeast into the Headquarters Area and visitor center. Bicycling is not allowed on the levees in the compartment areas or on the boardwalk. Users need to be aware that the same perimeter levee is traveled by refuge and South Florida Water Management District employees in vehicles.

### *Canoeing/Kayaking and Poleboating*

Canoeing has been enjoyed by many visitors in past years. Increased maintenance of the existing trail and the extension of it would allow more visitor use. Accessibility to the refuge interior via the canoe trail provides the visitor with an exceptional opportunity to experience the ‘Glades’ as did Native Americans and early settlers did. The longer trail would enable maximum exposure for the visiting public to the most unique feature of the northern Everglades, the numerous tree islands, and the wildlife that use them, which are more prevalent deeper into the refuge. A planned extension of the existing canoe trail would minimally impact wildlife habitat because there would not be an additional entry point from the perimeter canal for possible harmful phosphorous penetration to the refuge interior.

Canoes or kayaks could also be used in all designated public use waters, including areas in the south, west-northwest and east-northeast perimeter canals. Boats traveling within 1 mile either side of the headquarters boat ramp or the ACME 1 and 2 stations and north to the “first bend going north from Hillsboro,” would show courtesy to others and slow to “slow speed, minimum wake.” In any other areas of the canals, boaters would be in compliance with all applicable refuge, U.S. Coast Guard, and State of Florida laws, as codified in Title 50, Code of Federal Regulations, Section 27.32; Title 33, Code of Federal Regulations, Sections 1-187; Title 46, Code of Federal Regulations, Sections 1-199 and Florida Statutes, Chapters 327 and 328. A limited canoe rental operation at the Headquarters Area is not thought to negatively impact the refuge; rather, it would assist visitor efforts to experience and appreciate the refuge and the Everglades.

While a separate poleboat trail is planned, it would not be created until nutrients in the perimeter canal water are maintained at yet to be determined acceptable levels. It is expected that the refuge would become more crowded as more of the nearby 6 million residents visit the refuge. The proposed poleboat trail is another opportunity to experience a different portion of the refuge via a slightly different boat than a canoe. Poleboating would lead to aesthetic appreciation of the refuge, provide interpretation of the cultural history of the refuge, and enable the visitor to observe wildlife in a manner reminiscent of earlier times. Poleboats pose less impact to the wetland than canoes, as they are pushed rather than paddled. A primitive route would be marked with small flags or signs only. The only maintenance required for this project would be to cut a short path pass through the perimeter vegetation to access the interior marsh.

### *Camping on the Canoe Trail*

The canoe trail extension and overnight platforms would provide benefits such as learning about the Everglades, the unique opportunity to observe nocturnal wildlife by sight and sound, observation of celestial phenomenon somewhat away from urban light pollution, and an opportunity to recognize the uniqueness of the Everglades ecosystem. It is vital to provide ways to understand why supporting the cost of ongoing restoration/protection efforts is important to the residents of south Florida. To provide this experience, a very limited overnight opportunity is proposed on the extended canoe trail. Two platforms, large enough to support a composting outhouse and two small tents each, would be constructed on the trail. Visitors shall stay on the trail and use the platforms to stay the night.

Overnight stays would be by permit only, based on advanced reservations, limited by number and only during the winter months. Specific restrictions and guidelines would help keep visitors from becoming lost during the visit and reduce the number of emergency rescues by law enforcement staff. If mandatory rescue missions become too numerous, the camping experience would be shut down.

Further stipulations may be made to assure that wildlife or habitat are not disturbed, including ending the overnight option. Some disturbance to wildlife and habitat would initially occur with the construction of the platforms and development of a trail extension. However, long-term disturbance would be minimal.

### *Concession Operation at Hillsboro Recreation Area*

Phase 1: Initial facility construction and associated increase in public use: A building would be constructed to support interpretive exhibits, a refuge office, partner office space, refuge cooperating association, volunteers, bathrooms and public phones. Refuge management is considering partnering with other agencies on sharing a building as a “contact station/interpretive center” in the Hillsboro Area. The visiting public would be able to learn more about the wetlands through exhibits that highlight the similarities and unique differences between Water Conservation Areas 1, 2, and 3, showcasing the northern and central Everglades.

Anticipated biological impacts associated with the building and area use are minimal and concluded that a new interpretive building at Hillsboro would not necessarily increase visitation, but would increase resource awareness and environmental education for people currently frequenting the site. The planning team also agreed that constructing a new building to fit the footprint of a pre-existing building would not cause further impact (with appropriate construction safeguards) to the nearby wetlands and the vegetation currently in the fill area is

exclusively exotic. Furthermore, a formal refuge presence in the Hillsboro Area would assist in increasing visitor safety and reduce vandalism and other crime.

**Phase 2: Concession opportunity for motorboat/canoe/bicycle rentals and Zoned Use Areas:** The second phase of the Hillsboro project supports a preliminary framework of a limited concession where a few boats (canoes, kayaks, motorized johnboats), bicycles and fishing gear rentals would be offered. By limiting the number of rentals and adhering to the “use zones,” potential impacts to wildlife in this area should be minimal. To assist in everyone’s safety, designated water speed areas would be assigned for motorboats. Boats traveling within 1 mile either side of the headquarters boat ramp or the ACME 1 and 2 stations and north to the “first bend going north from Hillsboro,” would show courtesy to others and slow to “slow speed, minimum wake.” In any other area, boaters would be in compliance with all applicable refuge, U.S. Coast Guard and State of Florida laws. Only canoes or kayaks are allowed on the canoe trail. If a poleboat trail is opened, only poleboats would be allowed.

The “Public Use Area” (including the waterfowl hunt area) may be accessed by all visiting public, including canoeists, kayakers, poleboaters, and anglers during all months of the year. However, during waterfowl hunt season (generally November, December, and January), only hunters may access the “waterfowl hunt area” during hunt hours (early to late mornings on certain days of the week).

**Fishing guides:** The concessionaire may be approved to provide guided fishing along the refuge perimeter canals or into the interior public use area by motorboat. Because of the harmful effects of mercury-laden fish in the refuge, fishing by catch and release would be encouraged. Negative impacts could be expected with the projected increase in fishing, including an increase in discarded fishing line, hooks, and sinkers.

**Interpretive Pontoon Shuttle:** A dawn and dusk interpretive boat tour from the Hillsboro Area to the Headquarters Area would be established. Each boat would have an interpretive guide to assist visitors in seeing and hearing wildlife, interpret the surroundings, and educate passengers about the issues associated with the Everglades. A slow, quiet pontoon type boat would be used. Selling certain types of food at Hillsboro may not be allowed, pending Service appropriateness and compatibility determinations.

## *Hunting*

### **Waterfowl:**

Many of the local residents enjoy waterfowl hunting in the Everglades area and on the refuge. Implementation of the preferred alternative, as described in the Draft Comprehensive Conservation Plan, would ensure that opportunities for various types of hunting would continue for future generations of hunters.

Waterfowl hunting would continue to be limited to the southern portion of the refuge where some of the best habitat is located. While the newly designated hunting area is slightly less than the current hunt area, the new boundaries provide improved motorboat access and potentially better hunting habitat. The hunting area may eventually be made more accessible to motorboats by creating trails into the hunting area from the east and southern sides of the perimeter canal. However, these access trails would not be created until nutrients in the perimeter canals are maintained at acceptable (yet to be determined) levels. Recreational airboating for waterfowl hunting or fishing is not allowed on the refuge (*Appendix J*).

The proposed hunt area includes deep sloughs and shallower ‘peat flats,’ which provide habitat for both divers and dabblers. Duck habitats are expected to improve with the implementation of the prescribed burn management plan (fire management plan). While individual ducks are negatively impacted by hunting on the refuge, the overall duck population using the refuge is not thought to be significantly impacted. There are two reasons for this: 1) few of the Atlantic Flyway ducks come this far south to winter; and 2) approximately 75 percent of the refuge wetlands available for the birds to loaf and forage is not accessible to hunting.

### **Feral Hog:**

At Strazzulla Marsh, feral European hogs impact the refuge by uprooting vegetation, disrupting habitat, and creating potential exotic plant establishment sites. At times, the public may be asked to assist in removing these exotic animals from refuge lands. The occasionally announced hunt (primitive weapon only) time would be short and intensive to reduce the hog population and its impact on the refuge.

### **American Alligator:**

It is common knowledge to the visiting public, local hunters, and to the refuge staff that there is a sizable population of alligators in the perimeter canals. A survey of the alligator population, conducted from 1979-1987 in the L-40 canal north of Headquarters and in the Hillsboro Recreation Area canal, showed alligator densities of 7.8 to 100.7 alligators per mile depending on season and water levels. Recent surveys indicate that alligator

densities in the canals fluctuate with water levels, but are regularly higher than in canals adjacent to Water Conservation Areas 2 and 3.

Since alligator population levels are sufficiently high and alligator hunting is a traditional recreation in south Florida, alligator hunting would be instituted in the refuge perimeter canals. The hunt would take place for a limited time period in accordance with guidelines provided by the Florida Fish and Wildlife Conservation Commission and other refuge regulations. Concurrent with the alligator hunting program, scientific studies would be performed to ascertain population health and to determine if the canal populations remain sustainable. The hunt may be suspended at any time by staff biologists.

### *Fishing*

In south Florida, the public is a strong advocate for sport fishing. Largemouth bass, exotic tilapia, exotic oscar and other species are a traditional form of appropriate, compatible wildlife-dependent recreation in this region. On the refuge, sport fishing is the most common consumptive use of the refuge. Providing fishing opportunities allows the use of a renewable natural resource without adversely impacting other resources. Anglers must, of course, comply with state fishing regulations.

The refuge advocates catch and release fishing after research discovered the extent and severity of mercury in fish bodies. In 1989, the Florida State Health Officer advised fishermen to avoid consumption of several species of fish in more than 1,000,000 acres of the Everglades. The health advisory for the refuge is as follows: “The Florida Department of Health and Rehabilitative Services has issued a health advisory urging limited consumption of largemouth bass and warmouth caught in certain portions of the Everglades due to excessive accumulation of the element mercury. Fish caught in A.R.M. Loxahatchee National Wildlife Refuge (Water Conservation Area 1) should not be eaten more than once per week by adults and not more than once per month by children under 15 and pregnant women; and fish caught in Water Conservation Areas 2A and 3 should not be eaten at all. The refuge is a multi-agency partner supporting research to determine the source of mercury in Everglades waters.

Fishing tournaments (currently permitted only four times per year for one day by a limited number of boats) would be allowed. The impact to the landscape and wildlife in the south end of the refuge is minimal with these tournaments. Restricting the participation to 15 boats, and requiring that groups obtain all state permits, encourages only local clubs that enjoy competition as well as conservation. These same persons routinely fish on the refuge. These clubs, in lieu of a permit fee, support the refuge with volunteer projects such as removing litter at the Hillsboro Public Use Area or assisting refuge staff at youth fishing events.

Educational efforts would be increased to encourage anglers to collect and discard excess and old fishing line, hooks and sinkers, since wildlife are known to die after ingesting this debris. Problems associated with littering and illegal take of fish (undersized fish, over bag limit) would be controlled through law enforcement.

Recreational fishing would have minimal adverse impacts on the fisheries resource, other wildlife resources, listed or trust species, or other natural resources on the refuge. However, in the perimeter canal, the excessive speeds of some fishing boats, due to high-powered outboard engines, can result in collisions with wildlife, endangerment to canoeists, kayakers, and small johnboat operators, and disrupt the experience of the pontoon shuttle customers. To minimize these impacts, motorboats shall be operated in accordance with the following conditions: 1) boats traveling within 1 mile either side of the headquarters boat ramp or the ACME 1 and 2 stations and north to the “first bend going north from Hillsboro” would show courtesy to others and 2) slow to “slow speed, minimum wake.” In any other areas of the canals, boaters would be in compliance with all applicable refuge, U.S. Coast Guard, and State of Florida laws. Private airboats are not allowed on the refuge.

The estimated current and anticipated future levels of fishing is considered to be compatible with the purpose for which the refuge was established.

### **Environmental Education and Interpretation**

Limited amounts of environmental education /interpretation activities have been ongoing at the refuge. Expanding the facilities to encompass additional activities would cause a minimal impact to the surrounding vegetation and is anticipated to have an insignificant effect on refuge resources, including fish, wildlife, and their habitats.

To avoid impacts, new facilities would be located in existing public use areas such as parking lots or filled areas covered in exotic grasses. New facility construction in any of the alternatives would have little negative effect. Any or all fill operations would comply with the requirements of Section 404 of the Clean Water Act and other applicable regulations. Turbidity during construction would be limited by silt screens or other methods to minimize potential runoff during construction. Parking areas would be constructed to allow storm water to

percolate into the soil rather than allowing it to run directly into the adjacent wetlands. Short term negative effects to air, noise quality, and soils within the project site would be expected, and measures to protect the environment would be taken.

### **Research and Special Use Permits**

The refuge receives many requests to conduct scientific research and other types of activities. Priority would be given to studies that contribute to the enhancement, protection, use, preservation, and management of native wildlife populations and their habitats. The following are some of the things that would be considered in the determination of whether to issue a Special Use Permit: Will the project benefit the refuge? Does the project address an issue of direct management concern to the refuge? Does the project address an issue of concern for overall Everglades restoration? Is the proposed research redundant to previous research conducted in the Everglades or in the refuge. Can the research be conducted elsewhere? Is the activity compatible or appropriate with the purpose, goals or objectives of the refuge? Will the use set a precedent that will be difficult to contain or control in the future? Is the project inconsistent with public safety? Has the project already been determined to be inappropriate on this or any other refuge? Can the proposed research can be conducted elsewhere? Is the applicant qualified?

Research applicants would outline the potential impacts their study may have on refuge habitats or wildlife, including disturbance (short- and long-term), injury, or mortality. If the proposed research methods would impact or potentially impact refuge resources (habitat or wildlife), it must be demonstrated that the research is necessary, and the researcher must identify the issues in advance of the impact. Potential impacts would be explained by the applicant and reviewed by refuge staff. Mitigation measures to minimize potential impacts would need to be developed.

At any time, refuge staff may accompany the researchers to determine potential impacts. Staff may determine that previously approved research and special use permits be terminated due to impacts. All refuge rules and regulations must be followed unless otherwise excepted by refuge management.

### **Listed Species**

The refuge has documented or has suitable habitat for more than 63 state and federally listed threatened, endangered, State species of special concern, Fish and Wildlife Service species of management concern, species listed as Convention of International Trade in Endangered Species or Partners-In-Flight species (*Appendix K, Table 22*). Based on current information, it is anticipated that the current levels of wildlife-dependent recreation, environmental education and interpretation would not impact listed species, species of special concern, species of management concern, or designated/proposed critical habitat. Data gathered as a part of biological surveys and monitoring programs, regarding the presence or potential importance of the refuge to trust species or critical habitat, could result in changes to public use activities across time. If such changes are warranted, wildlife species would benefit from the change.

Incidental take of other wildlife species, either illegally or unintentionally, may occur with any public use program. At current and anticipated use levels, this incidental take would be small and would not directly or cumulatively impact wildlife population levels on the refuge or in the surrounding area. Implementation of an effective law enforcement program and development of site specific refuge regulations and special conditions would eliminate most incidental take problems.

### **Stipulations Necessary to Ensure Compatibility**

Wildlife-dependent uses would be permitted on the refuge with the following caveats:

Vehicles would be restricted to existing roads and parking lots. No all-terrain vehicles would be allowed on any portion of the refuge except occasional use by refuge staff. Wildlife observation or photography activities may result in disturbance to wildlife, but it is expected to be minimal. To mitigate potential disturbances, volunteers serving as naturalist rovers would help to educate visitors about the problems associated with their actions. If a visitor disregards the rover's instructions, law enforcement officers would handle the situation. If disturbances are severe, areas can be closed to public access for specific periods, such as during nesting season.

Bicycling would be restricted to certain areas to minimize potential wildlife disturbances and to retain the quiet atmosphere appreciated by walkers and hikers. Bicyclists would be able to access Lee road and the visitor center parking lot while in the Headquarters Area. Bicycles may also travel south on the levee from the Headquarters Area along the perimeter canal to Hillsboro Recreation Area and back. Because of increased public access (walking, wildlife observation, photography) on the levees of Compartments A, B, or C, and on the boardwalk, bicycling is not allowed.

Canoeing , kayaking or poleboating would cause minimal wildlife disturbance. Canoes, kayaks and poleboats are allowed on the canoe trail, in the perimeter canal around the refuge interior, and in the Hillsboro Public Use Area. These boaters can use the designated hunting areas when hunting is not in season. This area is shared by motorboat users as well. Motorboats must be courteous to other visitors in the public use area, hunt area, or canals and must proceed at “slow speed and minimum wake” when encountering any canoeists and kayakers to reduce the potential of swamping them. Motorboats shall also proceed at “slow speed, minimum wake” when within 1 mile either side of the headquarters boat ramp or the ACME 1 and 2 stations and north to the “first bend north from Hillsboro”. Motorboat operators shall be in compliance with all applicable refuge, U.S. Coast Guard, and State of Florida laws.

Overnight stays on the extended canoe trail would occur under specific refuge guidelines and would be restricted to a designated area. A composting toilet and a platform would be provided, no glass containers or loud music would be allowed and regulations would be established to control the flow of visitors to the campsite.

Fishing and hunting would be allowed in accordance with State of Florida regulations and licensing requirements as well as specific refuge regulations. Firearms or bows are prohibited on the refuge except during designated hunting seasons and in designated areas.

The Hillsboro Recreation waterfowl hunt area would be located sufficiently far from the perimeter canals to protect boaters, hikers, and bicyclists from potential firearm overshooting.

The Strazzulla Marsh feral hog hunt (limited to primitive weapons) would also have a specific hunt area to limit potential overshooting.

All hunts are established on the basis of wildlife population levels and designed to provide quality hunting opportunities. Hunt season dates and bag limits would be adjusted as needed to achieve balanced wildlife population levels within carrying capacities, regardless of impacts to user opportunities. Refuge regulations could include, but may not be limited to: establishing season dates that differ from those of the surrounding hunt areas; suspending hunts; establishing new permit requirements; and closing areas on a permanent or seasonal basis to reduce disturbance to specific wildlife species or habitats (e.g., as bird nesting colonies, roosts, wintering waterfowl, or listed/trust species, or to provide public safety.)

No dogs (or other pets) would be allowed on the refuge because of their potential to cause disturbance to wildlife, except retrievers used in waterfowl hunting. No pet may be left in any vehicle because of the threat of animal overheating.

Additional buildings near the visitor center, the Marsh Trail, or at Hillsboro would be constructed on existing fill areas (parking lots and adjacent open, grassy areas). The construction of a Contact Station/Interpretive Facility at the Hillsboro Area would occur over an existing shellrock fill area in the same location as the former concession structure. All new facility construction would have little effect on water quality. All operations would comply with the requirements of Section 404 of the Clean Water Act and other applicable regulations. Turbidity during construction would be limited by silt screens or other methods to minimize potential runoff during construction. If necessary, affected parking areas would be constructed to allow stormwater to percolate into the soil, rather than allowing it to run directly into adjacent wetlands.

### **National Environmental Policy Act Compliance**

The wildlife-dependent and other recreational uses as evaluated in this compatibility determination have a negligible impact on refuge resources. Allowing these uses as part of an expanded public use program is not expected to be controversial regarding their potential impacts on refuge resources.

In assessing the potential impacts of the proposed refuge actions, all available tools were utilized. These tools included obtaining references from previous refuge management plans; other agency management plans; a review of pertinent scientific literature and technical reports; conversations with scientists and public use professionals; and a review of research conducted on or near the refuge. Input was also provided by the Service’s Regional Archaeologist, an Archaeologist at Florida Atlantic University, and three Sociologists at the University of Florida.

## Determination

Based on available information, the proposed uses, namely, hunting; fishing; wildlife observation; wildlife photography; environmental education and interpretation; walking; hiking; biking; canoeing; camping; concession operations; research; and Special Use Permit uses are deemed compatible with the purpose for which the refuge was established and the mission of the National Wildlife Refuge System. There is no indication at this time of any long-term adverse biological impacts associated with these uses.

There are a number of situations, harmful to plant and animal life, that would warrant refuge closure or the development of use restrictions. Examples of these situations include, but are not limited to, protection of trust and listed species (flora and fauna), impacted vegetation, nesting or denning species, and the protection of and possible conflicts with other refuge management programs.

## Justification

According to the National Wildlife Refuge System Improvement Act of 1997, wildlife conservation has first priority in refuge management; public uses are allowed and encouraged as long as they are appropriate and compatible with or do not detract from this priority mission and the purposes for which the refuge was established. Wildlife-dependent recreational uses (namely, hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation), assuming they are judged to be compatible, are considered as legitimate, appropriate and priority uses of the National Wildlife Refuge System. Other recreation uses, namely, walking, hiking, biking, canoeing, and camping have been determined not to materially interfere with or detract from the purposes of the refuge or the mission of the National Wildlife Refuge System.

## References and Literature Cited in Compatibility Determination

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## *Compliance Requirements*

There are many federal, state, and local laws and regulations affecting refuge management and development. Listed below are the key permits, approvals, and consultations needed to implement the preferred alternative and the step-down management plans on A.R.M. Loxahatchee National Wildlife Refuge.

National Wildlife Refuge System Improvement Act of 1997.

National Wildlife Refuge System Administration Act of 1966, as amended.  
Refuge Recreation Act of 1962, as amended.

Omnibus Parks and Public Lands Management Act of 1966.

Management and General Public Use of the National Wildlife Refuge System (Executive Order 12996).

Endangered Species Act of 1973, as amended.

Floodplain Management (Executive Order 11988).

Section 404, Clean Water Act of 1974, as amended.

Protection of Wetlands (Executive Order 11990).

National Historic Preservation Act of 1966, as amended.

Protection of Historical, Archaeological, and Scientific Properties (Executive Order 11593).

Intergovernmental Review of Federal Programs (Executive Order 12372).

Environmental Justice in Minority Populations and Low-Income Populations (Executive Order 12898).

Hazardous Substances Determinations (Secretarial Order 3127).



## *Key Legislation/Policies*

Antiquities Act (1906): Authorizes the scientific investigation of antiquities on Federal land and provides penalties for unauthorized removal of objects taken or collected without a permit.

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

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

Archaeological Resources Protection Act (1979) as amended: Protects materials of archaeological interest from unauthorized removal or destruction and requires Federal managers to develop plans and schedules to locate archaeological resources.

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

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

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

Emergency Wetlands Resources Act (1986): The purpose of the Act is “To promote the conservation of migratory waterfowl and to offset or prevent the serious loss of wetlands by the acquisition of wetlands and other essential habitat, and for other purposes.”

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

Executive Order 1312 Invasive species (1999): This order seeks to prevent the introduction of invasive species, provides for their control, and minimizes the economic, ecological, and human health impacts that are caused by invasive species.

Executive Order 13007 Indian Sacred Sites (1996): Directs Federal land management agencies to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, avoid adversely affecting the physical integrity of such sacred sites, and where appropriate, maintain the confidentiality of sacred sites.

Executive Order 12996 Management and General Public Use of the National Wildlife Refuge System (1996): Defines the mission, purpose, and priority public uses of the National Wildlife Refuge System. It also presents four principles to guide management of the System.

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

Federal Noxious Weed Act (1990): Requires the use of integrated management systems to control or contain undesirable plant species; and an interdisciplinary approach with the cooperation of other Federal and State agencies.

Fish and Wildlife Act (1956): Established a comprehensive national fish and wildlife policy and broadened the authority for acquisition and development of refuges.

Fish and Wildlife Coordination Act (1934); (amended in 1946, amended in 1958): Allows the Fish and Wildlife Service to enter into agreements with private landowners for wildlife management purposes.

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

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

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

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

National Wildlife Refuge System Administration Act of 1966 as amended by the National Wildlife Refuge System Improvement Act of 1997, 16 U.S.C. 668dd-668ee. (Refuge Administration Act): Defines the National Wildlife Refuge System and authorizes the Secretary to permit any use of a refuge provided such use is compatible with the major purposes for which the refuge was established. The Refuge Improvement Act clearly defines a unifying mission for the Refuge System; establishes the legitimacy and appropriateness of the six priority public uses (hunting, fishing, wildlife observation and photography, or environmental education and interpretation); establishes a formal process for determining compatibility; established the responsibilities of the Secretary of Interior for managing and protecting the System; and requires a Comprehensive Conservation Plan for each refuge by the year 2012. This Act amended portions of the Refuge Recreation Act and National Wildlife Refuge System Administration Act of 1966.

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

National Historic Preservation Act (1966) as amended: Establishes as policy that the Federal Government is to provide leadership in the preservation of the nation's prehistoric and historic resources.

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

Refuge Recreation Act (1962): Allows the use of refuges for recreation when such uses are compatible with the refuge's primary purposes and when sufficient funds are available to manage the uses.

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

## *Summary: Public Scoping Meeting*

A public scoping meeting was held August 17, 1998 concerning the future management of the A.R.M. Loxahatchee National Wildlife Refuge. The meeting began with brief presentations on the refuge mission and vision and the planning steps required to develop the current Comprehensive Conservation Plan and Environmental Assessment. After the presentations, approximately sixty meeting participants formed nine self-selected groups to discuss issues, concerns, and opportunities. Each comment was recorded in the participant's words on flip charts by volunteer recorders who were trained by the meeting facilitator. The meeting ended with a representative presenting the major themes that were generated by their group. All of the group comments were combined into the summary presented below.

### **A. General Refuge Management**

The management of the wildlife habitat should take priority over the public use of the refuge.

Open the refuge to the public for as many hours as possible.

Continue to manage the refuge, ensuring refuge uses maintain a pristine low-impact environment.

The Refuge Manager needs to give priority attention to flood control and water supply needs of adjacent agriculture and urban areas.

Do not renew the A.R.M. Loxahatchee National Wildlife Refuge's contract with the South Florida Water Management District.

The land on which the refuge is located should be managed by the Water Management District as Conservation Area Number One.

### **B. Wildlife Habitat Management**

Manage species and habitats to enhance the biodiversity of the largest remaining part of the northern Everglades.

Reduce and/or eliminate exotic species (e.g., melaleuca, Brazilian pepper, water hyacinth, feral hogs, cattails, and eels) from the refuge.

Protect, manage and restore the habitats of the fish and other aquatic species by appropriately managing the water quality, quantities and schedules.

### **C. Public Use Management**

#### *Hunting Opportunities and Management*

Enhance opportunities to hunt waterfowl.

Provide permit applications to begin in early October.

Allow hunting at sunrise and sunset.

Allow frogs to be hunted during the day and at night.

#### *Fishing Opportunities and Management*

Allow fishing in the south.

Improve bank fishing at headquarters.

Allow nighttime fishing.

### *Birdwatching, Hiking, Camping and Other Opportunities*

Provide more birdwatching opportunities.  
Provide more hiking opportunities.  
Allow limited overnight camping.  
Allow opportunities for stargazing.

### *Horseback and Mountain Biking Opportunities*

Allow horseback riding on levees.  
Allow mountain biking on levees.

### *Canoeing Opportunities and Management*

Enhance canoeing by increasing access.  
Improve maintenance of the canoe trails including the removal of exotics.

### *Airboat Opportunities*

Provide recreational airboat access to more of the refuge.  
Provide public airboat tours.  
Consider private airboat tours.

### *Management at Hillsboro Recreation Area*

Reduce the access charge at Lee road and Hillsboro Recreational Area.  
Provide adequate boat ramps, build a boat dock, and provide public telephones.  
Tear down the store.  
Provide law enforcement on the water as well as on land areas at Hillsboro Recreation Area.

## **D. Environmental Education and Interpretation**

Enhance the current environmental education program by increasing the amount of events that target population niches such as: children and their families, schools, senior citizens, youth camps, and adult education classes.  
Provide more interpreters on the marsh trail.  
Provide more wildlife art exhibits.  
Conduct summer activities and more special events such as a native species zoo.  
Provide more printed interpretive information on the marsh native trail and the cypress boardwalk.  
Provide more tours for the general public, elementary and secondary school population, and youth service organizations such as scouting groups.  
Increase staff (all classifications) and volunteers to provide more educational programs.

## **E. Partnerships and Communications**

Form a local Friends of the National Wildlife Refuge chapter.  
Coordinate planning with other natural resource agencies in Palm Beach County for ecosystem management.  
Prepare a joint stewardship report with the Fish and Wildlife Service, Florida Fish and Wildlife Conservation Commission, and the South Florida Water Management District.  
Create connections between the refuge and hotels, tourist council, recreational sport organizations, and business.  
Work with your excellent group of volunteers to raise funds.  
Engage in ongoing talks between the Refuge Manager and recreational user groups

# Comment Packet and Sheet

## Future Management of A.R.M. Loxahatchee National Wildlife Refuge

The U.S. Fish and Wildlife Service is beginning to develop a comprehensive conservation plan for A.R.M. Loxahatchee National Wildlife Refuge that will guide its future direction. We would like to know the issues and concerns about the refuge that are important to you.

To provide you with information about the refuge and the planning process, the Comment Packet is divided into three sections: Background Information, Comment Sheet, and Mailing Request Form. If you would like to give us your ideas, please complete the Comment Sheet. If you also wish to be on our mailing list for further information, please complete the Mailing Request Form. You may return some or all of the sections to the refuge mailing address found inside or outside the Packet.

### Background Information

#### *National Wildlife Refuge System*

The U.S. Fish and Wildlife Service is the principal Federal agency responsible for conserving, protecting, and enhancing the nation's fish and wildlife and its habitat. As a part of its major responsibility for migratory birds and fish, endangered species, and certain marine mammals, the Service manages the National Wildlife Refuge System. The System began in 1903 when President Theodore Roosevelt designated Pelican Island, a pelican and heron rookery in Florida, as a bird sanctuary.

The System, now consisting of over 520 refuges, is a "network of lands and waters managed 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" (Refuge Improvement Act of 1997). In the management of the System:

- Wildlife has first priority.
- Recreation uses are allowed as long as they are appropriate, wildlife-dependent and compatible with wildlife conservation.
- Wildlife-dependent recreational activities will be emphasized.

Refuge Environment. Established in 1951, Loxahatchee National Wildlife Refuge encompasses 221 square miles of the remaining northern Everglades. Sawgrass marshes, wet prairies, sloughs, and tree islands compose over 90 percent of the area's unique wetlands. The Refuge provides habitat for the snail kite, American alligator, neotropical birds, wading birds, and numerous other threatened and endangered species. The vision for this refuge is:

*To serve as an outstanding showcase for ecosystem management that restores, protects, and enhances a portion of the unique northern Everglades biological community. This public asset provides for the enjoyment and enhanced quality of life for future generations.*

The Refuge's diversity of wildlife species, coupled with the visitor center, provides opportunities for hunting, fishing, wildlife observation, photography, environmental education, and interpretation. Over 116,000 people visit the refuge each year.

#### *Comprehensive Planning*

The Fish and Wildlife Service is beginning to develop a plan to guide the future direction of the refuge over the next 15 years. A planning team, consisting of persons from government agencies and state universities, has been assembled to: gather information about the refuge environment; identify problems affecting the refuge; evaluate the impacts of various management alternatives, and recommend a plan of action to the Fish and Wildlife Service.

In keeping with the National Environmental Policy Act (NEPA), the Fish and Wildlife Service will look at, and seriously consider, all reasonable alternatives in the development of the plan. The planning team will actively seek public input in the preparation of the comprehensive plan. To carry out the project, the Fish and Wildlife Service has begun a six-step planning process:

- Step 1. Gather information on the refuge environment
- Step 2. Hold a public meeting to identify issues and concerns
- Step 3. Identify management alternatives, and evaluate their effects
- Step 4. Prepare and release a draft comprehensive plan and environmental assessment
- Step 5. Hold a public meeting on the draft plan and environmental assessment
- Step 6. Prepare a final comprehensive plan

*Involvement Opportunities*

The U. S. Fish and Wildlife Service is looking for your ideas concerning its future direction. Please give us your ideas at a public meeting on August 17, 1998 at 7:00 p.m. at the Boynton Beach Civic Center. The Center is located at 128 East Ocean Avenue. This meeting will give you an opportunity to:

- Learn more about the refuge
- Express ideas about issues, concerns, and needed management programs
- Share your vision for the refuge.

This packet will be given to everyone who attends the public meeting. If you cannot attend the public meeting, please complete the comment sheet and mail it to: Loxahatchee National Wildlife Refuge, U.S. Fish and Wildlife Service, 10216 Lee Road, Boynton Beach, FL 33437-4796.

The packet provides:

- background information on the refuge, the refuge system, and the planning process
- a way to share your concerns, ideas, and thoughts on refuge management
- an effective way to make certain your thoughts will be taken into consideration

The comment sheet should be returned to the refuge no later than *September 18, 1998*.

**Loxahatchee National Wildlife Refuge**  
*Comment Sheet*

1. What do you VALUE most about the Refuge?

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2. What are your major CONCERNS about: the Refuge, current refuge management, or its future direction?

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3. Listed below are some of the issues concerning the future management of the Refuge.

In developing the new plan, how important are these issues to you? For each issue, circle the number that best reflects its importance.

<i>Issues</i>	<i>Not Important</i>	<i>Important</i>	<i>Very Important</i>	<i>Don't Know/ No Opinion</i>
Protecting wildlife habitat	1	2	3	0
Increasing law enforcement to prevent poaching, vandalism	1	2	3	0
Making the Refuge more accessible to the public	1	2	3	0
Protecting threatened and endangered wildlife	1	2	3	0
Providing opportunities for wildlife viewing or hiking	1	2	3	0
Addressing urban development around the Refuge	1	2	3	0
Conserving native plants and animals	1	2	3	0
Providing more recreational opportunities	1	2	3	0
Addressing agricultural production near the Refuge	1	2	3	0
Protecting the whole biological system	1	2	3	0
Managing specific wildlife for hunting or fishing	1	2	3	0
Working closer with neighboring land owners and business	1	2	3	0
Controlling the spread of exotic or invasive plants	1	2	3	0
Protecting water quality	1	2	3	0
Educating the public about wildlife, & cultural resources	1	2	3	0
Limiting public access if needed to protect wildlife	1	2	3	0

4. Are there other issues of concern to you? (Please identify as many as come to mind)

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5. Have you ever visited the Refuge?  Yes  No

6. Listed below are some of the recreational activities occurring on the Refuge. Please check which activities, if any, you would like to do.

- |   |  |                                  |
|---|--|----------------------------------|
| <input type="checkbox"/> Wildlife Observation                   | <input type="checkbox"/> Photography or Painting | <input type="checkbox"/> Hunting |
| <input type="checkbox"/> Canoeing/kayaking                      | <input type="checkbox"/> Running/Jogging         | <input type="checkbox"/> Hiking  |
| <input type="checkbox"/> Boating                                | <input type="checkbox"/> Fishing                 |                                  |
| <input type="checkbox"/> Interpretation/Environmental Education |  |                                  |

7. What other activities, if any, would you like to do at the Refuge?

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8. What activities, if any, should not be allowed at the Refuge?

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9. Where do you reside most of the year? City/Town \_\_\_\_\_ State \_\_\_\_\_

10. Are you attending the public meeting as member of an organization? \_\_Yes \_\_No  
If yes, what is its name? \_\_\_\_\_

11. Where did you obtain the Comment Sheet? \_\_\_\_\_

*Thank you very much for your comments!*

Please place this sheet in the Comment Box at the public meeting or mail it to: Loxahatchee National Wildlife Refuge, U.S. Fish and Wildlife Service, 10216 Lee Road, Boynton Beach, FL. 33437-4797. Your comments are needed by September 18, 1998.

**Mailing Request Form**

To place your name and address on our mailing list, we must have your written permission. The reason for this is that federal government mailing lists must be released to the public upon request. If you wish to receive future information about the Loxahatchee National Wildlife Refuge Comprehensive Conservation Plan and Environmental Assessment, please complete the information below and return the form to:

Return to:       A.R.M. Loxahatchee National Wildlife Refuge  
                    U.S. Fish and Wildlife Service  
                    10216 Lee Road  
                    Boynton Beach, FL 33437-4796

*Yes, I wish to be on the mailing list to receive future information about the refuge comprehensive plan. I understand that the names and addresses on federal government mailing lists must be released to the public upon request, under the provisions of the Freedom of Information Act of 1974.*

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

First Name: \_\_\_\_\_ Last Name: \_\_\_\_\_

Mailing Address: \_\_\_\_\_  
\_\_\_\_\_

City \_\_\_\_\_ State: \_\_\_\_\_ Zip Code: \_\_\_\_\_

If you are acting in an official capacity as the representative of an organization, please complete the following two items:

Organization: \_\_\_\_\_

Title: \_\_\_\_\_

Note: After you have completed the Comment Sheet and/or Mail Request Form simply fold it in half (with the return mailer on the outside), and tape together. Attach the proper postage and drop it in the mail. Your Comment Sheet must be received by September 18, 1998. Thank you for your help!

## Summary: Comment Sheets

Early on in the process of developing the Conservation Plan, the planning team requested input from the public regarding the future direction of the refuge. The following explains how the information was gathered and analyzed.

### A. Written Comments

Two types of comment sheets were used. A simple, open sheet requesting ideas was developed early in the process while a more complex comment packet was developed by staff members and planning team members from the University of Florida. Comment sheets or packets could be picked up from the refuge headquarters, the visitor center or from law enforcement officers. Comment packets were also sent out with each telephone and mail request. Individual letters were encouraged. The comment period was over three months long to allow as many people as possible to contribute and to insure the public had adequate time to respond.

### B. Analysis of Open Comment Sheets and Complex Comment Packets

The two types of comment sheets and letters were analyzed for content. For statistical analysis, each question was examined as well as responses within each question (if they were multiple). Some respondents did not answer every question, and others gave numerous answers to a single question. Issues and concerns that were received in the open comment sheets and letters were integrated into the analysis. Each issue was counted and analyzed separately. The number of responses to a particular question is listed as 'N'. Please note; the value of 'N' changes with each question because individuals listed issues and concerns or answered questions in multiple ways.

The number of responses to questions ranged from 47 to 795. One hundred and ninety comment sheets and 26 letters/postcards were received for a total of 216.

#### Question 1. What do you value most about the refuge?

<i>Topics</i>	<i>N</i>	<i>Percentage</i>
Wildlife Protection/Observation	133	49.63%
Beauty/Solitude	51	19.03%
Hunt/Fish	8	2.99
Public Access	37	13.80
Everglades Ecosystem	26	9.70
Education	5	1.87
Administration	4	1.49
Other	4	1.49
Total	268	100.00%

All complex comment packets, open sheets, and letters that stated refuge values were used in the analysis of this question. Each value was counted separately, thus, the large N total.

#### Question 2. What are your major concerns about: the refuge, current refuge management, or its future direction?

#### Question 4. Are there other issues of concern to you?

**Appendix I - Summary: Comment Sheets**

<i>Topics</i>	<i>N</i>	<i>Percentage</i>
Protection of Ecosystem/Wildlife	97	19.96%
Limit Access	48	9.88%
Increase Access	25	5.14
Development	46	9.47
Management of Habitat	33	6.79
Management/Ownership	58	11.93
Water Issues	21	4.32
Hunting/Fishing	31	6.38
Motorized Vehicles	39	8.02
Maintenance	33	6.79
Exotics/Pollution	34	7.00
Other	21	4.32
Total	486	100.00%

All complex comment packet sheets, open comment sheets and letters with concerns were analyzed for question two. Only complex comment packet sheets were used in question four as any other concern from letters and open comment sheets were already used in question two. Question two and four were analyzed together as the questions were very similar in meaning. Each concern was counted separately.

**Question 3. Listed below are some of the issues concerning the future management of the refuge. In developing the new plan, how important are these issues to you? For each issue, circle the number that best reflects its importance.**

<i>Issues</i>	<i>N</i>	<i>Not Important</i>	<i>Important</i>	<i>Very Important</i>	<i>Don't Know/ No Opinion</i>
Protecting wildlife habitat	155	0.65%	7.10%	92.26%	0%
Increasing law enforcement to prevent poaching, vandalism	153	8.50%	28.76%	54.90%	7.84%
Making the refuge more accessible to the public	151	43.71%	30.46%	24.50%	1.32%
Protecting threatened and endangered wildlife	152	1.32%	11.18%	87.50%	0%
Providing opportunities for wildlife viewing or hiking	152	15.13%	49.34%	34.87%	0.66%
Addressing urban development around the refuge	150	4.00%	18.00%	77.33%	0.67%
Conserving native plants and animals	153	1.96%	13.07%	84.97%	0%
Providing more recreational opportunities	154	62.99%	22.08%	14.94%	0%
Addressing agricultural production near the refuge	150	4.67%	39.33%	54.67%	1.33%
Protecting the whole biological system	151	0.66%	12.58%	86.75%	0%
Managing specific wildlife for hunting and fishing	151	53.64%	20.53%	23.18%	2.65%
Working closer with neighboring land owners and business	147	9.52%	53.74%	31.97%	4.76%
Controlling the spread of exotic or invasive plants	153	1.96%	18.95%	79.08%	0%
Protecting water quality	153	1.31%	10.46%	88.24%	0%
Educating the public about wildlife, & cultural resources	154	3.90%	44.16%	51.95%	0%
Limiting public access if needed to protect wildlife	149	6.71%	23.49%	69.13%	0.67%

**Question 4. (included in Question 2)**

**Question 5. Have you ever visited the refuge?**

N=216, Yes = 90.74% No = 2.78% Unknown = 6.48%.

*All comment sheets and letters were used. If no reference was made in letters or in open comment sheets or the question was unanswered this was analyzed as unknown.*

**Question 6. Listed below are some of the recreational activities occurring on the refuge. Please check which activities, if any, you would like to do.**

**Question 7. What other activities, if any, would you like to do at the refuge?**

Activities (Question 6)	N	Percentage
Wildlife Observation (Question 6)	178	22.39%
Canoeing/Kayaking (Question 6)	83	10.44%
Boating (Motorized) (Question 6)	31	3.90%
Interpretation/Environmental	119	14.97%
<b>Education (Question 6)</b>		
Photography or Paining (Question 6)	104	13.08%
Running/Jogging (Question 6)	14	1.76%
Fishing (Question 6)	58	7.29%
Hunting (Question 6)	31	3.90%
Hiking (Question 6)	113	14.21%
<b>Activities (Question 7)</b>		
Other (Question 7)	30	3.77%
Biking (Question 7)	12	1.51%
Expanded Canoeing (Question 7)	1	0.13%
Frogging (Question 7)	8	1.01%
Airboating (Question 7)	10	1.26%
Horseback Riding (Question 7)	3	0.38%
<i>Total (Q6 &amp; Q7)</i>	<i>795</i>	<i>100.00%</i>

All packet and open comment sheets, plus letters stating any activities enjoyed on the Refuge were used to answer the above questions. If answers in Question 7, were the same category as in Question 6, they were integrated and analyzed as Question 6. If answers in Question 7 were something else than categories already listed in Question 6, they were analyzed separately and are listed as such. There were some (N =30) answers that did not fit into any of these categories, they are listed as Other. Note: the large N value is because of the many different answers most people gave for this question.

**Question 8. What activities, if any, should not be allowed at the refuge?**

Activities	N	Percentage
Airboat	44	13.66%
Motorized boats	52	16.15%
Hunting	63	19.57%
Fishing	10	3.10%
Land vehicles	31	9.63%
New activities	11	3.42%
Camping	16	4.97%
Commercialization	14	4.35%
Picnicking	10	3.10%
Biking	13	4.04%
Horseback riding	8	2.48%
Canoe/kayak	2	0.62%
Hiking/run	3	0.93%
Anything harmful to the environment	29	9.01%
Other	16	4.97%
Total	322	100.00%

All complex comment packet sheets, open comment sheets, and letters were used. Each activity listed by individuals was counted separately, thus the high N value.

**Question 9 Where do you reside most of the year?**

City/Town	N	Percentage
Unknown	9	4.17%
Boca	22	10.19%
Boynton	30	13.89%
Coconut Creek	2	0.93%
Deerfield	6	2.78%
Delray	25	11.57%
Ft. Lauderdale	16	7.40%
Greenacres	4	1.85%
Juno	2	0.93%
Jupiter	2	0.93%
Lantana	10	4.63%
Lake Park	2	0.93%
Lake Worth	25	11.57%
Loxahatchee	6	2.78%
Margate	3	1.39%
Miami	3	1.39%
Ocean Ridge	1	0.46%
Palm Beach Gardens	1	0.46%
Pompano	4	1.85%
Royal Palm Beach	4	1.85%

**Appendix I - Summary: Comment Sheets**

Stuart	2	0.93%
Tallahassee	1	0.46%
Tequesta	1	0.46%
Wellington	1	0.46%
North Palm Beach	1	0.46%
West Palm Beach	22	10.19%
Other (including other States)	11	5.09%
<i>Total</i>	<i>216</i>	<i>100.00%</i>

All complex comment packet sheets, open comment sheets, and all letters were used in the analysis of the above question. Only one address counted for each comment sheet or letter, therefore, the N equals the exact amount of responses.

**Question 10. Are you attending the public meeting as member of an organization?  
Yes/No If yes, what is its name?**

N = 216      Yes = 21.76%      No = 43.98%      Unknown = 34.26%

<b>Organization</b>	<b>N</b>	<b>Percentage</b>
Airboat & Halftrack Conservation Club	2	4.26%
Audubon Society	9	19.14%
Coalition for Wilderness Islands	1	2.13%
Concerned Citizen	1	2.13%
Ducks Unlimited	1	2.13%
FL Consumer Action Network	1	2.13%
FL Outdoor Writers Association	1	2.13%
FL Sportsman Conservation Association	3	6.38%
FL Trail Association	3	6.38%
Gator Bass Masters	1	2.13%
Lake Worth Drainage District	1	2.13%
A.R.M. Loxahatchee NWR Refuge	3	6.38%
Loxahatchee Groves Landowners Association	1	2.13%
Loxahatchee Natural History Association	7	14.89%
Nature & Heritage Tourism Association	3	6.38%
Palm Beach College Environmental Coalition	2	4.26%
Sierra Club	4	8.50%
Storm Boats	1	2.13%
Other	2	4.26%
<i>Total</i>	<i>47</i>	<i>100.00%</i>

All complex comment packet sheets, open comment sheets, and letters were used in Question 10 analysis. Not all responses were associated with the August 17, scoping meeting (where some people acquired the complex comment packet sheets). Open comment sheets were given out before the scoping meeting and letters were usually in response to newspaper articles about the refuge Comprehensive Conservation Plan.

**Question 11. Where did you obtain the comment sheet?**

<b>Options</b>	<b>N</b>	<b>Percentage</b>
Scoping Meeting	32	16.75%
Audubon Society	8	4.19%
Friend	20	10.47%
Mail	32	16.75%
Native Plant Society	1	0.53%
Palm Beach College Environmental Coalition	7	3.66%
Sierra Club	1	0.53%
Visitor Center/ A.R.M. Loxahatchee NWR	76	39.79%
Other	3	1.57%
Unknown/Unanswered	11	5.76%
<i>Total</i>	<i>191</i>	<i>100.00%</i>

Only complex comment packet sheets and open comment sheets were used in the analysis since the question refers to obtaining a comment sheet. Additionally, 25 letters were also received, but not included in this question.

## *Public Issues Addressed but Not Allowed or are Pending*

### **Frog Gigging Impacts**

The following reasons outline why frog gigging was not included in the Draft Comprehensive Conservation Plan or Environmental Assessment.

Frog gigging, requested by some of the public comments, uses a spotlight, a spear, and an airboat. It is considered a traditional recreational use in the Everglades, and in the past was allowed in the refuge. According to historical narratives written by refuge staff, the numbers of pig frogs (*Rana grylio*), commonly known as “bull frogs” dwindled significantly under commercially driven hunting pressures in the 1950s.

Frogs are an important link in the food web of the Everglades traditionally poor nutrient system. The loss of frogs and associated tadpoles from the refuge interior would be considered significant and negatively impact wildlife which depend upon them for prey. Research has shown a wide spread of age classes in the refuge alligator population and the population appears to be healthier than in other areas of the Everglades ecosystem. This may be due in part to an abundant food supply (frogs and tadpoles) for these animals, in comparison to other areas of the ecosystem where gigging is allowed.

The use of spotlights and night airboat activity disrupts wildlife in the refuge interior during their normal night-time activities, such as resting or catching prey. At a minimum, the animals that would be impacted by the disruption associated with this activity include alligators, night herons (a species of concern), bats, and owls.

If gigging were allowed in a specific area of the refuge interior, the ability of refuge officers to enforce the regulations containing giggers to an area are poor. Because the refuge interior is large (approximately 150,000 acres) and airboats allow access to any and all portions of the refuge interior, there would be little ability to contain hunters in specific hunt areas. In Big Cypress National Preserve Management Plan, the inability to regulate airboaters to restricted areas was noted.

### **Airboat Impacts**

Refuge staff initially considered, under the Public Use Alternative, allowing the public to use airboats within a designated area of the refuge on a seasonal basis. However, due to incompatible impacts of noise, disturbance, and habitat loss from the creation of airboat trails this use was withdrawn from consideration. Furthermore, the Service is reviewing the use of airboats and jet skis nationwide for consistency throughout the National Wildlife Refuge System.

As more and more land is lost to development in south Florida, increasing pressure is put on tracts set aside as “natural lands” from both wildlife populations and from humans seeking recreation. The increasing numbers of people and the increasing popularity of airboating, and outdoor activities in general, have resulted in more human-related disturbances to wildlife

“natural areas.” As natural area managers respond to these threats of disturbance to resident, migratory, and wintering wildlife, more and more areas are being protected from the possibility of human disturbances (Rodgers and Smith, 1995). Some land managers are prohibiting the use of swamp buggies and airboats because of disturbance factors. As indicated below, airboats can impact the environment that visitors come to enjoy (noise factors), the substrates upon which they operate (soil, water and vegetation), and the wildlife near their operation.

Described below is the pertinent research regarding the positive and negative impacts of airboats on the environment. These impacts were identified by south Florida biologists from the National Audubon Society, South Florida Water Management District, Everglades National Park, Fish and Wildlife, and the Florida Fish and Wildlife Conservation Commission. Airboats impact vegetation by promoting the breakdown of organic matter, adding habitat diversity, and creating pathways for invasion of exotic plants. Airboats impact fauna by: creating a means of fish dispersal; destroying apple snail eggs; colliding with and striking birds, alligators and other animals; displacing foraging birds; and creating noise disturbance. Also, airboat trails result in unnatural water movement and these trails can act as fire breaks (Johnston 1983).

### *Noise*

Studies have shown airboats can generate noise in excess of 120 dB when accelerating, 86dB to 92dB while cruising three meters from a sound meter, and 63 dB to 75dB while cruising 100 meters from a sound meter. In comparison, noise generated by airboats would be above acceptable noise levels for cars and motorcycles but probably be within the limit allowed for large trucks on a roadway (Florida Vehicle Noise Prevention and Control Act of 1974, Section 316.293). The position of airboat engines and propellers high above the water surface and most vegetation, causes noise from these sources to travel much farther than noise from other types of off-road-vehicles, including outboard motorboats (Duever et. al.,1981). In the refuge, airboat engines can be heard at least one to two miles away from the noise source.

In another study, detectable off-road-vehicle noise was determined to be generally unacceptable to persons who desired a wilderness experience (Harrison 1974a, 1974b). It was recognized in these studies; when airboats are in an area there is no acceptable ‘natural quiet’ Airboats have the unique ability to bring a substantial amount of noise to some of the quietest areas remaining in South Florida.

The refuge is not an area where hearing vehicle noise is considered the norm, rather it is a place set aside because of its unique biological resources. It is managed for the protection of wildlife while allowing quality, compatible, wildlife-dependent recreational opportunities for visitors in a manner that does not negatively impact wildlife population levels or the natural diversity of the area.

## *Vegetation*

### *General Information:*

Many, if not all, types of plant communities can be negatively impacted by airboat operation. Continuous airboat operation through the edge of sawgrass and wet prairies damages both emergent vegetation (e.g., spike rush, maidencane, and white water lily) and submergent vegetation (e.g., bladderwort and periphyton). Continuous operation of airboats through sawgrass eventually causes the sawgrass to die and results in the formation of trails. Anecdotal evidence supports the notion that airboats can remove vegetation and in fact are used in frog-gigging to open up vegetation.

Commonly used airboat trails in the Water Conservation Areas 2, 3, and in the refuge interior remain open with use. As noted in the Big Cypress National Preserve Management Plan, the greater the numbers of airboats and airboat users, the greater the number of airboat trails (Department of the Interior, National Park Service, 1999). Conversations with recreational airboat operators confirm that they, like many airboat drivers, like to explore areas other than an established trail. This tendency to create yet another trail impacts more vegetation and wildlife. Aerial photos and infrared imagery of Water Conservation Areas 2 and 3 shows the number of trails (both new and old trails) created by and maintained by airboats through the vegetation. A comparison between the refuge and these Water Conservation Areas shows differences between a relatively pristine marsh and an airboat-impacted marsh.

Studies by Duever et.al., 1981 and the Department of the Interior 1999, showed airboats directly affect vegetation by: breaking or crushing plants (as they are run over); defoliation due to high wind energy (created by the propeller); and soil erosion (due to the energy of the wake being higher than the surrounding vegetation, especially during low water conditions). It has also been reported that airboats traveling at high speeds caused greater damage to vegetation than did slower traveling airboats.

### *Epiphytes and Periphyton:*

Leaf loss and epiphytic plant displacement occurs from airboat propeller wind. There are a number of listed epiphytes growing in the refuge. The loss of leaves on tree islands can cause the remaining epiphytes to be exposed to greater amounts of light than is optimal (Department of the Interior 1999). Woody plants such as wax myrtle and willow are more severely impacted by moderate airboat use than other shrubby plants are.

Airboats damage periphyton by disrupting and displacing the algal mats, especially in wet prairies (Duever et al., 1981, 1986). Although periphyton looks different in the refuge compared to the rest of the Everglades, it is the critical base of the Everglades food web.

An airboat impact study, begun on the refuge in 1983, by a Service biologist, identified that airboat operation in sawgrass causes a reduction in stem densities and could result in permanent trails in the marsh. These trails can change drainage patterns. It was the opinion of the refuge staff in the 1980s, that airboat operation in wet prairies (to avoid damaging more dense vegetation) will also cause reduction in stem density, specifically in beak and spike rushes. Operation of airboats within the refuge inevitably results in apple snail egg clusters being destroyed, possibly to the detriment of the apple snail population and to some of the listed species (limpkin, snail kite, and alligator) dependent upon the snails.

The channels created by airboat usage could allow high nutrient water and exotic floating plants into the relatively pristine refuge interior. If any number of trails are created into the refuge interior via airboat use, water quality would deteriorate and cattail growth would proliferate in these areas as long as high levels of nutrients are in the canal waters.

### *Exotics*

It is a known fact that motorboats and boat trailers carry exotic plants into different waterways, including the refuge. Airboats used in other areas would contribute to this transference. Additionally, airboat use near invasive exotics like melaleuca and Old World climbing fern could contribute to the spread of seeds or spores. These plant's microscopic seeds and spores would be easily blown to new germination sites (tree islands, floating peat islands) by the forceful winds generated by the airboat propeller. During periods of low water in the refuge, peat in wet prairies and in well traveled airboat trails tend to "float to the surface" and potentially become fertile seed beds for exotic plants. Limiting the areas of exposed peat will reduce the potential for exotic plant establishment.

### *Wildlife*

Documentation of human disturbance on wildlife has been conducted by many researchers. A 14-foot airboat (operating at 95-105 dB) approaching colonial waterbirds will cause behavior disruption at a greater distance than an approach on foot, canoe, or by a 14-foot johnboat (operating at 80-85 dB). Research has also shown that a minimum non-approach distance should be 300 meters in an airboat for nesting, roosting, and foraging waterbirds (Rodgers and Smith 1995).

Secretive birds, especially listed species such as the bitterns and rails breeding and wintering in the transition area between the wet prairies, sloughs, and sawgrass are negatively impacted by airboat disturbance and habitat damage. Additional species of wildlife using wet prairies, sloughs, and sawgrass marshes may be run over, disrupted, or may be forced to abandon their habitat due to numerous disruptions.

In another study, visual disturbances from the presence of an airboat were found to occur with the sporadic but repeated operation through an area that is a primary foraging or roosting site. This disruption can cause the animals to relocate to a less desirable site. If the disturbed area is one of the few that is available at the time or is a prime location, the disturbance may adversely impact the species. Direct impacts to wildlife caused by airboat collisions include adult and fledgling birds, alligators, snail egg clusters, and bird nests. The severity of these impacts on the species is not known as no known study has addressed this issue (Johnston 1983).

From December to June the refuge has low water and it is also the nesting season for a wide variety of wading birds and the endangered Florida snail kite. In the past, refuge staff observed anglers fishing at wading bird colony islands. The islands are usually surrounded by deeper water which is where the fish have taken refuge. Fishing at such locations has caused significant disturbance to the nesting wading birds, eggs, and/or chicks. Since these airboats were observed tied or anchored within a few feet of nests, it is likely that eggs and nestlings were dislodged from nests as a result of this activity. In at least one instance, an airboat was driven through a colony, causing the colony to be abandoned. Thousands of wading birds, most of which are in decline, nest in the refuge.

A study on energy depletion in wildlife notes, disruption of normal activities in wildlife is considered a disturbance. This disturbance has negative effects on the energy and nutrient budgets and the disturbance contributes to the potential decline of an individual (Bromley 1985). Adverse affects of environmental disruptions (e.g., motorboat, airboat, off-road recreational vehicles) including flight, avoidance, or interference with movement uses up energy that could be used for reproduction and growth. If animals are not able to adjust to the additional energy outlay caused by the disturbance: survival, reproduction, and growth may be negatively affected (Department of the Interior, National Park Service, Crocodile Study).

Some studies have found that some wildlife can adapt to environmental disruptions and learn to limit their energy expenditure in relation to human recreational activity. However, types of harassing activity which cause alarm and the expenditure of avoidance energy include: 1) unfamiliar or unpredictable behavior, 2) quick movements, sudden noises, loud noises and 3) close and direct approach. It was found that if the harassing activity was constant, the animal would become adapted to it and learn to adjust to the threat or permanently leave the area for other habitat. However, the animal may end up in less quality habitat than what it gave up and potentially suffer less reproductive success or a lower survival rate. An occasional disturbance caused by an airboat could constitute a harassing activity and would elicit an alarm response from most wildlife. Avoidance behavior involves moving to another location or defiance activities. This energy expenditure would be detrimental to wildlife over time (Department of the Interior, National Park Service, Crocodile Study).

It should be noted that a low nutrient system such as the northern Everglades will not provide as productive foraging opportunities or as large prey as estuarine habitats, mangroves, coastal shores, or high-nutrient fresh water marshes. Thus the disturbance factor associated with unlimited airboating should be weighed more heavily in all Water Conservation Areas, including the refuge, as the disturbance to wildlife may carry a higher energetic cost than in more productive areas.

#### *Water Quality*

In another study, concentrated airboat usage has been found to negatively affect water quality. Airboats create water channels as a result of energy generated by airboat wakes and hull displacement, and in areas of constant use, the channel effect is magnified (Department of the Interior, National Park Service, 1999). A dye trace study determined water flows are accelerated in airboat trails (Pernas et al., 1995).

Airboat operation increases soil and organic particulate suspension. A turbidity study revealed higher turbidity during periods of airboat traffic, especially in association with low water levels (Weeks 1989). The resultant turbidity reduces the potential growth of vegetation and periphyton and may cause fish and aquatic plant mortality (Department of the Interior, National Park Service, 1999).

#### *Soils*

Other studies have shown soil erosion can be caused by the energy of the airboat wake (Department of the Interior, National Park Service, 1999). Hull displacement and boat weight can cause peat compaction, and concentrated use of airboats in trails can loosen soil and organic particles and eliminate vegetative regrowth. As the suspended particles wash out of the trail, the trail becomes deeper and deeper thus inhibiting vegetative recruitment. During the dry season, the loss of vegetative cover allows the water temperature in the trail to become 6-10 degrees higher than surrounding surface water, adjacent soils and vegetation (Schemnitz and Schortemeyer 1972).

#### *Other Areas to Airboat*

There are number of opportunities available to people wishing to experience airboating. Opportunities for private airboating or ORV use include hundreds of thousands of acres in: Water Conservation Areas 2 and 3; Lake Okeechobee; Big Cypress National Preserve; a portion of Everglades National Park; Holey Land, as well as J.W. Corbett, Rotenberger and Cecil M. Webb State Wildlife Management Areas and other local marshes. Also, numerous areas to the north and south of the refuge offer public airboat rides. Because these other areas are open to airboating, prohibiting recreational airboating on the refuge would not significantly restrict the public's ability to find airboat access.

## Horseback Riding

In response to comments expressed during the public scoping process, refuge staff took a close look at the feasibility of allowing horseback riding on a portion of the levee. National wildlife refuges are special places set aside specifically for the conservation of our Nation's wildlife resources. The National Wildlife Refuge System Administration Act of 1966, amended by the National Wildlife Refuge System Improvement Act of 1997, requires the Service to first manage for wildlife conservation and second, when compatible, facilitate wildlife-dependent recreational uses; i.e., hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation. Wildlife-dependent recreational uses are dependent upon healthy populations of wildlife and, therefore, are directly related to the refuge system mission and most refuge purposes. Wildlife-dependent recreational uses have a legitimate, appropriate, and recognized association with national wildlife refuges; the same cannot be said of other forms of recreational activities. National wildlife refuges are not multiple-use public lands and cannot be all things to all people.

Some recreational activities, while wholesome and enjoyable, are not dependent on the presence of wildlife, nor dependent on the expectation of encountering wildlife. These non-wildlife-dependent recreational activities are more appropriately conducted on private lands or other public lands not specifically dedicated for wildlife conservation. Horseback riding on the refuge would primarily be recreational in nature and would not support one of the six priority uses. Several opportunities exist in the form of riding trails adjacent to the refuge as well as throughout the county.

Safety, resource threats, and parking also pose concerns. Because of the narrow width of the perimeter levee (16 feet at the top), it is not suited to support the three major user groups at the same time and, in fact, could pose a safety hazard. In addition, the eastern side is the only area that provides the most direct access to the refuge. However, because of existing hiking or bicycle use on sections of the east side, as well as safety concerns at the northernmost section of the L-40 levee (construction of Storm Water Treatment Area 1E and very steep levee slopes), the only area that could be reasonably studied is around the ACME District pump stations.

Impacts to the resource were also considered. The possible negative effects of cowbirds on certain resident birds would need to be considered. Because cowbirds eat undigested grain in horse "patties" and lay their eggs in nests of other birds during the breeding season, they have the potential to undermine the reproductive efforts of resident songbirds.

Another negative effect of horse use is the possible spread of exotic plants. This may happen in two ways. Exotic and invasive plant seeds may be deposited on the refuge levee from horse "patties." Conversely, plants and seeds eaten by horses while on the levee may be deposited off the refuge. The only alternative to reduce these impacts would be to require that all horses accessing the refuge wear diapers, an apparatus worn by horses used for carriage tours, in order to keep "patties" off the levee and keep invasive and exotic plants from being deposited on the refuge. However, in discussions with knowledgeable horse owners, it is difficult to get a trail horse to use this type of apparatus.

Another limiting factor was trailer parking for equestrians bringing their horses in from a distance. Refuge property at each ACME District pump station location would provide only limited parking and would best serve as a loading/unloading area. Parking would have to be provided off refuge. Presently, each area is accessed by only a two-lane, dirt road. The potential exists, at any given time, for a large number of users (35-50 vehicles) to access the refuge just for hiking, fishing, or wildlife observation. The refuge would have to partner with the Village of Wellington to provide parking space. When a refuge considers the opening of a recreational use, it must allow for users from the local area as well as the Nation. The refuge cannot open up a section of the levee just for the immediate surrounding area. In addition, impacts to existing users must be considered. Information concerning public uses, listed on refuge brochures and on the Internet, is available to persons worldwide. Therefore, reasonable expectations of access, parking, and a quality wildlife experience should be expected.



*Flora & Fauna***Table 20. Fauna of A.R.M. Loxahatchee National Wildlife Refuge (Exclusive of Birds)**

*This is a partial list of faunal species found on the refuge which have been documented and verified by refuge biologists. Exotic species are designated by the \* symbol.*

<i>Group</i>	<i>Scientific Name</i>	<i>Common Name</i>
<b>MAMMALS</b>		
	<i>Didelphis virginiana</i>	Opossum
	<i>Tadarida brasiliensis</i>	Mexican Free-tailed Bat
	<i>Procyon lotor</i>	Raccoon
	<i>Lutra canadensis</i>	River Otter
	<i>Urocyon cinereoargenteus</i>	Gray Fox
	<i>Lynx rufus</i>	Bobcat
	<i>Sciurus carolinensis</i>	Eastern Gray Squirrel
	<i>Peromyscus gossypinus</i>	Cotton Mouse
	<i>Oryzomys palustris</i>	Marsh Rice Rat
	<i>Sigmodon hispidus</i>	Hispid Cotton Rat
	<i>Neofiber alleni</i>	Round-tailed Muskrat
	<i>Rattus rattus</i>	Black Rat*
	<i>Mus musculus</i>	House Mouse*
	<i>Rattus norvegicus</i>	Norway Rat*
	<i>Sylvilagus floridanus</i>	Eastern Cottontail
	<i>Sylvilagus palustris</i>	Marsh Rabbit
	<i>Odocoileus virginianus</i>	White-tailed Deer
	<i>Dasyopus novemcinctus</i>	Nine-banded Armadillo*
	<i>Sus scrofa</i>	Feral Hog*
	<i>Canis familiaris</i>	Feral Dog*
	<i>Felis domesticus</i>	Feral Cat*
	<i>Felis jaguarundi</i>	Jaguarundi*
	<i>Vulpes vulpes</i>	Red Fox*
<b>REPTILES</b>		
Crocodylians:	<i>Alligator mississippiensis</i>	American Alligator
Turtles:	<i>Chelydra serpentina osceola</i>	Florida Snapping Turtle
	<i>Sternotherus odoratus</i>	Stinkpot (Common Musk Turtle)
	<i>Kinosternon subrubrum steindachneri</i>	Florida Mud Turtle
	<i>Kinosternon baurii</i>	Striped Mud Turtle
	<i>Terrapene carolina bauri</i>	Florida Box Turtle
	<i>Pseudemys floridana peninsularis</i>	Peninsula Cooter
	<i>Pseudemys nelsoni</i>	Florida Redbelly Turtle
	<i>Gopherus polyphemus</i>	Gopher Tortoise
	<i>Apalone ferox</i>	Florida Softshell
	<i>Kinixys homeana</i>	Home's Hinge-back Tortoise*

<i>Group</i>	<i>Scientific Name</i>	<i>Common Name</i>
Lizards:	<i>Hemidactylus garnotii</i>	Indo-Pacific Gecko*
	<i>Anolis carolinensis</i>	Green Anole
	<i>Anolis sagrei sagrei</i>	Cuban Brown Anole*
	<i>Cnemidophorus sexlineatus sexlineatus</i>	Six-lined Racerunner
	<i>Scincella lateralis</i>	Ground Skink
	<i>Eumeces inexpectatus</i>	Southeastern Five-lined Skink
	<i>Ophisaurus ventralis</i>	Eastern Glass Lizard
	<i>Ophisaurus compressus</i>	Island Glass Lizard
	<i>Leiocephalus carinatus</i>	Northern Curly-tailed Lizard*
	<i>Iguana iguana</i>	Green Iguana*
	Monitor Lizard spp.*	
Snakes:	<i>Nerodia cyclopion floridana</i>	Florida Green Water Snake
	<i>Nerodia taxispilota</i>	Brown Water Snake
	<i>Nerodia fasciata pictiventris</i>	Florida Banded Water Snake
	<i>Regina alleni</i>	Striped Crayfish Snake
	<i>Seminatrix pygaea cyclas</i>	South Florida Swamp Snake
	<i>Storeria dekayi vieta</i>	Florida Brown Snake
	<i>Thamnophis sirtalis sirtalis</i>	Eastern Garter Snake
	<i>Thamnophis sauritus sackeni</i>	Peninsula Ribbon Snake
	<i>Diadophis punctatus punctatus</i>	Southern Ringneck Snake
	<i>Farancia abacura abacura</i>	Eastern Mud Snake
	<i>Coluber constrictor priapus</i>	Southern Black Racer
	<i>Coluber constrictor paludicola</i>	Everglades Racer
	<i>Opheodrys aestivus</i>	Rough Green Snake
	<i>Drymarchon corais couperi</i>	Eastern Indigo Snake
	<i>Elaphe guttata guttata</i>	Corn Snake (Red Rat Snake)
	<i>Elaphe obsoleta quadrivittata</i>	Yellow Rat Snake (Chicken Snake)
	<i>Elaphe obsoleta rossalleni</i>	Everglades Rat Snake
	<i>Lampropeltis triangulum elapsoides</i>	Scarlet Kingsnake
	<i>Micrurus fulvius fulvius</i>	Eastern Coral Snake
	<i>Agkistrodon piscivorus conanti</i>	Florida Cottonmouth
	<i>Sistrurus miliarius barbouri</i>	Dusky Pygmy Rattlesnake
	<i>Crotalus adamanteus</i>	Eastern Diamondback Rattlesnake
	<i>Boa constrictor</i>	Boa Constrictor*Ball Python*

**Appendix K - Flora & Fauna**

<i>Group</i>	<i>Scientific Name</i>	<i>Common Name</i>
<b>AMPHIBIANS</b>		
Salamanders:	<i>Amphiuma means</i>	Two-toed Amphiuma (Congo Eel)
	<i>Siren lacertina</i>	Greater Siren
	<i>Pseudobranchius striatus belli</i>	Everglades Dwarf Siren
	<i>Notophthalmus viridescens piaropicola</i>	Peninsula Newt
Frogs & Toads:	<i>Eleutherodactylus planirostris planirostris</i>	Greenhouse Frog *
	<i>Bufo terrestris</i>	Southern Toad
	<i>Bufo quercicus</i>	Oak Toad
	<i>Bufo marinus</i>	Giant Marine Toad*
	<i>Acris gryllus dorsalis</i>	Florida Cricket Frog
	<i>Hyla cinerea</i>	Green Treefrog
	<i>Hyla squirella</i>	Squirrel Treefrog
	<i>Osteopilus septentrionalis</i>	Cuban Treefrog*
	<i>Limnaoedus ocularis</i>	Little Grass Frog
	<i>Rana grylio</i>	Pig Frog
	<i>Rana sphenoccephala</i>	Southern Leopard Frog
<b>INSECTS</b>		
Butterflies: Swallowtails	<i>Papilio polyxenes</i>	Black Swallowtail
	<i>Papilio cresphontes</i>	Giant Swallowtail
	<i>Papilio palmedes</i>	Palamedes Swallowtail
Whites	<i>Appias drusilla</i>	Florida White
	<i>Pontia protodice</i>	Checkered White
	<i>Ascia monuste</i>	Great Southern White
Sulphurs	<i>Phoebis sennae eubule</i>	Cloudless Sulphur
	<i>Phoebis philea</i>	Orange-barred Sulfur
	<i>Eurema nicippe</i>	Sleepy Orange Sulfur
	<i>Nathalis iole</i>	Dainty Sulfur
	<i>Eurema lisa</i>	Little Yellow
Blues	<i>Leptotes cassius</i>	Cassius Blue
Hairstreaks	<i>Strymon melinus</i>	Gray Hairstreak
	<i>Calycopis cecrops</i>	Red-banded Hairstreak
Brushfoots	<i>Agraulis vanillae nigrior</i>	Gulf Fritillary
	<i>Dryas iulia</i>	Julia
	<i>Heliconius charitonius</i>	Zebra (Zebra Longwing)
	<i>Phyciodes phaon</i>	Phaon Crescent
	<i>Phyciodes tharos</i>	Pearl Crescent
	<i>Vanessa atalanta</i>	Red Admiral
	<i>Junonia coenia</i>	Common Buckeye
	<i>Anartia jatrophae guantanamo</i>	White Peacock

**Appendix K - Flora & Fauna**

	<i>Scientific Name</i>	<i>Common Name</i>
Brushfoots (continued)	<i>Siproeta stelenes</i>	Malachite
	<i>Limenitis archippus floridensis</i>	Viceroy
	<i>Marpesia petreus</i>	Ruddy Daggerwing
Milkweed Butterflies	<i>Danaus plexippus</i>	Monarch
	<i>Danaus gilippus</i>	Queen
	<i>Danaus eresimus</i>	Soldier
Spreadwinged Skippers	<i>Urbanus proteus</i>	Long-tailed Skipper
	<i>Urbanus dorantes</i>	Dorantes Longtail
	<i>Pyrgus oileus</i>	Tropical Checkered
Grass Skippers	<i>Copaeodes minimus</i>	Southern Skipperling
	<i>Ancyloxypha numitor</i>	Least Skipper
	<i>Hylephila phyleus</i>	Fiery Skipper
	<i>Polites vibex</i>	Whirlabout
	<i>Anatrytone logan</i>	Delaware Skipper
	<i>Lerodea eufala</i>	Eufala Skipper
	<i>Asbolis capucinus</i>	Monk Skipper
	<i>Oligoria maculata</i>	Twin-spot Skipper
<b>DRAGONFLIES</b>		
Darners - Aeshnidae	<i>Anax junius</i>	Common Green Darner
	<i>Coryphaeschna adnexa</i>	Blue-faced Darner
	<i>Coryphaeschna ingens</i>	Regal Darner
	<i>Gynacantha nervosa</i>	Twilight Darner
	<i>Nasiaeschna pentacantha</i>	Cyrano Darner
Emeralds - Corduliidae	<i>Epitheca stella</i>	Florida Baskettail
	<i>Brachymesia gravida</i>	Four-spotted Pennant
Skimmers - Libellulidae	<i>Celithemis eponina</i>	Halloween Pennant
	<i>Crocothemis servilia</i>	Scarlet Skimmer
	<i>Erythemis plebeja</i>	Black Pondhawk
	<i>Erythemis simplicicollis</i>	Eastern Pondhawk
	<i>Erythemis vesiculosa</i>	Great Pondhawk
	<i>Erythrodiplax connata minuscula</i>	Blue Dragonlet
	<i>Erythrodiplax umbrata</i>	Band-winged Dragonlet
	<i>Libellula exusta deplanata</i>	Corporal Skimmer
	<i>Libellula needhami</i>	Needham's Skimmer
	<i>Miathyria marcella</i>	Greater Hyacinth Glider
	<i>Orthemis ferruginea</i>	Roseate Skimmer
	<i>Pachydiplax longipennis</i>	Blue Dasher
	<i>Pantala flavescens</i>	Wandering Glider
	<i>Tramea abdominalis</i>	Vermillion Glider
	<i>Tramea carolina</i>	Violet-masked Glider
<i>Tramea lacerata</i>	Black-mantled Glider	

<i>Group</i>	<i>Scientific Name</i>	<i>Common Name</i>
FISH		
	<i>Scientific Name</i>	<i>Common Name</i>
	<i>Lepisosteus osseus</i>	Longnose Gar
	<i>Lepisosteus platyrhincus</i>	Florida Gar
	<i>Amia calva</i>	Bowfin
	<i>Anguilla rostrata</i>	American Eel
	<i>Dorosoma cepedianum</i>	Gizzard Shad
	<i>Dorosoma petenense</i>	Threadfin Shad
	<i>Esox americanus</i>	Redfin Pickerel
	<i>Esox niger</i>	Chain Pickerel
	<i>Notemigonus crysoleucas</i>	Golden Shiner
	<i>Opsopoeodus emiliae</i>	Pugnose Minnow
	<i>Notropis petersoni</i>	Coastal Shiner
	<i>Notropis maculatus</i>	Taillight Shiner
	<i>Erimyzon sucetta</i>	Lake Chubsucker
	<i>Ictalurus punctatus</i>	Channel Catfish
	<i>Ameiurus catus</i>	White Catfish
	<i>Ameiurus natalis</i>	Yellow Bullhead
	<i>Ameiurus nebulosus</i>	Brown Bullhead
	<i>Noturus gyrinus</i>	Tadpole Madtom
	<i>Clarias batrachus</i>	Walking Catfish*
	<i>Hypostomus spp.</i>	Suckermouth Catfish*
	<i>Aphredoderus sayanus</i>	Pirate Perch
	<i>Fundulus seminolis</i>	Seminole Killifish
	<i>Fundulus chrysotus</i>	Golden Topminnow
	<i>Fundulus lineolatus</i>	Lined Topminnow
	<i>Lucania goodei</i>	Bluefin Killifish
	<i>Cyprinodon variegatus</i>	Sheepshead Minnow
	<i>Floridichthys carpio</i>	Goldspotted Killifish
	<i>Fundulus confluentus</i>	Marsh Killifish
	<i>Fundulus grandis</i>	Gulf Killifish
	<i>Jordanella floridae</i>	Flagfish
	<i>Poecilia latipinna</i>	Sailfin Molly
	<i>Gambusia holbrooki</i>	Mosquitofish
	<i>Heterandria formosa</i>	Least Killifish
	<i>Labidesthes sicculus</i>	Brook Silverside
	<i>Elassoma evergladei</i>	Everglades Pygmy Sunfish
	<i>Pomoxis nigromaculatus</i>	Black Crappie

<i>Group</i>	<i>Scientific Name</i>	<i>Common Name</i>
FISH (continued)		
	<i>Enneacanthus gloriosus</i>	Blue-spotted Sunfish
	<i>Micropterus salmoides</i>	Largemouth Bass
	<i>Lepomis gulosus</i>	Warmouth
	<i>Lepomis punctatus</i>	Spotted Sunfish
	<i>Lepomis macrochirus</i>	Bluegill
	<i>Lepomis microlophus</i>	Redear Sunfish
	<i>Lepomis marginatus</i>	Dollar Sunfish
	<i>Etheostoma fusiforme</i>	Swamp Darter
	<i>Astronotus ocellatus</i>	Oscar*
	<i>Tarpon atlanticus</i>	Tarpon+
	<i>Cichlasoma bimaculatum</i>	Black Acara*
	<i>Strongylura marina</i>	Atlantic Needlefish+
	<i>Centropomus undecimalis</i>	Snook+
	<i>Mugil cephalus</i>	Striped Mullet+
	<i>Dormitator maculatus</i>	Fat Sleeper+
	<i>Gobiomorus dormitor</i>	Bigmouth Sleeper
	<i>Lophogobius cyprinoides</i>	Crested Goby+
	<i>Microgobius gulosus</i>	Clown Goby+
	* <i>exotic species</i>	
	+ <i>salt water species (generally not observed in refuge since the levees were installed in the 1950's)</i>	

**Table 21. Birds of A.R.M. Loxahatchee National Wildlife Refuge.**

<i>Order</i>	<i>Scientific Name</i>	<i>Common Name</i>
Gaviiformes	<i>Gavia immer</i>	Common loon
	<i>Podilymbus podiceps</i>	Pied-billed grebe
	<i>Podiceps auritus</i>	Horned grebe
	<i>Podiceps nigricollis</i>	Eared grebe
Pelecaniformes	<i>Pelecanus erythrorhynchos</i>	American white pelican
	<i>Pelecanus occidentalis</i>	Brown pelican
	<i>Phalacrocorax auritus</i>	Double-crested cormorant
	<i>Anhinga anhinga</i>	Anhinga
Ciconiiformes	<i>Fregata magnificens</i>	Magnificent frigatebird
	<i>Botaurus lentiginosus</i>	American bittern
	<i>Ixobrychus exilis</i>	Least bittern
	<i>Ardea herodias</i>	Great blue heron
	<i>Ardea alba</i>	Great egret
	<i>Egretta thula</i>	Snowy egret
	<i>Egretta caerulea</i>	Little blue heron
	<i>Egretta tricolor</i>	Tricolored heron
	<i>Bubulcus ibis</i>	Cattle egret
	<i>Butorides virescens</i>	Green heron
	<i>Nycticorax nycticorax</i>	Black-crowned night heron
	<i>Nyctanassa violacea</i>	Yellow-crowned night-heron
	<i>Eudocimus albus</i>	White ibis
	<i>Plegadis falcinellus</i>	Glossy ibis
	<i>Eudocimus ruber</i>	Scarlet ibis
	<i>Ajaia ajaja</i>	Roseate spoonbill
	<i>Mycteria americana</i>	Wood stork
	<i>Coragyps atratus</i>	Black vulture
	<i>Cathartes aura</i>	Turkey vulture
	Anseriformes	<i>Dendrocygna bicolor</i>
<i>Cygnus columbianus</i>		Tundra swan
<i>Chen caerulescens</i>		Snow goose
<i>Anas crecca</i>		Green-winged teal
<i>Anas rubripes</i>		American Black duck
<i>Anas fulvigula</i>		Mottled duck
<i>Anas platyrhynchos</i>		Mallard
<i>Anas bahamensis</i>		White-cheeked pintail
<i>Anas Acuta</i>		Northern Pintail
<i>Anas Discors</i>		Blue-winged Teal

Table 21. Birds of A.R.M. Loxahatchee National Wildlife Refuge. (continued)

<i>Order</i>	<i>Scientific Name</i>	<i>Common Name</i>
Anseriformes (continued)	<i>Anas cyanoptera</i>	Cinnamon teal
	<i>Anas clypeata</i>	Northern shoveler
	<i>Anas strepera</i>	Gadwall
	<i>Anas americana</i>	American wigeon
	<i>Aythya valisineria</i>	Canvasback
	<i>Aythya americana</i>	Redhead
	<i>Aythya collaris</i>	Ring-necked duck
	<i>Aythya marila</i>	Greater scaup
	<i>Aythya affinis</i>	Lesser scaup
	<i>Bucephala clangula</i>	Common goldeneye
	<i>Bucephala albeola</i>	Bufflehead
	<i>Lophodytes cucullatus</i>	Hooded merganser
	<i>Mergus merganser</i>	Common merganser
	<i>Mergus serrator</i>	Red-breasted merganser
	<i>Nomonyx dominicus</i>	Masked duck
	<i>Oxyura jamaicensis</i>	Ruddy duck
	Falconiformes	<i>Pandion haliaetus</i>
<i>Elanoides forficatus</i>		Swallow-tailed kite
<i>Elanus leucurus</i>		White-tailed kite
<i>Rostrhamus sociabilis</i>		Snail kite
<i>Haliaeetus leucocephalus</i>		Bald eagle
<i>Circus cyaneus</i>		Northern harrier
<i>Accipiter striatus</i>		Sharp-shinned hawk
<i>Accipiter cooperii</i>		Cooper's hawk
<i>Buteo lineatus</i>		Red-shouldered hawk
<i>Buteo platypterus</i>		Broad-winged hawk
<i>Buteo brachyurus</i>		Short-tailed hawk
<i>Buteo swainsoni</i>		Swainson's hawk
<i>Buteo jamaicensis</i>		Red-tailed hawk
Falconiformes	<i>Caracara plancus</i>	Crested caracara
	<i>Falco sparverius</i>	American kestrel
	<i>Falco columbarius</i>	Merlin
	<i>Falco peregrinus</i>	Peregrine falcon
Galliformes	<i>Meleagris gallopavo</i>	Wild turkey
	<i>Colinus virginianus</i>	Northern bobwhite

**Table 21. Birds of A.R.M. Loxahatchee National Wildlife Refuge. (continued)**

<i>Order</i>	<i>Scientific Name</i>	<i>Common Name</i>
Gruiformes	<i>Coturnicops noveboracensis</i>	Yellow rail
	<i>Laterallus jamaicensis</i>	Black rail
	<i>Rallus elegans</i>	King rail
	<i>Rallus limicola</i>	Virginia rail
	<i>Porzana carolina</i>	Sora
	<i>Porphyryla martinica</i>	Purple gallinulelli
	<i>Gallinula chloropus</i>	Common moorhen
	<i>Aramus guarauna</i>	Limpkin
	<i>Grus canadensis</i>	Sandhill crane
	<i>Grus americana</i>	Whooping crane
Charadriiformes	<i>Pluvialis squatarola</i>	Black-bellied plover
	<i>Charadrius semipalmatus</i>	Semipalmated plover
	<i>Charadrius vociferus</i>	Killdeer
	<i>Himantopus mexicanus</i>	Black-necked stilt
	<i>Recurvirostra americana</i>	American avocet
	<i>Tringa melanoleuca</i>	Greater yellowlegs
	<i>Tringa flavipes</i>	Lesser yellowlegs
	<i>Tringa solitaria</i>	Solitary sandpiper
	<i>Catoptrophorus semipalmatus</i>	Willet
	<i>Actitis macularia</i>	Spotted sandpiper
	<i>Limosa fedoa</i>	Marbled godwit
	<i>Calidris canutus</i>	Red knot
	<i>Calidris pusilla</i>	Semipalmated sandpiper
	<i>Calidris mauri</i>	Western sandpiper
	<i>Calidris minutilla</i>	Least sandpiper
	<i>Calidris fuscicollis</i>	White-rumped sandpiper
	<i>Calidris melanotos</i>	Pectoral sandpiper
	<i>Calidris alpina</i>	Dunlin
	<i>Calidris himantopus</i>	Stilt sandpiper
	<i>Limnodromus griseus</i>	Short-billed dowitcher
	<i>Limnodromus scolopaceus</i>	Long-billed dowitcher
	<i>Gallinago gallinago</i>	Common snipe
	<i>Scolopax minor</i>	American woodcock
	<i>Larus atricilla</i>	Laughing gull
	<i>Larus philadelphia</i>	Bonaparte's gull
<i>Larus delawarensis</i>	Ring-billed gull	
<i>Larus argentatus</i>	Herring gull	

**Table 21. Birds of A.R.M. Loxahatchee National Wildlife Refuge. (continued)**

<i>Order</i>	<i>Scientific Name</i>	<i>Common Name</i>	
Charadriiformes (continued)	<i>Sterna nilotica</i>	Gull-billed tern	
	<i>Sterna caspia</i>	Caspian tern	
	<i>Sterna forsteri</i>	Forster's tern	
	<i>Sterna antillarum</i>	Least tern	
	<i>Chlidonias niger</i>	Black tern	
	<i>Rynchops niger</i>	Black skimmer	
	<i>Columba livia</i>	Rock dove	
	<i>Streptopelia decaocto</i>	Eurasian-collared-dove	
Columbiformes	<i>Zenaida asiatica</i>	White-winged dove	
	<i>Zenaida macroura</i>	Mourning dove	
	<i>Columbina passerina</i>	Common ground-dove	
Cuculiformes	<i>Coccyzus erythrophthalmus</i>	Black-billed cuckoo	
	<i>Coccyzus americanus</i>	Yellow-billed cuckoo	
	<i>Crotophaga ani</i>	Smooth-billed ani	
Strigiformes	<i>Tyto alba</i>	Barn owl	
Strigiformes	<i>Otus asio</i>	Eastern screech-owl	
	<i>Bubo virginianus</i>	Great horned owl	
	<i>Athene cunicularia</i>	Burrowing owl	
	<i>Strix varia</i>	Barred owl	
	<i>Asio flammeus</i>	Short-eared owl	
Caprimulgiformes	<i>Chordeiles acutipennis</i>	Lesser Nighthawk	
	<i>Chordeiles minor</i>	Common Nighthawk	
	<i>Caprimulgus carolinensis</i>	Chuck-will's-widow	
	<i>Caprimulgus vociferus</i>	Whip-poor-will	
Apodiformes	<i>Chaetura pelagica</i>	Chimney swift	
Apodiformes	<i>Archilochus colubris</i>	Ruby-throated hummingbird	
Coraciiformes	<i>Ceryle alcyon</i>	Belted kingfisher	
Piciformes	<i>Melanerpes erythrocephalus</i>	Red-headed woodpecker	
	<i>Melanerpes carolinus</i>	Red-bellied woodpecker	
	<i>Sphyrapicus varius</i>	Yellow-bellied sapsucker	
	<i>Picoides pubescens</i>	Downy Woodpecker	
	<i>Picoides villosus</i>	Hairy Woodpecker	
	<i>Colaptes auratus</i>	Northern flicker	
	<i>Dryocopus pileatus</i>	Pileated woodpecker	
	Passeriformes	<i>Contopus virens</i>	Eastern wood-pewee
		<i>Empidonax virescens</i>	Acadian flycatcher
		<i>Empidonax traillii</i>	Willow flycatcher

**Table 21. Birds of A.R.M. Loxahatchee National Wildlife Refuge. (continued)**

<i>Order</i>	<i>Scientific Name</i>	<i>Common Name</i>
Passeriformes (continued)	<i>Empidonax minimus</i>	Least flycatcher
	<i>Sayornis phoebe</i>	Eastern phoebe
	<i>Myiarchus crinitus</i>	Great crested flycatcher
	<i>Tyrannus melancholicus</i>	Tropical kingbird
	<i>Tyrannus vociferans</i>	Cassin's kingbird
	<i>Tyrannus verticalis</i>	Western kingbird
	<i>Tyrannus tyrannus</i>	Eastern kingbird
	<i>Tyrannus dominicensis</i>	Gray kingbird
	<i>Tyrannus forficatus</i>	Scissor-tailed flycatcher
	<i>Lanius ludovicianus</i>	Loggerhead shrike
	<i>Vireo griseus</i>	White-eyed vireo
	<i>Vireo bellii</i>	Bell's vireo
	<i>Vireo solitarius</i>	Blue-headed vireo
	<i>Vireo Flavifrons</i>	Yellow-throated vireo
	<i>Vireo philadelphicus</i>	Philadelphia vireo
	<i>Vireo olivaceus</i>	Red-eyed vireo
	<i>Vireo altiloquus</i>	Black-whiskered vireo
	<i>Cyanocitta cristata</i>	Blue jay
	<i>Aphelocoma coerulescens</i>	Florida scrub-jay
	<i>Corvus brachyrhynchos</i>	American crow
	<i>Corvus ossifragus</i>	Fish crow
	<i>Eremophila alpestris</i>	Horned lark
	<i>Progne subis</i>	Purple martin
	<i>Tachycineta bicolor</i>	Tree swallow
	<i>Stelgidopteryx serripennis</i>	Northern rough-winged swallow
	<i>Riparia riparia</i>	Bank swallow
	<i>Petrochelidon pyrrhonota</i>	Cliff swallow
	<i>Hirundo rustica</i>	Barn swallow
	<i>Thryothorus ludovicianus</i>	Carolina wren
	<i>Troglodytes aedon</i>	House wren
	<i>Cistothorus platensis</i>	Sedge wren
	<i>Cistothorus palustris</i>	Marsh wren
	<i>Regulus calendula</i>	Ruby-crowned kinglet
	<i>Polioptila caerulea</i>	Blue-gray gnatcatcher
	<i>Catharus fuscescens</i>	Veery
	<i>Catharus minimus</i>	Gray-cheeked thrush

Table 21. Birds of A.R.M. Loxahatchee National Wildlife Refuge. (continued)

<i>Order</i>	<i>Scientific Name</i>	<i>Common Name</i>
Passeriformes (continued)	<i>Catharus ustulatus</i>	Swainson's thrush
	<i>Catharus guttatus</i>	Hermit thrush
	<i>Turdus migratorius</i>	American robin
	<i>Dumetella Carolinensis</i>	Gray catbird
	<i>Mimus polyglottos</i>	Northern mockingbird
	<i>Toxostoma rufum</i>	Brown thrasher
	<i>Anthus rubescens</i>	American pipit
	<i>Bombycilla cedrorum</i>	Cedar waxwing
	<i>Sturnes vulgaris</i>	European starling
	<i>Vermivora pinus</i>	Blue-winged warbler
	<i>Vermivora chrysoptera</i>	Golden-winged warbler
	<i>Vermivora peregrina</i>	Tennessee warbler
	<i>Vermivora celata</i>	Orange-crowned warbler
	<i>Vermivora ruficapilla</i>	Nashville warbler
	<i>Parula americana</i>	Northern parula
	<i>Dendroica petechia</i>	Yellow warbler
	<i>Dendroica pensylvanica</i>	Chestnut-sided warbler
	<i>Dendroica magnolia</i>	Magnolia warbler
	<i>Dendroica tigrina</i>	Cape may warbler
	<i>Dendroica caerulescens</i>	Black-throated blue warbler
	<i>Dendroica coronata</i>	Yellow-rumped warbler
	<i>Dendroica virens</i>	Black-throated green warbler
	<i>Dendroica fusca</i>	Blackburnian warbler
	<i>Dendroica dominica</i>	Yellow-throated warbler
	<i>Dendroica pinus</i>	Pine warbler
	<i>Dendroica discolor</i>	Prairie warbler
	<i>Dendroica palmarum</i>	Palm warbler
	<i>Dendroica castanea</i>	Bay-breasted warbler
	<i>Dendroica striata</i>	Blackpoll warbler
	<i>Mniotilta varia</i>	Black-and-white warbler
	<i>Setophaga ruticilla</i>	American redstart
	<i>Protonotaria citrea</i>	Prothonotary warbler
	<i>Helmitheros vermivorus</i>	Worm-eating warbler
	<i>Limnothlypis swainsonii</i>	Swainson's warbler
<i>Seiurus aurocapillus</i>	Ovenbird	
<i>Seiurus noveboracensis</i>	Northern waterthrush	
<i>Seiurus motacilla</i>	Louisiana waterthrush	

**Table 21. Birds of A.R.M. Loxahatchee National Wildlife Refuge. (continued)**

<i>Order</i>	<i>Scientific Name</i>	<i>Common Name</i>
Passeriformes (continued)	<i>Oporornis formosus</i>	Kentucky warbler
	<i>Geothlypis trichas</i>	Common yellowthroat
	<i>Wilsonia citrina</i>	Hooded warbler
	<i>Wilsonia pusilla</i>	Wilson's warbler
	<i>Wilsonia canadensis</i>	Canada warbler
	<i>Icteria virens</i>	Yellow-breasted chat
	<i>Piranga rubra</i>	Summer tanager
	<i>Piranga olivacea</i>	Scarlet tanager
	<i>Pipilo erythrophthalmus</i>	Eastern towhee
	<i>Spizella passerina</i>	Chipping sparrow
	<i>Spizella pallida</i>	Clay-colored sparrow
	<i>Poocetes gramineus</i>	Vesper sparrow
	<i>Chondestes grammacus</i>	Lark sparrow
	<i>Passerculus sandwichensis</i>	Savannah sparrow
	<i>Ammodramus savannarum</i>	Grasshopper sparrow
	<i>Melospiza lincolni</i>	Lincoln's sparrow
	<i>Melospiza georgiana</i>	Swamp sparrow
	<i>Cardinalis cardinalis</i>	Northern cardinal
	<i>Pheucticus ludovicianus</i>	Rose-breasted grosbeak
	<i>Guiraca caerulea</i>	Blue grosbeak
	<i>Passerina cyanea</i>	Indigo bunting
	<i>Passerina ciris</i>	Painted bunting
	<i>Spiza americana</i>	Dickcissel
	<i>Dolichonyx oryzivorus</i>	Bobolink
	<i>Agelaius phoeniceus</i>	Red-winged blackbird
	<i>Sturnella magna</i>	Eastern meadowlark
	<i>Xanthocephalus xanthocephal</i>	Yellow-headed blackbird
	<i>Euphagus carolinus</i>	Rusty blackbird
	<i>Quiscalus quiscula</i>	Common grackle
	<i>Quiscalus major</i>	Boat-tailed grackle
	<i>Molothrus ater</i>	Brown-headed cowbird
	<i>Icterus pectoralis</i>	Spot-breasted oriole
	<i>Icterus spurius</i>	Orchard oriole
	<i>Icterus galbula</i>	Baltimore oriole
<i>Carduelis pinus</i>	Pine siskin	
<i>Carduelis tristis</i>	American goldfinch	
<i>Passer Domesticus</i>	House Sparrow	

**Table 22. Listed Species at A.R.M. Loxahatchee National Wildlife Refuge**

*Listed species (Federal and State listed endangered, threatened, or species of special concern; US Fish and Wildlife Service species of management concern; and the Convention of International Trade in Endangered Species) known to occur or could occur on A.R.M. Loxahatchee National Wildlife Refuge.*

<i>Scientific Names</i>	<i>Common Names</i>	<i>Federal</i>	<i>FWS smc</i>	<i>Florida GFW-FC</i>	<i>Florida Dpt.of Ag.</i>	<i>CITES</i>	<i>FNAI</i>
<b>BIRDS</b>							
<i>Botaurus lentiginosus</i>	American bittern		*				
<i>Elanoides forticatus</i>	American swallow-tailed kite		*				S2S3
<i>Falco peregrinus tundrius</i>	Arctic peregrine falcon			E		*	S2
<i>Haliaeetus leucocephalus</i>	Bald eagle	T		T		*	S3
<i>Laterallus jamaicensis</i>	Black rail		*				S3
<i>Dolichonyx oryzivorus</i>	Bobolink		*				
<i>Tyto alba</i>	Common barn owl		*				
<i>Columbina passerina</i>	Common ground-dove		*				
<i>Polyborus plancus audubonii</i>	Crested caracara	T		T			S2
<i>Sturnella magna</i>	Eastern meadowlark		*				
<i>Grus canadensis pratensis</i>	Florida sandhill crane			T		*	S2S3
<i>Sterna antillarum</i>	Least tern			T			S3
<i>Ixobrychus exilis</i>	Least bittern		*				S4
<i>Aramus guarana</i>	Limpkin			SSC			S3
<i>Egretta caerulea</i>	Little blue heron			SSC			S4
<i>Lanius ludovicianus migrans</i>	Loggerheaded shrike, migrant	*					
<i>Falco columbarius</i>	Merlin					*	SU
<i>Colaptes auratus</i>	Northern flicker		*				
<i>Circus cyaneus</i>	Northern harrier		*			*	
<i>Pandion haleaetus</i>	Osprey					*	S3S4
<i>Colaptes auratus</i>	Painted bunting		*				S3
<i>Dendroica discolor</i>	Prairie warbler		*				S3
<i>Egretta rufescens</i>	Reddish egret			SSC			S2
<i>Ajaia ajaja</i>	Roseate spoonbill			SSC			S2S3
<i>Passerulus sandwichensis</i>	Savannah sparrow		*				
<i>Cistothorus platensis</i>	Sedge wren		*				
<i>Buteo brachyurus</i>	Short-tailed hawk		*				S3
<i>Rostrhamus sociabilis</i>	Snail kite	E		E			S1
<i>Egretta thula</i>	Snowy egret			SSC			S4
<i>Falco sparverius paulus</i>	Southeastern kestrel			T		*	S3
<i>Buteo swainsoni</i>	Swainson's hawk			SSC			
<i>Egretta tricolor</i>	Tricolored heron			SSC			S4
<i>Bartramia longicauda</i>	Upland sandpiper		*				
<i>Eudocimus albus</i>	White ibis			SSC			S4

**Appendix K - Flora & Fauna**

<i>Scientific Names</i>	<i>Common Names</i>	<i>Federal</i>	<i>FWS smc</i>	<i>Florida GFW-FC</i>	<i>Florida Dpt.of Ag.</i>	<i>CITES</i>	<i>FNAI</i>
<i>Grus americana</i>	Whooping crane	XN		SSC			SXC
<i>Mycteria americana</i>	Wood stork	E		E			S2
<i>Helmitheros vermivorus</i>	Worm-eating warbler		*				S1
<i>Coturnicops noveboracensis</i>	Yellow rail		*				
<i>Coturnicops noveboracensis</i>	Yellow-billed cuckoo		*				
<b>MAMMALS</b>							
<i>Lynx rufus</i>	Bobcat					*	
<i>Felis concolor coryi</i>	Florida panther	E		E		*	S1
<i>Lutra canadensis</i>	River otter					*	
<b>REPTILES</b>							
<i>Alligator mississippiensis</i>	American alligator	TS/A		SSC		*	S4
<i>Drymarchon corais couperi</i>	Eastern indigo snake	T		T			S3
<i>Gopherus polyphemus</i>	Gopher tortoise			SSC			S3
<b>PLANTS</b>							
<i>Ionopsis utricularioides</i>	Delicate ionopsis			E		*	S1
<i>Thelypteris interrupta</i>	Fern, aspidium			T			
<i>Thelypteris kunthii</i>	Fern, aspidium			T			
<i>Thelypteris palustris</i>	Fern, aspidium			T			
<i>Osmunda cinnomomea</i>	Fern, cinnamon				CE		
<i>Acrostichum danaeifolium</i>	Fern, giant leather				CE		
<i>Nephrolepis biserrata</i>	Fern, giant sword				T		
<i>Azolla caroliniana</i>	Fern, mosquito				T		
<i>Phlebodium aureum</i>	Fern, polyploidy				T		
<i>Actinostachys pennula</i> <i>Schizaea germanii</i>	Fern, ray or Spike-ray fern also known as Tropical curly-grass fern			E			S1
<i>Osmunda regalis</i>	Fern, royal			SCC	CE		
<i>Campyloneurum latum</i>	Fern, strap				E		
<i>Psilotum nudum</i>	Fern, whisk				T		
<i>Salvinia rotundifolia</i>	Water spangles				T		
<i>Tillandsia fasciculata</i>	Wild pine, cardinal (stiff-leaved)				E		
<i>Tillandsia utriculata</i>	Wild pine, giant				E		
<i>Tillandsia balbisiana</i>	Wild pine, reflexed (inflated)				T		
<i>Tillandsia flexuosa</i>	Wild pine, twisted				E		

<p>* FWS species of management concern</p> <p>CE Commercially exploited</p> <p>E Endangered</p> <p>S1 Critically impeiled in Florida because of extreme rarity or of extreme vulnerability to extinction due to some natural or manmade factors.</p> <p>S2 Imperiled in Florida because of rarity or of vulnerability to extinction due to some natural or man-made factor.</p>	<p>S3 Either vary rare and local throughout its range or found locally in a restricted range or vulnerable to extinction from other factors.</p> <p>S4 Apparently secure in Florida, may be rare in parts of its range.</p> <p>SSC Species of special concern in State of Florida (FFWCC)</p> <p>SU Due to lack of information no range can be given</p>	<p>SXU Believed to be extinct throughout its range in Florida, being reestablished.</p> <p>T Threatened</p> <p>T(S/A) Threatened due to similarity of appearance.</p> <p>XN Nonessential experimental population in Florida, is listed as Endangered elsewhere in the US.</p>
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**Table 23. Exotic animals of A.R.M. Loxahatchee National Wildlife Refuge**

*Exotic Animals reported from, or expected to be present on A.R.M. Loxahatchee NWR.  
Those noted with \*\* are pending threats to the refuge.*

<i>Group</i>	<i>Scientific Name</i>	<i>Common Name</i>	<i>Breeding Status</i>
<b>Birds</b>			
	Melopsittacus undulatus	Budgerigar	no
	Nymphicus hollandicus	Cockatiel	no
	Anas platyrhynchos	Domestic mallard	no
	Streptopelia decaocto	Eurasian collared-dove	no
	Sturnis vulgaris	European starlin	yes
	Passer domesticus	House sparrow	no
	Myiopsitta monachus	Monk parakeet	no
	Cairina moschata	Muscovy duck	no
	Amazona spp.	Parrot sp.	no
	Columbia livia	Rock dove or common pigeon	no
	Molothrus bonariensis	Shiny cowbird	no
<b>Mammals</b>			
	Rattus rattus	Black rat	yes
	Canis latrans	Coyote**	no
	Canis familiaris	Feral dog	no
	Sus scrofa	Feral hog	yes
	Felis domesticus	Feral cat	no
	Mus musculus	House mouse	yes
	Felis yagouaroundi	jaguarundi	no
	Dasyopus novemcinctus	Nine-banded armadillo	yes
	Rattus norvegicus	Norway rat	yes
	Vulpes fulva	Red fox	no
<b>Reptiles</b>			
	Boa constrictor	Boa constrictor	no
	Anolis sagrei sagrei	Brown anole	yes
	Iguana iguana	Green iguana	no
	Kinixys homeana	Home's hinge-back tortoise	no
	Hemidactylus garnotii	Indo-Pacific gecko	yes
	Hemidactylus turcicus turcicus	Mediterranean gecko	yes
		Monitor lizard spp.	no
	Leiocephalus carinatus	Northern curly-tailed lizard	no
		python spp.	no
<b>Amphibians</b>			
	Osteopilus septentrionalis	Cuban treefrog	yes
	Bufo marinus	Giant marine toad	no

<i>Group</i>	<i>Scientific Name</i>	<i>Common Name</i>	<i>Breeding Status</i>
<b>Invertebrates</b>			
	<i>Aedes albopictus</i>	Asian tiger mosquito	yes
	<i>Viviparus georgianus</i>	Banded mystery snail	yes
	<i>Metamasius callizona</i>	Bromeliad beetle**	?
		crayfish spp.	?
	<i>Apis mellifera mellifera</i>	European honeybee	yes
	<i>Marissa cornuarietis</i>	Goldenhorn marissa**	?
	<i>Solenopsis invicta</i> imported	Red fire ant	yes
	<i>Plecia nearctica</i>	Love bug	yes
	<i>Pseudomyrmex gracilis</i>	Mexican elongate twig ant	yes
	<i>Pomacea bridgesis</i> spike-topped	Apple snail	yes
<b>Fish</b>			
	radiated ptero	Armour-plated catfish	yes
	<i>Monopterus albus</i>	Asian swamp eel**	no
	<i>Trichopsis vittata</i>	Croaking gourami	?
	<i>Ctenopharyngodon idella</i>	Grass carp	?
	<i>Xiphophorus helleri</i>	Green swordtail	?
	<i>Liposarcus multiradiatus</i>	Sailfin catfish	?
	<i>Hoplosternum littorale</i>	South American armored catfish **	no
	<i>Xiphophorus maculatus</i>	Southern platyfish	?
	<i>Hypostomus</i> spp.	Suckermouth catfish	yes
	<i>Hypostomus</i> spp.	Suckermouth catfish	?
	<i>Xiphophorus variatus</i>	Variable platyfish	?
	<i>Liposarcus disjunctivus</i>	Vermiculated sailfin catfish	?
	<i>Clarias batrachus</i>	Walking catfish	yes
<b>Fish:</b>			
Cichlid Family	<i>Hemichromis letourneauxi</i>	Black aracara	?
	<i>Cichlasoma bimaculatum</i>	Black acara	yes
	<i>Sarotherodon melanotheron</i>	Blackchin tilapia	?
	<i>Oreochromis aureus</i>	Blue tilapia	yes
	<i>Cichlasoma meeki</i>	Firemouth	?
	<i>Cichlasoma octofasciatum</i>	Jack Dempsey	?
	<i>Cichlasoma urophthalmus</i>	Mayan cichlid	?
	<i>Cichlasoma citrinellum</i>	Midas cichlid	?
	<i>Oreochromis mossambicus</i>	Mozambique tilapia	?
	<i>Astrontus ocellatus</i>	Oscar	yes
	<i>Geophagus surinamensis</i>	Redstriped eartheater	?
	<i>Cichlasoma cyanoguttatum</i>	Rio Grande cichlid	?
	<i>Tilapia mariae</i>	Spotted tilapia	yes

**Table 24. Category I Exotic Plants found on A.R.M. Loxahatchee National Wildlife Refuge**

<i>Scientific Name</i>	<i>Common Name</i>
Casuarina equisetifolia	Australian pine
Lygodium microphyllum	Old World climbing fern
Bischofia javanica	Bishchofia
Bauhinia variegata	Orchid tree
Schinus terebinthifolius	Brazilian pepper
Rhoeo spathacea	Oyster plant
Acacia auriculiformis	Earleaf acacia
Brachiaria mutica	Para grass
Psidium guajava	Guava
Abrus precatorius	Rosary pea
Hydrilla verticillata	Hydrilla
Ardisia elliptica	Shoebuttton ardisia
Syzygium cumini	Java plum
Eugenia uniflora	Surinam cherry
Lantana camara	Lantana
Nephrolepis cordifolia	Sword fern
Ficus microcarpa	laurel fig
Panicum repens	Torpedo grass
Melaleuca quinquenervia	Melaleuca
Eichhornia crassipes	Water hyacinth
Pistia stratiotes	Water lettuce

**Table 25. Category II Exotic Plants found on A.R.M. Loxahatchee National Wildlife Refuge**

<i>Scientific Name</i>	<i>Common Name</i>
Alternanthera philoxeroides	Alligatorweed
Syngonium podophyllum	Arrowhead vine
Nephrolepis multiflora	Asian sword fern
Urena lobata	Caesar's weed
Murraya paniculata	Orange-jasmine
Tribukus cistoides	Puncture vine
Terminalia catappa	Tropical almond
Wedelia trilobata	Wedelia
Ficus benjamina	Weeping fig

**Table 26. Plants of the Cypress Swamp Boardwalk of A.R.M. Loxahatchee National Wildlife Refuge (Partial List)**

<i>Scientific Name</i>	<i>Common Name</i>
<b>TREES &amp; SHRUBS</b>	
<i>Aster carolinianus</i>	Aster, Climbing
<i>Annona glabra</i>	Apple, Pond
<i>Taxodium distichum</i>	Bald-cypress
<i>Persea boronia</i>	Bay, Red
<i>Myrica cerifera</i>	Bayberry, Southern (Wax Myrtle)
<i>Cephalanthus occidentalis</i>	Buttonbush, Common
<i>Ilex cassine</i>	Dahoon (Dahoon Holly)
<i>Sambucus canadensis</i>	Elder, American (Elderberry)
<i>Ficus aurea</i>	Fig, Strangler
<i>Psidium guajava</i>	Guava
<i>Ficus microcarpa</i>	Laurel, Indian (Laurel Fig)
<i>Acer rubrum</i>	Maple, Red
<i>Rapanea punctata</i> ( <i>Myrsine guianensis</i> *)	Myrsine
<i>Schinus terebinthifolius</i>	Pepper, Brazilian
<i>Chrysobalanus icaco</i>	Plum, Coco
<i>Taxodium ascendens</i>	Pond-cypress
<i>Ludwigia peruviana</i>	Primrosewillow, Peruvian
<i>Baccharis glomerulifera</i>	Silvering (Saltbush)
<i>Salix caroliniana</i>	Willow, Carolina (Coastal Plain Willow)
<i>Itea virginica</i>	Willow, Virginia
<b>HERBS</b>	
<i>Alternanthera philoxeroides</i>	Alligatorweed
<i>Sagittaria lancifolia</i>	Arrowhead, Bulltongue
<i>Peltandra virginica</i>	Arum, Green Arrow
<i>Erechtites hieracifolia</i>	Burnweed, American (Fireweed)
<i>Urena lobata</i>	Caesarweed
<i>Typha</i> spp.	Cattail
<i>Commelina diffuse</i>	Dayflower
<i>Spirodela punctata</i> (=S. oligorhiza)	Duckweed, Dotted
<i>Chromolaena odorata</i> (=Eupatorium odoratum)	Jack-in-the-bush
<i>Ludwigia repens</i>	Primrosewillow, Creeping (Red Ludwigia)
<i>Kosteletzkya virginica</i>	Mallow, Virginia Saltmarsh
<i>Hydrocotyle umbellata</i>	Marshpennywort, Manyflower
<i>Boehmeria cylindrica</i>	Nettle, False
<i>Pontederia cordata</i>	Pickernelweed
<i>Hydrolea corymbosa</i>	Skyflower

**Table 26. Plants of the Cypress Swamp Boardwalk of A.R.M. Loxahatchee National Wildlife Refuge (continued)**

<i>Scientific Name</i>	<i>Common Name</i>
<b>HERBS (continued)</b>	
<i>Nuphar lutea</i>	Spatterdock (Yellow Pondlily)
<i>Crinum americanum</i>	String-lily
<i>Pluchea odorata</i>	Sweetscent (Saltmarsh Fleabane)
<i>Saururus cernuus</i>	Tail, Lizard's
<i>Polygonum hydropiperoides</i>	Waterpepper, Mild (Smartweed)
<b>VINES</b>	
<i>Momordica charantia</i>	Balsampear (Wild Balsam Apple)
<i>Parthenocissus quinquefolia</i>	Creeper, Virginia
<i>Smilax laurifolia</i>	Greenbrier (Bamboo Vine)
<i>Mikania scandens</i>	Hempvine, Climbing
<i>Ipomoea alba</i>	Moonflowers
<i>Ipomoea sagittate</i>	Morningglory, Saltmarsh
<i>Vitis rotundifolia</i>	Muscadine (Fox Grape)
<i>Ampelopsis arborea</i>	Peppervine
<i>Sarocostemma clausum</i>	Twinevine, White (Whitevine)
<b>SEDGES</b>	
<i>Cyperus</i> spp.	Flat Sedge
<b>FERNS &amp; FERN-ALLIES</b>	
<i>Azolla caroliniana</i>	Carolina Mosquito Fern
<i>Osmunda cinnamomea</i> (C)	Cinnamon Fern
<i>Acrostichum danaeifolium</i>	Giant Leather Fern
<i>Nephrolepis biserrata</i> (T)	Giant Sword Fern
<i>Phlebodium aureum</i>	Golden Polypody (Cabbage Palm Fern)
<i>Thelypteris interrupta</i>	Hottentot Fern (Tri-vein Fern)
<i>Campyloneurum phyllitidis</i>	Long Strap Fern
<i>Pleopeltis polypodioides</i> (=Polypodium p.)	Resurrection Fern
<i>Osmunda regalis</i> (C)	Royal Fern
<i>Nephrolepis exaltata</i>	Sword Fern (Wild Boston Fern)
<i>Blechnum serrulatus</i>	Toothed Midsorus Fern (Swamp Fern)
<i>Salvinia minima</i> (=S. rotundifolia*)	Water Spangles
<i>Psilotum nudum</i>	Whisk-fern
<i>Thelypteris kunthii</i> (=T. normalis)	Widespread Maiden Fern

**Table 26. Plants of the Cypress Swamp Boardwalk of A.R.M. Loxahatchee National Wildlife Refuge (continued)**

<i>Scientific Name</i>	<i>Common Name</i>
<b>BROMELIADS</b>	
<i>Tillandsia recurvate</i>	Ballmoss
<i>T. fasciculata</i> (E)	Cardinal Airplant
<i>T. utriculata</i> (E)	Giant Airplant
<i>T. floridana</i> (=T. polystachya*)	Hybrid Airplant (Reddish Wildpine)
<i>T. balbisiana</i> (T)	Northern Needleleaf (Reflexed Wildpine)
<i>T. setacea</i>	Southern Needleleaf (Needle-leaved Wildpine)
<i>T. usneoides</i>	Spanish Moss
<b>LICHENS</b>	
<i>Cryptothecia rubrocincta</i> (=Chiodecton sanguineum) (=Herpothallon s.)	Baton Rouge (Red Stick; Red Blanket)
<i>Usnea strigosa</i>	Old Man's Beard

(E) Endangered

(T) Threatened

(C) Commercially Exploited

(\*) Name Changed

**Table 27. Wildflowers of A.R.M. Loxahatchee National Wildlife Refuge (Partial List)**

<i>Scientific Name</i>	<i>Common Name</i>
<i>Tillandsia fasciculata</i>	Air-plant, Cardinal (Stiff-leaved Wild-pine)
<i>Peltandra virginica</i>	Arum, Arrow (Green Arum)
<i>Sagittaria lancifolia</i>	Arrowhead
<i>Thalia geniculata</i>	Arrowroot (Alligator Flag)
<i>Aster carolinianus</i>	Aster, Climbing (Carolina Aster)
<i>Momordica charantia</i>	Balsam Apple, Wild
<i>Senecio glabellus</i>	Butterweed (Golden Ragwort)
<i>Cephalanthus occidentalis</i>	Buttonbush
<i>Urena lobata</i>	Caesar-weed
<i>Typha</i> spp.	Cattail
<i>Vigna luteola</i>	Cow-pea
<i>Melothria pendula</i>	Cucumber, Climbing
<i>Commelina erecta</i>	Dayflower
<i>Sambucus canadensis</i> ( <i>S. simpsonii</i> )	Elderberry
<i>Eupatorium capillifolium</i>	Fennel, Dog

**Table 27. Wildflowers of A.R.M. Loxahatchee National Wildlife Refuge (continued)**

<i>Scientific Name</i>	<i>Common Name</i>
<i>Pluches odorata</i>	Fleabane, Salt-marsh
<i>Erigeron queroifolius</i>	Fleabane, Southern
<i>Lippia (Phyla) nodiflora</i>	Frog-fruit (Carpetweed)
<i>Gaura augustifolia</i>	Gaura, Southern
<i>Mikania scandens</i>	Hempweed, Climbing
<i>Lantana camaraana</i>	Lantana
<i>Lactuca graminifolia</i>	Lettuce, Wild
<i>Hymenocallis</i> spp.	Lily, Spider
<i>Crinum americanum</i>	Lily, String
<i>Saururus cernuus</i>	Lizard's-tail
<i>Kosteletzkya virginica</i>	Mallow, Saltmarsh
<i>Ipomoea alba</i>	Moonflower
<i>Hydrocotyle umbellata</i>	Pennywort, Marsh
<i>Lepidium virginicum</i>	Pepper-grass
<i>Ampelopsis arborea</i>	Pepper-vine
<i>Catharanthus roseus</i>	Periwinkle, Madagascar
<i>Pontederia cordata</i>	Pickernelweed
<i>Plantago lanceolata</i>	Plantain, English
<i>Poinsettia cyathophora</i>	Poinsettia, Wild (Painted-leaf)
<i>Tribulus cissoides</i>	Puncture-weed (Burnut)
<i>Rivina humilis</i>	Rouge-plant (Bloodberry)
<i>Cenchrus incertus</i>	Sandspur, Coast
<i>Dichromena colorata</i>	Sedge, White-top (Star Rush)
<i>Sida</i> sp.	Sida
<i>Bidens alba</i> (B. pilosa)	Spanish Needles
<i>Nuphar luteum</i> (N. lutea)	Spatterdock (Yellow pond-lily)
<i>Emilis fosbergii</i>	Tasselflower
<i>Coreopsis</i> spp.	Tickseed
<i>Desmodium</i> spp.	Tick-trefoil
<i>Linaria canadensis</i>	Toadflax, Blue
<i>Nymphaea odorata</i>	Waterlily, White
<i>Wedelia trilobata</i>	Wedelia (Creeping Oxeye)
<i>Sarcostemma clausum</i>	White-vine (Climbing milkweed)
<i>Ludwigia peruviana</i>	Willow, Primrose
<i>Itea virginica</i>	Willow, Virginia

*Subtropical Florida Partners-in-Flight  
Bird Conservation Plan:  
Section 2 Avifaunal Analysis*

**Table 28. Priority bird species for subtropical Florida: entry criteria and selection rationale**

Priority Entry Criteria <sup>1</sup>	Species	Total PIF Priority Species Score	Concern Area Importance	Score Population Trend	Percent of BBS Population	Local Migratory Status	Geographic or Historical Notes
Ia.	Snail Kite <sup>5</sup> (Everglade)	34	5	4 <sup>4</sup>	100?	D	
	Seaside Sparrow <sup>5</sup> (Cape Sable)	34	5	4	100 <sup>3</sup>	D	
	Snowy Plover (SE US)	34	5	5		D	Gulf side only
	Red Knot (SE US)	32	5	5		C	
	Crested Caracara <sup>5</sup> (Florida pop.)	32	3 <sup>4</sup>	5 <sup>4</sup>		D	
	Florida Scrub-Jay <sup>5</sup>	32	2	5		R	Presently extipated?
	Grasshopper Sparrow <sup>5</sup> (Florida)	32	2	5		R	Presently extipated?
	Piping Plover <sup>5</sup>	31	4	5		C	
	Roseate Tern <sup>5</sup> (N. Am. Pop.)	31	4	4		B	
	Burrowing Owl (Florida)	31	5	4 <sup>4</sup>		D	
	Wood Stork <sup>5</sup> (SE US)	30	5	4		D	
	Short-tailed Hawk (Florida pop.)	30	5 <sup>4</sup>	3		D	
	Prairie Warbler (Florida)	30	5 <sup>4</sup>	4 <sup>4</sup>		D	
	Painted Bunting (Eastern)	30	4	5		C	
	Swallow-tailed Kite (SE US)	29	5 <sup>4</sup>	3		B	
	Red-cockaded Woodpecker <sup>5</sup>	29	3 <sup>4</sup>	3		R	
	Great Blue Heron (Great White)	28	5	3	100 <sup>3</sup>	R	
	Mottled Duck	28	5	3		D	
	American Oystercatcher (Eastern NA pops.)	28	5	3		D	
	Yellow Warbler (Cuban)	28	3 <sup>4</sup>	4 <sup>4</sup>	“100”	R	
Ib.	American Kestrel (SE US)	27	2	5 <sup>4</sup>		R	Extirpated?
	Black Rail	27	4	3		D	
	Sandhill Crane (Florida)	27	4 <sup>4</sup>	3		R	
	Wilson’s Plover	27	4	3		D	
	White-crowned Pigeon	27	4 <sup>4</sup>	4 <sup>4</sup>	100?	D	
	Nelson’s Sharp-tailed Sparrow	27	3	3		C	
	Audubon’s Shearwater (Caribbean)	26	5	3		P	
	Reddish Egret	26	4	3		D	
	Brown-headed Nuthatch	26	2	5		R	Nearing extirpation?
	Bicknell’s Thrush	26	5	3		A	
	Henslow’s Sparrow	26	2	4		C	Formerly more regular
	Yellow Rail	25	3	3		C	
	Buff-breasted Sandpiper	25	3	4		A	Most southbound migration
	Black-whiskered Vireo	25	5	4 <sup>4</sup>	100?	B	
	Black-throated Blue Warbler	25	5	3		A	
	Bachman’s Sparrow	25	2	3		D	More frequent winter?
	Brown Pelican (SE US)	24	5	1 <sup>4</sup>		D	

**Appendix L - Avifaunal Analysis**

Priority Entry Criteria <sup>1</sup>	Species	Total PIF Priority Species Score	Concern Area Importance	Score Population Trend	Percent of BBS Population	Local Migratory Status	Geographic or Historical Notes
	Marbled Godwit	24	3	4		C	
	Short-eared Owl (Greater Antillean)	24	1	1		PB	Status and taxonomy unclear
	Gray Kingbird	24	5	3	95.5?	B	
	Bobolink	24	5	5		A	
	White Ibis	23	5	4 <sup>4</sup>		D	
	Solitary Sandpiper	23	5	3		A	
	Whimbrel	23	3	5		A	
	Stilt Sandpiper	23	4	3		A	
	Mangrove Cuckoo	23	4 <sup>4</sup>	3	100?	D	
	Cape May Warbler	23	5	3		A	
	Connecticut Warbler	23	5	3		A	
	American Bittern	22	5	5		C	
	Clapper Rail	22	4	3		R	
	Semipalmated Sandpiper	22	5	5		A	
	Short-billed Dowitcher	22	5	5		C	
	Black Tern	22	5	5		A	
	Black Skimmer	22	5	5 <sup>4</sup>		D	
	Sedge Wren	22	4	2		C	
	Palm Warbler	22	5	5		C	
II a.	Magnificent Frigatebird	21	5	3		D	
	Black-bellied Plover	21	4	5		D	
	Willet	21	5	3		D	
	Western Sandpiper	21	5	3		C	
	White-eyed Vireo	21	5		33.2	D	
	Veery	21	4	5		A	
	Grasshopper Sparrow (Eastern)	21	5	5		C	
	Least Bittern	20	5 <sup>3</sup>		26.2?	D	
	Bald Eagle <sup>5</sup>	20	5 <sup>4</sup>	3		D	
	Northern Harrier	20	4	4		C	
	Limpkin	20	5	3	66.8?	R	
	King Rail	20	5	3		D	
	Ruddy Turnstone	20	3	4		D	
	Least Sandpiper	20	5	5		C	
	Dunlin	20	4	5		C	
	Least Tern	20	5	4 <sup>4</sup>	B		
	Common Ground-Dove	20	5	4	4.2?	R	
	Smooth-billed Ani	20	5	4 <sup>4</sup>	79.2?	R	
	Tricolored Heron	19	5	3	15.7?	D	
	Yellow-crowned Night-Heron	19	5	3		D	
	Roseate Spoonbill	19	5	3		D	
	Red-shouldered Hawk	19	5	3	4.7	D	
	American Avocet	19	3	3		C	
	Greater Yellowlegs	19	5	3		C	
	Sanderling	19	3	5		C	
	Pectoral Sandpiper	19	5	3		A	

**Appendix L - Avifaunal Analysis**

Priority Entry Criteria <sup>1</sup>	Species	Total PIF Priority Species Score	Concern Area Importance	Score Population Trend	Percent of BBS Population	Local Migratory Status	Geographic or Historical Notes
	Royal Tern	19	5	3		D	
	Barn Owl	19	5 <sup>4</sup>	3		D	
	Gray Catbird	19	4	5		C	
III.	Chuck-will's-widow	20	3	3		D	
IV.	Scissor-tailed Flycatcher	21	2	3		C	
	Yellow-throated Warbler	21	4	3		C	
	Prothonotary Warbler	21	2	3		B	Breeding?
	American White Pelican	20	4	1		C	
	Redhead	20	2	4		C	
	American Woodcock	20	2	4		D	
	Cave Swallow	20	2	1 <sup>4</sup>		B	Expanding range?
	Red-headed Woodpecker	20	2	3		D	Extirpated?
	Peregrine Falcon	19	5	1		A	Winters in small numbers
	Sooty Tern	19	4	3		B	Dry Tortugas
	Antillean Nighthawk	19	2	3		B	
	Florida Keys Loggerhead Shrike	19	4	3		D	
	Common Loon	18	4	3		C	
	Wood Duck	18	3	3		D	
	Ring-necked Duck	18	3	2		C	
	Lesser Scaup	18	3	5		C	
	Northern Bobwhite	18	3	3		R	
	Brown Noddy	18	4	3		B	Dry Tortugas
	Yellow-billed Cuckoo	18	3	3		B	
	Northern Parula	18	3	3		C	
	Rusty Blackbird	18	2	5		C	
	Little Blue Heron	17	5	3		D	
	Blue-winged Teal	17	5	3		A	
	Summer Tanager	17	2	3		B	Extirpated?
	Eastern Towhee	17	4	3		D	
	Eastern Meadowlark	17	4	4		D	
	Northern Pintail	16	3	5		C	
	Brown Thrasher	16	2	3		D	
	Black-and-white Warbler	17	3	3		C	
	Eastern Kingbird	15	3	3		B	
	Blue-gray Gnatcatcher	15	5	1		C	
	Northern Flicker	13	3	3		D	

<sup>1</sup>Entry criteria (Area Importance [AI] scores roughly mean “1” irregular and unpredictable occurrence, “2” rare to uncommon but regular occurrence, “3” low relative abundance, “4” moderate to high relative abundance, “5” highest relative abundance; Population Trend [PT] scores roughly mean “1” definite increase, “2” stable or possible increase, “3” trend unknown, “4” possible decrease, “5” definite decrease):

- Ia. Overall Highest Priority Species. Species with total score 28-35. Ordered by total score. Consider deleting species with AI < 2 confirmed to be of peripheral occurrence and not of local conservation interest, but retain species potentially undersampled by BBS or known to have greatly declined during this century.
- Ib. Overall High Priority Species. Species with total score 22-27. Ordered by total score. Consider deleting species with AI < 2 confirmed to be of peripheral occurrence and not of local conservation interest, but retain species potentially undersampled by BBS or known to have greatly declined during this century.
- II. Area Priority Species. Species with slightly lower score total 19-21 with PT+AI=8+(a) or with high percent BBS population (b). Ordered by total score. These are overall moderate priority species.
- III. Additional Species of Global Priority. Add WatchList species (Partners in Flight-National Audubon Society priority species at national level), not already listed in either I or II, with AI=2+. Order by total score. Consider deleting species with AI=2 if confirmed to be of peripheral occurrence and not of local conservation interest, but retain if a local population is viable and/or manageable. These are also overall moderate priority species.
- IV. Local or Regional Interest Species. Includes game or nongame species identified by State Working Groups. Also, may include species often meeting criteria for I or II within other physiographic areas and therefore of regional interest for monitoring throughout the Southeast. These are overall low priority species within physiographic area, but may be more important within one or more States (especially where multiple states have designated some special protective status on the species).

<sup>2</sup> Local Migratory Status, codes adapted from Texas Partners in Flight as follows:

- A = Breeds in temperate or tropical areas outside of region, and winters in temperate or tropics outside of region (i.e., passage migrant).
- B = Breeds in temperate or tropical areas including the region, and winters exclusively in temperate or tropics outside the region (i.e., includes both breeding and transient populations).
- C = Breeds in temperate or tropical areas outside of region, and winters in both the region and in temperate or tropical areas beyond area (i.e., includes both transient and wintering populations).
- D = Breeds and winters in the region, with perhaps different populations involved, including populations moving through to winter beyond the region in temperate or tropical areas (i.e., populations may be present throughout year, but may include a large number of passage migrants).
- E = Species reaching distributional limits within the region, either as short-distance or long-distance breeding migrants, but at population levels above peripheral status.
- F = Same as E except for wintering (non-breeding) migrants.
- R = Resident, generally non-migratory species (though there may be local movements).
- RP= Resident, non-migratory species, reaching distributional limits within the region, but at population levels above peripheral status.
- P = Pelagic, breeding grounds outside of region, but can occur during breeding season.
- PB = Post-breeding dispersal or non-breeding resident; species present during breeding season, but not known to be breeding in the region proper.

<sup>3</sup> Highest percent of breeding population recorded in temperate North America; numbers in “ ” are likely projections; ? indicates species widespread outside of temperate North America and/or waterbirds poorly sampled by Breeding Bird Survey within physio. area.

<sup>4</sup> AI or PT score revised from what was derived by BBS data, or lack thereof, based on better local information.

<sup>5</sup> Species listed as either Federal Endangered or Threatened.

**Table 29. Species suites for A.R.M. Loxahatchee National Wildlife Refuge based on present and potential habitat**

<i>Priority Level</i>	<i>Shrub-Scrub</i>	<i>Forested Wetlands/ Hammocks,</i>	<i>Transient Landbirds</i>	<i>Emergent Wetlands<sup>2</sup></i>	<i>Colonial Nesting Waders</i>	<i>Shorebirds<sup>3</sup></i>
<i>Extremely High</i>	Painted Bunting	Short-tailed Hawk Swallow-tailed Kite Snail Kite		Wood Stork Mottled Duck Snail Kite	Wood Stork	
<i>High</i>	Gray Kingbird Palm Warbler Prairie Warbler		Bicknell's Thrush Black-throated Blue Warbler Bobolink Cape May Warbler Connecticut Warbler	Black Rail Florida Sandhill Crane Yellow Rail White Ibis Am. Bittern Black Tern Sedge Wren Wood Duck	White Ibis	Solitary Sandpiper Stilt Sandpiper Buff-breasted Sandpiper Short-billed Dowrtcher Semipalmated Sandpiper
<i>Moderate</i>	White-eyed Vireo Common Ground-Dove Smooth-billed Ani Gray Catbird	Bald Eagle Limpkin Red-shouldered Hawk	Veery	Least Bittern Bald Eagle Northern Harrier Limpkin King Rail Tricolored Heron Yellow-crowned Night-Heron Roseate Spoonbill Barn Owl Least Tern Lesser Scaup Grasshopper Sparrow	Tricolored Heron Yellow-crowned Night-Heron Roseate Spoonbill	American Avocet Greater Yellowlegs Western Sandpiper Least Sandpiper Pectoral Sandpiper

**Table 29. Species suites for A.R.M. Loxahatchee National Wildlife Refuge based on present and potential habitat (continued)**

<i>Priority Level</i>	<i>Shrub-Scrub</i>	<i>Forested Wetlands/Hammocks<sup>1</sup></i>	<i>Transient Landbirds</i>	<i>Emergent Wetlands<sup>2</sup></i>	<i>Colonial Nesting Waders</i>	<i>Shorebirds<sup>3</sup></i>
<i>Local or Regional Interest</i>	Eastern Towhee Brown Thrasher	Yellow-throated Warbler Yellow-billed Cuckoo Northern Parula Black-and-white Warbler Black-and-white Warbler Blue-gray Gnatcatcher Wood Duck		Peregrine Falcon Eastern King-bird Little Blue Heron Snowy Egret Am. White Pelican Short-eared Owl Loggerhead Shrike Common Nighthawk Blue-winged Teal Northern Pintail Redhead Ring-necked Duck		

<sup>1</sup> Includes Tree Islands and Cypress Swamp, habitats that also support many colonial nesting waders and transient landbirds (along with Shrub-scrub)

<sup>2</sup> Includes Wetland Sloughs, Wet Prairies, Sawgrass, and Cattail, as well as open water and drier grasslands

<sup>3</sup> In addition to other birds using impoundments, shorebirds require special management attention and priority species are listed here.

## *Existing & Potential Partners*

### **Federal, State, and Local Agencies**

ACME Drainage District  
 City of Boca Raton  
 City of Boynton Beach  
 City of Delray Beach  
 Florida Fish and Wildlife Conservation Commission  
 Florida Division of Forestry  
 Florida Department of Environmental Protection  
 Florida Department of Tourism  
 Florida Park Service  
 Lake Worth Drainage District  
 Palm Beach County Planning Department  
 Palm Beach County Environmental Resources Management  
 Palm Beach County Cooperative Extension Service  
 South Florida Water Management District  
 Town of Lantana  
 Town of Royal Palm Beach  
 Town of Palm Springs  
 Town of Loxahatchee  
 United States National Park Service (Everglades National Park)  
 United States Corps of Engineers  
 United States Geological Survey-Biological Research Division (Florida Cooperative Fish and Wildlife Research Unit)  
 Village of Wellington  
 West Palm Beach Convention and Visitors Bureau  
 West Palm Beach County Commission

### **Landowners in the Everglades Agricultural Area**

Agricultural Community Groups  
 Sugar Cane League  
 Surrounding Land Owners

### **Universities and Other Learning Institutions**

Environmental Sciences and Technology at Forest Hill High School  
 Environmental Academy at Jupiter High School  
 Florida State University  
 Florida International University  
 Florida Atlantic University  
 Lynn University  
 Miami-Dade School Board  
 Nova University  
 Palm Beach County School Board  
 Palm Beach Community College  
 Palm Beach Atlantic College  
 Region 5 - Regional Service Project (Broward Community College)  
 School Board of Broward County  
 University of Florida (Department of Wildlife Ecology and Conservation)  
 (Institute of Food and Agricultural Sciences)  
 (Department of Recreation, Parks and Tourism)

### **Organizations**

1000 Friends of Florida  
 4-H Club  
 Arthur R. Marshall Foundation  
 Atala Chapter of the North American Butterfly Association  
 Audubon Society of the Everglades  
 Big Reel Bassmasters of Margate  
 Boys and Girls Club of Palm Beach County  
 Christian Bass Anglers Association  
 Ducks Unlimited  
 Everglades Coordinating Council  
 FLEPPC - Florida Exotic Pest Plant Council  
 Florida Greenways  
 Florida Trail Association  
 Florida Wildlife Federation  
 Florida Wildlife Society  
 Florida Greenways

Friends of the Everglades  
 Governor's Council  
 Graves Museum (Broward County Archaeological Society)  
 Gulfstream Boy Scout Council  
 Local Media Contacts - Television, Newspaper, Radio  
 Loxahatchee Natural History Association  
 Miami Geological Society  
 Miccosukee Tribe of Indians of Florida  
 National Audubon Society Everglades Conservation Office  
 Native Plant Society  
 Outdoor Media Writers  
 Palm Beach Heritage and Tourism Association  
 Palm Beach County Parks and Recreation  
 Palm Beach County's Environmental Sensitive Lands Acquisition Committee (ESLASC)  
 Palm Beach County Horse Industry Council, Inc.  
 Palm Glades Girl Scout Council  
 Palm Beach Pack and Paddle Club  
 PalmNet - Palm Beach County Environmental Network  
 Renegade Bass Club  
 Royal Palm Audubon Society  
 Seminole Tribes of Florida  
 Sierra Club  
 South Florida Sportsmen and Conservation Association  
 Southeast Archaeological Society  
 Southeast Exotic Pest Plant Council (SEPPC)  
 The Nature Conservancy  
 Treasure Coast Regional Planning Council  
 Waterfowl USA



COOPERATIVE AND LICENSE AGREEMENT  
BETWEEN  
THE CENTRAL AND SOUTHERN FLORIDA  
FLOOD CONTROL DISTRICT  
AND  
THE UNITED STATES OF AMERICA

THIS AGREEMENT, made and entered into between Central and South Florida Flood Control District, (hereinafter referred to as the District) pursuant to Chapters 25209 and 25214, Laws of Florida, Acts of 1949, and the United States Department of the Interior, acting by and through the Fish and Wildlife Service (hereinafter referred to as the Service), pursuant to the Act of August 14, 1946, (60 Stat. 1080).

WITNESSETH:

The parties hereto, for themselves and their respective successors and assigns, do hereby mutually covenant and agree as follows:

1. The District hereby grants a license upon, and makes available to the Service for the purposes and subject to the terms and conditions hereinafter set forth, all those portions of the real property, or interests therein, acquired or to be acquired by District in connection with the area designated as Conservation Area Number One, a part of the Central and Southern Florida Flood Control District, in Palm Beach County, Florida, together with all improvements which are located thereon (hereinafter referred to as the property). Those portions of the property already acquired by the District in connection with Conservation Area Number One, which are to be made subject to the terms and conditions of this license and agreement, are described in "Exhibit A", and those portions of the property to be acquired by the District in connection with Conservation Area Number One, which are to be made subject to the terms and conditions of this license and agreement, are described in "Exhibit B", such exhibits being attached hereto and expressly made a part hereof. The property described in "Exhibit B", or any part of such property, shall become subject to all of the terms and conditions of this license and agreement, or any renewal thereof, when any interest or title thereto has vested in the District, but not before such time. The District shall notify the Service in writing when title to any of the property described in "Exhibit B" has vested in the District.
2. The Service shall use said property as a Wildlife Management Area, to promote the conservation of wildlife, fish and game, and for other purposes embodying the principles and objectives of planned multiple land use.

These objectives are to be attained through the following management practices covering the wildlife and recreational phases of land use represented by this area.

- (a) Wildlife: Adequate provisions shall be made to maintain the wildlife resources in a productive condition, through:
  - (1) Maintaining as closed areas for breeding and feeding grounds so much of the unit as will ensure maximum stocks of game, fish and furbearers and thus permit the harvesting of surpluses.
  - (2) Maintenance and development of wildlife environments and habitat where such use is not inconsistent with the use of the land for flood control and water retention purposes.
  - (3) Planting of cultivated crops and natural wildlife foods to increase the carrying capacity of the area for wildlife.
  - (4) Construction, operation, and maintenance of such canals, ditches, and subimpoundments as may be deemed necessary by the Service for the purposes of creating conditions suitable for wildlife species using the area. Provided, that such construction, operation and maintenance shall be consistent with the objectives of flood control and other allied purposes in the area.

- (5) Opening by regulation of the Service of portions of the area to controlled public hunting, fishing and trapping, whenever the Service determines such procedure to be necessary for the harvesting of surplus stocks of game, fish and furbearers. Open only for harvesting the surplus stock and shall conform to State law and regulations.
  - (b) Recreation:  
Recreational facilities existing or to be developed, shall be operated, maintained, and administered according to the following principles and objectives:
    - (1) The recreational facilities shall be available for the use and benefit of the general public.
    - (2) Fees charged for the use of the facilities shall be non-discriminatory and consistent with the public non-profit character of the area. Such controlled public hunting and fishing as is allowed by the Service shall be made available to the general public without charge.
    - (3) All recreational facilities which may be developed in the future shall be located where their use will not interfere with the use of the land for flood control and water retention purposes.
  - (c) Monies obtained from the sale or granting of permits by the Service for trapping and other economic uses are to be retained by the Service for deposit and distribution under Section 401 of the Act of June 15, 1935 (49 Stat. 383-16 U.S.C. 715s).
3. The use of said property by the Service shall be subject to the requirements and uses by the Corps of Engineers and the District for flood control and other salied purposes and the Service shall not be obligated in any manner for costs, charges, expenses, or other obligations as are properly chargeable to the maintenance and development of the flood control activities. The use of said property shall be further subject all valid easements, rights-of-way, licenses, and outstanding interests in, upon, across, or through said property.
4. The District reserves all right not vested in private persons, corporations or other public agencies, to the oil, gas, coal and other mineral ores whatsoever, upon, in or under said property, together with the using mineral rights, powers and privileges, including the right of access to the use of such parts of the surface of the promises an may be necessary for mining and saving said minerals. The Service, however, shall have the right to use stone, marl, sand or peat and similar substances from, said property, provided such materials are used for construction purposes upon or in connection with said property. The license herein granted to the Service is subject to the rights of the District and to the rights heretofore vested in private persons and public agencies, as the same appear of record, to mine, explore for and develop, any mineral in, under or upon said lands, including oil and gas, and including the right of ingress and egress on, upon or across such lands as may be necessary for the purposes stated.

In the event the District determines that the exercise of the said mining rights are necessary and not inconsistent with the purposes referred to in Section 2 above, it agrees that the exploration by the District, its successors or assigns, the drilling for, development of, and the transportation or removal of mineral resources, including oil, and the control of abandoned wells or wells taken out of production, shall be conducted by the most approved methods. Paramount consideration shall be given to the prevention both of pollution and contamination by oil or field brine and of other oil field contamination or damage of the lands for wildlife refuge purposes. Human occupancy and housing facilities therefor and structures erected for drilling, development, transportation removal of mineral resources, will be held to a minimum. Any inevitable waste in proximity to the sources will be so confined as to prevent escape that might otherwise occur as a result of rains or high water.

Suitable provisions will be made for the removal of oil field brine from the area, by pipe line or any other approved method, so as not to contaminate the lands or the water in the ponds or lakes now created or that may thereafter be created.

5. The terms of this license and agreement shall be fifty (50) years beginning on the 1st day of January, 1951, and ending on the 1st day of January, 2001, and shall automatically be renewed for three (3) successive terms of fifteen (15) years unless written notice to the contrary is given by either party to the other not less than ninety (90) days prior to the termination of this instrument, or any renewal thereof, and each renewal shall be subject to all of the terms and conditions of this license and agreement.
6. The Service shall not use or permit to be used, and shall take such measures as may be necessary to prevent the use or occupancy of said property, or any portion thereof, for any purpose which is inconsistent or incompatible with the purposes set forth in Section 2 above; nor shall the Service, except with the written consent of the District, assign any of its rights or obligations under this license and agreement, or any renewal thereof, or grant or create any rights in favor of third persons with reference to said property. This provision shall not be construed to apply to such employees of the Service as are engaged in the administration of said property during the period they are actually so engaged.

The Service shall not, except with the written consent of the District, authorized or permit third persons, including employees of the Service engaged in the administration of the area, to erect structures or dwellings on the property, whether such authorization or permission creates any rights in such third persons or not. This provision shall not be construed as requiring a permit from the Service to mine, explore or develop the minerals, including oil and gas, as provided for in Section 4.
7. The Service shall assume and defray all costs, charges, expenses, and other obligations except as otherwise provided for under Section 3, incident to the use of said property for the purposes provided herein, shall maintain said property in good condition and repair, making all repairs and replacements necessary caused by deterioration, damage, use, negligence, or any other cause whatsoever, and shall not remove any improvements except in accordance with Section 12 below, or alter any major improvements without the written consent of the District.
8. The obligations of the Service under this agreement are conditioned upon the passage of an appropriation by Congress from which expenditures thereunder may be made and shall not obligate the Service upon the failure of Congress to so appropriate.
9. The District agrees to hold and save the Service free from damages due to the right to operate under the terms of this license and agreement. The Service agrees to hold and save the District free from damages due to operations under the terms of this license and agreement.
10. The Service shall submit, not later than one year after the effective date of this license and agreement, a general plan of operation and development, setting forth the measures to be taken by the service to effectuate the purposed of this license and agreement. The Service shall also permit at all times, any duly authorized representative or representatives of the District to enter upon and inspect said property.
11. Upon the expiration or termination of this license and agreement, or any renewal thereof, the service shall quietly and peaceably vacate said property and surrender possession thereof, and the District may immediately, or at any time thereafter, re-enter and take possession of the property and remove all persons therefrom.
12. Upon the expiration or termination of this license and agreement, or any renewal thereof, the Service shall have the right to remove only those improvements which have been erected exclusively with funds specifically or generally appropriated by the Congress of the United states. Provided, however, that no such right for removal shall extend to, or include, any works constructed as a part of the flood control program.
13. The invalidity or any provision of this instrument, or of any part thereof, shall not affect the validity of the remaining provisions or the rights and obligations of the parties thereunder.

- 14. The failure of the District to insist upon the strict performance of any of the terms, covenants, agreements and conditions herein contained shall not constitute a waiver or relinquishment of the right of the District to enforce thereafter such terms, covenants, agreements, or conditions, but the same shall continue in full force and effect.
- 15. Any notice, consent, or other action to be given or done by the District under this license and agreement, or any renewal thereof, shall be valid only if in writing and executed by the Chairman of the Board of Governors of the Central and Southern Florida Flood Control District, or his duly authorized representative, or in the case of a successor to the rights of the Central and Southern Florida Flood Control District, by the chief administrative officer of such successor, or his duly authorized representative. All notices to be given by the District under this license and agreement, or any renewal thereof, shall be delivered or forwarded by mail to the Director, Fish and Wildlife Service, United States Department of the Interior, Washington, D.C.  
  
Any notice, consent, or other action to be given by the Service under this license and agreement, or any renewal thereof, shall be valid only if in writing and executed or performed by the Secretary of the Interior or his duly authorized representative, or in the case of a successor to the rights of the Department of the Interior, by the chief administrative officer of such successor or his duly authorized representative. All notices to be given by the Service under this license and agreement, or any renewal thereof, shall be delivered or forwarded by mail, addressed the Central and Southern Florida Flood Control District, West Palm Beach, Florida, or its successor hereunder.
- 16. No member of or delegate to Congress or Resident Commissioner shall be admitted to any share or part of this license and agreement, or any renewal thereof, or to any benefit to arise therefrom.
- 17. This license and agreement shall become effective when duly executed by all parties indicated below, but possession of the said property shall not be granted until January 1, 1951, the beginning of the 50-year primary term provided for in paragraph 5 hereof.
- 18. It is understood and agreed that in the operation and management of the Conservation area lands for the primary purpose of flood control and other allied purposes, the lands and waters will be managed and operated in the manner most consistent with Section 2 hereof, so far as it is not inconsistent with the said primary purpose.

IN WITNESS WHEREOF, the parties hereto have hereunto subscribed their names as of the date indicated.

CENTRAL AND SOUTHERN FLORIDA  
FLOOD CONTROL DISTRICT

Date \_\_\_\_\_ BY \_\_\_\_\_  
Chairman of the Board of Governors

THE UNITED STATES OF AMERICA

\_\_\_\_\_  
Secretary of the Interior

Date \_\_\_\_\_ BY \_\_\_\_\_  
Director, Fish and Wildlife Service

*NOTE: THE SIGNATURES ARE MISSING BECAUSE THIS DOCUMENT WAS RE-TYPED FOR THIS CCP. THE DOCUMENT WAS RE-TYPED IN ITS ENTIRETY.*

AMENDMENT TO COOPERATIVE LICENSE AGREEMENT BETWEEN THE  
CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT  
AND  
UNITED STATES OF AMERICA

WHEREAS, a cooperative license agreement was entered into between Central and Southern Florida Flood Control District and the United States of America acting by and through the Fish and Wildlife Service of the Department of Interior, pertaining to Conservation Area No. 1, which, among other things, provided for the southerly and southwesterly boundary of said Conservation Area No. 1 as described therein to be generally the northeastern canal bank of the Hillsboro Canal in Palm Beach Country, Florida, and

WHEREAS, it is desirable to establish the southerly and southwesterly boundary of said Conservation Area No. 1, as described in said agreement and "Exhibit A" and "Exhibit B" attached thereto, as the centerline of Levee L-39 to be hereafter constructed along the southerly and southwesterly side of said Hillsboro Canal, and

WHEREAS, such a boundary line for said conservation area will conform to the boundary line between Conservation Area No. 1 and Conservation Area No. 2 as provided in the flood control project document, namely, House Document No. 643, 80th Congress, 2d Session.

NOW, THEREFORE, in consideration of the premises, and the mutual covenants and agreements hereinafter set forth, the parties hereto for themselves and their respective successors and assigns do hereby amend the said cooperative license agreement to provide therein that the southerly and southwesterly boundary of Conservation Area No. 1 comprising the lands that are described in "Exhibit A" and Exhibit B" of said agreement shall henceforth be the centerline of Levee L-39 to be constructed along the southerly and southwesterly side of the Hillsboro Canal and that except for the establishment of the new southerly and southwesterly boundary line for said Conservation Area No. 1, as provided herein, all of the terms, provisions and covenants contained in said cooperative and license agreement shall remain in full force and effect.

IN WITNESS WHEREOF, the parties hereto have hereunto subscribed their names as of the dates indicated.

CENTRAL AND SOUTHERN FLORIDA  
FLOOD CONTROL DISTRICT, AND ITS  
GOVERNING BOARD

Date \_\_\_\_\_

BY \_\_\_\_\_  
Chairman

ATTEST

\_\_\_\_\_  
Secretary  
THE UNITED STATES OF AMERICA

*NOTE: THE SIGNATURES ARE MISSING BECAUSE THIS DOCUMENT WAS RE-TYPED FOR THIS CCP. THE DOCUMENT WAS RE-TYPED IN ITS ENTIRETY.*

SECOND AMENDMENT TO COOPERATIVE AND LICENSE AGREEMENT  
BETWEEN THE  
CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT  
AND  
THE UNITED STATES OF AMERICA

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WHEREAS, on June 8, 1951, the United States of America, acting by and through the Fish and Wildlife Service of the Department of the Interior, did enter into a cooperative and license agreement with the Central and Southern Florida Flood Control District, for the use of certain property in Palm Beach County, Florida, known as Conservation Area No. 1, for a wildlife management area, and

WHEREAS, by amendment dated July 8, 1953, the said parties extended the southerly and southwesterly boundary to the centerline of Levee L-39, which has been constructed along the southerly and southwesterly side of the Hillsboro Canal, and

WHEREAS, because of changes in construction plans south of the Palm Beach Canal, the original northern boundary of the Loxahatchee National Wildlife Refuge is impractical to administer, and it is desirable to revise said boundaries to permit posting on the ground, and

WHEREAS, the Central and Southern Florida Flood Control District, the Florida Game and Fresh Water Fish Commission, and the Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, propose to authorize a joint recreational concession on the Hillsboro Canal in the vicinity of Structure S-39, and

WHEREAS, in order to establish the proposed concession, it is necessary to further amend the boundary of land included in the Loxahatchee National Wildlife Refuge so as to clarify the line between Conservation Areas No. 1 and No. 2, and to add a small area of land not now included in the aforesaid cooperative license agreement, as amended,

NOW, THEREFORE, in consideration of the premises, and the mutual covenants heretofore set forth, the parties hereto, for themselves, their respective successors and assigns, do hereby further amend the said cooperative and license agreement to provide that the following-described portions of the boundary shall henceforth replace the respective lines described in Exhibits "A" and "B" of said agreement, as amended, and that except for this change in boundary, all of the terms, provisions, and covenant contained in said cooperative and license agreement shall remain in full force and effect.

DESCRIPTION - NORTH BOUNDARY

The following description is a revision to and the reestablishment of the north boundary of that part of Conservation Area No. 1, in sec. 32, T. 43 S., R. 40E., under the cooperative and license agreement between the Central and Southern Florida Flood Control District and the United States Fish and Wildlife Service.

From the Southwest corner of said Section 32, bear South 88°16'55" East along the South line of said Section, a distance of 537.69 feet to the intersection thereof with a line that is 32 feet Northwesterly of and parallel to the centerline of Levee L-7; said point of intersection being the point of BEGINNING.

Thence, North 34°28'58" East, a distance of 852.78 feet to the point of curvature of a curve to the right, having a central angle of 57°06'31" and a radius of 1,032.00 feet;

Thence, Northeasterly, along the arc of said curve, a distance of 1,028.63 feet to the point of tangency;

Thence, continuing along a line that is 32 feet Northerly and parallel to the centerline of Levee L-7 on a bearing of South 88°24'31" East, a distance of 1,668.42 feet to the centerline of Levee L-12;

Thence, South 28°48'13" East, along said centerline, a distance of 37.10 feet to the centerline of Levee L-7;

Thence, South 88°24'31" East, a distance of 185.32 feet to the intersection with a line that is 25 feet Southeasterly of and parallel to the Southerly face of the Structure S-5A Pump Station building;

Thence, North 46°31'41" East, a distance of 347.19 feet to the centerline of a connecting levee embankment;

Thence, along said centerline of levee embankment and its easterly projection, South 80°49'13" East, a distance of 966.81 feet to a point, said point being on a line that is 30 feet southerly of the centerline of Structure S-5A South;

Thence, South 89°02'36" East, a distance of 321.17 feet to the East line of the right-of-way of Levee L-40 and the end of the specifically described line; said point being North 0°57'24" East, a distance of 1,287.85 feet from Southeast corner of Section 32.

**DESCRIPTION - SOUTH BOUNDARY**

The following description is a revision to and the reestablishment of the south boundary of that part of Conservation Area No. 1, in sec. 13, T. 47 S., R. 40 E. and sec. 19, T. 47 S., R. 41E. Under the cooperative and license agreement between the Central and Southern Florida Flood Control District and that United states Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife.

Beginning at the intersection of the west right-of-way line of Levee L-36 and the centerline of Levee L-39;

Thence, South 72°11'31" East, a distance of 383.4 feet, more or less, along the centerline of Levee L-39, extended, to the intersection therefor with the centerline of Levee L-36;

Thence, East a distance of 175 feet, more or less, to the East bank of Levee L-36 Borrow Canal;

Thence, South along the East bank of said Borrow Canal, a distance of 985.4 feet;

Thence, East a distance of 112 feet, more or less, to the East line of sec. 13, T. 47 S., R. 40 E.,

Thence, North 0°03'33" West along the East line of said Section 13, a distance of 978.83 feet;

Thence, South 72°11'31" East, along a line parallel to the centerline of the Hillsboro Canal, a distance of 347.12 feet;

Thence, North 17°11'31" West, a distance of 415.6 feet, more or less, to the intersection thereof with the East right-of-way line of Levee L-40 and the end of the said portion of description.

The bearings in the above descriptions refer to the standard plane rectangular coordinate system for the East Zone of Florida.

IN WITNESS WHEREOF, the parties hereto have hereunto subscribed their names as of the dates indicated.

**CENTRAL AND SOUTHERN FLORIDA FLOOD  
CONTROL DISTRICT, BY ITS GOVERNING  
BOARD**

Date \_\_\_\_\_

By \_\_\_\_\_  
Vice Chairman

Attest \_\_\_\_\_  
Secretary

THE UNITED STATES OF AMERICA

Date \_\_\_\_\_

FRED A. SEATON  
Secretary of the Interior

By \_\_\_\_\_  
Regional Director Bureau of Sport  
Fisheries and Wildlife

NOTE; THE SIGNATURES ARE MISSING BECAUSE THIS DOCUMENT WAS RE-TYPED FOR THIS CCP. THE DOCUMENT WAS RE-TYPED IN ITS ENTIRETY.

THIRD AMENDMENT TO COOPERATIVE AND LICENSE AGREEMENT  
BETWEEN THE  
CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT  
AND  
THE UNITED STATES OF AMERICA

WHEREAS, on June 8, 1951, the United States of America, acting by and through the Fish and Wildlife Service of the Department of the Interior, did enter into a cooperative and license agreement with the Central and Southern Florida Flood Control District, for the use of certain property in Palm Beach county, Florida, known as Conservation Area No. 1, for a wildlife management area, and

WHEREAS, by amendment dated July 8, 1953, the said parties extended the southerly and southwesterly boundary to the centerline of Levee L-39, which has been constructed along the southerly and southwesterly side of the Hillsboro Canal, and

WHEREAS, by second amendment dated December 15, 1959, the said parties further modified the southwesterly and northern boundaries in order to establish a proposed concession, to clarify the line between Conservation Areas Nos. 1 and 2, and to add a small area of land to the refuge, and

WHEREAS, it is desirable to establish an administrative boundary along the southwest side of United States Tract (10 so as to include a portion of the right-of-way of the Hillsboro Canal held by said Central and Southern Florida Flood Control district which is not now included in the aforesaid cooperative and license agreement as amended.

NOW, THEREFORE, in consideration of the premises and the mutual covenants heretofore set forth, the parties hereto, for themselves, their respective successors and assigns, do hereby further amend said cooperative and license agreement to include that portion of the Hillsboro Canal right-of-way in Palm Beach County, Florida, extending from the northeast bank of said canal northeasterly to the right-of-way line in Lot 4, Hiatus Township 45-46 South, Range 39 East, and in Section 4, Township 46 South, Range 30 East, which is more particularly described as follows:

A strip of land about 220 feet wide and 9,147.5 feet long lying between the northeast bank of the Hillsboro Canal and the northeast right-of-way line of said Hillsboro Canal, and bounded: On the northeast by U.S. tract (10): on the east by the east line of sec. 4, T. 46 S., R. 39 E.; on the southwest by the bank of said Hillsboro Canal; and on the west by the west line of Lot 4, Hiatus T. 45-46 S., R. 39 E.; containing 46.20 acres, more or less.

The lands contained in this amendment are hereby added to and made a part of the Cooperative and License Agreement dated June 8, 1951, as amended, and the terms, provisions, and covenants contained in said Cooperative and License Agreement as amended shall apply to the lands hereinbefore described.

This Amendment may be revoked at anytime upon 6 months' written notice of the Central and Southern Florida Flood Control District to the United States of America.

IN WITNESS WHEREOF, the parties hereto have hereunto subscribed their names as of the dates indicated.

CENTRAL AND SOUTHERN FLORIDA FLOOD  
CONTROL DISTRICT, BY ITS GOVERNING  
BOARD

Date July 23, 1962

By \_\_\_\_\_  
Chairman

Attest \_\_\_\_\_  
Secretary

THE UNITED STATES OF AMERICA

Date \_\_\_\_\_  
Secretary of the Interior

STEWART L. UDALL

By \_\_\_\_\_  
Regional Director, Bureau of  
Sport Fisheries and Wildlife

NOTE; THE SIGNATURES ARE MISSING BECAUSE THIS DOCUMENT WAS  
RE-TYPED FOR THIS CCP. THE DOCUMENT WAS RE-TYPED IN ITS  
ENTIRETY.

AMENDMENT NO. 4  
TO THE COOPERATIVE AND LICENSE AGREEMENT  
BETWEEN THE  
SOUTH FLORIDA WATER MANAGEMENT DISTRICT  
AND  
THE UNITED STATES OF AMERICA

This AMENDMENT NO. 4 entered into on the 7th Day of Jan. 1994 to that Cooperative and License Agreement (“AGREEMENT”), dated June 8, 1951, as amended July 8, 1953, December 15, 1959, and July 23, 1962 between the “Parties”, the South Florida Water Management District, (“DISTRICT”) formerly known as Central and Southern Florida Flood Control District and the United States of America, acting by and through the Fish and Wildlife Service of the Department of The Interior (“the USA”);

WHEREAS, on June 8, 1951, the USA, did enter into a certain Cooperative and License Agreement, hereinafter referred to as the “License Agreement”, with the Central and Southern Florida Flood Control District, n/k/a the South Florida Water Management District, for the use of certain property in Palm Beach County, Florida, known as Conservation Area No. 1, hereinafter referred to as the “Refuge”, for a wildlife management area, and

WHEREAS, by amendment to the AGREEMENT, dated July 8, 1953, the parties extended the southerly and southwesterly boundary to the centerline of Levee 39, which has been constructed along the southerly and southwesterly side of the Hillsboro Canal, and

WHEREAS, by second amendment to the AGREEMENT, dated December 15, 1959, the parties further modified the southwesterly and northern boundaries in order to establish a proposed concession, to clarify the line between Conservation Areas Nos. 1 and 2, and to add a small area of land to the Refuge, and

WHEREAS, by third amendment to the AGREEMENT, dated July 23, 1962, the parties established an administrative boundary along the southwest side of United States tract (10) so as to include a portion of the right-of-way of the Hillsboro Canal held by the DISTRICT, and

WHEREAS, it is desirable to modify and adjust the boundaries of the Refuge, so as to exclude certain lands from the Refuge which are currently included in the License Agreement; and

WHEREAS, the DISTRICT and the USA desire that the USA perform management services for certain additional lands similar to services provided for the Refuge; and

Amendment No. 4 to Contract No. C-3359, Page 1 of 5

WHEREAS, the Governing Board of the DISTRICT, at it April 15, 1993 meeting, has authorized entering into this AMENDMENT NO. 4 and has authorized the DISTRICT’S Executive Director, or his designee, to execute this AMENDMENT NO. 4:

NOW, THEREFORE, in consideration of the premises and the mutual covenants heretofore set forth, the parties hereto, for themselves, their respective successors, and assigns, do hereby further amend the License Agreement as follows:

1. EXCLUSION OF PROPERTY

The property described in Exhibit “A: and depicted in Exhibit “B” both Exhibits being attached hereto and made a part hereof (the “Excluded Property”) is hereby removed, released and excluded from the Refuge and from the License Agreement and the terms, provisions and covenants contained therein.

2. ADDITIONAL PROPERTY

The property described in Exhibit “C” and depicted in Exhibits “D”, “E” and “F” all Exhibits being attached hereto and made a part hereof (the “Additional Property”) is hereby made subject to the License Agreement, as modified by this AMENDMENT, and shall become a part of the Refuge, subject to the provisions herein, including but not limited to paragraphs 10, 11, and 13, below.

3. MALRITE LEASE

The Strazzulla Property is subject to the existing lease with Malrite of Florida, Inc. attached hereto and made a part hereof as Exhibit "G". All rental payments due under the terms of said lease shall remain payable to the DISTRICT. Representatives of Malrite of Florida, Inc. Shall have the full right of access to the Strazzulla Property for the purposes set forth in said lease.

4. FUTURE EXCLUSION OF PROPERTY

The parties hereby agree that the hatched area, depicted on Exhibit "H" attached hereto and made a part hereof, and any other minor boundary adjustments related thereto which the parties deem desirable to make (the "Future Excluded Property"), shall be automatically removed, released and excluded from the License Agreement and the terms, provisions and covenants contained therein in the future, upon the sending by the District to the USA of a detailed legal description of the Refuge boundary and the Additional Land Boundary which excludes the Future Excluded Property (the "New Boundary Description"). The New Boundary Description shall be prepared by the District after completion of proposed Levee 101 and after consultation with the USA.

Amendment No. 4 to Contract No. C-3359, Page 2 of 5

5. EFFECTIVE DATE

The effective date of this amendment shall be the date that the last party hereto executes this AMENDMENT. The effective date of the removal, release and exclusion of the future Excluded Property shall be the date that the USA receives the New Boundary Description. The New Boundary Description shall be effective without further consent or approval by the DISTRICT'S Governing Board or the USA.

6. RIGHT TO CONTINUE REFUGE ADMINISTRATION

Prior to the receipt of the New Boundary Description by the USA, the USA shall have the right to continue with the administration on the Future Excluded Property, including but not limited to the right to patrol and enforce the rules and regulations thereon pursuant to the License Agreement as hereby amended.

7. RIGHT OF ENTRY TO CONSTRUCT AND MAINTAIN

USA hereby grants the DISTRICT, its agents and contractors, the right to enter the Refuge for the purpose of constructing and maintaining Levee 101 and its associated borrow canal, as shown on Exhibit "H", together with any other associated facilities. USA agrees to execute and all other instruments that may be reasonably required to acknowledge the USA's consent to the DISTRICT'S construction and maintenance of Levee 101 and borrow canal and any associated structures.

8. APPROVAL OF PLANS AND SPECIFICATIONS

The DISTRICT agrees to consult with USA in the development and preparation of the plans and specifications for the construction of Levee 101, its associated borrow canal, and any related structures. The plans and specifications will be submitted to the United States Army Corps of Engineers District Engineer, Jacksonville District for review, permitting, and approval prior to the DISTRICT commencing construction.

9. DOCK INSTALLATION

USA agrees to install a dock at a suitable location on the south side of Levee 30 for the use of airboaters patronizing the Hillsboro Recreation Area Concession. The DISTRICT retains the unrestricted right to use the dock.

Amendment No. 4 to Contract No. C-3359, Page 3 of 5

10. MANAGEMENT AND USE OF ADDITIONAL LANDS

USA agrees to manage the Strazzulla Property in accordance with the environmental restoration and protection goals and objectives of Florida's Save Our Rivers program and to permit public access and use of the Strazzulla Property for recreational activities consistent with those goals and objectives and the needs of the Refuge. USA recognizes the DISTRICT'S rights, duties, and obligations with respect to the Strazzulla Property under the Save Our Rivers program, and acknowledges that said rights, duties, and responsibilities and use of the Strazzulla Property related thereto are in no way diminished by the addition of the Strazzulla Property to the License Agreement for purposes of management by USA. USA further acknowledges the unrestricted right of the DISTRICT to use the Strazzulla Property for any purposes consistent with the DISTRICT mission and goals including but not limited to the unrestricted right to flow water on, over and across the Strazzulla Property as the DISTRICT deems necessary.

11. INTENT OF THE PARTIES

The parties believe that management of the Strazzulla Property can be provided more efficiently and economically by the USA as a part of the Refuge than by the DISTRICT. The USA can provide on-site presence, public use opportunities, security, exotic control, as well as other public benefits, using nearby available resources while the DISTRICT would have to bring that effort from a remote location. The parties recognize that the Strazzulla Prepaid provides a good transition between the Refuge to the west and the development area to the east.

The parties also recognize that large amounts of fresh water are being lost to tide each year, and that plans/projects which would provide for repeated cycling of fresh water of appropriately high quality to the everglades would be in the public interest. To that end, the DISTRICT is considering a number of options to reduce loses to tide and increase flows to the Everglades. One or more of those options could involve the use of appropriate lands east of the everglades as transition or buffer areas. Further, it is understood and agreed that such uses of the Strazzulla Property by the DISTRICT may be considered by the USA to be incompatible with the continued inclusion of the Strazzulla Property as a part of the Refuge.

It is the express intent of the parties that this AMENDMENT not be used as the basis for limiting or restricting options available to the DISTRICT regarding the ultimate use of the Strazzulla Property.

12. ACCESS TO LEVEES 39 AND 7

USA acknowledges the need for and agrees to access along and over Levee 39 and Levee 7 by personnel of the Florida Game and Fresh Water Fish Commission in carrying out their duties and responsibilities.

Amendment No. 4 to Contract No. C-3359, Page 4 of 5

13. TERMINATION

This AMENDMENT shall be subject to termination by either party as to the Strazzulla Property as follows:

In the event continued inclusion of the Strazzulla Property as a part of the Refuge is or may become incompatible, or if for any other reason either of the parties choose to terminate this portion of this AMENDMENT, the sole remedy available to both parties shall be to revoke this portion of this AMENDMENT so as to remove the Strazzulla Property from the Refuge and void any continued responsibility of USA for management of the Strazzulla Property.

14. AGREEMENT REMAINS IN FORCE

All other terms of the AGREEMENT, as amended, shall remain in full force and effect.

The parties or their duly authorized representatives hereby execute the AMENDMENT No. 4 on the date first written above.

Legal Form Approved  
SFWMD Office of Counsel

SOUTH FLORIDA WATER MANAGEMENT  
DISTRICT, formerly known as CENTRAL AND  
SOUTHERN FLORIDA FLOOD CONTROL  
DISTRICT, BY ITS GOVERNING BOARD

By: \_\_\_\_\_  
Date: \_\_\_\_\_

By: \_\_\_\_\_  
Assistant Executive Director

THE UNITED STATES OF AMERICA

\_\_\_\_\_  
By \_\_\_\_\_  
Regional Director, Bureau of Sport  
Fisheries and Wildlife n/k/a U.S. Fish and Wildlife  
Service

Amendment No. 4 to Contract No. C-3359, Page 5 of 5

*NOTE: THE SIGNATURES ARE MISSING BECAUSE THIS DOCUMENT WAS RE-TYPED FOR THIS  
CCP. THE DOCUMENT WAS RE-TYPED IN ITS ENTIRETY.*

C-3359-A4

EXHIBIT "A"

DESCRIPTION

EXCLUDED PROPERTY  
WATER CONSERVATION AREA 1

A parcel of land situate in Section 13, Township 47 South, Range 40 East and in Section 19, Township 47 South, Range 41 East, Palm Beach County, Florida; said parcel of land more specifically described as follows:

COMMENCE at the northeast corner of said Section 13; thence, South 00°03'48" East, along the east line of said Section 13, a distance of 3091.73 feet to the POINT OF BEGINNING; thence, South 72°11'31" East, along a line 130.00 feet southerly of and parallel with the center line of the Hillsboro Canal, a distance of 347.37 feet; thence, North 17°48'29" East, a distance of 65 feet, more or less, to a line which approximates the north edge of paving of State Road 827; thence, North 72°11'31" West, along said line, a distance of 630.00 feet; thence, South 17°48'29" West, a distance of 51.52 feet to the easterly prolongation of the physical center line of South Florida Water Management District Levee L-39; thence, South 71°55'25" East, along said easterly prolongation of the physical center line of South Florida Water Management District Levee L-39, a distance of 162.05 feet to a line which approximates the easterly edge of water of South Florida Water Management District Levee L-36 Borrow Canal; thence, South 00°00'00" East, along said line, a distance of 1027.82 feet; thence, North 90°00'00" East, a distance of 112 feet, more or less, to said east line of Section 13; thence, North 00°03'48" West along said east line, a distance of 978.83 feet to the POINT OF BEGINNING.

Bearings based on the Florida State Plane Coordinate System Transverse Mercator East Zone North American Datum 1927, 1972 free adjustment.

Exhibit "A" to Contract No. C-3359, Page 1 of 1

*THIS DOCUMENT WAS RE-TYPED IN ITS ENTIRETY FOR THIS CCP.*

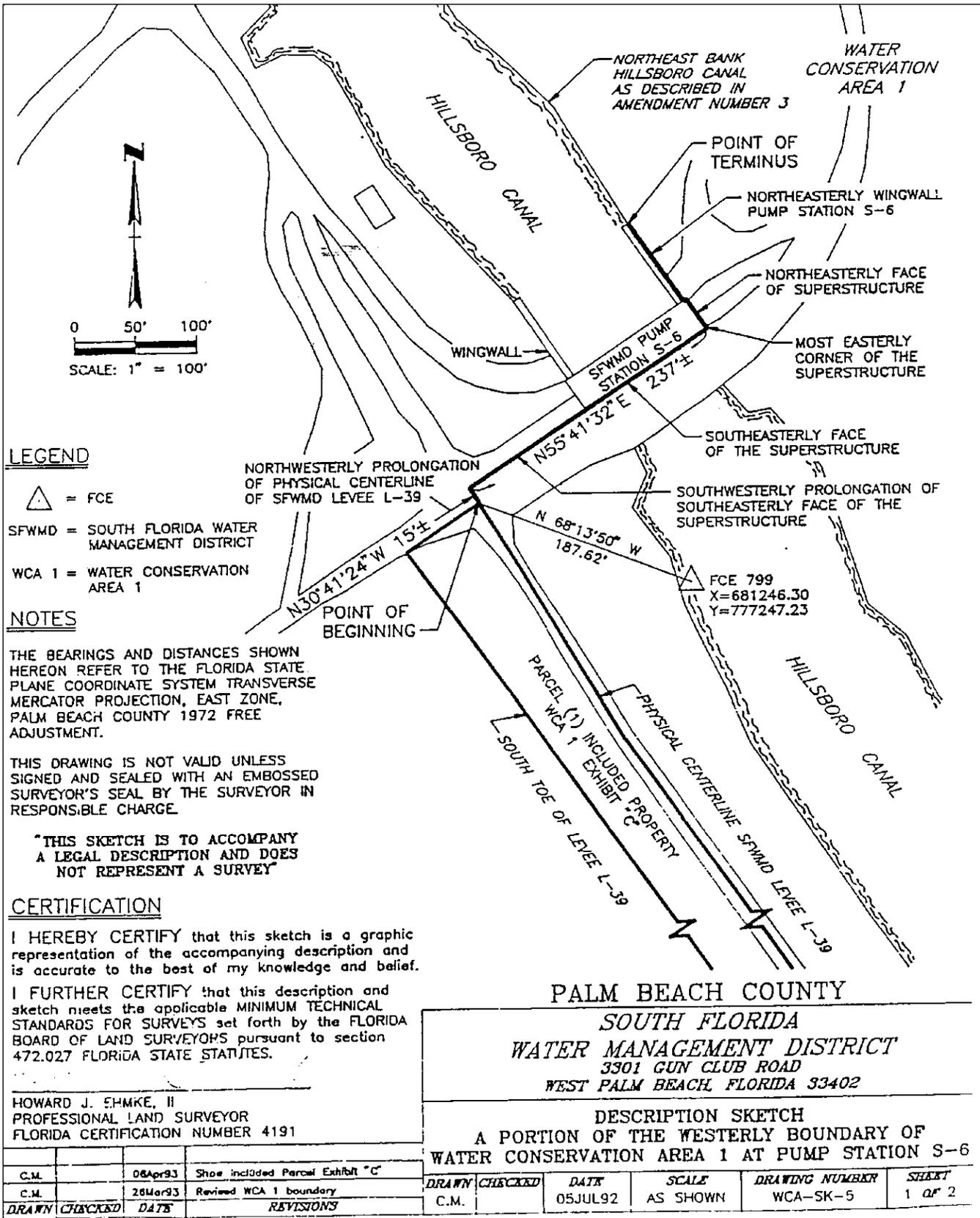


EXHIBIT "C"  
DESCRIPTION  
INCLUDED PROPERTY  
WATER CONSERVATION AREA 1

(1) A parcel of land situate in Township 46 South, Range 39 East and Township 46 South, Range 40 East and Township 47 South, Range 40 East, more particularly described as follows:

Commence at the Northeast corner of Section 13, Township 47 South, Range 40 East, Palm Beach County, Florida; thence,

South 00°03'48" East, along the East line of said Section 13, a distance of 3078.95 feet to the southeasterly projection of the physical center line of South Florida Water Management District's Levee L-39; thence,

North 71°55'25" West, along said projection, a distance of 278.71 feet to the Northerly projection of a line which approximates the easterly toe of South Florida Water Management District's Levee L-36 and the POINT OF BEGINNING; thence,

South 00°00'00" West, along said projection and said line which approximates the easterly toe of said Levee L-36, a distance of 577.00 feet; thence,

North 90°00'00" West, a distance of 121.67 feet to a line which approximates the easterly water's edge of Water Conservation Area 2; thence,

North 02°35'34" West, along said line, a distance of 208.14 feet; thence,

North 04°11'03" East, continuing along said line, a distance of 257.50 feet to a line approximating the northerly water's edge of said Water Conservation Area 2; thence,

North 68°03'54" West, along said line, a distance of 188.39 feet; thence,

North 60°38'19" West, continuing along said line, a distance of 184.57 feet; thence,

North 69°29'54" West, continuing along said line, a distance of 370.09 feet; thence,

North 73°47'44" West, continuing along said line, a distance of 480.62 feet; thence,

North 18°04'35" East, departing said line, a distance of 40.35 feet to a line approximating the southerly toe of said Levee L-39; thence, along said line by the following courses;

North 71°51'59" West, a distance of 1488.64 feet; thence,

North 72°08'56" West, a distance of 1780.30 feet to the beginning of a curve from which the radius point bears South 17°51'04" West a distance of 236.04 feet; thence,

Northwesterly, along the arc of said curve, a distance of 145.11 feet through a central angle of 35°13'25" to a point of reverse curvature from which the radius point bears North 17°23'21" West, a distance of 341.00 feet; thence,

Northwesterly along the arc of said curve, a distance of 310.32 feet through a central angle of 35°20'16"; thence,

North 72°02'05" West, a distance of 515.47 feet to the beginning of a curve from which the radius pint bears North 17°57'55" East, a distance of 337.39 feet; thence,

northwesterly, along the arc of said curve, a distance of 211.43 feet through a central angle of 35°54'21' to a point of reverse curvature of a curve from which the radius point bears South 53°52'16" West, a distance of 234.34 feet; thence,

northwesterly, along the arc of said curve, a distance of 145.94 feet through a central angle of  $35^{\circ}40'55''$ ; thence,

North  $71^{\circ}48'39''$  West, a distance of 2031.43 feet; thence,

North  $71^{\circ}51'59''$  West, a distance of 2000.00 feet; thence,

North  $72^{\circ}04'15''$  West, a distance of 2999.88 feet; thence,

North  $72^{\circ}09'02''$  West, a distance of 5534.10 feet to the beginning of a curve from which the radius point bears South  $17^{\circ}50'58''$  West, a distance of 230.59 feet; thence,

northwesterly, along the arc of said curve, a distance of 145.85 feet through a central angle of  $36^{\circ}14'22''$  to a point of reverse curvature from which the radius point bears North  $18^{\circ}23'24''$  West, a distance of 336.53 feet; thence,

northwesterly, along the arc of said curve, a distance of 213.53 feet through a central angle of  $36^{\circ}21'19''$ ; thence,

North  $72^{\circ}02'05''$  West, a distance of 516.00 feet to the beginning of a curve from which the radius point bears North  $17^{\circ}57'55''$  East, a distance of 357.90 feet; thence,

northwesterly, along the arc of said curve, a distance of 207.31 feet through a central angle of  $33^{\circ}11'16''$  to a point of reverse curvature from which the radius point bears South  $51^{\circ}09'11''$  West, a distance of 240.32 feet; thence,

northwesterly, along the arc of said curve, a distance of 136.30 feet through a central angle of  $32^{\circ}29'47''$ ; thence,

North  $71^{\circ}20'36''$  West, a distance of 275.92 feet; thence,

North  $73^{\circ}16'14''$  West, a distance of 5964.05 feet to the beginning of a curve from which the radius point bears North  $16^{\circ}43'46''$  East, a distance of 644.00 feet; thence,

northwesterly, along the arc of said curve, a distance of 428.37 feet through a central angle of  $38^{\circ}06'40''$ ; thence,

North  $35^{\circ}09'34''$  West, a distance of 4139.23 feet to the beginning of a curve from which the radius point bears South  $54^{\circ}50'26''$  West, a distance of 259.11 feet; thence,

northwesterly, along the arc of said curve, a distance of 152.53 feet through a central angle of  $33^{\circ}43'42''$  to a point of reverse curvature from which the radius point bears North  $21^{\circ}06'44''$  East, a distance of 351.34 feet; thence,

northwesterly, along the arc of said curve, a distance of 207.26 feet through a central angle of  $33^{\circ}47'57''$ ; thence,

North  $35^{\circ}05'19''$  West, a distance of 4309.15 feet; thence,

North  $35^{\circ}11'10''$  West, a distance of 32,808.70 feet to the end of said line approximating the southerly toe of Levee L-39; thence,

North  $54^{\circ}46'00''$  East, a distance of 72.35 feet to a line which approximates the physical centerline of said Levee L-39; thence, along said line by the following courses:

South  $30^{\circ}41'24''$  East, a distance of 233.43 feet; thence,

South  $35^{\circ}10'06''$  East, a distance of 36,885.21 feet to the beginning of a curve from which the radius point bears North  $54^{\circ}49'54''$  East, a distance of 301.34 feet; thence,

southeasterly, along the arc of said curve, a distance of 174.11 feet through a central angle of  $33^{\circ}06'14''$  to a point of reverse curvature from which the radius point bears South  $21^{\circ}43'40''$  West, a distance of 301.11 feet; thence,

southeasterly, along the arc of said curve a distance of 174.10 feet through a central angle of  $33^{\circ}07'40''$ ; thence,

South  $35^{\circ}08'40''$  East, a distance of 4149.33 feet to the beginning of a curve from which the radius point bears North  $54^{\circ}51'20''$  East, a distance of 600.00 feet; thence,

southeasterly, along the arc of said curve, a distance of 399.26 feet through a central angle of 38°07'34"; thence, South 73°16'14" East, a distance of 6231.53 feet to the beginning of a curve from which the radius point bears South 16°43'46" West, a distance of 293.32 feet; thence, southeasterly, along the arc of said curve, a distance of 176.35 feet through a central angle of 34°26'53" to a point of reverse curvature from which the radius point bears North 51°10'34" East, a distance of 304.90 feet; thence, southeasterly, along the arc of said curve, a distance of 176.74 feet through a central angle of 33°12'44"; thence, South 72°02'05" East, a distance of 516.00 feet to the beginning of a curve from which the radius point bears North 17°57'55" East, a distance of 283.53 feet; thence, southeasterly, along the arc of said curve, a distance of 179.86 feet through a central angle of 36°20'43" to a point of reverse curvature from which the radius point bears South 18°22'48" East, a distance of 283.89 feet; thence, southeasterly, along the arc of said curve, a distance of 179.87 feet through a central angle of 36°18'07"; thence, South 72°04'41" East, a distance of 8391.84 feet; thence, South 71°55'25" East, a distance of 4172.83 feet to the beginning of a curve from which the radius point bears South 18°04'35" West, a distance of 286.34 feet; thence, southeasterly, along the arc of said curve, a distance of 178.89 feet through a central angle of 35°47'43" to a point of reverse curvature from which the radius point bears North 53°52'18" East, a distance of 285.39 feet; thence, southeasterly, along the arc of said curve, a distance of 178.85 feet through a central angle of 35°54'23"; thence, South 72°02'05" East, a distance of 515.47 feet to the beginning of a curve from which the radius point bears North 17°57'55" East, a distance of 289.00 feet; thence, southeasterly, along the arc of said curve, a distance of 178.25 feet through a central angle of 35°20'18" to a point of reverse curvature from which the radius point bears South 17°22'23" East, a distance of 288.04 feet; thence, southeasterly, along the arc of said curve, a distance of 178.21 feet through a central angle of 35°26'58"; thence, South 71°55'25" East, a distance of 4539.85 feet to the POINT OF BEGINNING. Bearings based on the Florida State Plane Coordinate System Transverse Mercator East Zone NAD 1927.

(2) Section 4, Township 45 South, Range 41 East, Palm Beach County, Florida:

Less that portion lying southwesterly of the easterly line of South Florida Water Management District Levee 40 as described in Deed Book 942, Page 241, Public Records of said Palm Beach County, and

Less the North 80.00 feet of the East 50.00 feet of said Section 4.

For the purpose of the description, all references to Section 4, Township 45 South, Range 41 East, will include that portion of the Hiatus known as Township 44-1/2 South, Range 41 East which may have been historically described as said Section 4.

Together with:

Section 3, Township 45 South, Range 41 East, Palm Beach County, Florida:

Less those portions of said Section 3 lying southwesterly of the easterly line of said Levee 40 as described in Deed Book 929, Page 24 and Deed Book 934, Page 488, said Public Records, and

Less all that portion of said Section 3 lying southerly of the South line of hiatus Tract 39, Township 44-1/2 South, Range 41 East, and northerly of a line 592.45 feet South of said South line of Hiatus Tract 39 and easterly of the southerly prolongation of a line 2243.56 feet easterly of and parallel with the westerly line of said Hiatus Tract 39.

Together with:

All that portion of said Hiatus Tract 39 lying westerly of a line 2243.56 feet Easterly of and parallel with the westerly line of said Hiatus Tract 39.

Less the North 80.00 feet thereof.

Said Hiatus Tract 39 has also been known as the North 224.04 acres of Section 3, Township 45 South, Range 41 East.

Together with:

All that portion of Section 10, Township 45 South, Range 41 East, Palm Beach County, Florida lying northeasterly of the easterly line of said Levee 40.

Subject to easements of records.

Containing 1603.82 acres, more or less.

(3) All that portion of Water Conservation Area No.1 as bounded by lines defined and amended up to and including Amendment Number 3 to The Cooperative and License Agreement between the Central and Southern Florida Flood Control District and the United States of America, dated July 23, 1962, also bounded by the following described line:

Begin at a point on the physical centerline of South Florida Water Management District Levee L-39, which bears North 68°13'50" West, a distance of 187.62 feet from concrete monument known as FCE 799, having coordinates of X=681246.30 and Y=777247.23; thence,

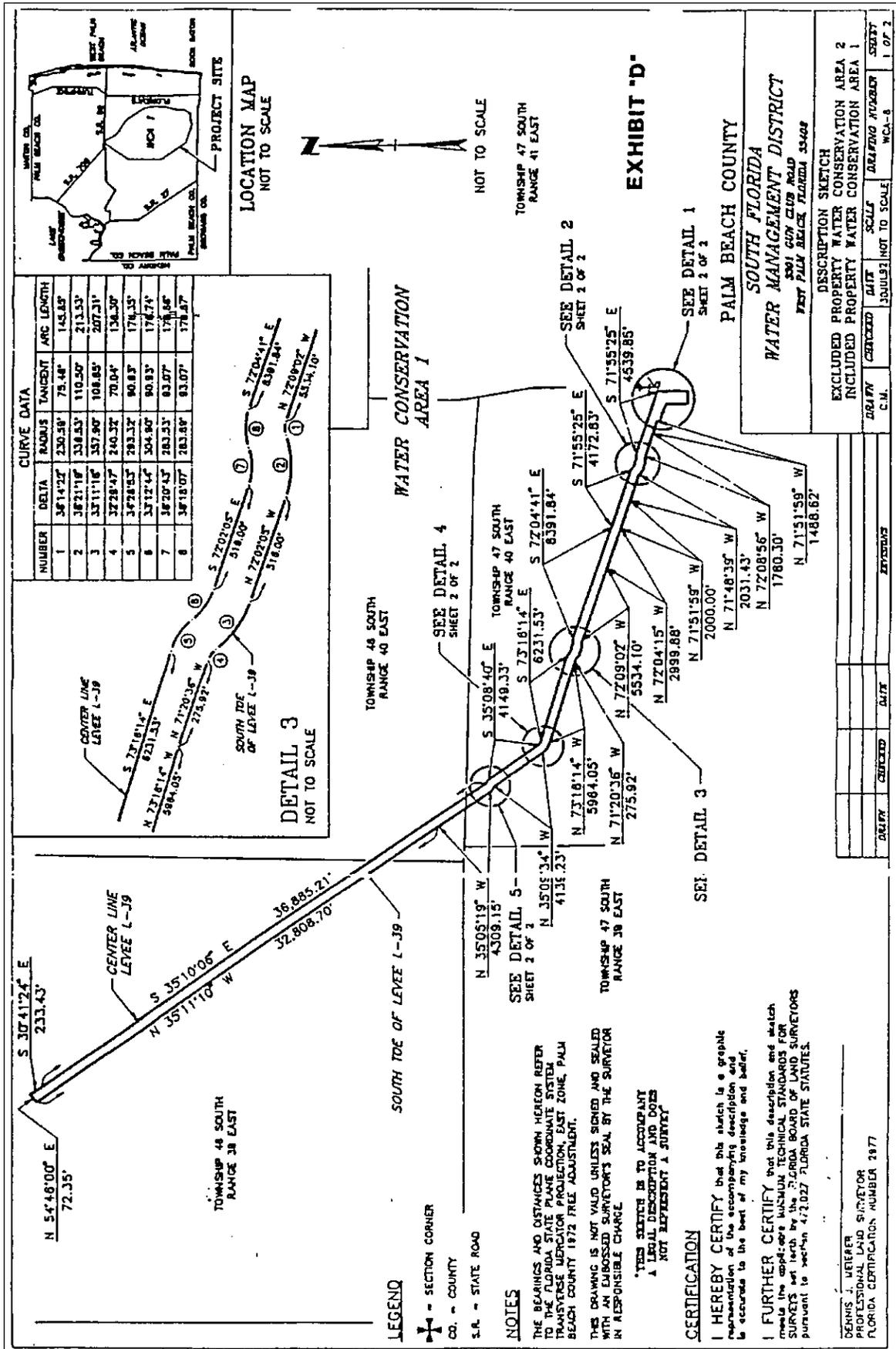
North 30°41'24" West, along the northwesterly prolongation of said centerline, a distance of 15 feet, more or less, to the southwestly prolongation of the southeasterly face of the superstructure of South Florida Water Management District Pump Station S-6; thence,

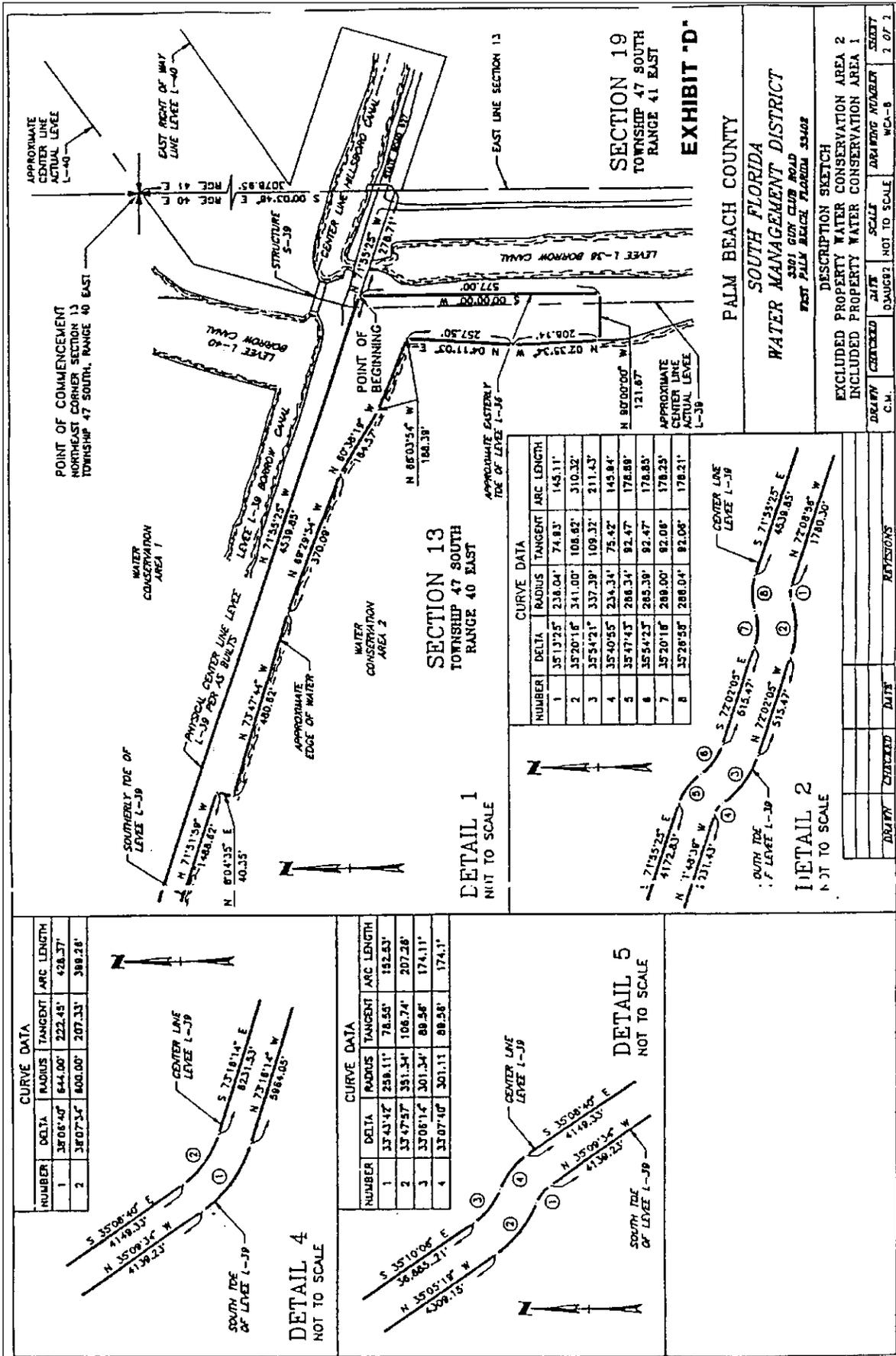
North 55°41'32" East, along said southwestly prolongation line and the southeasterly face of said superstructure, a distance of 237 feet, more or less, to the most easterly corner of said superstructure; thence,

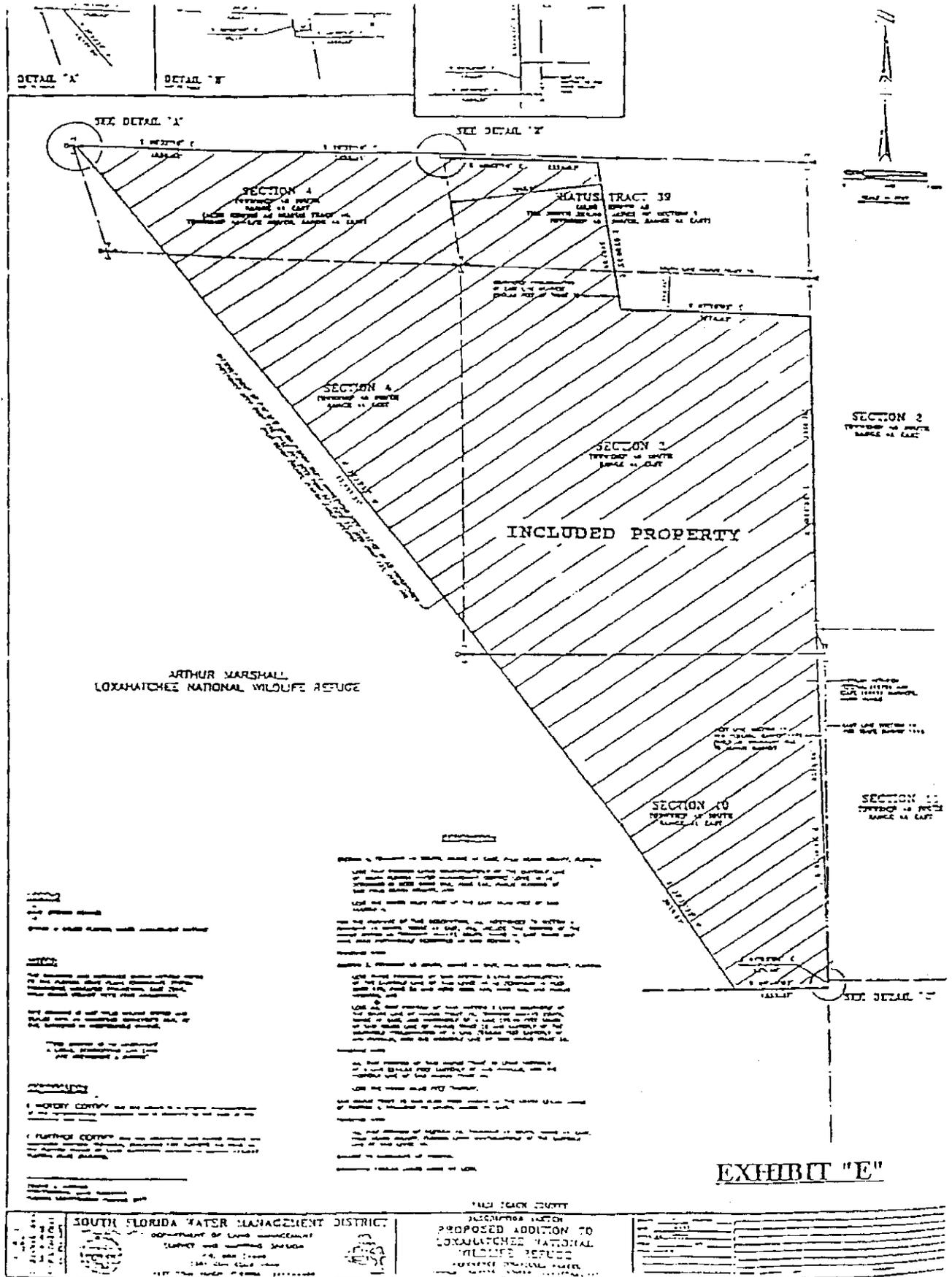
Northwesterly along the northeasterly face and the northeasterly wingwall of said Pump Station S-6, to the northeast bank of Hillsboro Canal as described in said Amendment Number 3 and the POINT OF TERMINUS of said described line.

Bearings based on the Florida State Plane Coordinate System, Transverse Mercator East Zone, NAD 1927. Palm Beach County 1972 Free Adjustment.

THIS DOCUMENT WAS RE-TYPED IN ITS ENTIRETY FOR THIS CCP.







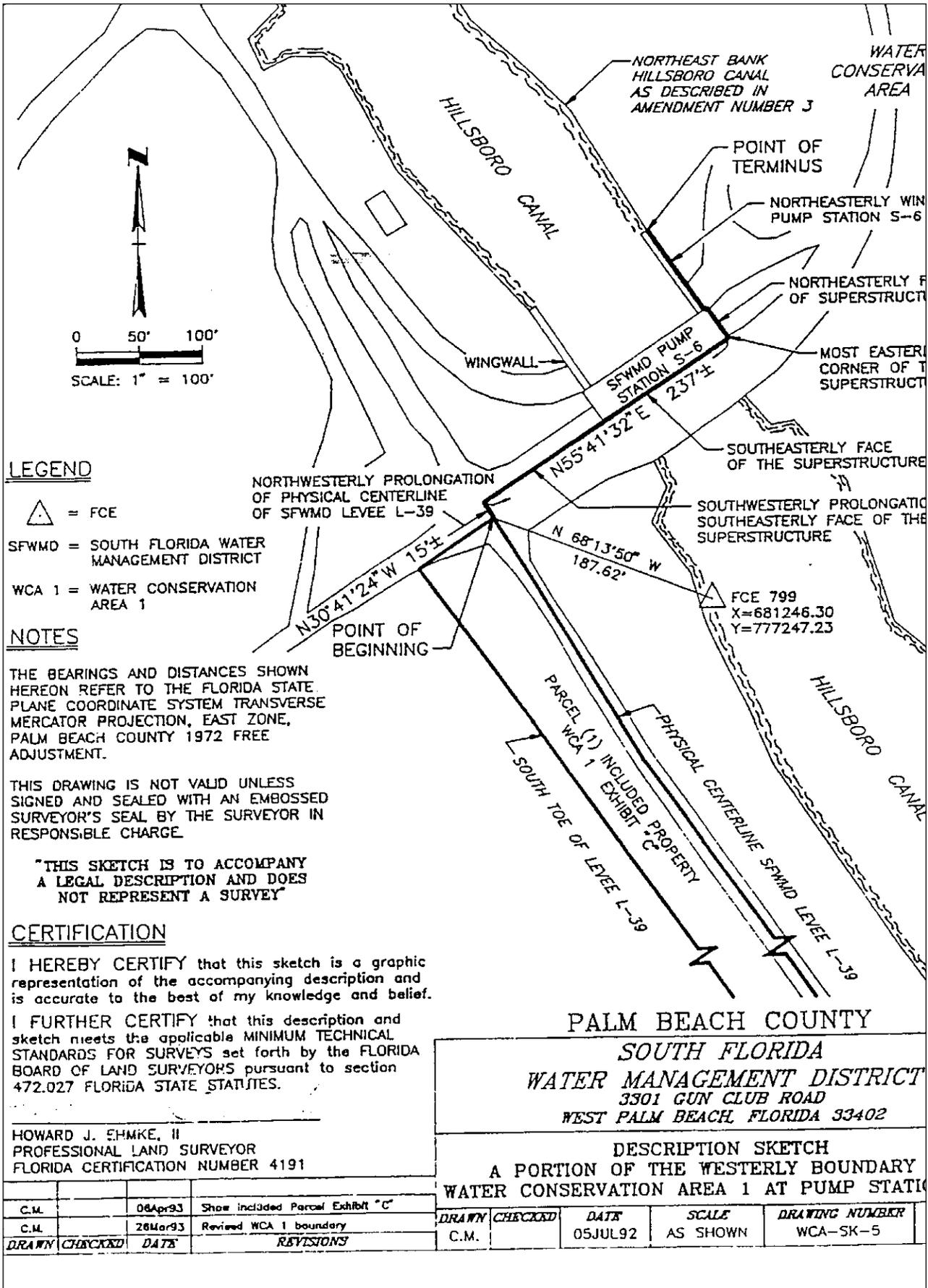


EXHIBIT "G"

LEASE

THIS LEASE AGREEMENT made this 21st day of April, 1981, between STRAZZULLA BROS. CO., INC., a Florida corporation, LESSOR, and MALRITE OF FLORIDA, INC., a Florida corporation, LESSEE.

WITNESSETH: That LESSOR does hereby lease to LESSEE the property described in that certain survey dated June 9, 1978, prepared by Mock, Roos and Searcy, as per the attached copy of said survey marked Exhibit A, together with a thirty-foot non-exclusive easement for ingress and egress to and from the leased property in Section 3, Township 45 South, Range 41 East, Palm Beach County, Florida, which easement is described as follows:

The South 30 feet of the North 589.68 feet of the East 130 feet of said Section 3, and the West 30 feet of the East 130 feet, less the North 589.68 feet of the NE1/4 of said Section 3. Extending southerly to its intersection with the North line of the parcel described on said attached survey.

1. Said lease to be upon the following terms and conditions:  
The term of this lease shall be for an initial five-year term beginning April 1, 1981 at an annual rental of Thirty Thousand Dollars (\$30,000.00) per year, plus Florida sales tax, payable quarterly in advance, the first quarterly payment of Seventy-five Hundred Dollars (\$7,500.00) due upon execution of the Lease by LESSEE.
2. Provided the Lease is in good standing and all prior payments have been timely made, LESSEE shall have the option to renew this Lease for nine (9) additional five-year terms, each of said five-year terms to be exercised independently in writing by notification by LESSEE to LESSOR within sixty (60) days of the expiration of the previous five-year term. If

LEASE - Page Two

each of said renewal terms is exercised by LESSEE then the lease payments for the fifty-year period of this lease shall be as follows:

TERM	CONSIDERATION
1st through 5th years	\$ 30,000.00 per year
6th through 10th years	35,000.00 per year
11th through 15th years	40,000.00 per year
16th through 20th years	50,000.00 per year
21st through 25th years	55,000.00 per year
26th through 30th years	60,000.00 per year
31st through 35th years	65,000.00 per year
36th through 40th years	70,000.00 per year
41st through 45th years	75,000.00 per year
46th through 50th years	80,000.00 per year

Any applicable Florida sales tax shall be added to the rental payments during the term of this lease and shall be paid by LESSEE to LESSOR and all lease payments shall be made on a quarterly basis in advance during the term of this lease and during any renewal terms hereof.

3. LESSEE agrees to pay all real estate taxes assessed during the term of this Lease and to pay any insurance on said premises.

4. The parties hereto recognize the firm of PHILIP D. LEWIS, INC., 31 West 20th Street, Riviera Beach, Florida, as the broker in this transaction and LESSOR agrees to pay to said broker a fee of six percent (6%) of all rentals received during the initial five-year term of this Lease, and six percent (6%) of all rentals received during all subsequent renewal terms hereof. Said brokerage commission shall be paid upon receipt by LESSOR of each quarterly lease payment provided for herein, after bank clearance of each rental payment.
5. On or before July 1, 1981, LESSOR agrees to provide a \$200,000.00 title insurance policy to LESSEE issued by Lawyers Title Guaranty Fund, Orlando, Florida, evidencing the title to the leased premises described herein to be free and clear of any mortgages and liens. Said title insurance policy

LEASE - Page Three

shall guarantee to LESSEE vehicular access to the leased premises and will contain no restrictions which will prevent use of the leased premises for broadcast tower purposes.

6. Upon receipt of all necessary approvals by LESSEE, LESSEE shall construct and install a 1,533 foot high broadcasting tower at LESSEE's expense. LESSEE agrees to pay for all utilities utilized on the leased premises.
7. LESSEE shall not operate more than two (2) television broadcasting stations and three (3) F.M. broadcasting stations from said tower.

If all of the covenants contained herein are performed by LESSEE, then during the term of this Lease LESSOR covenants that LESSEE shall have quiet enjoyment of the premises during the lease period and any renewals hereof.

EXECUTED by LESSOR, this 21st day of April, 1981.

STRAZZULLA BROS. CO., INC.  
a Florida corporation,

By \_\_\_\_\_  
Its President LESSOR

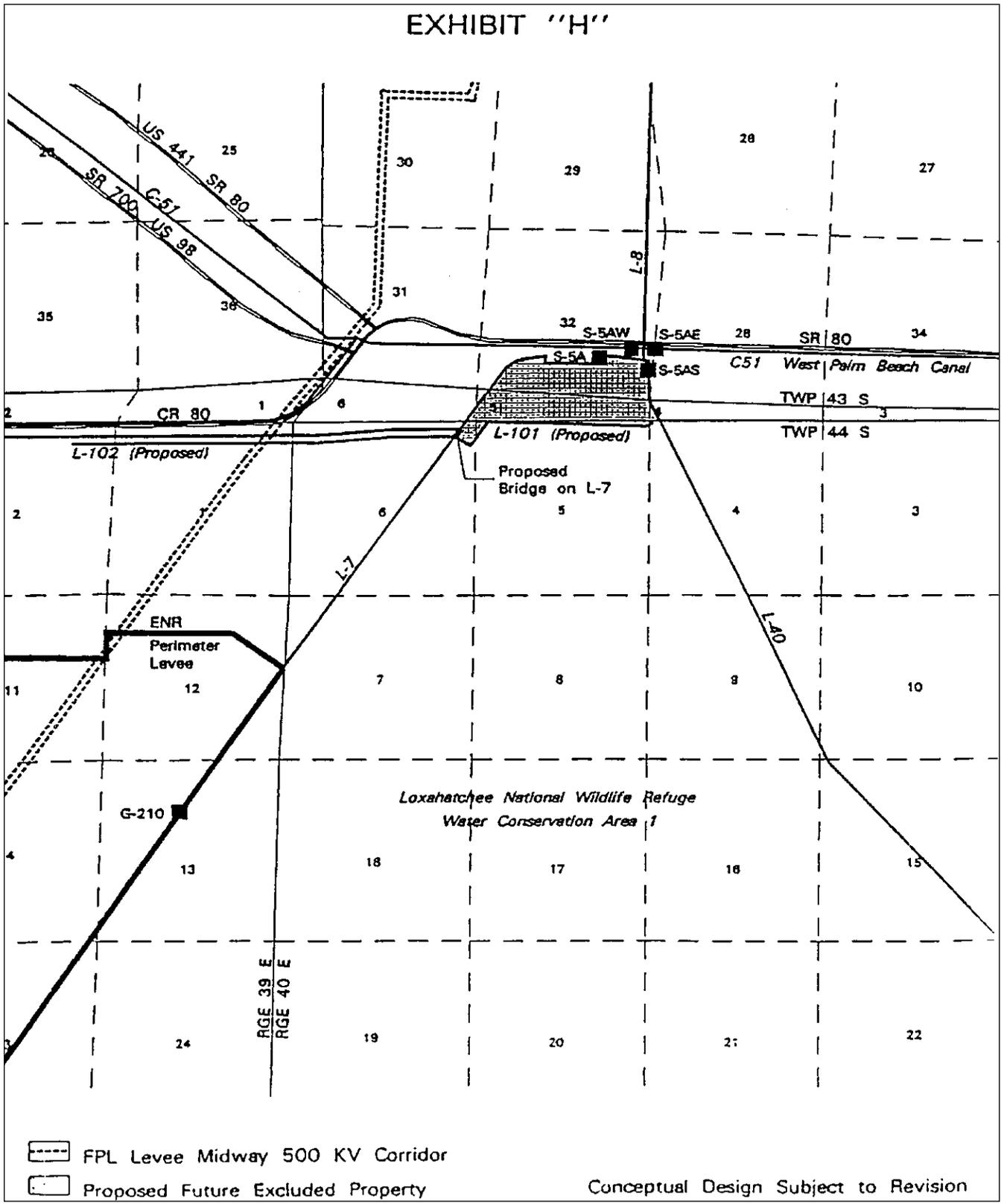
EXECUTED by LESSEE, this 21st day of April, 1981.

MALRITE OF FLORIDA, INC.

By \_\_\_\_\_  
Its Chief Executive Officer LESSEE

*NOTE: THE SIGNATURES ARE MISSING BECAUSE THIS DOCUMENT WAS RE-TYPED FOR THIS CCP. THE DOCUMENT WAS RE-TYPED IN ITS ENTIRETY.*

### EXHIBIT "H"





# *Staff Inventory and Monitoring Efforts*

This appendix outlines a list of biological monitoring, inventory, and research efforts that were (past two years) or are currently in progress on A.R.M. Loxahatchee National Wildlife Refuge. This limited list does not intend to show the comprehensive biological efforts that have occurred on the refuge in previous years. Rather, this list gives an indication of the recent efforts to provide biological data to be used in refuge management. Key: c=currenty occurring, h=historically occurring

## **Bird Surveys**

Snail Kite Survey (c=monthly during breeding season)  
 Interior Waterfowl Survey (was monthly for years, c=once per mid-winter)  
 Waterfowl Hunt Results (c=during hunt season)  
 Wading Bird Nest Attempts (c=comprehensive survey during spring)  
 Wading Bird Foraging Survey; Standard Reconnaissance Flights over Interior (c=annually by the University of Florida)  
 Impoundments (was monthly, c=tied to specific impoundment management)  
 National Christmas Bird Count (c=annually)  
 North American Migratory Bird (c=Spring and Fall)  
 Florida Migratory Landbird (Pond Cypress Route) (c=weekly during Spring and Fall seasons)  
 Tree Island Migratory Bird (Interior Route) (c=weekly)  
 Wood Duck Box Productivity (c=annual)

## **General Surveys**

Alligator- Interior and Canals (h=annually; c=quarterly)  
 Deer (aerial and airboat) (as funded)  
 Frog Calls (impoundments, cypress swamp and now interior) (c=seasonal)  
 Alligator Nest (c=annually)  
 North American Annual Butterfly (c=annually)  
 American Bittern Sightings; Cooperative Fish and Wildlife Service Effort (in 1998)  
 Mussel; U.S. Department of Agriculture (scheduled)  
 Strongyloides (fish collection and testing) (periodically by permit)

## **General Tree Island Projects (data evaluation in progress)**

Drift Fence Trapping (c=2x week for 1 year)  
 Small Mammal Trapping (once)  
 Bat Survey (once, scheduled to do in migration)  
 Fish Trapping (minnow) (once)  
 Survey for Animal Tracks (once)

## **Specific Tree Island Projects**

Flooding and Drought Impacts on Trees of Interior Tree Islands (c=in progress)  
 Forage Availability for Passerines on Bayhead vs. Melaleuca Infested vs. Old World Climbing Fern Tree Islands (c=in progress)  
 Impacts of Old World Climbing Fern on Tree Island Vegetation Composition (c=in progress)

### **Vegetation**

Exotic Plant Mapping; Surveillance and Reconnaissance Flights over Interior (h=every 3 years; c=scheduled for 2000)

Exotic Control Monitoring Plots-Old World Climbing Fern and Melaleuca (c=in progress)

Herbicide Efficacy Study on Melaleuca (h=one time effort)

Old World Climbing Fern Growth along Interior Sign Line (h=monthly; discontinued)

Herbarium Collection (c=continual)

Prescribed Fire Monitoring Plots-Interior and Impoundments (as treatment occurs; pre/post burn)

### **Water and Sediment Quality and Contamination Testing**

Four Atmospheric Deposition Stations (c=weekly)

Water Quality Sampling-Interior 16 Stations by helicopter (c=monthly)

Water Quality Sampling-ACME Stations 1 and 2 (h=monthly; discontinued)

Water Quality Sampling-ENR (h=monthly; discontinued)

Water Quality Sampling- Cypress Swamp (as funding available)

Sediment Sampling (Contaminants)- Cypress Swamp (as funding available)

Sediment Sampling (Contaminants)-Impoundment sediments (as funding available)

Fish Body Burden Sampling (Mercury Contamination)-Impoundments (as funding available)

### **Non-staff Efforts**

Phosphorus Dosing by FIU (c=weekly)

Phosphorus Dosing at South Florida Water Management District Mesocysm Site (c=daily)

**Special Use Permitted Research Projects**

*(an example but not comprehensive list from 1998-2000)*

- Mazzotti/Woodmansee-41560-98006 . . . . . To establish and study permanent monitoring plots to determine projected rates of expansion of Old World climbing fern populations.
- Shanholtzer-41560-99020 . . . . . Collect baseline data via wildlife (bird, amphibian, etc.) surveys in Strazzulla Marsh and the Cypress Swamp to assist in the restoration of the Loxahatchee Mitigation Bank site.
- Rice-41560-99024 . . . . . Capture alligators in the refuge for analysis of growth and condition for parameter estimation in support of Everglades restoration.
- Martens-41560-99034 . . . . . To collect surface water at 16 sites monthly on the refuge and evaluate water quality status and trends.
- Gilmour-41560-99035 . . . . . To study the mercury methylation process, particularly how mercury methylation and its product, methylmercury, is distributed within soils and periphyton in the refuge.
- McCormick-41560-99036 . . . . . To operate mesocosm chambers and conduct transect surveys for the purpose of characterizing spatial variation in ecosystem sensitivity to phosphorus enrichment as support for defining a Class III phosphorus criterion (funded by South Florida Water Management District).
- Pratt-41560-00005 . . . . . Study the establishment and spread of the snout beetle *Oxops vitilosa*, a biological control agent of exotic tree *Melaleuca quinquenervia*.
- William-41560-00006 . . . . . To collect soil samples (cores) on tree islands to develop a vegetational and geochemical history of tree islands as described in the project proposal: "Evolution of Everglades Tree Islands" prepared by Debra Willard and William Orem.
- Lange-41560-00008 . . . . . Evaluation of long-term trends of mercury in largemouth bass, sunfish and gambusia in the refuge.
- Frederick-41560-00009 . . . . . A long-term (4-year) study on white ibis reproductive biology in the Everglades ecosystem.
- Kitchens-41560-00011 . . . . . To continue the long-term, population demographic research on the endangered snail kites at the refuge.
- Percival-41560-00015 . . . . . To find and open alligator nests and capture alligators for the purposes of determining differences in alligator nesting characteristics and success between marsh and canal habitats.



# Budget Requests under Refuge Operating Needs System and Maintenance Management System

This is a list of budget requests for RONS (Refuge Operating Needs System) and MMS (Maintenance Management System) projects. The projects found in these lists will correlate to the formal refuge projects list found in Section V. Plan Implementation, Project Summaries (see the left side column). There are some seemingly duplicate requests for funding, but each of the following budget requests have differing monetary values and represent portions of a full project. Breaking a project up into many smaller segments often allows partial funding.

For example, to expect full funding from Congress for Project #1 Exotic Plant Control (\$3,000,000) in a single allotment may be unrealistic. So the project has been divided into different funding requests.

<i>Management Project Number (CCP Management Direction Section) primary project / support projects</i>	<i>Maintenance Management System (MMS) and Refuge Operating Needs System (RONS); Project Subject</i>	<i>Cost (in thousands)</i>
<b>1</b> / 2,5,7,9,14,16	Invasive Exotic Control	\$2000, 1000, 68, 250, 250, 100, 100, 23
<b>4</b> / 11,13,14,15	Expand Environmental Education and Outreach	\$133,150
<b>4</b> / 13,14,15,18	Enhance Visitor Experiences	\$122
<b>5</b> / 7,8,9	Initiate Prescribed Fire Program	\$60, 248
<b>6</b> / 2,5,7,8	Provide Scientific Data for Management Decisions	\$50
<b>2</b> / 5,6,7,8	Computer Model for Hydrologic Patterns to Evaluate Landscape Changes	\$200
<b>8</b> / 6,7,12	Restore Forested Wetland Habitat (Cypress)	\$70
<b>2</b> / 5,6,7,8,12	Monitor Harmful Contaminants and Nutrient Levels in Water, Soils and Wildlife	\$75, 60
<b>1,7</b> / 4,5,6,8,10	Monitor and Map Vegetation Changes, Native Plant Communities and Exotic Vegetation	\$280, 191
<b>3</b> / 4,11,13,14,15	Refuge Operations Support (infrastructure, projects)	\$255
<b>15</b> / 3	Headquarters Area - Recreation Opportunities	\$352
<b>9</b> /	Expand Hunting and Fishing	\$111
<b>10</b> / 7,5,12,1	Boundary Survey	\$75

**Appendix P - RONS and MMS Projects**

<i>Management Project Number (CCP Management Direction Section) primary project / support projects</i>	<i>Maintenance Management System (MMS) and Refuge Operating Needs System (RONS); Project Subject</i>	<i>Cost (in thousands)</i>
3 / 11,13,14,15	Restroom Facilities for Visitor Areas	\$177
8 / 3	Compartment (Impoundment) Management and Pumps	\$120, 95
6 / 1,2,4,5,7,8	Compile and Analyze Existing Data for Management Decisions	\$60
6 / 8	Everglades Success Monitoring	\$191
7 / 1,2,4,6,8,10,12	GIS/Mapping	\$123
11 / 3,14	Hillsboro Contact Station/Interpretive Center, Parking and Kiosks	\$485
4 / 5,6,7,11,13	Enhance Media Outreach	\$40
13 /	Strazzulla Marsh Public Use	\$305
3 /	Repair Damaged Roof/Ceiling of Headquarters Visitor Center	\$60
3 /	Remove and/or Replace Dilapidated Boat House	\$30
3 / 15	Building 5 Renovation	\$150
3 / 8	Replace Worn Engine for Pump Station P-1, P-2, P-3	\$25, 40, 300
8 /	Replace S-2, S-7, S-8 Water Control Structures	\$20,20,80
8 / 15	Replace Only Tractor - Worn 1978 Model	\$90
3 / 8	Replace 24" and 16" Water Pump	\$80,60
3 / 8	Replace Dragline	\$246
3 / 8	Replace Worn Roller Chopper	\$7
8 /	Replace Disk Harrow	\$7
3 / 4,8	Repair Brakes on Bulldozer	\$6
3 /	Repair Vegetation Cutting Machine	\$20
5 / 7,6,9,10	Repair Airboats (2)	\$5,5
1 / 2,3,5,9	Replace Work Boat (Airboat)	\$28
5 / 9,10	Replace Law Enforcement Vehicles (3 trucks)	\$29, 29,29
1 /	Removing Exotic Ficus Trees Which Are Damaging Residences	\$9
3 / 15	Resurface Paving Around Administrative Buildings and Quarters	\$75
3 / 4,15	Pave Poorly Surfaced Marsh Trail Parking Lot	\$120
14 /	Hillsboro- Build Multi-Agency Contact Station/Visitor Center	\$1000
3 / 15	Expand/Enhance HQ Visitor Center to Meet Needs	\$2000

# Intra-Service Section 7 Biological Evaluation

January, 1999

## REGION 4

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

### Originating Person:

Mark Musaus Telephone Number: 561-732-3684  
Email: Mark\_Musaus@fws.gov  
Date: 4/6/00

### PROJECT NAME (Grant Title/Number):

A.R.M. Loxahatchee National Wildlife Refuge  
Comprehensive Conservation Plan  
(a 15 year management plan for the refuge)

### I. Service Program:

- Ecological Services
- Federal Aid
  - Clean Vessel Act
  - Coastal Wetlands
  - Endangered Species Section 6
  - Partners for Fish and Wildlife
  - Sport Fish Restoration
  - Wildlife Restoration
- Fisheries
- Refuges/Wildlife

### II. State/Agency:

Florida, U.S. Fish and Wildlife Service

### III. Station Name:

A.R.M. Loxahatchee NWR

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

See attached Summary Document. There are four alternatives proposed, however only Alternative 2, Ecosystem Emphasis, describes the proposed management actions.

### V. Pertinent Species and Habitat:

#### A. *Include species/habitat occurrence map:*

Figure 14 shows the refuge interior (marsh) and Strazzulla Marsh. These areas and the vegetative components found in these areas can provide habitat for the snail kite and wood stork. The entire area is not used by either species at all times. Only when water levels, prey base, and vegetation structure are optimal do the kite and stork forage or attempt to nest. Both of these species could be found in the impoundments if water levels, prey base and vegetation structure are optimal.

*B. Complete the following table:*

<i>Species/Critical Habitat</i>	<i>Status<sup>1</sup></i>
Wood stork	E
Snail kite	E

<sup>1</sup>*Status*

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

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

*A. Ecoregion Number and Name:*

South Florida Eco-region

*B. County and State:*

Palm Beach, Florida

*C. Section, township, and range (or latitude and longitude):*

26°30.00N 80°14.00W (Headquarters Area)

*D. Distance (miles) and direction to nearest town:*

10 miles west of Boynton Beach, Florida

*E. Species/habitat occurrence:*

- Snail kites forage and sometimes nest in the open marsh areas of the main portion of the refuge. Kites could use the refuge year round, however in the recent past few kites have been observed on the refuge during monthly surveys.
- Wood storks could use the refuge habitat year round. However they seem to require low water levels to concentrate food resources. This combination of factors usually occurs in the refuge interior during the late winter/early spring dry down. In the impoundments, it can occur at various times of the year.

**VII. Determination of Effects:**

*A. Explanation of effects of the action on species and critical habitats in item V. B, (attach additional pages as needed):*

<i>Species/Critical Habitat</i>	<i>Impacts to Species/Critical Habitat</i>
Snail kite	The Preferred Alternative of the refuge's Comprehensive Conservation Plan calls for the implementation of a prescribed burning program in the main portion (interior) and in Compartments A,B,C, and D of the refuge. This management action will assist in opening the marsh and creating more preferred habitat for this species to forage and nest.
Wood storks	The preferred alternative of the refuge's Comprehensive Conservation Plan calls for the implementation of a prescribed burning program in the main portion (interior) and in Compartments A,B,C, and D of the refuge. This will assist in creating more habitat for this species to forage.  Additionally, some of the wetland impoundments in Compartments A, B, and C will be drawn down to enact vegetation control (by rollerchopping, discing or root cutting). This activity will result in better quality foraging habitat.

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

<i>Species/Critical Habitat</i>	<i>Actions to Mitigate/Minimize Impacts</i>
Snail kite	A nest survey would be conducted in the proposed burn area approximately 1 week prior to the scheduled burn date. If a nest of this species is found, the burn would not be conducted to reduce any chance of chick loss. Foraging adults or juveniles will fly from the area as flames or smoke approaches them and would not be permanently impacted. It is thought that kites would quickly return to the burn site to forage.
Wood stork	Foraging adults or juveniles will fly from the area as flames or smoke approaches them. No mitigation activity is needed.  This species has attempted to nest only 2 or 3 times in the last 15 years, however a preliminary survey of the proposed burn area for nests would be conducted. If nests are found, a burn would not be conducted near that area.  Drawing water down in select impoundments will concentrate fish and invertebrates, thus providing excellent albeit temporary foraging area for the storks. After vegetation treatment, reflooding the impoundment will allow the prey to repopulate and provide foraging opportunity for the storks. Only a few of the 12 impoundments will be managed in this manner per year. The other nearby impoundments will be maintained with water to provide foraging areas for these birds while the manipulation of the select impoundments occur.

<i>Species/Critical Habitat</i>	<i>Status<sup>1</sup></i>	<i>Determination<sup>2</sup></i>			<i>Response Requested<sup>3</sup></i>
		<i>NE</i>	<i>NA</i>	<i>AA</i>	
Snail Kite	E		X		concurrency
Wood Stork	E		X		concurrency

*<sup>1</sup>Determination/Response Requested:*

NE= no effect. This determination is appropriate when the proposed action will not directly, indirectly, or cumulatively impact, either positively or negatively, any listed, proposed, candidate species or designated/proposed critical habitat. Response Requested is optional but a “Concurrency: is recommended for a complete Administrative Record.

NA= not likely to adversely affect. This determination is appropriate when the proposed action is not likely to adversely impact any listed, proposed, candidate species or designated/proposed critical habitat or there may be beneficial effects to these resources. Response Requested is a “Concurrency”.

AA= likely to adversely affect. This determination is appropriate when the proposed action is likely to adversely impact any listed, proposed, candidate species or designated/proposed critical habitat. Response Requested for listed species is “Formal Consultation”. Response Requested for proposed or candidate species is “Conference”.

Mark Musans  
signature (originating station)

5/9/00  
date

Refuge Manager  
title

**IX. Reviewing Ecological Services Office Evaluation:**

A. Concurrence   X   Nonconcurrence \_\_\_\_\_

B. Formal consultation required \_\_\_\_\_

C. Conference required \_\_\_\_\_

D. Informal conference required \_\_\_\_\_

E. Remarks (attach additional pages as needed):

Thomas E Dahl  
signature

5/31/00  
date

Acting Field Supervisor  
title

# *Comments and Service Responses to the Draft Plan*

## **Section A: Comment Process**

### *Comment Period*

An Executive Summary or an entire Draft of the A.R.M. Loxahatchee National Wildlife Refuge Comprehensive Conservation Plan was sent to more than 700 individuals, non-profit organizations, government and non-government agencies, and the Florida Clearinghouse in April 2000. An introductory letter announced the 30-day comment period. In reality, comments were accepted for 40 days because of a delay with the Florida Clearinghouse. The availability of the plan and the date for the Public Meeting, April 26, 2000, were announced in local newspapers, the Federal Register, and via flyers placed in many local store fronts.

Refuge Manager Mark Musaus presented and explained the Draft Comprehensive Conservation Plan to approximately 85 citizens at the public meeting which was held at the Delray Beach Civic Center. A professional transcriptionist recorded all verbal comments for that evening. Following the Refuge Manager's presentation, 25 individuals voiced their comments regarding the draft plan. In addition, 109 letters and comment cards from individuals, agency representatives, organizational heads or representatives, conservation organizations, outdoor recreation associations, special interest groups, school participants, educational groups, and sports association leaders or members were sent or hand delivered to the refuge within the comment period.

### *Summary of the Draft Comprehensive Conservation Plan Comment Coding Process*

All responses were held until the comment period was over. They were then assigned a random 4-digit number starting with 0001. Comments were read and comment phrases were placed in a category. Some sentences containing multiple-ideas were divided, or retyped to allow the thought to be placed in appropriate categories. Sometimes a number of pertinent phrases were used from lengthy comments. Every attempt was made to retain the integrity of each of the ideas and to tie the assigned number to each idea.

Natural categories seemed to develop in support of or against specific ideas, concepts, projects and opportunities presented within the draft plan. After the comments were grouped into categories, they were reviewed, discussed, and analyzed by the planning team.

First the planning team considered the content and tone as a whole, obtaining an overall feel for public sentiments. It then considered the comments by subject. Comments concerning funding deficits, resource impacts, recreational use versus resource compatibility, compliance with Service directives, and unanticipated issues led the planning team to re-assess the projects described in the Plan Implementation Section and listed in Table 8. The bulk of the comments urged the refuge to make exotic species removal its highest priority and appeared to strongly support resource protection and environmental education. All the projects were re-assessed and re-analyzed. Some projects were re-structured and amended, some were split and all were prioritized. Thus the project order outlined in the Final Comprehensive Conservation Plan has been changed due in large part to public input.

### *Funding Issues*

Funding will be the first limiting factor determining if a specific project or public use expansion will occur. Ideally, the projects will be implemented in the listed priority order. However if funding is given for a particular project, it may be implemented before a higher ranked project. Often funds are contributed to the refuge for specific programs (i.e., environmental education) and cannot be used for other projects (i.e., exotic plant removal). The refuge will not turn away contributions even if the monies cannot be used for the number one funding priority, exotic plant removal.

The refuge does not have exclusive control over what projects or needs are funded. The following is a scaled down rendition of the process by which a national wildlife refuge is funded. A multi-step process includes each of the Service's refuges (more than 520) competing in many cases for limited discretionary/project funding. Refuges send funding requests (prioritized project and associated funding needs) to their respective Regional Offices each year (see Appendix P for the refuge's RONS and MMS funding requests). Each Regional Office prioritizes all projects, selects the top projects, and forward those to the Service's National Office. All the regionally selected projects are prioritized and some are chosen to be presented to the Department of the Interior for final review. Those projects that make the final review are forwarded, as part of larger funding initiatives, to the President's Office of Management and Budget for review and then to the U.S. Congress. These funding requests also include funding needs for the divisions of Ecological Services, Fisheries, and Law Enforcement. Congress usually approves some, but rarely all of the funding requests. Unfortunately, refuge funding requests may not be funded at all or may be partially funded. The refuge can spend allocated monies only on the projects for which they were intended, not for another project that may have a higher ranking. Thus, some projects on the refuge may be implemented before others, and some may languish without funding. It is likely not all projects will be implemented, due to funding shortfalls, staff limitations, new information on potential problems with a project, or other issues.

Other funding sources are available primarily from donations or grants. The Loxahatchee Natural History Association is an example of an organization that can raise monies for specific refuge projects. The refuge staff also submit project proposals to applicable grant opportunities.

**Reference Table for Comments on A.R.M. Loxahatchee National Wildlife Refuge Draft Comprehensive Conservation Plan. This list provides a cross reference of the name of the commentor and the random number assigned to their comments. Governmental agency comments were not broken into sub-categories, hence were not given an assigned number. Rather the full text of their comment letters is provided along with the refuges' responses.**

<i>Assigned Number</i>	<i>Private Citizen</i>	<i>Organization Member</i>
0001	Bludworth, David	
0002	Rosse Stella	Coalition for Wilderness Islands
0003	Unknown	
0004	Woody, Theresa	
0005	Bunze, Rebecca	Audubon Society
0006	Happel, Doris and William	
0007	Zane, Wilma	
0008	Ilnisky, Tanya	
0009	Unknown	
0010	Maddock, Mrs. Paul	
0011	Rossi, Enrico	
0012	Mitchell, Marthanne	Jupiter Environmental Research and Field Study Academy
0013	Mitchell, John	Audubon Soc. of the Everglades
0014	Johnson, Lydia	Fl. Audubon Society
0015	Kennedy, Terry and Betty	
0016	Schwencke, Matt	Boca Raton High School
0017	Rieneckel, BA	Audubon Society
0018	Calderon, Marvin	
0019	Calderon, Sheila	
0020	Specht, Paul and Susan	
0021	Gates, Jolly and Kathleen	
0022	Martin, Kyle	Bonaire (Boca Raton High School)
0023	Burt, Travis	Team Bonaire (Boca Raton High School)
0024	Fein, Henry	
0025	Fein, Doreen	Everglades Audubon Society
0026	Wilson, Edward	
0027	Wilson, Babara	
0028	Brook, Marilyn	Audubon Society
0029	Koegler, Jeanne	
0030	Heinlien, Joy	
0031	Aden, Frank	Audubon Society of the Everglades
0032	Slifkin, Eve	
0033	Padgett, Norman	
0034	Resen, Warren	Florida Trail Assoc.

**Appendix R - Service Response to Comments**

<i>Assigned Number</i>	<i>Private Citizen</i>	<i>Organization Member</i>
0035	Schaer, J.	
0036	Freedman, Stuart	Photographers
0037	Cogswell, Ruth	Loxahatchee Natural Wildlife Assn.
0038	Poleshuck, Jean	
0039	Taylor, Kent	Ducks Unlimited (chairman)
0040	Abramowitz, Frances	
0041	Lissone, Elena	
0042	Snyder, Robert	Florida Conservation Council
0043	Simpson, Margaret	
0044	Eisen, Harvey	Loxahatchee Natural History Association
0045	Bunting, David	
0046	Unknown	Audubon Society of the Everglades
0047	Stone, Mike	Audubon Society of the Everglades, VP
0048	Hill, Judy	
0049	Unknown	
0050	Unknown	
0051	Gunther, Vienneth Mr. and Mrs.	Loxahatchee Natural History Assn.
0052	Stark, Victor	
0053	Vollbracht, Nan and Ken	
0054	Friedman, Mrs. Toby	
0055	Moreton, D	
0056	Miller, Family	
0057	Traylor, M.	
0058	Kilmer, Mrs. Cecil	
0059	Parmalee, Alan	
0060	Jordan, Cindy	
0061	Martin, Vac	
0062	Steadman, Mr. and Mrs. Charles	
0063	Stambaugh, Kathy	Audubon Society of the Everglades
0064	Hutchis, William B.	
0065	Schardl, Alison	
0066	Iverson, Grace	
0067	Iverson, Roy	
0068	Siani, Tracy	
0093	Creasman, John R.	Palm Beach County Airboat and Halftrack Conservation Club
0096	Siskind, Michael	
0097	Greico, Andrea	

**Appendix R - Service Response to Comments**

<i>Assigned Number</i>	<i>Private Citizen</i>	<i>Organization Member</i>
100	Mulhall, Lisa N.	
0102	Arrington, Bruce	
0104	Worley, Amy Lynn	
0105	Kaplan, Neil	
0106	Kern, David D.	
0107	Louda, Dr. William J.	
0108	Louda, Dr. William J.	
0113	Matzkow, Steve and Grabo, Randy	
0120	Hemn, David L.	
0121	Rodriguez, Clemente	
0122	Warnke, Jim	
0123	Leserra, Jeff	
0124	Siani, Alfredo F.	
0126	Brennan, Kathleen	
0130	Middleman, Mort Mrs.	
0132	Harlman, Elizabeth	Florida Trails Assoc.
0069	Greico, Andrea	
0070	Albertson, Hal	Loxahatchee Natural History Association
0071	Eisen, Harvey	Loxahatchee Natural History Association
0072	Durando, Rosa	
0073	Guttridge, Laura	
0074	Butterfield, Mary	
0075	Rossi, Stella	
0076	Dr. Lovda, J. William	
0077	Middleman, April	
0078	Fleck, Donna	
0079	Moreton, Diana	
0080	Guttlieb, Sheldon	
0081	Thomas, Lyle	
0082	Behar, Mark	
0083	Dombrowski, Mark	
0084	Maharrey, Byron	Florida Hunters Coalition
0085	Schoen, Jed	
0086	Gabel, Todd	
0087	Brockway, Robert	Florida Sport and Conservation Association
0088	Keyes, Hillary	
0089	Parsons, Justin	Florida Sportsman Conservation Association

**Appendix R - Service Response to Comments**

<i>Assigned Number</i>	<i>Private Citizen</i>	<i>Organization Member</i>
0090	Tyson, Pete	Airboat Association of Florida
0091	Crenshaw, Ken	
0092	Ward, Gerald	
0139	Adcock, Jane	Loxahatchee Natural History Association and Friends Group

<i>Assigned Number</i>	<i>Formal Organization Letter</i>	<i>Signature Name</i>
0094	Defenders of Wildlife	Matson
0095	Quail Ridge Property Owners Association	Bloom
0099	The Ornithological Council	Paul
0109	Animal Rights Foundation of Florida, Inc.	Taksel
0110	Florida Hunting Coalition	Clavet
0111	Animal Protection Institute	Papouchis and Fox
0114	Everglades Coordinating Council	Powell
0115	Airboat & Halfback Conservation Club of Palm Beach County, Inc.	McDonald
0116	Palm Beach County Equestrian Trails Committee	Miller, Baker + 15 petition signatures
0117	Friends of the Everglades	Chenoweth
0118	Sierra Club, FL. Chapter	Lange
0119	Sierra Club, Broward County Group	Stone
0127	Audubon of Florida	Harrell
0129	Arthur R. Marshall Foundation	Marshall

\* some comments were inadvertently assigned two numbers. Numbers were removed and duplicate comments were deleted when a thorough cross-check was performed.

Agencies that commented on the A.R.M. Loxahatchee National Wildlife Refuge Draft Comprehensive Conservation Plan. A copy of the full comment letter and the refuge response follows.

<i>Governmental Agency</i>	<i>Signature Name</i>
Congress of the United States, House of Representatives	Hastings
South Florida Water Management District	Finch
Florida Fish and Wildlife Conservation Commission	Egbert
Department of the Army; Jacksonville Corps of Engineers	Duck
Florida Department of Environmental Protection	Hall
Florida Department of Environmental Protection	Meeker
Florida Fish and Wildlife Conservation Commission	Hartman
Treasure Coast Regional Planning Council	Hatton

**Service Responses to Public and Non-governmental Organization Comments on the Draft A.R.M. Loxahatchee Comprehensive Conservation Plan**

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## A. Alternatives

### 1. Combining Alternatives

- What I'd like was a combination of 2 and 3. (0072)
- I support elements of Alternatives 2 and 4 in some type of eco-friendly compromise. (0108)
- I feel that a combination of Alternative 2, 3, and 4 would be appropriate for the future planning of Loxahatchee National Wildlife Refuge. (0059)
- We cannot fully support any of the four alternatives, because two that are otherwise closest to our sentiments, numbers 2 and 3, provide for increased killing of wildlife. (0073)
- We cannot fully support one of the four alternatives, because the two that are otherwise closest to our sentiments, numbers 2 and 3, provide for increased killing of wildlife. (0109; Animal Rights Foundation of Florida, Inc.)

Response: Comments Noted

0073, 0109; The wishes to reduce or eliminate hunting and fishing are noted and addressed in more specific issue categories.

### 2. Alternative 1- Maintain Current Management

- Keep Loxahatchee as it is – I support Alternative 1. (0040)
- We would opt by default for Alternative 1. (0073)
- We support more aggressive efforts on behalf of the Service to increase water quality and provide opportunities for increased non-consumptive and non-intrusive activities on the land, we would opt by default for Alternative 1. (0109)
- Keep the same restrictions as are in effect. (0058)
- Keep the refuge as an environmental refuge. (0018)
- Keep the refuge as it is. (0009)
- Leave everything as it is. (0044)
- Continue to manage for environmental purposes. (0006)
- Continue the excellent management. (0022)
- Keep as pristine as it now is. (0005)
- Keep refuge the way it is (0024)
- I fully support keeping the Loxahatchee National Wildlife Refuge as it is now. (0103)

Response: Comments Noted

Unfortunately, a portion of Alternative 2 was placed in with Alternative 1 when the Draft Comprehensive Conservation Plan was printed. This gave the confusing impression that Alternative 1 advocated increased exotic management, aggressive water quality monitoring, and a balanced biological monitoring coupled with increased non-consumptive, non-intrusive activities. The refuge apologizes for this error and the confusion it caused for commentors. Alternative 2 actually has more aggressive exotic control, water, and biological monitoring issues along with greater wildlife-compatible, appropriate public use opportunities. This error was noted and taken into account by the planning team when interpreting the comments.

0073, 0109; Alternative 3 would have given less opportunity for hunting than Alternative 1. The wishes to reduce or eliminate hunting and fishing are noted and addressed in more specific issue categories.

### 3. *Alternative 2 - Ecosystem Emphasis*

- Like to go on record as supportive of Alternative 2, Ecosystem Emphasis in the Draft Comprehensive Conservation Plan for A.R.M. Loxahatchee National Wildlife Refuge. We fully support the Ecosystem Emphasis Alternative to restore seasonal water regimes, control invasive exotics, expand funding and staffing for inventory and mapping of wildlife habitats, and enhance wildlife habitat for resident and migratory avian species. (0118; Sierra Club, Florida Chapter)
- We embrace the refuge's position, for example, wildlife first. I like the idea of creating in memory where we're endorsing the ...all of the...ecosystems emphasis alternative two. (0070)
- I support the Ecosystem Emphasis Plan. (0123)
- We ask that you amend Alternative 2. Ecosystem Emphasis (Preferred Alternative ) to read; 'This plan will increase hunting accessibility and the number of huntable species to include feral hog, deer, turkey and alligator by limited permit (if periodic survey done in conjunction with the Florida Fish and Wildlife Conservation Commission is favorable for hunts). (0110; Florida Hunting Coalition)
- We support the Ecosystem Emphasis Alternative. We are supportive of the efforts to restore natural water regimes, control exotic plants, expand staffing to complete inventory and mapping of wildlife habitats, as well as enhance wildlife habitat for resident and migratory birds. (0119; Sierra Club, Broward County Group)
- I strongly support Alternative 2. (0124)
- Strongly favor Alternative 2. Those plants and animals need a true refuge, and that doesn't include people. (0068)
- I have read the CCP and want to endorse the plan - Alternative 2. (0035)
- Agree mainly with Alternative 2, but with less emphasis on additional public use. (0051)
- Prefer Alternative 2, give protection and flexibility to refuge. (0001)
- Alternative 2. (0067)
- ...concur with the opinion expressed by the Florida Sierra Club supporting Alternative 2, Ecosystem Emphasis in the Draft Comprehensive Conservation Plan for A.R.M. Loxahatchee NWR. (0117; Friends of the Everglades)
- I have seen the alternatives proposed for the future of the NWR. I would like to see an ecosystem emphasis; to improve water quality, timing and delivery within the refuge. This would benefit the wildlife. (0132)
- Alternative 2. Biological basis of the refuge, given restoration attempts for the Everglades (0067)
- I think the preferred alternative is well-balanced between ecosystem preservation and public outdoor recreational use. I especially like the increased emphasis on environmental education. (0132)

Response: Comments Noted

These comments suggest resource management should be a priority. More detailed responses can be found further into this comment and response document.

#### *4. Alternative 3 - Biological Emphasis*

- We support option 3, but also parts of 2 and some of 4. (0062)
- Option 3 includes the acquisition buffer areas and that is a good idea. (0068)
- We find alternative 3 (Biological emphasis) to be the most compelling because of its emphasis on reduced waterfowl hunting, restoration of native ecosystems, and overall emphasis on biology rather than public use. However, we cannot support it in its present form because it includes hunting for recreational and wildlife management purposes. If the FWS withdraws these provisions we would be in full support of Alternative 3. (0111; Animal Protection Institute)
- Please give priority to Alternative 3, with Alternative 2 as they should go along together. With sound biological base and continuing studies on which sound planning can be based. (0066)
- More emphasis on biology (0002)

Response: Comments Noted

0068; Alternative 2 also includes acquisition buffer areas, see Goal 2, Objective 3. Perhaps the designation was not made clear enough in Alternative 2.

0066, 0002; expressed the desire to see more biological basis in the plan.

0111; wishes to reduce or eliminate hunting and fishing are noted, and addressed in more specific issue categories.

#### *5. Alternative 4 - Public Use Emphasis*

- However, in Alternative 4, I would not like to see any hunting. (0059)
- However, in Alternative 4, I would not like to see any recreational motorboat use. (0059)

Response: Comments Noted

0059; The wishes to eliminate hunting and fishing or recreational motorboat use are addressed in more specific issue categories.

#### **B. Importance of the Refuge**

- I like Loxahatchee because the animal(s) are free. (0049)
- I love the reserve. (0022)
- Refuge is important to us all. (0007)
- We have a few preserves and must protect what we have. (0021)
- The refuge is a national treasure and should be preserved and expanded at all costs. The Everglades are stressed by those of short sight. (0037)
- We are grateful for the solitude and wildlife viewing opportunities this unique NWR offers. Please issue a Final Comprehensive Plan that will ensure these attributes are maintained in perpetuity. Thank you. (0118; Sierra Club, Florida Chapter)

Response: Comments Noted

### C. License Agreement and Plan Adequacy

- “Big Sugar” (is) writing legislation to use the refuge for their dumping grounds. (0063)
- Do not support the bill--keep refuge in FWS hands. (0016)
- Do not pass any bill--keep refuge in FWS hands. (0014)
- Attempt to free this issue of political influence...certainly preserve the refuge. (0031)
- Don't let refuge go back to State, keep FWS managing. (0002)
- ...Number two; the Department of the Interior, Fish and Wildlife Service is nothing but the tenant here. Moving to the NEPA issue; that's the most important part of this document...we attended a scoping meeting...there was obviously by Appendix G half of the management characteristics described that needed to be looked at. One of which was not to re-new your lease. That decision has come forward by the thirtieth of September of this year by the owner, the SFWMD, and that should have been fully laid out as an alternative. One of the things of NEPA is economics. What can be saved by making this an effective water quality and water quantity facility? It was designed that way 50 years ago, and you have progressively over the last decade and a half, attempted to convert it to things that are not in your agreement with the Water Management District. You are violating the agreement. The government is here. And you being the lowest level government we have to supply the infrastructure to serve the people first, and in that, the water quality and water quantity aspects of the design. The water conservation area number one, not refuge one, needs to be brought to the people. And that's why this statement is not adequate and it needs to be elevated to the environmental impact statement level. (0092)
- Overall, Nancy and I think this is a great document....noting that you have proposed a rather robust increase in budget to fund the preferred alternative, hope we can help you out here, in the near future. (0129; Arthur R. Marshall Foundation)
- The general public and conservationist and sportsmen like myself, weren't notified of the upcoming plans and didn't get a chance to remark or comment. So at the 11th hour, please hear my comments.... You already know that you cannot penetrate but a very small part of the Area One around the perimeter, except by airboat. You need us to explore this vast 147,392 acres and to map out trails and markers for other users. You, as managers, will have to use an airboat to fully get the 'lay of the land' and explore all the potential uses that are best for all concerned--especially the wildlife....I wish you well in your coming dilemmas and endeavors and only ask that you give us fair consideration.(0115; Airboat & Halftrack Conservation Club of Palm Beach County, Inc.)
- In summation;
  - 1) The Draft Plan does not include sufficient information to give the public the assurance it needs that the USFWS will improve its stewardship of the land the State of Florida has entrusted to it. A new license agreement should not be entered into without a complete analysis of prior management shortcomings and concrete, adequately funded solutions.
  - 2) The Draft Plan does not provide balanced emphasis on rerecreational components, and in fact demonstrates bias against rerecreational hunting and backcountry access.
  - 3) The refuge is not in “pristine” condition” as claimed. Rather it contains a shameful and irresponsible level of exotic vegetation that continues to expand. Top priority must be given to waging an

aggressive mechanical and chemical war on melaleuca and climbing fern. Further delay while waiting on biological control (insects) that may not prove fruitful is unwise and harmful to the resource.

4) The public must have written assurances refuge activities or facilities will not adversely impact existing public uses of adjacent state lands. After the long Draft Plan development process, we were very disappointed to discover that, overall, it is more of a plan-to-do-a-plan, rather than a plan itself. Almost all of the details our members consider vital to know before we can support an extension of the License Agreement have been deferred to future planning efforts. Examples of the specifics we had hoped to see include law enforcement, exotic plant and animal management, fire management, and public use plans. Missing is an option that provides the appropriate level of emphasis on rescuing the natural system from near-collapse due to exotic infestation, together with environmental education and multi-use recreational opportunities. (0114; Everglades Coordinating Council)

- Unique land lease agreement with South Florida Water Management District presents different set of circumstances from other refuges and working with them on these issues is of the utmost importance. The plan is well done, represents a great deal of work. (0051)
- We applaud the plan you have, we applaud the vision and scope. We want to compliment you on all your efforts. (0080)
- Good document. (0001)

Response: Comments Noted

Background information: Just days before the Loxahatchee Draft Comprehensive Conservation Plan public meeting on April 26, 2000, legislation was introduced to the State House and Senate calling for the termination of the license agreement between the refuge and South Florida Water Management District. This proposed legislative bill would have resulted in state management control in what is now the refuge. According to newspaper articles, the legislation was backed by sugar industries and a group of sportsman. The legislation was removed from the agenda just after it was introduced, due in part to public pressure and public support for the refuge. Governor Jeb Bush said the Florida Department of Environmental Protection would join South Florida Water Management District in drafting a new license agreement with the refuge and that there would be a public review process.

As reflected in our Comprehensive Conservation Plan, we feel that the refuge currently has tremendous natural resources and staff resources to be proud of: resources that have been managed well. However these resources can always be improved upon to provide even better wildlife habitat and opportunities of enjoyment by the public. Our 15-year vision, our plan, thanks to tremendous input by the public through open meetings and written comments, lays a clear path before us to implement those improvements. We feel that the refuge is managed well as both a national wildlife refuge and as part of a larger regional system—a water conservation area. We also feel we have demonstrated appropriate flexibility consistent (in the spirit and intent of the license agreement) with changing times in concert with the larger system issues.

A comprehensive conservation plan is required for each refuge as part of the National Wildlife Refuge System Improvement Act of 1997, which was passed by Congress and signed by President Clinton. The Congressional mandate states that the plan shall be written to guide refuge management, not whether or not these lands should be managed as part of the National Wildlife Refuge System. The entire plan process, nationally, is adaptive in nature. Lessons have been learned about the process as plans are

written. This refuge's plan is only the second to be drafted in Florida. The refuge concurs that ideally, it would have been best to have written the many step-down plans prior to completion of the plan. In light of negotiations over license agreement renewal, it was agreed upon with water management district staff that the plan would be an important document to identify the Service's vision for the refuge and involve public participation. Preparing the step-down plans would have required much greater detail and more time than the license agreement time frames allowed. The refuge staff view this document as the most comprehensive review of what is presently known about the refuge and what needs to be accomplished.

A formal part of developing a comprehensive conservation plan is to compile a mailing list. During the 2-year writing process, many addresses were collected, many people requested to be kept apprized of the plan's progress when they sent in preliminary comments. Approximately 700 addresses were used to notify the public of the availability of the draft plan. Included in this list were the most recent addresses the refuge had of non-profit organizations including conservation associations. News releases were sent to major newspapers in the area about the availability of the draft plan and of the upcoming public meeting regarding the draft. Finally, color posters were created and placed in area business windows in an attempt to further notify the public. Finally the Federal Register carried the announcement of the availability of the draft plan.

Partnering and keeping open lines of communication are paramount for this plan to succeed, and are noted under IV. Management Direction (Summary Statement and in the Discussion of Goals 1, 2 and 4).

## **D. General Refuge Management**

### *1. Emphasize Environmental Protection*

- Manage as a preserve. (0008)
- Keep reserve geared toward preservation. (0022)
- Protect and keep refuge pure. (0019)
- Keep refuge pure. (0018)
- ...get rid of anything that is spoiling the refuge. (0010)
- Don't destroy the natural beauty. (0029)
- Keep natural, our future depends upon it. (0025)
- Nature needs a chance and helping hand to survive. (0024)
- Please use the refuge for environmental uses. (0048)
- Manage for environmental purposes. (0009)
- Keep the park's purpose at environmental usage only. (0028)
- I think we need to keep the bulk of mankind out of the interior and leave it for its intended purpose. (0078)
- There is so little time left in a wild state, please do not encourage any more public use than already exists. (0068)
- .....but with less emphasis on additional public use. (0051)
- Keep the habitat free from the public. The encroachment of the Everglades is a serious mistake. No more public. (0057)
- I strongly support all efforts to discourage development of touristy and commercial attractions in Loxahatchee. At present, it is a unique natural wilderness area in Palm Beach County where caring visitors, naturalists, photographers, and birders can share this preserve. Over development is threatening our wildlife or ecology and our serenity. (0040)
- Imagine the serene silence which must have prevailed in the refuge prior to 1900. Please outlaw ALL man-made sources of noise inside the refuge boundaries. (0061)
- The draft CCP takes bold steps to improve stewardship of an important part of the American landscape, steps that cost millions of dollars. The preferred alternative represents a 450% increase in annual spending on the refuge over the status quo. While we hope the refuge receives the funding it needs to accomplish the vision outlined in the plan, we also hope that when there are funding shortfalls, the biological program retains its integrity above others. The protection of the resources is the first priority of the refuge. (0094; Defenders of Wildlife Organization)

Response: Comments Noted

These comments show the value of the refuge to the public, the wish to protect it, and to limit or at least not expand public use. See other responses for more details.

## 2. *Emphasize Wildlife*

- I'd just like to leave with this...protect the wildlife. Man has always found a way to destroy. Destroying for necessity is one thing, for pleasure is something else. (0070)
- Preserve wildlife. (0020)
- Manage it for wildlife....protect wildlife who live there (0004)
- Yes to birdwatching. (0012)
- Enjoy wildlife observation and habitat watching. (0015)
- We come to watch birds and wildlife. (0006)
- Leave the wildlife alone. (0049)
- Maintain refuge for wildlife (0021)
- Should be kept true to the meaning of refuge, which is protection of wildlife, not exploitation. (0058)
- I thoroughly support the refuge and the CCP draft, I hope that we will continue to keep it for wildlife and keep people second. Thank you. (0074)
- We too favor the keeping of the refuge for wildlife. (0080)
- The refuge is a refuge. (0063)
- There is a great need for the Loxahatchee NWR to continue to set its priority to preserve the wildlife of our most northern remnant of the Everglades. It is a national treasure of our state and country. (0038)
- I, of course, agree with you that Loxahatchee should be for wildlife and considerations for the enjoyment of people a distant second. After all there's no place on this planet like the Everglades. (0130)
- And the refuge should also be what it is, a refuge for people to enjoy and to have a peaceful experience there. (0086)

### Response: Comments Noted

These comments suggest the citizens value observing nature, knowing wildlife reside on the refuge habitats and keeping the refuge for wildlife is important, even at the expense of curtailing human activities. See other Responses for more details.

### 3. Protect Buffer Lands

- Land acquisition priorities should be expanded to include state identified Strategic Habitat Conservation Areas that abut the refuge. The proposed boundary expansion will further protect the cypress swamp and other refuge resources. We suggest also including lands identified by the Florida Game and Fresh Water Fish Commission in their “Closing the Gaps in Florida’s Wildlife Habitat Conservation System” report. This type of large scale planning is exactly what the FWS should be involved in to prioritize land acquisitions and to understand how refuges and other conservation efforts fit into the larger landscape. The FWS should work closely with the State to see if there are opportunities to acquire lands identified by the State as SHCAs that are close to the refuge. There are indeed a number of small parcels of SHCAs that might make sense for the FWS to include in their boundary expansion. (0094)
- I’m not sure how well integrated you will be with the supposed water preserve areas and buffers, and I hope you will work with the county. (0072)
- We support expansion or buffers. (0062)
- The other thing is.... I was concerned about buffer areas. Everyone is talking about the buffer areas west of 441 or highway seven. And as I look at the map of the refuge, I could understand that when you get to the northern section. But I was wondering about the buffer areas to the south of Boynton Beach Boulevard. And everyone is talking about west of for 441, and I realize that it costs money, but I was more concerned about developing buffer areas east of 441. I was wondering if there were any plans along those lines? (0080)
- The AG reserve is a joke. The proposed density was an outrage, the solution wasn’t much better in that taxpayers have to foot the bill and the density is still huge. Only the rich can afford. (0041)

#### Response: Comments Noted

The refuge is currently working with many local, county, and state agencies to develop options to protect the lands west of U.S. 441/State Road 7. Protecting these lands would also assist and buffer the refuge. Many ideas are still being formulated by a multitude of interested parties (especially natural resource management and water management agencies) to acquire lands as part of “water preserve areas,” a project component of the Comprehensive Everglades Restoration Plan. Refuge management is keeping abreast of these ideas and will continue to pursue management partnerships to prevent development along its eastern boundaries. Maps of the Strategic Habitat Conservation Areas and range maps of rare and imperiled wildlife identified by the Florida Fish and Wildlife Conservation Commission were consulted. The County’s Ag Reserve program includes some of these lands on the refuge’s eastern boundary to keep in an undeveloped state. Some of the Strategic Habitat Conservation Area lands have been acquired by various natural resource agencies, and some lands could be managed in partnership with the refuge. In light of these efforts, the refuge identified only those lands for acquisition consideration most critical to protecting intensively managed refuge lands outside the District’s levee.

## E. Wildlife Habitat Management

### 1. *Habitat Restoration*

- Clearly, restoration of ‘pond (cypress) swamp’ communities is a priority of the South Florida Multi-Species Recovery Plan. Restoring a cypress swamp community in compartment A and in the land adjacent to the Headquarters Area that is proposed for acquisition, is essential to conserving this community which has been dramatically reduced, particularly in southeast Florida. ... the proposed extension of the interpretive boardwalk through the existing cypress swamp and construction of an observation tower would reduce the quality of the interior forest habitat and is counter to this objective. These two proposed projects seem to conflict...we urge FWS to take a precautionary approach... until the ramifications of the proposed extensions are known. In addition, for pond swamps to recover, they need to have functioning ecological processes to sustain themselves - processes that are more likely to occur with larger, contiguous, intact systems, than in small remnant fragments. To strengthen the CCP, the restoration project should appear in the “goals” section of the CCP and not just as a project idea for implementation. (0094)
- The purpose of this letter is to extend our cooperation to you and your program to develop a partnership for future habitat restoration projects. I would most welcome your comments and to discuss the Audubon Cooperative Sanctuary Program and how we could enhance these programs for the mutual benefit of our community. (0095; Quail Ridge Property Owners Association)
- ...we agree with prescribed burning that will allow for the opening of new habitat areas for fowl and wildlife. (0110)
- I support the used of prescribed burning (0126)

Response: Comments Noted

0094; The map and/or description of the proposed observation platform is misleading in the draft plan. The intent is not to construct another long boardwalk. Rather, a short branch would be made off the existing boardwalk leading to an observation tower enabling the public to experience the cypress forest at the canopy level.

0095;The refuge supports partnerships with many entities, including private landowners. Please contact the refuge, as the Service employs a “private lands biologist” for south Florida. The role of this individual is to assist the refuge in developing land management partnerships with willing landowners to enhance fish and wildlife habitat.

### 2. *Research and Monitoring*

- Because research is by definition part of the NWRS mission, it should take priority over public uses, even priority public uses... In fact the CCP even lists as two of its objectives (p.58) the development of partnerships for research, control, and monitoring of exotic and invasive species and the development of new and existing partnerships for research and monitoring of biological resources with universities and conservation organizations... We are concerned that the CCP does not provide for biological research by outside scientists on the refuge. The Public Use section of the Management Plan addresses only wildlife-dependent recreational opportunities. We suggest that the Management Plan should include a provision for allowing and encouraging independent biological research. (0099; The Ornithological Council)
- The Animal Protection Institute believes these (see below) recommendations provide an excellent framework for complying with the letter and intent of the Act. We strongly suggest that the U.S. Fish and Wildlife Service follow these steps when finalizing the CCP for the ARM Loxahatchee NWR and that it withhold final compatibility determinations until population information is presented and analyzed. To do otherwise may be in violation of the Act.

1. Given the infeasibility of conducting an inventory for all organisms on a refuge, conduct refuge inventories to obtain, at minimum, information on the abundance and distribution of vascular plants, vertebrates, and all federally threatened and endangered species.
  2. In collaboration with the U.S. Geological Survey's Biological Resources Division biologists and other scientists, chose "focal" species suitable for monitoring on each refuge or refuge complex. Carefully chosen focal species will convey information about the status of the larger ecological system to which they belong and the integrity of specific habitats or ecosystem processes.
  3. Conduct research designed to test whether each focal species does indeed provide information on larger communities and processes. This is essential to the focal species approach.
  4. Select focal species and design the monitoring program for each refuge or refuge complex to produce information about internal and external threats to achieving refuge management goals. Management goals should be consistent with maintaining the biological integrity, diversity, and environmental health of each refuge and should be clearly described in the refuge's comprehensive conservation plan.
  5. Conduct rigorous, quantitative monitoring that is oriented toward management decisions to ensure that refuge management is scientifically based and as effective as it can be. (0111)
- A full blown archaeological survey is a must for all of the area north and west of the high line. It certainly makes common sense and stands to reason that there must be many more mounds, both midden and burial, in the area. It would take a team of machete wielding workers, of course, accompanied by a trained archaeologist ...Aerial infrared photos both day and night, satellite photos, GPS precision, US Geodetic survey cooperation and much more... If this area is not preserved we will have lost a very important and large page of our early history in south Florida! (0122)

Response: Comments Noted

0099; The Fish and Wildlife Service, via its National Wildlife Refuge System, developed a document in March 1999, entitled "Fulfilling the Promise" which outlines how important biological research is for the management of refuges. Formal research, as well as inventory and monitoring, are important to the refuge and the Everglades ecosystem, especially as Everglades restoration progresses. The refuge staff are aware they cannot accomplish all the projects and ideas that have been laid out in this plan with the current or even the proposed increased staffing and funding levels. The following references to research partnerships can be found in the plan under Management Direction, Partnership Opportunities Section, "Collaboration with colleges, universities...will enable the refuge to carry out its extensive plans for research...."; In the Environmental Assessment, Research and Monitoring Section "...greater numbers of research projects will be allowed...."; and in the Compatibility Determination, Research and Special Use Permits Section, "The refuge receives many requests to conduct scientific research ...." Application for a Special Use Permit is the starting point for qualified, independent researchers to submit their project proposals to the refuge management and biological staff. The Final Plan will be amended to contain a list of monitoring/inventory/research projects and biological special use permit research currently taking place or permitted within the past 2 years. In the Inventory and Monitoring Step-Down-Plan Management Plan, potential research direction important to the refuge will be further discussed. This will aid "independent researchers" in determining how to structure potential special use permit applications.

0111; As noted above, the Final CCP will contain a list of current inventory, monitoring, mapping projects as well as a 2-year year list of outside research projects that have contributed scientific and biological information for resource management. These lists give an indication of the scope of current projects and their tie to the Everglades environment.

The primary direction the inventory and monitoring plan will follow is governed by the Fish and Wildlife Service Refuge Manual, the “Promises” document, and a “Biological Needs Assessment document” that was developed. Issues such as the Everglades restoration and regional protection of listed, trust and focal species are addressed in the South Florida Ecosystem Team’s Ecosystem Plan, South Florida Multi-Species Recovery Plan and the Comprehensive Ecosystem Restoration Monitoring Plan. Each document assists refuge management and the refuge biological program to focus inventory and monitoring plans and limited resources on priority activities.

The following hierarchal lists are guidelines and steps Service refuges use to determine which habitats and species are inventoried and monitored. Note: inventory and monitoring projects are sometimes specific for the refuge, whereas others support regional, national and international emphasis.

- those habitats or species listed in the Refuge Purpose (wildlife habitat and migratory birds)
- the habitats and species of critical management importance. Usually this means the primary trust species (federally listed threatened and endangered species, migratory birds, anadromous fish and certain marine mammals) which reside on or are dependent upon the habitats found on the refuge (e.g., snail kite, wood stork)
- secondary trust species (federally listed threatened and endangered species, migratory birds, anadromous fish and certain marine mammals) which occasionally may use the refuge (e.g., bald eagle, crested caracara)
- state listed species (e.g., Florida sandhill crane, strap fern), Service Species of Management Concern (e.g., yellow rail, American bittern) and CITES species (e.g., river otter, delicate ionopsis)
- those habitats or species of concern in South Florida Ecosystem Team’s Ecosystem Plan, South Florida Multi-Species Recovery Plan and the Comprehensive Ecosystem Restoration Monitoring Plan (e.g., tree islands, wading birds, alligators). These focal habitats and focal species were selected because they can provide information and indicate changes on larger communities and ecological processes.

The refuge agrees that it is cost prohibitive and unproductive to attempt inventorying or monitoring all habitats and species (even listed species). However, biological groups which are thought to be “umbrella,” indicator, or focal species are and will continue to be inventoried and monitored. Adjustments will be made to phase out less productive efforts and include methods providing sensitive indications of population dynamics. Although the refuge is quite large for a refuge, it is not isolated. Rather it is an important portion of the greater Everglades ecosystem and surveys will be closely tied to monitoring the restoration efforts.

0122; The refuge staff and the Service’s Regional Archaeologist fully intend to follow through with Goal 2, Objective 6. Partnerships and Memorandums of Understanding will be forged with a wide variety of organizations, agencies and Indian Nations to further protect our state and nations’ cultural resources as is described in Goal 2, Objective 8.

### *3. Exotic Plant Control*

- Remove exotics. (0045)
- Clear exotics. (0047)
- Get rid of exotics, remove exotics. (0010)
- Get rid of exotic plants and trees. (0048)

- Clear exotics. (0027)
- Rid refuge of exotics. (0009)
- Clear out exotics. (0030)
- Remove exotics. (0006)
- Clean up exotics. (0029)
- Clear exotics. (0019)
- Remove exotic plants. (0028)
- ...and it's true when you start invading this beautiful area, it will not be so beautiful because exotics will come in. (0075)
- Get rid of the choking (exotic) plants, melaleuca, water lettuce and all others. (0060)
- Improve exotic plant control should be the main focus. (0051)
- Address the problems the Everglades are facing (exotic species, endangered species) (0022)
- Use funds to remove exotic vegetation such as Brazilian pepper, melaleuca (0020)
- I would like to see a large amount of money initially put into the area go to the exotic control. (0083)
- Use most monies for exotic control (0003)
- Spend most monies on exotics (0015)
- In relation to exotics, obviously, one person made a great point about the fact that further participation, the understanding that exotics exist is an important thing for most people. Those who fly over it can see the progression from the seventies, to the eighties, and to the nineties in exotic. But if the populous was out there, they would have been a control over it as some person represented. The previous managers 'lock it up and throw away the key' law enforcement mentality, caused a lack of perception about the exotic problems. (0092)
- I do believe that if it (the refuge ) was left open to the public to see more of the area (via airboat), that it would never become ninety thousand acres of exotics in the one-hundred-forty-five thousand. ... A really feel bad for he area because the lack of public use, I think, is the biggest reason that we've got so much exotics. (0090)
- I think that the key is prioritizing, and outstandingly most important, every million you can squeak and get --needs to control exotics. And I think before you even think of any expansion docks or boat trails, you need to get that...a handle on your exotic invasion. It's awful. (0072)
- The single largest threat to the refuge's ecological integrity is invasive species, and the plan tackles this head-on, with the largest budgetary line item, besides land acquisition, targeted towards invasive species (plant) management. (0094)
- The FWS should consider establishing a sport-fishing program to reduce exotic fish taxa. The CCP states that at least 32 non-indigenous fish taxa are found on the refuge; armored catfish and swamp eel being particular threats. Since fishing is a popular activity on the refuge, there is an opportunity to educate anglers about exotic species identification and their impacts, and encourage anglers to target exotic species when fishing. Anglers would catch-and-release native species and catch-and-retain exotics to be turned over to the FWS for disposal (assuming exotics have too high mercury levels to be safe to eat). Benefits of the program include: reduction in invasive species, education and engagement of the public, and limited monitoring of exotics caught. (0094)

Response: Comments Noted

The overwhelming response of most individuals, organizations and agencies was for the refuge to exert more effort in controlling exotics and to prioritize funds to remove exotics. The refuge staff interprets this to mean the following: use most available funding for exotic plant and animal control at the expense of other proposed initiatives and projects.

The current refuge staff and management recognize the immense scope of the exotic plant problem within its boundaries. It is a fact that exotic plants have invaded more than half of the refuge. These plants, specifically melaleuca, spread more quickly than past treatment efforts could control, in part because historic funding levels were inadequate to effectively combat the infestation. The lack of funding stems from a generalized lack of understanding of the ecologic and economic costs associated with invasive exotic plants. Obviously, the south Floridians responding to the draft plan are very much aware of these issues. But the nation's citizens as a whole, including U.S. Congressmen and women who make the large scale funding decisions for Service refuges, are just now learning about the issue and starting to recognize the cost of not controlling invasive exotics (Federal Noxious Weed Act, Executive Order 1312 Invasive Species).

Unfortunately, the acreage of the refuge's exotic plant infestation exceeds the acreage of cleared exotic plants. To date, more than 6,800 acres of melaleuca have been treated using Federal and State (South Florida Water Management District and Dept. of Environmental Protection) monies. Unfortunately, many people, including refuge management, did not recognize the invasive potential of Old World climbing fern until recently. In 1999, the first contractors were hired to start treating this invasive vine. However, it is very expensive (approximately \$500 an acre), and to date just small areas are being treated.

The refuge staff agrees with commentors in that treating exotics should take priority and we shouldn't wait for bio-controls to be developed. We have asked for \$3 million a year for the next 15 years to treat invasive exotic plants and animals on the refuge. If a well tested, effective bio-control becomes available from the U.S. Department of Agriculture, we will continue our physical treatment efforts and incorporate bio-control efforts on melaleuca and Old World climbing fern.

In response to the overwhelming public response for exotic plant treatment and maintenance control on the refuge; exotic species (melaleuca, Old World climbing fern, hydrilla, water hyacinth, water lettuce, Brazilian pepper, etc.) removal was confirmed to be the #1 Priority Project, the priority funding allocation and the priority funding request. See Plan Implementation Section (Table 8) and Appendix P for Refuge Operations Needs and Maintenance Management System requests for funding.

Invasive exotic species problems are directly related to importing, selling, purchasing and planting non-native, invasive ornamental plants, releasing aquarium fish and plants, stocking exotic game animals and stocking exotic fish in fresh waters. Until the ramifications of these issues are understood by the general public, governmental agencies and non-governmental organizations the practices will not stop nor will they slow down. Some populations of invasive non-native species such as Old World climbing fern, black acara, walking catfish, and oscars may never be fully controlled on large wetlands.

#### 4. Water Management

##### a. Quality:

- ...make efforts to keep water pure. (0028)
- ...clean up the water. (0004)
- One of the issues I was concerned with is the quality of water. (0080)
- My wife and I enjoy the refuge very much and would like to see more protection for the wildlife and water quality. (0062)
- Spend most monies on preventing phosphorus intrusion. (0015)
- According to Will Vangelder (FIU) periphyton communities can and will change over time with increased nutrient loadings, such as phosphorus. It would be advantageous to survey where high nutrient fed periphyton is, and where the low-nutrient fed periphyton is. I don't have any cost figures formulated. (0102)
- The refuge is also extremely impacted by water control activities. While largely out of the Fish and Wildlife Service's (FWS) direct control, the draft CCP recognizes that continued partnerships with the Army Corps of Engineers and the South Florida Water Management District and monitoring Everglades restoration success (Project 4) are vital to ensure that adequate water supply, timing and quality reach the refuge. (0094)
- You are part of the original lawsuit that Dexter Lighten filed years ago. It was Everglades National Park and the Loxahatchee National Wildlife Refuge. You will have a water quality problem in the future, and I don't see that sufficiently addressed with enough fear. Lake Okeechobee...as they started drawing it down...you're going to get a phosphorus loading in there, no question about it. And then if you can work with the City of Wellington you can do something I cannot. The only thing Wellington understands is a lawsuit. And last night they very blithely decided that (they) can discharge anything they well please through pump two (ACME 2) right into the refuge. (0072)

##### Response: Comments Noted

The refuge has been committed to improving the quality of water entering the refuge and the Everglades ecosystem for years. As a result of a Department of the Interior lawsuit against the State and the resulting Consent Decree; a multi-agency and multi-million dollar effort to restore the Everglades' degraded water quality (primarily high phosphorus levels) and test for contaminants is in progress. A joint effort with Everglades National Park has resulted in the formation of the Everglades Program Team, an interdisciplinary team of senior scientists working for the park and the refuge to specifically address Consent Decree issues. On the north end of the refuge, Storm Water Treatment Areas 1East and 1West are being constructed to reduce phosphorus loads to a yet-to-be determined level (likely in the vicinity of 10 parts per billion). This reduction technology shows great promise, however, more refined water treatment will be needed to achieve the numeric standard.

The refuge will continue to monitor incoming water quality and work with landowners, communities, governmental agencies, and private and corporate organizations toward that end. Four major monitoring projects (Water Quality/Quantity Monitoring, Everglades Restoration Monitoring, Monitoring Vegetation Changes and GIS Mapping) for the refuge are listed (Table 8) regarding water quality and its effect on the Everglades. The description of what the Water Quality Monitoring Step-Down Plan will entail has been amended in the Final CCP and will be finished before 2002. Additionally, independent outside research is continuing in the refuge interior to assess change in focal species (e.g., periphyton, macrophytic vegetation, invertebrates, fish) with differing nutrient doses.

b. Hydrology:

- Work towards proper high water mark legislation. (0017)
- I think that with you working with the South Florida Management District, and probably the Corps of Engineers, you can probably find a better utilization of the area. Particularly if you knock down the western dikes. (0091)
- Return Kissimmee River back to its original form from the early 1700s before the Spaniards. (0023)
- It's time to go into action and figure out how to not try to control the water, but let it flow naturally as it has in the past. (0091)

Response: Comments Noted

The refuge and the Everglades Program Team will continue to be involved with trying to emulate historic water flow, addressing the feasibility and ramifications of restoring original flow, new water movement routes, seasonally appropriate water availability, delivery and timing, wildlife or habitat related emergency water removal response timing, water allocation through the Everglades system, flood control response (for wildlife, urban, agricultural needs), seasonal agricultural demands, salt water intrusion and many other inter-related issues.

**F. Facility Development and Administration**

*1. Generally and at Headquarters Area*

a. Support for Facility Development:

- ...upgrade facilities. (0002)
- In the management of the area, see that all signage and other man-made structures blend with their background. (0036)
- The things I'm most interested in, is what people can do either by car or by foot, because this is most of the people that come in. We can, and should open up more boardwalks. We need to fix the road going out to the marsh trail so we don't ruin our cars getting out there. I'd like to see the Cypress Trail expanded. I'd like to see a boardwalk through C-7. I think that the boardwalk at Wakodathatchee proves how very popular the boardwalk that goes right out over the water can be. (0078)
- Increase appropriate areas for public use, make these areas more user friendly. (0031)
- Putting in a couple of trash cans on the boardwalk area. Occasionally we come across some people who have not been toilet trained, and who do not know about taking their cups and cigarette cases, and what not, and holding on to them. At least until they get to a proper receptacle. Perhaps if there were some receptacles out there, they would learn to use them. (0080)

b. Opposed to Facility Development in General and at Headquarters Area:

- Public access should be limited and controlled. We, the public are destroying nature and in the end destroying ourselves. (0124)
- There should be no further development of public services. (0132)
- The construction of an additional visitor center building with an auditorium and wet lab at an estimated cost of over \$1 million is one project (project 10) that should be scaled down. After attracting visitors to the refuge, the FWS should be educating people outside in the field. We urge the FWS to take the precautionary approach, and not extend the cypress swamp trail until the ramifications of such a project are known. (0094)

- I don't want to see buildings expanded at this time, because if you do that around headquarters, you're going to be invading wetlands, and you will be guilty of the same thing as the Florida Game and Conservation Commission, or whatever their name is. That's what they did in the wetlands there, and I would not like to see you guilty of the same thing. (0072)

Response:

In response to the overall tone of these comments, the CCP planning team has re-assessed, re-wrote, and re-prioritized all projects which supported new buildings, concession, boardwalks, and opening of new areas. Please see other appendices of this document, especially Appendices G and H.

The former Project 10 "Expand Recreational Opportunities at Headquarters Area" (Table 8) was re-assessed and re-numbered to be the lowest priority project. Because funding is always tight, monies that become available will be used first for exotic plant control, maintaining existing structures and facilities, the biological program and environmental education and outreach. Former Project 14, "Expand Environmental Education and Outreach" has been made No. 4 priority. This will provide greater learning opportunities about the refuge and the greater Everglades ecosystem. Please see Appendix G (Environmental Education and Interpretation.)

0080; placing more trash cans around refuge access points will be considered, but unfortunately, our experience has shown that more cans usually mean that less people pack their trash out. More trash cans doesn't translate unfortunately, by our experience, to mean less trash on the ground, rather more trash to pick up from cans. Our limited maintenance staff already spends a large amount of time emptying the existing trash.

## *2. Hillsboro*

a. Support of Hillsboro Facility Development:

- ...south end concession OK, if no air boats or motorboats. (0011)
- .... one of the things that I just wanted to bring up, was a space that we're going to need for parking for concession (at Hillsboro). (0081)
- The things I'm most interested in, is what people can do either by car or by foot, because this is most of the people that come in. We can, and should open up more boardwalks. We need to fix the road going out to the marsh trail so we don't ruin our cars getting out there. I'd like to see the Cypress Trail expanded. I'd like to see a boardwalk through C-7. I think that the boardwalk at Wakodathatchee proves how very popular the boardwalk that goes right out over the water can be. (0078)
- Many people visit the Hillsboro Recreation Area, particularly those engaging in recreation on the water. It is important to establish more of a presence by FWS personnel, both for educational purposes and for law enforcement. Infrastructure is sorely needed, and we support the construction of a satellite visitor center in the area. Because this area straddles the levee between WCA1 and WCA2, it is a good opportunity to partner with the State to share the cost and the facilities as a gateway to both Areas, to emphasize the ecosystems and to point out the differences in management and public-use regulations. (0094)

b. Opposed to Hillsboro Facility Development:

- Project twelve expands the recreation at the Hillsborough area. There is no justifiable reason, and therefore we strongly oppose awarding a concession contract that would provide fishing equipment and guides. Such a venture would place the service in a position of actively promoting fishing, when fishing serves an absolutely not conservation or educational purpose. Nowhere in the draft plan does it state that the killing and removal of fish from the refuge will enhance the quality of the land, or that the fish pose any threat to the refuge. (0073)
- Because WCA2 (access location) is at that point (Hillsboro), which allows many forms of recreation, there is less need to facilitate increased use of the refuge as proposed in the draft CCP. Currently, use in this area is self-limited to people owning their own equipment. A concession (proposed) may result in an increase of users, but at a large cost and increased management burden. The current self-limited system is much more efficient and compatible with the refuge's wildlife protection purposes. (0094)
- Concessions in our National parks and forests are damaging and hard to remove. Better if public funded or outside our land. (0066)
- Project 12: Expand Recreation at the Hillsboro area: There is no justifiable reason for, and, therefore, we strongly oppose, awarding a concession contract that would provide fishing equipment and guides. Such a venture would place the Service in the position of actively promoting fishing, when fishing serves absolutely no conservationist or educational purpose. (0109; Animal Right Foundation of Florida, Inc.)
- No concessions for food, ECT, beyond present offerings at the visitor center. (0040)
- I oppose bicycle rental shop. (0064)

Response: Comments Noted

The planning team considered all the comments found throughout this Comment and Response Appendix, as a whole, to get an overall feel for public sentiments and it also considered the comments by subject. Comments concerning funding deficits, resource impacts, recreational use versus resource compatibility, compliance with Service directives and issues with the Hillsboro project led the team to reassess the projects (Table 8). Also, because many comments urged the refuge to make exotic species removal the highest refuge priority, followed by resource protection and environmental education, all the projects were prioritized, some were amended, some were split and the overall order of projects in this the final plan has changed.

In response to the overall tone of the comments from citizens, non-governmental organizations and governmental agencies, the planning team re-considered, re-wrote and re-prioritized the "Hillsboro Recreation Area Project" (Table 8, formerly Project 12). The project was divided into two separate projects; Project No.11 (Hillsboro Contact Station and Interpretive Center Project) and Project No. 14 (Hillsboro Recreation).

The New Hillsboro Contact Station and Interpretive Center Project (No. 11), will establish a contact station/interpretive center. This option recognizes comments emphasizing environmental education, interpretation, resource protection and partnerships. Ideally this center's interpretive display would contrast the unique differences between WCA1, WCA2 and WCA3; showcasing the northern and central Everglades System. The refuge managers are entertaining ideas about partnering with other agencies on sharing a building as a "contact station/interpretive center" in the Hillsboro Area. Many comments also expressed concern about new facilities attracting more people, expanding buildings and loss of wetlands to site development. The planning team considered these points

and concluded that a new interpretive building at Hillsboro would not necessarily increase visitation, but would increase resource awareness and environmental education for people currently frequenting the site. The planning team also agreed that constructing a new building to fit the footprint of a pre-existing building would not cause further impact (with appropriate construction safeguards) to the nearby wetlands and would be publicly acceptable. Furthermore, a formal refuge presence in the Hillsboro Area would assist in increasing visitor security, reduce vandalism, crime, and drug abuse and decrease illegal activities regarding wildlife.

Project No. 14 (Hillsboro Recreation) is now lower on the priority list, yet still considered an important project. This re-written project scales back the potential footprint of a full-blown concession, so that an initial operation could be started up and recreational impacts monitored. A preliminary framework of limited boat (canoes, kayaks, motorized johnboats), bicycle and fishing gear rental opportunities will assist in keeping the congestion down and lessening the impact to wildlife in this area. A dawn and dusk interpretive boat tour from the Hillsboro Area to the Headquarters Area is still under consideration with a limited number of trips per day. Opportunities could expand depending on need and compatibility. Selling food at Hillsboro may not be allowed, pending Service appropriateness and compatibility determinations.

Hillsboro is visited most often for its fishing opportunities. Fishing can be an excellent interpretive activity, exposing young people and urban dwellers to the unique sounds of the marsh, the beauty of nature and the unique setting of the refuge. The refuge supports catch and release fishing because of the high mercury levels found in most predatory fish within the Everglades ecosystem. However, the refuge also supports the removal of exotic fish from the refuge waters.

### *3. Strazzulla Marsh*

#### *a. Support Opening to the Public and Development:*

- As to the Strazzulla marsh. I do support an elevated walkway and observation tower looking out over both the marsh and WCA-1A. This unfortunately, will require a ranger on station during visiting hours. If arranged in close enough proximity, the Strazzulla Marsh entrance and the proposed limited ramp facility at or around ACME 1 OR 2 could be patrolled by the same ranger(s) and both could be locked down during non-use (night) periods. Thus, I support limited public use for touring the dim ditch, use of the canoe trail, hiking, birdwatching, and in general absorbing the little bit of nature remaining. (0108)

#### *b. Oppose Opening to the Public and Development*

- Don't let people in the Strazzulla marsh because they will hurt it. (0049)
- I do not trust "us" as citizens to treat any public lands properly. A sad statement and you, more than I, likely have the data to support that. Please watch us closely - many of us are not custodians but rather violators. (0108)
- Don't open Strazzulla (0002)
- The next thing on my mind is; keep out of Strazzulla. Manage it, but don't open it to the public. Please don't open it to the public. (0072)
- I also see problems with expanding the access points to the refuge and would discourage that possibility. (0059)

Response: Comments Noted

The proposed Strazzulla Marsh project will facilitate minimal access into the “interior of the Strazzulla Marsh.” However, as previously noted, all projects (Table 8) have been re-assessed and prioritized differently in response to public and agency comments. The Strazzulla Project which includes developing limited facilities such as a fishing pier on the perimeter canal, an elevated observation tower and marsh boardwalk, interpretive panels, and restrooms became a lower priority and is now Project No.14.

The map in the draft plan is misleading. A boardwalk across the marsh is cost prohibitive and could impact the habitat. Instead the intent is to construct two, short (less than 100 yards) boardwalks that would be built to enable the public to experience the marsh up close as well as provide a better opportunity for nature photography.

*4. 20-Mile Bend*

- The removal of the historic boat ramp facility at the northern (‘20-mile bend’) of the refuge, albeit SFWMD owned and operated, has negatively impacted the availability of the rim canal and wildlife viewing opportunities for those of us in the so-called western communities of Palm Beach County. I read with interest the possibility of a ramp plus other facility somewhere along the NE rim canal at an ACME site in Wellington. This could be wonderful if it is not turned into an active site. (0108)
- I read with interest the possibility of a ramp plus other facilities somewhere on the line of the northeast rim and acme site in Wellington. This could be wonderful if it’s not turned into an active site. That is, if it’s just a passive access area with little or no extra added attractions. (0076)

Response: Comments Noted

From communications with the South Florida Water Management District, no plans are being considered to provide boat ramps at the north end near the new Stormwater Treatment Areas (artificial marshes that are being constructed as part of Everglades restoration). In addition, no boat ramp will be constructed near Strazzulla marsh. The grassy area near ACME 1 and 2 could possibly be used as a temporary parking area for those with a small boat/canoe/kayak. A small boat, which could be carried to the water’s edge could be put in the refuge’s perimeter canal at these locations.

**G. Environmental Education and Interpretation****1. General Support**

- ...use it for education and ecology. (0020)
- ...use refuge only (for) environmental education. (0027)
- ...designate land use for environmental and educational purposes. (0047)
- We do support among some of the other projects, project 14, which expands environmental education in a non-consumptive manner. Students, tourists, and residents alike can learn the importance of preservation, conservation, and the respect for nature. Our desire (is) to see more educational activities made available. (0073)
- Finally, we do support, among some of the other Projects, Project 14, which expands environmental education in a non-consumptive manner. Students, tourists, and residents alike can learn the importance of preservation, conservation, and the respect for nature that results when we turn away the bullets and arrows of the hunter, and the barbed hooks of the angler, and strive to live at peace with the last vestiges of our natural surroundings. (0109)
- After ecological considerations; most important public use is education; programs, meetings, tours, etc. If we want to save what's left, we have to let the public see it and teach them about their environment. We have a constantly growing population with no idea of what conditions are or where they are living. They need to be taught. Don't listen to those who want to put a fence around all Environmentally Sensitive Lands. (0034)
- I'm very excited about the things you have to say about education. You know we need to educate our kids, our adults, everyone on the joys of the landscapes, the creatures, that are here that have every bit as much right to be here, maybe more, than we do. (0088)
- Need more community involvement (0023)
- I was just wondering what efforts, if any, have been made in contacting all of these gated communities that have been growing and mushrooming in South Florida, Boynton Beach area, about raising money in all these communities to help fund some of the projects...because many of the communities do undertake various types of charitable work. (0080)
- All programs to welcome public participation in learning and enjoying the natural plant and animal life enriches all of us and encourages life-supporting values. (0038)
- ...use refuge for education and environmental appreciation. (0019)
- Use for environmental education. (0026)
- Preserve the natural beauty for nature groups and education. (0030)
- Possibly more educational venues for visitors. (0044)
- Only use refuge for observing the environment and supporting education. (0013)
- ...use for education. (0029)
- Keep educational areas to keep public informed and knowledgeable. (0018)
- I'm in favor of more education. (0075)
- I would like to see more education. (0072)
- ...yes to education. (0012)
- The educational programs are essential and the public should be made aware of the purpose and usefulness of the refuge. It is so important to the quality of life in South Florida. (0037)
- Education includes overall long term respect. (0066)

Response: Comments Noted

Many people support using the refuge for environmental education and interpretation. The original Expand Environmental Education and Outreach Project (No.14) was given a much higher priority in the final plan -- and moved to No. 4. This project (pending funding) will provide new educational materials (printed, electronic, and public service brochures) on the refuge's wildlife, habitats, and management, the Everglades ecosystem and impacts of human development on the Everglades. Also an outdoor classroom will be erected near Compartment C for visiting school classes and adult education. The refuge hopes its Friends group and other support groups can also help support the spirit of Project No. 4 (Expand Environmental Education and Outreach).

0080; Gated communities have not been contacted by the refuge about funding projects. But the suggestion will be passed on to our non-profit refuge support groups - a more appropriate venue for such a request.

## *2. Opposed*

- The National Wildlife "Refuge System Improvement Act" gave equal emphasis to six high priority wildlife-dependent recreational uses, yet a complex environmental education component is given expedited priority in the Draft Plan over a modest expansion of hunting opportunities that would be simple to implement. (0114)

Response: Comments Noted.

## H. Public Use Management

### 1. Cost of Public Use Initiatives

- The idea of doing the increased public use, biology and public use staff increases, building increases, additional trails, boardwalks and towers are great ideas. But we are worried about the development and maintenance of all new infrastructure associated with the increases. We work to maintain what we already have and the current maintenance staff cannot keep up with the current demands. There are currently 4 people maintaining the facilities – we are not young and we are getting older; i.e.; we cannot do all that is currently necessary, let alone do what is projected in this plan. We see that there will be dramatic increases in biology and public use staff. Unfortunately, there are not enough increases in the maintenance staff to begin to address the coming changes. We propose that at least 3 laborers (temporary) and 2 FTE's (full-time employees) be added to the staff in the proposed plan. (0113)
- Recognizing that wildlife-dependent recreation and environmental education are important to increase the public's appreciation, understanding, and support for refuge resources, we are concerned that some of the proposed activities may have negative impacts on Loxahatchee's unique environment, particularly when considered cumulatively. When the proposed uses are analyzed together, combined with the anticipated increases in visitation as a result of improved visitor facilities and outreach, the negative impacts of the public use program are large. An excellent study was conducted at Loxahatchee on the effects of people on bird behavior (Burger and Gochfeld 1998) Burger and Gochfeld found that:  
(1) all species examined altered their foraging and vigilance behavior in the presence of people; (2) alterations in behavior included changes in foraging time, foraging rate, vigilance behavior, and movement (away from people); (3) loudness, as well as the number of people, affected the foraging behavior of the birds; and (4) there were species differences in initial responses to people while they were present and in recovery time. The FWS should rely on research on the effects of ecotourism and recreation to aid in compatibility decision-making and cumulative effects analysis. (0094)
- I think that you need to pay attention to regulation and policing if you open it up to more public access, that will be an expensive problem.... (0072)
- We have concerns about how staff will monitor increased waterfowl hunt area and motorboat activity. (0119; Sierra Club, Broward County Group)

#### Response: Comments Noted

0113: Comments noted. The potential additional infrastructure and additional programs could not be adequately handled without much more support from the Operations Department (maintenance staff). The proposed staffing chart (Figure 20) in the final plan shows five additional positions in the Operations Department. In fact, new projects will not be implemented without proper funding for operations and maintenance (positions) as well as funding for construction.

0094: After the planning team examined all the public comments (verbal and written) for content and tone, they agreed with this specific comment on the potential for adverse cumulative impacts. Many other comments when viewed as a whole, pointed to the same idea, but did not put it as succinctly.

The planning team noted comment support for environmental education and interpretation support is very strong. But examining other comments showed a concern about too much facility development, a potential diversion of funds from exotic plant control to other projects (including education) and concern about losing emphasis on resource protection/

biology in place of education. Concern was raised by many about too much recreational activity and the potential impacts related to it.

The noted journal article has been consulted and reviewed and was taken into consideration. Refuge biologists and staff continue to recognize visitor presence and activities that can and do impact wildlife behavior. This awareness and responsibility contributed to changing some of the proposed projects expanding visitor access, how the projects would be monitored, and how projects were prioritized.

The original project listing was not in any type of priority order. After the draft plan was printed, the core planning team attempted to determine priorities and wondered how the public comments would fall. After the comments were noted, all the projects were reviewed. Some of the proposed projects were amended and some were split into phases. The projects were then prioritized. Please see the amended project list and Table 8 in this plan.

0072 & 0119: Comments noted. Additional law enforcement personnel are proposed to support the proposed changes; please see Table 9 and Figure 17 in this plan.

Funding will be the first limiting value in whether a project or public use expansion will occur. Ideally, the projects will be implemented in priority order. However, the refuge does not have exclusive control over what is funded and what is not. See the first portion of Appendix Q for funding processes.

Increasing public access including expanding the hunt zone will not be attempted until funding is available to adequately staff the law enforcement department. This plan is a 15 year plan; proposed changes will be made slowly, by prioritized project subject to funding. Biological monitoring programs will be enacted to assess potential negative impacts on wildlife or habitats associated with increased public use. Refuge management will be kept apprized of monitoring results; where and when negative impacts are identified, corrective measures will be taken.

## *2. Passive versus Consumptive Recreational Uses*

### *a. Support Passive Recreation Uses:*

- Loxahatchee National Wildlife Refuge should focus its management priorities on passive recreation opportunities, environmental education, and non-motorized opportunities. Our members are avid hikers, users and supporters of the refuge. (0118)
- Yes to passive activities. (0011)
- I am in favor of expanded passive recreational uses that allow visitors and wildlife to co-exist together. The park is currently a great place to take children to learn about nature. I want to see it remain a passive use area. (0100)
- Continue passive recreation. (0003)
- Yes to low key/low impact environmental activities. (0012)
- Activities which belong are such as; considering the wonder of Nature, birdwatching, walking, and talking-or better, walking and not talking-with ones life partner, fishing, and photography. (0108)
- Activities which belong are such as; considering the wonder of Nature, birdwatching, walking, and talking-or better, walking and not talking-with ones life partner, fishing, and photography. (0076)
- Our desire (is) to see non-consumptive activities made available. (0073)
- More emphasis on passive recreation. (0002)

- Management focus should target passive recreation opportunities, environmental education, and non-motorized outdoor opportunities to serve South Florida's growing population. (0119)
- Use for nature groups. (0029)

Response: Comments Noted

The projects described in the Plan Implementation Section and listed in Table 8 of this plan have been re-ordered and passive recreation has received greater priority. However, opening up new areas is a lower priority.

i. Opposed to Generalized Hunting or Fishing:

- While we recognize that the Refuge Improvement Act upgrades hunting and fishing to priority uses, at a minimum the FWS must conduct rigorous biological analyses of the refuge's wildlife populations before making any compatibility determinations about the commercial and/or recreational killing of wildlife on the refuge.... We strongly oppose the use of hunting as a method of wildlife management. For too long hunting has been used as a catchall solution by the FWS and other federal and state agencies for a broad range of management issues ranging from perceived overpopulation to human-wildlife conflicts. This has occurred despite the potential impacts of hunting on population dynamics and demography and humaneness of hunting practices. ... no hunting in Strazzulla....no trapping. Theodore Roosevelt established the first National Wildlife Refuge in 1903 as an "involute sanctuary" for wildlife. The original intent and purpose of wildlife refuges was clear. It was not until the early 1950s that the FWS began to allow the commercial and recreational killing of wildlife at some refuges. Most Americans still view wildlife refuges as places where wild animals are protected from human interference. That is in fact the common definition of the word "refuge." (0111)
- Most importantly hunting (including frog-gigging, gator harvesting and all types of mammal hunting) and air boat use should be prohibited. The topic of air boat use on the historically allowed wildfowl hunting areas in the south should be revisited and perhaps scaled back. (0076)
- Our desire is to keep hunting and increased fishing opportunities out of the refuge. (0067)
- Don't use Loxahatchee as a hunting park. Our natural areas in south Florida are vanishing at a ridiculous rate, and for a sheltered area for our dwindling wildlife to be considered as a hunting warzone is an outrage. (0052)
- I personally have only several reservations, and they have already been expressed. One would have been the hunting. (0083)
- ...the definition of a refuge is a 'safe place, a sanctuary' and Loxahatchee should be preserved, giving a safe place for animals to live out a natural life. No hunting. (0043)
- We are opposed to hunting on a wildlife refuge, in this case Loxahatchee NWR. Protect and preserve animals. There are so many elements that are causing our wildlife to dwindle: land encroachment, hunting, environmental poisons/toxins, natural disasters, over-fishing, destruction of natural environment by people and recreation vehicles. Don't the hunters have enough land in which to kill animals? Enough is enough. Leave something for our wildlife. Let's not be so selfish and greedy. (0053)
- I would like to point out that the animals receive absolutely no benefit from being shot, stabbed, or hooked. Concentrate your efforts on removing exotic and destructive plant life, and let the animals take care of themselves. I am therefore quite concerned to hear that the new Draft Comprehensive Conservation Plan contains proposals to increase access to Loxahatchee for hunting and fishing. (0105)

- Our desire to keep hunting and increased fishing opportunities out of the Refuge would outweigh our desire to see more educational and non-consumptive activities made available. (0109)
- My family and I have frequented Loxahatchee NWR. We are appalled that you are thinking of allowing hunting on the refuge. Refurbish and expand the park, but without hunting. We are against a policy that will not be successful. If your idea is to eliminate the so-called excess of wild hogs you are badly mistaken. Eventually the same number of animals will occupy that space. Unfortunately many of these animals will be maimed and suffer. Also many endangered animals are at risk. Hunters are a minute percentage of the population. To bow down to them would be unjustified. The vast majority of the population would vote against such a proposal. (0056).
- Last month, at the public meeting regarding the proposed changes, the public's voice was loud and clear; most attendees emphasized that they do not want hunting to be allowed at the Loxahatchee Refuge. (0097)
- Hunting is allowed on so many more public lands in South Florida that it's totally unnecessary. I think I saw in one of the alternatives it said a public concern was there's a need for hunting. Hunting is not a need. This is a refuge, and a sanctuary for wildlife life as I see it. And you know there are so few places for wildlife to be where they're not hunted. (0082)
- I would like to say that I oppose the section of your plan to allow men and women to murder bear, deer, alligators, wild pigs, and frogs on the Loxahatchee NWR. A refuge should be a sanctuary and protection from danger and distress for the animals that live there. (0079)
- Do not allow men and women to kill on this refuge. Mankind is already in great trouble due to gross indifference toward other species. (0055)
- Do not let the hunters in. (0049)
- We turn away the bullets and arrows of the hunter, and the barbed hooks of the angler and strive to live in peace with what is left of our natural surroundings. Thank you. (0073)
- No hunting. Almost every day I see opossums, raccoons, or armadillos lying dead on the roads, run over by cars. We have moved in and taken over almost every piece of land that they have lived in. How can anyone suggest going and killing any animal living in a refuge? It's a disgrace to even think that someone would even consider this proposal. Is there no where left where these animals can live in peace? (0054)
- I have reservations about hunting but would hope it would be controlled to prevent becoming nuisances. (0035)
- ...let hunters chase game somewhere else. (0009)
- Hunting should not be permitted in a wildlife refuge. (0050)
- No hunting, wildlife not wild death. (0032)
- No hunting noted by the following commentors: (0015), (0020), (0066), (0013), (0021), (0028), (0012), (0065), (0006), (0029), (0047), (0017), (0003), (0014), (0007), (0004), (0030), (0018), (0119), (0002), (0008), (0048).
- Most importantly hunting, including frog and gator harvesting, all types of mammal hunting and air boat use should be prohibited. (0076)
- ...(hunting) is a cruel and savage sport – no hunting in the refuge. (0046)
- We do not want to see hunting in the refuge or motorized vehicles or horses. (0062)

- The proposal to allow hunting of alligators, feral pigs, and frogs is the most absurd aspect of the changes. “Shelter from danger or trouble” is Random House Dictionary’s definition of “refuge.” A refuge that allows slaughter of wildlife is not only a contradiction of terms but also clearly not the original intent of the refuge. (0097)
  - I am not against hunting and I have hunted in the past but by the opening up the wildlife preserves to hunters that’s just defying everything people put into have wildlife preservation land. These restricted lands are for animals to be safe and not hunted. There are many other places where hunters can go and enjoy hunting and fishing without having to bother this land. (0104)
  - The thing that concerns me the most...the definition of refuge: protection or shelter as from danger or hardship. Now, if the purpose is for a refuge, and I kept hearing wildlife first, why would we want to encourage creature to feel like they have a safe haven, and then allow people to go in and kill them? (0088)
  - I am opposed to hunting of any type in a National Wildlife Refuge. There is a great irony in allowing hunting in a place called a refuge. There is no need for hunting on public lands. (0100)
- ii. Oppose Waterfowl Hunting or Hunt Boundary Expansion.
- I am opposed to any expansion of waterfowl hunting. Our waterfowl situation in the US is bad and getting worse. Why hasten its demise? (0064)
  - I strongly oppose its eviction, and I also oppose proposed changes in regulations that would allow hunting and intrusion by motorized water craft of any kind. (0103)
  - ....we do question redefining waterfowl areas to allow greater accessibility to motorboats by expanding existing interior hunt boundaries to the west (0018)
  - We also have concerns about redefining waterfowl areas to allow greater accessibility to motorboats by expanding existing interior hunt boundaries to the west and how staff will monitor this activity. (0119)
- iii. Oppose Alligator and Hog Hunting
- We oppose on biological and ethical grounds the FWS’s proposal to allow an alligator hunt in the Loxahatchee NWR. The sole stated purpose for the proposal is to allow increased hunting opportunities. Clearly, there is no need or justification for this hunt and the “beneficiaries” of such a proposal would be only a few individual alligator hunters. (0111)
  - I am opposed to the alligator hunt for some of the same reasons that the plan opposes frog gigging and air boat use. One can hunt gators in Lake Okeechobee, for instance. The refuge is one of the few places the gators can exist without any human interference. (0096)
  - I think the refuge should be the last refuge for the alligator. It should be left alone in the refuge. (0086)
  - I am opposed to ANY alligator hunting in the refuge. If alligators can’t live unmolested in a wildlife refuge wetland, or canal, where can they live? (0064)
  - I don’t want to see an alligator hunt....you really don’t have an alligator problem. .... leave the balance. There’s never been any establishment that the alligators in the canals move out and invade the public places. At certain times of the year, they will do that anyhow. (0072)
  - Alligator hunting should only be done on an irregular basis, as determined to be necessary through biological monitoring of the population. I would prefer that it not be done. (0126)

- Alligators are considered native wildlife and therefore, should never have been listed on alternative two as an animal to be killed. In fact, alligators on the refuge are precisely the very animals who have found their niche in the natural ecosystem, and are not a threat to the human population. (0073)
  - ... but the proposal to allow destructive activity, like hunting for the alligators, wild pigs, or frogs, is a mistake. (0069)
  - We are concerned about opening the refuge to alligator hunting. Does the biology say that there are too many alligators? We need to rely on sound biology to determine what is hunted and what is not hunted. In other words, the refuge should rely on baseline knowledge to support hunting only if it is conducive to maintaining the biological balance. We don't think the refuge should support hunting just for the sake of hunting.
  - We are also concerned that having gator hunts will spend the limited amount of money the refuge receives to operate. If this gator hunt occurs, the refuge will need to spend a lot of money on additional law enforcement (which will end up being overtime pay —time and a half or more). The hunters will be hunting at night and will be able to access the refuge interior if the water levels are high. Thus increasing the chance of uncontrolled access and poaching. We feel that gator hunting will lead to uncontrolled activities and attract undesirable people to the refuge. Having worked law enforcement on the refuge in earlier years, we know you cannot catch someone easily in the marsh. It would be a shame to open the refuge up to potential abuse. (0113)
  - The public hunt for feral hogs was proposed since they were blamed for general habitat degradation, yet no study was cited to determine if and what...to what extent...the hogs had hampered the existence of native plants and animals. It is widely accepted among wildlife biologists that hunting does not reduce hard numbers in the long run. (0073)
  - No hog hunting. (0026)
- iv. Oppose Frogging
- No frogging or turtle harvesting. (0064)
  - No frogging, etc. (0058)
- v. Oppose Pursuit Dogs
- No dogs. (0014)
  - Allowing dogs would harass wild boars. (0046)

Response: Comments Noted

As part of the National Wildlife Refuge System Improvement Act of 1997, wildlife-dependent recreational uses such as hunting, fishing, wildlife observation, wildlife photography, environmental education and interpretation are to be considered legitimate and priority public uses. These activities are dependent upon healthy fish and wildlife populations, good quality habitat, accessibility without habitat damage, and sound science; all determined by the Refuge Manager and staff. The responsibility of the refuge system also extends toward supporting the cultural heritage (which includes hunting and fishing) of the United States.

President Teddy Roosevelt created the first national wildlife refuge, Pelican Island in Florida, to protect wading birds from market hunters. The numbers of wading birds were being reduced at a phenomenal rate due to many factors such as economic demand for fashionable breeding feathers, use of rapid-fire or repeating guns and what is today considered “unethical hunting practice.” This first refuge was a sanctuary for birds (wildlife), but President Roosevelt was also an active hunter and fisherman. He recognized that balanced wildlife populations could

be maintained and hunting did not have to negatively impact a species' population. Many national wildlife refuges since that first one have been closed to hunting, but many more have been open to hunting. In fact, the majority of national wildlife refuges have some form of hunting as a management tool and/or public use opportunity. Hunttable wildlife populations are monitored, size (age) limits are imposed to ensure animals can reproduce before they can be taken, and harvest rates identified yearly, according to biological data.

While the public often focuses on individual animals, wildlife managers and biologists need to focus on wildlife populations, fully recognizing not all animals will survive and a landscape food web is natural and is needed. The refuge recognizes the many citizen responses against hunting and fishing as a whole. The refuge also considers the many citizens for a hunting program, as well as the nation's cultural past, the Improvement Act, and the opportunity to experience the refuge and engage in outdoor education and interpretation through hunting and fishing activities. The refuge will allow limited hunting for specific species (alligators, feral hogs, waterfowl) whose populations (in the case of alligator and waterfowl) will be relatively unaffected by the removal of a limited number of individual animals. It is the intent of the proposed feral hog hunting program to reduce the population of these exotic invasive animals that significantly degrade the natural habitat.

No commercial hunting or fishing of native species will be allowed on the refuge. Commercial operations would only be considered by contract or Special Use Permit to remove invasive exotic fish. In the case of feral hogs, contracts with USDA Wildlife Services could be used to supplement the refuge's efforts to minimize habitat damage. Biological surveys currently being conducted and those planned for the future will be used to determine if hunting activities are sound. Any and all hunts on the refuge will be controlled by law enforcement staff through permits, and biological staff will provide monitoring support for those hunts.

Fishing, along with wildlife observation and photography, hunting, interpretation and environmental education, is one of the Refuge Improvement Act priority wildlife-dependent recreation uses. This activity, if fish populations are sufficient, is to receive enhanced consideration over other public uses in planning and management. Fishing can be an excellent interpretive activity, exposing young people and urban dwellers to the unique sounds of the marsh, the beauty of nature, and the unique setting of the refuge. The refuge supports catch and release fishing because of the high mercury levels found in most predatory fish. However, the refuge also supports the removal of exotic fish from refuge waters.

Current alligator research indicates that controlled hunting could be supported in the perimeter canal area. An alligator hunt will be allowed on the refuge as funding permits and biological data supports it on a year-by-year basis. The proposed hunt will take place in a limited area of the perimeter canal only via conventional motorboats and for a limited time within the State alligator season. Few hunters will be allowed in each night, thereby reducing the difficulty of keeping track of boats. Law enforcement staff will be able to survey the hunted portions of the canal by boat and from the levee road. Because the proposed alligator hunt will take place at night after normal open refuge hours, the only people on the refuge will be a select number of permitted hunters, law enforcement, and biology staff operating the check stations. Partnering with other agencies to control the hunt and to operate the biological check stations will likely occur. All alligators harvested will be required to be brought to the refuge check station where valuable biological data can be obtained. This type of information not normally available will support current research on this species. As with all proposed projects, adequate funding will be a factor in determining when this hunt may occur. The proposed alligator hunt will not take place during drought conditions when many alligators from

the refuge interior move to the deep water of the perimeter canals. The alligator hunts may not occur on a regular basis, and the hunt may be suspended at any time by the refuge for biological or safety reasons.

Non-native, invasive feral hogs are destructive to the natural habitat and will be removed for resource management purposes. When feral hog populations can sustain a hunt (when hog populations exceed the refuge staff's ability to control their numbers), the public will be invited to assist in feral hog management by hunting/removing individual animals. This will occur by permit only and likely not be a yearly event.

The area proposed as the expanded waterfowl hunt area (Alternative 2, Figure 22) is entirely within the Alternative 1 (Maintain Current Management) public use area where anglers have used motorboats for years. This habitat does not appear to have been compromised by motor use and is in fact the best fishing and hunting area on the refuge. The water levels remain deepest in the southern end of the refuge because of impoundment effects and southward sheet flow. Some trails have been cut and maintained by motors into the southwestern portion of the marsh, but they do not appear to negatively impact the marsh or its inhabitants.

In the final plan, the use of dogs to assist waterfowl hunters is considered compatible and will be allowed, as they help reduce the loss/waste of game. Very few dogs accompany waterfowl hunters because of the threat of alligators. Dogs will not be allowed in feral hog hunting or alligator activities, nor will they be allowed to accompany visitors on the refuge. They will not be allowed to remain in vehicles while people participate in wildlife observation, education or interpretation activities due to the threat of overheating.

Please see "Support Consumptive Recreational Use" (below) for related topics and refuge responses.

b. Support Consumptive Recreational Use:

i. Support Generalized Hunting

- ...is a limited list of beneficial suggestions concerning the possibility of allowing the use of commercial trot lines, in the Loxahatchee rim canals to reduce exotic fish. (0120)
- ...No accommodation was made in the Draft Plan to assess whitetail deer populations for possible inclusion in hunting opportunities. (0114)
- There are more deer today than when Columbus landed. So, we were out there murdering them, just the seven percent of us who do that, then we are doing something right in the conservation area. ...Wildlife can be enhanced and can exist with hunting, and without being detrimental to wildlife in general. (0084)
- Many years ago it was not uncommon to see deer drinking from the L-7 or L-40 while I slowly fished these canals....From this report it appears that this is no longer a problem because the deer herd is virtually nonexistent. This is a shame. I believe that if the wildlife had been properly managed, there would be a larger deer population today... I believe that if the alligator population was thinned out and managed more closely, it would allow the deer herd to be reestablished. With fewer alligators there would be an over abundance of frogs. By allowing airboaters to gig frogs this would keep the frog population in check. (0093)
  - We are delighted to see that hunting is a part of the draft. The state's hunting community can be very important to the health of the Refuge.... We are troubled though in the fact that (in the Executive Summary Document) on page 9, under the column labeled 'Issue or Concern', subtitled Public Use, Section 3; it states "There is a need to provided increased access to the refuge for hunting waterfowl, deer,

alligator, turkey, bear and frogs.” Yet when we go to page 9, under the column labeled Alternative 2, subtitled “Ecosystem Emphasis” the UFS (USFWS) limits the hunting experience to waterfowl, feral hogs and limited alligator hunts. It seems that deer, turkey, (bear are not issue as they are illegal to hunt) and frogging have been left out. We ask that the following comments be considered for final drafting of the CCP for the refuge:

We agree with redefining the waterfowl hunt area to allow greater accessibility of motorboats by expanding existing interior hunt boundaries to the west.

We agree with the opening of refuge lands for the purpose of hunting HOG, DEER & TURKEY using WALK-IN, CANOE OR POLEBOAT methods using a limited permit system.

We whole heartedly agree with proposal for limited alligator hunts.

We ask that surveys determining the ability to hunt the area be done or reviewed by the Florida Fish and Wildlife Conservation Commission.

As hunters we understand, as you do, the need for game management. The current problem you are facing with feral hogs could just as well be a problem with over populations of deer or turkey. As you can see we are almost in full agreement with the plan proposed by UFS with the exception of limited hunting opportunities. As hunters we understand, as you do, the need for game management. (0110; Florida Hunting Coalition)

- As an avid sportsman and conservationist I can't help but notice that the draft is very restrictive to individuals that enjoy hunting, fishing and air boating (0093)
  - I would like to say that I support the option that allows big game and small game hunting, fishing, trapping, frogging, camping and air boats throughout the refuge. These activities are traditional American, family oriented sports, especially in South Florida. As you are aware, the above activities are allowed on the majority of the National Wild Refuges throughout the country and there is no reason these same activities cannot be allowed on your refuge. These activities also fit in nicely with other recreational activities such as bird watching and hiking which occur close to your Visitor Center. You won't find bird watchers and hikers back in the swamps! (0121)
  - We need more area open to public for recreational fishing along with limited hunting. (0039)
  - We would like more fishing area. (0060)
  - Our organization is made up of sportsmen's groups, so naturally responsible and well regulated hunting and fishing opportunities and back country access are very important to our members. The Draft Plan is especially biased against these interests. Using slight-of-hand wording it misrepresents facts in numerous instances to portray these activities in the worst manner possible. (0114)
- ii. Support Waterfowl Hunting or Hunt Boundary Expansion
- Your migratory birds that come into the refuge here are hunted all up and down the seaboard. Still they're on the recovery because of all the money that's spent by Ducks Unlimited for the nesting areas in Canada and in the northern United States. (0084)
  - I think waterfowl hunting maybe should continue. (0086)
  - ...open up more area for duck hunting, especially the north area. (0039)

iii. Support Hog and Alligator Hunting

- We do not oppose a feral hog hunt and limited alligator hunt .... (0118)
- I support hog hunting in Strazzulla marsh, because they are an introduced species. (0064)
- I support limited hunting of feral hogs. (0126)
- We think that getting rid of feral hogs is fine. If the refuge uses a public hunt to remove these exotic animals fine. We are concerned about how the hunt occurs. We think that hunt should be very intensive, and all hogs should be removed at one time; a two week hunt or however long to get them all off the land. We don't think the refuge should have a limited hunt and do it twice or more a year just to provide access to hunters. If the hogs cannot be eliminated from the site by hunters, sharp-shooters should come in and finish the job. (0113)
- I wanted to write you to support the hunting proposal. In these ecosystems, animals, such as hogs, have no predators and can overpopulate. Hunting can act as a natural check on the population and prevent mass starvation or excessive destruction of habitat. (0106)
- I do support the hunting-the alligator hunting. I do support the feral hog hunting. (0083)
- In my letter of 26 April 2000 and at the microphone, I came out against hunting of gator and hogs. Upon reflection, I find that I must recant on that stand, but only a bit. If hogs are a problem and if gators ever actually become a problem then I could support hunting/harvesting of these if done in one of 2 ways. First, only government hunters do the harvest. Surely, the Fish and Wildlife employs same. Second, if the Service wishes to perform a harvest and at the same time quiet cries of hunter organizations then a government guided and/or escorted hunt/harvest in which a citizen, having won this honor by lottery, participates could be considered. I still oppose the open range hunting/harvest of either or both species inside the refuge. If a lottery system, escorted hunt does occur, I may even throw my name in the pot. As you may recall, I am also a hunter but oppose this in a refuge! (0108)

iv. Support Frogging

- Allow frog hunting. (0033)
- For instance in predicting the impact of recreational frogging would have on the refuge, the plan describes the effects of commercial frogging activities that occurred a half century ago in an era when resource management was in its infancy. No consideration was given to allowing the activity subject to reasonable recreation methods of harvest and limit, much like fishing is regulated on the refuge. (0114)
- With fewer alligators there would be an over abundance of frogs. By allowing air boaters to gig frogs this would keep the frog population in check. (0093)

Response: Comments Noted

0120; The only commercial fishing permitted will be by Special Use Permit or contract to remove invasive exotic fish.

Overall Response:

The mission of the National Wildlife Refuge System emphasizes what has come to be known as our motto, "wildlife first." Each refuge in the system tailors allowed activities to its own wildlife populations, to the supporting habitat, and to other issues related to the specific area. Some refuges have no hunting and some have no public access at all. However, the majority of national wildlife refuges permit some form of hunting and the vast majority permit fishing. The staff and the planning team of

A.R.M. Loxahatchee National Wildlife Refuge have had the responsibility to consider many issues including: habitat availability, water delivery and timing, wildlife populations, health and ecology, public access, public comments, Service guidelines, and the laws and regulations under which we must operate.

In the Management Direction and Plan Implementation Sections, the need to survey, monitor, or inventory wildlife populations is recognized in Goal 1, Objectives 6 and 8. Because the Inventory and Monitoring Plan is incomplete, it is difficult to tell what should and should not be included. The refuge biologists are aware that little recent survey information is available regarding white-tailed deer populations in the refuge interior. The guiding principles governing what species are inventoried, monitored and surveyed is addressed in Appendix O, Staff Inventory and Monitoring Efforts.

Deer are occasionally observed by staff working in the refuge interior, but it does not appear that population levels are sufficient to support a harvest.. They were commonly observed last year on the levees during flooding of tree islands as a result of Hurricane Irene. The numbers have declined due to native habitat being converted to farmlands and then to residential development.

Occasional reports of turkey have been made on lands the refuge manages. No population estimates are currently available to ascertain population levels. Staff experience suggests, although anecdotally, that populations of turkey are very small and not capable of supporting a hunt.

Regarding the alligator population, they are the top predator in the food chain and are in healthy condition on the refuge. Although the refuge surveys show a population that can sustain a harvest in the perimeter canal, the staff cannot concur with the statement that they are the reason for low levels of deer and frogs.

Hog hunting will be used as a management tool. Currently the feral hog population is not large, but refuge management wants to prevent further habitat destruction by these animals. The goal will be to reduce the feral hog population as much as possible and to schedule occasional hunts to reduce hog impacts. Hunts will be held when a reasonable expectation of harvest occurs. The removal will be closely monitored and conducted for a limited time. The refuge understands, because the area does not have an exclusion fence, hog populations may rise again. Hunts will take place on an as needed basis to keep the feral hog population minimal. The issues on frogging were addressed in Appendix J.

### *3. Airboats*

#### *a. Support Airboat Use:*

- By allowing air boats the use of the area, the small amount of grass that is laid down in the trails would allow birds to feed in an open area where they could be aware of any predators that may be close by. I personally have never seen birds feed in areas where the grass was very high. (0093)
- You were directed to provide for air boaters in 1994, down at the south end. And I hear today...and I saw the notice on jet skis, which is inappropriate, but in fish and wildlife process of control. But air boaters certainly have a right to this, and it is an effective means for transport for a facility of this nature. (0092)
- I believe it was then, the Florida Fish and Game Commission, now the Fish and Wildlife, fenced in an area of a couple of hundred feet square. And the purpose of fencing this in, nobody knew this until a bit later, was to keep all of the air boat half track, buggy traffic off of this particular area. By the next hunting season, you could not tell the fenced in area

from the area immediately outside of that where all the traffic had occurred. So, the Glades has an excellent ability to respond. (0084)

- I think that there's enough area to coexist for air boaters, canoers, and poleboaters. I think that to utilize the northern area would be good. Historically, that whole area has been opened up for froggers. (0091)
- And one of the best ways we have found, and even the school board here in Palm Beach County finds, that what we do on an educational basis, taking people out. Showing people what happens and how things are done, and how air boats can be, and are, operated safely throughout the ecosystem. I've been out there since the sixties, and during the very height of the concession area out there in the mid-seventies, we used to fill all the parking lot up with air...not air boats...but we used to fill all the parking lot with people that wanted to come out and see if they wanted to go out on an air boat or not. There were motorboats and other things that were available. So I would like for that to be a consideration. (0081)
- The air boat is one of the realistic keys that opens up this area to a multiple-use concept, and all parties enjoyed the liberal use of the area. As air boats beat down trails of thick underbrush, cattails, and saw grass, it became an oasis for all wildlife. Let me explain! NOTHING can habitat out of control varieties of invasive plant life, so thick that neither wildlife, nor fish, gators, turtles and other species can survive. But when the air boats were allowed, they were vehicles to remedy this situation. As they made trails through this useless type of terrain, these watery trails became an oasis for both fish and wildlife. (0115; Airboat & Halftrack Conservation Club of Palm Beach County, Inc.)
- Air boating is another activity that was addressed in a shamefully biased fashion, listing perceived adverse impacts of unregulated operation and suggesting that air boaters are irresponsible and negligent when it comes to wildlife and wildlife habitat. A portion of the draft plan purports to list the benefits and adverse effects of air boating, yet it omits any reference to its benefits... It's odd that noise was a major factor in disallowing airboats in the refuge, yet the Draft Plan calls for establishing concession services at the Hillsboro Recreational Area which is one of the most popular airboat launching area in the region. Our members are concerned the USFWS will later use the presence of the concession facilities as justification for effort to eliminate traditional airboat access into WCA-2 under the guise of sound management. ... (0114)
- Allow air boating to manage habitat (to bring the big heads back, to revitalize the area, increase waterfowl habitat) (0033)
- Allow air boats for alligator hunting, frogging and duck hunting. (0042)
- Air boats can coexist with the canoe people. It would be an entirely different area that the air boats could run in, compared to where the canoes and the people are out bird watching. (0090)
- I believe the refuge is large enough to support wildlife watchers and air boaters at the same time, without causing interference amongst the two. (0087)
- I got to see a nice part of the refuge out there, and I think with responsible air boat use, (they're) not going to impact the wildlife too bad. We're out there every day (other than the refuge) with responsible guidelines that we have to follow. The airboat trail that we use, look better than the canoe trails in some areas that I've been on. We definitely need to have more public use within the boundaries, nobody gets to see that... (0089)
- Air boats are obviously required as transportation (for hunting and fishing) due to the nature of the refuge. (0121)
- Like to see some of the air boating on the area, on a limited use. (0083)

b. Opposed to Airboat Use:

- I oppose all air boat traffic except for scientists and law enforcement. (0064)
- I oppose the use of air boats except for management and research purposes. (0126)
- I have concerns about allowing the use of air boats within the refuge. Although air boats are common and somewhat popular water craft, their usage can have very detrimental effects on natural environments. Air boats are extremely fast and loud vehicles. Not only do they have the ability to travel over water but also over land that may separate water bodies, for short distances. This risk, along with disturbances from their loud engines can act to drive wildlife away from areas in which these vehicles are used. If air boat usage is allowed, this activity must be highly regulated and monitored. Air boat operators should be required to apply for and receive permits before being allowed to operate these crafts. The number of permits should also be limited. (0127; Audubon of Florida)
- In discussions of public use, the service repeatedly wants hiking, camping and canoeing with air boating. This is misleading and we suggest that these references should be reworded in the final plan. It simply isn't fair to equate the well-documented destruction and harassment caused by air boats with the more benign activities of hiking, camping and canoeing.
- The most horrifying experience I had out there wasn't alligators I saw, or any wildlife of any kind that I saw, but it was an air boat. I think it was back in the early eighties. We were in a little canoe boat, I was with a friend, as we were absolutely horrified. (0082)
- I guess my feeling is, that air boats are welcome within the Everglades and in the public use areas. But within the refuge, I think the refuge should be an area where it's peaceful, where people can come out to relax and enjoy the environment and the serenity. (0086)
- No air boats. Noted by the following commentors: (0010), (0040), (0002),
- Air boats distress slow-flying birds such as moorhen, coots and occasionally kills them. (0009)
- I applaud the US Wildlife Service for its recommendation against allowing air boats and water scooters in the refuge. (0069)
- The topic of air boat use, historically allowed wild fowl hunting areas in the south, should be revisited and perhaps scaled back. (0076)
- I personally have only several reservations, and they have already been expressed. One would have been the air boating. (0083)
- In addition, we too are opposed to the use of air boats on the canals. (0080)
- I oppose all air boat traffic except for scientists and law enforcement. (0064)
- I oppose the use of air boats except for management and research purposes. (0126)

Response: Comments noted. The issue of airboating is addressed in Appendix J.

#### 4. Motorboats

##### a. Support Gasoline Powered Boats:

- I would like the use of a “Go-devil” type boat/motor to be permitted which is now prohibited by the previous ARM refuge managers. Even if permitted during waterfowl season only. I would like to see some kind of practical public access (preferably motorized, possibly a go-devil, or special permitted air boat) for children, elderly, handicapped, and the general public (other than a canoe) to view and photograph the tree islands, wildlife, and other areas of the refuge . (0123)
- I’ve been out there since the sixties, and during the very height of the concession area out there in the mid-seventies, we used to fill all the parking lot up with air...not air boats...but we used to fill all the parking lot with people that wanted to come out and see if they wanted to go out on an air boat or not. There were motorboats and other things that were available. So I would like for that to be a consideration. (0081)
- Motorboats have always been used out there. The north end, you can’t even get to now that they’ve got it shut down (Twenty-mile Bend). It would be nice to have another area to be able to put a boat for people in the Western Communities. (0040)
- I think I would like to see pontoon. (0075)

Response: Comments Noted.

0123: The ‘go-devil’ type of motor, due to its design, permits access and impacts vegetation in many of the same areas that an airboat does. For this reason “go-devil” type motors will not be permitted. Reference Appendix J for more information.

0040: Refuge management gave up the northern portion of the refuge to the South Florida Water Management District in exchange for Strazzulla Marsh to enable water movement between stormwater treatment areas, and the refuge no longer manages access to that area. The South Florida Water Management District has decided against having a northern boat ramp along the stormwater treatment areas according to our communications with them. The refuge planning team did consider placing a boat ramp near ACME 1 or 2 but decided against it when facility development at Strazzulla Marsh was made a low priority and horseback riding was not allowed. However, if a boat is small enough to be carried, it could be put in the perimeter canal across from ACME 1 or 2. The transporting vehicle could be temporarily parked in the grass along the road east of the ACME pump stations (pending ACME approval).

##### b. Opposed to Gasoline Powered Boats:

- We support the use of electric motors for limited pontoon tours at Hillsboro Recreation Area. . .not motorized vehicles on water (0018)
- We also support the use of electric motors for limited pontoon boat tours at Hillsboro Recreation Area. (0119)
- I have reservations about motor boating but would hope it would be controlled to prevent becoming a nuisance. (0035)
- Even motorboats, anything that’s going to further pollute the area shouldn’t be allowed. (0082)
- We strongly support the speed restrictions on the east side of the refuge, but the unlimited motorboat speeds allowed in the west perimeter canal will reduce wildlife habitat by increasing wave activity and noise pollution. Electric motors should be encouraged if not required. Two-cycle engines, which release up to 30% of their fuel into the water, should not be allowed in refuge waters; waters that are already suffering poor quality (0094)

- I, like one of the other speakers, have great concern that allowing motorized boats in the refuge will create a noise disturbance for the wildlife. And for that matter, for those who wish to peacefully and unobtrusively observe them. (0077)
- In addition, we too are opposed to the use of motorboats on the canals. We love the serenity, and it should be kept that way. (0080)
- no gasoline boats (0028), (0002), (0066)
- Rental motorboats down at the concession... they certainly should be electrical if that takes place, or pontoon. I think motorboats are distressing. Very distressing. Shooting is distressing. So I'm not in favor of motorboats. (0075)
- I personally have only several reservations, and they have already been expressed. One would have been the motor boating. And having been a volunteer out at the refuge for twelve years, I think the resolution to those problems should lie in the hands of the staff of the refuge. Those are the people who are out there, who study it, who know it, and they should control the number of those extracurricular activities. (0085)

Response: Comments Noted

Hopefully cleaner running boat motor development will be successful and supported by the public. If an interpretive pontoon boat ride is initiated (it is a proposed project in plan), the boat will be powered by a quiet electric motor or quiet "clean fuel" powered motor.

All references to "unlimited speed" in the perimeter canal on the west side of the refuge has been changed (text and maps). All boats must be operated in a safe manner according to State of Florida and U.S. Coast Guard regulations. There will be three areas totaling about eight miles (out of the 57 miles of canals) where motorized boats will have to proceed at "slow speed, minimum wake" in deference to canoeists and other paddies and to maintain a more serene environment for nearby non-water users of the refuge. These areas will be near the Hillsboro, headquarters, and ACME access points.

### 5. Motorized Vehicles

a. Support of Motorized Vehicles:  
Response No Comments Received

b. Opposed to Motorized Vehicles:

- Keep refuge entirely without motorized vehicles on land or in water. (0014)
- No half-tracks. (0058), (0014)
- No ATV, trucks, autos in the refuge. (0046), (0012)
- No off road vehicles. (0010), (0003)
- No motorized vehicles. Noted by the following commentors: (0006), (0017), (0027), (0013), (0020), (0008), (0063), (0009), (0025), (0019), (0015), (0045), (0026), (0005), (0021), (0012), (0028), (0062), (0119), (0030)
- No dune buggies. (0012)

Response: Comments Noted

No all-terrain vehicles and other similar 4-wheelers, dune buggies, half-tracks, off-road vehicles, private trucks or cars will be allowed on the impoundment levees, the perimeter dike, the impoundments, cypress swamp, any of the compartments or along Strazzulla Marsh. Visitors may drive street legal vehicles on paved roads and on shellrock roads.

## 6. Horseback Riding

### a. Support:

- Please receive this letter as a request to open a limited section of the Loxahatchee NWR as an equestrian trail. The refuge is located in the heart of one of the largest equestrian communities in the United States...approving equestrian access would be a great step in providing a unique, low impact educational experience. Equestrian access to other environmental areas such as the SFWMD's DuPuis Reserve, the FFWCC's Corbett Wildlife Area, the Hoover Dike Trail around Lake Okeechobee and other have proven to be successful partnerships. We look forward to your consideration of this request. Attached please find letters of support as well as petition signatures of 15 individuals and 5 equestrian organizations representing over 3,000 members. (0116; Palm Beach County Equestrian Trails Committee)
- However, one of the alternatives called for horseback riding to be allowed from ACME 2 northwest past ACME 1. Certainly horseback riders and hikers can coexist on such a broad trail with its excellent visibility. (0096)

### b. Opposed:

- We do not want to see horses in the refuge. (0062)
- We oppose the use of horseback riding within the boundaries of the refuge. (0119)
- I also oppose allowing horses into any part of the refuge (0064)
- Consideration needs to be given to the future/long-term effects of certain types of recreation activities. Horseback riding is one example. Constant hoof traffic usually results in a dirt trail, which turns to a mud trail with rain. Is this the type of activity you want in an area with aesthetic value, as well as ecological significance? (0127)

Response: Comments Noted.

The issue of horseback riding is addressed in Appendix J.

## 7. Hiking, Walking, Biking, and Trail Use

### a. Support:

- I think there's good arguments to be made for improving what's already there, such as the walking, biking and canoeing trails, but while leaving most of the refuge off limits to people. (0069)
- Hiking (rim dike and selected landside marsh sites), and limited boating (limited size, speed) will allow 'access' for viewing nature, exercise, and limited fishing. (0108)
- Hiking, rim dike and selected side marsh sites and limited boating (limited means speed and size) will allow for access, viewing nature, exercise and limited fishing, while still allowing wildlife to rest in an area free from over-intrusion, hunting, air boating, and man. (0076)
- I enjoy hiking, and I am sure I am one of the few individuals who has walked the stretch of perimeter levee from Lox Road to ACME pump station 1. (Although not all in one day.) Reading the report I was surprised to learn that the levee north of ACME pump station 2 is closed to the public. I am curious to know why? It had been my understanding that all of the perimeter levee was open to the public, if accessed from the main entrance or Lox Road. (0096)
- Let us use this area as a refuge, and limit our intrusion by visiting by foot. (0076)
- I use the refuge for walking and wildlife viewing (0020)
- I enjoy photography and walking in the refuge. (0048)

- Bikes, whether motorized or not, generally produce the same effect as hoofed animals. If these activities are to be permitted, they should be limited to less aesthetic and ecologically significant areas of the refuge. The overall purpose of the plan is to preserve the refuge, not recreational activities. (0127)
- I support bicycle trails (0064)
- Yes to biking (0012)

b. Opposed  
No Comments Received

Response:

Unfortunately, the hiking boundaries on the perimeter levee north of the Headquarters Area were not clearly worded and the associated maps sometimes conflicted in the draft plan. Currently (Alternative 1 and Alternative 3), visitors are not to go more than approximately 1 mile north of the headquarters boat ramp on the L-40 levee. Alternatives 2 and 4 proposed allowing hikers to go north approximately 7 miles if there are no construction or safety issues. This would allow individuals to drop a vehicle at either ACME1 or headquarters and make a good day hike.

Hiking south from headquarters through to Hillsboro and west, northwest to the S-6 Pump station will continue with the adoption of Alternative 2. Walking the levees throughout Compartment C including the 'Marsh Trail' will continue and portions of the surrounding Compartment A levee would be accessible to walking if construction or other management activities do not compromise visitor safety.

The planning team agrees that bicycle riding should be limited to just paved roads and a section of the main refuge levee that is often traveled by refuge and South Florida Water Management District staff in vehicles. The top of the L-40 levee is a narrow and fully disturbed area that is hard-packed with gravel. Persistent, early successional stage plants such as forbs (exotic and native) grow along the levee sides and would not be significantly impacted by bicycle tires.

## 8. *Canoeing/Kayaking/Poleboating*

a. Support:

- I think I would like to see canoe use.... (0075)
- Lengthen canoe trail.... (0066)
- Canoeing, kayaking would be fine. (0080)
- Canoeing .... will allow 'access' for viewing nature, exercise, and limited fishing while still allowing wildlife to rest in an area. (0108)
- Canoeing...will allow 'access' for viewing nature, exercise, and limited fishing while still allowing wildlife to rest in an area. The canoe trail expansion into another area, such as the northern site, could be a very desirable passive use addition. (0076)
- You can take a poleboat and get back in there, you can take an air boat, and even tonight you said the poleboat path might be available, so I would hope that would be the one. (0084)
- ...like to canoe. (0015)

b. Opposed  
No comments received

Response: Comments Noted

As discussed earlier and in this final plan, expansion of the canoe trail will only occur with adequate funding and staffing. This project requires new

construction as well as increased annual maintenance and manpower costs. The possible extension of the existing canoe trail would not be a conduit for high nutrient water to reach deep into the refuge interior. Rather, the trail would be a loop extension from the most interior portion of the existing trail.

Even though more than 95 percent of the proposed poleboat trail would not be actively cut or maintained as the canoe trail is, it will require a new cut through dense perimeter cattail vegetation to provide accessibility. This new cut into the interior could allow poor quality water into the northeastern portion of the refuge. The poleboat trail will not be attempted until the perimeter canal water quality is consistently within the legal Consent Decree phosphorus guidelines or other legal water quality guidelines.

## 9. *Camping*

### a. Support Overnight Camping:

We support a camping area (0060)

- ...allow strictly monitored use of overnight sites (i.e., abusing users must return and correct damage). (0066)
- As to my opposition of overnight camping on the proposed longer canoe trail. This too I must readdress. If the effort were closely monitored, then such a program might well benefit the public. However, it would need to be closely monitored for at least 2 main impacts. First, the problem of human waste which is a pretty good nutrient source for all plant species, look at the grass over the drain field, would need to be addressed. As precedent, one needs only to examine the Redfield Ratio (C/N/P) of nutrients in Eastern Florida Bay. That is, in the vicinity of bird (cormorant) rookeries in the Florida Keys, it has been found that nutrient enrichment can lead to localized eutrophication (Powell, G.V.M. et al., [1991] *Estuarine and Coastal Shelf Science* 32, pp.567-579). In that case changes in the ecosystem were due to phosphorous (P) loading whereas with human fecal input it would be nitrogen (N), and either would alter both the evolved “natural” N/P ratios and total overall supplies. Precedent for human fecal matter induced alteration of an ecosystem, albeit on a much grander scale, derives from the well publicized leakage of septic systems in the Florida Keys and inputs of both N and P to both Florida Bay and Hawk Channel, the latter impacting the near shore reef system. Second, as waters begin to flow into the WCA-1A system from the 20-mile bend Storm Water Treatment Areas (SWTAs) a new problem may arise. It is well known that artificial (‘nature mimic’) marshes and riparian-like structures (see Mitsch et al., [1995] *Ecological Applications* 5, pp. 830-845) do a very nice job of reducing nutrient, especially P, loads from the waters flowing through them. Thus, the SWTA strategy should greatly help in the removal of these nutrients and thus give WCA-1A (ARM Loxahatchee) ‘cleaner’ water. However, it has also recently been proven that accompanying the N and P, plus herbicides etc., one usually associates with EAA and other agriculturally recycled waters, are definitive tracers of EAA fertilizers (cf. Zielinski R.A., Simmons K.R. and Orem W.H. [2000] Use of <sup>234</sup>U and <sup>238</sup>U isotopes to identify fertilizer-derived uranium in the Florida Everglades. *Applied geochemistry* 15, 369-383). The uranium per se is not the ecological problem of note here, for it is of very low level but of distinctive isotopic ‘fingerprint’. However, the same methodology has now been applied to the sulfur isotopes (<sup>32</sup>S, <sup>34</sup>S) and S-enrichment in WCAs-2 and 3 has been traced to the same agricultural sources (W.H. Orem person. commun. 1998-2000: see “Awful Fishy” by Roger Williams; NewsTimes newspaper 04/27/00: <http://www.newtimesbpb.com>). Here the implication goes directly to the methylation of mercury. That is, sulfur/sulfate enriched areas, such as WCA-2 and 3 are extremely conducive to the growth of sulfate reducing bacteria. These bacteria and the rest of their Achaebacterial consortium are the agents for the methylation of mercury. WCA-1 likely has similar eolian loading of

metallic mercury but has little if any of the methyl mercury which is both mobile and bioaccumulates upwards in the food chain. Now, finally to the point. As the SWTAs come on-line and likely receive waters from the EAA, in order to reduce loading into Everglades National Park and the Micosukee lands, one wonders how the concentration of S in the SWAs will affect the methylation of mercury and the mobilization of methyl mercury into WCA-1A (ARM Loxahatchee). If this does negatively impact the incoming (ex. SWAs) waters then any and all penetration of rim ditch waters into the core of WCA-1A, such as with canoe and boat trails, must be avoided. Presently, the United States Geologic Survey (USGS) uses the core of WCA-1A as background representative of a historic rain fed Everglades (W.H. Orem, USGS, pers. comm., April 2000). (0108)

b. Opposed to Overnight Camping:

- No overnight camping. (0002)
- No overnight camping. (0011)
- We talk about overnight camping,... on the platforms you will have noise and lights. I don't know how that will be monitored. (0075)
- However, I am not in favor of overnight camping along the canoe trail(s) of the refuge, this would beg litter and abuse (0076)

Response: Refuge management and the planning team recognize that the first priority projects requested by the public are exotic plant control, water quality, and other biological support projects to maintain or improve the refuge's wildlife habitat. However, visitor education and interpretation opportunities are priority public uses and important to the development of a greater appreciation of this special natural resource and the Everglades system as a whole.

A full list of regulations, checks and balances will be initiated before any overnight activities are started. Other agencies that manage difficult access, backcountry overnight programs such as national parks, will be consulted. These contacts will assist the refuge in setting up a limited and controlled public access program.

Development of overnight platforms and the related administration support tasks for overnight experiences will take place as monies are made available. Often funds are contributed to the refuge for specific programs (i.e., public use) and cannot be used for other projects (exotic plant removal). The refuge will not turn away contributions even if the monies cannot be used for the number one priority (exotic plant removal).

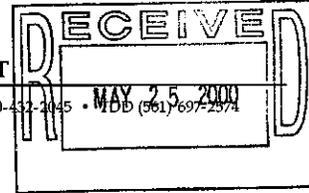
0108; Currently a portable toilet is located on the existing canoe trail and is frequently pumped out. A contractor is transported by airboat, the refuse is pumped into a temporary container and upon arrival back at the boat ramp, the refuse material is pumped to the contractor's truck. This is a costly and difficult procedure. The refuge plans to replace the existing trail facility with a state-of-the-art composting toilet. Our staff would periodically empty the material into a container and take it off the refuge. Each camping platform (one - maybe two) would contain the same state-of-the-art composting outhouses.

No new poleboat trails would be cut into the refuge interior from the perimeter canals until the incoming water quality was within soon-to-be decided legal limits. Although the relevance of the specific sulfur issue was not discussed in the draft plan, it is an important component of the incoming water quality and could have the potential to negatively impact the refuge.



**SOUTH FLORIDA WATER MANAGEMENT DISTRICT**

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**ADM 28-06 RF: 00-0321**

May 24, 2000

Mr. Mark J. Musaus, Refuge Manager  
Arthur R. Marshall Loxahatchee Wildlife Refuge  
10216 Lee Road  
Boynton Beach, FL 33437-4796

Dear Mr. Musaus:

The South Florida Water Management District (District) staff have reviewed the Arthur R. Marshall Loxahatchee Wildlife Refuge (Refuge) Comprehensive Conservation Plan (Plan) and we offer the following comments on the Plan.

Refuge staff and the U.S. Fish and Wildlife Service are to be commended on producing a comprehensive, detailed, and well-written fifteen (15) year plan for the Refuge.

Although District staff is impressed with your draft plan, we are concerned about the scope and cost of the improvements to the management, infrastructure and public use programs. We would prefer to see a prioritization of mission projects with management program elements such as exotic control, prescribed fire and floral/fauna inventories ranked high on the list. We realize the Refuge's responsibility to provide recreation and education opportunities on the site, and would suggest that improvements in educational programs take precedence over basic recreation facilities and programs.

The Refuge should carefully evaluate any expansion of public use facilities such as a concessionaire at Hillsboro, new canoe trails, boardwalks and observation towers to make sure that these facilities will not adversely impact the native habitats and the wildlife that depends on them.

For the benefit of your staff and others involved in the preparation of the Plan, I have enclosed a summary of specific and detailed comments generated in our review process.

We appreciate the close and cooperative working relationship you and your staff have creating during the development of this Plan. The District is particularly interested in this document as it will be the technical basis for our pending Refuge license agreement scheduled to be considered by the Governing Board this fall. We look forward to your presentation of the Plan to our Governing Board, currently scheduled for the July 12 workshop.

GOVERNING BOARD

Michael Collins, *Chairman*  
Michael D. Minton, *Vice Chairman*  
Mitchell W. Berger

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Patrick J. Gleason

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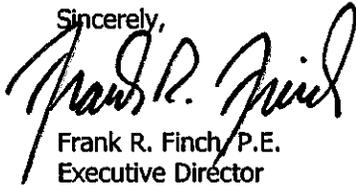
EXECUTIVE OFFICE

Frank R. Finch, P.E., *Executive Director*  
James E. Blount, *Chief of Staff*

Mr. Mark J. Musaus  
May 24, 2000  
Page 2

Thank you for the opportunity to comment on this Plan. Please contact Fred Davis, Director, Land Stewardship Department, Water Resources Operations, at (561) 687-6636, for questions or additional information.

Sincerely,



Frank R. Finch, P.E.  
Executive Director  
South Florida Water Management District

FRF/iw  
Enclosure

c: Fred Davis, WRO  
Dr. Patrick J. Gleason, Governing Board Member  
Sam D. Hamilton, USFWS  
Joseph W. Taylor, WRO

## SUMMARY OF STAFF COMMENTS

### Loxahatchee Refuge Comprehensive Conservation Plan

#### Refuge Management

- We support the alternative of removing levees between compartments A and B, which would have the effect of reconnecting the cypress swamp to the marsh while retaining public access. However, we recommend retaining some of the levees within compartment C (Alternative 3), because this will provide continued public access to the managed pond. Furthermore, cooperative efforts between the SFWMD and the Refuge to use impoundments within compartment C for tree island research is being planned. This research, which would manipulate water levels and measure the response of plants and animals, will help our agencies' effort to improve hydrological management and also will provide the public with a first-hand view of how science is an integral part of sound resource management. Note that increasing collaboration between the Refuge and other agencies is listed under objective 2 of Resource Protection.
- Some of the impoundments in compartment C should be set aside for research to aid in adaptive management as long as it is conducive to public education. They provide a rare opportunity to manipulate water levels and measure the response of some plants and animals. There is currently a cooperative effort between the SFWMD and the Refuge to do so and explicitly recognizing the research value of the impoundments might be useful for future collaborations. Also, increasing collaboration between the Refuge and other agencies is listed under objective 2 of Resource Protection.
- Project 3. Fire is a natural disturbance maintaining the unique Everglades ecosystem. Understanding historical fire pattern in the Refuge, including fire frequency, intensity, size, location, and season, is necessary for the implementation of a fire management program. Because the landscape of the Refuge is different from other parts of the Everglades, the Refuge needs a unique fire management plan. The fire research contract needs to evaluate historical fire patterns, fire patterns under current hydrologic and vegetation conditions, and how to use fire as an effective management tool.
- The Plan emphasizes the invasion of exotic plant species, but does not emphasize enough that these species cause the loss of native vegetation. Also, the Plan does not give a clear picture of the loss of wildlife (species and quantity). This point should be more clearly addressed in Project 4.

#### Water Quality & Hydrology

- It was explicitly stated that nutrient levels are more of a concern than hydrologic patterns. WCA 2 provides just one example to indicate that assumption may not be true. After years of receiving high nutrient water, the vegetation in a sizeable area of WCA 2 has been converted from sawgrass and sloughs to cattails. Despite the sizeable impacted area, most of WCA 2 still has native plant communities. On the other hand, because of altered hydropatterns almost all the tree islands and their associated fauna have been eliminated from the entire

area. In other words, both hydropatterns and nutrients are major problems but hydropatterns affect a larger area just as severely and are, therefore, more serious. This should be a particular concern in the Refuge where the abundant tree islands and their associated high biodiversity are a defining characteristic. One way the document could be strengthened is by devoting considerably more effort to monitoring explicitly for hydropattern restoration and conducting research aimed at setting hydropattern targets as part of the adaptive management process.

- It should be emphasized that physical and chemical characteristics within the Refuge, such as peat and soil structure and water quality (pH, Fe, conductivity, etc.), are different from these characteristics in other parts of the Everglades ( WCA 2, WCA 3, and Everglades National Park). These differences, as well as differences in hydrological patterns and fire patterns, result in a very different landscape patterns in the Refuge. The diversity and distribution of wildlife are strongly influenced by the landscape pattern of vegetation and water.
- The role of altered hydrologic conditions within the Refuge is not clearly presented, particularly with regard to the influence of these conditions on native vegetation and wildlife. How has altered hydrology in the Refuge influenced the loss of native vegetation and wildlife?

#### **Monitoring**

- One of the most important threats to the biological integrity of the Refuge is invasion by exotic species. A top priority should thus be Exotic Species Control. The Plan alternatives were somewhat lacking in detail with regard to alternatives for exotic control and associated monitoring.
- The Refuge should monitor and evaluate all species, not only key (umbrella) species. It is true that the key species are good indicators of overall ecosystem health. However, a Refuge should not increase public use while sacrificing its ability to document biodiversity. For example, the use of tree islands by invertebrates, reptiles, amphibians, and mammals is poorly documented and needs to be evaluated as a management goal.
- Consider folding Project 5 (GIS Database) and Project 6 (Monitor Vegetation Patterns) into one project and making it high priority. Hiring priorities need to be included since they were given for Alternatives 3 and 4 but not for Alternative 2.
- Project 1b. It is important not only have a list of exotic species, but also have their population size, age and area distribution. These data together with life history information can help to predict their expansion rate and area.
- Project 2. Greater detail is needed regarding the design for water quality and ecological monitoring (not simply, "throughout the Refuge"). The justification of monitoring sites should be ecologically and financially sound. In general, the sites will be selected at locations where the water flows in and out the Refuge. Given my concern about herbicides applied for the controlling for exotic plants, special sites for monitoring toxic compounds are necessary.

- Project 4. This project needs to set up criteria that measure the success of the Conservation Plan. In addition, the inventory and monitoring of target species should not only include life history and habitats, but also include population size, age structure, and areal distribution (particularly for animals). Population density and age structure are good indicators of whether populations are increasing, decreasing, or stable.

#### **Public Education and Use**

- The Refuge clearly is in a pivotal position to showcase the Everglades and increase the public's exposure to this vital resource. An ethos of environmental education is that we only protect and care about the things we know. The more we get to know the Everglades, hopefully the more we (a collective "we") will want to support measures to protect and restore it. The Everglades and our beaches are among our south Florida "signature resources." From a philosophical standpoint, consider that there are many places along the coast to enjoy the beach. However, there are very few points of entry for the general public into the Everglades--especially in Palm Beach County. The Refuge is an important gateway to expose and educate the public about the Everglades at large.
- Although staff strongly supports improvements in education opportunities, there was some concern over the increase in pure recreational activities that could result in negative impacts on the ecosystem. The cutting of trails through the marsh to improve access for hunting, canoeing, and pole boating are of foremost concern. Many of the negative characteristics of airboat trails recognized in this report occur with boat trails of any type. These pathways increase dispersal of exotic plants and fishes into the marsh interior, accelerated the input nutrients and other pollutants from the Refuge perimeter, alter the natural flow of water within the marsh, and create artificial fire breaks. Another concern regarding recreational activity is the hosting of fishing tournaments. This activity disturbs wildlife by concentrating fast-moving motorboats and large numbers of people in the marsh. This disturbance can have a negative impact on wading bird and waterfowl populations.
- The Refuge seeks to expand educational efforts in several ways--especially for school-age children via a curriculum for teachers and Refuge educators. We like the fact that the Refuge plans expanded partnerships and outreach to elected officials. So often, targeted segments of the adult population are neglected in attempts to focus on school students.
- The Refuge might also take the opportunity to educate the public about Everglades restoration, in addition to "human impacts." Restoration is probably part and parcel of "human impacts" but the Refuge does have a great opportunity to explicitly educate the public on restoration.
- The Refuge should consider outreach to business leaders as a specific target audience--but not just from the standpoint of involving interested entrepreneurs in the ecotourism aspects. The business community plays a key role in influencing the quality of life in the region. Specifically targeting business leaders would increase their exposure to the Everglades and related issues.

- The Refuge should consider an advisory committee, which taps different sectors of the community to review their education plans as they develop them, as they implement the CCP. That way they could involve all audiences and get buy-in from the community.

**Detailed Comments**

- Pg. 9, para. 2 - A minor point is that the Refuge is not the first to receive agricultural water. All of the WCAs receive agricultured water directly.
- Pg. 9, para. 2 - It might be informative if there was some mention of the benefits of increased flow to maintain tree islands.
- Pg. 9, para. 4 - This is where some concrete examples of monitoring that show benefits of the water schedule would be useful.
- Pg. 27, para 2 - There may not be enough discussion of how the STAs will affect the Refuge. Some mention is made of improvements to water quality but no mention is made of expected benefits of hydropattern restoration.
- Pg. 57, #7 - It might be worth considering the ecological advantages of reconnecting the cypress swamp with the marsh in compartments A and B. Also, it would cause no reduction in public use.
- Pg. 118, para 7 - The preferred alternative might not benefit non-target species. This seems to be in conflict with the USFWS ecosystem management emphasis and the intent of the Everglades ecosystem restoration.
- High P in the water along the canal resulted in cattail expansion in Fig.8. What is the difference between shrubs and tree islands in Fig. 8?
- According to the text, wet prairies occupies about 50% of land coverage, tree islands about 20%, sawgrass about 25%. The remainder of 5% area for open sloughs seems low. Is this estimate correct?
- Cattail is still very rare in the central and northern research area. It is not appropriate to include cattail in the category of "major vegetative communities" (p28).
- The health and loss of tree islands should be pointed out in "Tree Islands" on p30. How many acres of tree islands have been invaded by exotic species? What is status of tree islands within the Refuge and how do the Plan's alternatives protect, improve, or restore them?



# United States Department of the Interior

## FISH AND WILDLIFE SERVICE

A.R.M. Loxahatchee NWR  
10119 Lee Rd.  
Boynton Beach, FL 33437  
561-732-3684

September 11, 2000

Frank R. Finch, P.E.  
Executive Director  
South Florida Water Management District  
3301 Gun Club Road  
West Palm Beach, Florida 33406

Dear Mr. Finch:

Thank you for the South Florida Water Management District's comprehensive review of the U.S. Fish and Wildlife Service's Draft Comprehensive Conservation Plan for the Arthur R. Marshall Loxahatchee National Wildlife Refuge. Public input is important, especially from natural resource management agencies such as yours. The refuge has enjoyed a close working relationship with the District for years and I especially have during the two years that I've been Refuge Manager. The close involvement of District staff throughout the development of this plan was invaluable.

In response to the concerns the District expressed regarding the large scope of the proposed plan, its associated costs, and proposed increases in public use programs, the multi-agency planning team reassessed the plan. The team concurred with the District's suggestions to re-address the project priorities given the excellent opportunity the refuge has to showcase the Everglades ecosystem via educational efforts beyond basic recreational facilities and programs.

Our responses to the District's comments are enclosed. Once again, thank you for your thorough review and suggestions.

Sincerely yours,

Mark J. Musaus  
Refuge Manager

Enclosure

## Refuge Management

- The District combined a portion of Alternative 3 with Alternative 2 to support restoring more cypress swamp. After careful thought, the planning team supported this idea and has amended the proposed plan to include cypress swamp restoration of Compartment A (upper and lower impoundments) and parts of Compartment B. The levee separating the upper and lower sections of Compartment A will be removed, and perhaps when the restored area is well established and good water quality is assured, the levee separating the existing cypress swamp and Compartment A will be removed. Or at the very least, the two areas could be hydrologically connected via water control structures. Consistent with the District's recommendation, the levees in Compartments B and C will be maintained. The impoundments will be managed in a mosaic to benefit a variety of wildlife species groups, including wading birds, shorebirds, and waterfowl. Please see Section IV, Management Direction, Goal 1, Objective 7; and Section V, Plan Implementation, Project 8.

Environmental education, interpretation and outreach was elevated to the number four priority for the refuge, and we agree that impoundment management is an excellent tool for this. Please see Section V, Plan Implementation, Projects 4 and 8.

- Two of the ten impoundments in Compartment C are planned for a joint research project between the refuge and the District. We look forward to learning more about tree island restoration and overall hydrologic restoration through this project. Partnerships are also in place or are developing with several other entities to provide qualified researchers access to certain impoundments within Compartment C. Refuge Management and biological programs support impoundment research when it is tied to refuge management objectives, especially if it benefits wetland habitat management techniques for all of the Everglades and the south Florida ecosystem. Please see Section IV, Management Direction, Partnership Opportunities; Appendix A, Environmental Assessment, Research and Monitoring; and Appendix D, Compatibility Determination, Research and Special Use Permits.
- The refuge landscape is unique and developed under different fire conditions than the central and southern portions of the Everglades. In recognition of this, the planning team proposed Project No. 5 in the Draft CCP which read, "Implement a Fire Management Program" (Section V, Plan Implementation). This project includes hiring a prescribed fire specialist and a fire technician. Their responsibilities would include researching and understanding different fire aspects relating to the northern Everglades wetland habitats and developing an active fire management program for the refuge. Please see this project description. We also agreed that the refuge needs a unique Fire Management Plan, and have developed and forwarded a very comprehensive plan to our Regional Office for review and approval. Please see Section V, Plan Implementation, Project 5.
- The District indicated the Draft plan did not give a clear picture of wildlife species and quantity loss, nor did it clearly indicate the loss of native vegetation in relation to invasive exotic plants. The refuge has just begun a partnership (Spring 2000) to investigate the impacts of invasive exotic Old World climbing fern that has already resulted in one research paper being submitted for publication. However, we agree that the refuge is generally lacking this type of information. The current refuge management and biological staff certainly recognize the need to understand the changes on the landscape that have occurred over time and the ramifications of those changes. Project No.6 addresses that exact issue and proposes to find, compile and assess years of data, monthly and annual reports, and research reports, abstracts and summaries. We concur that refuge managers and biologists must understand how the refuge, species within it, and the landscape has changed over time, especially in light of the impacts of invasive exotic species. Project No. 7 will also work in concert with Project No.6 to provide the refuge with more of this comprehensive type of information. Please see Section III, Refuge Environment, Exotic Plants; and Section V, Plan Implementation, Projects 6 and 7.

## Water Quality and Hydrology

- The perception that water quality (nutrient levels) is more important in the refuge than hydrologic patterns was certainly not intended. The biological staff have been vocal in their concern about hydrologic patterns and as a result the current refuge management is very well aware of the issues surrounding the quantity of water in the refuge during the long and short hydroperiods, the delivery of water (large amounts in a very short time or none when needed), the timing of the delivery (large amounts at critical times can cause failure of reproductive seasons for many species of wildlife) and time frame of extreme water levels (extended periods of high water may be negatively impacting refuge tree islands). The need for a hydrologic model was listed in Project No.2 and many water level gauges will soon be placed in the refuge interior. The refuge biological staff and the Everglades Program Team (a joint refuge and Everglades National Park team of a half-dozen senior scientists) will be monitoring the effects of hydrology on the refuge landscape. The misrepresentation that water quality is more important than hydrologic patterns was amended in the final plan. Please see Section III, Refuge Environment, Hydroperiod and Hydropattern; and Section IV, Management Direction, Goal 1, Objective 1.
- The final plan was amended to more fully depict the differences in the physical and chemical properties of the refuge as compared to the rest of the Everglades ecosystem. Please see Section III, Refuge Environment, Physiography, Soils, and Geology.
- Text was added to further describe hydropatterns, effects on vegetation of the northern landscape, and the relationship between the diversity and distribution of wildlife and the wetlands and vegetation. However, we do not have as much information available as we would like, so Projects Numbers 2, 6, and 7 will be especially helpful to interpret the effects of altered hydrology on vegetation and wildlife. Please see Section III, Refuge Environment, Hydroperiod and Hydropattern; and Section V, Plan Implementation, Projects 2, 6, and 7.

## Monitoring

- Invasive exotic species control is the number one priority for the refuge and we have requested a significant funding boost. Public comments show similar concern over the presence and implied impact they are having on native vegetation and wildlife communities. Additional information on alternative exotic controls was provided in the final plan. Appendix O shows the current monitoring, inventorying, and research efforts at the refuge, some of which address exotic impacts on native tree islands. However, the soon to be completed Comprehensive Inventory and Monitoring Plan for the refuge will contain a much greater array of details, as will the Integrated Pest Management, Exotic Plant Control and Exotic Animal Control step-down plans. Please see Section III, Refuge Environment, Exotic Plants; and Section V, Plan Implementation, Projects 1,6, and 7; Appendices P and O.
- Unfortunately, it is cost prohibitive to attempt inventorying or monitoring of all habitats and species as the District recommends. Even with an exceptionally comprehensive management and monitoring plan, an "army" of biologists, and tremendous funding, all species on the refuge could not be monitored or evaluated. We are fortunate to have the largest biological staff of any national wildlife refuge in the southeastern United States (Region 4) with 4.5 full-time equivalents, but this still relatively small number of biologists needs to focus on more indicator-type species, to be as efficient as possible, until funding requests for increased biological staff are fulfilled. We plan to continue all opportunities available to inventory and monitor habitats and species including partnerships with other agencies and special use permits to conduct research. A list of current biological activities is included in Appendix O.

The primary direction the inventorying and monitoring plan will follow is governed by the Service's Refuge Manual and the "Fulfilling the Promises" and "Biological Needs Assessment" (internal management) documents. Issues such as the Everglades restoration and regional protection of listed, trust, and focal species are referenced in the South Florida Ecosystem Team's Ecosystem Plan, South Florida Multi-Species Recovery Plan, and the Comprehensive Ecosystem Restoration Plan. All these documents assist refuge management and the refuge biological program to focus inventory and monitoring plans and prioritize limited resources. The following hierarchical list gives the guidelines and steps refuges use to determine which habitats and species are inventoried and monitored. Note, inventory and monitoring projects are sometimes specific for the refuge, others support regional, national, and international emphasis.

- Those habitats or species listed in the Refuge Purpose (wildlife habitat and migratory birds);
- The habitats and species of critical management importance. Usually this means the primary trust species (federally listed threatened and endangered species, migratory birds, anadromous fish, and certain marine mammals) which reside on or are dependent upon the habitats found on the refuge (e.g., Everglades snail kite, wood stork);
- Secondary trust species (federally listed threatened and endangered species, migratory birds, anadromous fish, and certain marine mammals) which occasionally may use the refuge (e.g., bald eagle, crested caracara);
- State listed species (e.g., Florida sandhill crane, strap fern), Service's Species of Management Concern (e.g., yellow rail, American bittern) and CITES species (e.g., river otter, delicate ionopsis);
- Those habitats or species of concern in the South Florida Ecosystem Team's Ecosystem Plan, South Florida Multi-Species Recovery Plan, and the Comprehensive Ecosystem Restoration Plan (e.g., tree islands, wading birds, alligators). These focal habitats and focal species were selected because they can provide information and indicate changes on larger communities and ecological processes.

Adjustments will be made to phase out less productive efforts and include methods providing sensitive indications of population dynamics. Although the refuge is quite large for a refuge, it is not isolated. Rather it is an important portion of the greater Everglades ecosystem and surveys will be closely tied to monitoring the restoration efforts.

A limited list of current inventory and monitoring surveys the refuge staff and researchers conducted during the last 2 years was also added to the final plan to give readers a chance to understand what is being conducted on the refuge. The Comprehensive Inventorying and Monitoring step-down plan will show greater detail in deciding what and how sites or species are selected and how the monitoring will take place. Please see Section IV, Management Direction; Section V, Plan Implementation, Projects 4, 5, 6, 7, and Staffing and Funding; Appendices P and O.

- Considering the District's recommendation, the GIS Database and Monitor Vegetative Patterns Projects were combined into one project with a priority ranking of seven. The higher priority projects in order were invasive exotic species control; water quantity, quality, timing, and delivery monitoring; base maintenance; expand environmental education and outreach; fire management; and Everglades restoration monitoring. Please see Section V, Plan Implementation, Projects 7a and 7b.
- We agree that a mere list of exotic species is not as helpful as information on their population size, age, and distribution in the refuge along with natural history knowledge to predict their expansion rate and area. The refuge has some of this type of information on the more aggressive exotic species, but did not include this level of detail in the draft plan. Maps (1995) of *Lygodium* and *melaleuca* coverage are included in the final plan, as is a list of inventory, monitoring, and research efforts on the refuge for the past 2 years (which shows some of efforts relating to tree islands). Please see Section V, Plan Implementation, Projects 1, 6, and 7.

Questions arise over whether it is more important to have information on exotic populations or native populations. Many of the planned inventories will be stratified by habitat, thus some exotic species can be documented and perhaps aged and distributions developed. However, refuge priorities, limited staff, and funding all need to be considered. For example, collecting population size, age, and distribution data on oscars (an exotic predatory fish), would be a poor use of funding as realistically, little will be done to control the population, especially when this fish is artificially stocked in nearby freshwater wetlands.

When money and time are precious, some external sources can provide limited information to allow refuge biologists to make reasonable estimates of exotic area coverage and species distribution. The refuge at this point would rather focus limited funding on invasive exotic control efforts. This type of issue will be addressed more fully in the Inventorying and Monitoring step-down plan. Please see Section III, Refuge Environment, Exotic Plants; Section V, Plan Implementation; and Appendices P and O.

- More detailed hydrologic, invasive exotic species, and ecological monitoring step-down plans are being prepared. In the invasive Exotic Species Control Plan (in development) a cost/benefit matrix of different treatment methods per location will be prepared. Chemical contamination monitoring sites at exotic plant treated areas shall also be set up to assess the ecological cost of exotic control through herbicide treatment. Portions of the final plan text was amended to indicate specific monitoring sites. Please see Section IV, Management Direction, Goal 1, Objective 2; and Section V, Plan Implementation, Step-Down Plans.
- The criteria to measure the success of this final plan will be included in the Inventorying and Monitoring Plan (in development). The refuge has fostered many independent studies by universities and other agencies, in the areas of population demographic studies, age distribution surveys, and other types of inclusive research, which will be used to indicate changes in populations. Also, Projects 6 and 7 will provide support to evaluate the success of this adaptive management plan. Please see Section V, Plan Implementation, Projects 6 and 7; and Appendix O.

### Public Education and Use

- We agree on the importance of environmental education and interpretation of the Everglades for the citizens of south Florida, the United States, and the world. Recent public hearings on the Comprehensive Everglades Restoration Project have identified environmental education as a critical component of Everglades restoration. The refuge has recognized its responsibility and fortunate location to provide knowledge about and access to one of the nation's signature natural resources. Water Conservation Areas 2 and 3 allow recreational access. However, few educational opportunities seem to be available in the Everglades system south of the refuge until Everglades National Park. Project No. 4 (Expand Environmental Educational and Outreach) and Project Nos. 6, 8, 11, 13, and 15 show the refuge commitment to sharing the value of the Everglades with the public. Please see Section III, Refuge Environment, Exotic Plants; Section IV, Management Direction; Section V, Plan Implementation, Projects 4, 6, 8, 11, 13, and 15.
- After assessing the District's comments and others from conservation organizations, non-governmental organizations, and private citizens, the refuge planning team re-assessed the more active recreational opportunities supported in the draft plan. Although many of the activities were retained, their enactment priority was lowered and they were made more limited in scope. For example, the thrust at the Hillsboro Area changed. The original project was split into two separate entities. The higher priority project emphasizes a "contact station with interpretive center." The interpretive thrust would highlight the similarities and differences between the northern (refuge) and central (Water Conservation Areas 2 and 3) Everglades. A partnership could be formed with other local area agencies to share the center. The second portion of the original Hillsboro project is to expand the recreational activity facilities on a very limited basis. This has been lowered in priority. Please see Section IV, Management Direction, Goal 3, Objective 4; Section V, Plan Implementation, Projects 11 and 14.

Fishing tournaments (currently permitted only four times per year for one day by a limited number of boats) will still be allowed. The impact to the landscape and wildlife in the south end of the refuge is minimal with these tournaments. Restricting the participation to 15 boats, and requiring that groups obtain all state permits, encourages only local clubs that enjoy competition as well as conservation. These same persons routinely fish on the refuge. These clubs, in lieu of a permit fee, support the refuge with volunteer projects such as removing litter at the Hillsboro Public Use Area or assisting refuge staff at youth fishing events. Please see Appendix D, Compatibility Determination, Fishing.

- Exposing adults to the beauty and importance of the Everglades and the ramifications of past and present human impacts will be very rewarding. We believe enlightened adults will use their new knowledge to be more environmentally responsible in determining personal preferences regarding voting issues, expanding development, habitat loss, water quality, drainage issues, pesticide use, and other lifestyle issues. We currently offer more than 100 special interpretive programs throughout the year as part of our "Calendar of Events." All but just a few of these programs are geared towards adults. As funding and staffing allow, we would like to design an environmental education course for the adult population. Please see Section IV, Management Direction, Goal 3, Objectives 6 and 7; Section V, Plan Implementation, Project 4.

- This is an excellent point but our present public use staff of two full time positions is stretched to the limit. The refuge has participated in outreach programs such as hosting and educating business leaders and elected officials and plans to do more of this type of education. We plan to soon go on line with an interactive refuge web site. This site will be dynamic with changing articles and up-to-date information. This exposure will also enhance the public's awareness of the refuge and Everglades ecosystem. Please see Section V, Plan Implementation, Staffing and Funding.
- Thank you for the idea of an advisory committee to review our education plans. Community involvement and sense of ownership is critical to the success of environmental education programs. The Boynton Beach Chamber of Commerce has expressed the desire to support our educational program for schools in the Boynton Beach area. We hope to develop similar partnerships in the future.

### Detailed Responses

Please note pages in the final plan have changed from the draft. We note the original page number for clarity in relating to specific comments.

- p.9; This is true. Text revision addresses this. Please see Section I, The Role of the Refuge in Everglades Restoration.
- p.9; The text in this section has been amended. In addition, a brief discussion of flow is included in the Hydroperiod and Hydropattern section. Please see Section I, The Role of the Refuge in Everglades Restoration.
- p.9; Text is amended to show some of the realized and potential benefits of the revised water regulation schedule. Please see Section I, the Role of the Refuge in Everglades Restoration.
- p.27; Though two of the major goals of the Everglades Construction Project are to improve water quality and to improve the volume, timing, and distribution of water entering the Everglades, the former has been the focus of the development of Stormwater Treatment Area 1. The area's ability to store water in addition to treating water could benefit refuge hydropatterns by making additional water available for delivery at needed times. However, detailed analyses have not been conducted that demonstrate the potential effects of changing the location of water inflows to the refuge (both moving inflows from S5-A south to G-251 on the west and the equivalent structure for Stormwater Treatment Area 1E, and removing inputs at S-6). Refuge staff have concerns that these changes may have the potential to negatively impact hydropatterns. The development of a hydrologic model of the refuge that examines these impacts is listed in the final plan as a needed project. Please see Section III, Refuge Environment, Hydroperiod and Hydropattern, Overview of the Water Regulation Schedule; Section III, Refuge Environment, Water Quality, Legal Action; and Section I, The Role of the Refuge in Everglades Restoration.
- p.57; This suggestion was included in the final plan; see our prior response in this document. Please see Section IV, Management Direction, Goal 1, Objective 7; and Section V, Plan Implementation, Project 8.
- p.118; No conflict was intended. We were stating a predicament encountered when managing artificially created habitats such as impoundments. The sentence will be reworded. It was not the best way to say that there are always tradeoffs in active wildlife management processes. Ecosystem management seems to provide the most well rounded scenario for species that evolved in that environment, usually native species. However, in south Florida, impoundments need to be actively managed or they are lost to rank vegetative growth. During the management process, either draining, burning, or discing can temporarily displace and cause minimal benefit to fish, small mammals, and some invertebrates. Additionally, managing an impoundment or two to provide prey and habitat for some target species will often preclude impoundment use for other species (i.e., non-target species). As an example, managing for shorebirds that require relatively large areas of open, very shallow water, or exposed mudflats with high invertebrate populations or snowy egrets and wood storks does not benefit secretive marsh birds such as king and black rails that prefer dense vegetative growth. Please see Appendix A, Section VI, Environmental Consequences, Hydrology.

- fig.8; Unfortunately the black and white draft plan version did not show the legend breakdown very well. The District will receive full color copies (not printed in draft) of the final plan.
- The 5 percent open slough estimation came from an interpretation of the legend supporting the Loxahatchee vegetation map found in the 1990 Report; “An Evaluation of Refuge Habitats and Relationships to Water Quality, Quantity and Hydroperiod” by Richardson, et., al. Anecdotally, refuge staff believe this to be a reasonable estimate from their experience traversing the refuge. Projects in the plan support a more up-to-date map that would more thoroughly address this question. Please see Section V, Plan Implementation, Projects 1, 2, 6, and 7.
- p.28; Cattail, although a native plant in the Everglades, has become an invasive plant. It out-competes sawgrass on the refuge only because of its characteristic of thriving in unnaturally high phosphorus laden water that people have introduced into the Everglades. Whereas cattail would have historically been found in a grand total of maybe a couple hundred acres (around rookeries or alligator holes), it now infests more than 5,000 acres on the refuge. This community was included in this section because it does occupy a large number of acres in the refuge, is an indicator of water quality changes, and is a topic that the public asks about. The cattails section was moved lower in the section, next to a paragraph on Wildflowers, also not a major community. We have also changed the section title to Vegetative Communities and dropped the word “major.” Please see Section III, Refuge Environment, Native Vegetation.
- p.30; Text has been amended to include a note about the impacts of invasive exotics on tree islands. Recent surveys have shown the areas that have been impacted by exotics, but no survey to date has quantified their acreage impact specifically on tree islands. High priority projects within the final plan will, if funded, address questions such as tree island exotic invasion, health, loss, and overall status. The plan also includes a number of projects such as monitoring hydrology that will directly benefit management decisions for tree island’s protection and enhancement, and the invasive exotic control projects will certainly benefit them directly and immediately. Please see Section III, Refuge Environment, Exotic Plants, Melaleuca; Section IV, Management Direction, Goal 1, Old World Climbing Fern; Section V, Plan Implementation, Projects, and Monitoring and Evaluation.

## FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION



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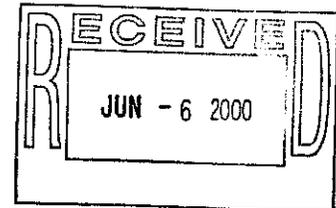
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OFFICE OF THE EXECUTIVE DIRECTOR  
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May 17, 2000



Mr. Mark Musaus, Refuge Manager  
A.R.M. Loxahatchee NWR  
U.S. Fish and Wildlife Service  
10216 Lee Road  
Boynton Beach, Florida 33437-4796

Dear Mr. Musaus:

Thank you for the opportunity to review the Draft Comprehensive Conservation Plan (CCP) for the Arthur R. Marshall Loxahatchee National Wildlife Refuge. We found the plan to be comprehensive in scope and were encouraged to see a renewed emphasis on providing outdoor recreational opportunities for the public compatible with preserving the biological integrity of the refuge. We were also pleased regarding the strong commitment for the control of exotic plant species. We have a shared concern over the potential spread of *Lygodium* into the Everglades Wildlife Management Area (Water Conservation Areas 2 and 3).

Appendix J discusses in great detail the various factors that ultimately led to the decision to sustain the prohibition on airboat use on the refuge. However, inherent in many of the referenced studies therein are speculative conclusions on the effects of airboat use on wildlife and plant communities that have not held true in practice. Accordingly, we encourage refuge staff to revisit this issue and tour the Everglades Wildlife Management Area (Water Conservation Areas 2 and 3), where airboating is allowed, to experience first-hand the wading bird rookeries, snail kite nesting activity, and biological processes that are unaffected by recreational airboating. We further suggest special consideration be given for the use of airboats in conjunction with the waterfowl and proposed alligator hunting seasons, as these are regulated uses available to only a limited number of participants. Finally, we also suggest that the renovation of Hillsboro Recreational Area be assigned a high priority to better accommodate public access.

In reviewing the Plan Implementation section, it became apparent that there were several projects listed where FWC could provide support to refuge staff to accomplish the established goals, particularly Project 3 (Implement a Fire Management Program) and Project 13 (Provide Additional Hunting and Fishing Opportunities). Our staff in the Everglades region have extensive experience in using prescribed fire as a management tool in the area and in developing successful hunting and fishing programs for the public. In the past, we have coordinated these types of activities closely with the Miccosukee Tribe of

620 South Meridian Street · Tallahassee · FL · 32399-1600  
[www.state.fl.us/fwc/](http://www.state.fl.us/fwc/)

Mr. Mark Musaus  
May 17, 2000  
Page 2

Indians of Florida, who have reservation lands west of the Everglades Wildlife Management Area, and we would welcome the opportunity to assist refuge personnel in developing and implementing similar programs for the Loxahatchee National Wildlife Refuge, and expect there would be mutual benefits for both agencies in working together on these types of activities.

We hope these comments are helpful in the development of a comprehensive plan that serves to protect the resources of the refuge while providing recreational opportunities for the public. If we can be of further assistance in development or implementation of your CCP, please do not hesitate to contact our Everglades Regional Director, Mr. Mark Robson (561-625-5122). Thank you and we look forward to working cooperatively with refuge staff to manage and protect the resources of the Everglades in south Florida.

Sincerely,



Allan L. Egbert, Ph.D.  
Executive Director

ALE/W201/sc  
FWC 1-3

cc: Mr. Frank Montalbano  
Mr. Mark Robson

# FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION



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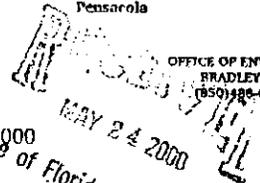
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May 24 2000  
State of Florida Clearinghouse

Ms. Cherie Trainor  
Florida State Clearinghouse  
Florida Department of Community Affairs  
2555 Shumard Oak Boulevard  
Tallahassee, Florida 32399-2100

Re: SAI #FI.200005040236C (Arthur R.  
Marshall Loxahatchee National Wildlife  
Refuge Draft Comprehensive Conservation  
Plan), Palm Beach County

Dear Ms. Trainor:

The Florida Fish and Wildlife Conservation Commission (FWC) is in the process of reviewing the referenced document, and we will be pleased to provide a copy of that report when it is complete. In general, we would encourage the selection of alternatives that integrate water management of the A.R.M. Loxahatchee National Wildlife Refuge into the management of the greater Everglades ecosystem (i.e., the Everglades and Francis S. Taylor Wildlife Management Area, also known as Water Conservation Areas 2 and 3; and Everglades National Park).

Sincerely,

*Bradley J. Hartman*  
Bradley J. Hartman, Director  
Office of Environmental Services

BJH/MAP  
ENV 1-3-2

INWR.SAI



# United States Department of the Interior

## FISH AND WILDLIFE SERVICE

A.R.M. Loxahatchee NWR  
10119 Lee Rd.  
Boynton Beach, FL 33437  
561-732-3684

September 11, 2000

Mr. Allan L. Egbert  
Executive Director  
Florida Fish and Wildlife Conservation Commission  
620 South Meridian Street  
Tallahassee, Florida 32399-1600

Dear Mr. Egbert:

Thank you for reviewing the U.S. Fish and Wildlife Service's Draft Comprehensive Conservation Plan for the A.R.M. Loxahatchee National Wildlife Refuge. We appreciate the efforts of your agency to review and provide comments. With this letter, I would like to address the two letters sent by the Florida Fish and Wildlife Conservation Commission.

In a letter received May 24, 2000, by the Florida State Clearinghouse from Bradley Hartman, Director of the Office of Environmental Services, he encouraged the refuge to select alternatives that integrate water management with the greater Everglades system. We agree that the refuge is a part of the greater landscape and have increased efforts to partner with other agencies and the public for the benefit of the natural resource throughout the Everglades. The first priority for water management in the refuge is wildlife, but we realize wildlife use habitats beyond our borders. In that context, we have tried whenever feasible to take other management areas' water needs into consideration. For example, last year after the heavy rainfall from Hurricane Irene we were asked to hold water longer in the refuge to help reduce high water problems in Water Conservation Areas 2 and 3. After assessing potential negative effects to refuge habitats (particularly tree islands) and wildlife versus potential benefits to the other conservation areas, we agreed with this request.

Water management for the greater Everglades ecosystem has to be balanced with demands placed on us for water storage and supply for agriculture as well as the rapidly growing population in south Florida. This requires open lines of communication and close coordination with water managers at the South Florida Water Management District and the Army Corps of Engineers. We welcome opportunities for the various water managers to meet and discuss water management for the entire Everglades landscape.

Thank you also for your comments, dated May 17, 2000, supporting our efforts to provide appropriate outdoor recreational opportunities for the public compatible with preserving the biological integrity of the refuge as well as our commitment for the control of exotic plant species. We also appreciate your offers to provide support for our goals related to implementing a fire management program and additional hunting and fishing opportunities. We are aware of the expertise your agency has and look forward to coordinating with you in these areas.

With regards to your suggestions to revisit the issue of airboats in the refuge, we did review our draft plan and will keep in place the decision to prohibit the use of airboats for recreational purposes. For the reasons stated in the plan we feel this type of use is not compatible with our efforts to protect and restore Everglades habitats for wildlife. National wildlife refuges are special places set aside specifically for the conservation of our Nation's wildlife resources. They are not multiple use public lands and cannot be all things to all people. We received strong support from public comments and conservation organizations desiring us to maintain our "wildlife first" mandate and to not allow airboats. The fact that the Everglades Wildlife Management Area (Water Conservation Areas 2 and 3) is open to airboating provides a balance, enabling enthusiasts of this type of recreation access to several hundred thousand acres of Everglades habitat.

We agree with your comments regarding renovation of the Hillsboro Area and are very pleased to report that a successful bidder has been found to rehabilitate our boat ramps. We hope work will begin within the next few weeks and look forward to having four new parallel ramps in place for the public. Subject to funding and possible partnerships with other agencies such as the Commission, we have identified projects in the final plan to develop an interpretive facility and concession operation at this area.

In closing, we would like to thank you for your interest and offers of support. We have enjoyed working with Mr. Mark Robson, Regional Director for this area, and other staff members. We are especially pleased with the excellent working relationship that has developed between the law enforcement officers of both of our agencies. We look forward to partnering with you in the future.

Sincerely yours,

Mark J. Musaus  
Refuge Manager



Jeb Bush  
Governor

## Department of Environmental Protection

Marjory Stoneman Douglas Building  
3900 Commonwealth Boulevard  
Tallahassee, Florida 32399-3000

David B. Scrubs  
Secretary

May 22, 2000

Ms. Cherie Trainor  
Florida State Clearinghouse  
Department of Community Affairs  
2355 Shumard Oak Boulevard  
Tallahassee, Florida 32399-2100

MAY 22 2000

State of Florida Clearinghouse

Re: U.S. Department of the Interior, Fish and Wildlife Service Summary and Draft Comprehensive Conservation Plan for Arthur R. Marshall Loxahatchee National Wildlife Refuge, Palm Beach County

SAI: FL200005040236C

Dear Ms. Trainor:

This Department has reviewed the above-described project proposal and based on the information provided, we submit the following comments and recommendations.

### Background

The Arthur R. Marshall National Wildlife Refuge is the only remnant portion of the northern Everglades in Palm Beach County. The 147,000 + acre refuge is owned by the State of Florida and managed by the Service under a 1951 license agreement with the South Florida Water Management District. The refuge is managed under the mission of The National Wildlife Refuge System for the conservation, management, and where appropriate, restoration of the fish and wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

A draft plan was developed by a planning team to identify the role of the refuge in support of the mission of the National Wildlife Refuge System and to provide guidance in refuge management and public use activities. Four alternative plans were evaluated and Alternative 2, Ecosystem Emphasis was selected as the preferred alternative for guiding the refuge direction over the next 15 years. Key features of the preferred plan include control of exotic and invasive plants, fire management to simulate historical Everglades ecosystem, increased monitoring of water quality and assess wildlife and habitat responses to the 1995 water delivery schedule, support of the Comprehensive Everglades Restoration Plan, acquire adjacent lands to buffer refuge from urban development patterns, and develop environmental educational partnerships and expand public use areas.

### Comments:

The following comments are offered to assist the Service in implementing the proposed conservation plan.

*"Protect, Conserve and Manage Florida's Environment and Natural Resources"*

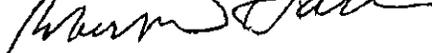
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1. We agree that restoration, protection and enhancement of the biological resources of the refuge, as proposed under the preferred conservation plan, should be the primary goal of the resource management plan. Public access and recreational use of the area should be allowed where and when it is compatible with protection of the natural system.
2. We noted that the list of preparers of the conservation plan did not include a representative of the Department. The Department has the responsibility for water quality protection under its regulatory program authorities for structures that discharge into, within or from the Everglades Protection Area. Since the refuge's living resources are sensitive to nutrient inputs and hydroperiod changes it is requested that the Service include the Department on future planning teams.
3. Urban encroachment can be expected to continue near the Refuge boundaries. We agree that the Service should partner with land acquisition entities both public and private to expand the spatial extent of the northern Everglades and to acquire lands needed to buffer the refuge from incompatible land uses.
4. The Service should partner with federal, state, regional, state and private entities to control exotic plant and animal species that threaten refuge resources.
5. Environmental education programs can generate public awareness of the problems facing the Everglades ecosystem and restoration efforts planned under the Comprehensive Everglades Restoration Plan. We suggest that the Service's programs be coordinated with the Public Outreach Steering and Support Team of the South Florida Ecosystem Restoration Working Group.

Please note the attached letter from Ms. Melissa Meeker, Director of the Department's Southeast District Office in West Palm Beach. Although mailed directly to the Refuge Manager in response to an earlier request that preceded the Clearinghouse transmittal, it supports the above comments, and should be considered an integral part of the department's response.

Thank you for the opportunity of commenting on this proposal. If you have any questions regarding this letter please give me a call at (850) 487-2231.

Sincerely,



Robert W. Hall  
Office of Legislative and Governmental Affairs

Attachment

cc: Melissa Meeker  
Ernie Barnett  
Herb Zebuth  
John Outland



# United States Department of the Interior

## FISH AND WILDLIFE SERVICE

A.R.M. Loxahatchee NWR  
10119 Lee Rd.  
Boynton Beach, FL 33437  
561-732-3684

September 11, 2000

Mr. Robert W. Hall  
Office of Legislative and Governmental Affairs  
Florida Department of Environmental Protection  
3900 Commonwealth Blvd.  
Tallahassee, Florida 32399-3000

Dear Mr. Hall:

Thank you for your review of the U.S. Fish and Wildlife Service's Draft Comprehensive Conservation Plan for the Arthur R. Marshall Loxahatchee National Wildlife Refuge. We believe public input is critical to making the plan better, especially the input of a natural resource management agency such as the Department of Environmental Protection. Our responses to your numbered comments are as follows:

1. We have noted that you concur with our preferred alternative. Your summary comments about protecting the biological resources of the refuge first, but providing compatible public use where appropriate, sums up our vision for the next 15 years through this plan. In fact, your comments capture the essence of the mission of the National Wildlife Refuge System.
2. We invited the State of Florida, through the South Florida Water Management District and the Florida Fish and Wildlife Conservation Commission, to participate in developing the plan by having representatives serve on an interagency planning team. The District became closely involved, however, the Commission declined to participate due to staffing constraints. However, the Commission did express its intent to closely review the draft plan and provide comments. Not inviting your department was an unintended oversight, and please accept our apologies. Your input as a team member would have certainly been valuable. We will invite you to participate in future interagency refuge planning teams as you requested. In fact, we are in the process of drafting a Comprehensive Conservation Plan for Hobe Sound National Wildlife Refuge and would welcome your participation.
3. As stated in Goal 2, Objective 3, of our plan, we do hope to develop collaborative relationships to help protect the remaining lands identified adjacent to the refuge, all of which are incorporated in Palm Beach County's Agricultural Reserve and many in other conservation designations. We also hope to cooperatively restore and manage these areas through progressive partnerships, or acquire these lands from willing sellers to be made a part of the refuge.
4. Only through effective partnerships will the invasive exotic problems be properly managed on the refuge and throughout the Everglades and the south Florida ecosystem. It will take partners at all levels as you suggested. One of our federal partners, the Department of Agriculture, is attempting to develop effective biocontrols. Our state partners include your Department which contributed more than \$155,000 last year toward removal of the invasive exotic Old World climbing fern (*Lygodium*) on the refuge. A regional partner of ours, the South Florida Water Management District, has contributed \$75,000 annually for a number of years to aid in the control of melaleuca on the refuge. The District is also a partner in exotic control research and monitoring. We must also acknowledge the tremendous work of volunteers in this fight, including our refuge "Friends" group, the Loxahatchee Natural History Association, as well as high school and college students who have worked many hours on the refuge to remove exotics.

5. Your final comment concerning the coordination of outreach and education programs with larger regional efforts is an excellent one. Recently, we have initiated a number of partnerships in this regard. For example, we are currently working closely with the District and the Florida Exotic Pest Plant Council to initiate an intensive outreach program on invasive exotics. The state supervisor of the Fish and Wildlife Service's Ecological Services Division represents the Service at all South Florida Ecosystem Restoration Working Group meetings. I serve as his alternate and also attend the meetings. We are aware of the Public Outreach Steering and Support Team's outreach plan and will coordinate with the team in its efforts.

Once again, thank you for your review and suggestions, as they were helpful to us as we developed the final plan.

Sincerely yours,

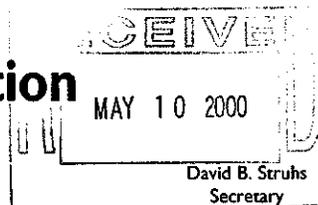
Mark J. Musaus  
Refuge Manager



Jeb Bush  
Governor

## Department of Environmental Protection

Southeast District  
P.O. Box 15425  
West Palm Beach, Florida 33416



Mr. Mark J. Musuas  
Refuge Manager  
ARM Loxahatchee Wildlife Refuge  
10216 Lee Road  
Boynton Beach, FL 33437-4796

Dear Mr. Musuas,

Re: ARM Loxahatchee Wildlife Refuge  
Summary of the Draft Comprehensive Conservation Plan

Rapid development in Florida and especially south Florida, has resulted in the loss of about half of the original Everglades Ecosystem. You have the important responsibility for the management of a very significant and unique portion of what remains. We agree that the protection of the ecological values of the refuge must be your top priority. While public access and use are important components of refuge management, it must always be developed and tempered in light of the overriding need for resource protection. Selection of *Alternative 2, Ecosystem Emphasis*, appears to offer the best opportunity to conserve and restore the refuge's natural resources while building the public awareness and understanding through access, use and education, that is necessary to ensure its long-term protection. We offer the following suggestion in an effort to assist in this important planning process.

I fully agree with the plan's vigorous program to address the invasion of the refuge by exotic species. In an effort to help reduce the cost for exotic plant species removal, the refuge could consider using volunteers to assist in the removal process. The FDEP Southeast District and Palm Beach County Environmental Resources Management have frequently used volunteers to assist in projects that involve the removal of exotic and invasive plant species. Since these events always include training on the appropriate removal processes, a base group of volunteers that are somewhat experienced in this arena currently exists. Interagency cooperation to provide these volunteers an opportunity to assist the refuge in this effort might be worthwhile.

Such interagency cooperation could also be useful in buffering the refuge from incompatible adjacent land uses and expanding the extent of valuable native habitat. Lands to be purchased through Palm Beach County's Agricultural Reserve and Environmentally Sensitive Lands Acquisition Programs may adjoin land currently owned or managed by the refuge. Where appropriate, the opportunity for cooperative restoration and management of these lands by the refuge should be fully investigated.

*"More Protection, Less Process"*

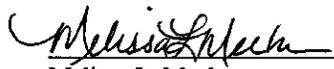
*Printed on recycled paper.*

As true in most of south Florida, hydrologic conditions in the refuge have been unnaturally altered. Habitat conditions are drier than normal in the north and water ponds in the south. The historic, natural sheet flow connection to the remaining Everglades Ecosystem has been severed and the refuge remains isolated from the remaining natural system by man made barriers. Drainage facilities have altered water quality to the extent that presently available water can not be discharged into the refuge's marsh without causing environmental impacts. A pH and total dissolved solids content problem remains to be solved before flows can be reintroduced directly into the northern end of the refuge.

During development of the Comprehensive Everglades Restoration Project (CERP) an adequate solution to these problems was not found. Although a time limitation was a major reason for the failure to solve this complex problem, it is important to remember that the CERP process is ongoing and an opportunity to address these issues remains. I encourage you to participate actively in the "Recover" process of the CERP. This process is designed to ensure that an adequate evaluation of ecosystem performance is made for all CERP projects as design, construction and operation proceeds. A commitment was also made to use the process of adaptive management. Such a process should ensure that we learn as we proceed and that we use that knowledge to reevaluate project design and maximize benefits.

I appreciate the opportunity to provide agency comments on the refuge's Draft Comprehensive Conservation Plan. The Arthur R. Marshall Loxahatchee National Wildlife Refuge is a valuable resource that must be protected and restored if Everglades restoration is to be realized. If you have any questions regarding these comments, please do not hesitate to call me at 561 681-6661 or our Everglades Environmental Manager, Herb Zebuth, at 561 681-6703. Thank you for your consideration.

Sincerely,

 5/8/00  
Melissa L. Meeker Date  
Director of District Management  
Southeast District

MLM/hhz

cc: Herb Zebuth  
Dianne Crigger



# United States Department of the Interior

## FISH AND WILDLIFE SERVICE

A.R.M. Loxahatchee NWR  
10119 Lee Rd.  
Boynton Beach, FL 33437  
561-732-3684

September 11, 2000

Melissa L. Meeker  
Director of District Management  
Florida Department of Environmental Protection  
Southeast District  
P.O. Box 15425  
West Palm Beach, FL 33416

Dear Ms. Meeker:

Thank you for your review of the Fish and Wildlife Service's Draft Comprehensive Conservation Plan for the Arthur R. Marshall Loxahatchee National Wildlife Refuge. We believe public input is critical to making the plan better, especially the input of a natural resource management agency such as the Department of Environmental Protection which has experience in land management.

Thank you for your suggestion about using volunteers in the control of invasive exotic plants. We currently use both high school and college student volunteers to help with this program, as well as our regular corps of volunteers to remove exotics from easily accessed areas near our public use facilities. Your suggestion of interagency cooperation by providing volunteers is particularly appreciated, as we are always looking for volunteers to help remove these noxious plants as well as with our many other projects. Our invasive exotic plant problem, though, will take a major funding initiative as noted in our plan. We have more than 90,000 acres impacted by exotics; volunteers at their best would be able to help with only a few hundred acres any given year. However, volunteers through their efforts in our highly visited, easily accessed areas will be a tremendous outreach tool with the general public to gain even greater support for invasive exotic control programs.

As our Goal 2, Objective 3 states, we do hope to develop collaborative relationships to help protect the remaining lands identified adjacent to the refuge, all of which are incorporated in Palm Beach County's Agricultural Reserve area. We also hope to cooperatively restore and manage these areas through progressive partnerships.

Your third comment regarding hydrologic restoration and water quality monitoring is considered and included in our Goal 1, Objectives 1, 2, 6, and 8, as well as Goal 2, Objectives 1 and 4. We are currently working, and plan to step up our efforts, to promote appropriate hydrologic restoration and proper quality of water entering the refuge. A major step toward this will be the development of a hydrologic model that can be linked with water quality and vegetation models. Such a tool would allow us to better evaluate potential impacts of hydrologic changes and to make appropriate management decisions. It is our hope that such a model could be developed cooperatively with other agencies.

We agree with your statement regarding the importance of RECOVER to the Comprehensive Everglades Restoration Plan. Our senior biologist, Dr. Laura Brandt, serves as a co-team leader of the Adaptive Assessment Team and member of the RECOVER Leadership Group. We hope research and monitoring on the refuge will help to measure the progress and benefits of Everglades restoration in support of this adaptive management process.

Once again, thank you for your review and suggestions as they were helpful to us as we developed the final plan.

Sincerely yours,

Mark J. Musaus  
Refuge Manager



REPLY TO  
ATTENTION OF

**DEPARTMENT OF THE ARMY**  
**JACKSONVILLE DISTRICT CORPS OF ENGINEERS**  
P. O. BOX 4970  
JACKSONVILLE, FLORIDA 32232-0019

JUN 01 2000

Planning Division  
Environmental Branch

Mr. Sam D. Hamilton  
Regional Director  
U.S. Fish and Wildlife Service  
1875 Century Boulevard  
Atlanta, Georgia 30345

Dear Mr. Hamilton:

This is in response to your April 13, 2000 letter inviting our comments on the vision, goals, and objectives presented in the Draft Comprehensive Conservation Plan for Arthur R. Marshall Loxahatchee National Wildlife Refuge. We have reviewed the draft plan and found that it will not likely impact any of the U.S. Army Corps of Engineers' (Corps) on-going programs.

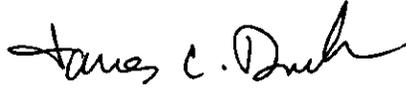
The draft plan is generally consistent with the Central and Southern Florida (C&SF) Comprehensive Everglades Restoration Plan. However, concerning the proposed boundary expansion, the proposed expansion of lands east of the existing boundary to US 441 or SR 7 encompasses lands that are also known as the "Ag Reserve Reservoir" in the C&SF Water Preserve Areas (WPA) Feasibility Study. Currently, Plan D13R of the C&SF Comprehensive Plan shows the use of these lands as a reservoir. The WPA study may recommend using these lands for a conveyance canal that will allow multiple use of the property. Also, as the WPA Feasibility Study continues, the Corps will continue to coordinate with other agencies in order to maximize recreational benefits from the Strazzulla Wetlands and the Hillsboro Recreational site.

We suggest that a section discussing the Everglades Nutrient Removal Project (ENR), specifically the STA 1W, STA 1E, and STA 2 could also be added. The ENR is briefly mentioned in the section on water quality but could also be added to the section on Water Intake on page 21.

-2-

Thank you for the opportunity to comment on the draft plan. We look forward to continued coordination with your agency as your plan proceeds into its final stages.

Sincerely,

A handwritten signature in black ink that reads "James C. Duck". The signature is written in a cursive style with a large, prominent initial "J".

James C. Duck  
Chief, Planning Division



# United States Department of the Interior

## FISH AND WILDLIFE SERVICE

A.R.M. Loxahatchee NWR  
10119 Lee Rd.  
Boynton Beach, FL 33437  
561-732-3684

September 11, 2000

James C. Duck  
Chief, Planning Division  
Corps of Engineers - Jacksonville District  
U.S. Department of the Army  
P.O. Box 4970  
Jacksonville, Florida 32232-0019

Dear Mr. Duck:

Thank you for reviewing the Fish and Wildlife Service's Draft Comprehensive Conservation Plan for the A.R.M. Loxahatchee National Wildlife Refuge. We believe it is critical to have reviews at all levels—federal, state, private, and public in order to develop the best possible management plan.

We are pleased to know that after your review of our plan it will not likely impact any on-going programs of the Corps and that it is consistent with the Central and Southern Florida Comprehensive Everglades Restoration Plan.

Regarding our proposed boundary expansion, we are well aware of the Water Preserve Area feasibility study and other possible uses for the area in question. We recognized this study as we developed our plan, and our intent was to not show acquisition of land for the refuge as the highest priority. We realized there was the possibility some of these lands might not be acquired in light of the many alternatives being considered by the Corps. We felt the public should be made aware of the importance of these lands to the refuge and start the process by which the Service might acquire or accept these lands if the opportunity ever arose.

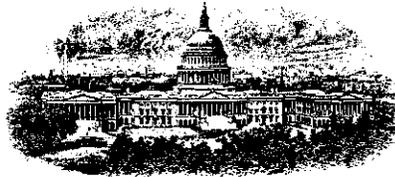
We agree with your suggestion to discuss in greater detail the Everglades Nutrient Removal Project and the role of the Stormwater Treatment Areas. It is important for everyone to realize the importance of these cleansing marshes and the role of the South Florida Water Management District and the Corps in constructing them. Please refer to Section I, Planning Issues and Opportunities - Significant Resource Problems; Section III, Refuge Environment - Hydroperiod and Hydropattern - Water Intake; and Section III, Refuge Environment, Water Quality - Legal Action.

Once again, thank you for taking the time to review our draft plan and we look forward to continued coordination with the Corps on water management and Everglades restoration efforts.

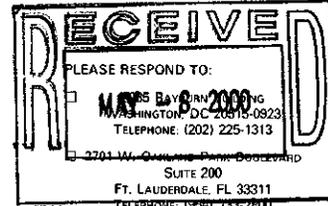
Sincerely yours,

Mark J. Musaus  
Refuge Manager

ALCEE L. HASTINGS  
23rd CONGRESSIONAL DISTRICT,  
FLORIDA  
COMMITTEE ON  
INTERNATIONAL RELATIONS  
SELECT COMMITTEE  
ON INTELLIGENCE



Congress of the United States  
House of Representatives  
Washington, DC 20515-0923  
May 5, 2000



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FAX: (561) 684-3613  
E-Mail Address:  
alcee.pubhastings@mail.house.gov  
World Wide Web Page:  
<http://www.house.gov/alceehastings/welcome.html>

Mr. Mark J. Musaus  
Refuge Manager  
Loxahatchee National Wildlife Refuge  
10216 Lee Road  
Boynton Beach, Florida 33437

Dear Mr. Musaus:

I am writing as one of many Floridians concerned about the state of Florida's environment. With our rivers, lakes, forests and other natural areas under attack from those with narrow self-interests or lack of foresight, we who truly care about our quality of life and natural surroundings must band together to defend Florida's dwindling number of wild places. For this reason, I fully support keeping the Loxahatchee National Wildlife Refuge as it is now.

I strongly oppose its eviction, and I also oppose proposed changes in regulations that would allow hunting and intrusion by motorized water craft of any kind. All Floridians, as stewards of our environment, must consider how our actions will affect us and our future generations. Protecting this very valuable resource and others like it should be of major concern to all of us.

Sincerely,  
  
Alcee L. Hastings  
Member of Congress

ALH:dl



# United States Department of the Interior

## FISH AND WILDLIFE SERVICE

A.R.M. Loxahatchee NWR  
10119 Lee Rd.  
Boynton Beach, FL 33437  
561-732-3684

September 11, 2000

The Honorable Alcee L. Hastings  
2701 West Oakland Park Boulevard  
Suite 200  
Ft. Lauderdale, Florida 33311

Dear Representative Hastings:

Thank you for reviewing the U.S. Fish and Wildlife Service's Draft Comprehensive Conservation Plan for the Arthur R. Marshall Loxahatchee National Wildlife Refuge. We are heartened to know you support keeping the Everglades' only national wildlife refuge as a vital component of the Everglades system.

Thank you for your comment regarding hunting. The refuge received many citizen comments both for and against expanding hunting opportunities. Hunting is permitted on a majority of the 520 national wildlife refuges located in every state in the nation. Hunting was identified as one of the "big six" priority public uses identified in the National Wildlife Refuge System Improvement Act of 1997, which was passed by Congress and signed by the President. Along with fishing, wildlife observation, wildlife photography, and environmental education and interpretation, hunting is considered an appropriate use of a refuge when populations can sustain a hunt and when compatible with the purpose for which the refuge was established.

In our final plan, waterfowl hunting will continue on the refuge as it has for many years. The total acreage for waterfowl hunting will be reduced, but the effective acreage--areas that can actually be accessed by the public--will increase. Hunting for feral hogs, an exotic species that can do untold habitat damage, will be permitted only on an as needed basis to control the impacts of these animal on the landscape. Alligator hunting will be permitted only when its population can support a hunt. Alligator hunting will be limited in terms of the number of participants, time of day (at night when the refuge is already closed to the general public), number of hunt days, and restricted to the perimeter canal. It will be controlled by law enforcement officers and monitored by biologists in cooperation with partnering agencies.

We appreciate also your comment regarding motorized watercraft. As noted in the draft plan, airboating impacts were closely examined and in our final plan will not be permitted on the refuge. The use of conventional motor boats will continue to be allowed in certain areas of the refuge (perimeter canal and deepwater areas at the southernmost end of refuge). "Slow speed, minimum wake" restrictions along limited areas of the perimeter levee will be in effect. Boat speed will be restricted in these areas in deference to the safety and resource enjoyment of canoeists and other paddlers. These minimum speed areas will also lessen the noise impact in the adjacent areas of the refuge that are frequented by the public. The proposed guided boat tour by a concessionaire will be permitted only via a quietly running motor, preferably electric, to reduce potentially disturbing noise, and will be restricted to the perimeter canal.

Once again, thank you for your review and comments on our draft plan. Feel free to contact me at 561-732-3684, for any additional information.

Sincerely yours,

Mark J. Musaus  
Refuge Manager

**TREASURE COAST REGIONAL PLANNING COUNCIL  
INTERGOVERNMENTAL COORDINATION AND REVIEW LOG**

**TCRPC NUMBER:** 00-PB-05-03

**APPLICANT:** U.S. Fish and Wildlife Service

**PROJECT DESCRIPTION:** The U.S. Fish and Wildlife Service has developed a Draft Comprehensive Conservation Plan for the Arthur R. Marshall Loxahatchee National Wildlife Refuge. Four alternatives were evaluated for managing the refuge. The Ecosystem Emphasis alternative was selected as the preferred alternative.

Under this alternative, appropriate water quality, quantity, and delivery are critical to achieve refuge objectives and Everglades ecosystem objectives. Water management will rely upon developing progressive partnerships with South Florida Water Management District and Army Corp of Engineers. Another crucial element of this plan is controlling exotic and invasive plants and aggressively pursuing funding to eliminate these threats to the refuge. An Integrated Pest Management Plan will be developed to attack this problem. This alternative enhances biological and research programs, inventorying, mapping, and monitoring of wildlife and habitat. All of the compartments (2,030 acres) will be actively managed to enhance wildlife habitat. The refuge will adjust the acquisition boundary to include the lands immediately east of the headquarters area to potentially buffer the refuge from development. (See attached location map.)

The previously closed Strazzulla Marsh will be opened to the public for limited recreational activities as well as the expansion of activities at the Hillsboro Recreation area.

**FUNDING AGENCY:** N/A

**PROJECT COSTS:** N/A

**RECOMMENDATIONS:** The proposed plan is consistent with SRPP Regional Goal 6.6 which calls for the protection of

wetland and deepwater habitats; **Regional Goal 6.7** which calls for the protection of upland natural communities and ecosystems; **Regional Goal 6.8** which calls for the protection of endangered and potentially endangered species; and **Regional Goal 6.9** which calls for the protection and sustainability of the Everglades ecosystem.

**AGENCIES CONTACTED:**

Palm Beach County  
All Palm Beach County Municipalities



# United States Department of the Interior

## FISH AND WILDLIFE SERVICE

A.R.M. Loxahatchee NWR  
10119 Lee Rd.  
Boynton Beach, FL 33437  
561-732-3684

September 11, 2000

Wynsum Hatton  
Treasure Coast Regional Planning Council  
301 East Ocean Blvd.  
Suite 300  
Stuart, Florida 34994

Dear Mr. Hatton:

Thank you for reviewing the U.S. Fish and Wildlife Service's Draft Comprehensive Conservation Plan for the Arthur R. Marshall Loxahatchee National Wildlife Refuge. We believe it is critical to have public review and input to develop a truly effective management plan.

The refuge formulated a 15-year vision and concrete management plan which dovetails with and supports many of the goals in your Strategic Regional Policy Plan. These shared goals that you identified include protection of natural communities and ecosystems, protection of threatened and endangered species, and protection and promotion of a sustainable Everglades ecosystem. We feel that we have also presented a range of appropriate, compatible, wildlife-dependent recreational opportunities that will foster greater awareness of refuge resources without compromising the purpose for which the refuge was established or the mission of the National Wildlife Refuge System.

Once again, thank you for taking the time to review our draft plan and for providing your comments.

Sincerely yours,

Mark J. Musaus  
Refuge Manager