LIGNUMVITAE KEY

AQUATIC PRESERVE MANAGEMENT PLAN

1991

DEPARTMENT OF NATURAL RESOURCES

LIGNUMVITAE KEY AQUATIC PRESERVE

MANAGEMENT PLAN

ADOPTED

DECEMBER 17, 1991

VIRGINIA WETHERELL

Executive Director

Florida Department of Natural Resources

This plan was prepared by the
Bureau of Submerged Lands and Preserves
Division of State Lands

Funds for this management plan were provided by the Department of Environmental Regulation, Office of Coastal Management using funds made available through the National Oceanic and Atmospheric Administration under the Coastal Zone Management Act of 1972, as amended.

EXECUTIVE SUMMARY

Lignumvitae Key Aquatic Preserve is recognized as an exceptional water resource of the state. The preserve encompasses 7,500 acres of seagrass meadows, deep water channels and hard bottom communities that provide nursery and settlement habitat for a wide variety of marine species. The three navigable channels that traverse the preserve from north to south are a transitional zone between Florida Bay and the Atlantic Ocean. The channels are flanked on either side by broad seagrass flats that may be partially exposed during low tide. The shallow water flats are prime feeding areas for many wading birds and a valuable nursery area for juvenile fish and invertebrates, including many of commercial interest. Hard bottom areas exhibit soft and hard corals, marine algae and a host of colorful invertebrates and tropical fish.

The nearby islands are remnants of ancient coral patch reefs that emerged from the sea 10,000 years ago. The islands support lush growths of tropical hardwood hammocks, saltmarsh, buttonwood, and mangrove forests on their undisturbed shorelines. The Lignumvitae Key Aquatic Preserve was established for the purpose of maintaining this rich mosaic of natural resources so that their aesthetic, biological and scientific values may endure for the enjoyment of future generations.

The preserve lies between the urban settlement of Islamorada on Upper Matecumbe Key and the primarily residential community on Lower Matecumbe Key. The Overseas Highway traverses the center of the preserve offering scenic vistas of the nearby islands and access to the preserve. The Florida Park Service also offers boat tours to Indian Key State Historic Site and Lignumvitae Key State Botanical Site. Shell Key State Preserve, a mangrove island that serves as a valuable rookery habitat is also within the preserve boundary. Other activities within the preserve include boating, snorkeling, diving, commercial fishing, marine life collecting, charter sport fishing and recreational fishing for finfish and lobster. There are five commercial marinas in close proximity to the preserve. Two immediately adjacent to the preserve offer rental boats to the public.

The main objective of the resource management program for the preserve is to protect natural resources for the benefit of future generations. On site management will be directed toward the maintenance of existing or essentially natural conditions and restoring damaged or degraded areas. Management activities include gathering data on resources and protection of existing conditions through review of proposed and existing projects, input into local government planning efforts, and cooperative efforts with the Florida Park Service field staff.

To protect natural resources and allow traditional uses, the preserve has been divided into several management areas. The management area designation is based upon the existing shoreline use and the quality of the adjacent submerged resources. The upland areas within the preserve consist of state-owned lands managed by the Division of Recreation and Parks and the Department of Transportation. Lands adjacent to the preserve are developed with commercial and residential uses. Wetlands and currently vacant lands include many sensitive natural and cultural resource features that may degenerate or be destroyed by development. Acquisition of environmentally sensitive lands adjacent to the preserve is an additional management strategy to protect the preserve's resources.

Primary impacts to the preserve's resources include boating and fishing activities and poorly planned development. Major marina facilities and private docks outside the preserve account for the majority of recreational boats in the area. The three navigation channels in the vicinity provide the most convenient access between Florida Bay and the Atlantic Ocean for several miles on either side of the Matecumbe Keys. Boating related impacts involve prop dredging, siltation and groundings. Most of these impacts could be prevented or minimized with improved channel marking, land acquisition, public education, restricted areas, and an enforcement presence. This management plan establishes goals and objectives to address these and other management issues.

The management plan also outlines the responsibilities of various different agencies and their subdivisions as provided for through statutory direction and other applicable authorities. Management of certain aspects of the preserves resources can be enhanced through application of these programs. Whenever possible, existing programs and resources will be integrated into the management of the preserve. The statutory management authority for public and privates uses of the preserve, as well as specific criteria for those uses are also provided. These uses are subject to the approval of the Board of Trustees or their designee. Approval is normally predicated upon demonstration that the proposed use is environmentally sound, and in the opinion of the Board, in the public interest.

Management and protection of the aquatic preserve can be enhanced through research and education programs. Research is critical to determining the status of existing resources and to provide a standard for future reference. Environmental education programs will coordinate with and be complimentary to existing programs whenever possible.

Funding and staffing levels to initiate the identified goals and objectives for resource management, protection, education and research are the minimum practicable for the identified areas. Continual monitoring of the accomplishments of this management plan will provide a standard for evaluating whether present budgetary and staffing estimates are adequate to manage and protect the preserve's resources for future generations.

TABLE OF CHAPTER CONTENTS

LIST OF FIGURES AND TABLES

LIST OF APPENDICES

Copies of the legal description of the Lignumvitae Key Aquatic Preserve, as well as copies of Chapter 253 and 258, F.S., and Chapter 18-21, F.A.C., may be obtained from:

Bureau of Submerged Lands and Preserves
Department of Natural Resources
3900 Commonwealth Blvd.
Mail Box 125
Tallahassee, Florida 32399

CHAPTER I

INTRODUCTION

Lignumvitae Key Aquatic Preserve is located in the upper half of the Florida Keys in Monroe County. The aquatic preserve includes approximately 7500 acres of submerged lands lying north and south of U.S. Highway 1 (Overseas Highway), between Upper Matecumbe Key (Islamorada) and Lower Matecumbe Key (Figure 1). Lignumvitae Key is one of three that are located in the Keys. (Coupon Bight Key Aquatic Preserve is in the lower Keys and the Card Sound portion of Biscayne Bay Aquatic Preserve is located between north Key Largo and the Florida mainland.) Lignumvitae Key is unique within the state system because it encompasses expansive marine grassbeds, bisected by channels that exchange waters between Florida Bay and the Atlantic Ocean. It also surrounds Lignumvitae Key State Botanical Site and Shell Key State Preserve. The southern boundary lies immediately north of Indian Key State Historic Site. There are currently 42 aquatic preserves throughout the state (Figure 2).

The role of the Aquatic Preserve Program is to manage and protect the natural resources within the boundaries of a preserve through staff programs and coordination with other state and federal resource management programs. An integrated management plan encompassing all the legislatively delegated resource management and protection laws is essential in preserving the resource values of the preserve. Local government will also be encouraged to incorporate this plan's policy guidelines into the local government comprehensive plan.

The rich mosaic of resource types within Lignumvitae Key Aquatic Preserve contributes to the biological diversity and productivity of marine systems and enhances man's enjoyment of the area. The aquatic preserve was designated by the Florida Legislature in 1969 to conserve and protect these values. This plan is intended to be used as the primary tool for management of the preserve to attain these goals. It is designed to be site-specific in addressing resource management issues relative to lands within the preserve.

The process of developing this management plan involved compiling an inventory of resource information, coordinating with other plans that have been developed for the area and state, and identifying resource and management issues related to present and future uses of the preserve and adjacent uplands. Various management areas will be identified or delineated. Supporting goals, objectives and policies were developed to be consistent with statutory authority and the overall intent of the Aquatic Preserve Program for helping

ensure that the resources of Lignumvitae Key Aquatic Preserve will remain for future generations to enjoy. As additional resource information becomes available or as laws are implemented or revised, changes may have to be made to the plan to reflect those events.

The Governor and Cabinet, sitting as the Board of Trustees of the Internal Improvement Trust Fund has been legislatively delegated statutory authority (Section 253.03, F.S.) to exercise proprietary control over state-owned lands and may assign management responsibilities for those lands to appropriate governmental agencies. Development and implementation of this management plan will be through the administrative support and the field staff of the Department of Natural Resources (DNR), Division of State Lands, Bureau of Submerged Lands and Preserves. Input from and cooperation with the Division of Recreation and Parks will also play a vital role in developing and implementing this plan.

More specifically, this plan is divided into chapters according to their management application:

Chapter II cites the statutory authorities upon which this resource management program and plan are built.

Chapter III provides a description of the aquatic preserve and details the physical, biological and cultural components of the preserve. It also contains an overview of regional and local land use and associated impacts.

Chapter IV delineates the management areas within the preserve. These areas are defined by taking into account the quantity and the quality of the biological resources in conjunction with the use of the adjacent lands.

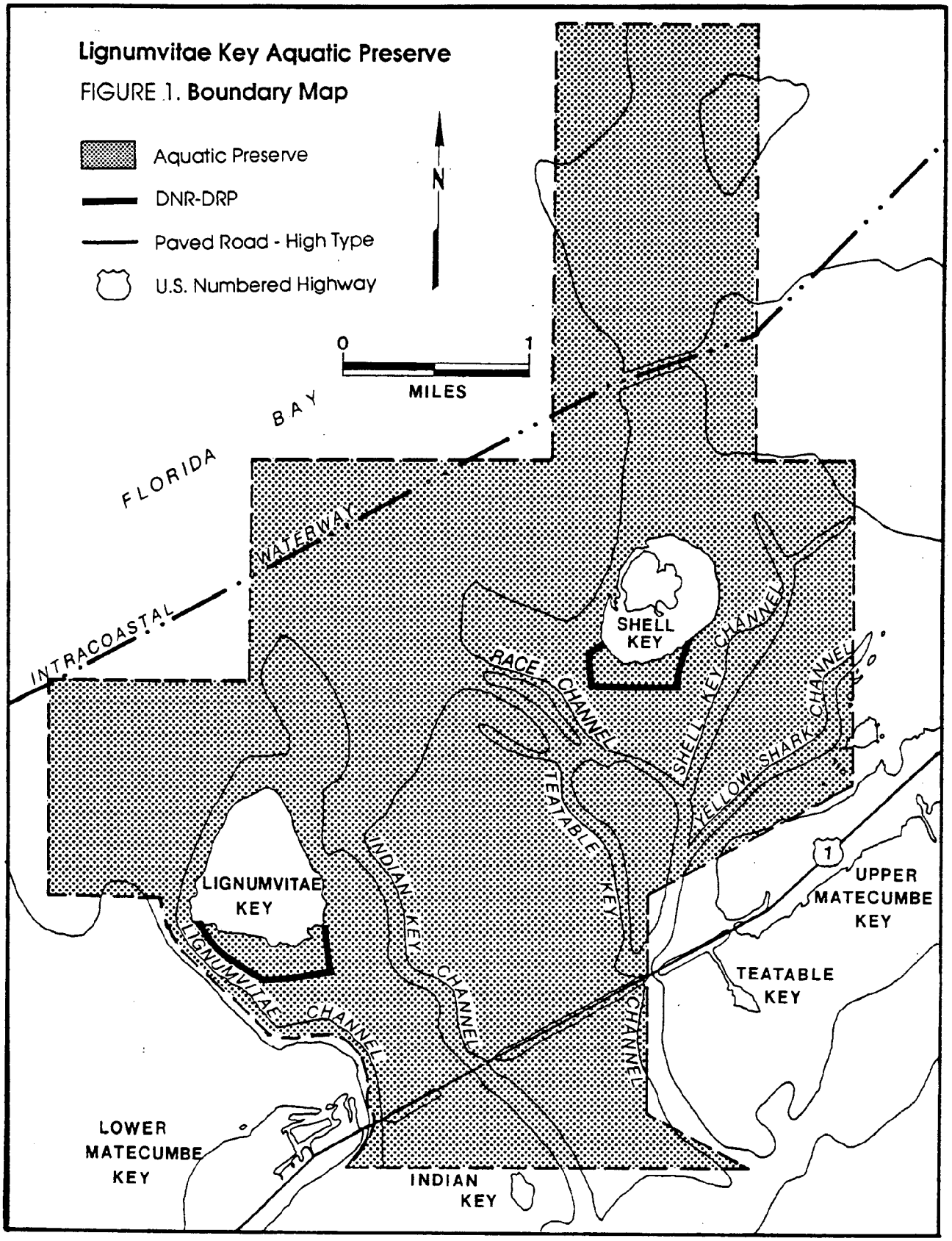
Chapter V presents specific needs and issues that are unique to the preserve that are not addressed through statute or code.

Chapter VI outlines the program's goals, objectives, and the tasks required to fulfill those needs within the preserve for resource management, resource protection, research, and environmental education.

Chapter VII identifies local, regional, state, and federal agencies, their authorities and programs, and how they relate and assist in protection and management of the preserve. It also identifies non-governmental organizations, interest groups, and individuals that have interests in or may assist in management objectives.

Chapter VIII projects future staffing and fiscal needs necessary for providing effective management and protection of the preserve, as well as supporting research and environmental education.

Chapter IX outlines a monitoring program for recording and reporting resource changes and establishes a tracking system for detailing the progress and accomplishments in resource management.


Lignumvitae Key Aquatic Preserve
FIGURE 1. Boundary Map
Aquatic Preserve
DNR-DRP
Paved Road - High Type
U.S. Numbered Highway
N
0
1
MILES
FLORIDA BAY
INTRACOASTAL WATERWAY
SHELL KEY
RACE CHANNEL
SHELL KEY CHANNEL
YELLOW SHARK CHANNEL
LIGNUMVITAE KEY
LIGNUMVITAE CHANNEL
INDIAN KEY CHANNEL
TEATABLE KEY
CHANNEL
1
UPPER MATECUMBE KEY
TEATABLE KEY
LOWER MATECUMBE KEY
INDIAN KEY

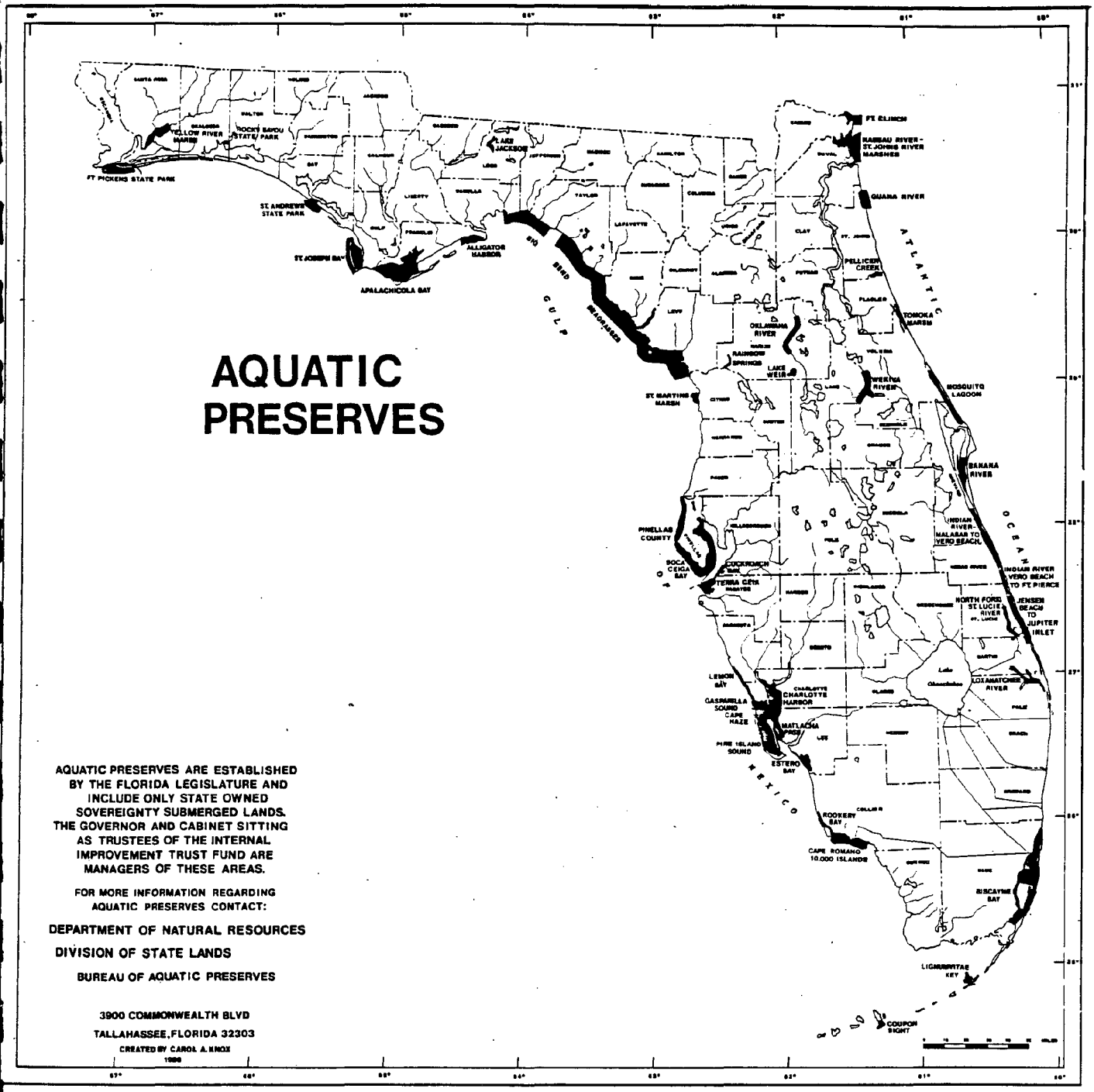


FIGURE 2. **Florida Aquatic Preserves**

CHAPTER II

MANAGEMENT AUTHORITY

A. STATUTORY AUTHORITY

The primary statutory authorities available to the staff for the management of aquatic preserves are found in Chapters 253 and 258, Florida Statute (F.S.). In particular, Sections 258.35-258.46 enacted in 1975 by the Florida Legislature represent the Florida Aquatic Preserves Act. These statutes set forth a standardized management criteria for all designated aquatic preserves and represent the primary laws governing the use of sovereignty submerged lands. These authorities also clearly establish the proprietary management role of the Governor and Cabinet in their capacity as the Board of Trustees of the Internal Improvement Trust Fund. All management responsibilities assigned to the Trustees may be fulfilled directly by the Governor and Cabinet or indirectly via staff through delegations of authority, management agreements, or other legal mechanisms. All references to the "Board" or the "Trustees" in this plan potentially include staff in addition to the Governor and Cabinet themselves.

Aquatic Preserve staff may be designated to review requests for use of state-owned lands and provide comments to the Board of Trustees, via the Division of State Lands and Department of Natural Resources administrative staff, relevant to the environmental impacts of a proposed use. The staff review is conducted within the confines of Section 258.42, F.S., and in conjunction with other governmental bodies, comments and recommendations are presented to the Board as an agenda item for their deliberations.

B. ADMINISTRATIVE RULES GOVERNING AQUATIC PRESERVES

Chapters 18-20 and 18-21, Florida Administrative Code (F.A.C.), are two administrative rules directly applicable to the DNR's/Trustees' actions regarding uses of lands in aquatic preserves and other state-owned submerged lands.

1. CHAPTER 18-20, F.A.C.

Chapter 18-20, F.A.C., addresses the aquatic preserves and derives its authority from Sections 258.35, 258.36, 258.37 and 258.38, F.S., and is found in Appendix 1. The intent of this rule is contained in Section 18-20.001, F.A.C., which states:

> "(1) All sovereignty lands within a preserve shall be managed primarily for the maintenance of essentially natural conditions, the propagation of fish and

wildlife, and public recreation, including hunting and fishing where deemed appropriate by the Board and the managing agency.

(2) The aquatic preserves which are described in 73-534, Laws of Florida, Sections 258.39, 258.392 and 258.393 Florida Statutes, future aquatic preserves established pursuant to general or special acts of the legislature, and in Rule 18-20.002, Florida Administrative Code, were established for the purpose of being preserved in an essentially natural or existing condition so that their aesthetic, biological and scientific values may endure for the enjoyment of future generations.

(3) The preserves shall be administered and managed in accordance with the following goals:

(a) To preserve, protect, and enhance these exceptional areas of sovereignty submerged lands by reasonable regulation of human activity within the preserves through the development and implementation of a comprehensive management program;

(b) To protect and enhance the waters of the preserves so that the public may continue to enjoy the traditional recreational uses of those waters such as swimming, boating, and fishing;

(c) To coordinate with federal, state, and local agencies to aid in carrying out the intent of the Legislature in creating the preserves;

(d) To use applicable federal, state, and local management programs, which are compatible with the intent and provisions of the act and these rules, to assist in managing the preserves;

(e) To encourage the protection, enhancement or restoration of the biological, aesthetic, or scientific values of the preserves, including but not limited to the modification of existing man-made conditions toward their natural condition, and discourage activities which would degrade the aesthetic, biological, or scientific values, or the quality, or utility of a preserve, when reviewing applications, or when developing and implementing management plans for the preserve;

(f) To preserve, promote, and utilize indigenous life forms and habitats, including but not limited to: sponges, soft coral, hard corals, submerged grasses, mud flats, estuarine, aquatic and marine reptiles, game and non-game fish species, estuarine, aquatic and marine invertebrates, estuarine, aquatic and marine mammals, birds, shellfish and mollusks;

(g) To acquire additional title interests in lands wherever such acquisitions would serve to protect and enhance the biological aesthetic, or scientific values of the preserves;

(h) To maintain those beneficial hydrologic and geologic functions, the benefits of which accrue to the public at large."

(4) Nothing in these rules shall serve to eliminate or alter the requirements or authority of other governmental agencies, including counties and municipalities, to protect or enhance the preserves provided that such requirements or authority are not inconsistent with the act and this chapter.

Chapter 18-20.004, F.A.C. outlines policies, standards and criteria for approval of projects and activities within aquatic preserves, evaluates the public interest merits of a project, establishes resource management criteria, standards for docking facilities and the board's authority to enter into management agreements with local agencies for the administration and enforcement of standards and criteria for single family docks.

Among other resource management directives, Chapter 18-21.004 (3), specifically states that:

(a) All proposed activities in aquatic preserves having management plans adopted by the Board must demonstrate consistency with the management plan.

2. CHAPTER 18-21, F.A.C.

Chapter 18-21, F.A.C., controls activities conducted on state-owned submerged lands and is predicated upon the provisions of Sections 253.12 and 253.03, F.S. The stated intent of this administrative rules is:

"(1) To aid in fulfilling the trust and fiduciary responsibilities of the Board of Trustees of the Internal Improvement Trust Fund for the

administration, management and disposition of sovereignty lands;

(2) To insure maximum benefit and use of sovereignty lands for all the citizens of Florida;

(3) To manage, protect, and enhance sovereignty lands so that the public may continue to enjoy traditional uses including but not limited to, navigation, fishing, and swimming;

(4) To manage and provide maximum protection for all sovereignty lands, especially those important to public drinking water supply, shellfish harvesting, public recreation, fish and wildlife propagation and management;

(5) To insure that all public and private activities on sovereignty lands which generate revenues or exclude traditional public uses provide just compensation for such privileges; and

(6) To aid in the implementation of the State Lands Management Plan."

Chapter 18-21.0041 provides more specific statements regarding multi-slip docking facilities in the Florida Keys Marina and Dock Siting Policies and Criteria. This section of the F.A.C. requires consistency and conformity with the "Principles for Guiding Development in the Florida Keys Area of Critical State Concern" designation (Chapters 27F-8, -9, -10, -11, -12, -13, and -15, F.A.C.). In summary, this rule is intended to protect endangered, threatened and species of special concern, the Florida Reef Tract, other corals, wetland and submerged vegetation, and benthic communities. Additionally, this rule requires that facilities be located in areas with adequate tidal flushing and adequate water depths to avoid dredging and other bottom disturbance. More specific criteria require a minimum depth of -4 feet and that depth be adequate in the mooring, turning and access channel areas, with greater depth requirements for those facilities intended for mooring of boats with drafts greater than 3 feet. Specific structure design criteria are also contained in Chapter 18-21.

C. RELATIONSHIP TO OTHER PLANS AND PROGRAMS

As mandated in 18-20.001, 3 (a), F.A.C., this plan, as well as plans for other aquatic preserves have and are being developed as funding is made available. Presently, 14 management plans have been approved by the Trustees, which cover 21 of the State's 42 aquatic preserves. Former plans were designed to be generic in nature, with policies and management guidance

generally applicable to all aquatic preserves. However, this plan and all future plans will be more site-specific and contain policy guidance applicable to an individual preserve. The former management plans were incorporated into rule in 1988 (18-20.004(7), F.A.C). This and future plans will be similarly incorporated. As such, these plans carry the same authority as do Chapters 18-20 and 18-21, F.A.C.

The Conceptual State Lands Management Plan, adopted on March 17, 1981, and amended by the Trustees on July 7, 1981 and March 15, 1983, contain specific policies concerning spoil islands, submerged land leases, "Outstanding Native Florida Landscapes", unique natural features, seagrass beds, archaeological and historical resources, and endangered species. These policies also provide management direction for the Aquatic Preserve Program.

The State Comprehensive Plan, established by Chapter 187, F.S., provides broad policy guidance for the development of management plans for the statewide system of aquatic preserves. Therefore, the goals, objectives and policies set forth in this aquatic preserve management plan are designed to be consistent with the goals and policies of the State Comprehensive Plan pertaining to the water resources, coastal and marine resources and natural systems.

The Local Government Comprehensive Planning Act of 1975 (Section 163.3163, F.A.C.) (as amended by Chapter 85-55, Laws of Florida, to the Local Government Comprehensive Planning and Land Development Regulation Act) requires that all counties in Florida have a Local Government Comprehensive Plan (LGCP) by 1990. Monroe County government is required to provide planning for various elements including: housing, physical facilities, land use, conservation, and coastal zone protection. This plan has been developed to be consistent with present conservation and coastal management elements of the local government plan and will endeavor to provide criteria and standards that will be used in local plan revision. Monroe County's LGCP was submitted to DCA in August of 1990. When the LGCP plan is adopted, applicable policy statements will be incorporated into this management plan.

D. OTHER MANAGEMENT AUTHORITIES

Other Department of Natural Resources management authorities applicable to aquatic preserves include management and protection of fisheries and marine mammals as well as beach and shore preservation programs outlined in Chapters 370 and 161, F.S., respectively. Land acquisition programs conducted under the Environmentally Endangered Lands (EEL) authorities of Chapter 259, F.S., and the Conservation and Recreation Lands (CARL) program, authorized by Chapter 253, F.S., will

enhance management and protection of the natural resources adjacent to or within the aquatic preserves.

Chapter 403, F.S., which is an important adjunct to Chapters 253 and 258, F.S., governs, in part, the State's regulatory programs affecting water quality and biological resources. The Department of Environmental Regulation (DER), through a permitting and certification process, administers this program. Section 253.77, F.S. as amended by the Warren S. Henderson Wetlands Protection Act of 1984, requires that any person requesting use of state-owned land to have approval of the proposed use from the Trustees before commencing the activity. An interagency agreement between DNR and DER provides an avenue for staff comments on the potential environmental impacts of projects in aquatic preserves through the DER permitting process. Additionally, the DER has designated through administrative rule, a series of waterbodies as Outstanding Florida Waters (OFWs). The DER has adopted stringent use criteria for these OFWs. The inclusion of all aquatic preserve waters within this classification greatly enhances the protective provisions of Chapter 258, F.S. As the designated "306" Coastal Zone Management Agency, the DER also provides a source of funding matched by federal monies for data collection and planning in various areas. Funding for this plan was provided, in part, from these sources.

The DER's administrative rules of primary significance to the aquatic preserve management program are based upon the authorities contained in Chapter 403, F.S. Chapter 17-3, F.A.C., addresses water quality standards and establishes the OFW category. Chapter 17-4, F.A.C. addresses permit requirements.

Other opportunities for environmental review and input into activities potentially affecting aquatic preserves are afforded by the Department of Community Affairs (DCA). The DCA is statutorily responsible for administering the Development of Regional Impact (DRI) and Area of Critical State Concern (ACSC) designation. The DRI program, authorized by Section 380.06, F.S., was established by the Legislature to provide a review and monitoring procedure for those development projects potentially affecting more than one county. The Governor and Cabinet designated the Florida Keys as an Area of Critical State Concern on April 15, 1975. A prime objective of the designation and regulations (or "Principles for Guiding Development" established for the Keys in 1984) was to strengthen local land use management capabilities. DCA has been working with the local governments in a cooperative intergovernmental effort to meet this objective. DCA also has the authority to approve or amend the local comprehensive growth management plan and implement land use regulation within the ACSC.

The Department of State's Division of Historical Resources (DHR) is legislatively assigned to preserve and manage Florida's archaeological and historical resources. DHR holds title to the cultural resources located on state-owned lands, including state-owned submerged lands, pursuant to Chapter 267, F.S.

The Department of Health and Rehabilitative Services (HRS), under their public mandate, administers two programs directly affecting the aquatic preserve management program. The regulation of septic tanks is typically administered by the county health department. The arthropod (mosquito) control program is implemented through the local Mosquito Control District (MCD). Administration of these programs may potentially have significant impacts upon the aquatic preserve. Although there is no legislatively created vehicle, establishment of close working relationships between the aquatic preserve staff and HRS is a necessary element of the aquatic preserve management program.

The South Florida Water Management District (SFWMD) administers permitting programs for the local potable water supply, stormwater discharges, and some dredge and fill activities. Stormwater discharges in the area of the aquatic preserve may potentially affect certain management objectives. Close coordination with SFWMD permitting review is indicated when a particular project could pose threats to the quality or quantity of water introduced into the preserve.

Additional agencies and organizations that have interests or regulatory authority within the aquatic preserve or the adjacent uplands are listed in Chapter VII (Management Coordination Network) of this plan.

CHAPTER III

RESOURCE DESCRIPTION

The geology, climate, and hydrology of the Florida Keys have combined to create a unique environment suitable for colonization by tropical plants and animals that are highly specialized and limited to a relatively small geographic area on this continent. Lignumvitae Key Aquatic Preserve encompasses a variety of habitats or communities that support many of these species.

Detailed information on the resources (e.g., species lists, water quality data, archaeological and historical site information, life histories, supporting maps, cultural resource information, etc.) is listed in the following sections. The resource information presented in this chapter is intended to be generally descriptive of major management functions and resources in the area of the preserve.

A. LOCATION AND BOUNDARIES

Lignumvitae Key Aquatic Preserve is located in the upper half of the Florida Keys archipelago. Lying between the inhabited islands of Upper and Lower Matecumbe Keys, the preserve is traversed from east to west by the U.S. 1 roadway with a series of three bridges and a causeway, referred to locally as Indian Key Fill. Approximately four-fifths of the preserve area lies north of the roadway. This area encompasses submerged lands with expansive grass 'flats', deep water channels and two state-owned islands managed by the Division of Recreation and Parks, Florida Park Service. Shell Key State Preserve is a mangrove island that is managed for colonial nesting birds and other wildlife. Lignumvitae Key State Botanical Site is managed for botanical and historic resources and is open to the public. To the south of the U.S. 1 roadway, the preserve includes portions of two large grass flats and three deep water channels. South of the boundary, lies Indian Key State Historic Site, a small island managed by the Florida Park Service.

It should be noted that on previous boundary maps for the preserve, the southern boundary extended to the south of Indian Key out to Hawk Channel. Subsequent research of the legal description revealed that the previous boundary map was not reflective of the legally recorded description. Copies of the original boundary maps adopted by the Governor and Cabinet indicate that this was their intended boundary, however the recorded legal description supersedes the maps. This issue will be discussed further in Chapter V (Site Specific Management Issues) of this plan. The area described and

discussed in this management plan will otherwise conform to the boundaries depicted in Figure 1 and more generally described below. The preserve encompasses approximately 7,500 acres of sovereignty submerged lands.

From the northeastern edge of the Tea Table Bridge, the preserve boundary jogs north along the edge of Tea Table Channel then northeast immediately north of Yellow Shark Channel to near Little Basin on the east. The line then extends north of Shell Key, turns west for a short distance then runs due north again across Steamboat Channel and along the eastern edge of Shell Key Bank to Ironwood Channel at its northernmost limit. The boundary then turns west for a short distance and then runs due south along the western edge of Shell Key Bank, across Steamboat Channel to a point northwest of Shell Key, then runs due west to a point north of Lignumvitae Key, then runs west to the east side of Peterson Key Bank. The line then runs due south for a short distance, then east to the center of Lignumvitae Key Channel, following the channel to the south of U.S. 1, then angles southeast to Tea Table Channel, then turns again to the north to the point of beginning at Tea Table Bridge.

That portion of the preserve north of Steamboat Channel also lies within the boundary of Everglades National Park (ENP). The ENP boundary includes all waters of Florida Bay north of the Intercoastal Waterway in this vicinity and special federal provisions apply to activities in that area.

B. GEOLOGY

Both the ancient and modern geology of the Florida Keys is reflective of the biological communities and the marine environment that have shaped and continue to influence the configuration of these islands and adjacent marine areas. In geological time, the area is still very young and the present period heralds further change as sea levels rise with the retreat of glacial ice fields.

The present geological formations began 100,000 years ago during the Pleistocene Era when sea level was approximately 25 feet above present level (Hoffmeister and Multer, 1968). Corals and other marine organisms assimilated calcium carbonate from marine waters and constructed reef formations very similar to the living reefs of today. As the plants and animals died, their skeletal remains became part of the fossilized patch reefs and sea floor that were exposed as sea level receded during the Wisconsin glaciation period.

The glacial fields bound up large volumes of the earth's water and sea level dropped to approximately 325 feet below present levels approximately 10,000 years ago. The limestone reefs

became exposed islands. The islands were subjected to the erosive forces of wind, rain, and plants and began to take on their present appearance. During the recent Holocene period, sea level rose to its present level and is continuing a slow rise of about two inches every 100 years (Hoffmeister, 1974, Wanless, 1969). More recent calculations by Wanless (1989) estimate that sea level in Florida may be rising at 8-16 inches per 100 years.

The geological formations of the Keys may be further subdivided into two distinct physiographic and geologic regions. The Upper Keys (from Soldier Key to the eastern edge of Big Pine Key) are distinguished by the elongate dome and linear configurations that are the remains of the ancient coral reefs. This porous aggregate of fossil skeletal remains is referred to as the Key Largo limestone. Many of the fossilized remains are recognizable as the progenitors of species that inhabit the reef today (Multer, 1977; Hoffmeister and Multer, 1964). Lignumvitae Key is an excellent prototype of the ancient domed patch reef formation. Elevations at the center of the island are approximately 16.5 feet above sea level.

In the Lower Keys (Big Pine Key to Key West), the Key Largo limestone is overlain by the Miami limestone. The Miami limestone was formed in a high energy, shallow water environment with low silt content and high levels of calcium carbonate. Spherical ooid films were cemented together in dense layers around a core material, usually a grain of sand (Multer, 1977). This geological formation is less porous than the Key Largo limestone and shallow depressions on larger islands may retain freshwater pools or subsurface lenses.

C. PHYSIOGRAPHY

Based upon biogeography and physical characteristics, the modern geologic environments of the preserve may be divided into four regions: lagoon, transitional, emergent islands and disturbed areas. Each environment or region is significantly influenced by existing basement geology, as well as tidal circulation patterns and the biological communities that occur in each.

1. Lagoon

The complex lagoonal systems of Florida Bay are characterized by limestone and oolite basement rock, overlain by serpentine chains of mud banks that encompass shallow basins. The network of mud banks are composed of primarily calcareous sediments of a molluscan and foraminiferan origin. Minor constituents of quartzous sand and colloidal clays are also introduced from remote regions via littoral drift and tidal import. Mangrove

peats are also a minor constituent of the sediment layers (Scholl, 1966; Ginsburg, 1953).

The present configuration of these mud banks may be attributed to several factors. Prevailing winds, irregular rises on the bottom and converging currents may have initiated formation of the banks over 4,000 years ago, as sea level rose and flooded Florida Bay. Subsequent sediments continued to accumulate aided by the stabilizing effects of marine grassbeds and mangrove colonization. Still more sediments are deposited during storms and stabilized by algal mats in the supratidal areas. Ginsburg (1953) describes the importance and the process of algal matting in the formation of the marine sediments.

Lignumvitae Basin is representative of this geophysical region. Water depths in the basin average seven feet. The sediment mantle is thin near the center of the basin and gradually increases in depth moving toward the surrounding banks. The basin is encompassed by calcarious mud banks on all sides. Shell Key Bank lies to the east, an unnamed bank between Crab and Panhandle Keys on the north, Twin Key Bank on the northwest, Buchanon and Peterson Key Bank on the southwest, with Lignumvitae Key and Lignumvitae Bank to the south.

Currents and drainage patterns have carved numerous small channels across the northern banks in a north/south orientation. Larger channels, such as Steamboat and Ironwood Channels, bisect Shell Key Bank in an east/west direction. Bowlegs Cut crosses the Peterson Key Bank in a northeast to southwest orientation on the west side of the basin. The orientation and configuration (width and depth) of the individual channels of the basin are due in large part to the influence of currents and tidal movement across Lignumvitae Bank and through the deeper channels to the south.

The biological environment of the lagoon is typically determined by varying depths of sediments over bedrock. More exposed portions of the basement rock are colonized by sponges, small corals or algae. Areas of deeper sediments are colonized by marine grasses and algae. Areas of thinner sediments are dominated by algae and sponges with sparse colonies of grasses.

2. Transitional

The north to south channels across Lignumvitae Bank and the southern portion of Shell Key Bank (described collectively by Ebanks and Bubb (1975) as the Matecumbe Keys Tidal Bank) are major tidal passages between Florida Bay and the Atlantic Ocean. Lignumvitae, Indian Key, Teatable, and to a lesser extent Race and Shell Key Channels are the transitional area

between these different water bodies. The ebb and flood of tidal currents cuts through the sediment layers to the underlying bedrock in several locations. The dynamic forces of wind, tide and currents continually shape and reshape the configuration and depths of these channels as sediments are eroded and redeposited. This process is readily visible east of Indian Key where waters from Indian Key Channel are scouring a new channel across the bank to the southwest.

The transition from Bay waters to the open waters of the Atlantic is also evident in the sediment composition and particle size. Finer, molluscan sediments and a greater percentage of living mollusks on the Bay side give way to courser coral/algal sediments and increasing density and diversity of corals as one progresses seaward through the channels (Multer, 1977). Figure 3 (adapted from Ebanks and Bubb, 1975) illustrates the transition from molluscan to coral/algal sediment facies and channel depths in the area.

Other physical parameters, such as salinity, turbidity levels, temperature and chemistry also play an important role in the biological make-up of the transitional areas. Later discussions of community associations will expand upon these important effects and their relationship to the organisms that inhabit these areas.

3. Emergent Islands

The emergent islands within the aquatic preserve boundary are of two distinctly different geological origins. Lignumvitae Key is an ancient patch reef composed of Key Largo limestone. The raised, rocky platform is several feet above sea level and supports upland plant communities similar to the larger emergent islands of the Upper Keys. Lignumvitae Bank flanks the southern one third of the island. This low wave energy environment is ideal for the accumulation of additional sediments where an extensive mangrove fringe has developed.

Interior platform elevations on Lignumvitae Key support lush growths of tropical hardwood hammock vegetation that has laid down organically rich top soils over the parent material. Acids leached from the humus soil attack the porous limerock creating solution holes and sinks. Close examination of the exposed limerock on the north side of the island reveals subaerially formed crusts of geologically recent origin. Evidence suggests that the laminated crust is formed from the dissolution of carbonate materials from the upland soils which is then deposited by aqueous migration over the limestone bedrock. This laminate crust gives a fairly smooth appearance to the protrusions and cavities of the exposed limerock creating a knobby effect (Multer and Hoffmeister, 1968). The crust may range in color from light brown to red, while, the

underlying fossilized coral is white or pale orange-yellow in color.

Intertidal areas near the rocky shoreline exhibit a crenalate appearance with spherical voids and sharp projections. In this zone the parent limestone and the subaerial crust are subjected to the erosive forces of marine waters and biological agents. As it is being eroded, crustose and filamentous algae bind sediments and as they are alternately wetted and dried, form a karst-like layer over the underlying limestone in the intertidal zone (Ginsburg, 1953; Neuman, 1966; Robertson, 1963). Subtidal areas are typically hardbottom strewn with rock rubble that has been eroded from the shoreline interface.

In contrast, Shell Key is a supratidal mud bank island typical of other Florida Bay keys. Initial sediment deposits may have began over a raised ridge on the lagoon floor. The present configuration of the island is the result of the stabilizing influence of marine grasses, algal mats and mangrove colonization. A large supratidal pond occupies approximately one third of the interior of the island. Tidal exchange with open water is partially obstructed by a low storm berm. Conversations with long-term residents of the area, indicate that the northwest side of the pond was open to waters of the Bay less than 30 years ago, when the area was used as a fish camp (Cotheran, E., personal communication, 1983). Current observations from waterward of the island reveal a substantial mangrove fringe that completely screens the interior pond.

4. Disturbed Areas

Large scale alteration of the natural features of the marine environment were initiated during the construction of Flagler's railroad in the early 1900's. As the railway advanced south, it became apparent that a system of tressels and causeways would be needed to traverse the expanse of channels and banks between Upper and Lower Matecumbe Keys. Tressels were built over the channels and spur lines were built over the banks to provide access for a large clam dredge. Box cars with collapsible sides were then loaded with limestone and sediments dredged from the marine bottom. The cars were then rerouted to the main tressel and the fill was dumped to form a causeway between the channels. Most of these deep dredged areas lie parallel to and north of the existing roadway between Teatable and Indian Key Channels. One area is perpendicular to the roadway, east of Teatable Channel and extends to Horseshoe Key, a small spoil island. Additional fill was dredged from either side of the roadway across the entire length of the tidal bank for later road improvements (Cotheran, E., personal communication, 1983).D.

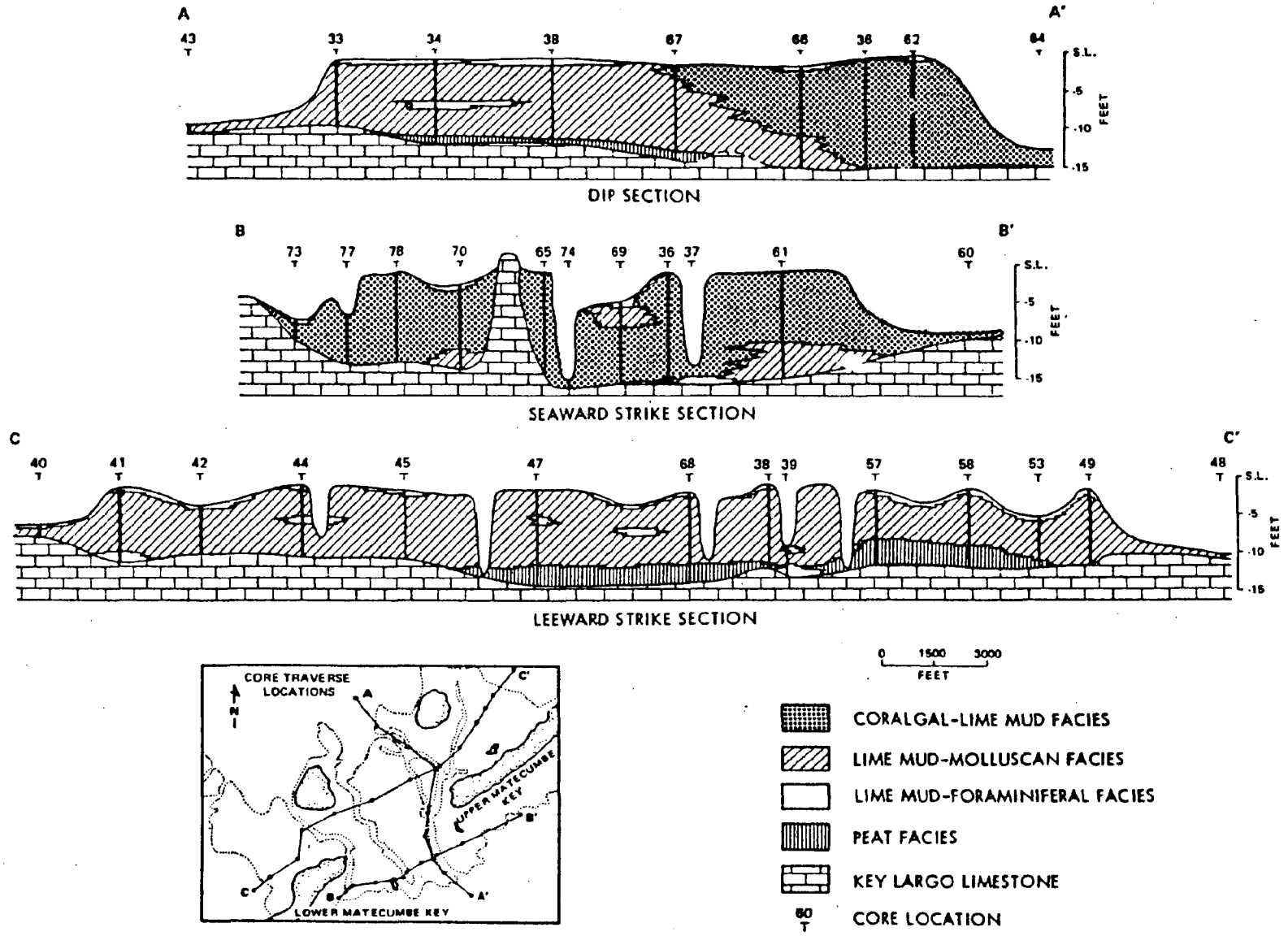


FIGURE 3. **Holocene Sediment Facies**

Holocene Sediment Facies
(from Eubanks and Bubb, 1975)

D. HYDROLOGY

The present geological landforms and the hydrological regime interact to influence the distribution of biological communities and the ongoing processes of deposition and erosion that sculpture the appearance of the area. The slope of the continental shelf to the depths of the Florida Straits created a gradient for the drainage of run-off from the uplands during earlier periods of lower sea level. These drowned rivers or stream beds are now marine channels. Silt and sediments are transported by tidal ebb and flood through the main channels. As current velocity diminishes, sediments fall to the bottom forming bars or filling in depressions in the bedrock. Obstructions to tidal flow and/or storm surge alter these normal patterns and may cause rechannelization. Tidal direction, stage and cycle are instrumental in the movement and deposition of both waters and sediments.

The channels facilitate mixing of the less saline waters of Florida Bay with the Atlantic Ocean and conversely, the more thermally stable waters of the Atlantic moderate temperature extremes in the immediate vicinity of the preserve.

Wind plays a secondary role in the hydrological patterns in the lagoonal basins. The shallow waters are easily agitated and fine sediments are easily suspended by wind-driven currents, especially during winter cold fronts that pass over the area. Flood tides entering the basin may be pushed back by strong winds and 'pile up' in the channels or along the shorelines of adjacent islands. Out going tides may be propelled in a similar fashion and push additional waters out of the basin and leave the adjacent banks completely exposed during low tide. Seasonal low tides will have a similar effect.

Tide cycles are semidiurnal, having two highs and two lows within each lunar period. Average tidal range is approximately 1.8 feet, with slightly higher and lower levels during full moon.

Freshwater resources were historically recorded for the area of Lower Matecumbe Key as early as 1775. Gauld (in Jutro, 1975) reported five natural wells "constantly full of excellent water". Since these 'wells' were "about four feet deep", they may have been large solution holes or sinks. These natural features typically retain water throughout the rainy season but may dry up completely during the winter dry season.

E. WATER QUALITY

The Florida Department of Environmental Regulation has designated waters of the preserve as Outstanding Florida

Waters (OFW) (17-3.041, F.A.C.). As such, these waters are to be afforded the highest protection possible. To qualify for this designation, water quality must be maintained within the established standards. All activities that may potentially alter these standards are evaluated accordingly.

Water quality data is limited in the area of the preserve. A summary of conditions for both ambient and impacted stations was published in the "Report to the Environmental Regulation Commission on the Proposed Designation of the Florida Keys as an Outstanding Florida Water" (DER, 1984). Initial sampling from one station in the preserve and one near Teatable Key indicates that chemistry, temperature, clarity and nutrient content were quite similar at both the inshore and off shore locations during that sampling period.

Other water quality research in the Keys has centered on the effects of septic tank effluent on ground and surface waters in the Big Pine Key area. This study has determined that septic effluent increases contamination in ground waters during the dry (winter) season and that horizontal subsurface transport introduces these effluents to contiguous (marine) surface waters during the wet (summer) period. Nutrient loading of surface waters is also indicated with the use of aerobic treatment units with shallow injection wells. The non-saline wastewater effluent is buoyant and rises within the rock strata to mix with surface waters. Continued increases in land use density and use of on-site sewage disposal systems (OSDS) are predicted to increase nutrient contamination of marine waters (Lapointe, 1989). Similar research and water quality monitoring are needed for the preserve area.

F. CLIMATE

The nearly tropical climate is characterized by mild, dry winters and warm, humid summers. Prevailing trade winds from the east and southeast are frequently interrupted by winter cold fronts that move over the area from the northern quadrants from December until March. Infrequent tropical storms and depressions in the summer months may also shift wind directions (Warzeski, 1976). The average rainfall (at Key West) is 39.8 inches per year with large peaks occurring in June and September (NOAA, 1965, 1979). Slightly higher amounts fall in the Upper Keys, due to the closer proximity of the mainland land mass. Average annual rainfall may vary considerably from year to year and from one location to another. Summer thunderstorms and the occasional tropical storm provide the bulk of the rainfall, with minor amounts associated with the winter cold fronts.

Annual average air temperature (measured at Key West) is 77.5 degrees Fahrenheit (F). Seasonal mean highs of 84.7 degrees

F occur in July and August. Mean lows of 69.0 degrees F occur during December and January (NOAA, 1965, 1979). Ambient temperatures are a direct influence of the Gulf Stream (Jordan, 1973). Neither frost nor freeze have been recorded for the area. As with most maritime climates, average humidity is typically high.

The tropical storms and hurricanes that visit this area deserve more than a casual mention. They tend to have major effects on the biology and natural features of a large area and on the activities of the human populations that visit and inhabit those areas. The long term benefits and deficits to the natural environment are poorly understood. Ball et al., (1967) and Craighead and Gilbert (1962) reported extensive biological and geological rearrangement and destruction of the coastal zone in South Florida and the Keys after the passage of Hurricane Donna in 1960. The greatest destruction or erosion of shorelines occurred where shoreline vegetation or shallow water marine grassbeds had been previously damaged or destroyed. Recovery of these areas was hindered by these alterations, as erosion often continued after the initial onslaught of the storm (Multer, 1977).

It is necessary to understand a hurricane's potential as a dynamic agent and to be prepared for its occurrence. It is also necessary to plan development that will minimize destruction of natural coastal communities. Although natural communities may be severely altered by hurricanes, the coral reefs, marine grassbeds and mangroves provide a natural buffer that can reduce the severity of impacts on coastal areas. They demonstrate a capacity to recover when functional integrity has not been undermined by manmade alterations to biological and geological features.

Some of the devastation to portions of Upper and Lower Matecumbe Key during the 1935 Labor Day Hurricane is attributed to the poor design of Flagler's railroad between the two islands. Newspaper reports from that era postulate the theory that the length of the two islands created a barrier to the 15 foot storm surge that made landfall before the storm. The large expanses of filled causeway between the two islands further restricted the only 'safety valve' for the passage of storm waters. The fill created a dam that backed storm waters even higher along both shorelines until it overwashed portions of both islands causing great loss of life and property. Large sections of Flagler's Overseas Railroad were also lost, never to be rebuilt.

G. BIOLOGICAL COMMUNITIES

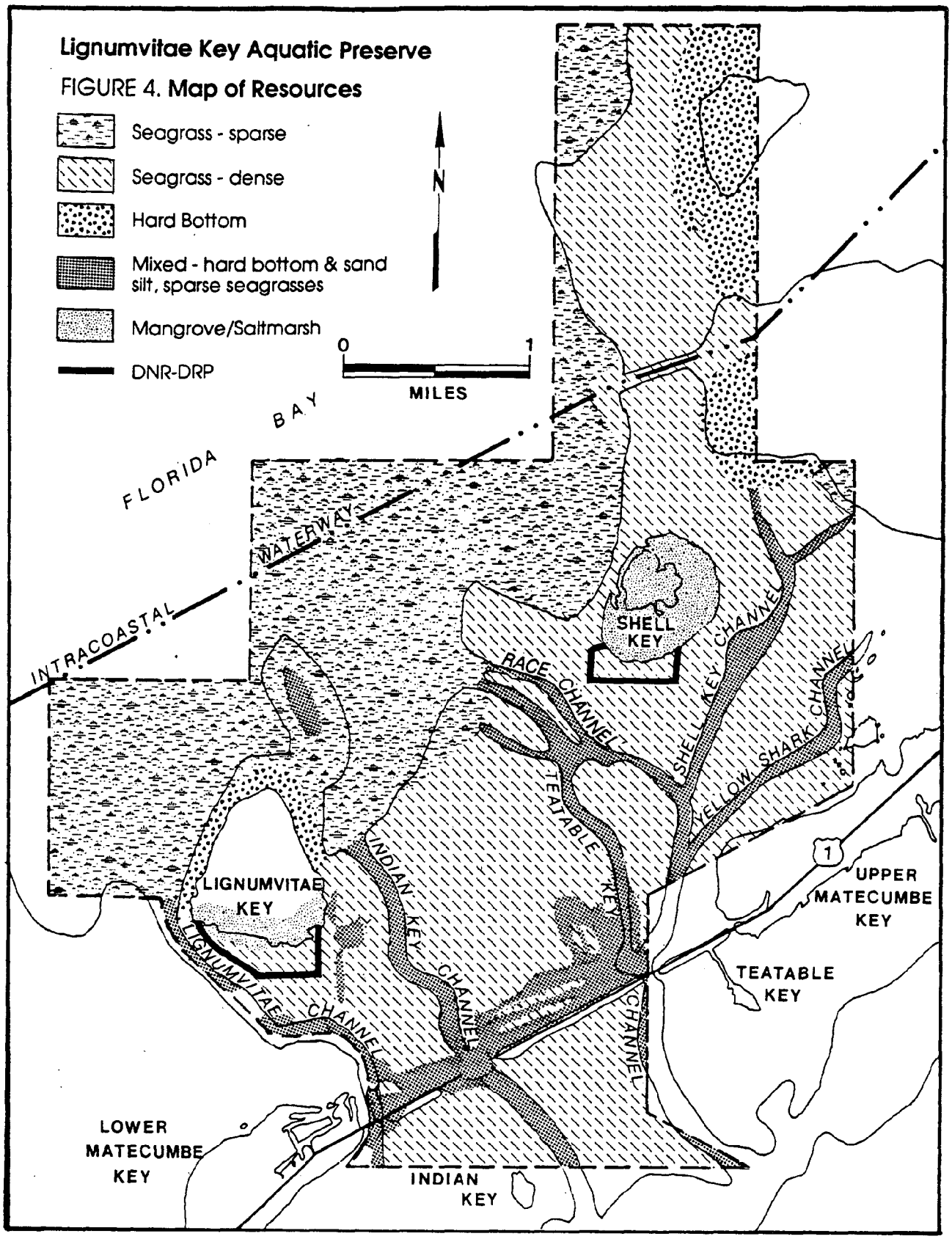
This section will discuss some of the plant and animal associations within the preserve. Individual species are grouped in representative community types based upon dominance or absence of certain floral and faunal constituents. General descriptions and species lists are intended to be reflective of the community being discussed under each subheading. The listing of a species in one community does not limit its occurrence to only that community. Each community association is presented separately, but in reality they display an infinite variety of mixed and interdependent associations. Major community associations in the preserve are mangroves, marine grassbeds and hardbottom. Figure 4 represents the relative distribution of these resources in the preserve. The tropical hardwood hammock resources of Lignumvitae Key State Botanical Site will not be discussed in the plan, as descriptions and management of those resources are provided by the Division of Recreation and Parks, Florida Park Service.

Subtle differences in geology, topography, microclimate and other physical parameters may determine the initial dominance of a particular association in an area, or the particular area may be modified by the existing biota and thus evolve or succeed into an entirely different association. The natural components of the environment are never static and usually progress in an orderly sequence of change from one sere to the next. Each succeeding sere is generally more complex and diverse than the previous association. Those communities that have reached a climax or balanced condition are usually most productive in terms of biomass and species diversity.

Catastrophic events, such as hurricanes and man-made alteration of natural features disrupt orderly progression and may set back the sere to an earlier stage that is less productive. Many of the man-made disturbances will be discussed in the text. These changes not only inhibit or reverse succession but may replace entire associations with other less productive environments. The affected environment or community is not the only one to be diminished. All marine systems are interrelated and thus changes to one association will directly or indirectly affect a number of other related and interdependent associations. The importance of marine productivity has been expounded upon since ancient times yet only recently has modern man begun to appreciate the intricate and vital role that these communities play in the larger ecological profile of our region and our planet.

1. Mangrove

Mangrove communities contribute substantially to the health and productivity of marine systems in the preserve, although much of this community association lies outside the preserve


Lignumvitae Key Aquatic Preserve
FIGURE 4. Map of Resources
Seagrass - sparse
Seagrass - dense
Hard Bottom
Mixed - hard bottom & sand silt, sparse seagrasses
Mangrove/Saltmarsh
DNR-DRP
N
0
1
MILES
FLORIDA BAY
INTRACOASTAL WATERWAY
SHELL KEY
RACE CHANNEL
SHELL KEY CHANNEL
YELLOW SHARK CHANNEL
TEATABLE KEY
INDIAN KEY CHANNEL
LIGNUMVITAE KEY
LIGNUMVITAE CHANNEL
CHANNEL
1
UPPER MATECUMBE KEY
TEATABLE KEY
LOWER MATECUMBE KEY
INDIAN KEY

boundary. Shoreline stabilization, storm protection, filtration and stabilization of sediments, nutrient cycling and habitat diversity are only a few of the many functions that this community performs.

Mangroves are a pan-tropical group, occurring on seventy-five percent of the world's tropical coastline (McGill, 1959). Of the 72 species recognized by Chapman (1976), only three species occur in Florida. Red mangrove (Rhizophora mangle) and white mangrove (Languncularia racemosa) grow along low energy shorelines from the Florida Keys to near Cedar Key on the west coast (Rehm, 1976) and north to Ponce de Leon Inlet on the east coast (Teas, 1977). Black mangrove (Avicennia germinans) extends farther north on the east coast to near 30 degrees north latitude and along the Gulf coast to Louisiana and Texas (McMillan, 1971). These tropical trees are sensitive to fluctuating temperatures and prolonged periods of cold or frost (Davis, 1940). Prolonged temperatures below 66 degrees F may be lethal or cause stunted growth forms (Waisel, 1972). Accordingly, the largest mangrove forests (90% according to estimates by the Coastal Coordinating Council, 1974) are located in the more southern areas of the state, primarily in Lee, Collier, Dade, and Monroe Counties. Monroe County encompasses approximately 234,000 acres (95,000 ha.) of mangroves, the majority lying within the boundaries of Everglades National Park and the small islands in Florida Bay.

Of the six mangrove forest types described by Lugo and Snedaker (1974), only the fringing forest and overwash forest are well represented in the area of the preserve. Fringing mangroves occur along the intertidal shoreline surrounding the southern half of Lignumvitae Key and extensive areas of the bayside shorelines of Upper and Lower Matecumbe Keys. A narrow, disjunct fringe is also present along the filled areas of the U.S. 1 roadway.

The mangroves of Shell Key may be considered an overwash forest type. This low island may be partially overwashed during high tides or completely overwashed during storm events. This situation affords flushing of the accumulated detritus and export to marine systems on a regular basis. The island serves as a major bird rookery. Additional nutrients, in the form of avian feces would also be exported during overwash periods.

Local distribution of mangroves is affected by several physical parameters. Wave energy and substrate are probably most significant within the area of the preserve. Mangrove forests reach optimum development on low energy shorelines with adequate sediment depths. This environment is typical in the more protected areas of Florida Bay and along the Bayside shoreline of the two Matecumbe Keys. Other areas lack sufficient sediment depths or are buffeted by waves or swift

currents that would bury seedlings or sweep them away. This type of environment is especially prevalent along the Atlantic shoreline of Indian Key. The north shoreline of Lignumvitae Key, although usually protected from prevailing wind and waves, is a rocky outcrop that offers few areas with adequate soil depths for mangroves to become rooted.

Tidal regime in coastal areas also plays an important part in mangrove dominance of the shoreline. The advance and retreat of marine waters facilitates import of necessary nutrients into the community and exports organic carbons and other compounds to marine systems. Tides are also instrumental in dispersing the buoyant seeds and propagules.

Ambient marine salinities benefit mangroves in several ways. Competition from less tolerant terrestrial plants is minimized and soil salinities are moderated by daily flushing. Unlike their terrestrial counterparts mangroves have evolved mechanisms to exclude or excrete salt from plant tissues. The red mangrove can exclude salt at the root surface (Scholander, 1968). Black and white mangroves secrete salt through modified glands on the leaf or trunk and by storing salt in succulent leaves and fruit that fall from the tree. Most halophytic plants are believed to use these mechanisms or a combination of them to dispose of excess salt (Teas, 1979).

Excessive soil or water salinity, however, can stress mangroves. Salinities above 65 parts per thousand (ppt) can kill red mangroves (Cintron et al., 1978). Salinities at or above 80 ppt may stunt white and black mangroves, especially in combination with high water temperatures (Lugo and Zucca, 1977). Impounded mangroves are frequently subjected to this type of stress. As normal tidal circulation is interrupted, water temperatures may exceed 100 degrees F and evaporation increases salinity to debilitating levels. Highly fluctuating temperatures and salinities combined with low sediment deposition, and low nutrient import create an extremely inhospitable environment. Impoundment may be the result of natural topographic features (e.g., coastal berms) or caused by ditching and other manmade alterations to drainage patterns.

Excessive temperatures and salinities (greater than 100 ppt) are also thought to be responsible for the relatively barren salt ponds or salinas that persist in many areas (Teas, 1979). Although these hypersaline areas may be inhospitable for most vascular plants, they perform other functions and should not necessarily be considered wasteland. They serve as valuable repositories for storm water runoff and sediments. These shallow water environments also support a broad range of algae that serve as a food source and provide cover for an equally diverse faunal community. Large numbers of larval fish species, gastropods, and crustaceans utilize this environment

and are in turn valuable food reserves for many of the wading birds when other feeding areas may be flooded during high tides or inaccessible during periods of unfavorable winter weather (Sprunt, personal communication, 1988). The small lagoon on Shell Key exemplifies the condition and use of the salinas.

The mangrove association is a major compliment to the preserves resources, both in distribution and ecological value. This community is the most common natural interface between the upland and the marine environment in Florida Bay. Major contributions from this community involve the complex and often poorly understood detrital food webs that are an integral part of tropical and temperate marine systems. Nutrients from both marine and terrestrial sources are assimilated and recycled in the vegetative tissues of the mangroves and everpresent root and mud algae. Primary productivity is difficult to partition because all levels of the community have not been thoroughly researched. It is, however, a widely accepted hypothesis that the organic carbons exported by mangrove systems are a major source of energy for many biologically and economically important species of invertebrates and fishes.

Carbon and other nutrients from terrestrial sources (Carter et al., 1973), rainfall (Lugo et al., 1980), and from marine sources are assimilated and recycled in the form of plant material that is fed upon by a host of arboreal, epiphytic, infaunal, and pelagic life forms. Energy pathways may originate from several different sources within the community. Seagrasses and benthic algae are trapped and broken down into particulate matter that is used by large numbers of consumers (Brook, 1975). Senecsed mangrove leaves are attacked by fungi (Fell et al., 1975) and bacteria (Casagrande and Given, 1975) that colonize the leaf surface. As the leaf surface is fragmented, plant starches and proteins are broken down or converted to other compounds that are more easily consumed and assimilated by other microscopic life forms that break down the plant material to even smaller fragments. As more surface area is actually made available, the biotic community expands, thus increasing the net available energy. As these smaller, protein rich particles are consumed, the resulting energy is passed on to higher order consumers (Odum, 1970 and 1971; Odum and Heald, 1972; Odum and Heald, 1975; and Odum et al., 1982).

Epiphytic and benthic algae that live on and near the mangrove roots also contribute substantially to the energy transfer to higher trophic levels. Rehm (1974) recorded 74 species of red, brown, green and blue-green algae associated with mangrove areas. This abundant resource is actively grazed by numerous faunal species on site or may die to become part of the detrital food web. The net primary production of prop-

root epiphytes and mud algae may equal emergent leaf production in some areas (Lugo et al., 1975).

The contributions of plankton to local marine energy budgets are difficult to evaluate. This dynamic group is subject to abrupt changes in density depending upon season, currents and nutrient levels. Although quantitive research has not been done specifically for mangrove estuaries, the importance of planktonic food chains has been well documented for other regions and it may be assumed that there are large numbers of invertebrate grazers that benefit from this community component. The abundance of phytoplankton and zooplankton within the immediate area of mangroves would indicate that this energy source is important to many larval food webs (Odum, 1970). Table 2 contains a partial list of non-vascular plants and phytoplankton of the mangrove association.

TABLE 1

A PARTIAL LIST OF THE MANGROVE FLORA

Black mangrove	Avicinnia germinans
Saltwort	Batis maritima
Sea oxeye daisy	Borrichia spp.
Saltgrass	Distichlis spicata
Barbed-wire cactus	Cereus pentagonus
Buttonwood	Conocarpus erectus
Clamshell orchid	Encyclia cochleata
Butterfly orchid	Encyclia tampensis
Sedge	Fimbristylis castanea
Seaside heliotrope	Heloiotropium curassavicum
White mangrove	Languncularia racemosa
Herbaceus sea lavender	Limonium carolinianum
Christmas berry	Lycium carolinianum
Gutta percha mayten	Maytenus phllanthoides
Poisonwood	Metopium toxiferum
Key grass	Monanthochloe littoralis
Prickly pear cactus	Opuntia stricta
Knot grass	Paspalum distichum
Purslanes	Portulaca spp.
Red mangrove	Rhizophora mangle
Rouge berry	Rivina humilis
Glasswort	Salicornia spp.
Sea purslane	Sesuvium portulacastrum
Virginia dropweed	Sporobolus virginicus
Sea blight	Suaeda linearis
Bay cedar	Suriana maritima
Air plants	Tillandsia spp.

TABLE 2

A PARTIAL LIST OF THE NON-VASCULAR MANGROVE FLORA

	Genera	Location	Reference
FUNGI			
	Nigrospora	Leaf	Fell, et
	Phyllostica	"	al, 1975,
	Pestalotica	"	1980
	Phytophora	"	"
	Drechslera	"	"
	Gloeosporium	"	"
	Lulworthia	"	"
ALGAE			
	Monostroma	High water	Taylor,
	Rhizoclonium	mark on red and black mangrove	1960
	Bostrychia	Just below high	"
	Catenella	water mark on red	"
	Caloglossa	prop roots	"
	Acanthorphora	Submerged on	Almodovar
	Caulerpa	red prop roots	and Biebl
	Hypnea	"	1962
	Laurencia	"	"
	Spyrida	"	"
	Valonia	"	"
	Wrangelia	"	"
	Centroceras	"	"
	Dasya	"	Taylor,
	Dictyota	"	1960
	Halimeda	"	"
	Murrayella	"	"
	Polysiphonia	"	"
	Wurdemaniia	"	"
	Boodleopsis	Mud near roots	Taylor, 1960
	Cladophoropsis	"	"
	Enteromorpha	"	"
	Vaucheria	"	"
PHYTOPLANKTON			
	Chaetocerus	Water column	Mattox,
	Thalassothrix	"	1949
	Nitzschia	"	Wood, 1965
	Skeletonema	"	Walsh, 1965
	Rhizosolenis	"	Bacon, 1970

Disploneis	Benthic	Wood, 1965
Mastogloia	sediments	"
Pluerosigma	"	"
Peridinium	Water column	Odum et al., 1982
Gymnodinium	"	"

(From Odum et al., 1982)

Faunal components of the mangrove community are as diverse as the floral counterpart. This community provides food, cover, spawning, nesting and resting habitat for many species of mammals, birds, reptiles, amphibians, fish and invertebrates. Many species are dependent upon this community during all of their life cycle. This interdependency may be critical for several endangered and threatened species that will be discussed in subsequent sections.

Animal life that graze directly upon arboreal leaf material include large numbers of insects including the olethrautid moth (Ecdytolopha sp.) and beetles (principally, Poecilips rhizophorae) (Onuf et al., 1977). Simberloff and Wilson (1969) list 200 species of insects that are associated with mangrove communities. The mangrove tree crab (Aratus pisonii) is also a primary consumer of mangrove leaves (Beever et al., 1979). Other invertebrate fauna of the emergent mangrove/saltmarsh include large numbers of gastropods. The snails (Littorina sp., Cerithidea sp. and Melampus sp.), isopods (Ligea spp.), and fiddler crabs (Uca spp.) are especially plentiful on the forest floor (Odum et al., 1982). These invertebrates are in turn a staple food for many species of birds.

The striking avifauna is often the most noticeable in the mangrove association. Many species depend upon the community for feeding, nesting and resting sites. Large wading birds, such as the egrets, ibis, spoonbill, herons and the open-water piscivorous birds, such as the osprey and pelican are especially dependent upon mangrove areas for both food sources and resting or nesting habitat. Others are only occasional or seasonal visitors. Odum et al., (1982) list 181 species that may be expected to use the mangrove community.

Other macrofauna that utilize mangroves include a number of terrestrial and aquatic reptiles, amphibians and mammals. Among the marine turtles, only the Atlantic loggerhead (Caretta caretta caretta) is relatively common in the preserve. This species may use mangroves as nursery areas (Odum et al., 1982). The Atlantic hawksbill (Eretmochelys imbricata) and the Atlantic green turtle (Chelonia mydas) are known to feed upon mangrove roots and leaves (Ernst and Barbour, 1972; Carr and Goin, 1955) and may occasionally frequent mangrove edges in the preserve area. The Atlantic

ridley (Lepidochelys kempii) is an occasional visitor to shallow coastal areas of south Florida (Carr and Goin, 1955). Green turtles were once plentiful in the Keys and were an important commercial fishery until populations were nearly extirpated from overharvesting and egg collecting. Current research is investigating the high incidence and cause of fibropapilloma in green sea turtles. These often debilitating tumors form primarily on soft tissues in grotesque clusters. Large growths can interfere with locomotion and feeding.

Other reptiles include several species of snakes and anoles, and the Mangrove terrapin. Of the snakes, only one, the mangrove water snake (Nerodia fasciata compressicauda) is entirely dependent upon mangrove areas. The others are transitory in habit and may utilize a variety of environments.

Amphibians are generally not well represented due to the shortage of freshwater areas that are usually necessary for reproduction. Those listed are suitably adapted to reproducing during the brief rainy period and may utilize brackish water pools for this purpose. The giant toad (Bufo marinus) and the Cuban treefrog (Hyla septentrionalis) are introduced species that have expanded their ranges considerably in the last several decades (King and Krakauer, 1966; King and Krakauer, 1968; and Krakauer, 1970).

The more common mammals of the mangrove include the Virginia opossum (Didelphis virginiana) and the Raccoon (Procyon lotor). The opossum is generally confined to small populations in close proximity to human habitations on the adjacent inhabited Upper and Lower Matecumbe Keys. Recent signs of range expansion in other areas of the Keys may also be duplicated on islands in the preserve. The raccoon is now reported on Shell Key where it may present an imminent threat to the future of the wading bird nesting colony on the island (Wells, personal communication, 1990). The marsupial and the raccoon are extremely versatile omnivores and are known to forage in mangrove habitats (Layne, 1974).

The marsh rabbit (Sylvilagus palustis paludicola) and several rodents, both naturally occurring and introduced species may also frequent mangrove areas.

The Eastern white-tailed deer (Odocoileus virginianus) was introduced on Lignumvitae Key and still persists. Signs of the deer have been observed in the mangrove saltmarsh areas and it is believed that there are 3 deer still on the island (P. Wells, pers. comm. 1990). The deer use a variety of habitats and the mangrove fringe offers excellent cover for foraging.

The marine life of the mangrove association is by far the most diverse group of organisms in this association. Detritus and plankton are primary food sources for a large number of

invertebrate fauna that attach themselves to prop roots, live in adjacent muds, or swim in the water. Courtney (1975), Tabb et al., (1962), and Odum and Heald (1972) reported extensive lists of invertebrates that are associated with mangroves.

The prop root complex is also important to many species of fish. Ample food and close proximity to cover that offers protection from predators is essential for large numbers of juvenile and adult fish. Many complete their life cycle within the mangrove community. Others are dependent upon mangroves during juvenile stages and migrate to grassbeds and/or coral reefs when mature. Still others are opportunistic vagabonds that utilize a variety of habitats and may be only seasonally or locally abundant. The proximity of other habitat types greatly increases the overlap of species from the other communities.

Many species of invertebrates and fishes that utilize the mangrove are important to the region's recreational and commercial fisheries. Important species of commercial fisheries include; pink shrimp (Penaeus duorarum), stone crab (Menippe mercenaria), spiny lobster (Panulirus argus), jacks (family Caranigadae), grunts (family Pomadasyidae), grouper (Epinepelus spp.), seabass (family Serranidae), snapper (Lutjanus spp.), mullet (family Mugilidae), red drum (Sciaenops ocellata), ladyfish (Elops saurus), spotted sea trout (Cynoscion nebulsus), and menhaden (Brevoortia patronus). Jewfish (Epinepelus itajara) were once important to local fisheries but overharvesting and poorly understood reproductive potential have required protected status for this species.

The above species represent a major portion of the annual seafood landings in Monroe County and are an integral part of the local economy. Finfish from the above groups represented an estimated $ 5,541,086 of the landings value for the county in 1989. Shrimp, spiny lobster and stone crabs represented an estimated $ 30,454,687 of the total value of all species taken. Total landings for all species represented approximately 38 million dollars to the local economy (FDNR, 1989). These figures reflect commercial dockside landing prices and do not include income derived from local support facilities (fuel, repair, dockage, tackle, etc.). Table 3 provides commercial data for finfish, crustaceans and sponges landed at local docks in 1989.

Many of the commercial species are also important to local recreational fisherman. Additionally, tarpon (Megalops atlantica), snook (Centropomus undecimalis), barracuda (Sphyraena barracuda) and bonefish (Albula vulpes) are avidly pursued by local enthusiasts as well as thousands of annual visitors. Unfortunately, statistics are not currently available for recreational landings and income. Although the

pounds landed would not approach the commercial statistics, conservative estimates would indicate that local income from hook and line enthusiasts is probably in excess of 50 million dollars a year. Once again, the total value of support services cannot be separated from local income statistics.

The statistics themselves do not and cannot reflect the many values of this important resource. They cannot, for example, assign a dollar figure to the aesthetic and ecological values associated with mangrove habitats. Nor can they relate the cost or efficiency of the intricate transfer of energy from one organism to the other. They can, however, provide some rudimentary knowledge of the importance of this habitat to the many species that enrich our culinary pleasure and our local economy. They also reaffirm man's close association with and dependency on the vital marine food web that emanates from mangrove and saltmarsh estuaries.

TABLE 3

MONROE COUNTY 1989 FISHERIES LANDINGS

Category	Pounds	Estimated Value ($) *
Finfish	8,148,656	5,541,086
Stone crabs	1,617,860	8,202,550
Spiny lobster	5,535,309	16,827,339
Pink shrimp	2,885,531	5,424,798
Bait shrimp	45,051	158,129
Sponges	298,550	5,424,798
Totals	18,530,957	37,739,202

* Values are estimated using the average price per pound paid statewide.

FDNR/Marine Fisheries Information Service (1989)

Table 4 includes a partial list of the major invertebrate groups and the vertebrate fauna of the mangrove association. For additional information on specific species, the reader is directed to the noted references. Odum et al. (1982) provide comprehensive lists of habitat types and diet preferences for fish and birds from published literature.

TABLE 4

PARTIAL LIST OF THE MANGROVE FAUNA

INVERTEBRATES

Zooplankton
This extensive group includes single-celled protozoans and the larvae and eggs of the invertebrates and fish listed below.

Jellyfish (Scyphozoa)	
Upside-down jellyfish	*Cassiopeia xamachana*
Marine worms (Annelida)	
	Armandia agilis
	Cirratulus sp.
	Lumbrineries maculata
Mollusks	
Blackhorn snail	*Batillaria minima*
Ladderhorn snail	*Cerithidea scalariformis*
Periwinkle	*Littorina* spp.
Saltmarsh snail	*Melampus coffeus*
Bleeding tooth	*Nerita* spp.
Predatory snail	*Pisania tincta*
Crustaceans (may comprise 70% of zooplankton)	
Barnacle	*Chthamalus stellatus*
	Lithortrya dorsalis
Copepod	*Acartia* spp.
Searoach	*Ligia* spp.
Wood borer	*Sphaerom terebans*
Pistol shrimp	*Alpheus* spp.
Pink shrimp	*Penaeus duorarum*
Shore shrimp	*Palaemonetes* spp.
Cleaning shrimp	*Periclimenes* spp.
Shrimp	*Synalpheus fritzmuelleri*
Spiny Lobster	*Panulirus argus*
Hermit crab	*Pagurus* spp.
Hermit crab	*Clibanarius* sp.
Blue crab	*Callinectes sapidus*
Crab	*Cyclograpsus* sp.
Shore crab	*Pachygrapsus* spp.
Mangrove tree crab	*Aratus pisonni*
Marsh crab	*Sesarma* sp.
Fiddler crab	*Uca* spp.
Stone crab	*Menippe mercenaria*
Holothurians	
Sea cucumber	*Holothuria floridana*

(References: Odum et al., 1982)
See Simberloff, 1976; Simberloff and Wilson, 1969 for comprehensive list of insects

VERTEBRATES

Fishes

Nurse shark	Ginglymostoma curratum	
Blacktip shark	Carcharhinus limbatus	*
Lemon shark	Negaprion brevirostris	
Bonnethead	Sphyrna tiburo	
Smalltooth sawfish	Pristis pectinata	
Guitarfish	Rhinobatos letiginosus	
Lesser electric ray	Narcine brasiliensis	
Southern stingray	Dasyatis american	
Yellow ray	Urolophus jamaicensis	
Spotted eagle ray	Aetobatus narinari	
Ladyfish	Elops saurus	
Tarpon	Megalops atlantica	*
Bonefish	Albula vulpes	*
Scaled sardine	Harengula pensacolae	
Atlantic thread herring	Opisthonema oglinum	
Bigeye anchovy	Anchoa lamprotaenia	
Bay anchovy	Anchoa mitchilli	
Inshore lizardfish	Synodus foetens	
Sea catfish	Aruis felis	
Gulf toadfish	Opsanus beta	
Skilletfish	Gobiesox strumosus	
Shortnose batfish	Ogcocephalus nasutus	
Key brotula	Ogilbia cayorum	
Halfbeak	Hyporhamphus unifasciatus	
Redfin needle fish	Strongylura notata	
Timucu	Strongylura timucu	
Houndfish	Tylosurus crocodulus	
Sheepshead minnow	Cyprinodon variegatus	
Rainwater killifish	Lucania parva	
Rivulus	Rivulus marmoratus	
Mosquitofish	Gambusia affinis	
Mangrove mosquitofish	Bamvusia rhizophorae	
Sailfin molly	Poecilia latipinna	
Reef silverside	Allanetta harringtonensis	
Rough silverside	Membras marinica	
Tidewater siverside	Menidia beryllina	
Lined seahorse	Hippocampus erectus	
Dwarf seahorse	Hippocampus zosterae	
Pipefish	Syngnathys spp.	
Snook	Centorpomus undecimalis	*
Black seabass	Centropristis striata	*
Sand perch	Diplectrum formosum	
Jewfish	Epinephelus itajara	
Red grouper	Epinephelus morio	*
Nassua grouper	Epinephelus Striatus	*
Barred hamlet	Hypolectrus puella	
Gag	Mycteroperca microlepis	*
Bronze cardinalfish	Astrapogon alutus	
Conchfish	Astrapogon stellatus	

Bluefish	Pomatomus saltatrix	*
Cobia	Rachycentron canadum	*
Whitefin sharksucker	Echeneis neucratoides	
Blue runner	Caranx crysos	*
Jack crevalle	Caranx hippos	*
Bar jack	Caranx ruber	
Atlantic bumper	Chloroscombrus chrysurus	
Leatherjacket	Oligoplites saurus	
Florida pompano	Trachinotus carolinus	*
Permit	Trachinotus falcatus	*
Lookdown	Selene vomer	
Mutton snapper	Lutjanus apodus	*
Schoolmaster	Lutjanus apodus	*
Gray snapper	Lutjanus griseus	*
Dog snapper	Lutjanus jocu	
Lane snapper	Lutjanus synagris	*
Striped mojarra	Diapterus plumieri	
Mojarras	Eucinostomus spp.	
Grunts	Haemulon spp.	*
Pigfish	Orthopristis chrysoptera	
Sheepshead	Archosargus probatocephlus	*
Sea bream	Archosargus rhomboidalis	
Grass porgy	Calamus arctifrons	
Saucereye porgy	Calamus calamus	*
Pinfish	Lagadon rhomboides	*
Blue croaker	Bairdiella batabana	
Silver perch	Bairdiella chrysura	
Spotted seatrout	Cynoscion nebulosus	*
Southern kingfish	Menticirrhus americanus	*
Gulf kingfish	Menticirrhus littoralis	*
Atlantic croaker	Micropogon undulatus	*
Black drum	Pogonias cromis	
Red drum	Sciaenops ocellata	*
High hat	Equetus acuminatus	
Atlantic spadefish	Chaetodipterus faber	
Sergeant major	Abudefduf saxatillis	
Slippery dick	Halichoeres bivittatus	
Parrotfishes	Sparisoma spp.	
Mullet	Mugil spp.	*
Great barracuda	Sphyraena barracuda	*
Mottled jawfish	Opistognathus maxillosus	
Bluethroat pikeblenny	Chaenopsis ocellata	
Marbled blenny	Paraclinus marmoratus	
Banded blenny	Paraclinus fasciatus	
Blackbelly blenny	Stathmonotus hemphilli	
Florida blenny	Chasmodes saburrae	
Seaweed blenny	Blennuis marmoreus	
Spotted dragonet	Callionymus pauciradiatus	
Gobys	Gobionellus spp.	
	Gobiosoma spp.	
	Lophogogius sp.	
	Microgobius spp.	
Spanish Mackerel	Scomberomorus maculatus	*

King Mackerel	Scomeromorus cavalla	*
Barfish	Scorpaena brasiliensis	
Plumed scorpionfish	Scorpaena grandicornis	
Searobins	Prionotus spp.	
Eyed flounder	Bothus ocellatus	
Spotted whiff	Citharichthys macrops	
Fringed flounder	Etropus crossotus	
Gulf flounder	Paralichthys albigutta	
Southern flounder	Paralichthys lethostigma	
Dusky flounder	Syacium papillosum	
Lined sole	Achirus lineatus	
Scrawled sole	Trinectes inscriptus	
Hogchoker	Trinectes maculatus	
Blackcheek tonguefish	Symphurus plagiusa	
Orange filefish	Aluterus schoepfi	
Fringed filefish	Monacanthus ciliatus	
Planehead filefish	Monacanthus hispidus	
Gray triggerfish	Balistes capriscus	
Queen triggerfish	Balistes vetula	
Scrawled cowfish	Lactophrys quadracornis	
Trunkfish	Lactophrys trigueter	
Puffers	Sphoeroides spp.	
Burrfish	Chilomycterus spp.	

(List modified from Odum et al., 1982)
* = Locally important species of commercial, sport and bait fisheries.

Amphibians and Reptiles

Giant toad	Bufo marinus
Southern toad	Bufo terrestris
Treefrog	Hyla squirella
Cuban treefrog	Hyla septentrionalis
Mangrove terrapin	Malaclemys terrepin rhizophorarum
Keys mud turtle	Kinosternon baurii baurii
Atlantic loggerhead	Caretta caretta caretta
Atlantic green turtle	Chelonia mydas mydas
Atlantic hawksbill	Eretmochelys imbricata imbricata
Atlantic ridley	Lepidochelys kempii
American anole	Anolis carolinensis
Cuban anole	Anolis sagrei
Southern black racer	Columber constrictor
Red ratsnake	Elaphe guttata guttata
Mangrove water snake	Nerodia fasciata compressicauda
Rough green snake	Opheodrys aestivus carinatus

(References: Carr and Goin, 1955; Duellman and Schwartz, 1958; Ernst and Barbour, 1972; Paulson, 1968; Lazell, 1989)

Birds

Great egret	Casmerodius albus
Snowy egret	Egretta thula
Cattle egret	Bubulcus ibis
Great white heron	Ardea herodia occidentalis
Great blue heron	Ardea herodias
Little blue heron	Egretta caerulea
Reddish egret	Egretta rufescens
Louisiana heron	Egretta tricolor
Green heron	Butorides striatus
Black-crowned night heron	Nycticorax nycticorax
Yellow-crowned night heron	Nyctanassa violacea
White ibis	Eudocimus albus
Roseate spoonbill	Ajaia ajaja
Semiplamated plover	Charadrius semipalmatus
Black-bellied plover	Pluvialis squatarola
Ruddy turnstone	Arenaria interpres
Spotted sandpiper	Actitis macularia
Solitary sandpiper	Tringa solitaria
Greater yellowlegs	Tringa melanoleucas
Lesser yellowlegs	Tringa flavipes
Dunlin	Calidris alpina
Western sandpiper	Calidris mauri
Least sandpiper	Calidris minutilla
Semipalmated sandpiper	Calidris pusilla
Short-billed dowitcher	Limnodromus griseus
Black-necked stilt	Himantopus mexicanus
Brown pelican	Pelecanus occidentalis
Double-crested cormorant	Phalacrocorax auritus
Mallard	Anas platyrhynchos
Blue-winged teal	Anas crecca carolinensis
Red-breasted merganser	Mergus serrator
Herring gull	Larus argentatus
Laughing gull	Larus atricilla
Ring-billed gull	Larus delawarensis
Least tern	Sterna albifrons
Royal tern	Sterna maxima
Belted kingfisher	Megaceryle alcyon
Magnificent frigatebird	Fregata magnificens
Red-shouldered hawk	Buteo lineatus
Osprey	Pandion haliaetus
American kestrel	Falco sparverius
White-crowned pigeon	Columba leucocephala
Mangrove cuckoo	Coccyzus minor
Red-bellied woodpecker	Melanerpes carolinus
Gray kingbird	Tyrannus domincensis
Great crested flycatcher	Myriarchus crinitus
Eastern phoebe	Sayornis phoebe
Mockingbird	Mimus polyglottos
Catbird	Dumetella carolinensis
Brown thrasher	Toxostoma rufum
White-eyed vireo	Vireo griseus
Black-whiskered vireo	Vireo altiloguus

Red-eyed vireo	Vireo olivaceus
Black-and-white-warbler	Mniotilta varia
Yellow-throated warbler	Dendroica dominica
Yellow warbler	Dendroica petechia
Yellow-rumped warbler	Dendroica coronata
Prairie warbler	Dendroica discolor
Palm warbler	Dendroica palmarum
Yellowthroat	Geothlypus trichas
American redstart	Setophaga ruticilla
Northern parula	Parula americana
Red-winged blackbird	Agelajus phoeniceus
Boat-tailed grackle	Quiscalus major
Cardinal	Cardinalis cardinalis

(References: Robertson and Kushlan, 1974; Sprunt, 1954; Bent, 1932)

Mammals

Virginia opossum	Didelphis virginiana
Raccoon	Procyon lotor
White-tailed deer	Odocoileus virginianus
Marsh rabbit	Sylvilagus palustris paludicola
Key cotton rat	Sigmodon hispidus exsputus
Black rat	Rattus rattus
Key Largo woodrat	Neotoma floridana smalli
Key Largo cottonmouse	Peromyscus gossypinus allapaticola

(References: Layne, 1974; Humphrey and Barbour, 1979; Spitzer and Lazell, 1978; Lazell, 1984)

2. Marine Grassbeds

Marine grassbeds are the most important feature in the aquatic resources of the preserve. Seagrasses stabilize sediments, baffle wave energy, cycle nutrients, and provide substrate for a complex floral and faunal community. Abundant food and cover make this an important resource for invertebrates and a nursery area for many fish species. However, biological productivity is not limited to the area of distribution. Marine energy cycling is enhanced as detrital material and nursery species are dispersed to other areas. Species from geographically and physiologically isolated habitats, such as, the patch reef and the mangrove communities also forage in the seagrass community. Thus marine grassbeds function as an interface between other communities and enrich the ecological diversity and productivity of all marine systems.

Dominant marine grasses in the preserve are turtle grass (Thalassia testudium), Manatee grass (Syringodium filiforme), and Cuban shoalweed (Halodule wrightii). Shoalweed is

typically a pioneer species that colonizes disturbed sites and areas where water depth (too shallow or too deep) or substrate is less favorable for turtle grass. Turtle grass is a climax species (Phillips, 1960), and as such is usually considered to be the primary producer in this community. Turtle grass meadows are most expansive where sediments are deepest over the bedrock. Manatee grass and several species of Halophila may also be present within the turtle grass beds.

Seagrasses are flowering plants that have evolved to a totally aquatic existence. They have adapted physiological and chemical mechanisms that facilitate photosynthesis, growth, maintenance and reproduction while completely submerged. Unlike their terrestrial counterparts seagrasses lack stomata on the leaf surfaces, thus gases are slowly diffused through the leaf tissue. Oxygen is stored in interstitial cell spaces and passed to root structures and rhizomes when needed. Stored gases provide buoyancy to the leaf blade, keeping it vertical to the substrate and allowing a much larger surface area to be exposed to solar radiation. (Zieman and Wetzel, 1980). The release of gaseous bubbles from leaf surfaces is often the source of the faint popping sounds heard when grass flats are exposed at low tide.

Certain plant nutrients are derived from the sediments, while others are taken from the water column. Nitrogen fixation can occur in the rhizomes, on the leaf surface and in some cases may be transferred between the leaf surface and epiphytes on the leaf (Harlin, 1971). Nitrogen and carbons are also derived from the particulate organic matter from dead plant material and animal excretion. This highly efficient use of relatively limited nutrients and sunlight are the basis for a level of productivity often compared to the coral reefs and mangroves.

The study of seagrass reproduction has evolved primarily as a means to restore or mitigate those areas that have been adversely impacted by man's activities or natural disturbances. Marine grasses may reproduce both sexually and vegetatively. Vegetative reproduction originates from the root or rhizome of the plant. Vegetative starts (plug or turion) are usually preferred for transplanting as they become established more quickly and survive longer. However, relative cost of this type of restoration may be prohibitive for large areas. Cost ranged from $27,000 to 86,500/ha to revegetate one area in the Upper Keys (Lewis et al., 1981). This technique has also caused much controversy, as many scientists and environmentalists have questioned the possibly negative impacts to donor (source) areas. Donor areas are slow to recolonize and large scale removal may cause a more serious disturbance than it is intended to remedy.

Sexual reproduction in marine grasses is less clearly understood. Orpurt and Boral (1964) observed flowering turtle grass in the Keys during April and fruiting until September. Seed production and seedling survival, however, may vary considerably from year to year. Lewis and Phillips (1980) while monitoring a revegetation project near Craig Key, reported a "prodigious" seed crop in the intertidal area of Lower Matecumbe Key during 1979. Previous observations by Moffler (from Lewis and Phillips, 1980) indicated little fruiting occurred in 1975 and Phillips reported large numbers of seedlings in the same area in 1960. Periods of high seed production certainly offer the opportunity to harvest and propagate seedlings for revegetation of disturbed areas but cost may again be prohibitive. Thorhaug and Austin (1976) reported costs of $42,000-$280,000/ha (depending on desired plant cover) for collection, propagation, planting and overhead for restoration efforts. Survival rates for transplanted seedlings are also very low, less than 30% (Zieman, 1982).

Marine grassbed distribution is influenced by physical and chemical factors similar to those described for mangroves. Temperatures and salinities are usually well within the tolerance limits of the species listed. Optimum temperatures (68-86 degrees F) and salinities (24 ppt to 35 ppt) for turtle grass (Phillips, 1960), occur throughout the aquatic preserve waters.

The three most important parameters determining grassbed distribution in the preserve are photic zone access, current velocity, and substrate. Like their emergent counterparts, marine plants must have access to sunlight to carry on the photosynthetic process. Unlike terrestrial plants, the water column lies between the source and recipient. Water depth and clarity affect the amount of sunlight that reaches the leaf surface. Shading from docks and bridges and turbidity in the water column inhibit photic zone access. Propeller (prop) wash or dredging is also a source of excessive turbidity. Prop dredging is usually localized and not normally of a duration or intensity to cause extensive light reduction but has other more severe consequences that will be discussed later.

Current velocities in larger channels continually erode and redeposit sediments at sporadic intervals and may scour sediments to bedrock in some locations. These dynamic processes are not conducive to seagrass colonization. Prop wash or prop dredging in shallow channels or 'wheel channels or ditches' may also inhibit seagrasses even when sediment depths are adequate for colonization.

Turtle grass requires sediment depths from 3 inches (Scoffin, 1970) to 20 inches (Zieman, 1972) for optimum growth. These conditions are exemplified in the expansive tidal banks or

'flats' in the preserve. Estimated depths for these sand/mud banks are from several inches to more than 5 feet in areas adjacent to the channels and dredged areas. Shallow depressions in typically hardbottom communities and shallow channels also support lush colonies of turtle grass (Unpublished field notes, 1985).

In addition to the previously noted marine grasses, several species of algae are also commonly found in this community. Benthic algae include Halimeda, Penicillus, Caulerpa, Rhipocephalus, and Udotea species. These calcareous algae are instrumental in producing organic carbons and calcium carbonate that are incorporated into the sediments (Zieman, 1982). Benthic algae are also early colonizers of fine sediments and their rhizoid holdfasts may stabilize these sediments so that seagrasses may become established on otherwise unoccupied areas (Williams, 1981). Drift algae, primarily Laurencia, is also a common component of the grassbeds.

Seagrass leaves provide substrate for a wide range of epiphytic algae. Some 66 species have been recorded to utilize seagrasses for attachment (Ballantine and Humm, 1975). While access to the photic zone is enhanced by this arrangement, the encrusting of the leaf surface may effectively reduce photosynthesis in the host plant (Sand-Jensen, 1977). The overall loss of photosynthetic production may be off-set by the increased habitat for marine fauna and a corresponding increase in animal and plant protein.

The faunal constituents of the marine grassbeds range from the microscopic zooplankton that drift with the currents, epiphytic biota that live upon the grasses and the pelagic invertebrates, fishes and mammals that utilize these areas. Trophic structure presents ample food for a variety of specialized feeders. Herbivores that feed directly upon the algae or seagrasses include a wide variety of invertebrates. Most notable are the crabs, queen conch, and sea urchins. Vertebrate herbivores include the green, loggerhead, and hawksbill turtles, and a wide variety of fishes. Zieman (1982) lists 63 species that utilize seagrass in their diet. Many of these species also consume varying amounts of detritus and epifauna as they forage.

Detrital feeders make up a large percentage of the grassbed fauna and may well represent the primary pathway of energy transfer to higher tropic levels (Zieman, 1982). This group is composed of many small organisms that feed upon the decomposing plant and animal material in the vicinity of the grassbeds. Corals, sponges, tube worms and shrimp filter detritus and plankton from the water column. Others glean material from the sediments and leaf surfaces. Exported detritus becomes available to an even wider range of consumers

in more remote areas. Carr and Adams (1973) found detrital feeders to be a major food source for at least one feeding stage in 15 of 21 juvenile marine fishes studied. Commercially important detrital feeders include the pink shrimp (Penaeua duorarum), spiny lobster (Panulirus argus), and mullet (Mugil curema).

Higher order consumers include the myriads of fishes usually associated with grassbeds, as well as many that are more commonly associated with coral reefs and mangrove areas. Some spend early development stages in the shelter of the sea grasses and move to other habitats when mature. Still others, by alternating periods of diurnal and nocturnal activity, may utilize grassbeds for foraging at night and seek shelter in mangroves or coral reefs during the day. This partitioning of time and resources serves to eliminate competition between similar species and affords a much greater number of niches in the ecological structure of the community. Fishes of recreational and commercial interest include most of those from the annotated list for the mangroves in Table 4.

Marine grassbeds are heavily utilized by several bird species. The abundant marine fauna of this community are the staple food for most of these birds (Kushlan, 1978). Heron, egrets, and spoonbills exploit fish, crustaceans and other marine organisms in shallow water grassbeds and upon exposed grass flats during low tides. Open water piscivorous birds include the cormorant, osprey, pelican, and gulls.

Mammals that utilize marine grassbeds include the manatee and the bottle-nosed dolphin. The manatee, although not formerly recorded as a resident species in the preserve, may well frequent the area on occasion and is well known for its predilection for aquatic plant life. It is assumed that the abundant seagrasses would provide a welcome repast for this nomad. Bottle-nosed dolphin are occasional visitors of the aquatic preserve and undoubtedly take quantities of schooling fish as opportunity permits. Consult Table 5 for a list of animal species commonly associated with the marine grassbed community.

Major impacts to the marine grassbed community in Lignumvitae Key Aquatic Preserve are associated with human activities. Direct removal of grassbeds by prop scouring and dredging are most noticeable. Although the single prop scar may be comparatively insignificant, the cumulative impact from repeated scaring, which is evident on the tidal banks is of eminent concern. Zieman (1976) estimated recovery for these areas may take from 2-5 years and the natural recovery process may be further inhibited by rechanneling and increased erosion.

Dredging (and the spoiling of material) permanently eliminates grassbeds in most cases. The U.S. 1 roadway in the preserve was constructed with dredged fill. It is anticipated that future repairs and improvements will potentially affect adjacent grassbeds. These activities are integral to the safety and welfare of the general public and thus must be considered in the public interest.

Docks interrupt light penetration and "shade out" vegetation. Since submerged lands of the preserve do not abut private riparian lands, docks are not a major impact to resources of the preserve. The existing docks at Lignumvitae Key and Indian Key Fill are to facilitate access to public lands.

The effects of septic effluent and upland run-off in marine communities is often difficult to detect given the highly variable physical and chemical parameters of both the effluent and the community being studied. But recent and future technological improvements and additional research (and monitoring) may well scientifically validate the general assumption that all nearshore environments are subjected to measurable amounts of pollution from these sources when in close proximity to poorly planned development. Remedial and corrective actions will be time consuming and will require coordination with the appropriate agencies to insure that continued urbanization does not undermine the functional integrity of marine resources.

The value of marine grassbeds cannot be evaluated by any monetary formula presently available. In the opening paragraphs of this section, the comparatively high cost (and relatively low success) of restoring or mitigating damaged grassbeds were discussed. Further research and experimentation are to be encouraged in hopes of discovering more successful and cost efficient methods of replanting and encouraging expansion of marine grassbeds. However, the preferable alternative to costly and often futile restoration is to protect this dynamic and productive resource from further damage. To achieve that goal, preservation and protection of marine grassbed communities shall be a priority in the designation of management areas and the management procedure and policies in Chapters IV and V of this plan.

TABLE 5

A PARTIAL LIST OF MARINE GRASSBED FAUNA

INVERTEBRATES

Corals	
Golfball coral	*Favia fragum*
Rose coral	*Manicinia areolata*

Small finger coral	Porites furcata
Sponges	
Variable sponge	Anthosigmella varians
Chicken liver sponge	Chondrilla nucula
	Chondrosia collectrix
Boring sponges	Cliona spp.
Vase sponges	Ircinia campana
	Ircinia fasciculata
	Ircinia strobilina
Loggerhead sponge	Spheciospongia vesparium
Fire sponge	Tedania ignis
Anemones	
Pale anemone	Aiptasia pallida
Ringed anemone	Bartholomea annulata
Giant anemone	Condylactis gigantea
Sun anemone	Stoichactis helianthus
Annelids	
	Ammatrypane fimbriata
Lugworm	Arenicola cristata
	Eurythoe sp
Green bristle worm	Hermodice caruculata
	Eunice longicerrata
	Lysidice sp.
	Nereis sp.
	Phascolion sp.
Tube worm	Onuphis magna
	Sthenelais sp.
	Terebellides stroemi
Mollusks	
Gastropods	
	Anachis sp.
Sea slug	Aplysis dactylomela
	Astrea sp.
	Bittium varium
	Caecum sp.
	Cardita floridana
Cerith	Cerithium sp.
Slipper	Crepidula sp.
	Cymatum sp.
Tulip	Fasiolaria tulipa
	Mitrella lunata
	Modulus modulus
Horse conch	Pluroploca gigantea
	Rissoina sp.
Queen conch	Strombus gigas
	Tegula sp.
	Tridachia sp.
Caribbean vase	Vasum sp.

Pelecypods		
Cockle	Americardia sp.	
Arks	Anadara sp.	
Venus	Antigona sp.	
	Atrina sp.	
	Cardita floridana	
Barred venus	Chione cancellata	
Tiger lucine	Codakia orbicularis	
Cockle	Laevicarduim laevigatum	
Lucine	Lucina pennsylvanica	
Radiant tellin	Tellina radiata	
Amphipods		
	Cymadus compta	
	Gammarus mucronatus	
	Melita nitida	
	Grandidierella sp.	
Cephalopods		
	Octopus briareus	
Crustaceans		
Shrimp and lobster		
Snapping shrimp	Alpheus normanni	
	Hyppolyte pleuracantha	
	Latreutus focorum	
Shore shrimp	Palaemonetes spp.	
Spiny lobster	Penulirus argus	*
Pink shrimp	Penaeus duorarum	*
Cleaning shrimp	Periclimenes spp.	
	Thor floridanus	
	Tozeuma sp.	
Crabs		
Box crab	Calappa sp.	
Blue crabs	Callinectus sp.	
Stiped hermit crab	Clibanarius sp.	
Bar-eyed hermit crab	Dardanus sp.	
	Glyptoxanthus sp.	
Spider crab	Libinia sp.	
Decorator crab	Macrocoeloma sp.	
Spider crab	Microphrys sp.	
Spider crabs	Mithrax spp.	
Hermit crabs	Pagurus spp.	
Giant hermit crab	Petrochirus sp.	
	Pilumnus sp.	
Pitho crab	Pithos sp.	
Mantis shrimp		
False squilla	Pseudosquilla ciliata	
Echinoderms		
Starfish		
Thorny starfishes	Echinaster spp.	
Cushion starfish	Oreaster reticulata	

Sea urchins		
Long-spined black urchin	Diadema antillarium	
	Echinometria sp.	
Varigated urchin	Lytechinus variegatus	
Sea egg	Tripneustes ventricosus	
Sea biscuit	Clypeaster rosaceus	
Holothurians		
Sea cucumber	Actinopyga agassizi	
Florida sea cucumber	Holothura floridana	

(From Bock, 1971 and Zieman, 1982)
* = Species of commercial interest

VERTEBRATES

Fishes		
Nurse shark	Ginglymostoma curratum	
Lemon shark	Negeprion brevirostris	
Bonnethead	Sphyrna tiburo	
Smalltooth sawfish	Pristis pectinata	
Southern stingrayf	Dasyatis americana	
Ladyfish	Elops saurus	
Tarpon	Megalops atlantica	*
Bonefish	Albula vulpes	*
Scaled sardine	Harengula pensacolae	
Atlantic thread herring	Opisthonema oglinum	
Anchovies	Anchoa spp.	
Inshore lizardfish	Synodus foetens	
Sea catfish	Arius felis	
Gulf toadfish	Opsanus beta	
Skilletfish	Gobiesox strumosus	
Hardhead halfbeak	Chridorus atherinoides	
Needlefish	Hyporhamphus unfasciatus	
Goldspotted killifish	Flordichthys carpio	
Rainwater killifish	Lucania parva	
Sheepshead minnow	Cyprinodon variegatus	*
Rivulus	Rivulus marmoratus	
Sailfin molly	Poecilia latipinna	
Reef silverside	Allanetta harringonenesis	
Hardhead silverside	Atherinomorus stipes	
Dwarf seahorses	Hippocampus zosterae	
Dusky pipefish	Syngnathus floridae	
Fringed pipefish	Micrognathus crinigerus	
Snook	Centropomus undecimalis	*
Gag	Mycteroperca microlepis	
Jewfish	Epinephalus itajara	
Cobia	Rachycentron canadum	*
Jacks	Caranx spp.	*
Permit	Trachinotus falcatus	*
Florida pompano	Trachinotus carolinus	*

Leatherjacket	Oligoplites zaurus	
Lookdown	Selene vomer	
Snappers	Lutjanus spp.	*
Silver blenny	Eucinostomus gula	
Grunts	Haemulon spp.	*
Pigfish	orthopristis chrysoptera	
Porgies	Archosargus spp.	
Pinfish	Lagodon rhomboides	*
Red drum	Sciaenops ocellata	*
Silver perch	Bairdiella chrysura	
Spotted seatrout	Cynoscion nibulosu	*
Southern kingfish	Menticirrhus americanus	*
Atlantic spadefish	Chaetodipterus faber	
Sergeant major	Abudefduf saxatilis	
Slippery dick	Halichoeres bivittatus	
Hogfish	Lachnolaimus maximus	
Parrotfishes	Scarus spp.	
	Sparisoma spp.	
Mullet	Mugil spp.	*
Barracuda	Sphyraena barracuda	
Blennies	Paraclinus spp.	
	Chaenopsis spp.	
	Blennius sp.	
Dragonet	Callionymus parciradiatus	
Gobies	Bathygobius sp.	
	Gobiosoma spp.	
	Microgobius spp.	
Scorpionfishes	Scorpaena spp.	
Searobin	Prionotus spp.	
Lined sole	Achirus lineatus	
Tonguefish	Symphurus plagiusa	
Filefish	Monocanthus ciliatus	
Cowfish	Lactophrys quadricornis	
Trunkfish	Lactophrys trigonus	
Southern puffer	Sphoeroides nephalus	
Burfish	Chilomycterus schoepfi	

(Adapted from Zieman, 1982)
* = Important sport, commercial and bait species

Reptiles

Green sea turtle	Chelonia mydas
Loggerhead sea turtle	Caretta carretta carretta
American crocodile	Crocodylus acutus

Birds

Roseate spoonbill	Ajaja ajaja
Great blue heron	Ardea herrodias
Great white heron	Ardea occidentalis
Great egret	Casmerodius albus
Little blue heron	Florida caerulea

Reddish egret	Dichromanassa rufescens
Louisiana heron	Hydranassa tricolor
Bald eagle	Halieaeetus leucocephalus
Red-breasted merganser	Mergis serrator
Osprey	Pandion haliaetus
Brown pelican	Pelecanus occidentalis
Double-crested cormorant	Phalacrocorax auritus
Mammals	
Bottle-nosed dolphin	Tursiops truncatus
West Indian or Florida manatee	Trichechus manatus latirostris

(From Kushlan, 1976, 1978)

3. Hardbottom

This community association is referred to as live bottom (Jaap, 1984) or hard bottom (Voss, 1982; Marzalak et al., 1977; Marzalak, 1982: and others). It is generally included as a subcategory of the coral reef habitats, as described by these authors. Lignumvitae Key Aquatic Preserve does not encompass coral reef habitats but does exhibit suitable substrate and many of the species described by these authors, and thus will be treated as a separate community association within this plan and in the resource maps. Portions of the Atlantic sea floor, channel bottoms and lagoonal basin are representative of this community association. Artificial hardbottom substrate is also provided by rock rubble and concrete associated with the bridges and abutments of U.S. 1. Marine grassbeds, sand, and mud bars are usually intermixed with the naturally occurring hard bottom communities. Distribution of macrofauna is generally scattered in random patterns and is never as compact or diverse as are grassbeds or coral reefs. Never the less, this community association supports a diverse invertebrate and vertebrate fauna and is a valuable nursery area for many sport and commercial fish species (Jaap, 1984).

The flora and fauna of this association are highly variable and may contain species of the patch reef, mangrove and seagrass associations but species composition is usually dominated by algae and invertebrate species such as soft corals, sponges, and small stony corals. The algal species are well represented by the calcareous greens, Acetabularia, Batophora, Halimeda, and Udotea spp. These species are instrumental in binding sediments and the formation of calcareous sands that are the byproducts of their skeletal remains. They are also a food source for herbivorous fish and invertebrates. The brown Sargassum supports a relatively

complex microcommunity within it's delicate leaves and nodules.

The soft corals (octocorals or gorgonians), such as sea whips (Pterogorgia spp.), sea fan Gorgonia ventalina), sea rods (Plexaura spp.), and the sea plumes (Pseudopterogorgia spp.) are more common in the Atlantic portion of the preserve. Stony corals found in the live bottom communities include clubbed finger coral (Porites porites), porous coral (P. asteroides), starlet coral (Siderastrea radians), rose coral (Manicina areolata), lobed star coral (Solenastrea hyades), and smooth star coral (S. bournoni). These species vary from a few inches to a foot in height. Colonies of finger corals may cover several square meters in the clear, shallow waters near protected banks.

The sponges are well represented in the hardbottom community. Dominance of this group in areas of the lagoonal basin is typical where sediments are thin or basement rock is exposed. The delicate holdfast is attached to the bare rock. The most prevalent species are the chicken liver sponge (Chondrilla nucula), vase sponge (Ircinia campana), cake sponge (I. etherea), stinking sponge (I. felix), the little blue heavenly sponge (Dysidea etherea), the large loggerhead sponge (Spheciospongia vesparia), and the tube sponges (Aplysina cauliformis and Callispongia spp.). Both sponges and octocorals are host or prey to a wide variety of organisms that live on or in their framework. Both groups glean sustenance from the surrounding water and in doing so act as filtering mechanisms to remove minute particles and nutrients from the water.

Lesser numbers of the sheepswool (Hippiospongia lachne), yellow sponge (Spongia barbara), and keys grass sponge (Spongia graminea) are found mixed in both hardbottom and marine grassbeds. Sparse numbers of these once common sponges may be due to harvesting pressure. There were 298,550 pounds of sponges harvested in Monroe County in 1989 (FDNR, 1989). This represents an increase of 275,533 pounds over 1984 figures (NMFS/SEFC, 1986).

Motile fauna of the hardbottom include many invertebrates and fishes of mangrove and seagrass communities. This area provides microhabitats for many juvenile fishes as well as infaunal organisms that tunnel the shallow sediments. Marine turtles are also quite frequently observed feeding or resting in these areas. The hawksbill turtle is especially fond of sponges which may comprise as much as 95 percent of it's diet (Meylan, 1988).

The reader is referred to previous sections on mangroves and marine grassbeds for additional information and species lists.

H. DESIGNATED SPECIES

The many resource types within the preserve support a rich and varied population of plants and animals. Previous sections have enumerated the many material and aesthetic values accrued to man in conserving and protecting these resources. This section will discuss the often critical importance of these resources to other species of plants and animals that are endangered or threatened with extinction throughout part or all of their geographic range. In most cases, their endangerment is the direct result of man's exploitation of the natural resources of an area. Excessive harvesting, collecting, landclearing, construction, dredging, treasure salvage, ditching, the use of pesticides, and the introduction of exotic plants and animals have contributed to the decline of many of these species and will continue to stress recovery capabilities for most of them.

It shall be a major objective of this plan's management policy to identify, map, and protect the endangered and threatened species habitat within the preserve boundary and provide input in decisions that would affect known habitat of these species on adjacent lands and in marine areas. To the maximum extent possible (where biologically and economically feasible), disturbed habitats will be restored to benefit endangered and threatened species. Educational programs for the general public, organizations, and governmental agencies shall be prepared and disseminated in hopes of informing and enlisting support for the conservation and protection of vital habitats.

The small islands in and adjacent to the preserve are host to a large number of endangered and threatened plant species. Most are tropical species of West Indies origin. A preponderance of the listed species occur within the mangrove, saltmarsh and tropical hardwood hammock communities. The numbers and degree of endangerment may well reflect the stress imposed by development on Upper and Lower Matecumbe Keys, as well as other areas of the Keys. Equally devastating pressure is exerted by plant collectors and poachers whose primary objectives are the epiphytic orchids (Encyclia spp.), air plants (Tillandsia spp.), cacti (Cereus spp., Opuntia spp.), and palms (Thrinax spp.). Entire areas may be stripped of these plants. Displacement by exotic (introduced) plants is also a problem where soils have been disturbed.

The often maligned manchineel (Hippomane mancinella), a threatened species, has been totally eliminated from much of its former range in the Upper Keys. The often exaggerated toxic properties of this once abundant tree were reason enough to exclude it from inhabited areas. Several specimens still survive in the more remote wetland areas of Upper Matecumbe Key. Other less threatening or less conspicuous plants include

the endangered geiger tree (Cordia sebestena), wild cotton (Gossypium hirsutum), and bay cedar (Suriana maritima).

Endangered and threatened hardwood hammock species, or small colonies of these species are generally dispersed randomly throughout a hammock. This 'clumping' is often overlooked by those who clear land for development. This practice may eliminate an individual or an entire colony of an already limited species. The endangered Lignumvitae trees (Guaiacum sanctum), for which the island and preserve were named, have all but disappeared in the wild on the Upper Keys.

(The reader is referred to the Florida Park Service at Lignumvitae Key State Botanical site for additional information on tropical hardwood hammock species.)

Table 6 provides a partial species list of plants considered to be endangered or threatened by 1) Florida Department of Agriculture and Consumer Services, the official State list (Preservation of Native Flora of Florida Act, Florida Statutes, Section 581.185, 1978); 2) rare (R), endangered (E), threatened (T), and species of special concern (SSC) from the Florida Committee on Rare and Endangered Plants and Animals (FCREPA) list: and 3) Rare and Endangered Biota of Florida series (P.C.H. Pritchard, ed.). The U.S. Fish and Wildlife Service is currently reviewing several of these plants for federal listing.

The plant communities within and adjacent to the preserve are host to an equally diverse number of endangered and threatened animals. These areas provide food, cover, and nesting habitat for a broad range of resident animals and are equally important to several transitory species. Table 7 lists species that could be expected to utilize various habitats within or adjacent to the preserve.

The threatened Eastern indigo (Drymarchon corais couperi) will utilize a variety of habitats including mangroves and saltmarsh areas (Weaver, 1978 (a)). Loss of suitable habitat is probably the single most important influence on their survival. Public education may be beneficial in erasing the age old prejudice towards snakes in general. These snakes are non-poisonous and are beneficial to man, in that they feed upon insects and rodents that are considered vermin. Yet most of them are systematically eliminated from the environs of man out of fear or ignorance and the introduction of domestic pets. If this species still exists in the area of the preserve, it would most probably be on Lower Matecumbe Key.

The Key mud turtle (Kinosternon bauri bauri) utilizes fresh and brackish wetlands for feeding, resting and raising their young. The endangered mud turtle is an elusive creature that is often difficult to find even in its known habitat. Bottoms

of ponds and solution holes are often carpeted with thick layers of mud and leaf litter that offer excellent cover for this small turtle (Weaver, 1978 (b)). During periods of drought the turtle may burrow into crevices or tunnel under rocks to conserve body moisture and await the rains that replenish the pond (Dunson, 1981).

The American crocodile (Crocodylus acutus) would most probably be an infrequent visitor in the preserve. However, sitings in the Upper Keys have become more common and the crocodile may traverse large expanses of open water (Moler, personal communication, 1987).

The avifauna of the area represents the largest group of listed species. All except two species on Table 7 are dependent upon wetlands for their survival. The Little blue heron (Egretta caerulea), Snowy egret (Egretta thula), Reddish egret (Egretta rufescens), Tricolored (or Louisiana) heron (Egretta tricolor), and the Roseate spoonbill (Ajaja ajaja) are currently listed as species of special concern. These colonial nesters were easy prey for the plume hunters of the early part of the century. Entire rookeries were annihilated as plume hunters killed the adult birds in breeding plumage and left chicks to die or fed them to their hogs. As the demand for plumes declined, the real estate boom began in south Florida. Thousands of acres of wetlands were drained for agriculture and residential development. Depleted breeding stocks and ever vanishing habitat brought these species and others to the brink of extinction. Loss of habitat, water management practices on the mainland, and the introduction of pesticides into the food web may still imperil the survival of many.

The modest colony on Shell Key accommodates breeding pairs of Snowy egrets, Brown pelicans, Great blue, Great white and Little blue herons, Roseate spoonbills and White ibis. Other wading birds may also be observed there.

The Southeastern snowy plover (Charadrius alexandrinus tenuirostris) is a summer visitor to our shorelines and shallow-water wetlands but does not nest here (Wofenden, 1978). This species has been decimated by excessive hunting and destruction of habitat in many of the Caribbean countries. It is currently listed as a threatened species (Arendt et al., 1979; Wiley, 1979).

The White-crowned pigeon (Columba leucocephala), a threatened species, is also hunted for sport and food in many of the Caribbean countries. Excessive hunting pressures, egg collecting and removal of tropical hardwood forests have seriously depleted resident populations in at least two countries. Cooperative agreements, closed seasons and complete protection in several areas have slowed the decline

of this species. Resident populations in the Keys are protected from hunting but efforts must continue to stem the loss of tropical hardwood trees that the pigeon depends on for food. Poisonwood (Metopium toxiferum) is a favored food during the fruiting period. As the name implies, this tree has certain toxic properties that irritate sensitive human skin (and may cause more severe complications for hypersensitive persons) and it is frequently eradicated from human environs. Other less objectionable hammock trees and shrubs, such as, Pigeon plum (Coccoloba diversifolia), Snowberry (Chiococca alba), stoppers (Eugenia spp.), Wild coffee (Psychotria nervosa) and wild figs (Ficus spp.) are also staple foods. However, few of these plant species are given explicit protection under local landclearing ordinances (personal observations). The pigeon feeds in the hammocks and nests in the more remote mangroves. It is shy and sensitive to human habitation or disturbance in both areas (Robertson and Kushlan, 1978; Sprunt, personal communication).

The endangered Peregrin falcon (Falco peregrinus) is a winter visitor to the Keys. Pesticides in the food chain were instrumental in the decline of this raptor. Elimination of certain insecticides and reintroduction of the peregrin are proving successful in reestablishing this species in the former range. Perched upon utility wires or hovering over open areas, it can overtake and capture other birds in midflight. It may be encountered in variety of habitats from September to May (Snyder, 1978).

Open-water piscivorous birds include the endangered Bald eagle (Haliaeetus leucocephalus) and the threatened Eastern brown pelican (Pelecanus occidentalis carolinensis). The eagle population has suffered a 50% decline over the last 30 years. Florida populations have dropped from 1,000 to less that 350 breeding pairs (Robertson, 1978). Eagles have been documented for the preserve area.

The Eastern brown pelican has suffered a similar fate on a national level. A massive die-off in Texas and Louisiana during the 1960's prompted the federal government to list the pelican as an endangered species until 1984. It appears that local populations have remained fairly stable and the pelican has been deleted from the endangered category and it is now considered to be a species of special concern in Florida. There are 19 breeding colonies of brown pelicans in the Keys. This represents 38% of the Florida population (Schreiber, 1978). The pelican prefers more remote mangrove areas for nesting and will often join other colonial species.

The Osprey (Pandion haliaetus), which is not currently listed, may well reach threatened status if present populations continue to decline. The locally limiting factors are thought to be availability of suitable nesting habitat and adequate

food during the nesting season. The osprey is tolerant of human occupation but like the eagle, prefers large, dead trees that rise above the surrounding canopy for nesting. Hurricanes and landclearing have removed many of these suitable trees and the osprey has opted for nesting on utility poles and elevated platforms. Artificial nesting platforms have been successful in attracting breeding pairs in the vicinity of the preserve.

Continued protection of mangrove rookeries and the mangrove/detritus food chain are vital for the eagle, pelican, osprey and the many wading birds that depend upon fish and marine invertebrates for food.

Qualitative information on marine fishes and invertebrates are conspicuously absent from the literature. Of those listed, only the Common snook (Centropomus undecimalis) has been extensively studied. This species is a prized sport and food fish and much controversy currently rages regarding the reasons for it's decline and the appropriate measures for ensuring a return to former abundance. Pesticides spraying (EPA, 1981), habitat destruction and overharvesting are the primary concerns. Egg and larval stages of most marine species are adversely affected by insecticides. Removal of larger fish, through uncontrolled commercial or sport fishing, depletes brood stock. The effects of both were quickly evident. Destruction of mangroves and marine grassbeds are additional stresses that have negatively affected the snook statewide.

Discontinued spraying for mosquitos over aquatic preserves and federal refuge and park lands may have already contributed to higher hatch success for snook. The long term data will undoubtedly prove this policy beneficial. Closing certain areas to commercial net boats and imposing closed seasons and strict size limits for both commercial and sport fisheries may also reverse the previous trend. Current reports from professional guides and sportfisherman indicate that this is the case and that more fish are being taken in the Keys. Those over or under the size and over the bag limits should be returned to the water, uninjured.

This and other listed fish species are adversely affected by modification or loss of habitat. Alteration of mangroves and marine grassbeds eliminates habitat and often creates turbidity that smothers eggs and clogs gills. Preservation of these and other species requires that disturbances in marine wetlands be kept to a minimum and that these areas be protected from upland drainage that introduces silt and pollution into nearshore habitats.

The marine turtles have suffered depredation similar to that described for the wading birds. The Atlantic green turtle

(Chelonia mydas mydas) was once a mainstay to Keys fisherman. Shortly after the turn of the century, most of these turtles had been eliminated from local waters. Overharvesting and egg collecting, and entanglement in other parts of the Caribbean and Gulf of Mexico have continued to stress survival for all marine turtles. Suitable habitat for nesting does not exist in the preserve but all three species may be encountered in the area, the Loggerhead (Caretta caretta caretta) being the most common.

The endangered West Indian manatee (Trichechus manatus latirostris) is an occasional visitor to the preserve area. Individual animals or small groups are often reported to appear in marinas and residential boat basins or canals during the winter months and occasionally during summer. Cool water temperatures farther north may prompt this migration out of the usual winter range. Well meant offerings of food and fresh water will often entice the manatee to linger in these areas for longer periods. This practice should be strongly discouraged, as it increases the manatee's exposure to danger from boats. Although there are no designated "manatee areas", boaters should be cautious and reduce speed when manatees are in an area. Heavy penalties are imposed for harassing or negligently injuring or killing this highly endangered species.

The endangered Key Largo woodrat (Neotoma floridana smalli) and Key Largo cotton mouse (Peromyscus gossypinus allapaticola) were introduced to Lignumvitae Key from north Key Largo when populations on the later island were threatened by impending development. It was felt that since Lignumvitae was protected from urban development that the introduced stocks would preserve the gene pool of the rodents. The woodrat has survived on the island but recent trapping efforts did not produce any cotton mice (Wells, pers. comm., 1990). Additional surveys are needed to confirm presence/absence of the cotton mouse. State acquisition of critical habitat on north Key Largo will hopefully insure their continued survival. Both rodents use a variety of habitats with a preference for tropical hardwood hammocks for feeding and nesting.

Although state law (F.S. 370.110) prohibits the taking of hard corals (Millepora spp. and the Scleractinia) and a few species of sea fans (Gorgonia ventalina and G. flabellum) from State waters, many of the octocorals (gorgonians), tropical fish, mollusks, crustaceans, anemones, and other invertebrates are less stringently regulated. Permits are required for these activities but monitoring and regulating collectors is difficult, if not impossible, given the broad geographic extent of the State's marine waters. Local collecting is still conducted by both professional and amateur aquarists,

often with little regard for non-target species when pursuing specimens.

Overharvesting is also a potential problem. Intensive collecting of a single species may eliminate that species from an area. The ecological repercussions are problematic but each organism fills a particular biological niche and mass alteration of community structure would affect other organisms that interact with the target species (e.g. predator/prey, parasitic, symbiotic, and mutualistic relationships).

The concern for an individual endangered species may prompt a concerted effort for preservation and has proved successful in a limited number of cases. The Peregrin falcon and the Alligator are such examples. Other efforts have proved only marginally successful. The Florida manatee has benefitted from designated sanctuaries and captive breeding efforts but the steady growth of recreational power boats still imperils this slow moving siren throughout much of it's already diminished range. The most recent population estimate indicates that there may be less than 1,500 individuals statewide.

The onslaught of human populations and development leave little hope for many of these animals. Designated refuges and preserves, stringent laws and a "conservation ethic" are possibly all that separate them from extinction.

TABLE 6

FLORAL SPECIES OF THE LIGNUMVITAE KEY AQUATIC PRESERVE AREA THAT ARE CLASSIFIED AS ENDANGERED, THREATENED OR COMMERCIALLY EXPLOITED

Scientific Name	Common Name	Status	
		FDA	USFWS
Acrostichmu danaeifolium	Giant leather fern	T	
Cereus gracilis	Prickly apple cactus	E	UR
Cereus pentagonus	Barbed-wire cactus	T	
Chrysophyllum olivaeforme	Satinleaf	E	
Cocos nucifera	Coconut palm	T	
Cordia sebestena	Geiger tree	E	
Encyclia boothiana	Dollar orchid	E	UR
Encyclia cochleata	Clamshell orchid	T	
Encyclia tampensis	Butterfly orchid	T	
Gossypium hirsutum	Wild cotton	E	
Guaiacum sanctum	Lignumvitate	E	
Hippomane mancinella	Manchineel	T	
Hymenocallis latifolia	Spider lily		UR
Jacquinia keyensis	Joewood	T	
Limonium carolinianum var.angustatum	Narrow-leaved sea lavender		UR
Opuntia compressa	Prickly pear cactus	T	
Opuntia stricta	Prickly pear cactus	T	
Suriana maritima	Bay cedar	E	
Swietenia mahogani	West Indian mahogany	T	
Thrinax floridana	Florida thatch palm	C	
Thrinax microcarpa	Brittle thatch palm	C	
Tillandsia balbisiana	Reflexed wild pine	T	
Tillandsia circinata (= T.paucifolia)	Twisted air plant	T	
Tillandsia fasciculata	Wild pine or Air plant	C	
Tillandsia flexuosa	Banded wild pine	T	
Tillandsia setacea	Needle-leaved air plant	T	
Vanilla barbellata	Wormvine orchid	E	

Note:
FDA==Florida Department of Agriculture and Consumer Services (list published in Preservation of Native Flora of Florida Act, Section 581.185-187, Florida Statutes).
E = Endangered
T = Threatened
C = Commercially Exploited

USFWS==United States Fish and Wildlife Service (list published in List of Endangered and Threatened Wildlife and Plants, 50 DFR 17.11-12).
E = Endangered
UR = Under review for federal listing

TABLE 7

FAUNAL SPECIES OF THE LIGNUMVITAE KEY AQUATIC PRESERVE AREA THAT ARE CLASSIFIED AS ENDANGERED, THREATENED, OR OF SPECIAL CONCERN

Scientific Name	Common Name	Status	
		FGFWFC	USFWS
Centropomus undecimalis	Common snook	SSC	
Rivulus marmoratus	Rivulus	SSC	
Starksia starcki	Key Blenny	SSC	
Caretta caretta caretta	Atlantic loggerhead turtle	T	T
Chelonia mydas mydas	Atlantic green turtle	E	E
Crocodylus acutus	American crocodile	E	E
Dermochelys coriacea	Leatherback turtle	E	E
Drymachon corais couperi	Eastern indigo snake	T	T
Eretmochelys i. imbricata	Atlantic hawksbill turtle	E	E
Eumeces egregius egregius	Florida Keys mole skink	SSC	UR
Kinosternon bauri bauri	Key mud turtle	E	UR
Lipidochelys kempi	Atlantic ridley turtle	E	E
Ajaja ajaja	Roseate spoonbill	SSC	
Columba leucocephala	White-crowned pigeon	T	UR
Egretta caerulea	Little blue heron	SSC	
Egretta rufescens	Reddish egret	SSC	UR
Egretta thula	Snowy egret	SSC	
Egretta tricolor	Louisiana or Tricolor heron	SSC	
Falco peregrinus	Peregrine falcon	E	T
Falco sparverius paulus	Southeastern Kestrel	T	UR
Haliaeetus leucocephalus	Bald eagle	T	E
Pelecanus occidentalis	Brown pelican	SSC	
Neotoma floridana smalli	Key Largo wood rat	E	E
Peromyscus gossypinus allipaticola	Key Largo cotton mouse	E	E
Trichechus m. latirostris	West Indian manatee	E	E

Note:
FGFWFC==Florida Game and Fresh Water Fish Commission (list published in Section 39-27.03-05, Florida Administrative Code) E = Endangered, T = Threatened, SSC = Species of Special Concern

USFWS===United States Fish and Wildlife Service (list published in List of Endangered and Threatened Wildlife and Plants, 50 CFR 17.11-12) E = Endangered, T = Threatened, UR = Under review for federal listing

I. ARCHAEOLOGICAL AND HISTORIC RESOURCES

The early native Indians and Bahamian fisherman exploited the abundant fish and turtles and salvaged the cargos of unfortunate sailing ships that were dashed upon the treacherous reefs offshore. The somewhat sketchy but colorful exploits of the pirates who plundered the treasure laden ships of the Spanish fleets were also to become an indelible page in the Keys' history. Later, the descendants of these enterprising sailors and the immigrants from the Bahamas and Cuba were to become permanent colonizers of this chain of islands. The ever present threat to navigation, the tropical growing climate and the rich bounty of the sea were the mainstay of a culture devoted to ship salvage (or "wreckers"), citrus and pineapple plantations, and the sponge, turtle and fishing industries (Carter, 1976) (Eyster, 1987).

To the south of Indian Key in 18 feet of water lies the San Pedro wreck that sank in 1733. A fleet of Spanish merchant and military ships had sailed from Havana in route to Europe heavily laden with trade goods and precious metals. A hurricane scattered the fleet and all but one were sank. The wreck site was rediscovered in the 1960's. Most of the artifacts and treasure were plundered prior to this time. On April 2, 1989, the San Pedro Underwater Archaeological Site was established by the Florida Department of State for interpretation of Florida's rich maritime history.

Indian Key, the small island to the south of the preserve boundary, has been occupied by various cultures from pre-historic times. During the 1830's this 10 acre island served as the county seat for Dade County and was a prosperous wrecking village. Jacob Housman, the owner and developer of the island, gained some notoriety for his wrecking exploits and treatment of the native Indians in the area. Dr. Henry Perrine was also a prominent resident on the island. Dr. Perrine gathered and cultivated tropical food and fiber plants from around the world in hopes of developing products for local markets. The sisal plants (Agave spp.) that Perrine introduced still persist on the island today.

In 1840, the island was attacked by a band of 100 Indians. Dr. Perrine was killed in the attack and all the buildings and supplies on the island were pillaged or burned. Housman had escaped prior to the attack but died the following year in a wrecking accident. The island was sold and has not been inhabited since the 1930s. The state purchased the island in 1970. The remaining streets and foundations have been reclaimed from the prolific vegetation and the island is open to the public for tours conducted by Florida Park Service personnel. The Indian Key Festival is held in the spring and attracts thousands of visitors during the two day event. Other

historic memorials and/or events are also held on the island each year.

The Spanish are believed to have been the first post-Columbian visitors to Lignumvitae Key in the early 1700's. Later, Bahamian fishermen and wreckers probably visited the island but no permanent settlement was established there, even during Housman and Perrine's time. Exposure to prevailing sea breezes that drove away the swarms of mosquitos most probably favored Indian Key for settlement. The island has been occupied by various owners since the early 1900's, most notable of these were the Matheson family of Miami during the early part of this century. Their home and the surrounding grounds are maintained as they were during that time period. Guided tours of both the cultural and natural history of the island are conducted by the Florida Park Service.

The twentieth century brought many changes to both the culture and utilization of the areas natural resources. A chain of lighthouses on the reef edge guided vessels on a safer course. Blight and more productive ports in Cuba usurped the agricultural markets and declining numbers of turtles and sponging grounds eliminated those industries as sources of subsistence. Motorized vessels and improved fishing methods were to become the basis for an ever expanding fishery. Flagler's railroad and a developing tourist industry on the mainland soon lured hundreds and then thousands to the tranquil splendor of the Keys. The railroad was eventually replaced with a roadway and bridges after the Labor Day Hurricane of 1935. The Overseas Highway would accommodate ever increasing numbers of sightseers and fisherman. Coupled with the tropical climate and year round abundance, both the commercial and sport fisheries flourished (Martin, 1949; Dean, 1982).

J. USES OF THE PRESERVE

In the last half of this century, improved snorkel and scuba equipment has added an exciting dimension to the local tourist industry. A short, comfortable boat ride will deposit visitors in the clear, warm waters to observe the natural wonders of the marine environment first hand. Commercial dive operations, tour boats, and other tourist accommodations cater to several million visitors a year. The dive industry contributes substantially to the local economy and employs a substantial number of the local and seasonal residents.

Pleasure boat registrations for Dade County doubled in the period between 1964 and 1978. Registrations for Monroe County quadrupled during the same time period (Mathis et al., 1979). Currently (1989-1990) Dade County residents have registered 49,360 vessels and Monroe has registered 19,053 (FDNR, 1990).

Many of the boats registered in Dade County are used in Monroe County waters. This pattern is expected to continue as regional population increases.

Numerous hotels, motels and private residences offer dockage in the vicinity of the aquatic preserve. Additionally, there are 5 commercial marinas on the western end of Upper Matecumbe. Four of these are on the bayside of the island. Ingress and egress to these marinas are through areas with extremely shallow waters, expansive banks and marine grassbeds. Traffic from these marinas and the Intercoastal Waterway access the Atlantic Ocean via Teatable and Indian Key Channels in the preserve. The other marina on Upper Matecumbe is located on the Atlantic side of the island with a privately maintained channel to deeper waters. One commercial marina on the northeast tip of Lower Matecumbe is located immediately adjacent to the aquatic preserve boundary and their vessels must traverse waters of the preserve to access Florida Bay or the Atlantic Ocean. This marina and two on Upper Matecumbe offer rental boats to the general public.

Personal individual watercraft (jet skis, jet boats, water taxis) have increased in popularity throughout Florida and have recently become more frequently observed in the preserve. Most enter the preserve from the U.S. 1 road shoulder or from nearby marinas. They are extremely portable (up to 6 per trailer) and convenient to launch from a sloped shoreline or skid board, without the need for a boat ramp.

Income from sport (recreational) fishing is a major contributor the local economy. Guide services, charter boats, boat rentals, bait, fuel, food, ice and taxidermy services are procured from local businesses. This income is generally lumped with the tourist industry data and it is therefore difficult to assign a dollar amount to these services. Conservative estimates for 1986-87 indicated that more than 145 million dollars were spent by recreational fishermen in the Keys (NMFS, 1988).

The commercial fishery is probably the third most important industry in the county. Commercial harvest of lobster, stone crab, shrimp and finfish represented an estimated $36,000,000 to Monroe County in 1989 (FDNR, 1990). Boat yards, fuel, ice, transportation and processing facilities are accessory industries that employ additional workers who are indirectly dependent upon the fishery.

Commercial harvesting of tropical fish, invertebrates and sponges are also expanding industries. Current data for the local tropical marine life fishery are not available but the popularity of display aquariums and the proliferation of shops and businesses dedicated to procurement and shipping has increased considerably. There are approximately 60 firms in

south Florida that are involved in the marine life harvesting industry and it is predicted to expand by 10-15% each year (Young, 1989).

The harvesting of 'live rock', although currently banned in state waters, has been a thriving industry in the Keys for the past decade. 'Live rock' (or reef rock, mat rock, etc.) are fragments of limestone with the living organisms attached that are highly prized by the aquarium trade. These 'mini environments' support algae, soft and hard corals, as well as, many of the epifaunal and infaunal species associated with the coral reef and hardbottom communities. The live rock is typically harvested in shallow waters. One firm in Monroe County estimated that their annual export of 'live rock' was 80,000 pounds per year (Young, 1989). There is currently a total ban on live rock harvesting in state waters. Live rock from federal waters is still landed in the county. The long-term impacts to local resources was a primary concern in imposing the ban in state waters (Wheaton, 1989).

Aquaculture offers an alternative to harvesting 'wild' products from the natural environment. Culturing live rock is being explored by a few of the those in the industry, as well as by other scientists. Algae and reef fishes are being successfully cultured in tanks and abandoned barrow pits in the Keys. The success of culturing Pacific reef tropical fish is a case in point for further exploration of this alternative.

Commercial sponge harvesting has seen a resurgence throughout southern Florida in the last few years. Stevely, et al., (1978) reported that the sponge harvest for Monroe County in 1976 was approximately 5,000 pounds. Figures from NMFS for 1984 indicate that more than 23,000 pounds were harvested in Monroe County. Landings value of the 1984 catch is estimated at $228,844 (NMFS, 1986). Recent data indicate that more than 298,000 pounds with an estimated value of $ 1,585,300 were landed in Monroe County in 1989 (FDNR, 1990). Small flotillas of skiffs and a 'mother boat' ply both the bay and ocean nearshore waters. Spongers must hook sponges from the boat rather than having divers clip the sponges. The hook or rake must have a 5 inch tooth spread to prevent taking of smaller sponges (Chapter 370.17, F.S.). Harvested species include; Sheepswool sponge (Hippiospongia lachne), Yellow sponge (Spongia barbara) and grass sponge (Spongia graminea).

Impacts Associated with Resource Use

The financial interests of both the fisheries and tourist industries are inextricably linked to the presence and products of the marine environment. Yet many scientists, fisherman, divers, and environmentalists have expressed concern for the past and present pressures and stresses

exerted upon this unique environment. Some areas have been seriously damaged from negligent or accidental vessel groundings. Still others have been impoverished by overharvesting, coral and tropical fish collecting and spearfishing.

Careless boat operation in shallow water is a major source of damage to the preserve's resources. Many new arrivals and visitors to the area are novice operators or new boat owners and most are ill equipped for navigation in the shallow waters around the barely submerged grassbeds. Without major efforts to educate the boating public and improved navigational aids, damage from boat groundings and prop dredging will undoubtedly increase in proportion to the number of boats utilizing the area.

Personal individual watercraft have been observed to impact the feeding activities of wading birds and are disruptive to nesting activities. Operation on shallow banks can damage or destroy seedling mangroves and may damage marine grassbeds. Irresponsible operation is also hazardous to other boaters, swimmers, divers, and snorkelers in the preserve.

These and other impacts to preserve's resources will be discussed further in Chapters V and VI.

K. REGIONAL LAND USE, DEVELOPMENT AND ASSOCIATED IMPACTS

1. Regional Land Use and Development

The south Florida region may be interpreted to include a variety of locations or features depending upon: political subdivision, county lines, geological formations, climate, watershed or any number of other natural or artificial boundaries. For purposes of this discussion, the south Florida region will include Monroe, Dade, Broward, Palm Beach, Hendry, Glades, Charlotte, Lee, Collier and the southern portion of Martin counties. This delineation is based upon their proximity to the Aquatic Preserve. All counties except Glades and Hendry, which are principally agricultural lands, are coastal areas with substantial population densities. All are within a five hour driving time of the preserve.

As an ecological unit the south Florida region is often characterized as the Kissimmee-Okeechobee, Everglades-Florida Bay-Coral Reef system. Water quality, accumulation, aquifer recharge, retention, dispersal and use are the common elements that unit this region. Water needs of agricultural and urban development must be balanced with the need to maintain or restore quality, quantity and periodicity of water flow to the larger environmental complex and for aquifer recharge. Pollution, depletion, flooding, drought, salt water intrusion,

alteration or loss of environmentally sensitive wetlands, and priority of use are ongoing issues that must be addressed by the public and various management entities.

Potable water for the Florida Keys is provided by pipeline from well fields in the Biscayne Aquifer in south Dade County. Overland water flow moves south from the Kissimmee River basin, Lake Okeechobee and the Everglades to enter Florida Bay and eventually waters of the Gulf Stream and the Atlantic Ocean. Because these systems are interconnected, the impacts to one part of the system will eventually impact all of the system, depending upon severity and/or duration. The aquatic preserve lies 'down stream' of this complex system in the Coral Reef zone. It is linked to the larger region both environmentally and economically.

The Keys have historically been a haven for respite from the heavily developed urban areas along the east coast of Florida and the northeastern states. From the early days of Flagler's railroad to the present, a large proportion of the visitors to Keys are from the neighboring counties to the north. Many are seasonal visitors or part time residents. Interstate road system and international airports connect the islands with the region and the world.

U.S. Highway 1 links the Florida Keys with the mainland of Florida with a series of 43 bridges and several causeways. This is the only arterial roadway into or out of the Keys. Miami International Airport is approximately 80 miles northeast via U.S. 1 and the Florida Turnpike. Marathon Airport on Key Vaca and Key West International offer local commuter service to Miami and several other cities in the region.

From earliest recorded history, the Keys have been an important maritime area. European trade routes and Caribbean basin traffic have linked the islands with the rest of the world. Ports in Miami and Key West continue that tradition. They are major points of cultural and economic exchange. Cruise ships and tour boats provide additional access for the millions of tourists who visit the area annually.

Fisheries were probably one of the primary enticements to the early explorers and settlers of the Keys. Sponges, turtles, finfish, conch, shrimp, and spiny lobster supported many families and entire villages in some areas. All but the now protected turtles and queen conch are still a mainstay to the local commercial fisheries. Although this industry employees a relatively small proportion of the population, it is probably the third most important industry in the Keys. Economies are also stimulated by the facilities and services related to recreational and commercial fishing.

Geographically and historically, the region has been a strategic location for national security interests. The U.S. Navy, Coast Guard and Air Force staff and maintain several facilities throughout the Keys. Local populations and economies are affected by the presence of these facilities. Many of the retired staff have remained as residents after service.

The combination of climate, clear clean waters, coral reefs, abundant fish and wildlife and accessibility are the main attractions to both visitors and residents of the Florida Keys. The Keys are the most popular diving destination in the region and state and possibly, the continent. Millions of visitors generate billions of dollars to the local economies of the Keys and the region. Dive shops, schools, boats, lodging, apparel, restaurants, marinas, car rentals, airlines, photography and sundry other shops and businesses are geared to the needs and services for this industry.

2. Local Land Use and Development

A major portion of the land area adjacent to Lignumvitae Key Aquatic Preserve is undeveloped or is developed with low density commercial and residential use. Commercial development has proliferated along the U.S. 1 corridor through the center of Upper Matecumbe. Residential development is typically relegated to the side streets. Most of the commercial development is composed of hotel/motels, marinas and other resident and visitor services. Lower Matecumbe is devoted to primarily residential use with a single motel and marina adjacent to the preserve.

It should be noted that most development is serviced by septic tanks rather than central sewage in the Lignumvitae Key vicinity. Several commercial facilities have secondary treatment plants. Some new development is being required to install secondary treatment plants which incorporate boreholes for injection of effluents.

For purposes of this management plan, immediately adjacent uplands will be limited to four categories based upon type and intensity of existing use. These designations do not reflect any particular zoning or planning area districts as applied by Monroe County government. Residential will include properties and facilities developed with multi-family and single family homes. Commercial uses are typically hotel/motel, restaurants and marinas. Public lands include the U.S.1 right-of-way (including adjoining utility easements) and those facilities or areas administered or managed by the Florida Park Service. The Undeveloped areas category will include those lands that are primarily mangrove wetlands and adjacent sovereignty submerged lands. Figure 5 illustrates the various land use categories adjoining or adjacent to the preserve.

3. Associated Impacts

On a regional level, impacts to the preserve may be evaluated both from the economic and environmental perspectives. Visitors and part time residents contribute substantially to the local economy and tax base. Monies distributed for goods and services support existing businesses and foster new development of businesses and residences. The natural resource and aesthetic values of the preserve are more difficult to define but are none the less important to the local economy.

Environmentally, the influx of visitors and new residents place added potential for increasing use and development that directly affect the aquatic preserve. Increased use by boaters, fisherman, and snorkelers may stress certain resources of the preserve and in some cases will require new or revised evaluations of the compatibility of these activities with the long term conservation of biological and aesthetic values for which the preserve was established. Maintenance of water quality, listed species habitat, viable fisheries, healthy benthic communities and a quality recreational experience may be adversely affected by excessive numbers or types of activities in the relatively small area of the preserve. At the minimum, a system of monitoring the types and intensity of use must be established to anticipate some of these impacts.

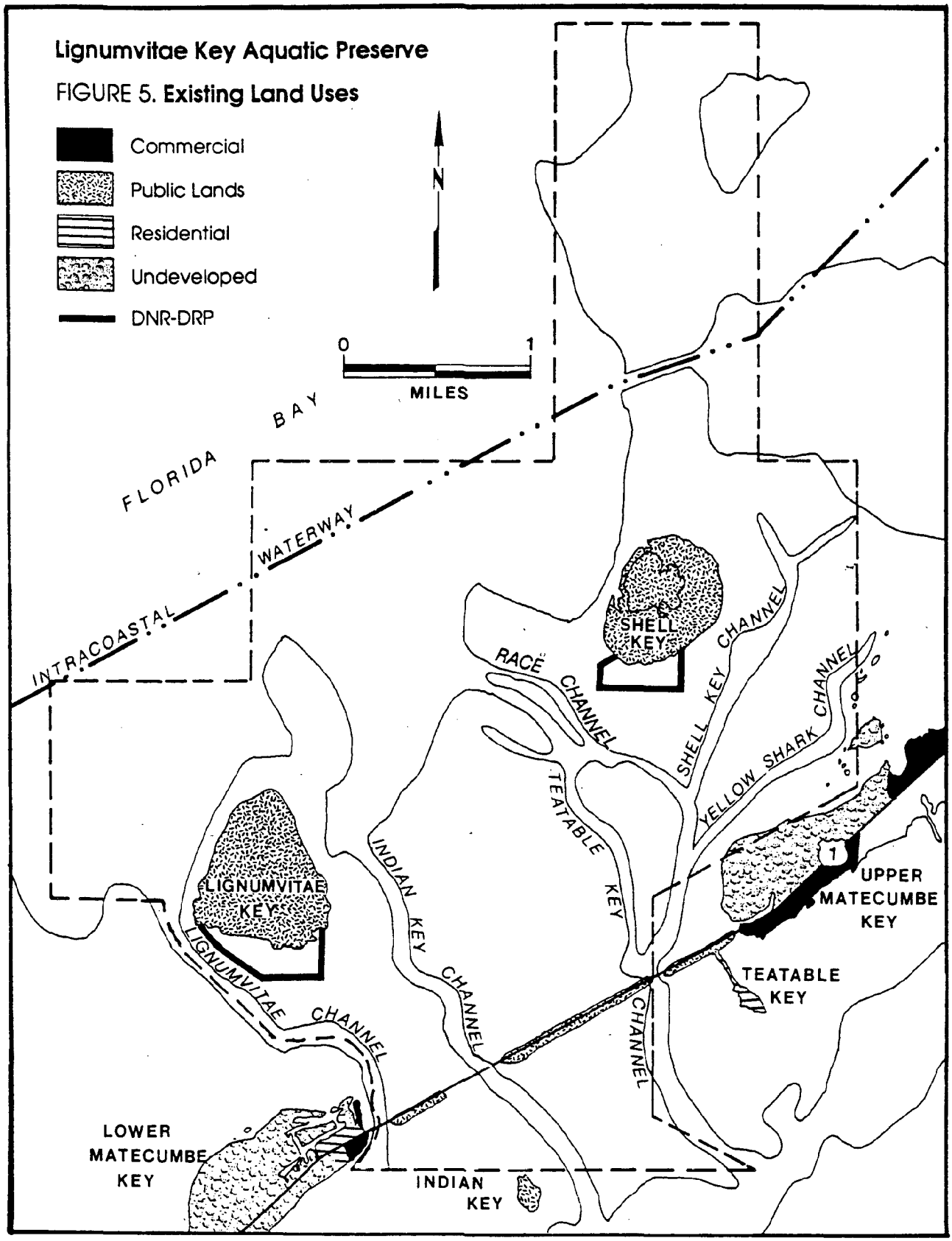
Commercial and residential development also impacts the quality and utility of the preserve. Excessive or poorly planned development may negatively impact water quality, vegetation, listed species, and the biological and aesthetic qualities for which the preserve was established. As thousands of new residents and tourists come to south Florida and the Keys, so does new construction of homes, resorts, roads, marinas, and facilities for disposal of the tons of solid and liquid wastes of an expanding population. Upland run-off contains heavy metals, petroleum, pesticides and other chemicals that pollute nearshore waters and are dispersed to other areas either by waves and currents or through the food chain. Heavy metal (mercury, zinc, lead, and cobalt) concentrations in sediments and corals have been reported off southeast Florida by Manker (1975). Evidence from studies on the effects of petroleum hyrocarbons has determined that these substances are detrimental to corals and that massive or chronic concentrations would also be harmful to other organisms (Japp, 1984). Other chemicals may be quickly diluted and dispersed, therefore more difficult to detect and the long-term effects more difficult to predict.

Septic effluent is also transported well away from the point of origin and this customary method of sewage disposal has caused much controversy and concern for the health of

nearshore marine environments and the reef tract. The porous limestones of the Keys do not retain the effluent long enough for adequate decomposition to occur (Bight et al., 1981). Tidal activity, currents, and wind easily transport seepage from surface water drainage and contaminated sediments to nearshore and offshore areas. Likewise, the deep and shallow well injection of inadequately treated sewage has proliferated without sufficient knowledge of the particular geological features of the injection site (Lapointe, 1989). Deep strata test boring has been primarily limited to the mainland of Florida and little testing has been done in the Keys. Information on the vertical and lateral movement of injected materials and the final disposition of these substances and their mutant byproducts is speculative without further research.

The geologic strata, tidal regime, currents, thermal stratification, chemistry and marine flora and fauna all interact with human occupation of the coastal zone. The ultimate effect upon the biological resources are at best poorly understood and long-term research and monitoring will reveal the foresight or folly of present activities, trends and attitudes towards the protection and conservation of water quality and the productivity of all marine systems. The true value of this unique resource cannot be fully appreciated by its many benefactors without some knowledge of the delicate balances and natural processes and relationships that exist within and between various community associations. Neither can the long term survival of marine systems, as we know them, be guaranteed without adequate research to determine the point at which the system can realistically recover from natural catastrophe and the cumulative impacts of man.

As control of regional or local populations, economies, and politics are beyond the scope of this management plan, monitoring of activities and active participation in local planning efforts are seen as one avenue of addressing these concerns. However, many of the existing and anticipated impacts to the preserve's resources will be addressed by the legislated statutes and rules and within the following chapters of the plan.


Lignumvitae Key Aquatic Preserve
FIGURE 5. Existing Land Uses
Commercial
Public Lands
Residential
Undeveloped
DNR-DRP
N
0
1
MILES
FLORIDA BAY
INTRACOASTAL WATERWAY
SHELL KEY
RACE CHANNEL
SHELL KEY CHANNEL
YELLOW SHARK CHANNEL
TEATABLE KEY
INDIAN KEY CHANNEL
LIGNUMVITAE KEY
LIGNUMVITAE CHANNEL
CHANNEL
1
UPPER MATECUMBE KEY
TEATABLE KEY
LOWER MATECUMBE KEY
INDIAN KEY

CHAPTER IV

MANAGEMENT AREAS

A. INTRODUCTION

This chapter of the plan divides Lignumvitae Key Aquatic Preserve into separate management areas and establishes the general or special rule criteria for allowable uses associated with each management area. Since the statute and rule specifically addresses docks, marinas, shoreline stabilization and dredging, the primary focus of allowable uses will be directed toward structures and construction activities. Non-structural activities are addressed in Chapter V under management issues and policy guidelines.

The intent of establishing management areas is four-fold: 1) to provide a better understanding of the general and special criteria designed to preserve and protect biological resources and habitat through the management of activities and structure design, 2) to identify the types of allowable uses on state-owned lands within a preserve, 3) to provide both the Bureau of Submerged Lands and Preserves' staff and other agencies a continuity of direction in the management of the preserve, and 4) to provide local planners with a guide for land use decisions.

Section B of this chapter will establish management area categories based upon upland land use and relative values of adjacent aquatic preserve resources. Section C delineates minimum criteria for allowable uses in the preserve, as established by statute and rule.Section D delineates each management area as to boundaries, description of resources and allowable uses, specific criteria and the rationale for each designation.

B. MANAGEMENT AREA CLASSIFICATIONS

The management areas are determined by identifying and delineating relatively homogenous areas of (1) adjacent upland uses, and 2) natural resources in the aquatic preserve. The upland use classifications acknowledge the local government's decision as to how a specific upland area can be used or developed. By necessity, the classification of management areas in this system is broader than county zoning or planning areas (e.g., Commercial (C) compared to the Monroe County Urban Commercial (UC) and Suburban Commercial (SC) Planning Districts). The land use categories employed in this management plan are intended to group similar uses relative to the types of structures and activities that may be associated with each and to establish the types of uses and activities

that may be authorized on state-owned submerged lands within the preserve. Specific land uses to be incorporated in the classification of management areas include:

Commercial (C): This broad category represents state-owned lands adjacent to lands designated for these uses in the local Land Use Plan. It is also intended to incorporate structures or facilities on or over state-owned lands whose use involves the charging of fees or generation of revenue. Exceptions to this are federal, state or county owned properties that may charge a nominal fee, these facilities are considered a public use. Examples of Commercial uses are marinas that charge fees, business concerns, such as, dive shops, guide services, boat rentals, industry, and private educational facilities, that depend heavily on their direct access to the aquatic preserve in order to function, and establishments such as hotel/motels and restaurants, that use their direct access to the aquatic preserve as an economic enhancement. The structures associated with this category are many and diverse, including docks, marinas, ship stores, fishing piers, boat ramps, mooring buoys, utilities and pilings. No structures associated with this type of use are located within the preserve boundary. However, uses associated with existing Commercial facilities access and impact resources of the preserve.

Public Lands (PL): This category includes aquatic preserve areas adjacent or adjoining: facilities owned and/or operated by state, federal or local agencies for use by the general public at no charge or for a minimal fee; and public services, such as roadways and utilities. Certain lands within this category may have restricted or limited access depending upon season and/or management objectives and existing resources. Examples are identified rookeries, critical habitat of endangered species, controlled research areas, and areas being restored.

The natural resources portion of the classification system is established by evaluating the quality of a particular submerged or emergent resource within the preserve. Resources will be identified either as a **Primary Resource Protection Area (PRPA)** or a **Secondary Resource Protection Area (SRPA)**. The methodology used to determine this resource value shall be consistent with the latest methodology approved by the Bureau of Submerged Lands and Preserves. Discrepancies in Management Area Maps and actual resources on a site will be decided by onsite surveys and evaluation by preserve staff.

The **Primary Resource Protection Areas** are those areas recognized as having the greatest value to the overall

biological integrity and diversity of the preserve. They are assigned a value of "1". A PRPA essentially combines Resource Protection Areas 1 and 2, as defined in Sections 18-20.003(31), and 18-20.003(32), F.A.C. Resource attributes which determine a PRPA include:

1. non-exotic and non-invasive aquatic/wetland vegetation (e.g., marine grasses, attached algae, mangroves, marsh vegetation) that covers more than 1% of the surveyed area;

2. unvegetated soft-bottom communities (i.e., infaunal invertebrates) with a Shannon-Weaver Diversity Index greater than 1.00;

3. hard-bottom communities (e.g., corals, soft corals, sponges, algal beds) that have a frequency greater than 5% within the survey area;

4. species designated as endangered, threatened, or of special concern (as contained in the most recent updates of the Florida Game and Fresh Water Fish Commission and the U.S. Fish and Wildlife Service) that occupy or use the area for habitat (e.g., feeding, breeding, refuge or nesting); and

5. nesting or feeding sites for solitary or colonial birds.

State-owned submerged lands that are characterized by the absence of the above resource attributes will be identified as a **Secondary Resource Protection Area (SRPA)** and assigned a resource value of "2". A SRPA is a Resource Protection Area 3, as defined by Section 18-20.003(33), F.A.C.

As stated previously, resource values are to be incorporated into the classification of management areas. For instance, if an area within the preserve is determined to be a Primary Resource Protection Area with a value of 1 and the adjacent upland is classified as Public Lands, then this management area would be classified as **PL/1**.

C. MINIMUM CRITERIA FOR ALLOWABLE USES

Chapter 18-20, F.A.C., provides the minimum standards with regard to the utilization of state-owned submerged lands within an aquatic preserve. The minimum standards for each allowable use are detailed below.

All Dock Structures: Section 18-20.004(5)(a), F.A.C., states that all docking facilities within an aquatic preserve shall meet the following standards and criteria:

1. no dock shall extend waterward of the mean or ordinary high water line more than 500 feet or 20% of the width of the waterbody at that particular location, whichever is less;

2. areas of significant biological, scientific, historic, and/or aesthetic value require special management considerations. Modifications to docks in these areas may be more restrictive and shall be determined on a case-by-case basis;

3. the number, lengths, drafts, and types of vessels allowed to utilize the proposed facility may be stipulated;

4. where local governments have more stringent standards and criteria for docking facilities, the more stringent standards for the protection and enhancement of the aquatic preserve shall prevail;

Boundaries of the preserve do not adjoin any upland property that is currently zoned for single-family or multi-family use. Therefore, the criteria for single-family and multi-family docks, as outlined in Sections 18-20.004(5)(b) and (c), F.A.C., respectively, are not included within this plan but may be consulted in Appendix A.

Commercial-Industrial Docking Facilities and Marinas: Section 18-20.004(5)(d), F.A.C., states that commercial, industrial, and other revenue generating/income related docking facilities, as defined by Section 18-20.003(10), F.A.C., shall conform to the following specific design criteria and standards:

1. docking facilities shall only be located in or near areas with good circulation, flushing, and adequate water depths;

2. docking facilities shall not be located in Resource Protection Areas 1 and 2 (= PRPA); however, main access piers may be allowed to pass through Resource Protection Area 1 or 2 that are located along the shoreline to reach an acceptable Resource Protection Area 3 (=SRPA), provided that such crossing will generate minimal environmental impact;

3. the siting of docking facilities shall take into account the access of boat traffic to avoid marine seagrass beds or other aquatic resources in the surrounding area;

4. the siting of new facilities within the preserve shall be secondary to the expansion of existing facilities when such expansion is consistent with other standards;

5. the location of new facilities and expansion of existing facilities shall consider the use of upland dry storage as an alternative to multiple wet slip docking;

6. marina siting will be coordinated with local governments to ensure consistency with local plans and ordinances;

7. marinas shall not be sited within state designated manatee sanctuaries;

8. in any areas with known manatee concentrations, manatee warning/notice and/or speed limit signs shall be erected at the marina and/or ingress and egress channels, according to Florida Marine Patrol specifications.

Exceptions to the standards and criteria for any docking facility may be considered, but only upon demonstration that such exceptions are necessary to ensure reasonable riparian ingress and egress. The following special criteria and standards are also applicable for use of state-owned submerged lands in the Keys.

Florida Keys Marina and Dock Sitings Criteria: Section 18-21.0041(1) establishes general policies and specific criteria for applications for leases, easements or consent to use sovereignty submerged lands in Monroe County for multi-slip docking facilities. Section 18-21.9941(1)(a) provides that special attention and consideration shall be given to the following:

1. the proximity to and potential adverse impacts on any rare, threatened or endangered species, or species of special concern, or their habitat, or on any portion of the entire Florida Reef Tract and other corals;

2. eliminating any adverse impacts on wetland or submerged vegetation or benthic communities; and

3. requiring adequate tidal flushing and/or circulation; and

4. maintaining or enhancing water quality at levels within or above State water quality standards; and

5. requiring adequate water depths to avoid dredging and other bottom disturbance; and

6. requiring consistency and conformity with local government land use plans, zoning and other land use or development regulations; and

7. requiring consistency and conformity with Chapters 27F-8, 27F-9, 27F-10, 27F-11, 27F-12, 27F-13, and 27F-15,

F.A.C., as amended, "Principles for Guiding Development in the Florida Keys Area of Critical State Concern."

Section 18-21.0041(1)(b)

1. provides for a moratorium on all leases in the upper Keys until such time as rules are adopted for a Keys-wide aquatic preserve or until the Monroe County Comprehensive Plan with marina sitings policy is adopted, whichever occurs first.

Section 18-21.0041(1)(b) further requires that:

2. no docking facilities shall be approved which require either dredging or filling to provide access by canal, channel, road, or any other means, except for maintenance dredging of existing canals, basins, or channels, providing such maintenance does not exceed currently acceptable water depths;

3. docking facilities shall only be approved in locations having adequate water depths in the boat mooring, turning basin, access channels and other such areas to accommodate the proposed boat use;

   a. a minimum depth of -4 feet MLW shall be required;

   b. greater depths for those facilities designed for or capable of accommodating boats having greater than a 3 foot draft, so that a minimum of one foot of clearance is provided between the deepest draft of a vessel and the bottom;

   c. depth requirements shall also apply to the area between the proposed facility and any natural or other navigation channel, inlet or deep water. Where necessary, marking of navigational channels may be required. At the Board's discretion, the conditions of the lease may stipulate the number, lengths, drafts and types of vessels to be moored in a facility.

4. Requirements for the size of the dock:

   a. no dock shall be shall exceed 500 feet in length, unless the Board determines that it is not contrary to the public interest;

   b. no dock shall preempt more than 20% of the affected waterbody;

   c. a dock intended for the use of a private residence, which is not subject to obtaining a lease, shall not exceed 4 feet in width, terminal platform shall not

exceed 160 square feet, the width of which shall not exceed 8 feet;

5. Special conditions for new or expanded docking facilities for 10 or more boats require that water quality standards be maintained, monitored, and that violations of same are to be corrected and establishes penalties for failure to do so;

6. New or expanded docking facilities will identify ways to improve, mitigate or restore adverse environmental impacts caused by previous activities and encourages marina development to locate in already developed or disturbed areas;

7. Docking facilities for 10 or more boats shall be required to have a lease;

8. All applicants will be required to provide documentation to show that there is an economic demand for the number of boat slips requested, if the number is not consistent with the Department's Projections of Marina Needs for Monroe County;

9. multi-slip docking facilities shall not be considered for approval if located over a benthic community, except main access docks that may cross benthic communities to reach acceptable areas. This shall not preclude applications for consent of use for the purpose of using the minimum amount to obtain reasonable ingress and egress; and

10. the Board may grant special considerations to the approval of leases or other consent to use state lands for projects which are approved by the Department of Community Affairs which are for the purpose of furthering the commercial fishing village or commercial fishing enterprise zone concept.

Lease or Transfer of Lands: Section 18-20.004(1)(b), F.A.C.. states that there shall be no further lease or transfer of sovereignty lands within an aquatic preserve unless such transaction is in the public interest. Section 18-20.004(2), F.A.C., specifically defines the public interest test (see Appendix A for a copy of Chapter 18-20, F.A.C.). Section 18-20.004(1)(e), F.A.C., states that a lease, easement, or consent of use may be authorized for only the following activities: (1) a public navigation project; (2) maintenance of an existing navigation channel; (3) installation or maintenance of approved navigational aids; (4) creation or maintenance of a commercial/industrial dock, pier, or marina; (5) creation or maintenance of private docks; (6) minimum dredging of navigation channels attendant to docking

facilities; (7) creation or maintenance of oil and gas transportation facilities; (9) creation, maintenance, replacement, or expansion of facilities required for the provision of public utilities; and (10) other activities which are a public necessity or which are necessary to enhance the quality or utility of the preserve and which are consistent with the Florida Aquatic Preserves Act (Sections 258.35 and 258.46, F.S.). Section 18-20.004(1)(f), F.A.C., states that structures to be built in, on, or over sovereignty lands are limited to those necessary to conduct water-dependent activities.

Utility Easements: Section 18-20.004(3)(c), F.A.C., states that utility cables, pipes, and other such structures shall be constructed and located in a manner that will cause minimal disturbance to submerged resources (e.g., seagrass beds, corals) and do not interfere with traditional uses. It will be policy to place additional utilities within designated corridors or existing easements unless no other reasonable alternative exists.

Spoil Disposal: Section 18-20.004(3)(d). F.A.C., states that spoil disposal within an aquatic preserve shall be strongly discouraged and may be approved only where the applicant has demonstrated that there is no other reasonable alternative and that the spoiling activity may be beneficial to, or at a minimum, not harmful to the quality or utility of the preserve. It will be the policy to prohibit spoil disposal onto a PRPA within the aquatic preserve.

Boardwalks: Boardwalks shall be limited to the riparian upland, with the exception of sovereignty submerged lands adjacent to public lands, in which case they shall meet the minimum design criteria for single family docks and be constructed in such a manner as to allow maximum light penetration, natural flow of waters and have hand rails to prevent pedestrian access to traversed wetlands. Boat docking or mooring within 500 feet of a boardwalk is prohibited and "Docking Prohibited" signs will be displayed on the waterward face(s) of the structure. The only exception to the 4 feet width shall be to accommodate public access for documented handicapped use. If a public boardwalk is intended for handicapped use, it will be allowed to have 3 feet wide by 6 feet long by-pass(es) at 300 feet interval(s) on one or the other side of the main four feet wide walkway.

Ramps: Boat ramps will be reviewed on a case-by-case basis. Factors to be evaluated will include: (1) the extent of alteration or elimination of natural resources or habitat (e.g., seagrasses, shoreline vegetation, nesting areas), and (2) accessibility to the ramp from water and land routes (e.g., adequate water depths over sovereignty submerged

lands). In no event shall dredging or filling of sovereignty lands in a PRPA be authorized.

Additional criteria for the repair, replacement, and expansion of existing structures are provided for in Chapter 18-21, F.A.C. Replacement and expansion of structures must comply with the minimum criteria provided for in Chapter 18-20, F.A.C.

Criteria more restrictive than those listed in Chapter 18-20, F.A.C., will be used if the biological and physical conditions of an area warrant it. As an example, docks may be limited in size to protect seagrasses and corals. Areas requiring more stringent criteria will be referred to as special management areas and such areas will be labeled with the additional letter **"a"** on resource maps. Again, as an example, if management area PL/1 requires more restrictive criteria, then this special management area would be classified as **PL/1a.**

D. MANAGEMENT AREAS

In this section, each management area is delineated with boundaries, descriptions, and allowable uses. Specific criteria and supporting rationale for each special management area is also provided. Final determination of allowable uses will be made by the Bureau of Submerged Lands and Preserves staff on a case-by-case basis. Figure 6 is a map of the management areas within the preserve. The purpose of providing this map is to give some general guidance and an understanding of where the management areas lie within the preserve.

Some of the management areas reflect specific upland uses in association with differing boundaries. As an example, two or more upland parcels may have a similar use, yet the adjoining submerged lands may have different resource types, and thus have a different designated use. Other management areas may have a specific activity occurring within that is not reflective of the overall upland use.

It should be noted that the following described boundaries include **only state-owned submerged lands.** Privately held submerged lands and privately owned riparian uplands are excluded from the boundaries, as provided for in Section 18-21.0041(3). Likewise, those submerged lands north of the Intercoastal Waterway and contained within the boundaries of Everglades National Park are specifically excluded from the established management areas and criteria for state-owned submerged lands. All activities, structures and uses within the park boundary are dictated at the discretion of the National Park Service.

MANAGEMENT AREA PL/1 a
(public lands/primary resource protection area)
special management area

Boundaries: The Public Lands (Primary Resource Protection Area with specific criteria) management area includes all sovereignty submerged lands within the Lignumvitae Key Aquatic Preserve not previously conveyed or leased to the Division of Recreation and Parks, Florida Department of Transportation, Everglades National Park, private entities or as described for PL/2 and C/1 below.

Description: The area is characterized by fringing mangroves, mangrove islands, hardbottom and marine grassbed associations. The shallow grassbeds and mangrove areas provide feeding and refuge habitat for wading and diving birds. State owned lands adjoining the area exhibit salt marsh, mangrove, buttonwood, and tropical hardwood hammock associations and are habitat for endangered, threatened, and species of special concern.

Present development adjoining or within the area includes the U.S. roadway and associated structures, the docks at Lignumvitae Key, and navigational markers. Existing county land use classification on Upper Matecumbe Key (that adjoins the management area) is Native Area and consists of a wide, undisturbed mangrove fringe. Water depths are typically shallow near shore.

Allowable Uses: Public docks; utility easements; navigation aids; highway maintenance/improvements; boardwalks; boat ramps, preserve signage and normal repair and maintenance of existing state facilities.

Specific Criteria: The dock shall be the minimum size for safe loading and off loading of passengers and mooring of the attendant vessel(s). Trimming or removal of fringing mangroves shall be limited to the minimum required for the access pier of the dock or boardwalk to reach open water. Handrails and/or signage may be required to discourage docking at the access pier or other portions of the dock or boardwalk that traverse waters of less than -4 feet MLW.

Off shore structures will be limited to navigational aids that may be established in the vicinity of the channels to discourage boat groundings and prop dredging and/or approved signs or buoys to mark the boundaries of the preserve, to mark research areas, to display environmental education messages or to identify limited or restricted access areas.

Rationale: The dock criteria are designed to limit impacts to important marine resources, such as mangroves, corals and marine grasses. Minimum depths are necessary to prevent scouring of bottom features and to prevent excessive

suspension of sediments by prop wash. Public access elevated board walks are preferable to use of foot trails that compact soils, create erosion channels and destroy vegetation in wetland areas. Heights and widths of boardwalks are intended to reduce shading and to eliminate obstructions to natural water flow.

MANAGEMENT AREA PL/2
(public land/secondary resource protection area)

Boundary: This Public Lands (within Secondary Resource Protection Area) management area includes all sovereignty submerged lands parallel and north of the U.S. 1 roadway between Teatable and Lignumvitae Channels to a distance of 300 feet from the roadway edge.

Description: Submerged lands have been dredged and filled over much of this area. The two natural channels traverse the preserve in this location. This area adjoins the boat basin, landing and staging areas for the Park Service tour boat and a make-shift boat ramp and parking area. The west end of the boat basin was originally used as a designated ramp but poor design and subsequent filling-in has preempted use of this area. Poor orientation and flushing capabilities create a catchment for nutrient rich detrital sediments that are anaerobic in the western one-third of the basin. The eastern portion exhibits a mix of unconsolidated rock rubble and marine grassbeds. Other areas along the shoreline exhibit a mix of patchy grassbeds, hardbottom, rock rubble and sand/mud bars.

Currents in the vicinity of the three channels may exceed 5 knots during flood and ebb tides, making these hazardous areas for small boats, swimmers and divers.

Allowable uses: Public docks; boat ramps; utility easements; highway maintenance/improvements; normal repairs and maintenance of existing state facilities; approved preserve and state park signage; and navigational aids.

Specific Criteria: The existing aerial utility lines shall be maintained in a safe condition to prevent accident or injury to the public and resources of the preserve. Any application to replace or substantially repair all or portions of the line or poles shall be evaluated by the anticipated impacts to marine grassbeds. In no event shall dredging be authorized to access, repair or replace the line. Tug, barge or other equipment to access or operate in the area shall be of a draft that does not substantially disturb or prop dredge the bottom. Applications for such work shall be required to contain a description of the types, draft and numbers of vessels or

equipment to be used and a detailed plan and time frame for restoring and replanting areas that may be damaged.

Rationale: The line and poles traverse extremely shallow waters adjacent to lush grassbeds. Conventional marine construction equipment could inflict serious damage to marine grassbeds in the area.

MANAGEMENT AREA C/1 a
(commercial/primary resource protection area)
special management area

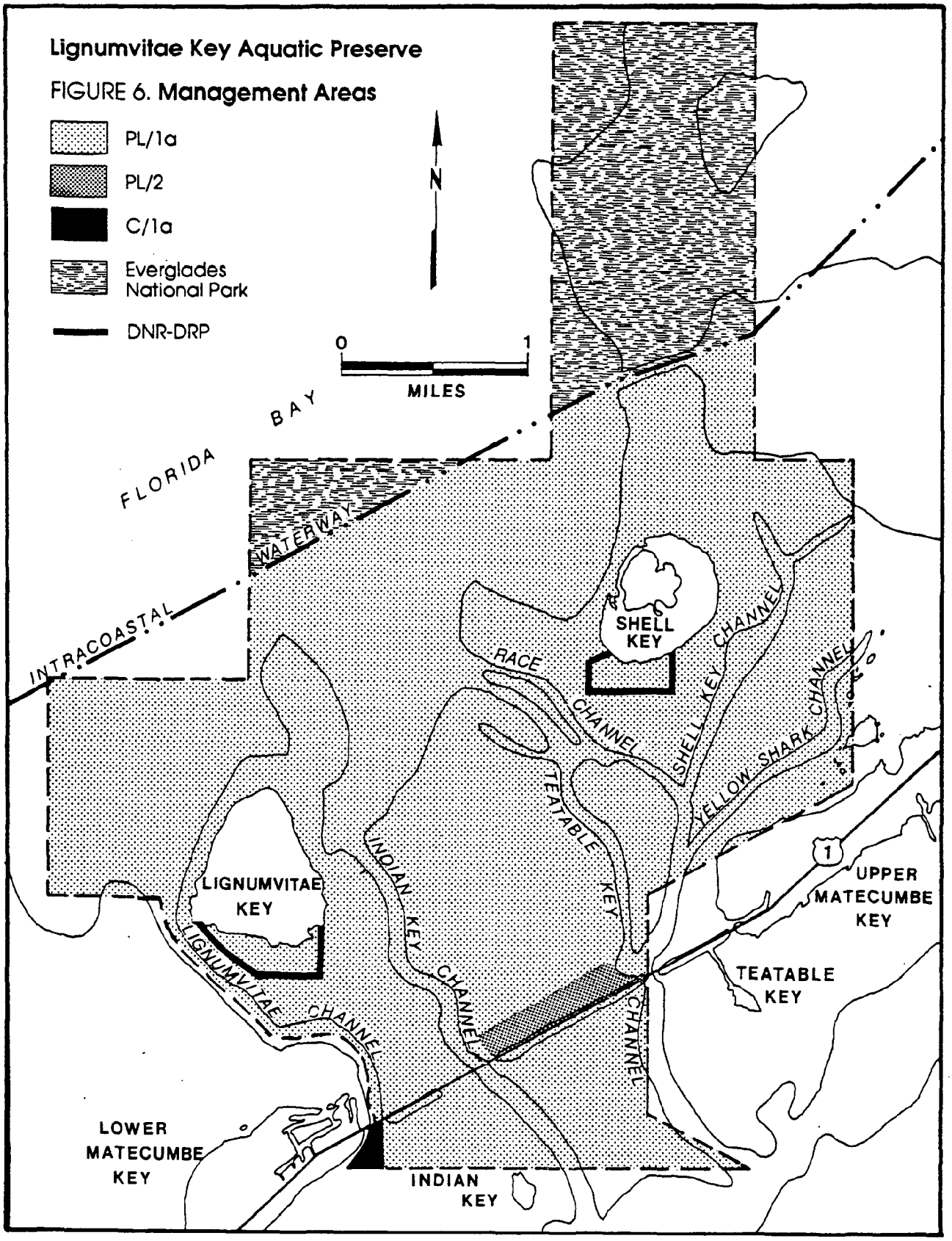
Boundary: The Commercial (within a Primary Resource Protection Area with specific criteria) management area will include all sovereignty submerged lands within the preserve adjacent to the southeast shoreline of Lower Matecumbe Key south of the U.S. 1 right-of-way, except for privately held submerged lands.

Description: Adjoining uplands are composed of saltmarsh, buttonwood, beach/berm and disturbed vegetation. Submerged lands are typically hardbottom, marine grassbeds and mud/sand flats. Water depth is less than three feet on high tide except in Lignumvitae Channel. This area provides access to waters of the Atlantic and Florida Bay. The two adjoining parcels of privately held submerged lands are similar in depth and biological components and have a privately maintained channel that accesses the preserve boundary in Lignumvitae Channel.

Allowable Use: Highway maintenance/improvements; and navigational aids.

Specific Criteria: Activities in this management area will be limited to improvements or repairs to U.S.1 right-of-way and navigational aids. No new dredging or filling will be authorized on submerged lands in the preserve, except in connection with highway projects.

Rationale: Present use adjoining this area is for a motel and related amenities, including a boat basin and privately maintained channel. The channel was dredged on privately held submerged lands and accesses the boundary of the preserve at Lignumvitae Channel. The present access is considered to be adequate for riparian use.


Lignumvitae Key Aquatic Preserve
FIGURE 6. Management Areas
PL/1a
PL/2
C/1a
Everglades National Park
DNR-DRP
N
0
1
MILES
FLORIDA BAY
INTRACOASTAL WATERWAY
SHELL KEY
RACE CHANNEL
SHELL KEY CHANNEL
YELLOW SHARK CHANNEL
TEATABLE KEY
INDIAN KEY CHANNEL
LIGNUMVITAE KEY
LIGNUMVITAE CHANNEL
CHANNEL
1
UPPER MATECUMBE KEY
TEATABLE KEY
LOWER MATECUMBE KEY
INDIAN KEY

CHAPTER V

SITE SPECIFIC MANAGEMENT ISSUES

The first part of this chapter deals with management issues involving specific activities, as opposed to permitted structures, that directly affect the biological integrity of the Lignumvitae Key Aquatic Preserve. The issues that are specific to this area include, but are not limited to: conflicting uses, increasing watercraft traffic, damage to marine resources, the protection of designated species and their habitat, the protection of bird feeding and resting areas, research needs, acquisition of environmentally sensitive lands, boundary extension, and enforcement. Other issues may arise as future use intensifies and these will be identified as they develop.

The second part of this chapter establishes policy guidelines for these issues. These policy guidelines are intended to provide additional management direction and supplement those set forth by Chapter 258, F.S., Chapters 18-20 and 18-21, F.A.C., and Chapter IV of this plan.

A. MANAGEMENT ISSUES AND SPECIAL NEEDS

1. CONFLICTING USES

To some extent many of the issues identified in this section are directly related to uses that may fulfill one individual or groups needs but are in conflict with another's activities (or safety) and/or the legislative intent for establishing the preserve. Activities that compromise or damage resources may not always seem significant unless cumulative impacts are taken into account. Any of the following activities should be evaluated for the long-term cumulative impacts.

Vessel mooring for extended periods shades submerged grasses and may create hazards to navigation. Liveaboard vessels often compound impacts with wastes and sewage that are introduced to surrounding waters, whether intentional or accidental. Boat operation and anchorage in shallow water disturbs bottom communities and resuspends sediments that affect light penetration to vegetation and coral. Anchoring in grassbeds causes damage when anchors are dragged across the bottom. (Policy Guidelines 1 and 11)

Both commercial and amateur collectors remove tropical fish and marine invertebrates from the preserve. Chapter 46-42.001, F.A.C., states that recreational collectors may take up to 25 individuals from the restricted species lists per day (fish, invertebrates and algae). Commercial collectors are generally

licensed and have established daily bag and size limits for some (but not all) fishes and invertebrates and four species of algae. Commercial harvest limits may exceed recreational limits for angelfish (75 per person/150 per boat/per day) and butterflyfish (75 per vessel/per day). There are no limits on commercial collecting of gorgonians (except Gorgonia ventalina and Gorgonia flabellum, which are totally protected), until the limits in federal waters have been met. There are 7 or 8 commercial collectors working either seasonally or annually in the preserve. The number of amateur collectors is unknown.

Uncontrolled or excessive collecting pressure on tropical fishes and other marine life may seriously alter species, age and size class distribution in the preserve. Selective removal of the 'aquarium size' fish and invertebrates alters food webs and ecological partitioning in various communities. Diversity and the long term stability of these environments may be compromised. Collectors also detract from others' enjoyment of the area by removing many of the more colorful fish and invertebrates. Most of the collectors have been observed near the bridges and thus may create navigational and safety hazards for other preserve visitors. (Policy Guidelines 1, 6 and 16)

2. INCREASED AIR AND WATER CRAFT USE

The use of aircraft in and over the preserve area has given rise to heated outrage by many of local fishermen and residents and is extremely disruptive to bird life. The northern most portion of Lignumvitae Key Aquatic Preserve (within the boundary of Everglades National Park) is federally restricted air space. There is no locally specified air port district which allows this type of activity, nor is there a designated federal landing area in the vicinity. The use of commercial or private seaplanes and ultra light air craft are not compatible with the traditional uses recognized for the preserve. Nor are these uses compatible with the resource management goals outlined in Chapter VI of this plan. (Policy Guideline 12 and 16)

Logically, the numbers and types of watercraft within any given body of water must be compatible with the available space and existing water depths. Most boat traffic utilizes the channels in the preserve for access to the Atlantic Ocean and Florida Bay and thus are only passing through the area. As previously noted, a large number of sport fisherman also frequent the grass flats in the preserve. As populations increase, so do the numbers and types of watercraft in the preserve. Increased pressure on limited resources and space invariably generates conflicts with other visitors and public safety.

Increasing use of the areas adjoining U.S. 1 for swimming and snorkeling is a paramount concern. Boaters use the parallel channels between Upper and Lower Matecumbe to circumnavigate the large grassbeds and to access deeper waters in Indian Key Channel. South of U.S. 1, the channel is narrow and shallow. This area attracts many swimmers and snorklers. The boaters may also use the channel to the north of the highway. To alleviate the potential danger to swimmers and snorklers, the area between Lignumvitae Channel and Indian Key Channels needs to be designated as an idle speed zone and all swimmers and snorklers should be required to display a divers down flag.(Policy Guideline 15 and 16)

Additionally, one must consider the purposes for designating the preserve; to manage primarily for the maintenance of essentially natural conditions, the propagation of fish and wildlife and public recreation. Preservation of natural conditions is critical to maintaining fish and wildlife habitats. If preserve visitors are to experience safe areas for swimming and snorkeling, quiet areas for fishing and wildlife observation, some regulation of boating traffic is essential. (Policy Guidelines 1, 2, 4, 8, 15 and 16)

3. PROTECTION OF DESIGNATED SPECIES AND THEIR HABITAT

The Florida Keys are host to a variety of marine life and other species that have been designated as endangered, threatened or species of special concern. Designated animal species are not sedentary but traverse and utilize a wide variety of habitats. Many designated species are frequent visitors to or 'residents' of the Lignumvitae Key Aquatic Preserve.

Listed Bird Species: Colonial wading and diving birds nest in close proximity to the preserve and use the area extensively for feeding and resting. The shallow grassbeds, mangroves and saltmarsh buttonwood areas are especially attractive to them. Destruction of grassbeds and mangroves, boat traffic in shallow waters and vehicular traffic in the saltmarsh buttonwood areas disrupts or destroys vital habitat and inhibits expansion of nesting areas. Ground nesting birds are equally subject to disturbance from foot and vehicular traffic.

Other Listed Wildlife Species: As new species are listed or as more information becomes available about the life histories and habitat needs of presently listed species, certain activities and management policies may need to be established or revised to reflect these changes. For the present, all state owned lands will be maintained in their 'essentially natural condition,' as listed species' affinity for these types of areas has been demonstrated.

Listed Plant Species: To the greatest extent possible, state owned lands within the preserve should be protected from land clearing, mangrove trimming and topographic alterations that would negatively impact habitats for these plants. Collecting, vehicular and foot traffic, altered water flow and herbicides represent serious impacts to the plants themselves and the habitat required for their survival. Restoration of historic plant communities and eradication of invasive exotic plants would also enhance habitat for these species and wildlife. (Policy Guidelines 3, 4, 5, 6, 7, 9, 10, 12, 13 and 16)

4. DAMAGE TO SUBMERGED RESOURCES

Damage may be due to natural events, such as hurricanes or disease but is most often the direct result of man's activities in or adjacent to the preserve. Tropical storms may erode or bury grassbeds, alter channels and blanket corals and hardbottom communities with sediments. These are natural cyclic events that have occurred for thousands of years. As previously noted, the capabilities for recovery of these communities may be inhibited by the activities of man.

Inexperienced boaters and careless boat operation in shallow waters are responsible for extensive propeller scouring or dredging of marine grassbeds in the preserve. Bottom scouring removes valuable habitat, resuspends sediments creating turbidity plumes that blanket adjacent grassbeds and hardbottom areas. These prop scars are slow to revegetate and may be subject to additional erosion on channel edges. (Policy Guidelines 1, 2, 4, 5, 7 and 15)

5. RESEARCH NEEDS

Current research being conducted will hopefully provide a better understanding of the origins, processes, extent and severity of mortality of marine grassbeds in Florida Bay. Since this phenomena (and others) are a regional concern, and since the grassbed communities are habitat for a broad range of commercially and biologically significant species, all efforts to identify affected areas and garner funding support for research are considered a major priority.

Sediment and water quality research and monitoring are also a priority. Nutrients, metals, pesticides, and other organic compounds associated with septic and sewage treatment, farming activities on the mainland and run-off from poorly planned development are potential sources of pollution. Knowledge of the sources, concentrations and long term effects of pollutants that enter waters and sediments of the preserve are needed. (Policy Guideline 7)

6. ACQUISITION OF ENVIRONMENTALLY SENSITIVE LANDS

Extensive areas of saltmarsh and mangrove wetlands lies to the east and west of the preserve. A large parcel on Lower Matecumbe has been purchased by the state and the submerged portions of that tract should be included within the preserve or otherwise managed to prohibit prop dredging of the narrow, shallow channel that parallels this shoreline. Persistent scouring in this area resuspends sediments and damages marine grassbeds and fringing mangroves. Poor visibility and dangerous passing conditions in this channel have caused some boaters to prop dredge a second channel across the shallow flat to the north. Development of the presently vacant lands in this area would serve to exacerbate boating related impacts. (Policy Guidelines 3, 9 and 16)

7. BOUNDARY EXTENSION

Large corals, significant hardbottom and grassbeds lie seaward of the present Atlantic boundary. These areas are in waters from -4 to -18 foot depths and include the San Pedro wreck site and waters around Indian Key. As discussed in earlier sections of this plan, the original boundary map of the preserve would have included most of this area and it is believed that this was the intent of the Governor and Cabinet in designating the preserve. (Policy Guideline 10)

8. DEVELOP A MOSQUITO CONTROL PLAN

Past and present mosquito control activities have and will continue to impact resources within the aquatic preserve. Aerial or ground application of insecticides and carrier substances may introduce toxic substances into waters of the preserve. Coordination and cooperation with the local mosquito control district to develop a mutually acceptable management plan is imperative to protect human health and welfare and the aquatic resources of the preserve. (Policy Guideline 13)

9. DEVELOP AN ENFORCEMENT MANAGEMENT AGREEMENT

The Florida Park Service (Division of Recreation and Parks) has on-site law enforcement certified staff to protect and enforce laws applicable to the administration of park lands. However, jurisdictional boundaries for their authority do not include water areas of the preserve. Present activities are limited to observation and reporting violations and damages to the aquatic preserve staff and Florida Marine Patrol. Since many of the violations are resource related and are of a misdemeanor nature, observation by the arresting officer is

required. Therefore, infractions of marine fisheries, diving, spearfishing and boating laws are often not cited, even though observed. Cooperative management of the area cannot be effective unless laws and rules can be enforced. (Policy Guideline 14)

10. PUBLIC SAFETY

High speed boating through the channel that parallels the south side of U.S. 1 between Lignumvitae and Indian Key Channels has resulted in a near fatal accident when a snorkler was run down. Boaters have the option of using the channel to the north of the roadway or circumnavigating the grass flat to the north or south. Swimming and snorkeling should not to be encouraged to the north of the roadway because of deeper waters, the existing boat ramp and heavier boating traffic. Vessel mooring in the previous area obstructs safe passage by other vessels and represents a hazard to swimmers and snorklers. Since boating and swimming activities are considered traditional uses of the preserve, some compromise must be made in this area. Limiting boat traffic to idle speed in the south channel would not preclude use but would increase safety for swimmers and snorklers. Conversely, all swimmers and snorklers should be required to display divers flags to alert boaters to their activity. (Policy Guideline 15)

B. POLICY GUIDELINES

This section of the plan contains a number of management policies guidelines that address the site specific management issues identified as being particular to Lignumvitae Key Aquatic Preserve. Adoption of these policy guidelines will provide specific direction for managing those issues not addressed directly by statute or rule. The major policy guidelines for these issues include:

1. Promote recognition and appreciation of the fact that marine grassbeds provide essential habitat and food sources for a variety of organisms essential to the biological integrity of the preserve. This biological integrity translates into significant economic value to this region, especially in terms of recreation, tourism and fisheries.

2. Reduce the impacts to marine grassbeds from prop dredging and grounding damage by establishing a uniform system of channel marking in the preserve.

3. Promote the acquisition of privately owned mangrove wetlands, submerged lands and uplands adjacent to and in close proximity of the preserve in order to enhance the

available habitat for endangered, threatened and species of special concern.

4. Protect valuable feeding and resting areas for birds and other wildlife by prohibiting jet skis and (motor) boat operation in shallow waters, through supporting appropriate rule changes or encouraging local ordinances.

5. Protect all biological resources by providing public information displays, brochures and other programs to increase awareness of the preserves resources.

6. Monitor and protect the biological diversity and ecological balance of the hardbottom and marine grassbed communities by seeking legislation that would require all collectors of ornamental, aquarium marine life species (including those regulated by Chapter 46-42, F.A.C.) to provide detailed species and quarterly landings data for all species harvested in the preserve to the Division of State Lands Field Office.

7. Identify specific research needs and actively seek support on a Division level for research funding.

8. Promote the protection of marine and upland resources by disseminating literature and conducting environmental education activities, both on and off site.

9. Promote acquisition of privately held, environmentally sensitive lands to protect upland and marine resources, and to maintain scenic vistas and aesthetic qualities of the preserve.

10. Support extension of the Atlantic preserve boundary to the -18 foot contour to protect larger corals, hardbottom and marine grassbeds.

11. Protect water quality, aesthetic values and benthic communities by seeking appropriate legislation to prohibit liveaboard vessels and restrict transient mooring in the preserve.

12. Reduce impacts to feeding and nesting birds, as well as aesthetic appreciation of the preserve by seeking appropriate federal, local and/or state code, statute or rule changes to prohibit commercial and private aircraft from flying less than 500 feet over or landing in the preserve.

13. Reduce or eliminate adverse impacts to biological resources of the preserve by coordination and cooperation with Monroe County Mosquito Control District and the Department of Health and Rehabilitative Services to

develop a mutually acceptable arthropod control management plan for the preserve area, pursuant to Chapter 388.411, F.S.

14. Pursue formulation of a management agreement that would authorize on-site Division of Recreation and Parks staff to enforce relevant laws regarding marine pollution, fisheries violations, trespass and the destruction of natural features.

15. Reduce potential conflicts between user groups and protect public safety by establishing an idle speed zone between Lignumvitae and Indian Key Channels, south of U.S. 1 and prohibit mooring in that area.

16. Encourage activities within the preserve which are compatible with the purposes of protecting biological diversity and productivity. Examples would be the use of non-motorized shallow draft watercraft, such as canoes and kayaks, and activities such as photography and nature study.

CHAPTER VI

MANAGEMENT ACTION PLAN

The purpose of this chapter is to establish guidelines that allow for the sound management and protection of the aquatic preserves natural resources for the benefit of future generations (Section 258.35, F.S.)

Before an effective program can be designed to manage and protect natural resources, one must complete an inventory of the resources, establish what their functions are, decide the importance of these functions, and where these resources are located. Additional efforts will consist of identifying those activities or parameters that affect these resources, either positively or negatively. This information will form the foundation from which action will be initiated to manage and protect these resources. The management strategies for an aquatic preserve program must consist of a variety of components such as resource management, resource protection, research, and environmental education.

In general, the role of the program in management of the aquatic preserve includes: 1) providing information on the ecological functions and economic importance of resources within the preserve, 2) overseeing those activities that affect the natural resources, 3) ensuring that accurate biological and physical information is considered in permitting and planning decisions, 4) ensuring that all statutes and rules regarding the preserve's natural resources are complied with and that violations of these provisions are investigated and corrected by appropriate enforcement agencies, 5) conducting on site surveys for specific activities, 6) coordinating with other resource management and enforcement agencies, 7) educating the public on the inherent values associated with natural resources, 8) conducting or cooperating with a comprehensive management program that can be periodically updated to reflect the dynamics of natural systems and the changing needs of man and the resources. To achieve those ends this section of the plan establishes goals and identifies the supportive objectives and develops tasks to accomplish those goals.

For all of the following goals, objectives and tasks, the Department of Natural Resources will, when appropriate and practical, participate with other agencies and organizations dedicated to protecting the local resources. In order to avoid duplication of effort the Department will initiate programs only when they do not overlap or compete with programs operated by other governmental agencies or non-profit corporations.

A. RESOURCE MANAGEMENT

The overall goals of resource management within aquatic preserves are: 1) conducting and maintaining resource inventories, 2) assessing the impact of human activities on the resources, 3) establishing habitat restoration programs, and 4) cooperating with other agencies in assessing, improving and/or maintaining conditions that are conducive to preserving the resources and water quality.

GOAL A.1: CONDUCT AND MAINTAIN RESOURCE INVENTORIES

Objective A.1.1: To conduct and maintain a resource inventory of submerged resources for the aquatic preserve.

Task A.1.1.1: Conduct an inventory of marine grassbeds, algal beds, coral banks, and hardbottom areas by using LANDSAT imagery, aerial photography, and groundtruthing efforts every three years, or more often if warranted.

Task A.1.1.2: The data base generated from these inventories will be used to create and maintain biological resource maps that will be consulted when assessing a proposed activity or evaluating potential impacts from manmade or natural events.

Task A.1.1.3: All additional sources of data such as marine life landings statistics, marine mammal strandings, die-offs, or other unusual events will be recorded.

Task A.1.1.4: These inventories will be available to public agencies involved in resource management and land planning.

Objective A.1.2: To conduct and maintain a resource inventory of emergent vegetation and habitats for the preserve lands.

Task A.1.2.1: Conduct and maintain an inventory of mangroves and buttonwood/saltmarsh, other shoreline vegetation and associated organisms in and adjacent to the preserve by using LANDSAT imagery aerial photography and groundtruthing efforts every three years, or more often if necessary.

Task A.1.2.2: The database generated from these inventories will be used to create and maintain biological resource maps that will be consulted when assessing a proposed activity or evaluating potential impacts from manmade or natural events.

Task A.1.2.3: These inventories will be available to public agencies involved in resource management and land planning.

Objective A.1.3: Conduct and maintain inventories of designated species and their habitats for the preserve.

Task A.1.3.1: Conduct and maintain inventories of designated species and their habitats by using data from existing literature, managing agencies, field observations and current research studies every three years, or more often if deemed necessary.

Task A.1.3.2: Coordinate with appropriate management and enforcement agencies to ensure that preserve management decisions and public actions or activities are compatible with the viability and management of a species or habitat.

Objective A.1.4: To conduct and maintain inventories of wading and diving birds and their habitats in the preserve.

Task A.1.4.1: Conduct and maintain inventories of coastal waterfowl and migratory bird species that feed, nest, roost and loaf in the preserve and adjacent areas by using existing literature, bird counts, field observations, and current research studies every three years, or more often if deemed necessary.

Task A.1.4.2: Coordinate with appropriate management, enforcement and research agencies to ensure that preserve management decisions and public actions or activities are compatible with the viability and management of a species or habitat.

Task A.1.4.3: Coordinate with public or conservation agencies that may be conducting similar inventories of species, populations, life histories, migration patterns and habitat needs where mutual benefits in knowledge and management objectives are to be gained.

GOAL A.2: ASSESS THE EFFECTS OF HUMAN ACTIVITIES/CUMULATIVE IMPACTS

Objective A.2.1: To inventory and assess the effects of structures and human activities on the natural resources of the preserve.

Task A.2.1.1: Survey and inventory structures in the preserve every three years or more often if necessary. This survey shall contain at a minimum:

a) types of structures (dock, pier, seawall, rip-rap, piling, mooring buoy, utility pole, etc.);

b) design of structures (width, length, height above MHW, square footage of access pier and terminal platform, number of pilings, number and size of finger piers, construction material (wood, boulder or concrete), deck spacing, material treatment (pressure and/or chemical treated), type of anchorage for buoys or pilings, etc.);

c) the water depth at the terminus of the structure and/or relation to MHW line for shoreline stabilization;

d) number of boats using a structure;

e) functional condition of the structure;
f) any accessory facilities and ancillary uses associated with the structure;

g) the structure's use category (e.g., single family, commercial, etc.);

h) an inventory of the biological resources within the preempted area and within 25 feet of the structure or activity;

i) the distance, depth and width of the primary access channel;

j) a survey of all dredged areas including:
    1) the location, length, width, and depth of the dredged area;
    2) depth of profiles of the surrounding area;
    3) traditional use of the area;
    4) biological resources in the dredged and surrounding area;
    5) whether the dredged area is a private or public project;
    6) review of information on pre-existing resource conditions;
    7) potential alternatives to alleviate the need for maintenance dredging (shoreline stabilization, wave baffles, etc.); and
    8) whether channel markers may be needed to direct traffic away from adjacent submerged resources.

k) a survey of all shoreline stabilization projects, including:
    1) location and total length of riparian shoreline;
    2) length of the shoreline stabilization;
    3) design of project;
    4) review of existing and pre-existing biological resources in the vicinity of the structure;
    5) whether the project is effective in stabilizing the shoreline; and
    6) whether toe rip-rap or mangrove plantings may improve upon the effectiveness of the structure.

l) a determination as to whether the structure or activity complies with the applicable statute or rule and with lease, easement or consent of use conditions, where appropriate;

Task A.2.1.2.: Survey and inventory human activities within the preserve annually. This inventory will include at the minimum:

a) numbers of individuals or groups involved in activities by category (consumptive/nonconsumptive; water dependent/non-water dependent, commercial/recreational, etc.) from weekly patrol logs, reports, or expanded visitor surveys and monitoring;

b) illegal, unsafe or ecologically disruptive activities; and

c) activities that require additional monitoring to evaluate intensity or trends in use of the preserve or its resources.

Objective A.2.2: To assess cumulative impacts of structures and activities on the resources of the preserve.

Task A.2.2.1: All activities and structures will be surveyed as outlined in Task A.2.1.1 and appropriate files kept and updated every three years to establish net loss or gain of resources as related to structures and construction activities. Files shall contain at the minimum:

a) size, configuration and preempted area of the structure and related use;

b) a survey of the biological resources within the preempted area and within 50 feet of the preempted area;

c) condition and extent of those resources as related to previous surveys (grassbeds expanding or declining, prop scouring, establishment of different type of community, etc.);

d) whether existing use is consistent with the type of use or activity authorized.

Task A.2.2.2: Survey major access and use areas for impacts to natural resources associated with human activities. This file shall contain but is not limited to the following information:

a) assessments of areas or resources damaged by visitors or transient traffic in the preserve (erosion, pollution, destruction of vegetation, interruption of wildlife habitat or behavior, vessel groundings, prop dredging, turbidity, trash dumping, etc.);

b) illegal or unauthorized activities that require assistance from other agencies or enforcement authorities to resolve;

c) management alternatives to alleviate impact; and

d) recommendations for management.

GOAL A.3: HABITAT RESTORATION

Objective A.3.1: Restore or enhance suitable habitats or resources where feasible.

Task A.3.1.1: Using resource inventories generated from A.1., identify those resource areas that have been or are being negatively impacted by external influences. These influences may include, but are not limited to; prop scars, spoil banks, dredged areas, boat grounding areas, clearings, dumping, mosquito ditches, erosion, abandoned traps or vessels, exotic vegetation, and roads.

Task A.3.1.2: Prioritize potential restoration areas according to severity of impact to the immediate resources and to the overall functional integrity of the preserve.

Task A.3.1.3: Develop procedures and guidelines for addressing the priority areas for restoration, such as exotic plant removal, beach clean-up, removal or planting of spoil banks, revegetating grassbed or mangrove areas, enhancing listed species habitats, removal of derelict vessels and abandoned traps, filling in mosquito ditches, reestablishing historic water flows, etc.

Task A.3.1.4: Investigate and contact other agencies, groups, institutions, and individuals who may be available to provide scientific, logistic, financial, enforcement, manpower or other support in accomplishing the habitat restoration or enhancement.

Task A.3.1.5: Monitor and review progress on restoration projects.

a) Monitor restoration procedures while in progress and restored areas on at least an annual basis.

b) Maintain accurate records of the project including but not limited to:

1) type of project;
2) anticipated results;
3) benefits to the resource;
4) location, date, parties involved, duration of project;
5) completion date;
6) monitoring schedule;
7) results or changes observed;
8) additional maintenance or monitoring required;
9) estimated cost of project in time and funding;
10) an assessment of the success of the project or an explanation of why anticipated results were not achieved;
11) recommendations as to how the project could or should be improved upon; and

12) if the procedure could or should be used for future or similar projects.

GOAL A.4.: RESTORE, ENHANCE OR MAINTAIN WATER QUALITY

Objective A.4.1.: Coordinate with appropriate agencies to improve and/or maintain water quality in the preserve.

Task A.4.1.1: Acquire, maintain and review all records of water quality data for the preserve area.

Task A.4.1.2: Coordinate with regulatory and management agencies in identifying and managing areas within the preserve that may be contributing to sedimentation or other undesirable impacts to waters of the preserve (mosquito ditches, compaction of soils and channelization of run-off from roads, previous land clearing, etc.).

Task A.4.1.3: Report suspected or identified instances of violations to appropriate regulatory and enforcement agencies.

B. RESOURCE PROTECTION

In order to maintain the biological integrity of the aquatic preserve, it is imperative to protect the resources that comprise the system. In most cases, it is not feasible, nor is it desirable, to provide protection for individual species that are a part of the various habitats that make up the preserve. Therefore, the goals of resource protection outlined in this element will be directed toward protecting the habitats that are vital to the survival of the species and in conjunction with other habitat types are the functional basis of biological integrity and stability within the preserve. These goals include: 1) protection of submerged resources (patch reefs, coral banks and heads, grassbeds and hardbottom habitats), 2) protection of emergent vegetation (mangroves, saltmarsh/buttonwood, beach/berm and tropical hardwood hammock habitats), and 3) protection of designated species habitats.

GOAL B.1.: PROTECTION OF SUBMERGED RESOURCES

Objective B.1.1.: Minimize potential damage to submerged resources through the review of applications for use of state-owned lands in the aquatic preserve.

Task B.1.1.1.: Develop a written description of a scientifically based, standardized method to inventory the minimum, this method will contain the following information:

a) The area to be surveyed will be described:
   1) as a polygon, and

2) it will include a buffer zone surrounding the project of sufficient size to include a majority of the potentially affected area.

b) How the survey is to be performed:
1) The submerged bottom, including:
i. a description of all communities/habitats,
ii. a description of the bottom type,
iii. depth profiles,
iv. tidal amplitude and stage,
v. a physical description of the surrounding waterbody,
vi. adjacent and adjoining uses, and
vii. distance to navigation channels:
2) The shoreline, including:
i. a description of the vegetation,
ii. a description of the shoreline type,
iii. a description of existing structures,
iv. a description of adjoining and adjacent uses,
v. presence/absence of listed animal species or their habitat or whether known to occur in the area; and
vi. presence/ absence of other wildlife or their signs.

c) A definition of a Primary Resource Protection Area (PRPA). This definition will be used to determine if significant resources or habitats exist within the area of expected impact. A PRPA will include, but is not limited to:
1) Marine grassbeds,
2) algal beds,
3) mangroves,
4) hardbottom communities,
5) coral banks or heads,
6) saltmarsh/buttonwood associations,
7) listed species or their habitat, and
8) nesting sites for solitary or colonial birds.

Task B.1.1.2.: Coordinate with the appropriate regional DNR staff to process field staff comments to applications for use in a timely manner.

Task B.1.1.3.: Coordinate, when possible, with other appropriate agencies that have regulatory authority for these projects.

Objective B.1.2.: Ensure that projects and activities that have been built or are occurring have been authorized.

Task B.1.2.1.: Report activities that do not appear to have been authorized to the appropriate DNR enforcement agent.

Task B.1.2.2.: Coordinate and cooperate, when possible, with other appropriate agencies that have regulatory or enforcement authority for these projects or activities.

Task B.1.2.3.: Maintain records of reports and subsequent actions taken by regulatory and enforcement agencies. At a minimum, these records will contain:

1) Date, location first observed and observers name;
2) Date reported to appropriate agency, agency name, and reporters name;
3) Action taken by agency; and
4) Resolution of report, if known.

Objective B.1.3.: Ensure that projects and activities are in compliance with the authorization granted.

Task B.1.3.1.: Coordinate with the appropriate regional DNR staff to receive copies of all letters of consent, easement agreements, lease agreements, and other forms of authorization.

Task B.1.3.2.: Report variations from the authorized conditions to the appropriate DNR enforcement agent.

Task B.1.3.3.: Coordinate and cooperate, when possible, with other appropriate agencies that have regulatory or enforcement authority for these projects or activities.

Objective B.1.4.: Ensure that projects and activities do not degrade submerged resources of the preserve.

Task B.1.4.1.: Seek authorizations to establish no motorized vessels or personal watercraft zones in areas of shallow water.

Task B.1.4.2.: Require that all dredge projects in and adjacent to the preserve use current turbidity control practices.

Task B.1.4.3.: Inventory and report all abandoned vessels and traps to the Florida Marine Patrol and encourage removal in a timely manner.

Task B.1.4.4.: Encourage or require the establishment of channel markers, where appropriate, to protect marine grassbeds and corals from boating damage.

Task B.1.4.5.: Seek appropriate legislation and rule changes to prohibit (as opposed to ban) the harvesting of live rock in the preserve.

Task B.1.4.6.: Using available data from resource inventories, research and landings statistics, monitor the effects of commercial and amateur marine life collecting on target populations within the preserve.

Task B.1.4.7.: Should biological inventories or research indicate declines in formerly abundant marine life species, seek appropriate legislation and rule changes for immediate closure or substantial restrictions on marine life collecting in the preserve until a management and/or recovery plan is developed for the depleted species.

Task B.1.4.8.: Promote public acquisition of privately held submerged lands, mangroves and uplands within and adjacent to the preserve.

GOAL B.2.: PROTECTION OF EMERGENT VEGETATION AND HABITATS

Objective B.2.1.: Minimize potential damage to emergent vegetation through the review of all applications for use of state-owned land in the preserve.

Task B.2.1.1.: Field staff will develop a written format describing a scientifically based, standardized method to inventory the emergent vegetation and characteristics of a project site and it shall include, at a minimum, the following information:

a) Description of the area to be surveyed:
    1) legal description of the subject property;
    2) as a polygon; and
    3) with a buffer zone surrounding the project of sufficient size so as to include a majority of the potentially affected area.

b) Detailing how the survey is to be performed:
    1) a description of the vegetation with notations as listed plant species within the project site and buffer zone;
    2) a description of geological features or formations, including the following, if beach/berm is present:
        i. length and width of beach/berm on riparian shoreline;
        ii. approximate height of the ridge crest; and
        iii. distance from MHW to the ridge crest:
    3) a description of existing structures or uses;
    4) a description of adjoining or adjacent uses;
    5) presence/absence of listed animal species, their habitat, or whether known to occur on the site;
    6) presence/absence of other wildlife species or their sign.

Task B.2.1.2.: Coordinate with other DNR staff in order to process surveys and related comments in a timely manner.

Task B.2.1.3.: Coordinate with other appropriate agencies that have regulatory authority for these projects.

Task B.2.1.4.: Coordinate and cooperate, whenever possible, with other agencies or conservation organizations that have specific management objectives, research projects or other interests in the area of a project, or that may own lands adjacent to the project site, including but not limited to:

a) Division of Recreation and Parks (Park Service)
b) U.S. Department of the Interior (Everglades N.P.)
c) Florida Department of State (DHARM);
d) Florida Game and Fresh Water Fish Commission
e) U.S. Fish and Wildlife Service;
f) National Audubon Society;
g) Trust for Public Lands; and
h) The Nature Conservancy.

Objective B.2.2.: Ensure that structures and activities that have been built or are occurring have been authorized.

Task B.2.2.1.: Report activities that do not appear to have been authorized to the appropriate DNR enforcement agent.

Task B.2.2.2.: Coordinate and cooperate, whenever feasible and appropriate, with other agencies that have regulatory or enforcement authority for the project or activity.

Objective B.2.3.: Ensure that structures and activities that have been authorized are in compliance with the conditions of the authorization.

Task B.2.3.1.: Coordinate with the appropriate regional DNR staff to receive copies of all letters of consent, easement agreements, lease agreements and other authorizations for the use of state lands.

Task B.2.3.2.: Report variations from the authorized conditions to the appropriate DNR enforcement agent.

Task B.2.3.3.: Coordinate and cooperate, when feasible and appropriate with other agencies that have regulatory or enforcement authority for these projects or activities.

GOAL B.3.: PROTECT LISTED SPECIES AND THEIR HABITAT

Objective B.3.1.: Determine which portions of the aquatic preserve serve as habitat for listed species.

Task B.3.1.1.: Assimilate a working library of relevant literature and information on listed species expected to occur in the preserve.

Task B.3.1.2.: Coordinate with the Florida Game and Fresh Water Fish Commission, U.S. Fish and Wildlife Service, the Audubon Society, and any other relevant group or agency to determine which listed species use what portion of the aquatic preserve for various aspects of their life cycle.

Task B.3.1.3.: Coordinate and cooperate, whenever possible, with appropriate agencies and groups to conduct monitoring, inventories, habitat evaluations or other activities that relate to the status or distribution of listed species or their habitat.

Task B.3.1.4.: During the course of routine field work and patrols, preserve staff will observe and record, whenever practical, sightings, locations, activity and other information relevant to a listed species.

Task B.3.1.5.: Report all manatee sightings to the Marathon office of the Division of Marine Resources.

Objective B.3.2.: Protect all listed species of plants and animals.

Task B.3.2.1.: Be familiar with listed species, identification, status and relevant laws pertaining to listed species.

Task B.3.2.2.: Report, without delay, any incidence of harassment, poaching, killing, taking or other unlawful activity, including unleashed dogs and artificial feeding stations, to the appropriate enforcement agencies.

Task B.3.2.3.: Maintain a current list of agencies and individuals who enforce relevant laws and those who are permitted or otherwise authorized to rescue, attend, hold, rehabilitate or salvage listed species or their remains.

Task B.3.2.4.: Coordinate and cooperate with appropriate management and enforcement agencies in identifying any activity or project that may potentially affect a listed species.

Objective B.3.3.: Protect habitat of listed species.

Task B.3.3.1.: Ensure that potential impacts to listed species habitats are identified in the review of projects or activities. Such potential impacts may include, but are not limited to:

1) Modification or obstruction of nesting areas;

2) Dock or marina siting;
3) Disruption of feeding activities; and
4) Removal of vegetation, except invasive exotics.

Task B.3.3.2.: Coordinate and cooperate, whenever possible, with appropriate management and enforcement agencies to evaluate potential impacts to listed species as a result of a proposed project or activity.

Task B.3.3.3.: Recommend, where appropriate, modifications to a proposed project or activity that would eliminate or minimize encroachment upon the habitat of listed species.

Task B.3.3.4.: Seek appropriate state statute and rule changes and/or local ordinances to prohibit operation of personal/individual, motor powered watercraft within listed species habitat.

Task B.3.3.5.: Seek appropriate federal statute, state rule and/or local ordinance changes to prohibit operators of ultra-light, private and commercial aircraft from flying less than 500 feet over or landing in the aquatic preserve.

Task B.3.3.6.: Coordinate and cooperate with appropriate DNR and other enforcement agencies in the investigation of potential violations of federal, state or local laws that impact listed species or their habitats.

C. RESEARCH

Effective management of a biological system relies almost entirely on information as to how that system functions. Research is the progenitor of this information. Great strides have been made in marine grassbed and mangrove ecology, yet large gaps remain in understanding the functions of the various components of these systems and how they interact with one another. The goals for research in the aquatic preserve will be directed toward primarily applied research programs, rather than basic, or theoretical research.

The goals of the research program are (1) to gain a better understanding of what factors are essential to the functional, biological integrity of the major habitats within the aquatic preserve and (2) to gain a better understanding of the factors that govern the continued survival and propagation of designated species that use the various habitats of the preserve.

GOAL C.1.: MAINTAIN OR ENHANCE THE FUNCTIONAL INTEGRITY OF HABITATS

Objective C.1.1.: Determine the primary factors that influence the survival of marine grassbeds and algae.

Task C.1.1.1.: Pursue and support research directed toward identifying physical, chemical and/or pathogenic sources of marine grassbed damage.

Task C.1.1.2.: Pursue, at the bureau level, funding to conduct research on the effects of dock/pier shading on the various species of marine grasses and algae of the preserve.

Task C.1.1.3.: Pursue, review and support, where deemed practical, research directed toward protecting or restoring marine grassbeds.

Objective C.1.2.: Determine the primary factors that influence the distribution, survival and productivity of mangrove habitats.

Task C.1.2.1.: Promote and support research on the physical, chemical, and pathogenic factors that influence mangroves.

Task C.1.2.2.: Pursue funding and support research projects directed toward restoration of artificially altered mangrove systems.

Task C.1.2.3.: Promote and support research on the effects of mangrove trimming.

Objective C.1.3.: Determine the primary and secondary factors that affect species of the hardbottom communities.

Task C.1.3.1.: Promote and support research that identifies the physical, chemical and pathogenic factors that influence invertebrate growth, recruitment and mortality in hardbottom communities.

Task C.1.3.2.: Compile a complete inventory of the benthic fauna in the hardbottom communities in the preserve.

Task C.1.3.3.: Seek, at a Department level, funding for research on the effects of fish and invertebrate collecting on the species, size range, distribution, density, and diversity of populations in marine grassbeds and hardbottom communities.

Task C.1.3.4.: Seek, at a Department level, funding for research on the effects of sponge harvesting on hardbottom communities.

Task C.1.3.5.: Seek, at a Department level, funding for research on the effects of trap placement and retrieval methods on the submerged resources of the preserve.

Task C.1.3.6.: Review and accept, where appropriate, experimental, Department supervised research proposals for the culture of sponges in the preserve.

Objective C.1.4.: Monitor water quality data.

Task C.1.4.1.: Compile records of historic water quality data for locations in or adjacent to the preserve.

Task C.1.4.2.: Seek funding for establishment of a permanent DER sampling program in the preserve.

Task C.1.4.3.: Monitor available data for trends or marked changes in suspended sediments, nutrients, pollutants, salinity, temperature, and dissolved oxygen.

Task C.1.4.4.: Report incidents of pollution and epidemic marine life mortality to the Marathon DER office.

GOAL C.2.: SURVIVAL AND PROPAGATION OF LISTED SPECIES

Objective C.2.1.: Determine those factors or habitat requirements that are critical to listed species survival.

Task C.2.1.1.: Maintain a data base of listed species sightings, condition, habitat, etc.

Task C.2.1.2.: Pursue, at a Department level, funding for research on the distribution, life histories and habitat requirements of listed species of plants and animals.

Task C.2.1.3.: Coordinate with appropriate agencies, organizations and universities/colleges to promote applied research projects for listed species.

1. Review current literature for relevant information and determine those fields and species that may benefit from additional research.

2. Prepare a priority list for those identified research needs that would be most beneficial to effectively manage for listed species.

Task C.2.1.4.: Continue collecting and reporting marine turtle and mammal sitings, strandings and/or salvage activities.

Task C.2.1.5.: Ensure that preserve staff are cognizant of listed species laws and procedures for dealing with reports and handling distressed wildlife.

1. Preserve staff or volunteers who participate in strandings and salvage activities shall be properly trained and permitted and shall maintain accurate records and make timely reports of all activities in the preserve.

Task C.2.1.6.: Encourage the propagation and utilization of native listed plant species for revegetation and landscaping within and adjacent to the aquatic preserve.

Task C.2.1.7.: Encourage research and monitoring of nesting success in birds, especially with relation to frequency of nest flushing events and the factors causing the behavior.

D. ENVIRONMENTAL EDUCATION

Public awareness and involvement is potentially the most valuable tool a resource management program may utilize. The public is often not aware of the resources of the preserve nor of the various impacts that human activities have upon those resources. The 'public' may be students, property owners, user groups (e.g., divers, fishing enthusiasts, boaters, etc.), special interest groups (realtors, developers and contractors), conservation or preservation organizations, and local, regional and state government agencies that are involved in making planning or regulatory decisions affecting the preserve.

The many values derived from marine habitats, including water quality, viable fisheries, recreation and open space, attract many visitors and residents to the preserve area. These same values may be irreparably harmed, if the public is not environmentally sensitive or informed. Therefore, one of the primary aims of the aquatic preserve program will be to educate the public as to the importance of the resources and to enlist public support and participation in the protection and conservation of those resources for present and future generations to enjoy.

GOAL D.1.: PUBLIC EDUCATION TO PROMOTE WISE RESOURCE USE

Objective D.1.1.: Coordinate and provide assistance to existing environmental education programs at public and private schools.

Task D.1.1.1.: Notify the county school board and private schools of the preserves programs and the availability of its staff to assist or provide guidance for their existing environmental educational programs.

Task D.1.1.2.: Participate in the development and utilization of the Monroe County Environmental Story teaching aids for public and private schools in the county.

Task D.1.1.3.: Seek funding to develop an educational display and literature for the preserve.

Task D.1.1.4.: Seek funding and staffing to establish and conduct classroom programs and field trips in the preserve.

Task D.1.1.5.: Encourage development of community college and university level field classes which offer a detailed course or seminar on the preserve resources and/or ecology.

Objective D.1.2.: Produce environmental educational literature and materials that inform the adult public of the preserve's natural resources and the importance of preserving and protecting those resources.

Task D.1.2.1.: Seek funding for the development of educational literature, materials and staffing for presentations to:
1) Homeowners' associations;
2) Civic and church groups;
3) Special interests (realtors, consultants, developers, contractors, fishermen, divers, utilities, etc.);
4) Boating/sport shows and special events;
5) Camping facilities and tourist resorts;
6) Marinas, tackle shops and boat ramps;
7) Agency and local government staffs;
8) Environmental educators; and
9) Conservation, preservation, conference, and research groups.

Task D.1.2.2.: Develop media articles and presentations for local radio, television and publications to inform the general public of the preserve, its resources, protection needs, programs, research findings, as well as to encourage compatible uses within the preserve.

Task D.1.2.3.: Coordinate with other resource management agencies and, where appropriate, co-sponsor exhibits, programs or other public contact activities.

Task D.1.2.4.: Coordinate with commercial and recreational fishing interests in order to educate and disseminate information regarding environmentally safe fishing methods, the importance of habitat preservation and the positive contributions to made at the individual level for helping to ensure sustained yields.

Objective D.1.3.: Pursue coordination with organizations and agencies and, where appropriate, assist in the development of special programs for physically and mentally challenged adults and children.

Task D.1.3.1.: Contact appropriate agencies to determine the need for special programs.

Task D.1.3.2.: Seek funding for development and staffing of needed programs.

Objective D.1.4.: Seek funding for development and staffing of a permanent environmental education facility for the preserve.

Task D.1.4.1.: Seek funding for development, maintenance, and staffing for permanent displays, specimen collections, a reference library and interpretive programs.

Objective D.1.5.: Provide environmental education workshops to instruct other environmental educators.

Task D.1.5.1.: Pursue development and funding for biannual instructional workshops for environmental, science, and other interested teachers and instructors.

Task D.1.5.2.: Encourage aquatic preserve staff and volunteers to attend conferences and seminars to further teaching skills and become familiar with other education programs.

CHAPTER VII

MANAGEMENT COORDINATION NETWORK

This chapter presents a general overview of the various federal, state, regional, and local agencies that regulate or hold any interests in the management or use of Lignumvitae Key Aquatic Preserve. The success of the aquatic preserve management plan is dependent upon coordination with these agencies to achieve many of the goals and objectives of resource management and protection. A breakdown of the specific jurisdictions is presented in Table 8.

A. FEDERAL AGENCIES

A number of federal agencies have property interests, land and wildlife management programs, research activities, construction activities, and regulation programs that deal either directly or indirectly with the aquatic preserve.

In accordance with the federal consistency review process, the Bureau of Submerged Lands and Preserves reviews many of the federal programs and activities as to their affect on the management objectives of the aquatic preserve programs. This review is coordinated through the Florida Department of Environmental Regulation's Office of Coastal Management in order to enforce the provisions of the Federal Coastal Zone Management Act of 1972, as amended.

U.S. Department of the Interior/National Park Service (ENP)
As noted in chapter III, Lignumvitae Key Aquatic Preserve extends into the boundary of Everglades National Park north of the ICW. Special fisheries and other regulations apply to all lands and resources within the park. Enforcement of those regulations are vested solely with the park. Any proposals for use or activities within that boundary should be coordinated with the office at Flamingo.

U.S. Fish and Wildlife Service (USFWS)
The USFWS has responsibility for fish and wildlife as authorized in the Coastal Resources Barrier Act, National Environmental Protection Act, Migratory Bird Act, Endangered Species Act, and Fish and Wildlife Coordination Act. Locally, their personnel administer and manage wildlife refuge and preserved lands, review dredge and fill projects, and are charged with the protection and recovery of endangered species and bird rookeries.

U.S. Army Corps of Engineers (COE)
The COE has jurisdiction over the navigable waters of the United States under the Rivers and Harbors Act of 1899. A

revision of the Rivers and Harbors Act in 1968 extended the COE jurisdiction, allowing them to consider impacts to the fish and wildlife, conservation, pollution, aesthetics, ecological and other relevant factors of a proposed project. The COE regulatory programs were expanded in 1972 with the Federal Water Pollution Control Act Amendments, also known as the Clean Water Act (CWA). Section 404 of this act controls dredge and fill activities and has since been extended to wetlands from Amendments to the CWA in 1977.

U.S. Geological Survey (USGS)
The USGS performs surveys and research pertaining to topography, geology, mineral and water resources of the United States. USGS also collects and publishes water resources data.

U.S Environmental Protection Agency (EPA)
The EPA has jurisdiction over surface water of the state. Enforcement authority was given under the Clean Water Act of 1972 and broadened under the 1977 revision. In general, EPA is responsible for pollution control and abatement, including: air, water, noise, solid waste, toxic waste, and radiation. Under Section 104 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), EPA may initiate studies, clean-up, and pursue restitution of incurred expenses for pollution violations and damages. Authority is divided between EPA and the U.S. Coast Guard regarding the management of oil or hazardous substances discharged into surface waters. They also review permits issued by DER for the treatment, disposal and storage of hazardous wastes.

U.S. Coast Guard (USGS)
The USGS regulates boating safety, enforces maritime law, operates search and rescue missions, and surveillance and interdiction of contraband importation. USGS also regulates construction of bridges, causeways, and aerial utilities that may pose navigation hazards and the placement and maintenance of public navigation aids. Joint responsibility for response to the discharge or spillage of oil or other hazardous substances into surface waters is shared with EPA.

National Marine Fisheries Service (NMF)
The NMF is under the U.S. Department of Commerce and records commercial fish landing, enforces national fishery laws, and protects vital fishery habitats. Under the Endangered Species Act, this agency may also regulate activities and enforce marine turtle and mammal protection legislation.

National Oceanic and Atmospheric Administration (NOAA)
Under the Department of Commerce, Office of Coastal Zone Management, NOAA administers two programs of local interest. The National Marine Sanctuaries (NMS) program oversees the

management of Looe Key and Key Largo National Marine Sanctuaries, as well a several National Marine Estuaries in the region. A management plan is currently being developed for the newly created Florida Keys National Marine Sanctuary. Scoping and planning meetings involve citizen and agency input. NOAA in cooperation with the Department of Natural Resources' Division of Marine Resources, Bureau of Sanctuaries and Research Reserves and the Office of Marine Programs and Planning will evaluate and coordinate or incorporate existing state management programs were mutual goals are to be achieved.

NOAA also administers the Hurricane Center in Miami, which monitors and issues bulletins on tropical weather for the north and south Atlantic and the Caribbean Basin.

B. STATE AGENCIES

Many state agencies have property interests, land and wildlife management programs, research activities, regulatory authority and construction activities with the preserve. Additionally, DNR administers programs which may affect the resources and watersheds of the preserve.

Department of Natural Resources (DNR)
Several Divisions within the Department perform various functions of administration, regulation and enforcement of laws and programs related to natural resources and/or their use.

The Division of Marine Resources has several programs beneficial to the management of aquatic preserves. The Marine Research Laboratory in St. Petersburg and the Marathon Field Office have several projects which include resource protection area mapping, fishery habitat utilization studies, conch reintroduction programs and spiny lobster research. The Division is instrumental in administering manatee protection programs and marine turtle data gathering. They also administer a permitting program for the collection of certain marine species and the use of certain chemicals. As previously noted, this Division's Bureau of Sanctuaries and Research Reserves, in conjunction with the Office of Marine Programs and Planning will assume lead positions in coordinating with NOAA to plan and manage the Florida Keys National Marine Sanctuary.

The Division of Law Enforcement's Marine Patrol, whose legal authority is granted under Chapter 370, F.S., enforces Florida laws relating to marine resources, fishery laws, boating safety, vessel titling/registration, contraband interdiction, and the protection of endangered and threatened species.

The Division of State Lands, under the provisions of Chapters 253 and 258, F.S., performs the staff duties related to the acquisition, administration and disposition of public lands on behalf of and with the approval of the Governor and Cabinet, sitting as the Board of the Internal Improvement Trust Fund. Staff duties include review and recommendations to the Board regarding applications for the use, sale, lease or transfers of all state-owned lands and enforcement of the provisions for unauthorized use of those lands. Under Chapter 18-21, F.A.C., the Division is charged with management of sovereignty submerged lands and spoil islands.

Aquatic preserves were established under Chapter 258, F.S. Originally administered by the Division of Recreation and Parks, the administration of aquatic preserves was transferred to the Division of State Lands in 1988. Specific management policy, standards and criteria for most aquatic preserves are contained within Chapter 18-20, F.A.C.

The authority for the Conservation and Recreational Lands program (CARL) is also derived from Chapter 253, F.S. This program is the primary vehicle for the acquisition of private lands that are deemed to be environmentally sensitive or that may serve as potential lands for future recreational needs. Recent passage of the Conservation 2000 legislation will greatly enhance funding for targeted purchases.

The Division of Resource Management is responsible for the management of aquatic plants, mineral resources, oil and gas exploration, and geologic studies. It also supervises state Navigation Districts and the Canal Authority.

The Division of Beaches and Shores is charged with developing inventories and management plans for beaches in Florida. The inventory of Monroe County beaches was completed in 1990.

Department of Environmental Regulation (DER)

The DER administers programs regulating air, water, noise, wastewater, stormwater, and hazardous waste pollution through a permitting and certification process. Chapter 376, F.S. directs DER to cooperate with DNR in offering consultation, enforcement, prosecution, and technical advise in pollutant discharge, control and removal.

Chapter 403, F.S. enumerates the DER responsibilities in the areas of water and air quality, facilities siting, resource recovery and management, pollution control and wetland permitting. This chapter serves as the authority for the initiation of dredge and fill applications in conjunction with COE and DNR. The authority to regulate activities and protect water quality granted in Chapter 403 is facilitated by the Water Quality Standards established in Chapter 17-3, F.A.C. This chapter of the administrative code sets forth specific

criteria for surface water classifications and permitting criteria for those classifications. The Special Protection, Outstanding Florida Waters (OFW) classification is assigned to waters of the aquatic preserve and most waters of the Florida Keys. The OFW classification affords the highest protection for state waters.

Chapter 17, F.A.C. also contains sections governing permitting procedure and criteria for facilities, dredge and fill projects, stormwater discharge, and deepwater ports.

The DER Office of Coastal Management is charged with coordinating activities related to coastal management and reviewing federal actions for consistency with the State Coastal Management Program. The Office of Coastal Management also awards grants for research and management planning.

Chapter 253.77, F.S., as amended by the Warren S. Henderson Wetlands Protection Act of 1984, requires that any request for the use of state-owned lands shall have prior approval of the Trustees. An interagency agreement between DNR and DER provides for DNR staff comments into the DER permitting process for identifying environmental impacts to the resources of the aquatic preserve.

Department of Community Affairs (DCA)

DCA reviews Developments of Regional Impact (DRI), designates Areas of Critical State Concern (ACSC), and approves comprehensive plans. The DRI process involves major development projects that have impacts on a larger area than is covered by just one county and involves a regional review from neighboring local governments and from state agencies.

The ACSC program is intended to protect the areas of the state where development has endangered or may endanger resources of regional or statewide significance. Under an ACSC designation, the local governments are required to notify the DCA of any application for a development permit. The Florida Keys portion of Monroe County were designated as an ACSC in 1979. In 1984, under authority granted in Chapter 380, F.S. and defined in Administrative Rule 27F-8, the Boundary and Principles for Guiding Development for the Florida Keys Area of Critical State Concern were adopted to conserve and protect the natural, environmental, historic and economic resources, and other values of the lands and waters of the Florida Keys. The Florida Keys ACSC designation and the Principles for Guiding Development are intended to remain in place until such time as Monroe County shall have developed a comprehensive growth management plan and future development regulations as required by Chapter 163, F.S. Such plan shall be consistent with the State Comprehensive Plan, State Statutes, Codes and rules. Conformance to the minimum criteria established in Chapter 9J-5, F.A.C. is also required.

Monroe County is currently involved in this planning process. Their submitted plan is currently undergoing review by DCA for compliance with Chapter 9J-5, F.A.C. The Coastal Management and Conservation Elements of the future plan are the most significant to the management goals and objectives of the aquatic preserve. These elements should establish goals and objectives that are consistent with those of this plan. Cooperation and coordination in developing the plans is critical to the successful development and implementation of either plan.

Department of Transportation (DOT)
The DOT is involved with aquatic preserves where they maintain the U.S. 1 or Overseas Highway and the bridges and causeways that traverse the preserve boundary. Leases or permits for the use of state-owned rights-of-way are coordinated through the DOT. Applications for these uses are not generally circulated for field review. Local cooperation is vital to establish lines of communication regarding projects that may affect the preserve. The DOT also administers funding for environmental restoration projects, which has in the past been available for aquatic preserve projects.

Department of State/Division of Historical Resources (DHR)
Under Chapter 267, F.S. DHR is granted responsibility for the preservation and management of the state's archaeological and historical resources. This responsibility includes those cultural resources located on state-owned lands. All activities that may potentially affect a known or suspected resource must be coordinated with and/or approved by the DHR.

Department of Health and Rehabilitative Services (HRS)
HRS administers numerous programs to protect public health by overseeing functions that involve water supplies, sewage disposal and solid waste control. Authority for these responsibilities are found in Chapters 154, 381, and 386, F.S. and in the 10D series of F.A.C., known as the Sanitary Code. HRS is also responsible for mosquito control activities under Chapter 388, F.S. and may delegate that authority to a local mosquito control district (MSD).

Mosquito control and septic tank permitting are of immediate concern to the management of the aquatic preserve. The Monroe County MSD administers the local program through ground and aerial application of larvicides and adulticides. Chapter 10D-54, F.A.C. requires that any arthropod (mosquito) control activities conducted by local MSDs on environmentally sensitive public lands, such as parks, aquatic preserves and similar properties be coordinated in advance by the responsible mosquito control agency with the Executive Directory of DNR, GFC, and the regional director of the USFWS. This chapter also establishes areas, types, rates, timing and equipment standards for control activities.

HRS administers the permitting and placement of septic tanks under Chapter 10D-6, F.A.C. This chapter establishes standards for onsite sewage disposal systems (OSDS). Part II of that chapter establishes specific standards for OSDS installation, operation and monitoring in the Key Largo Limestone or Miami (Oolite) rock formations.

Marine Fisheries Commission (MFC)
The MFC manages marine life by regulating the harvesting of all marine life, except listed species. Their authority covers gear specifications, bag limits, size limits, species that may not be sold, protected species, closed seasons or areas, quality control codes, special considerations related to egg bearing females, and the harvest and relaying of oyster and clams. The MFC makes annual recommendations to the Governor and Cabinet regarding marine fisheries research priorities and changes to existing laws.

Game and Fresh Water Fish Commission (GFC)
The GFC, authorized under Chapters 39.101 and 39.102, F.A.C. implements and enforces specific regulations to protect all wildlife and their habitats. As such, the GFC is the state coordinator for species designated for protection in Florida.

C. REGIONAL AGENCIES

In addition to federal and state agencies, two regional agencies have functions and programs that may affect the aquatic preserve. These organizations conduct activities that are on a broader scale than are those of the local governments.

South Florida Water Management District (WMD)
The WMD was established by Chapter 61-69, Laws of Florida, as a public corporation for carrying out Chapter 378, F.S> and operates under and is governed by provisions of Chapter 373, F.S. Chapters 40D-4 and 40D-40 were adopted to ensure continued protection of the water resources of the district including wetlands and other natural resources. The statutes resulted from passage of Chapter 84-79, Laws of Florida, also known as the Warren G. Henderson Wetlands Protection of 1984.

The WMD administers permitting programs for consumptive water use, management, storm water discharge, storage of surface water, well drilling and operation, water level control, regulation of artificial recharge facilities, and works of the district. The WMD is also responsible for developing Surface Water Improvement Management (SWIM) plans as authorized by Chapter 87-97, Laws of Florida and Chapter 373, F.S. The SWIM plans are designed to improve, restore and manage surface waters.

South Florida Regional Planning Council (RPC)
The RPC serves as a regional planning body for the local government of Monroe County, as well as incorporated areas in the Keys and other south Florida counties and municipal areas. The RPC duties include: aid to local government planning efforts; regional representative for the DRI process; regional clearing house for state and federal projects and programs; providing information from the local governments to the state and federal levels; assisting local governments in securing grants in aid; and preparing and administering the Regional Policy Plan.

The DRI review of projects which affect the preserve will be reviewed by both the field staff and central office personnel. DRIs for marinas, major developments, subdivisions, and commercial or industrial developments adjacent to the preserve and will be reviewed closely for their potential impact on the preserve.

D. LOCAL GOVERNMENT/AGENCIES (LGT)

Local government consists of unincorporated Monroe County and the incorporated areas of Key Colony Beach, Layton and the City of Key West. The incorporated areas are governed by a city commission and the unincorporated areas are governed by a five member County Commission.

As previously noted, the Florida Keys portion of Monroe County has been designated as an Area of Critical State Concern and both incorporated and unincorporated areas are in the process of formulating Comprehensive Growth Management Plans.

Relationship to Local Management Plans
The Florida Keys Comprehensive Plan of 1986 (Volume II, Analysis and Policy Element) established several Areas of Particular Concern (APC), including Lignumvitae Key Aquatic Preserve. Specific management policies for Lignumvitae Key include:

"a. Management and recreational usage for the State Parks on the Keys in the aquatic preserve must be consistent with preservation of the Aquatic Preserve.

b. Development activity on Upper and Lower Matecumbe Keys, including dredging and filling will be prohibited so as not to degrade the waters of the Preserve."

Generic Marine Resource Areas of Particular Concern (APC) include marine grassbeds, coral formations and fringing mangroves, including associated vegetation within 50 feet of

the landward edge of those mangroves. Management policies mandate that these biotic communities be preserved to the fullest extent possible and that creation and restoration of these communities will be encouraged whenever feasible and necessary.

Local governments are required by the Local Government Comprehensive Planning Act of 1975 (Section 163.3163, F.S.), as amended by Chapter 85-55, Laws of Florida, to the Local Government Comprehensive Planning and Land Development Regulation Act (LGCP), to have a management plan with elements relating to different governmental functions (i.e., housing, physical facilities, conservation, land use, coastal zone protection, etc.). Recent statutory amendments require these plans to be updated and for counties to adopt land development regulations and improve coastal management protection. The coastal management element of the LGCP, along with the land use and conservation elements, establishes long range plans for orderly, and balanced development, with particular attention to the identification and protection of environmental resources in the planning area. Conformance with the criteria, policies, and practices of a local government comprehensive plan is required for all development within the local government jurisdiction.

Monroe County is currently revising and formulating new goals, objectives and policies that are intended to fulfill the requirements for the LGCP act and the criteria of 9J-5, F.A.C. The intent of the aquatic preserve management program, and this plan, is to guide county efforts during the planning process towards developing local plan criteria and standards that will be consistent with and complementary to the objectives of the aquatic preserve program.

TABLE 8 : MANAGEMENT COORDINATION NETWORK

LOCAL AGENCIES

LGT	Local Governments (Cities, Towns, Municipalities)
CGT	County Governments
LDD	Local Drainage Districts
MCD	Mosquito Control Districts
ICD	Inlet Commissions/Districts
SWC	Soil and Water Conservation Districts

REGIONAL AGENCIES

RPC	Regional Planning Council
WMD	Water Management Districts
FIN	Florida Inland Navigation District

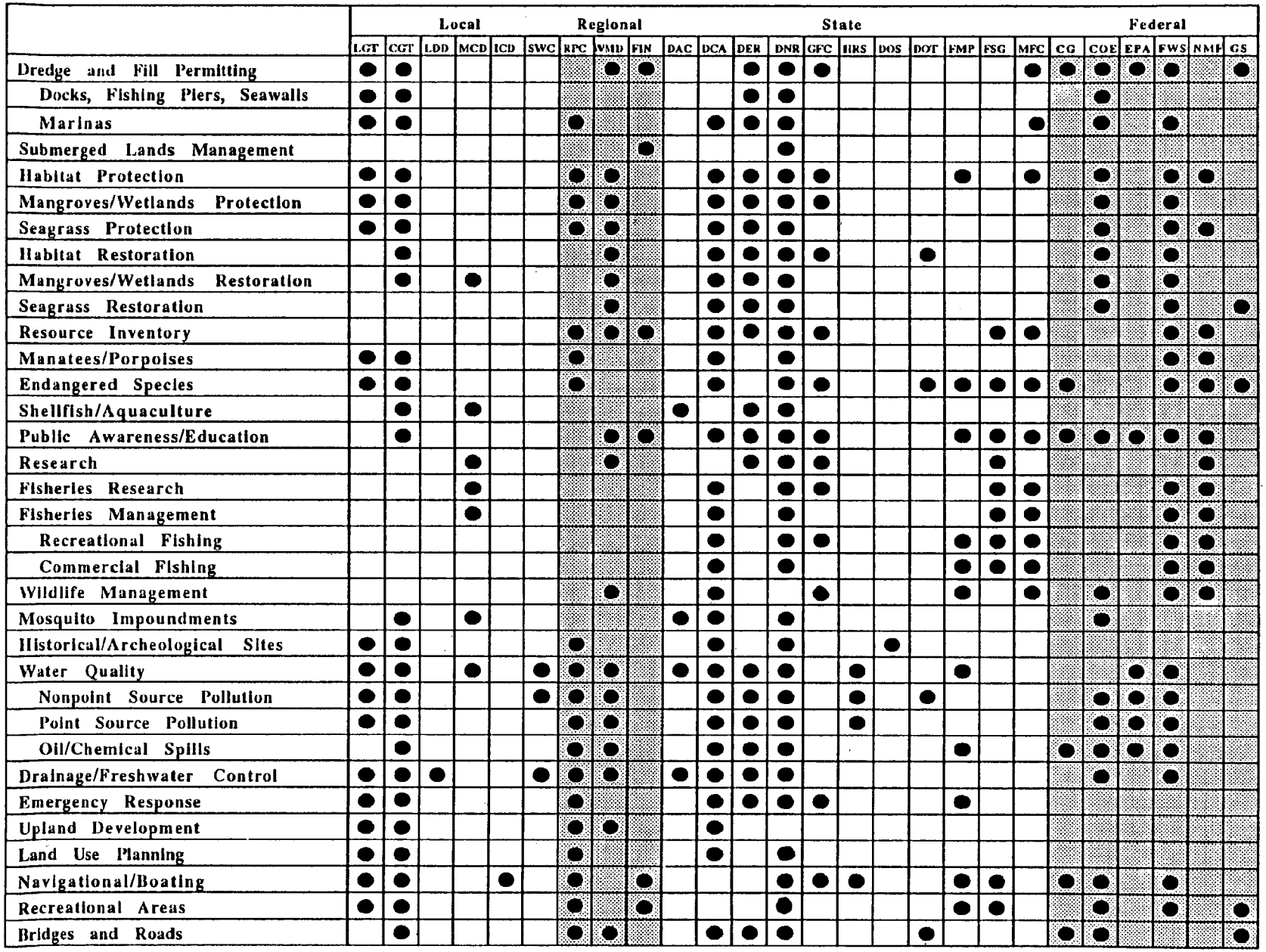
STATE AGENCIES

DCA	Florida Department of Community Affairs
DER	Florida Department of Environmental Regulation
DNR	Florida Department of Natural Resources
GFC	Florida Game and Freshwater Fish Commission
DOS	Florida Department of State
DOT	Florida Department of Transportation
FMP	Florida Marine Patrol
FSG	Florida Sea Grant
MFC	Marine Fisheries Commission
DAC	Florida Department of Consumer and Agricultural Services
HRS	Florida Department of Health and Rehabilitative Services

FEDERAL AGENCIES

CG	United States Coast Guard
COE	United States Army Corps of Engineers
EPA	United States Environmental Protection Agency
FWS	United States Fish and Wildlife Service
NMF	National Marine Fisheries
GS	United States Geological Survey

Source: modified from the Indian River Lagoon Joint Reconnaissance Report, 1987


Local
Regional
State
Federal
LGT CGT LDD MCD ICD SWC RPC VMD FIN DAC DCA DER DNR GFC HRS DOS DOT FMP FSG MFC CG COE EPA FWS NMF GS
Dredge and Fill Permitting
Docks, Fishing Piers, Seawalls
Marinas
Submerged Lands Management
Habitat Protection
Mangroves/Wetlands Protection
Seagrass Protection
Habitat Restoration
Mangroves/Wetlands Restoration
Seagrass Restoration
Resource Inventory
Manatees/Porpoises
Endangered Species
Shellfish/Aquaculture
Public Awareness/Education
Research
Fisheries Research
Fisheries Management
Recreational Fishing
Commercial Fishing
Wildlife Management
Mosquito Impoundments
Historical/Archeological Sites
Water Quality
Nonpoint Source Pollution
Point Source Pollution
Oil/Chemical Spills
Drainage/Freshwater Control
Emergency Response
Upland Development
Land Use Planning
Navigational/Boating
Recreational Areas
Bridges and Roads

CHAPTER VIII

STAFFING AND FISCAL NEEDS

Historically, the Aquatic Preserves Program has been largely dependent on federal coastal zone grant funds for its operation, and as a result, the funding of both field positions and central office positions has been limited.

In order for the Lignumvitae Key Aquatic Preserve to be managed in accordance with the goals, objectives and policies, set forth in this plan, adequate funding, staffing and equipment is essential. It is anticipated that the management and administration of the three aquatic preserves in the Keys (Lignumvitae Key, Coupon Bight and Biscayne Bay-Card Sound portion) could be accomplished with one field office staffed with five full time employees. An annual review of the accomplishments of the program relative to the tasks listed in Chapter VI will help to determine if the initial staffing estimate is adequate to meet the legislative intent of the program.

A budget covering projected staff time, equipment, travel and other expenses for this area, which would include Lignumvitae Key Aquatic Preserve, is found in Table 9. The budget is required to fulfill the short range needs of the preserve as described in this management plan, and to accomplish the Department goal of on-site management for all aquatic preserves by 1991, as expressed in the Agency Functional Plan.

TABLE 9

ANTICIPATED TWO-YEAR BUDGET FOR LIGNUMVITAE KEY, COUPON BIGHT AND THE CARD SOUND PORTION OF BISCAYNE BAY AQUATIC PRESERVES

SALARY	1ST YEAR	2ND YEAR
ES III (with benefits)	$ 38,424	$ 39,577
ES II (with benefits)	33,836	34,851
ES I (with benefits)	28,224	29,071
Secretary (with benefits)	17,255	17,773
Environmental educator	22,391	23,063
Subtotal	$140,130	$144,335
OPERATING CAPITAL OUTLAY		
Vehicles (3 @ $12,000 each)	$ 36,000	
Office equipment	11,500	
Computer	5,000	
Education materials	2,500	
Subtotal	$ 55,000	
OPERATING EXPENSES		
Rent/Gas/Phone/Supplies	$ 28,000	$ 32,000
Education supplies	1,500	1,600
Subtotal	$ 29,500	$ 33,600
TOTAL COST	$246,630	$177,935

CHAPTER IX

RESOURCE AND ACTIVITY MONITORING PROGRAM

To ensure that this management plan is effectively implemented, on-site staffing is imperative. Additional staffing will be necessary in order to institute programs targeted at 1) monitoring changes in the natural resources, 2) recording use activities, 3) tracking progress and accomplishments that are directed at retaining the original integrity and value of the preserve, and 4) preparing and conducting environmental education activities.

A. RESOURCE MONITORING

To monitor changes in the natural resources, a geographic information system (GIS) will be necessary. A GIS is a computer based system that is used to capture, edit, display, and analyze geographic information. The first GIS programs were developed about 20 years ago to manage large collections of natural resource and environmental information. Since their development, they have been used in other areas, such as utilities mapping, inventory management, and land use planning. However, their most important application continues to be natural resource monitoring and management.

Future use of a GIS system would include the periodic inventory, compilation, and analysis of temporal and spatial data concerning the present state of the natural resources within the preserve. Historical aerial photography could be computerized for comparison with later data to conduct a temporal analysis of resource abundance. Detailed monitoring of revegetation/restoration efforts could also be computer analyzed. The on-line access to these natural resource data bases will facilitate informed management decisions concerning the use and protection of lands and their resources. Cooperation and file sharing is possible with other agencies handling such data with identical and similar systems. Similar environments and relationships between various resources may be compared and analyzed to gain a more integrated approach to protection and management.

B. ACTIVITY MONITORING

As human interaction in and around the preserve increases, additional pressures are to be expected in the form of recreational and development activities. Monitoring the types of use and their compatibility, their frequency of occurrence, as well as, proven and expected detrimental effects on the preserve's natural resources, will provide a foundation for developing any additional future plan amendments and restrictions required to protect these resources. Periodic

boat counts, user questionnaires and structure inventories are various methods that may be employed to gather relevant data on activities and user group profiles.

C. PROGRESS MONITORING

For this management plan to be effectively implemented and evaluated, it is necessary to monitor the accomplishments and progress on a regular basis. Sharing this information with other units and agencies, will help develop a team approach to problem solving and implementing management strategies.

The compilation of the monitoring program will be directed to the central office in Tallahassee in the form of a field office annual report. This information will then go into the development of a state-wide status report on the Aquatic Preserve Management Program focusing on resource restoration/deterioration, compatible and non-compatible use activities, and will aid in developing more appropriate management strategies system wide.

The field office annual report should detail the following:

1. The state of the natural environment of the aquatic preserve.

    a. Through the use of the resource inventories and the GIS system, document the status of biological resources (e.g., seagrass loss or gain).

    b. Identify the current number of structures/activities either started, occurring or completed in the preserve. These structures/activities will be categorized as follows:
        1) authorized projects,
        2) unauthorized projects, and
        3) projects not in compliance with the original authorization

2. A list of accomplishments of those policies and tasks outlined in Chapter VII.

    a. Each task will be listed and the activities required to complete that task will be detailed. If the task was not done or not completed, an explanation will be given. If the explanation was due to insufficient funding/staff, then this fact will be detailed so that an update of Chapter IX can be made.

3. Any new goals and/or objectives will be reflected in an update of Chapter VII.

REFERENCES

Adey, W. 1977. Shallow Water Holocene Bioherms of the Caribbean Sea and West Indies. Pp. xxi-xxiv, Vol. 2 IN Proceedings: Third International Coral Reef Symposium. University of Miami, Miami, Fla.

Almodovar, L.R., and R. Biebl. 1962. Osmotic resistance of mangrove algae around La Parguaera, P.R. Rev. Algol. (N.S.): 6(3):203-208.

Arendt, W.J., T.A. Vargas Mora, and J.W. Wiley. 1979. White-crowned Pigeon: Status Rangewide and in the Dominican Republic. Proc. Ann. Conf. S.E. Assoc. Fish and Wildlife Agencies. 33:111-122.

Bacon, P.R. 1970. The Ecology of Caroni Swamp. Special Publication, Central Statistical Office, Trinidad. 68 pp.

Ball, M.M., E.A. Shinn, and K.W. Stockman. 1967. The Geologic Effects of Hurricane Donna in South Florida. Florida J. Geol. 75(5):583-597.

Ballentine, D., and H.J. Humm. 1975. Benthic Algae of the Anclote Estuary I. Epiphytes of Seagrass Leaves. Fla. Sci.38(3):150-162.

Barnes, R.D. 1974. Invertebrate Zoology. Third Ed. W.B. Saunder Co., New York. 870 pp.

Beever, J.W., D. Simberloff, and L.L. King. 1979. Herbivory and Predation by the Mangrove Tree Crab, Aratus pisonii. Oecologia 43:317-328.

Bent, A.C. 1932. Life Histories of North American Birds. U.S. Natl. Mus. Bul. 162 pp.

Bock, W.D. 1971. A Handbook of the Benthonic Forminifera of Florida Bay and Adjacent Waters, IN A Symposium of Recent South Florida Foraminifera, W.D. Bock, et al., Memoir I, Miami Geol. Society, Miami. 245 pp.

Bright, T., W. Jaap, and C. Cashman. 1981 Ecology and Management of Coral Reefs and Organic Banks. Pp. 53-160 IN Proceeding of Environmental Research Needs in the Gulf of Mexico. U.S. Dept.of Commerce, NOAA, E.R.L., Miami, Florida.

Brook, I. 1975. Some Aspects of the Trophic Relationships Among the Higher Consumers in a Seagrass Community (Thalassia testudinum) in Card Sound, Florida. Dissertation. Univ. of Miami, Coral Gables, Fla. 133 pp.

Carr, A.W., and C.J. Goin. 1955. Reptiles, Amphibians and Freshwater Fishes of Florida. Univ. of Florida, Gainesville. 341 pp.

Carr, W.E.S., and C.A. Adams. 1973. Food Habits of Juvenile Marine Fishes Occupying Seagrass Beds in the Estuarine Zone Near Crystal River. Florida. Trans. Am. Fish. Soc. 102(3):511-540.

Carter, K.E. 1976. The Rumskudgeon: Housman, Wrecker of Indian Key. BPK Press, Hialeah, Florida. 125 pp.

Carter, M.R., L.A. Burus, T.R. Cavinder, K.R. Dugger, P.L. Fore, D.B. Hicks, H.L. Revells, and T.W. Schmidt. 1973. Ecosystem Analysis of the Big Cypress Swamp and Estuaries. U.S. Environmental Protection Agency Region IV, Atlanta,

Casagrande, D.J. and P.H. Given. 1975. Geochemistry of Amino Acids in Some Florida Peat Accumulations. I. Analytical Approach and Total Amino Acid Concentration. Geochim. Cosmochim. Acta 38:419-434.

Chapman, V.J. 1976. Coastal Vegetation. Pergamon Press, New York. 292 pp.

Cintron, G., A.E. Lugo, D.J. Pool, and G. Morris. 1978. Mangroves of Arid Environments in Puerto Rico and Adjacent Islands. Biotropica 10:110-121.

Coastal Coordinating Council, State of Florida. 1974. Florida Coastal Zone Management Atlas. Coastal Coordinating Council, Tallahassee, Fla.

Cotheran, E. 1983. Personal communication regarding dredging/ filling and other development in the Islamorada area.

Courtney, C.M. 1975. Mangrove and Seawall Oyster Communities at Marco Island, Florida. Bull. Am. Malacol. Union Inc. 41:29-32.

Craighead, F.C., Sr., and V.C. Gilbert. 1962. The Effects of Hurricane Donna on the Vegetation of Southern Florida. Q.J. Fla. Acad. Sci 25:1-28.

Davis, J.H., Jr. 1940. The Ecology and Geologic Role of Mangroves in Florida. Carnegie Institute, Washington, D.C. Publ. 517. Tortugas Lab Pap. 32:303-412.

Dean, L. 1982. Reef Lights. J.B. Klay and Sons, Tampa, Florida. 134 pp.

Duellman, W.E., and A. Schwartz. 1958. Amphibians and Reptiles of Southern Florida. Bull. Fla. State Mus. 3:181-324.

Ebanks, W.J., and Bubb, J.N. 1975. Holocene Carbonate Sedimentation Matecumbe Keys Tidal Bank, South Florida. Jour. Sed. Pet. 45(2):422-439.

Environmental Protection Agency. 1981. Effects of Baytex and Malathion on Early Life Stages of Snook, Centropomus undecimalis. Surveillance and Analysis Division, Ecology Branch, Athens, Georgia. 7 pp.

Ernst, C.H. and R.W. Barbour. 1972. Turtles of the United States. University of Kentucky Press, Lexington. 299 pp.

Eyster, I. 1987. Personnal Communication re: historic and arcaeological sites in Florida Keys.

Fell, J.W., R.D. Cefalu, I.M. Master, and S.S. Tallman. 1975. Microbial Activities in the Mangrove (Rhizophora mangle) Leaf Detrital System. Pp. 661-679 IN G. Walsh, S. Snedaker and H. Teas, eds. Proceedings of the International Symposium on the Biology and Management of Mangroves. University of Florida, Gainesville.

Fell, J.W., I.M. Master, and S.Y. Newell. 1980. Laboratory Model of the Potential Role of Fungi (Phytophthora spp.) in the Decomposition of Red Mangrove (Rhizophora mangle) Leaf Litter. IN K.R. Tenore and B.C. Coull, eds. Marine Benthic Dynamics. Univ. of South Carolina Press, Columbia.

Florida Department of Community Affairs. 1984. Boundary and Principles for Guiding Development in the Keys Area of Critical State Concern. Adopted March 6, 1984. Chapter 27F-8.26 pp.

Florida Department of Environmental Regulation. 1984. Work Plan 205(J): Keys Monitoring Study. Final Report. South Florida District, Marathon Branch Office. 32 pp.

Florida Game and Fresh Water Fish Commission. 1984. Endangered and Threatened Species Management and Conservation Plan, 1984 Update and Progress Report. Tallahassee, Florida. 33 pp.

Florida Game and Fresh Water Commission. 1990. Endangered and Potentially Endangered Fauna and Flora in Florida, Official List. Tallahassee, Florida. 19 pp.

Florida Department of Natural Resources. Title and registration section unpublished data for 1989-90 vessel registrations Monroe and Dade County.

Florida Department of Natural Resources. 1989. Preliminary Annual Landings Summary for 1989. Unpublished report by Marine Fisheries Service. St. Petersburg, Florida. 35 pp.

Frank, N. 1985. Former Director of National Hurricane Center (NOAA) Miami. Unpublished presentation on hurricanes. John Pennekamp Coral Reef State Park, Key Largo, Florida.

Gilbert, C.R. 1978. Key Silverside. Pp. 1-2 IN Gilbert, C.R., ed. Rare and Endangered Biota of Florida, Vol. 4, Fishes. University Presses of Florida, Gainesville.

Ginsburg, R.N. 1953. Intertidal Erosion on the Florida Keys. Bull. Mar. Sci. 3(1):54-69

Ginsburg, R.N., and J. Schroeder. 1973. Growth and Submarine Fossilization of Algal Cup Reefs, Bermuda. Sedimentology 20:575-614.

Ginsburg, R.N., and E.A. Shinn. 1964. Distribution of the Reef-building Community in Florida and the Bahamas. Bull. Mar. Assoc. Petrol Geol. 48:527.(Abstr.)

Harlin, M.M. 1971. Translocation Between Marine Hosts and Their Epiphytic Algae. Plant Physiol. 47(suppl.):41.

Hoffmeister, J.E., 1974. Land from the Sea. University of Miami Press, Miami, Florida. 143 pp.

Hoffmeister, J.E., and H.G. Multer. 1964. Pleistocene Limestones of the Florida Keys. Pp. 57-61. Guidebook for Field Trip No. 1, Geol. soc. Amer. Annual Meeting, Miami, Florida.

Hoffmeister, J.E., and H.G. Multer. 1968. Geology and Origin of the Florida Keys. Geol. Soc. Amer. Bul. 79:1487-1502.

Humm, H., and S. Wicks. 1980. Introduction and Guide to the Marine Bluegreen Algae. John Wiley and Sons, New York. 104 pp.

Jaap, W.C. 1984. The Ecology of the South Florida Coral Reefs: A community Profile. U.S. Fish Wildl. Serv. FWS/OBS-82/08. 138 pp.

Jordan, C.L. 1973. Climate. pp. 1-22. IN A Summary of the Knowledge of the Eastern Gulf of Mexico, State University Systems, Florida. Institute of Oceangraphy IIA.

Jutro, P.R. 1975. Lignumvitae Key: The History, Natural History and Politics of the Preservation of a Unique Area. Unpublished Doctoral Thesis, Cornell University. 356 pp.

King, W., and T. Krakauer, 1966. The Exotic Herpetofauna of Southeastern Florida. Quart. J. Florida Acad. Sci. 29:149-154.

King, W., and T. Krakauer. 1968. The Ecology of the Neotropical Toad, Bufo marinus, in South Florida. Herptological 24:214-221.

Krakauer, T. 1970. The Invasion of the Toads. FL. Nat. 44:12-14.

Kushlan, J.A. 1976. Wading Bird Predation in a Seasonally Fluctuating Pond. Auk 93(3):464-476.

Kushlan, J.A. 1978. Feeding Ecology of Wading Birds. Pp. 249-297. IN A. Sprunt IV, J. Ogden, and S. Wicker, eds. National Audubon Society Res. Rep. 7. New York.

Lapointe, B.E. 1989. Pollution of Ground Waters and Surface Waters of Big Pine Key. Pp. 100-113 IN Fresh and Surface Water Resources of Big Pine Key, Monroe County Florida. M.L. Robertson and J.M. Young, eds. The Nature Conservancy. Key West. 122 pp.

Layne, J.N. 1974. The Land Mammals of South Florida. Miami, Geol. Soc. Mem. 2:386-413.

Lazell, J.D. 1984. A New Marsh Rabbit (Syylvilagus palustris) from Florida's Lower Keys. J.Mamm. 65(1):26-33.

Lazell, J.D. 1989. Wildlife of the Florida Keys: A Natural History. Island Press, Washington, D.C. 250 pp.

Lewis, R.R.. and R.C. Phillips. 1980. Occurrence of Seeds and Seedlings of Thalassia testudinum Banks EX Konic in the Florida Keys (USA). Aquatic Bot. 9:377-380.

Lewis, R.R., R.C. Phillips, D.J. Adamek, and J.C. Cato. 1981. Draft Final Report on Seagrass Revegetation Studies in Monroe County. Report by Continential Shelf Associates to the Florida Department of Transportation. 65 pp.

Lugo, A.E., G. Evink, M.M. Brinson, A. Broce, and S.C. Snedaker. 1975. Diurnal Rates of Photosynthesis, Respiration and Transpiration in Mangrove Forests in South Florida. Pp. 335-350 IN F. Golley and G. Medina, eds. Tropical Ecological Systems. Academic Press, New York.

Lugo, A.E., and S.C. Snedaker. 1974. The Ecology of Mangroves. Annu. Rev. Ecol. Syst. 5:39-64.

Lugo, A.E., R.R. Twilley, and C. Patterson-Zucca. 1980. The Role of Black Mangrove Forests in the Productivity of Coastal Ecosystems in South Florida. Report to E.P.A. Corvallis Environmental Research Laboratory. Carvallis, Oregon. 281 pp.

Lugo, A.E. and C.P. Zucca. 1977. The Impact of Low Termperature Stress on Mangrove Structure and Growth. Trop. Ecol. 18:149-161.

Manker, J.P. 1975. Distribution and Concentration of Mercury, Lead, Cobalt, Zinc, and Chromium in Suspended Particles and Bottom Sediments-Upper Florida Keys, Florida Bay and Biscayne Bay. Ph.D. Thesis. Rice University, Houston, Texas. 114 pp.

Martin, S.W. 1949. Florida's Flagler. University of Georgia Press, Athens, Georgia. 280 pp.

Marszalek, D. 1982. Florida Reef Tract Marine Habitat and Ecosystems Maps. Published in Cooperation with the Florida Department of Natural Resources, Department of the Interior, Bureau of Land Management and University of Miami, Miami, Florida.

Marszalek, D., G. Babashoff, M. Noel, and P. Worley. 1977. Reef Distribution in South Florida. pp. 223-230. IN Proceedings: Third International Coral Reef Symposium, Vol. 2. University of Miami, Florida.

Mathis, K., J.C. Cato, R.L. Degner, P.D. Landrum, and F.J. Prochaska. 1979. Commercial Fishing Activity and Facility Needs in Florida: Dade and Monroe Counties. Florida Agricultural Market Research Center, University of Florida. Gainesville, Florida 68 pp.

Mattox, N.T. 1949. Studies on the Biology of the Edible Oyster, Ostrea rhizophorae Guilding. in Puerto Rico. Ecol. Monogr. 19:339-356.

McGill, J.T. 1959. Coastal Classification Maps. Pp. 1-22 IN R.J. Russell, ed. Second Coastal Geography Conference. Coastal Studies Instit., Louisiana State University, Baton Rouge, Louisiana.

McMillan, C. 1971. Environmental Factors Affecting Seedling Establishment of the Black Mangrove on the Central Texas Coast. Ecology 52:927-930.

Meylan. A. 1988. Spongivory in Hawksbill Turtles: A Diet of Glass. Science News 133(5):70.

Moler, P. 1986. Personnal Communication regarding the American Crocodile.

Monroe County. 1986. Florida Keys' Comprehensive Plan. Vol. I- III.

Multer, H.G. 1977. Field Guide to Some Carbonate Rock Environments-Florida Keys and Western Bahamas. Kendall/Hunt Publishing Co., Dubuque, Iowa. 425 pp.

Multer, H.G., and J.E. Hoffmeister. 1968. Subaerial Laminate Crusts of the Florida Keys. Geol. Soc. Amer.Bul. v. 79: 183-192.

National Marine Fisheries Service. 1988. The Economic Value of the Sport Fisheries of the Florida Keys. Xerox copy.

National Marine Fisheries Service (NOAA) and Florida Department of Natural Resources. 1981. Florida Landings, Annual Summary 1975, Current Fisheries Statistics No. 6916. Washington, D.C. 12 pp.

National Marine Fisheries Service SEFC. 1984, 1985 & 1986. Unpublished data Florida Fish Landings (Monroe and Dade County). National Marine Fisheries, Southeast Fisheries Center. Virginia Key, Florida. 6 pp.

National Oceanic and Atmospheric Administration. 1965. World Weather Records 1951-1960. Vol. 1 North America. U.S. Department of Commerce, NOAA Weather Bureau.

National Oceanic and Atmospheric Administraiton. 1979. World Weather Records 1961-1970. Vol. 1 North America. U.S. Department of Commerce, NOAA Weather Bureau.

Neumann, A.C. 1966. "Observations on Coastal Erosion in Bermuda and Measurements of the Boring Rate of the Sponge Cliona lampa." Linnol. Oceanographic. 11:92-108.

Odum. W.E. 1970. Pathways of Energy Flow in a South Florida Esturary. University of Miami Sea Grant Bull. 7. 162 pp.

Odum, W.E. 1971. Fundamentals of Ecolgy. Saunders Publ. Col, Philadelphia, Pa. 574 pp.

Odum, W.E., and E.J. Heald. 1972. Trophic Analysis of an Estuarine Mangrove Community. Bull. Mar. Sci. 22:671-738.

Odum, W.E., and E.J. Heald. 1975. The Detritus-Based Food Web of an Estuarine Mangrove Community. Pp. 265-268 IN Estuarine Research. Academic Press, New York.

Odum, W.E., C.G. McIvor, and T.J. Smith, III. 1982. The Mangroves of South Florida: A Community Profile. U.S. Fish and Wildlife Service, Office of Biological Services. Washington, D.C. FWS/OBS-8/24. 144 pp.

Onuf, C.P., J.M. Teal, and I. Valiela. 1977. Interactions of Nutrients, Plant Growth and Herbivory in a Mangrove Ecosystem. Ecology 58:514-526.

Orpurt, P.A., and L.L. Boral. 1964. The Flowers, Fruits, and Seeds of Thalassia testudinum Konig. Bull. Mar. Sci. Gulf Carib. 14:296-302.

Paulson, D.R. 1968. Variation in Some Snakes from the Florida Keys. Quart. Jour. Florida Acad. Sci. 29(4):294-308.

Phillips, R.C. 1960. Observations on the Ecology and Distribution of the Florida Sea Grasses. Prof. Pap. Ser. Fla. Board Conserv. (2):1-72.

Rehm, A.E. 1974. A Study of the Marine Algae Epiphytic on the Prop Roots of Rhizophora mangel L. from Tampa to Key Largo, Florida. Dissertation. University of South Florida, Tampa. 183 pp.

Rehm, A.E. 1976. The Effects of the Wood-Boring Isopod, Sphaeroma terebrans, on the Mangrove Communities of Florida. Environ. Conserv. 3:47-57.

Robertson, P.B. 1963. A Survey of the Marine Rock-Boring Fauna of Southeast. Florida Unpublished Masters Thesis. Instit. of Mar. Sci., University of Miami.

Robertson, W.B. 1978 (a). Roseate Tern. Pp. 39-40 IN Kale, H.W. I, ed. Rare and Endangered Biota of Florida, Vol. 2, Birds. University Presses of Florida, Gainesville.

Robertson, W.B. 1978 (b). Southern Bald Eagle. Pp. 27-30 IN Kale, H.W. II .ed. Rare and Endangered Biota of Florida, Vol. 2, Birds. University Presses of Florida, Gainesville.

Robertson, W.B., Jr., and J.A. Kushlan. 1974. The Southern Florida Avifauna. Miami Geol. Soc. Mem. 2:414-452.

Sand-Jensen, K. 1977. Effect of Epiphytes on Eelgrass Photosynthesis. Aquat. Bot. 3:55-63.

Scholander, P.F. 1968. How Mangroves Desalinate Seawater. Physiol. Plant. 21:258-268.

Schomer, N.S., and R.D. Drew. 1982. An Ecological Characterization of the Lower Everglades, Florida Bay and the Florida Keys. State of Florida DER Cooperative Agreement 14-16-009-80-999. Performed for U.S. Fish and Wildlife Service Office of Biol. Services and the U.S. Dept. of the Interior, Bureau of Land Management. FWS/OBS-82/58.1. 246 pp.

Scholl, D.W. 1966. Florida Bay. A Modern Site of Limestone Formation. pp 282-288. IN The Encyclopedia of Oceanography. R.W. Fairbridge, ed. Reinhold Publishing Corp., New York.

Schreiber, R.W. 1978. Eastern Brown Pelican. Pp. 23-25 IN Kale, H.W. II, ed. Rare and Endangered Biota of Florida, Vol. 2, Birds. University Presses of Florida, Gainesville.

Scoffin, T.P. 1970. The Trapping and Binding of Subtidal Carbonate Sediments by Marine Vegetation in Bimini Lagoon,Bahamas. J. Sediment Petrol. 40(1):249-273.

Simberloff, D. 1976. Experimental Zoogeography of Islands: Effects of Island Size. Ecology 57:629-648.

Simberloff, D., and E.O. Wilson. 1969. Experimental Zoogeography of Islands: The Colonization of Empty Islands. Ecology 50:278-296.

Snyder, H. 1978. Peregrine Falcon. Pp. 7-9 IN Kale, H.W., II, ed. Rare and Endangered Biota of Florida, Vol. 2, Birds. University Presses of Florida, Gainesville.

Spitzer, N.C., and J.D. Lazell, Jr. 1978. A New Rice Rat (genus Oryzomys) from Florida's Lower Keys. J.Mamm. 59(4):787-792.

Sprunt, A., Jr. 1954. Florida Birdlife. Coward-McCann, Inc., New York. 527 pp.

Sprunt, A., Jr. 1986. Personnal communication regarding Florida Keys birds.

Stevely, J.M., J.C. Thompson, R.E. Warner. 1978. The Biology and Utilization of Florida's Commercial Sponges. Sea Grant Tech. Pap. # 8 University of Florida, Gainesville. 45 pp.

Swanton, J.R. 1979. The Indians of the Southeastern United States. Smithsonian Institution Press, Washington, D.C. 943 pp.

Tabb, D.C., D.L. Dubrow, and R.B. Manning. 1962. The Ecology of Northern Florida Bay and Adjacent Estuaries. Florida Board of Conservation. Tech. Serv. 39. 79 pp.

Taylor, W.R. 1960. Marine Algae of the Eastern Tropical and Subtropical Coasts of the Americas. Univ. of Michigan Press, Ann Arbor. 879 pp.

Teas, H. 1977. Ecology and Restoration of Mangrove Shorelines in Florida. Environ. Conserv. 4:51-57.

Teas, H. 1979. Silviculture with Saline Water. Pg. 117-161 IN A. Hollaender, ed. The Biosaline Concept. Plunum Publ. Corp.

Thorhaug, A., and B. Austin. 1976. Restoration of Seagrasses with Economic Analysis. Environ. Conserv. 3:259-267.

U.S. Fish and Wildlife Service. 1984. Endangered and Threatened Wildlife and Plants. Department of the Interior. 24 pp.

Voss, G.L. 1976. Seashore Life of Florida and the Caribbean. E.A. Seemann Publ. Co. Inc., Miami, Fla. 168 pp.

Voss, G.L. 1988. Coral Reefs of Florida. Pineapple Press, Sarasota, Florida. 80 pp.

Waisel, Y. 1972. Biology of Halophytes. Academic Press, New York. 395 pp.

Walsh, G.E. 1967. An Ecological Study of a Hawaiin Mangrove Swamp. PP. 420-431 IN G.H. Lauff, ed. Estuaries. American Association Advancement Science Publ. 83. Washington, D.C.

Wanless, H.R. 1969. Sediments of Biscayne Bay-Distribution and Depositional History. Tech. Report 69-2, Inst. Mar. Sci., University of Miami, Florida. 260 pp.

Wanless, H.R. 1989. The inundation of our coastlines. Sea Frontiers 35(5):264-271.

Weaver, W.G. 1978a. Florida Brown Snake. Pp. 44-45, IN McDiarmid, R.W., ed. Rare and Endangered Biota of Florida, Vol. 3, Reptiles and Amphibians. University Presses of Florida, Gainesville.

Weaver, W.G. 1978b. Keys Mud Turtle. Pp. 30-31, IN McDiarmid, R.W., ed. Rare and Endangered Biota of Florida, Vol. 3, Reptiles and Amphibians. University of Florida Presses, Gainesville.

Wells, P. 1990. Personal communication regarding fauna of Shell Key State Preserve.

Wheaton, J.L. 1989. The Marine Life Fishery for "Live-rock": Biological and Ecological Assessment of the Product and Implications for Harvest. Florida Marine Research Institute. Unpublished report. 18 pp.

Wiley, J.W. 1979. The White-crowned Pigeon in Puerto Rico: Status, Distribution and Movements. J. Wildl. Manage. 3(2):402-413.

Williams, S.L. 1981. Caulerpa cupressoides: The Relationship of the Uptake of Sediment Ammonium and of Algal Decomposition for Seagrass Bed Development. Ph.D. Dissertation, University of Maryland.

Wofenden, S.L. 1978. Snowy Plover. Pp. 8-10 IN Kale, H.W. II, ed. Rare and Endangered Biota of Florida, Vol. 2, Birds. University Presses of Florida, Gainsville.

Wood, E.J.F. 1965. Marine Microbial Ecology. Reinhold Publ. Corp., New York. 243 pp.

Young, F.A. 1989. Communication to P. McVety of Florida Department of Natural Resources regarding live rock industry in south Florida.

Zieman, J.C. 1972. Origin of Circular Beds of Thalassia (Spermatophyta:Hydrocharitaceae) in South Biscayne Bay, Florida, and their Relationship to Mangrove Hammocks. Bull. Mar. Sci. 22(3):559-574.

Zieman, J.C. 1975. Quantitative and Dynamic Aspects of the Ecology of Turtle Grass, Thalassia testudinum. Pp. 541-561 IN L.E. Cronin, ed. Estuarine Research. Vol. I Academic Press, New York.

Zieman, J.C. 1976. The Ecological Effects of Physical Damage from Motorboats on Turtle Grass Beds in Southern Florida. Aquat. Bot. 2:127-139.

Zieman, J.C. 1982. The Ecology of the Seagrasses of South Florida: A Community Profile. U.S. Fish and Wildlife Services, Office of Biological Services, Washington, D.C. FWS/OBS-82/25. 158 pp.

Zieman, J.C., and R.G. Wetzel. 1980. Methods and Rates of Productivity in Seagrasses. Pp. 87-116 IN R.C. Phillips and C.P. McRoy, eds. Handbook of Seagrass Biology. Garland STMP Press, New York.

CHAPTER 18-20
FLORIDA AQUATIC PRESERVES

Library References: Riparian rights to navigable waters. I. Henry Dean, 55 Fla. Bar J. 247, 250 (Mar., 1981).

18-20.001 Intent.

(1) All sovereignty lands within a preserve shall be managed primarily for the maintenance of essentially natural conditions, the propagation of fish and wildlife, and public recreation, including hunting and fishing where deemed appropriate by the board, and the managing agency.

(2) The aquatic preserves which are described in 73-534, Laws of Florida, Sections 258.39, 258.391, 258.392 and 258.393, Florida Statutes, future aquatic preserves established pursuant to general or special acts of the legislature, and in Rule 18-20.002, Florida Administrative Code, were established for the purpose of being preserved in an essentially natural or existing condition so that their aesthetic, biological and scientific values may endure for the enjoyment of future generations.

(3) The preserves shall be administered and managed in accordance with the following goals:

(a) To preserve, protect, and enhance these exceptional areas of sovereignty submerged lands by reasonable regulation of human activity within the preserves through the development and implementation of a comprehensive management program;

(b) To protect and enhance the waters of the preserves so that the public may continue to enjoy the traditional recreational uses of those waters such as swimming, boating, and fishing;

(c) To coordinate with federal, state, and local agencies to aid in carrying out the intent of the Legislature in creating the preserves;

(d) To use applicable federal, state, and local management programs, which are compatible with the intent and provisions of the act and these rules, and to assist in managing the preserves;

(e) To encourage the protection, enhancement or restoration of the biological, aesthetic, or scientific values of the preserves, including but not limited to the modification of existing manmade conditions toward their natural condition, and discourage activities which would degrade the aesthetic, biological, or scientific values, or the quality, or utility of a preserve, when reviewing applications, or when developing and implementing management plans for the preserves;

(f) To preserve, promote, and utilize indigenous life forms and habitats, including but not limited to: sponges, soft coral, hard corals, submerged grasses, mangroves, salt water marshes, fresh water marshes, mud flats, estuarine, aquatic, and marine reptiles, game and non-game fish species, estuarine, aquatic and marine invertebrates, estuarine, aquatic and marine mammals, birds, shellfish and mollusks;

(g) To acquire additional title interests in lands wherever such acquisitions would serve to protect or enhance the biological, aesthetic, or scientific values of the preserves;

(h) To maintain those beneficial hydrologic and biologic functions, the benefits of which accrue to the public at large.

(4) Nothing in these rules shall serve to eliminate or alter the requirements or authority of other governmental agencies, including counties and municipalities, to protect or enhance the preserves provided that such requirements or authority are not inconsistent with the act and this chapter.

Specific Authority 120.53, 258.43(1) FS. Law Implemented 258.35, 258.36, 258.37, 258.39, 258.393 FS. Chapter 80-280 Laws of Florida. History—New 2-23-81, Amended 8-7-85, Formerly 16Q-20.01, Transferred from 16Q-20.001.

18-20.002 Boundaries and Scope of the Preserves.

(1) These rules shall only apply to those sovereignty lands within a preserve, title to which is vested in the board, and those other lands for which the board has an appropriate instrument in writing, executed by the owner, authorizing the inclusion of specific lands in an aquatic preserve pursuant to Section 2(2) of Chapter 73-534, Laws of Florida, Sections 258.40(1) and 258.41(5), Florida Statutes, future aquatic preserves established through general or special acts of the legislature, and pursuant to Rule 18-20.008, Florida Administrative Code. Any publicly owned and maintained navigation channel authorized by the United States Congress, or other public works project authorized by the United States Congress, designed to improve or maintain commerce and navigation shall be deemed to be excluded from the

provisions of this chapter, pursuant to Subsection 258.40(2), Florida Statutes. Furthermore, all lands lost by avulsion or by artificially induced erosion shall be deemed excluded from the provisions of this chapter pursuant to Subsection 258.40(3), Florida Statutes.

(2) These rules do not apply to Boca Ciega Bay, Pinellas County or Biscayne Bay Aquatic Preserves.

(3) These rules are promulgated to clarify the responsibilities of the board in carrying out its land management functions as those functions apply within the preserves. Implementation and responsibility for environmental permitting of activities and water quality protection within the preserves are vested in the Department of Environmental Regulation. Since these rules are considered cumulative with other rules, a person planning an activity within the preserves should also consult the other applicable department rules (Chapter 18-21, Florida Administrative Code, for example) as well as the rules of the Department of Environmental Regulation.

(4) These rules shall not affect previous actions of the board concerning the issuance of any easement or lease; or any disclaimer concerning sovereignty lands.

(5) The intent and specific provisions expressed in 18-20.001(e) and (f) apply generally to all existing or future aquatic preserves within the scope of this chapter. Upon completion of a resource inventory and approval of a management plan for a preserve, pursuant to 18-20.013, the type designation and the resource sought to be preserved may be readdressed by the Board.

(6) For the purpose of clarification and interpretation, the legal description set forth as follows do not include any land which is expressly recognized as privately owned upland in a pre-existing recorded mean high water line settlement agreement between the board and a private owner or owners. Provided, however, in those instances wherein a settlement agreement was executed subsequent to the passage of the Florida Coastal Mapping Act, the determination of the mean high water line shall be in accordance with the provisions of such act.

(7) Persons interested in obtaining details of particular preserves should contact the Bureau of State Lands Management, Department of Natural Resources, 3900 Commonwealth Blvd., Tallahassee, FL 32303 (telephone 904-488-2297).

(a) The preserves are described as follows:

1. Fort Clinch State Park Aquatic Preserve, as described in the Official Records of Nassau County in Book 108, pages 343-346, and in Book 111, page 409.

2. Nassau River — St. Johns River Marshes Aquatic Preserve, as described in the Official Records of Duval County in Volume 3183, pages 547-552, and in the Official Records of Nassau County in Book 108, pages 232-237.

3. Pellicer Creek Aquatic Preserve, as described in the Official Records of St. Johns County in Book 181, pages 363-366, and in the Official Records of Flagler County in Book 33, pages 131-134.

4. Tomoka Marsh Aquatic Preserve, as described in the Official Records of Flagler County in Book 33, pages 135-138, and in the Official Records of Volusia County in Book 1244, pages 615-618.

5. Wekiva River Aquatic Preserve, as described in Section 258.39(30), F.S.

6. Mosquito Lagoon Aquatic Preserve, as described in the Official Records of Volusia County in Book 1244, pages 619-623, and in the Official Records of Brevard County in Book 1143, pages 190-194.

7. Banana River Aquatic Preserve, as described in the Official Records of Brevard County in Book 1143, pages 195-198, less those lands dedicated to the U. S. A. prior to the enactment of the act, until such time as the U. S. A. no longer wishes to maintain such lands for the purpose for which they were dedicated, at which time such lands would revert to the board, and be managed as part of the preserve.

8. Indian River — Malabar to Sebastian Aquatic Preserve, as described in the Official Records of Brevard County in Book 1143, pages 199-202, and in the Official Records of Indian River County in Book 368, pages 5-8.

9. Indian River — Vero Beach to Fort Pierce Aquatic Preserve, as described in the Official Records of Indian River County in Book 368, pages 9-12, and in the Official Records of St. Lucie County in Book 187, pages 1083-1086.

10. Jensen Beach to Jupiter Inlet Aquatic Preserve, as described in the Official Records of St. Lucie County in Book 218, pages 2865-2869.

11. North Fork, St. Lucie Aquatic Preserve, as described in the Official Records of Martin County in Book 337, pages 2159-2162, and in the Official Records of St. Lucie County in Book 201, pages 1676-1679.

12. Loxahatchee River — Lake Worth Creek Aquatic Preserve, as described in the Official Records of Martin County in Book 320, pages 193-196, and in the Official Records of Palm Beach County in Volume 1860, pages 806-809.

13. Biscayne Bay — Cape Florida to Monroe County Line Aquatic Preserve, as described in the Official Records of Dade County in Book 7055, pages 852-856, less, however, those lands and waters as described in Section 258.165, F. S., (Biscayne Bay Aquatic Preserve Act of 1974), and those lands and waters within the Biscayne National Park.

14. Lignumvitae Key Aquatic Preserve, as described in the Official Records of Monroe County in Book 502, pages 139-142.

15. Coupon Bight Aquatic Preserve, as described in the Official Records of Monroe County in Book 502, pages 143-146.

16. Cape Romano — Ten Thousand Islands Aquatic Preserve, as described in the Official Records of Collier County in Book 381, pages 298-301.

17. Rookery Bay Aquatic Preserve, as described in Section 258.39(31), FS.

18. Estero Bay Aquatic Preserve as described in Section 258.39(28), Florida Statutes.

19. Pine Island Sound Aquatic Preserve, as described in the Official Records of Lee County in Book 648, pages 732-736.

20. Matlacha Pass Aquatic Preserve, as described in the Official Records of Lee County in Book 800, pages 725-728.

21. Gasparilla Sound — Charlotte Harbor Aquatic Preserve, as described in Section 258.392, F.S.

22. Cape Haze Aquatic Preserve, as described in Section 258.39(29), F.S.

23. Cockroach Bay Aquatic Preserve, as described in Section 258.391, F.S.

24. St. Martins Marsh Aquatic Preserve, as described in the Official Records of Citrus County in Book 276, pages 238-241.

25. Alligator Harbor Aquatic Preserve, as described in the Official Records of Franklin County in Volume 98, pages 82-85.

26. Apalachicola Bay Aquatic Preserve, as described in the Official Records of Gulf County in Book 46, pages 77-81, and in the Official Records of Franklin County in Volume 98, pages 102-106.

27. St. Joseph Bay Aquatic Preserve, as described in the Official Records of Gulf County in Book 46, pages 73-76.

28. St. Andrews State Park Aquatic Preserve, as described in the Official Records of Bay County in Book 379, pages 547-550.

29. Rocky Bayou State Park Aquatic Preserve, as described in the Official Records of Okaloosa County in Book 593, pages 742-745.

30. Yellow River Marsh Aquatic Preserve, as described in the Official Records of Santa Rosa County in Book 206, pages 568-571.

31. Fort Pickens State Park Aquatic Preserve, as described in the Official Records of Santa Rosa County in Book 220, pages 60-63, in the Official Records of Escambia County in Book 518, pages 659-662, less the lands dedicated to the U. S. A. for the establishment of the Gulf Islands National Seashore prior to the enactment of the act, until such time as the U. S. A. no longer wishes to maintain such lands for the purpose for which they were dedicated, at which time such lands would revert to the board and be managed as part of the preserve.

32. For the purpose of this section the boundaries of the Lake Jackson Aquatic Preserve, shall be the body of water in Leon County known as Lake Jackson in Sections 1, 2, 3, 5, 10, 11 and 14, Township 1 North, Range 1 West and Sections 11, 12, 13, 14, 15, 21, 22, 23, 26, 27, 28, 29, 32, 33, 34, and 35, Township 2 North, Range 1 West lying below the ordinary high water line. Such lands shall include the submerged bottom lands and the water column upon such lands, as well as all publicly owned islands, within the boundaries of the preserve. Any privately held upland within the boundaries of the preserve shall be deemed to be excluded therefrom; provided that the Board may negotiate an arrangement with any such private upland owner by which such land may be included in the preserve.

33. Terra Ceia Aquatic Preserve, as described in Section 258.393, Florida Statutes.

34. Future aquatic preserves established pursuant to general or special acts of the legislature.

Specific Authority 120.53, 258.43(1) FS. Law Implemented 258.39, 258.391, 258.392, 258.393, 258.40, 258.41, 258.42, 258.43, 258.44, 258.45 FS. History—New 2-23-81, Amended 8-7-85, Formerly 16Q-20.02, Transferred from 16Q-20.002.

18-20.003 Definitions. When used in these rules, the following words shall have the indicated meaning unless the context clearly indicates otherwise:

(1) "Act" means the provisions of Section 258.35 through 258.46, F.S., the Florida Aquatic Preserve Act.

(2) "Activity" means any project and such other human action within the preserve requiring board approval for the use, sale, lease or transfer of interest in sovereignty lands or materials, or which may require a license from the Department of Environmental Regulation.

(3) "Aesthetic values" means scenic characteristics or amenities of the preserve in its essentially natural state or condition, and the maintenance thereof.

(4) "Applicant" means any person making application for a permit, license, conveyance of an interest in state owned lands or any other necessary form of governmental approval in order to perform an activity within the preserve.

(5) "Beneficial biological functions" means interactions between flora, fauna and physical or chemical attributes of the environment, which provide benefits that accrue to the public at large, including, but not limited to: nutrient, pesticide and heavy metal uptake; sediment retention; nutrient conversion to biomass; nutrient recycling and oxygenation.

(6) "Beneficial hydrological functions" means interactions between flora, fauna and physical geological or geographical attributes of the environment, which provide benefits that accrue to the public at large, including, but not limited to: retardation of storm water flow; storm water retention; and water storage, and periodical release;

(7) "Biological values" means the preservation and promotion of indigenous life forms and habitats including, but not limited to: sponges, soft corals, hard corals, submerged grasses, mangroves, saltwater marshes, fresh water marshes, mud flats, marine, estuarine, and aquatic reptiles, games and non-games fish species, marine, estuarine, and aquatic mammals, marine, estuarine, and aquatic invertebrates, birds and shellfish.

(8) "Board" means the Governor and Cabinet sitting as the Board of Trustees of the Internal Improvement Trust Fund.

(9) "Channel" means a trench, the bottom of which is normally covered entirely by water, with the upper edges of its sides normally below water.

(10) "Commercial, industrial and other revenue generating/income related docks" means docking facilities for an activity which produces income, through rental or any other means, or which serves as an accessory facility to other rental, commercial or industrial operations. It shall include, but not be limited to docking for: marinas, restaurants, hotels, motels, commercial fishing, shipping, boat or ship construction, repair, and sales.

(11) "Department" means the State of Florida Department of Natural Resources, as administrator for the board.

(12) "Division" means the Division of State Lands, which performs all staff duties and functions related to the administration of lands title to which is, or will be, vested in the board, pursuant to section 253.002, F.S.

(13) "Dock" means a fixed or floating structure, including moorings, used for the purpose of berthing buoyant vessels either temporarily or indefinitely.

(14) "Essentially natural condition" means those functions which support the continued existence or encourage the restoration of the diverse population of indigenous life forms and habitats to the extent they existed prior to the significant development adjacent to and within the preserve.

(15) "Extreme hardship" means a significant burden, unique to the applicant and not shared by property owners in the area. Self-imposed circumstances caused to any degree by actions of any person subsequent to the enactment of the Act shall not be construed as an extreme hardship. Extreme hardship under this act shall not be construed to include any hardship which arises in whole or in part from the effect of other federal, state or local laws, ordinances, rules or regulations. The term may be inherent in public projects which are shown to be a public necessity.

(16) "Fill" means materials from any source, deposited by any means onto sovereignty lands, either for the purpose of creating new uplands or for any other purpose, including spoiling of dredged materials. For the purpose of this rule, the placement of pilings or riprap shall not be considered to be filling.

(17) "Lease" means a conveyance of interest in lands, title to which is vested in the board, granted in accordance with specific terms set forth in writing.

(18) "Marina" means a small craft harbor complex used primarily for recreation.

(19) "Oil and gas transportation facilities" means those structures necessary for the movement of oil and gas from the production site to the consumer.

(20) "Person" means individuals, minors, partnerships, corporations, joint ventures, estates, trusts, syndicates, fiduciaries, firms, and all other associations and combinations, whether public or private, including governmental entities.

(21) "Pier" means a structure in, on, or over sovereignty lands, which is used by the public primarily for fishing, swimming, or viewing the preserve. A pier shall not include a dock.

(22) "Preserve" means any and all of those areas which are exceptional areas of sovereignty lands and the associated water body so designated in Section 258.39, 258.391, and 258.392, F.S., including all sovereignty lands, title to which is vested in the board, and such other lands as the board may acquire or approve for inclusion, and the water column over such lands, which have been set aside to be maintained in an essentially natural or existing condition of indigenous flora and fauna and their supporting habitat and the natural scenic qualities and amenities thereof.

(23) "Private residential single dock" means a dock which is used for private, recreational or leisure purposes for a single family residence, cottage or other such single dwelling unit and which is designed to moor no more than two boats.

(24) "Private residential multi-slip dock" means a docking facility which is used for private recreational or leisure purposes for multi-unit residential dwellings which shall include but is not limited to condominiums, townhouses, subdivisions and other such dwellings or residential areas and which is designed to moor three or more boats. Yacht clubs associated with residential developments, whose memberships or utilization of the docking facility requires some real property interest in the residential area, shall also be included.

(25) "Public interest" means demonstrable environmental, social, and economic benefits which would accrue to the public at large as a result of a proposed action, and which would clearly exceed all demonstrable environmental, social, and economic costs of the proposed action. In determining the public interest in a request for use, sale, lease, or transfer of interest in sovereignty lands or severance of materials from sovereignty lands, the board shall consider the ultimate project and purpose to be served by said use, sale, lease, or transfer of lands or materials.

(26) "Public navigation project" means a project primarily for the purpose of navigation which is authorized and funded by the United States Congress or by port authorities as defined by Section 315.02(2), F.S.

(27) "Public necessity" means the works or improvements required for the protection of the health and safety of the public, consistent with the Act and these rules, for which no other reasonable alternative exists.

(28) "Public utilities" means those services, provided by persons regulated by the Public Service Commission, or which are provided by rural cooperatives, municipalities, or other governmental agencies, including electricity, telephone, public water and wastewater services, and structures necessary for the provision of these services.

(29) "Quality of the preserve" means the degree of the biological, aesthetic and scientific values of the preserve necessary for present and future enjoyment of it in an essentially natural condition.

(30) "Resource management agreement" means a contractual agreement between the board and one

or more parties which does not create an interest in real property but merely authorizes conduct of certain management activities on lands held by the board.

(31) "Resource Protection Area (RPA) 1" — Areas within the aquatic preserves which have resources of the highest quality and condition for that area. These resources may include, but are not limited to corals; marine grassbeds; mangrove swamps; salt-water marsh; oyster bars; archaeological and historical sites; endangered or threatened species habitat; and, colonial water bird nesting sites.

(32) "Resource Protection Area 2" — Areas within the aquatic preserves which are in transition with either declining resource protection area 1 resources or new pioneering resources within resource protection area 3.

(33) "Resource Protection Area 3" — Areas within the aquatic preserve that are characterized by the absence of any significant natural resource attributes.

(34) "Riparian rights" means those rights incident to lands bordering upon navigable waters, as recognized by the courts of this state and common law.

(35) "Sale" means a conveyance of interest in lands, by the board, for consideration.

(36) "Scientific values" means the preservation and promotion of certain qualities or features which have scientific significance.

(37) "Shore protection structure" means a type of coastal construction designed to minimize the rate of erosion. Coastal construction includes any work or activity which is likely to have a material physical effect on existing coastal conditions or natural shore processes.

(38) "Sovereignty lands" means those lands including, but not limited to: tidal lands, islands, sandbars, shallow banks, and lands waterward of the ordinary or mean highwater line, to which the State of Florida acquired title on March 3, 1845, by virtue of statehood, and of which it has not since divested its title interest. For the purposes of this rule sovereignty lands shall include all submerged lands within the boundaries of the preserve, title to which is held by the board.

(39) "Spoil" means materials dredged from sovereignty lands which are redeposited or discarded by any means, onto either sovereignty lands or uplands.

(40) "Transfer" means the act of the board by which any interest in lands, including easements, other than sale or lease, is conveyed.

(41) "Utility of the preserve" means fitness of the preserve for the present and future enjoyment of its biological, aesthetic and scientific values, in an essentially natural condition.

(42) "Water dependent activity" means an activity which can only be conducted on, in, over, or adjacent to, water areas because the activity requires direct access to the water body or sovereignty lands for transportation, recreation, energy production or transmission, or source of water and where the use of the water or sovereignty lands is an integral part of the activity.

Specific Authority 258.43(1) FS. Law Implemented 258.37, 258.43(1) FS. History—New 2-25-81, Amended 8-7-85. Formerly 16Q-20.03. Transferred from 16Q-20.003.

18-20.004 Management Policies, Standards and Criteria. The following management policies, standards and criteria are supplemental to Chapter 18-21, Florida Administrative Code (Sovereignty Submerged Lands Management) and shall be utilized in determining whether to approve, approve with conditions or modifications or deny all requests for activities on sovereignty lands in aquatic preserves.

(1) GENERAL PROPRIETARY

(a) In determining whether to approve or deny any request the Board will evaluate each on a case-by-case basis and weigh any factors relevant under Chapter 253 and/or 258, Florida Statutes. The Board, acting as Trustees for all state-owned lands, reserves the right to approve, modify or reject any proposal.

(b) There shall be no further sale, lease or transfer of sovereignty lands except when such sale, lease or transfer is in the public interest (see Section 18-20.004(2) Public Interest Assessment Criteria).

(c) There shall be no construction of seawalls waterward of the mean or ordinary high water line, or filling waterward of the mean or ordinary high water line except in the case of public road and bridge projects where no reasonable alternative exists.

(d) There shall, in no case, be any dredging waterward of the mean or ordinary high water line for the sole or primary purpose of providing fill for any area landward of the mean or ordinary high water line.

(e) A lease, easement or consent of use may be authorized only for the following activities:

1. a public navigation project;

2. maintenance of an existing navigational channel;

3. installation or maintenance of approved navigational aids;

4. creation or maintenance of a commercial/industrial dock, pier or a marina;

5. creation or maintenance of private docks for reasonable ingress and egress of riparian owners;

6. minimum dredging for navigation channels attendant to docking facilities;

7. creation or maintenance of a shore protection structure;

8. installation or maintenance of oil and gas transportation facilities;

9. creation, maintenance, replacement or expansion of facilities required for the provision of public utilities; and

10. other activities which are a public necessity or which are necessary to enhance the quality or utility of the preserve and which are consistent with the act and this chapter.

(f) For activities listed in paragraphs 18-20.004(1)(e)1.—10. above, the activity shall be

designed so that the structure or structures to be built in, on or over sovereignty lands are limited to structures necessary to conduct water dependent activities.

(g) For activities listed in paragraphs 18-20.004(1)(e)7., 8., 9. and 10. above, it must be demonstrated that no other reasonable alternative exists which would allow the proposed activity to be constructed or undertaken outside the preserve.

(h) The use of state-owned lands for the purpose of providing private or public road access to islands where such access did not previously exist shall be prohibited. The use of state-owned lands for the purpose of providing private or public water supply to islands where such water supply did not previously exist shall be prohibited.

(i) Except for public navigation projects and maintenance dredging for existing channels and basins, any areas dredged to improve or create navigational access shall be incorporated into the preempted area of any required lease or be subject to the payment of a negotiated private easement fee.

(j) Private residential multi-slip docking facilities shall require a lease.

(k) Aquaculture and beach renourishment activities which comply with the standards of this rule chapter and Chapter 18-21, Florida Administrative Code, may be approved by the board, but only subsequent to a formal finding of compatibility with the purposes of Chapter 258, Florida Statutes, and this rule chapter.

(l) Other uses of the preserve, or human activity within the preserve, although not originally contemplated, may be approved by the board, but only subsequent to a formal finding of compatibility with the purposes of Chapter 258, Florida Statutes, and this rule chapter.

(2) PUBLIC INTEREST ASSESSMENT CRITERIA

In evaluating requests for the sale, lease or transfer of interest, a balancing test will be utilized to determine whether the social, economic and/or environmental benefits clearly exceed the costs.

(a) GENERAL BENEFIT/COST CRITERIA:

1. any benefits that are balanced against the costs of a particular project shall be related to the affected aquatic preserve;

2. in evaluating the benefits and costs of each request, specific consideration and weight shall be given to the quality and nature of the specific aquatic preserve. Projects in the less developed, more pristine aquatic preserves such as Apalachicola Bay shall be subject to a higher standard than the more developed urban aquatic preserves such as Boca Ciega Bay; and,

3. for projects in aquatic preserves with adopted management plans, consistency with the management plan will be weighed heavily when determining whether the project is in the public interest.

(b) BENEFIT CATEGORIES:

1. public access (public boat ramps, boatslips, etc.);

2. provide boating and marina services (repair, pumpout, etc.);

3 improve and enhance public health, safety, welfare, and law enforcement;

4. improved public land management;

5. improve and enhance public navigation;

6. improve and enhance water quality;

7. enhancement/restoration of natural habitat and functions; and

8. improve/protect endangered/threatened/unique species.

(c) COSTS:

1. reduced/degraded water quality;

2. reduced/degraded natural habitat and function;

3. destruction, harm or harassment of endangered or threatened species and habitat;

4. preemption of public use;

5. increasing navigational hazards and congestion;

6. reduced/degraded aesthetics; and

7. adverse cumulative impacts.

(d) EXAMPLES OF SPECIFIC BENEFITS:

1. donation of land, conservation easements, restrictive covenants or other title interests in or contiguous to the aquatic preserve which will protect or enhance the aquatic preserve;

2. providing access or facilities for public land management activities;

3. providing public access easements and/or facilities, such as beach access, boat ramps, etc.;

4. restoration/enhancement of altered habitat or natural functions, such as conversion of vertical bulkheads to riprap and/or vegetation for shoreline stabilization or re-establishment of shoreline or submerged vegetation;

5. improving fishery habitat through the establishment of artificial reefs or other such projects, where appropriate;

6. providing sewage pumpout facilities where normally not required, in particular, facilities open to the general public;

7. improvements to water quality such as removal of toxic sediments, increased flushing and circulation, etc.;

8. providing upland dry storage as an alternative to wetslip; and

9. marking navigation channels to avoid disruption of shallow water habitats.

(3) RESOURCE MANAGEMENT

(a) All proposed activities in aquatic preserves having management plans adopted by the Board must demonstrate that such activities are consistent with the management plan.

(b) No drilling of oil, gas or other such wells shall be allowed.

(c) Utility cables, pipes and other such structures shall be constructed and located in a manner that will cause minimal disturbance to submerged land resources such as oyster bars and submerged grass beds and do not interfere with traditional public uses.

(d) Spoil disposal within the preserves shall be strongly discouraged and may be approved only

structures shall be constructed and located in a manner that will cause minimal disturbance to submerged land resources such as oyster bars and submerged grass beds and do not interfere with traditional public uses.

(d) Spoil disposal within the preserves shall be strongly discouraged and may be approved only where the applicant has demonstrated that there is no other reasonable alternative and that activity may be beneficial to, or at a minimum, not harmful to the quality and utility of the preserve.

(4) RIPARIAN RIGHTS

(a) None of the provisions of this rule shall be implemented in a manner that would unreasonably infringe upon the traditional, common law and statutory riparian rights of upland riparian property owners adjacent to sovereignty lands.

(b) The evaluation and determination of the reasonable riparian rights of ingress and egress for private, residential multi-slip docks shall be based upon the number of linear feet of riparian shoreline.

(c) For the purposes of this rule, a private, residential, single docking facility which meets all the requirements of Rule 18-20.004(5) shall be deemed to meet the public interest requirements of Rule 18-20.004(1)(b), Florida Administrative Code. However, the applicants for such docking facilities must apply for such consent and must meet all of the requirements and standards of this rule chapter.

(5) STANDARDS AND CRITERIA FOR DOCKING FACILITIES

(a) All docking facilities, whether for a single or multi-slip residential or commercial, shall be subject to the following standards and criteria:

1. no dock shall extend waterward of the mean or ordinary high water line more than 500 feet or 20 percent of the width of the waterbody at that particular location whichever is less;

2. certain docks may fall within areas of special or unique importance. These areas may be of significant biological, scientific, historic and/or aesthetic value and require special management considerations. Modifications may be more restrictive than the normally accepted criteria. Such modifications shall be determined on a case-by-case analysis, and may include, but shall not be limited to changes in location, configuration, length, width and height;

3. the number, lengths, drafts and types of vessels allowed to utilize the proposed facility may also be stipulated; and

4. where local governments have more stringent standards and criteria for docking facilities, the more stringent standards for the protection and enhancement of the aquatic preserve shall prevail.

(b) Private residential single docks shall conform to the following specific design standards and criteria:

1. any main access dock shall be limited to a maximum width of four (4) feet;

2. the dock decking design and construction will insure maximum light penetration, with full consideration of safety and practicality;

3. the dock will extend out from the shoreline no further than to a maximum depth of minus four (− 4) feet (mean low water);

4. when the water depth is minus four (− 4) feet (mean low water) at an existing bulkhead the maximum dock length from the bulkhead shall be 25 feet, subject to modifications accommodating shoreline vegetation overhang;

5. wave break devices, when necessary, shall be designed to allow for maximum water circulation and shall be built in such a manner as to be part of the dock structure;

6. terminal platform size shall be no more than 160 square feet; and

7. dredging to obtain navigable water depths in conjunction with private residential, single dock applications is strongly discouraged.

(c) Private residential multi-slip docks shall conform to the following specific design standards and criteria:

1. the area of sovereignty, submerged land preempted by the docking facility shall not exceed the square footage amounting to ten times the riparian waterfront footage of the affected waterbody of the applicant, or the square footage attendant to providing a single dock in accordance with the criteria for private residential single docks, whichever is greater. A conservation easement or other such use restriction acceptable to the Board must be placed on the riparian shoreline, used for the calculation of the 10:1 threshold, to conserve and protect shoreline resources and subordinate/waive any further riparian rights of ingress and egress for additional docking facilities;

2. docking facilities and access channels shall be prohibited in Resource Protection Area 1 or 2, except as allowed pursuant to Section 258.42(3)(c)1., Florida Statutes, while dredging in Resource Protection Area 3 shall be strongly discouraged;

3. docking facilities shall only be approved in locations having adequate existing water depths in the boat mooring, turning basin, access channels, and other such areas which will accommodate the proposed boat use in order to insure that a minimum of one foot clearance is provided between the deepest draft of a vessel and the bottom at mean low water;

4. main access docks and connecting or cross walks shall not exceed six (6) feet in width;

5. terminal platforms shall not exceed eight (8) feet in width;

6. finger piers shall not exceed three (3) feet in width, and 25 feet in length;

7. pilings may be utilized as required to provide adequate mooring capabilities; and

8. the following provisions of Rule 18-20.004(5)(d) shall also apply to private residential multi-slip docks.

(d) Commercial, industrial and other revenue generating/income related docking facilities shall conform to the following specific design standards and criteria:

1. docking facilities shall only be located in or near areas with good circulation, flushing and adequate water depths;

2. docking facilities and access channels shall be prohibited in Resource Protection Area 1 or 2, except as allowed pursuant to Sections 258.42(3)(e)1., Florida Statutes; while dredging in Resource Protection Area 3 shall be strongly discouraged;

3. the docking facilities shall not be located in Resource Protection Area 1 or 2; however, main access docks may be allowed to pass through Resource Protection Area 1 or 2, that are located along the shoreline, to reach an acceptable Resource Protection Area 3, provided that such crossing will generate minimal environmental impact;

4. beginning July 1, 1986 new docking facilities may obtain a lease only where the local governments have an adopted marina plan and/or policies dealing with the siting of commercial/industrial and private, residential, multi-slip docking facilities in their local government comprehensive plan;

5. the siting of the docking facilities shall also take into account the access of the boat traffic to avoid marine grassbeds or other aquatic resources in the surrounding areas;

6. the siting of new facilities within the preserve shall be secondary to the expansions of existing facilities within the preserve when such expansion is consistent with the other standards;

7. the location of new facilities and expansion of existing facilities shall consider the use of upland dry storage as an alternative to multiple wet-slip docking;

8. marina siting will be coordinated with local governments to insure consistency with all local plans and ordinances;

9. marinas shall not be sited within state designated manatee sanctuaries; and

10. in any areas with known manatee concentrations, manatee warning/notice and/or speed limit signs shall be erected at the marina and/or ingress and egress channels, according to Florida Marine Patrol specifications.

(e) Exceptions to the standards and criteria listed in Rule 18-20.004(5), Florida Administrative Code, may be considered, but only upon demonstration by the applicant that such exceptions are necessary to insure reasonable riparian ingress and egress.

(6) MANAGEMENT AGREEMENTS

The board may enter into management agreements with local agencies for the administration and enforcement of standards and criteria for private residential single docks.

(7) In addition to the policies, standards and criteria delineated in subsections (1) through (6), the provisions of the following management plans apply to specific aquatic preserves and are incorporated herein by reference. Where regulatory criteria in 16-20, F. A. C., may differ with specific policies in the management plans listed herein, the general rule criteria shall prevail.

	Date Adopted
Alligator Harbor	September 23, 1986
Banana River	September 17, 1985
Cockroach Bay	April 21, 1987
Estero Bay	September 6, 1983
Charlotte Harbor (Cape Haze, Gasparilla Sound-Charlotte Harbor, Matlacha Pass and Pine Island Sound)	May 18, 1983
Indian River-Malabar to Vero Beach	January 21, 1986
Indian River Lagoon (Vero Beach to Fort Pierce and Jensen Beach to Jupiter Inlet)	January 22, 1985
Loxahatchee River-Lake Worth Creek	June 12, 1984
Nassau River-St. Johns River Marshes and Fort Clinch State Park	April 22, 1986
North Fork of the St. Lucie River	May 22, 1984
St. Joseph Bay	June 2, 1987
St. Martins Marsh	September 9, 1987
Terra Ceia	April 21, 1987
Wekiva River	August 25, 1987

Specific Authority 258.43(1) FS. Law Implemented 258.41, 258.42, 258.43(1), 258.44 FS. History—New 2-25-81, Amended 6-7-85, Formerly 16Q-20.004, Transferred from 16Q-20.004, Amended 9-4-88.

18-20.005 Uses, Sales, Leases, or Transfer of Interests in Lands, or Materials, Held by the Board.

Specific Authority 258.43(1) FS. Law Implemented 253.02, 253.12, 258.42 FS. History—New 2-25-81, Repealed 6-7-85, Formerly 16Q-20.05, Transferred from 16Q-20.005.

18-20.006 Cumulative Impacts. In evaluating applications for activities within the preserves or which may impact the preserves, the department recognizes that, while a particular alteration of the preserve may constitute a minor change, the cumulative effect of numerous such changes often results in major impairments to the resources of the preserve. Therefore, the department shall evaluate a particular site for which the activity is proposed with the recognition that the activity may, in conjunction with other activities adversely affect the preserve which is part of a complete and interrelated system. The impact of a proposed activity shall be considered in light of its cumulative impact on the preserve's natural system. The department shall include as a part of its evaluation of an activity:

(1) The number and extent of similar human actions within the preserve which have previously affected or are likely to affect the preserve, whether considered by the department under its current authority or which existed prior to or since the enactment of the Act; and

(2) The similar activities within the preserve

which are currently under consideration by the department; and

(3) Direct and indirect effects upon the preserve and adjacent preserves, if applicable, which may reasonably be expected to result from the activity; and

(4) The extent to which the activity is consistent with management plans for the preserve, when developed; and

(5) The extent to which the activity is permissible within the preserve in accordance with comprehensive plans adopted by affected local governments, pursuant to section 163.3161, F.S., and other applicable plans adopted by local, state, and federal governmental agencies;

(6) The extent to which the loss of beneficial hydrologic and biologic functions would adversely impact the quality or utility of the preserve; and

(7) The extent to which mitigation measures may compensate for adverse impacts.

Specific Authority 258.43(1) FS. Law Implemented 258.36, 258.43, 258.44 FS. History—New 2-25-81, Formerly 16Q-20.006, Transferred from 16Q-20.006.

18-20.007 Protection of Riparian Rights.

Specific Authority 258.43(1) FS. Law Implemented 258.123, 258.124(8), 258.44 FS. History—New 2-25-81, Repealed 6-7-85, Formerly 16Q-20.07, Transferred from 16Q-20.007.

18-20.008 Inclusion of Lands, Title to Which Is Not Vested in the Board, in a Preserve.

(1) Lands and water bottoms which are within designated aquatic preserve boundaries, or adjacent thereto and which are owned by other governmental agencies, may be included in an aquatic preserve upon specific authorization for inclusion by an appropriate instrument in writing executed by the agency.

(2) Lands and water bottoms which are within designated aquatic preserve boundaries or adjacent thereto, and which are in private ownership, may be included in an aquatic preserve upon specific authorization for inclusion by an appropriate instrument in writing executed by the owner.

(3) The appropriate instrument shall be either a dedication in perpetuity, or a lease. Such lease shall contain the following conditions:

(a) The term of the lease shall be for a minimum period of ten years.

(b) The board shall have the power and duty to enforce the provisions of each lease agreement, and shall additionally have the power to terminate any lease if the termination is in the best interest of the aquatic preserve system, and shall have the power to include such lands in any agreement for management of such lands.

(c) The board shall pay no more than $1 per year for any such lease.

Specific Authority 258.43(1) FS. Law Implemented 258.40, 258.41 FS. History—New 2-25-81, Formerly 16Q-20.008, Transferred from 16Q-20.008.

18-20.009 Establishment or Expansion of Aquatic Preserves.

(1) The board may expand existing preserves or establish additional areas to be included in the aquatic preserve system, subject to confirmation by the legislature.

(2) The board may, after public notice and public hearing in the county or counties in which the proposed expanded or new preserve is to be located, adopt a resolution formally setting aside such areas to be included in the system.

(3) The resolution setting aside an aquatic preserve area shall include:

(a) A legal description of the area to be included. A map depicting the legal description shall also be attached.

(b) The designation of the type of aquatic preserve.

(c) A general statement of what is sought to be preserved.

(d) A statement that the area established as a preserve shall be subject to the management criteria and directives of this chapter.

(e) A directive to develop a natural resource inventory and a management plan for the area being established as an aquatic preserve.

(4) Within 30 days of the designation and establishment of an aquatic preserve, the board shall record in the public records of the county or counties in which the preserve is located a legal description of the preserve.

Specific Authority 258.43(1) FS. Law Implemented 258.41 FS. History—New 2-25-81, Formerly 16Q-20.09, Transferred from 16Q-20.009.

18-20.010 Exchange of Lands. The board in its discretion may exchange lands for the benefit of the preserve, provided that:

(1) In no case shall an exchange result in any land or water area being withdrawn from the preserve; and

(2) Exchanges shall be in the public interest and shall maintain or enhance the quality or utility of the preserve.

Specific Authority 258.43(1) FS. Law Implemented 258.41(5), 258.42(1) FS. History—New 2-25-81, Formerly 16A-20.10, Transferred from 16Q-20.010.

18-20.011 Gifts of Lands. The board in its discretion may accept any gifts of lands or interests in lands within or contiguous to the preserve to maintain or enhance the quality and utility of the preserve.

Specific Authority 258.43(1) FS. Law Implemented 258.42(5) FS. History—New 2-25-81, Formerly 16Q-20.11, Transferred from 16Q-20.011.

18-20.012 Protection of Indigenous Life Forms. The taking of indigenous life forms for sale or commercial use is prohibited, except that this prohibition shall not extend to the commercial taking of fin fish, crustacea or mollusks, except as prohibited under applicable laws, rules or regulations. Members of the public may exercise their rights to fish, so long as not contrary to other statutory and regulatory provisions controlling such activities.

Specific Authority 258.43(1) FS. Law Implemented 258.43(1) FS. History—New 2-25-81, Formerly 16Q-20.12, Transferred from 16Q-20.012.

18-20.013 Development of Resource Inventories and Management Plans for Preserves.

(1) The board authorizes and directs the division to develop a resource inventory and management plan for each preserve.

(2) The division may perform the work to develop the inventories and plans, or may enter into agreements with other persons to perform the work. In either case, all work performed shall be subject to board approval.

Specific Authority 258.43(1) FS. Law Implemented 253.03(7), 253.03(8) FS. History—New 2-25-81, Amended 6-7-85, Formerly 16Q-20.13, Transferred from 16Q-20.013.

18-20.014 Enforcement. The rules shall be enforced as provided in Section 258.46.

Specific Authority 258.43(1) FS. Law Implemented 258.46 FS. History—New 2-25-81, Formerly 16Q-20.14, Transferred from 16Q-20.014.

18-20.015 Application Form.

Specific Authority 253.43(1) FS. Law Implemented 258.43 FS. History—New 2-25-81, Repealed 6-7-85, Formerly 16Q-20.15, Transferred from 16Q-20.015.

18-20.016 Coordination with Other Governmental Agencies. Where a Department of Environmental Regulation permit is required for activities on sovereignty lands the department will coordinate with the Department of Environmental Regulation to obtain a copy of the joint Department of Army/Florida Department of Environmental Regulation permit application and the biological survey. The information contained in the joint permit application and biological assessment shall be considered by the department in preparing its staff recommendations to the board. The board may also consider the reports of other governmental agencies that have related management or permitting responsibilities regarding the proposed activity.

Specific Authority 253.43(1) FS. Law Implemented 258.43 FS. History—New 2-25-81, Formerly 16Q-20.16, Transferred from 16Q-20.016.

18-20.017 Lake Jackson Aquatic Preserve. In addition to the provisions of Rules 18-20.001 through 18-20.016, the following requirements shall also apply to all proposed activities within the Lake Jackson Aquatic Preserve. If any provisions of this Rule are in conflict with any provisions of Rules 18-20.001 through 18-20.016 or Chapter 73-534, Laws of Florida, the stronger provision for the protection or enhancement of the aquatic preserve shall prevail.

(1) No further sale, transfer or lease of sovereignty lands in the preserve shall be approved or consummated by the Board, except upon a showing of extreme hardship on the part of the applicant or when the board shall determine such sale, transfer or lease to be in the public interest.

(2) No further dredging or filling of sovereignty lands of the preserve shall be approved or tolerated by the Board of Trustees except:

(a) Such minimum dredging and spoiling as may be authorized for public navigation projects or for preservation of the lake according to the expressed intent of Chapter 73-534, Laws of Florida; and

(b) Such other alteration of physical conditions as may be necessary to enhance the quality or utility of the preserve.

(3) There shall be no drilling of wells, excavation for shell or minerals, and no erection of structures (other than docks), within the preserve, unless such activity is associated with activity authorized by Chapter 73-534, Laws of Florida.

(4) The Board shall not approve the relocations of bulkhead lines within the preserve.

(5) Notwithstanding other provisions of this act, the board may, respecting lands lying within the Lake Jackson basin:

(a) Enter into agreements for and establish lines delineating sovereignty and privately owned lands;

(b) Enter into agreements for the exchange and exchange sovereignty lands for privately owned lands;

(c) Accept gifts of land within or contiguous to the preserve.

Specific Authority 258.39(26) FS. Law Implemented 258.39(26), 258.43 FS. History—New 6-7-85, Formerly 16Q-20.017, Transferred from 16Q-20.017.