CM-106

FLORIDA KEYS - MONROE COUNTY

AQUATIC PRESERVE MANAGEMENT PLAN

FEBRUARY 5, 1985

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The Department of Natural Resources

FLORIDA KEYS-MONROE COUNTY
AQUATIC PRESERVE MANAGEMENT PLAN

FOR

PROPOSED FLORIDA KEYS-MONROE COUNTY AQUATIC PRESERVE

Dr. Elton J. Gissendanner
Executive Director

Department of Natural Resources
Division of Recreation and Parks
Bureau of Environmental Land Management

STATE OF FLORIDA

BOARD OF TRUSTEES OF THE INTERNAL IMPROVEMENT TRUST FUND

RESOLUTION

WHEREAS, the Board of Trustees of the Internal Improvement Trust Fund is charged with the acquisition, administration, management, control, supervision conservation, protection, and disposition of all lands title to which is vested in the Trustees under Chapter 253, Florida Statutes; and

WHEREAS, Chapter 258, Florida Statutes, directs that state-owned submerged lands within aquatic preserves be set aside forever in their essentially natural or existing condition for the benefit of future generations; and

WHEREAS, the Trustees are charged with the adoption and enforcement of reasonable rules and regulations to carry out the provisions of Sections 258.35 through 258.46, Florida Statutes, regarding the regulation of human activity within the aquatic preserves so as not to unreasonably interfere with lawful and traditional public uses of the preserves;

WHEREAS; Section 16Q-20.13, Florida Administrative Code, mandates the development of management plans for aquatic preserves; and

WHEREAS, the Trustees desire to serve the public by effectively planning, managing and protecting aquatic preserve; and

WHEREAS, the Trustees recognize the importance and benefits of protecting the natural resources and preserving the natural ecosystems of the aquatic preserves in the Florida Keys-Monroe County area, and

WHEREAS, the Trustees have formally designated the Florida Keys-Monroe County area as an aquatic preserve, subject to Legislative confirmation, and

WHEREAS, Chapter 84-312, Laws of Florida, directs the Department of Natural Resources to develop a management plan for the Florida Keys-Monroe County, specifically addressing preferred management boundaries, and transmit same to the Governor and Legislature, and

NOW THEREFORE BE IT RESOLVED that the Board of Trustees of the Internal Improvement Trust Fund hereby adopts the Florida Keys-Monroe County Aquatic Preserve Management Plan; and

BE IT FURTHER RESOLVED that the Trustees designate the Florida Keys-Monroe County Aquatic Preserve as predominately a "wilderness" preserve, wherein the primary management objective will be the maintenance of the ecosystems in an essentially natural state; with smaller enclaves of urbanized development categorized as "Urban", wherein management will emphasize natural systems restoration; and

BE IT FURTHER RESOLVED that the Florida Keys-Monroe County Aquatic Preserve Management Plan shall serve as a fundamental policy guideline for the Trustees and other state and local agencies having jurisdiction relative to maintaining the Florida Keys-Monroe County Aquatic Preserve system, and shall provide the overall policy direction for the development and implementation of all administrative rules and programs related to the management of state-owned submerged lands within the Florida Keys-Monroe County Aquatic Preserve; and

BE IT FURTHER RESOLVED THAT the Department of Natural Resources, Division of Recreation and Parks, is hereby designated as agent for the Trustees for Purposes of aquatic preserve planning and management.

IN TESTIMONY WHEREOF THE Board of Trustees of the Internal Improvement Trust Fund have hereunto subscribed their names and have caused the Official

Seal of the Board of Trustees of the Internal Improvement Trust Fund to be hereunto affixed in the City of Tallahassee, The Capitol, on this the 5th day of February, A.D., 1985.

Governor

Secretary of State

Commissioner of Education

Attorney General

Commissioner of Agriculture

Comptroller

As and Constituting the State of Florida Board of Trustees of the Internal Improvement Trust Fund

Treasurer

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Chapter I

INTRODUCTION

This plan addresses the management of the Florida Keys-Monroe County Aquatic Preserve (Map A) as specified by the April 19, 1984 resolution by the Board of Trustees of the Internal Improvement Trust Fund. The scope and boundaries of that resolution have been studied and modified, as necessary, under the mandate set forth in Chapter 84-312, Laws of Florida as passed by the 1984 Florida Legislature.

The Florida Keys have long been an area of state, regional and national attention. The line of islands from Key Largo to Key West with their mild tropical climate, crystal clear water, coral reefs and abundant fishing, well deserve this unique distinction. The Keys are also a graphic example of how a tremendous resource can be destroyed by massive, and sometimes uncontrolled, development. The many fine attributes that attract over a million tourists a year (some of whom later establish permanent residences) have been and are being degraded.

The designation of the Florida Keys as an aquatic preserve will apply to state-owned submerged lands within the boundary area. The area of this preserve is approximately 930,000 acres or 1,453 square miles. The boundary line along privately owned riparian lands will be at the mean high waterline.

This plan is designed and written on the premise that these lands are held in trust by the Board of Trustees of the Internal Improvement Trust Fund (Governor and Cabinet) for the benefit of present and future generations of state citizens. In this respect, given the past designation of the Florida Keys as an Area of Critical State Concern and the continuing degradation of this area's natural resources, this area should be designated an aquatic preserve.

The plan is based on the authority to manage those above noted submerged lands and the natural resources on and over those lands. The credible management of these lands requires the identification of problems and sources of problems that are not within the realm of this program's authority. The basis of this management program is to manage those lands and resources directly under its authority, cooperate with other agencies' programs to correct problems and needs and identify the need for new programs where no present agency or program exists.

The Florida Keys represent an area of more diversified natural resources and human interactions than in any other area of the state. The shoreline types, for example, range from mangrove lined to rocky shoreline to sandy beach. The coral community and its interactions with other communities have many diverse variations and structures. Geology, bottom sediments, zoogeography of species (bay vs. ocean) and many other facts make the Florida Keys a unique environment.

The Florida Keys-Monroe County Aquatic Preserve as described within this plan is designated a wilderness preserve, with significant urban areas within the

overall area designated as urban preserves. The major overall wilderness preserve area will be managed to emphasize maintenance and enhancement of existing conditions, while management in the smaller urban preserve areas will emphasize the restoration of natural conditions where possible. The urban preserve areas are aquatic preserve designations and are not to be confused with Monroe County urban upland designations.

The onsite staff resources necessary for the management program are identified in Chapter XII (G) Funding and Staffing Needs. The program as described will fill the minimum need for active management in the preserve and should provide the framework for future management needs. The administrative support for this management program will be provided by the Division of Recreation and Parks' Bureau of Environmental Land Management (BELM) in Tallahassee, known as the "Central Office". Field personnel will also be supported by the local Florida Park Service, Division of Recreation and Parks, Florida Marine Patrol and other local Bureau of Environmental Land Management staff, when available.

The Resource Description section will identify resource and habitat types or communities that are the major components of the Florida Keys natural environment as it exists today. Background data, journals, books, maps and all other material used to produce and support this plan are identified in the Bibliography or Appendices. The Resource Protection Area mapping is described in Chapter V(1)(C) and will also be maintained separately in the Appendices. Appendices and Resource Protection Area mapping will be placed in permanent office facilities after they are established in the Keys. These appendices and maps will be maintained as open files to update as additional data becomes available.

Initially, development of the resource inventory will be heavily dependent on LANDSAT satellite imagery, DOT aerial photography, and existing scientific and other literature. As the program proceeds and onsite managers are present, the experience and additional resource information will likely result in modifications to the program and plan, which are both designed to accommodate such changes or at least identify areas needing improvement.

This plan is divided into chapters according to their management application. Chapter II cites the authorities upon which this management program and plan are built. Chapter III (Major Program Policy Directives) highlights the major policy areas that are within this plan. Chapter IV presents a brief resource description and references the appendices which contain more detailed information on the resources.

Chapter V presents the management objectives of both the on-site managers, who actually work in the preserve, and the administrative staff in Tallahassee.

Chapter VI addresses how this plan will interface with local, regional, state, and federal agencies and programs; as well as its relevance to non-government organizations, interest groups, and individuals.

Chapters VII through IX address the various uses, from public to private to commercial. Chapters X and XI address the use of the aquatic preserve for scientific research and environmental education, respectively.

Chapter XII is an internal management improvement section identifying problems and needs in the progressive improvement of this aquatic preserve management plan.

Chapter II

MANAGEMENT AUTHORITY

The Florida Keys-Monroe County Aquatic Preserve was approved by resolution on April 19, 1984 by the Governor and Cabinet, sitting as the Board of Trustees of the Internal Improvement Fund. The Preserve was not confirmed by the 1984 Florida Legislature as required under Section 258.41, Florida Statutes (F.S.). The Legislature did direct the Department of Natural Resources to review the boundaries of that original preserve and to prepare this management plan, to hold public meetings in the Florida Keys and prepare a report on its findings and recommendations to be submitted to the Governor, Speaker of the House, and President of the Senate (Chapter 84-312, Laws of Florida).

BOUNDARY AREA AND DESIGNATION

The initial boundary configuration approved by the Trustees' April 19, 1984 Resolution included all the state-owned submerged lands within Monroe County, with the exception of those lands within the Everglades National Park. The Legislature directed the Department to review the boundaries of the above proposed aquatic preserve.

The Florida Keys-Monroe County Aquatic Preserve will be designated a wilderness preserve. Areas of urban buildup within this overall designation will be small urban preserve sections. These small urban areas include all or parts

of Ocean Reef, Key Largo, Rock Harbor, Tavernier, Windley Key, Islamorada, Plantation, Lower Matecombe Key, Layton, Conch Key, Duck Key, Marathon, Big Pine Key, Little Torch Key, Ramrod Key, Summerland Key, Cudjoe Key, Sugarloaf Key, Saddlebunch Key, Boca Chica Key and Key West (Map A).

The management emphasis in the wilderness portions of the preserve will be toward maintaining and enhancing the existing natural condition. The emphasis in the small urban sections will be aimed at restoring and enhancing the existing condition toward a natural condition, as much as possible.

AQUATIC PRESERVE MANAGEMENT AUTHORITY

The primary management authorities available to the staff for implementing management directives affecting aquatic preserves are found in Chapters 258 and 253, F.S. These authorities clearly establish the proprietary management overview role of the Trustees. Furthermore, all management responsibilities assigned to the Trustees by this plan may be fulfilled directly by the Governor and Cabinet or indirectly via staff or agents of the Trustees, pursuant to delegations of authority, management agreements, or other legal mechanisms. All subsequent references to the Board or Trustees should be presumed to potentially include staff and designated agents, in addition to the Governor and Cabinet. The staff of the Bureau of Environmental Land Management (BELM) (acting as "agents" for the Trustees) are able to review all requests for uses of, or directly affecting, state-owned sovereignty submerged lands within aquatic preserves. The review and subsequent staff comments are primarily designed to evaluate the environmental consequences of any proposed use of state-owned submerged land. The review is conducted within the

confines of the criteria contained in the "maintenance" provisions for aquatic preserves in Chapter 258, F.S.

Formal review comments are provided to the Department of Natural Resources (DNR), Division of State Lands by the Bureau of Environmental Land Management for inclusion in the comments and recommendations accompanying agenda items for Trustees consideration. This mechanism allows the Trustees, sitting as owners of the land, to evaluate public interest and project merits within the context of environmental impact upon the preserve.

BACKGROUND

In many respects, the authorities supporting aquatic preserve planning and management are the cumulative result of the public's awareness of the importance of Florida's environment. The establishment of the present system of aquatic preserves is a direct outgrowth of public concern with dredge and fill activities rampant in the late 1960's.

In 1967, the Florida Legislature passed the Randall Act (Chapter 67-393, Laws of Florida), which set up procedures regulating previously unrestricted dredge and fill activities on state-owned submerged lands. That same year the legislature also provided statutory authority (Section 253.03, F.S.) for the Trustees to exercise proprietary control over state-owned lands. In 1967, this governmental focus on protecting Florida's productive estuaries from the impacts of development led to the establishment of a moratorium by the Governor and Cabinet on the sale of submerged lands to private interests. In that same year, this action was followed by the creation of an Interagency

Advisory Committee on submerged lands management. In late 1968, that Committee issued a report recommending the establishment of a series of aquatic preserves. Twenty-six separate waterbodies were addressed in the original recommendation.

Also in 1968, the Florida Constitution was revised, declaring in Article II, Section 7, the State's policy of conserving and protecting the natural resources and scenic beauty of the state. That constitutional provision also established the authority for the Legislature to enact measures for the abatement of air and water pollution.

It was not until October 21, 1969 that the Governor and Cabinet acted upon the recommendations of the Interagency Advisory Committee and adopted, by resolution, 18 of the waterbodies as aquatic preserves. Other preserves were similarly adopted at various times through 1971.

Prior to the October 1969 action by the Governor and Cabinet, the Legislature had created the Boca Ciega Aquatic Preserve. Subsequent Legislative action in 1972, 1973 and 1974, created the Pinellas County, Lake Jackson and Biscayne Bay Aquatic Preserves, respectively.

In 1975, the Legislature established a Florida Aquatic Preserve Act (Codified in Chapter 258, F.S.), thereby bringing all existing preserves under a standardized set of maintenance criteria. Additional acts were passed subsequent to the 1975 action, such as the addition of the Cockroach Bay Aquatic Preserve in 1976 and the Gasparilla Sound-Charlotte Harbor Aquatic Preserve to the system in 1978.

The Charlotte Harbor Aquatic Preserve Management Plan, approved by the Trustees on May 18, 1983 was the first management plan for an aquatic preserve. The following aquatic preserves have approved plans: Estero Bay - September 6, 1983; North Fork of the St. Lucie River - May 22, 1984; and Loxahatchee River--Lake Worth Creek - June 12, 1984.

The State Lands Management Plan, adopted on March 17, 1981 by the Trustees, contains specific policies. The Plan also establishes policies concerning spoil islands, submerged land leases, "Outstanding Native Florida Landscapes", unique natural features, submerged grassbeds, archaeological and historical resources, and endangered species. All of these issues provide management guidance to the aquatic preserve program.

ADMINISTRATIVE RULES

Chapters 16Q-21 and 16Q-20, Florida Administrative Code (F.A.C.) are two administrative rules directly applicable to the DNR's/Trustee's actions regarding allowable uses of submerged lands, in general, and aquatic preserves specifically. Chapter 16Q-21, F.A.C. controls activities conducted on sovereignty submerged lands, and is predicated upon the provisions of Sections 258.03 and 253.12, F.S. The stated intent of this administrative rule 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, and 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 16Q-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. The intent of this rule is contained in Section 16Q-20.01, 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 Section 258.39, 258.391, and 258.392, F.S., and in 16Q-20.02, F.A.C., 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) 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

management programs, which are compatible with the intent of the Legislature in creating the 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 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 preserve;

(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 nongame 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."

OTHER MANAGEMENT AUTHORITIES

Other Department of Natural Resources management authorities applicable to aquatic preserves, which concern fisheries and marine mammal management and protection and beach and shore preservation programs outlined in Chapters 370 and 161, F.S., respectively. Land acquisition programs conducted under the Environmentally Endangered Lands authorities of Chapter 259, F.S. or the Conservation and Recreation Lands Program authorized by 253, F.S., will enhance the protection of the natural resources within the aquatic preserves.

Chapter 403, F.S. is an important adjunct to Chapter's 253 and 258, F.S. This governs, in part, the State's regulatory programs affecting water quality. 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 shall have approval of the proposed use from the Trustees before commencing the activity. An interagency agreement between the Department of Natural Resources (DNR) and DER provides an avenue for staff comments on potential environmental impacts of projects in aquatic preserves through the DER permitting process. Additionally, the DER has designated, by administrative rule, a series of waterbodies with stringent use criteria called "Outstanding Florida Waters" (OFW). 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 for data collection and planning in areas such as the Florida Keys area, as well as being the state agency responsible for implementing the "federal consistency" provisions of the federal Coastal Zone Management Act.

The DER's administrative rules of primary significance to the aquatic preserve management program include Chapters 17-3, 17-4, and 17-12, F.A.C. These rules are based upon the authorities contained in Chapter 403, F.S. Chapter 17-3, F.A.C. addresses water quality standards and establishes the category of "Outstanding Florida Waters", while Chapter 17-4 and 17-12, F.A.C. address permit requirements.

In December, 1982 a Memorandum of Understanding (MOU) between the DER, DNR, and the U.S. Army Corps of Engineers (COE) was executed. This MOU clearly establishes a process whereby the proprietary concerns of the Trustees, stated in Chapter 253, F.S. can be integrated into the DER/COE joint permit processing system.

Other opportunities for environmental review and input into activities potentially affecting aquatic preserves are afforded by the Department of Community Affairs (DCA), and the Department of State, Division of Archives, History, and Records Management (DAHRM). The Executive Office of the Governor also provides a mechanism for public input into federal projects via the State clearinghouse process.

The DCA is statutorily responsible for administering the "Development of Regional Impact" (DRI). 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.

Chapter 267, F.S. establishes the state policy regarding preservation and management of Florida's archaeological and historical resources. This responsibility is legislatively assigned to the DAHRM, which holds title to those cultural resources located on state-owned lands. This also applies to sovereignty submerged lands, including aquatic preserves.

The Department of Health and Rehabilitative Services, under their public mandate, administers two programs directly affecting the aquatic preserve management program. These programs are (1) septic tank regulation, usually administered by county health departments and (2) arthropod (mosquito) control programs, usually implemented through local mosquito control districts. Each of these programs holds the potential for creating significant impacts upon the aquatic preserve resources. Establishment of close working relationships between the aquatic preserve staff and the Department of Health and

Rehabilitative Services will be a necessary element of the aquatic preserves management program.

Each of the above referenced programs may provide an effective means of protecting aquatic preserves and their ecologically sensitive resources. Appendix A contains a compendium of the appropriate statutes and administrative rules.

Chapter III

MAJOR PROGRAM POLICY DIRECTIVES

This plan contains a number of management policy issues that are discussed either generally or definitively. This section highlights those major policy areas that comprise the basic thrust of this management effort. Adoption of these policies will provide specific staff direction for implementing the day-to-day aquatic preserve management program. Major program policy directives are:

(A) Manage all submerged lands within the aquatic preserve to ensure the maintenance of essentially natural conditions to ensure the propagation of fish and wildlife, and public recreation opportunities.

(B) Prohibit the disturbance of archaeological and historical sites within the aquatic preserve, unless prior authorization has been obtained from the Trustees and DAHRM, and such disturbance is part of an approved research design or authorized project.

(C) Develop a resource inventory and map natural habitat types within the aquatic preserve, with an emphasis on those habitat types utilized by threatened and/or endangered species.

(D) Protect and, where possible, enhance threatened and endangered species habitat within the aquatic preserve.

(E) Prohibit development activities within the aquatic preserve that adversely impact upon grassbeds, corals and other valuable submerged habitat, unless a prior determination has been made by the Board of overriding public importance with no reasonable alternatives, and adequate mitigation measures are included.

(F) Prohibit the trimming and/or removal of mangroves and other natural shoreline vegetation within the aquatic preserve, except when necessitated by the pursuit of legally authorized projects and local Mangrove Protection Ordinances.

(G) Provide research and educational opportunities for scientists and other interested researchers within the framework of a planned research program in the aquatic preserve.

(H) Acquire, where feasible, privately owned submerged lands located within the boundaries of the aquatic preserve pursuant to the authorities contained in Section 253.02(4), F.S.

(I) Prohibit the drilling of oil and gas wells, the mining of minerals, and dredging for the primary purpose of obtaining upland fill within the aquatic preserve.

(J) Prohibit non-water dependent uses of submerged lands within the aquatic preserve except in those cases where the Board has determined that the project is overwhelmingly in the public interest and no reasonable

alternatives exist. This prohibition shall include floating residential units, as defined in Section 125.0106(2), F.S.

(K) Prohibit storage of toxic, radioactive, or other hazardous materials within the aquatic preserve.

(L) Prohibit mosquito control practices within the aquatic preserve that require habitat modification or manipulation (i.e. diking, ditching) unless failure to conduct such practices would result in a threat to public health.

(M) Limit pesticide and biocide use within the aquatic preserve to those that are approved by the Environmental Protection Agency (EPA) for wetland and aquatic application.

(N) Prohibit the construction of new deep water ports within the aquatic preserve boundaries.

(O) Insure that artificial reef construction does not adversely impact environmentally fragile areas within the aquatic preserve and that the construction will maintain the essentially natural condition while enhancing the quality and utility of the preserve.

(P) Manage state-owned spoil islands within the aquatic preserve as bird rookeries and wildlife habitat areas.

(Q) Encourage public utilization of the aquatic preserve, consistent with the continued maintenance of its natural values and functions.

(R) Develop a well coordinated aquatic preserve management mechanism that recognizes and utilizes local government programs and authorities.

(S) Require, through the efforts of DER and the water management district, the maintenance of the naturally high water quality of the Florida Keys.

(T) Formally recognize and designate the Florida Keys-Monroe County Aquatic Preserve as a wilderness preserve with smaller urban preserve sections as noted in Chapter II and as delineated in Map A in accordance with the provisions of Section 16Q-20.13(d), F.A.C.

(U) Apply the management criteria contained in the adopted Florida Keys Monroe County Aquatic Preserve Management Plan to all subsequent legislative additions of land to the aquatic preserve.

(V) Encourage the assistance of federal, state, and local government agencies in implementing the aquatic preserve management plan, especially in the areas of protection of natural and cultural resources and the enforcement of applicable resource laws and ordinances.

(W) Marinas shall not be located in Class 1 or 2 Resource Protection Areas.

(X) Identify and document any problems caused by fishing activities and report them to the Marine Fisheries Commission. Enforce any rule adopted by the Marine Fisheries Commission and approved by the Trustees.

(Y) Allow special consideration for a commercial fishing village or zone concept.

Chapter IV

RESOURCE DESCRIPTION

The archipelago that comprises the Florida Keys represents a truly unique region in Florida and the United States. This island chain separates Florida Bay and the Gulf of Mexico from the Atlantic Ocean. Numerous channels between island groups facilitate tidal exchange between the waterbodies.

The elevation of most of the keys is just above the mean high tide line so there is extensive mangrove growth, especially along shorelines on the Gulf of Mexico and Florida Bay. Mangroves protect shorelines from erosion, particularly during storms, and provide habitat for many invertebrates and fishes. Sand beaches in the Keys are few and scattered.

Higher elevations support the growth of pinelands and tropical hammocks and such associated endangered animal species as the Key Vaca raccoon, Key deer, and Key Largo woodrat.

Probably the most distinguishing feature of this area is the band of living reefs located seaward of and parallel to the Keys toward the Straits of Florida. Several different types of reef formations occur at varying water depths. The coral assemblages and the hundreds of associated species of invertebrates and fishes are found nowhere else in the United States. The coral reefs make tourism and recreation a major factor in the local and regional economy.

The relatively stable subtropical climate makes the Keys home for a variety of plants and animals that depend on very specific conditions available only in highly differentiated habitats such as the coral reef and tropical hardwood hammock (Schomer and Drew, 1982). Due to indiscriminate development practices and water quality degradation, many plant and animal populations are declining. In this area forty-four species of plants and sixty-nine animal species in both terrestrial and aquatic communities are currently classified as endangered, threatened, or of special concern.

The tropical ecosystems of the Keys are naturally subjected to the stresses of wind and water damage from tropical storms and hurricanes. Damage to the natural communities from these forces can be quite severe. It is the manmade encroachments, however, that contribute continual stress in the form of water quality degradation (via improper use of septic tanks, storm water runoff, dredge and fill activities, increased turbidity) and indiscriminate development practices.

Detailed information on the resources (e.g., species lists, water quality data, archaeological and historical site information, life histories, geological background, supporting maps, cultural resource information) is located in Appendices C and D. The resource information presented in this chapter is intended to be generally descriptive of the major management functions and resources of the area surrounding the Florida Keys.

Climate

The climate in the Florida Keys is subtropical, characterized by mild dry winters and warm humid summers. Climatic conditions are divisible into three

intensity levels: (1) prevailing mild southeast and east winds (trade winds), (2) winter cold fronts and (3) infrequent major storms (tropical depressions and hurricanes) (Warzeski, 1976). The average rainfall at Key West is 39.8 inches per year (NOAA, 1965, 1979). The typical rainfall pattern is bimodal with large peaks usually occurring in June and September. The major seasonal low in precipitation occurs from December through April. Though this pattern is typical, year to year variability for each month is extremely high. The summer rainfall is due primarily to thunderstorm activity caused by the over-land rise and condensation of moisture in warm oceanic air associated with the trade winds. During the winter months, the little rain that does fall is caused by coldfronts that pass over the Keys from the northwest.

The average air temperature for Key West, measured over a 20 year period, is 77.5 °F (NOAA, 1965, 1979). A seasonal mean peak of 84.7 °F occurs in July through August, tapering to a mean low of 69.0 °F in the months of December and January. Temperature in the Keys is strongly affected by the warm waters surrounding the Keys and the Gulf Stream extending along the length of the Keys. The constancy of temperatures throughout the Keys is produced by the proximity of the Gulf Stream (Jordan, 1973; Thomas, 1974). In general, rainfall increases along the trend from Key West to the Upper Keys by about five inches per year.

Winds in the Keys are mild, averaging 10-15 knots over most of the year. The highest winds occur in the winter following the passage of cold fronts while

the trade winds predominate for the remainder of the year. The exceptional hurricane, however, may cause winds of 150 miles per hour (mph) (Gentry, 1974).

No discussion of the Florida Keys resources would be complete without a note on the occurrence and effect of hurricanes. They will be noted as having major effects throughout this text; from effects on geology, biology and other natural features to the effects on activities of the public and private sectors.

The probability that a hurricane will cross the Upper or Lower Keys in a given year is about 20 percent (Simpson and Lawrence, 1971). Three major forces contribute to the extensive damage caused by hurricanes: winds, storm surge and rains. The destructive capabilities of high winds are obvious. The force exerted by wind increases by the square of the wind speed; thus, if wind speed were to double, wind force would quadruple. The storm surge may be the most destructive element of a passing hurricane. As a result of wind interaction with the ocean surface, the affect of low pressures on the sea's surface, and the affect of the shallow bottom contour in piling up water, massive storm surges may form. Storm surges associated with Florida hurricanes have been reliably measured at 15 feet. A storm surge of this magnitude would devastate the Keys. Finally, large quantities of rain associated with hurricanes result in erosion and water runoff. Each factor will combine to produce massive destruction of natural and manmade features. Ball et al. (1967), and Craighead and Gilbert (1962) reported extensive biological and geologic rearrangement and destruction of the coastal zone in South Florida

and the Keys after the passage of Hurricane Donna in 1960. It is necessary to understand a hurricane's potential as a destructive agent, to be prepared for its occurrence, and to plan development in such a way that the environment does not become any more vulnerable than it already is. Multer (1977) has pointed out that manmade encroachments along shorelines and scarification of shorelines and bay bottoms will play a role in hindering recovery of these areas after a hurricane. Natural features (mangroves, coral reefs, etc.), though possibly damaged severely by a storm, will act to lessen the severity of impact on coastal areas (Multer, 1977).

A. Geological Features and Landforms

The Florida Keys form an elongate arc stretching southwest from Soldier Key in Biscayne Bay to Loggerhead Key in the Dry Tortugas. The overall length of this chain of islands is approximately 233 miles. Miami Beach, Virginia Key and Key Biscayne are not considered a part of the Florida Keys because, as barrier islands rather than emergent reefs, they have a different geologic origin. The Florida Keys lie in the physiographic province known as the Southern Zone of the Coastal Lowlands, the Florida Plateau (Hoffmeister, 1974). The Keys are composed of two emergent Pleistocene formations, the Key Largo Limestone and the Miami Limestone (or Miami Oolite) (Hoffmeister and Multer, 1964, 1968). The two formations split the Keys into two geologic areas; or three if the Dry Tortugas are considered. The Upper Keys, to the easterly extreme of Big Pine Key, are composed of Key Largo Limestone. The Lower Keys, from Big Pine Key to Key West, are composed of Miami Limestone which overlies the Key Largo formation. The Dry Tortugas are sand islands not firmly cemented to any geological rock facies (Brooks, 1963).

Several geologic environments may be defined in the Keys (Multer, 1977). Most of the Keys have fringing mangrove growth which is considered to be among the most important of constructional geologic agents of the nearshore (Multer, 1977). The tangle of roots catch and hold sediments and provide an environment for calcification. In addition there are rocky shore, carbonate sand beach, beach rock, tidal and supratidal nearshore environments. Lagoonal areas, for the purpose of this discussion, are classified according to size and complexity (e.g. Coupon Bight, Card Sound and Florida Bay). Transitional areas include channels and cuts between Keys. Offshore areas can be divided into innershelf and outer shelf areas such as Hawks Channel and the outer reefs (e.g., Molasses and Carysfort reefs), respectively.

Because the geology of the Upper and Lower Keys is different, there are notable differences in the geographic appearance and orientation of the regions. The Upper Keys lie with their axis parallel to the axis of the entire chain of Keys. Since most of these keys are elongate and have relatively few cuts or channels through the chain, the Upper Keys act as a barrier between the waters of Florida Bay and the Atlantic Ocean. It is because of this barrier that the long and extensive system of reefs exists offshore and parallel to the Upper Keys or the ocean side. Corals, which are extremely sensitive to conditions of high turbidity, are favored by the limited exchange of silty, carbonate rich waters from Florida Bay with those of the Florida Straits (Hoffmeister, 1974)

The axis of the islands making up the Lower Keys is oriented perpendicular to the axis of the chain as a whole. There are numerous and extensive channels

connecting Florida Bay with the Atlantic Ocean. This resultant influx of turbid water from Florida Bay is the reason that less extensive coral reefs exist in the Lower Keys.

The channels that are so characteristic of the Lower Keys are not believed to be an emergent geological feature of these islands, but rather a feature of the ancient depositional environment of the Miami Limestone. The Miami formation was deposited in a relatively high energy, shallow water environment. The present channels and keys originated as underwater topography created by tidal currents (Hoffmeister and Multer, 1968). During the last glaciation and subsequent transgression in sea level, the Keys became emergent features and tidal action continued to cut through the preexisting channels leaving the keys we see today.

Ancient Geologic Environment

The oldest rock formations on the South Florida mainland are only six million years old. The rock that forms the Florida Keys is even younger, aged at 100,000 years (Hoffmeister, 1974).

One important phenomenon that has worked to shape the geology of south Florida is the continual shift in sea level. During the formation of the Florida Keys, sea level rose to a peak approximately 25 feet above the present level. From 100,000 years until about 20,000 years ago there was a dramatic drop in sea level as a result of the Wisconsin period of glaciation. Sea level dropped to approximately 325 feet below its present level. During the recent

period (Holocene), sea level rose to its present level and is continuing a slow rise of about two inches every 100 years (Hoffmeister, 1974, Wanless, 1969).

Key Largo Limestone: Multer (1977) indicates that the Key Largo Limestone occupies an area roughly 12.5 miles x 235 miles or 2900 square miles. Multer and Hoffmeister (1968), after analyzing cores of the Key Largo formation, distinguished three facies: (1) an outer reef facies (2 to 4 miles seaward of the present keys), (2) a back-reef facies (2 miles seaward and approximately one mile lagoonward of the present keys), and (3) a lagoonal facies in the approximate site of the modern Florida Bay.

The thickness of this formation is variable and lies on a bedrock of lithified quartzose calcareous sand. Its depth at north Key Largo is about 145 feet; in south Key Largo its depth is only about 75 feet. Further south, its depth is 100 feet in Tavernier and about 170 feet in Grassy Key. At Big Pine Key, the Key Largo Limestone formation lies under 20 feet of the Miami Limestone Formation with a thickness of at least 180 feet; approximately the same situation exists in Key West. The Miami Limestone formation disappears toward the Tortugas and the Key Largo formation is found some 30 feet below sea level (Multer and Hoffmeister, 1968).

Miami Limestone Formation: The Miami Limestone Formation lies in two separate geographic areas of south Florida and is composed of two different facies; an oolitic facies and a bryozoan facies. The first geographic area of the Miami Limestone lies at the tip of mainland South Florida, and is visible throughout the Everglades, Homestead, and Miami areas.

The second location of the Miami Limestone is in the Lower Keys where it is composed only of the oolitic facies. It overlies the Key Largo limestone making surface contact along the Long Beach area of Big Pine Key to Key West. This is not an ancient coral reef formation like the Key Largo Limestone but, rather, was formed in a high energy environment at the shelf margin. These areas are typified by conditions of shallow water, very low silt content, saturated levels of calcium carbonate and high turbulence.

Modern Geological Environment

In the aquatic environment especially, the modern geology of the Keys is very closely aligned with its biology. The living carbonate reefs we see today are actively producing the carbonate limestones of tomorrow. The exposed Key Largo limestone formation is a good, ancient analogue of the modern patch reef communities. In addition, many other organisms, including algae and microscopic plants and animals, act to precipitate calcium carbonate out of the surrounding waters. When plants and animals die, they fall to the bottom to become a part of the carbonate sand, mud, and reef rubble environment which will lithify in the geologic future to become hard carbonate rock.

Six major modern geologic regions can be distinguished based largely on the physical and geographical characteristics of their locations: (1) lagoonal areas (Florida Bay), (2) intertidal and supratidal areas (the nearshore environment of the Keys), (3) transitional areas (tidal channels), (4) inner shelf areas (Hawks Channel), (5) outer shelf areas (outer coral reefs), and (6) shelf margin slope areas (Straits of Florida). Each of these areas is

currently forming, in a geologic sense. The processes involved, including biological agents, currents, and water chemistry, are active and produce continual changes.

The lagoonal areas range from large complex habitats to small "sea island" environments, all of which are biologically rich. They may be characterized as sedimentary carbonate mud bottom environments with high turbidity and high fluctuations in the temperature, salinity, and chemical parameters.

Variations in lagoonal environments may be attributed to three factors: (1) seasonal runoff from the bordering mainland to the north, (2) open ocean conditions to the west, and (3) tidal influences through cross channels to the south. Florida Bay is characterized by a lacework of individual submerged mud banks bordering small basins which contain a variety of lagoonal environments. Florida Bay receives a great deal of detrital sediment from the Florida mainland but much is produced by marine algae (primarily), and remains of invertebrate skeletons, mollusks and corals within the Bay. Marine grasses, algae and a wide variety of mollusks make up the predominant bottom community (Enos and Perkins, 1976; Ginsburg, 1956, 1957; Ginsburg et al., 1956, 1958; Multer, 1977; Scholl, 1966). It is a rich habitat for the feeding and protection of invertebrates and fish.

Coupon Bight provides an interesting example of a small sea island lagoonal environment. It covers an area of approximately 2.5 square miles near Big Pine Key. It is open to the ocean to the south through channels between the Newfound Harbor Keys, and to the west through Newfound Harbor Channel. For

such a small region it contains as many as six different faunal environments (Howard and Faulk, 1968).

Intertidal and supratidal areas include rocky shore, carbonate sand beach, beach rock, and tidal mud flat environments. Examples of rocky shore environments can be found at the Spanish Harbor Keys and Pigeon Key. These carbonate rock environments are distinguishable from other rocky shore environments for at least two reasons: (1) the highly soluble nature of limestones, and (2) the intensive destructive and constructive role that marine organisms play along such coasts. Burrowing and boring organisms such as sponges, worms, crustaceans, mollusks and echinoderms (sea urchins) are major erosive agents in the Keys' coastline. These are natural and normal processes. Some of the classic work on the geology and biology of this environment has been done by Ginsburg (1953), Neuman (1966), Robertson (1963), and Stephenson and Stephenson (1950).

Carbonate sand beach environments exist at Bahia Honda and Long Key, for example, but are not a common feature in the Keys. They exist almost exclusively on the ocean side and the sand often exists only as a veneer that overlies a seaward sloping bedrock surface. This feature is representative of areas where the longshore current in the Keys is retarded or interrupted by mangrove development, by an irregular shoreline, or by tidal channels between keys.

Transitional areas are characterized by stabilized or migrating channels or banks between two distinctly different environmental types. They are subject to tidal action and are usually limited in extent. The most interesting

feature of these environments is the transitional character of the organisms that live there. In Snake Creek and Whale Harbor Channels, for example, faunal assemblages typical of the ocean side of the Keys (finger corals and rose corals) will grade into typical Florida Bay fauna as one passes from the ocean side to the bay side of the Florida Keys (Multer, 1977).

Tidal and supratidal regions are typified in lagoonal areas such as Crane Key and adjacent Keys in Florida Bay. A common feature on the mud flats of such islands is a laminated mat of blue-green filamentous and unicellular algae and their desiccated byproducts (Ginsburg et al., 1954). These algae, found both in marine and freshwater environments, are important for their stabilizing effect and accreting ability. Similar areas may be found on many of the mud islands of Florida Bay as well as the tidal areas of the Sugarhead Keys (Enos and Perkins, 1968; Shinn, 1964).

Beach rock environments are typical of those found on Loggerhead Key in the Dry Tortugas. The rock consists primarily of mollusk shells, (Halimeda) calcareous green algae, coral and encrusting algal debris. Cementation of this rock is taking place as the beach is alternately wetted and dried with the tides. Skeletal sand grains provide a nucleus upon which carbonate supersaturated salt spray evaporates to leave a carbonate crust (Ginsburg, 1953; Multer, 1971).

The inner shelf areas in Hawks Channel, for example, are typified by four types of environments: shallow nearshore shoal environments, patch reefs, blanket sediment environments, and subtidal hardground.

Shoal environments are low energy environments protected from the high wave energy typical of the outer reefs. These are mud bottom areas often supporting extensive seagrass beds. A good example of this type of habitat is the nearshore area that extends seaward to about the six foot depth, found southeast of Tavernier.

Patch reefs are elevated solid frameworks around which loose skeletal sediments of the back reef accumulate. They are major stabilizers of the marine environment where they are found. They are not arranged haphazardly but lie in elongate bands parallel to the fore reef. In this way they receive maximum nutrients from the waters of the Florida Straits (Hoffmeister and Multer, 1968).

Blanket sediment environments are extensive areas of high sediment deposition such as much of Hawks Channel and the White Bank area near Key Largo. They are deeper than the shoal areas and are characterized by a loose sandy bottom of very regular grain size or by grassbeds on less uniformly sized sand. The first has a relative paucity of life, while grassbeds have a very rich and diverse flora and fauna.

Subtidal hardground areas are regions within the inner shelf that are not covered by mud, loose sand, grassbeds, or patch reefs as described above. These are areas of hard, uneven rock floors and cemented rubble, and may represent recently subaerially exposed surfaces of the Key Largo Limestone.

The outer shelf areas are represented by intermittent flourishing reefs, known so well in the Keys, and by rubble flats and mounds and shelf edge sands. The

Molasses and Carysfort Reefs are representative examples of these areas. A full discussion of living reef areas is presented in Chapter IV(B).

Rubble flats and mounds may be found at Trench Reef and Little Molasses Island. These reefs were formerly active, living reefs which were altered by hurricanes and the action of biological borers and burrowers. They are one end of a spectrum ranging from areas of active thriving reefs to areas of little flourishing reef activity.

The shelf edge sands are nothing more than an extension of those sandy areas that are found in the inner shelf areas. They lie between the reefs and rubble flats and mounds. The reefs themselves are the "factories" responsible for the production of sands that make up the shelf sands environment. Seagrasses and their rich association of flora and fauna help to stabilize this environment.

The shelf margin slopes are identified here as an extension of the outer shelf area. The slope area extends out under the Florida Straits and represents an area of steep topography and water depths exceeding 2,000 feet. Some of the rubble produced on the shelf areas is transported down over the slope. For a further discussion of the inner and outer shelf areas and the shelf margin slope consult Multer (1979).

Florida Bay

Much of the attention placed on the environments in the Florida Keys centers around the natural communities on the Atlantic side of the archipelago.

Florida Bay is briefly considered here to focus attention on the complex nature of its environment and the need for more research in the Bay itself.

Florida Bay is a shallow body of water characterized by carbonate mud banks (shoals) covered with marine grassbeds and calcareous blue-green algae on submerged portions and mangroves on emergent portions. The shoals are often surrounded by deeper, open water areas overlying limestone rock hardened substrate.

Because of the great size of the Bay and its varying contact with waters of the Gulf and Atlantic, salinities vary considerably. Upper portions of the Bay consist of hydrologically isolated sounds (Card and Barnes Sounds). In the Middle Keys, numerous channels and cuts permit mixing between Florida Bay and the Atlantic Ocean. In the Lower Keys, Florida Bay is heavily influenced by the temperate waters of the northern Gulf of Mexico. Observations of Causey (DNR, pers. com.) in the Contents Keys area over the past ten years, indicate much zoogeographic similarity between this portion of Florida Bay and the bottom communities from Tarpon Springs to Sarasota. Conversely, faunal assemblages in the Bay differ substantially from those on the Atlantic side of the Keys, particularly in the stony coral community. Clearly, more research is needed to fully understand the natural communities of Florida Bay.

B. Community Associations.

This section will reference some of the plant and animal associations within the preserve in both natural and artificial communities and habitat types.

Major community associations are the upland areas, mangrove/ buttonwood areas, beaches and berms, marine grassbeds, patch and outer coral reef areas, spoil islands, tidal flats, and deep water areas. Each community is presented separately, but in reality these communities display an infinite variety of mixed and interdependent associations. Final subsections address endangered, threatened, and species of special concern within the preserve.

1. Uplands

Tropical hardwood hammocks and rockland pine communities occur on the elevated areas of the ancient coral reef that constitute the land mass of the Florida Keys. Although these areas are outside the jurisdictional boundaries of the Keys Aquatic Preserve, they are discussed here to reiterate their close proximity to and interaction with marine systems within the preserve boundary. The various upland community associations interface with tidal and nearshore environments to form a rich mosaic of habitats that provide cover, resting, nesting and feeding areas for many wildlife species associated with the area.

Both upland communities exhibit differences in species composition and physiology that distinguish them from their mainland counterparts (Schomer and Drew, 1982). Differences in species composition have further classified the tropical hardwood hammocks into two types. High hammocks are associated with the elevated Key Largo Limestone substrate of the Upper Keys and are distinguished by a higher canopy. The low hammocks are present on the Miami oolite parent material of the Lower Keys and are distinguished by a lower canopy and the increased occurrence of palms (Thrinax sp.) (Davis, 1943).

Canopy vegetation associated with the tropical hardwood hammocks include: Tamarind (Lysiloma latisiliquum); mahogany (Swietenia mahagoni); Jamaica dogwood (Piscidia piscipula); and poisonwood (Metopium toxiferum). More common understory plants are: Wild coffees (Psychotria sp.); marlberry (Ardisia escalloniodes); stoppers (Eugenia sp.); and blackbead (Pithecellobium guadalupense) (Tomlinson, 1980; Weiner, 1974).

Pinelands of the Lower Keys are similar to the pine islands of the Everglades with exceptions in species dominance (Olmstead, et al., 1983). The presence of a subterranean freshwater lens, interspersed hammocks and freshwater solution holes distinguish this unique community that occurs locally only on the Lower Keys. Sawgrass (Cladium sp.) and cattail (Typha sp.) marshes provide habitat for the fish, birds, reptiles, amphibians, mammals and invertebrates commonly associated with freshwater areas.

Some common plant species in the pinelands are Caribbean pine (Pinus elliottii var. densa), silver palm (Coccothrinax argentata), pisonia (Pisonia rotundata), and locustberry (Byrsonima cuneata) (Craighead, 1971; Olmstead, et al., 1983).

Table I lists animal species associated with the upland communities. An additional list in the Endangered Species section identifies plant and animal species from these upland communities that are classified as endangered, threatened or of special concern.

Stormwater retention and diversity of habitat types are major attributes of the upland systems. Thin organic soils, deposited over the solution hole

Table I

ANIMAL LIFE ASSOCIATED WITH UPLAND COMMUNITIES

Mammals
- bobcat
- Key Vaca raccoon
- Key deer
- Key Largo wood rat
- Key Largo cotton mouse
- raccoon
- Hispid cotton rat
- least shrew

Birds
- black-whiskered vireo
- brown thrasher
- yellow-billed cuckoo
- chuck-wills-widow
- mangrove cuckoo
- mourning dove
- ground dove
- Carolina wren
- cardinal
- mockingbird
- pileated woodpecker
- red-bellied woodpecker
- common flicker
- screech owl
- swallow-tailed kite
- red-shouldered hawk

Reptiles
- American alligator
- box turtle
- Keys mud turtle
- coral snake
- Big Pine Key ringneck snake
- Eastern diamondback rattlesnake
- Eastern indigo snake
- Florida brown snake
- red rat snake
- Miami black-headed snake
- ring-neck snake
- Florida ribbon snake
- Keys mole skink
- blue-tailed skink

Amphibians
- green tree frog

Table 1 (Animal Life Associated with Upland Communities) Continued

Invertebrates
- Stock Island tree snail
- Florida tree snail
- Schaus' swallow-tail butterfly

References:
Modified from: Patton, et al., 1984, Natural Environment of the Florida Keys in Florida Keys Growth Management Plan Draft. Lane Kendig, Inc. Mundelein, Ill. 339 pp.

Odum, et. al., 1982. The ecology of the mangroves of South Florida. A community profile, U.S. Fish and Wildlife Service, Office of Bio. Services, Washington, D.C. FWS/OBS, 81/24.

pocked limestones, provide needed moisture, substrate and nutrients to sustain the plant communities. Continuous canopy and ground covers of the plant communities absorb vital moisture from seasonal rains, prevent soil erosion and deter leaching of important nutrients. Freshwater runoff is also retained in solution holes for later use by wildlife. Food, cover and/or nesting sites are also important to birds, reptiles, mammals, and invertebrates that frequent shoreline and marine areas.

The white-crowned pigeon and mangrove cuckoo feed in upland areas but most often nest in mangrove/buttonwood areas (Bent, 1932; Sprunt 1984). The endangered silver rice rat is known to use both freshwater and tidal marsh areas for foraging (Spitzer and Lazell, 1978). Key deer, raccoon, bobcat, marsh rabbit, and several species of reptiles frequent both upland and mangrove/buttonwood areas (Odum et al., 1982). Swallowtail kites (Snyder, 1974) blackbirds, woodpeckers, warblers and numerous arboreal avifauna frequent a variety of upland and wetland sites (Robertson and Kushland, 1974).

Upland hammocks and pinelands also provide storm and hurricane protection for wildlife and man. Wind resistant and salt-spray tolerant plants buffer and deflect wind and waves. Less tangible values include carbon dioxide/oxygen cycling, noise abatement, shade and aesthetics.

2. Mangroves

Mangrove/buttonwood communities contribute substantially to the health and productivity of marine systems within the aquatic preserve. Shoreline

stabilization, storm protection, filtration of sediments, cycling of nutrients, and habitat diversity are the most obvious contributions derived from this community.

Many variations of the mangrove/buttonwood community occur in the aquatic preserve, but the most dominant plant species usually represented are red mangrove (Rhizophora mangle), black mangrove (Avicennia germinans) and white mangrove (Laguncularia racemosa). Buttonwood (Conocarpus erectus) does not grow in areas that are frequently inundated by tides, but it is commonly associated with the mangrove species and exhibits a high degree of salt tolerance (Tomlinson, 1980).

Mangrove zonation described by Davis (1940) illustrates mangrove species distribution from the mean low water line (red) to slightly elevated (black) to inland (white). More recent literature (cf. Odum et al., 1982) indicates that interspecific species competition, sea level changes, and successional stages may facilitate mixing of the three species within the zones.

Of the six mangrove forest community types described by Lugo and Snedaker (1974), four are well represented on the preserve. Overwash mangrove forests are typical on smaller islands and low peninsulas in the Keys. Red mangroves are usually dominant and the islands are frequently overwashed by tides.

Fringing mangrove forests of varying widths are typical of slightly elevated shorelines. This type is representative of the zonation described above and the most common type in the preserve. Riverine mangrove forests are repre-

sented along tidal creeks in the preserve. Red mangroves frequently dominate species composition. Mangroves may reach optimum size in riverine areas with protection from storms. Scrub or dwarf mangrove forests are best represented in the Lower Keys. Although all three species of mangroves are present, mature specimens are less than five feet in height. Poor tidal flushing, nutrient impoverishment, and soil characteristics appear to be limiting factors to size and distribution.

Buttonwood occurs on more elevated areas landward of the mangroves. This area is commonly referred to as the "buttonwood transition zone" and, as the name implies, it lies between the mangrove and upland plant communities. Wide spacing of trees and an open canopy allow greater light penetration to the ground, which encourages a proliferation of air plants, succulents, grasses and woody plants that are tolerant of periodic tidal flooding.

Other plant species commonly associated with mangrove/buttonwood communities are glasswort (Salicornia spp.), sea purslane (Sesuvium portulacastrum), Key grass (Monanthochloe littoralis), saltgrass (Distichilis spicata), saltwort (Batis maritima) sea ox-eye daisies (Borrichia sp.), mangrove rubber vine (Rhabdadenia biflora), and air plant species in the genus Tillandsia.

The prop roots of red mangroves, the extensive pneumatophores (aerating root branches) of black mangroves and the root mats of the buttonwoods and white mangroves and other vegetation, entrap and utilize sediments from upland areas and from tidal import. The roots, stems and branches of these plants also buffer the effects of storm surge and help retard erosion and protect upland

areas from intrusion of salt water wash and spray. This shoreline plant community can also deflect strong winds which desiccate upland plant communities and evaporate soil moisture.

Nutrient cycling and energy flow in mangrove systems have been studied by numerous scientists (see references). The system's capability to assimilate nutrients and export detrital material to marine food webs is the basis for its productivity. Litterfall (leaves, stems, animal droppings, etc.) and sea grass wrack are attacked by a host of micro flora and fauna. Desiccated particulate and dissolved carbons are exported to marine systems by tidal action where they are available to a wide range of aquatic consumers (Heald, 1969, Odum, 1970). Man is also a benefactor through commercially valuable food fishes and invertebrates (especially shrimp) that are dependent upon the food web.

Root structures provide points of attachment for marine organisms and stabilize muds for algal colonization. Invertebrate grazers and filter feeders ingest algae and detritus on or near the roots. They, in turn, are prey to a varied assortment of mobile invertebrates and fishes (Tabb et al., 1962). The tangle of roots also provides shelter and protection from larger predators (fish and birds) that forage for the crabs, shrimp, juvenile spiny lobster, snapper, mullet, killifish and pinfish.

Predatory fish that haunt these areas include a vast array of lesser known species as well as many that are of interest to avid sport fishermen in the area. Tarpon, snook, drum, seatrout, snapper, bonefish, sharks and pompano

are only a sampling of the fare available to hook and line fisherman. Tidal flushing and normal migration to marine grassbeds and coral reefs subject the mangrove nursery species to a wide range of predators in the food web, including many commercially valuable fish, such as grouper, snapper, jacks, king mackeral and tuna.

Arboreal portions of the mangroves are grazed by the mangrove tree crab (Aratus pisonii) (Warner, 1967), and over 200 species of insects (Simberloff and Wilson, 1969). Branches are also useful platforms for foraging bird life. Odum et al. (1982) list 181 species of birds that frequent mangrove/buttonwood communities. Open water piscivorous (fish eating) birds (eg., osprey, cormorant, pelican, bald eagle) use mangrove trees for resting and nesting sites. Herbivorous and insectivorous passerine (perching) birds are also well represented within the mangrove/buttonwood community. White-crowned pigeons and mangrove cuckoos seek out nest sites in this area too. The large pileated woodpecker finds nest cavities in old weather worn black mangrove trees (personal observations).

Fifteen species of wading birds (eg., egrets, herons, ibis and spoonbills) are dependent upon mangrove areas for nesting and feeding (Robertson and Kushlan, 1974). An even larger number of probing shore birds (eg., rails, plovers, sandpipers, etc.) frequent mangrove fringes to feed on mollusks, crustaceans, and marine worms that are exposed on low tides (Howell, 1932).

Marine turtles (including the endangered green, hawksbill and Ridley), terrestrial turtles and terrapins, snakes, anoles and frogs, the American

crocodile and alligator are representative reptiles and amphibians that utilize mangrove/buttonwood areas. Endangered or threatened mammals that utilize mangrove/buttonwood communities include the silver rice rat, Key Vaca raccoon, Key deer and the West Indian manatee.

The value of this community to many endangered, threatened and species of special concern cannot be underestimated. Life cycles of many are directly dependent upon the continued health and productivity of mangrove/buttonwood communities. Additional information is presented in the Endangered Species subsection.

Table II lists invertebrates, fish, amphibians, reptiles, birds and mammals that are associated with the mangrove/buttonwood community.

The mangrove/buttonwood community is inherently susceptible to hurricanes and rising sea levels. Hurricanes may affect large areas of vegetation. Desiccation of vegetative parts is by far the most obvious impact. However, more subtle impacts may not be detected for some time after the event. Over wash areas may be stripped of sediments that have taken years to accumulate. These sediment loads are the base materials for nutrients and trace elements necessary to the growth and maintenance of the system. Stripped sediments and other flotsam are also deposited in fringing mangrove/buttonwood systems. Deposition of excessive sediment can be equally devastating to this community (Craighead and Gilbert, 1962). Adverse impacts to the faunal inhabitants from oxygen depletion are discussed in Tabb et al. (1962).

Table II
A PARTIAL LIST OF ANIMAL SPECIES
ASSOCIATED WITH THE MANGROVE-BUTTONWOOD COMMUNITY

INVERTEBRATES
Snails (Marine and terrestrial)
Crabs (Marine and terrestrial)
Wood borers
Bivalves
Barnacles
Zooplankton
Shrimp
Spiny lobster

Fish
Black-tipped shark
Bonnet-head shark
Southern sting-ray
Ladyfish
Tarpon
Bonefish
Sardine
Menhaden
Permit
Lookdown
Sheepshead
Mullet
Blenny
Goby
Pinfish
Barracuda
Anchovy
Catfish
Needlefish
Killifish
Jewfish (juvenile)
Bluefish (young)
Blue runner
Snapper
Grunt
Seatrout
Red drum
Filefish
Triggerfish
Puffers

Amphibians and Reptiles
Cuban tree frog
Mud turtle
Mangrove terrapin
Green anole
Cuban anole
Mangrove water snake
Eastern indigo snake
American crocodile
Rat snake

Birds
Roseate spoonbill
Snowy egret
Great white heron
Great blue heron
Great egret
Reddish egret
Louisiana heron
Yellow-crowned night heon
Black-crowned night heron
White ibis
Ruddy turnstone
Lesser yellowlegs
Double crested cormorant
Hooded merganser
American coot
Laughing gull
Least tern
Royal tern
Belted kingfisher
Magnificent frigatebird
Turkey vulture
Swallow-tailed kite
Red-shouldered hawk
American kestrel
Black whiskered vireo
Blue-gray gnatcatcher
Carolina wren
Yellow warbler
Boat-tailed grackle
Summer tanager

Animal Species Associated with the Mangrove/Buttonwood Community
Continued

Mammals
Opossum
Marsh rabbit
Gray squirrel
Cudjoe Key rice-rat
Raccoon
Bobcat
Bottle-nosed dolphin

Source: Odum et al. (1982)

Exotic (non-native) plant species are often efficient colonizers on despoiled areas. Brazilian pepper (Schinus sp.) and Australian pine (Casaurina sp.) have become established in many areas in the preserve. These exotics offer less desirable habitat to native species (Mazzotti et al., 1981), and inhibit recolonization by native plants.

3. Beach and Berm Communities.

Beach and berm communities, although not abundant, are unique and valuable resources within the Keys Aquatic Preserve. These areas offer open vistas and scenic variation to the primarily forested shorelines. Numerous plant species enrich the ecological diversity of the system and are well adapted to the rigors of this harsh environment. The diversity of habitats for feeding and nesting also attracts a wide range of animal species.

Beach and dune formation in the Keys is not a common occurrence and is not comparable to the broad strand communities in other areas of the state. Fine grained silica sands, that are transported by riverine systems and littoral drift along the east and west coasts of Florida, are not found in the Keys (Multer, 1977; Wanless, 1969).

Major component materials of beach and berm areas are the fragmented remains of corals, cast off shells and calcareous algae. The larger, more angular fragments are sorted by wave action and deposited by storm waves along the crest of beaches or berms. The relative size and weight of the fragments inhibit formation of extensive dune systems because they are less susceptible to erosion or deposition by winds.

The offshore coral reefs and gently sloping bottoms disperse oceanic wave energy and preclude extensive beach development in most areas. Several islands in the Middle and Lower Keys that are oriented to receive the direct effects of waves and onshore currents have developed modest beach strands along their Atlantic shorelines.

Berms are low, usually narrow coastal ridges that are common on many shorelines in the preserve. Berms are formed during storm events and may be overwashed during seasonal high tides. Occasionally a second berm parallels the shoreline ridge, indicating a previous storm event.

Tide and wave actions deposit sea grass wrack and detrital nutrients that enhance the capabilities of plant colonization. Plant colonizers must, by necessity, survive in an extremely hostile environment and have evolved adaptive mechanisms to do so. Successful plant colonizers must survive intense sun, (almost) constant wind, high salinity, tidal wash and shifting substrate.

Physiological adaptations to prevent moisture loss from salt, sun, and winds are evidenced in the succulent, shortened leaves of sea purslane (Sesuvium portulacastrum), saltwort (Batis maritima) and glasswort (Salicornia Sp.). Other plant species possess thickened or involute (curled) leaves, surface hairs or spines that slow moisture loss and inhibit grazing. Abundant seed production, rapid seed germination and vegetative reproduction from rhizomes are effective methods evolved by herbaceous and woody plants to overcome exposure to desiccating influences, bouyant seeds are dispersed over a large

area to ensure survival of new colonizers. The extensive horizontal and vertical root systems of the grasses (Distichilis sp., Spartina sp., Panicum sp. and Uniola paniculata) intercept locally available moisture and nutrients. Their root masses bind and stabilize the soil to prevent erosion and enhance plant colonization. Low horizontally spreading growth forms allow optimum leaf surface areas for photosynthesis and a low profile to damaging winds. Railroad vine (Ipomoea pes-caprae) sends out horizontal "runners" or branches that may extend 20-30 feet from the main stem. Brittle woody plants, such as Bay cedar (Suriana maritima) and sea grape (Coccoloba uvifera), show a similar tendency of horizontal crown spread to withstand high winds. Other plants commonly associated with beach and berm communities are sea rocket (Cakile fusiformis), spurge (Chamaesyce mesembryanthifola), sea lavender (Tournefortia graphalodes), spider lily (Hymenocallis latifolia), gray nickerbean (Caesalpinia crista), sea daisy (Borrichia aboresens), and prickly pear cactus (Opuntia stricta). Species from more upland communities include joewood (Jacquinia keyensis), silver palm (Coccothrinax argentata) and black-bead (Pithecolobium keyense).

Animal species of beach and berm communities include raccoons and opossums that forage for fruit, crabs and tidbits washed up in the seagrass wrack. Wading and probing birds also take advantage of the mollusks, crustaceans and marine worms in the wrack and just below the surface of the sand. Retreating tides expose other invertebrates and stranded fish to complement their diet. Herbivorous rodents and marsh rabbits harvest abundant foliage and grass seeds and seek out nest sites in the dense foliage.

Snakes and avian predators hunt the more open spaces for anoles, rodents and small birds. The loggerhead turtle, a threatened marine species is known to nest on several Keys beaches. The endangered American crocodile utilizes berms or high, marl banks of narrow, coastal creeks for nesting.

Additional animal species associated with the beach and berm community are listed on Table III. Additional endangered, threatened or species of special concern that may frequent the beach and berm community are listed under the Endangered Species Section of this management plan.

4. Coral Reefs

Coral reef environments are among the most beautiful, diverse and productive environments in the world. Their structural complexity and biological richness make them the subject of much interest and the source of much pleasure.

Coral reefs are a tropical and subtropical phenomenon, limited in distribution by such factors as light, temperature, substrate availability and sedimentation.

Reef builders, an assemblage of corals and other carbonate precipitating organisms, begin construction on a hard consolidated substrate in shallow water. As a reef increases in age, new colonizers add volume to the reef by filling in empty space. The physical and biological breakdown of the reef, due to major storms, climate fluctuations, coral grazers, burrowers and

TABLE III

ANIMAL LIFE ASSOCIATED WITH BEACH AND BERM COMMUNITIES

Invertebrates
Snails
Marine worms
Mole crab
Ghost crab
Clam
Insects
Isopods
Barnacles

Reptiles
American anole = Carolina anole
Cuban anole
Red rat snake
Eastern indigo snake
Atlantic loggerhead turtle
American crocodile

Birds
Great blue heron
Sand pipers
Plovers (Snowy and Wilson's)
Ruddy turnstone
Sanderling
Killdeer
Short billed dowitcher
Willet
Dunlin
Gulls

Mammals
Opossum
Raccoon
Marsh rabbit
Hispid cotton rat

Source: Schomer and Drew, (1982)

borers, creates carbonate skeletal rubble within the reef zone. This rubble is recycled and cemented through biological and geochemical processes to yield new substrate for coral and other invertebrate growth. Coral reefs exist in a balance between active construction and breakdown.

The coral reefs in the Florida Keys are unique within the United States. They are a valued resource and much vocational and recreational activity is dependent on them. Important fisheries are tied to the reef community and many vacationers visit the reefs each year to witness their profound beauty. It is a resource that needs to be understood and preserved. Many impacts, other than natural ones, now affect the Keys reef area (Bright et al., 1981; Davis, 1977; Dustan, 1977; Straughn, 1972; Voss in Multer, 1977; Voss, 1973, 1982). Impacts include commercial and sport fishing, collection of reef species, diver related activities, shipwreck salvage, anchor damage, ship groundings, oil spills, reduced water quality and increased turbidity. It is the intent of this section to identify features of coral reef ecology, the importance of the reef and other communities to one another, and the significance of impacts.

Corals are members of phylum Cnidaria which includes such organisms as jelly fish, sea anemones, and hydrozoans. Two classes of Cnidaria are the principle colonial forms associated with, or responsible for, producing reefs: the Hydrozoa and the Anthozoa. The Hydrozoa are represented, in part, by the fire corals. The Anthozoa contain two subclasses, the Octocorallia or soft corals (e.g. whipcorals, sea feathers and sea fans) and the Zoantharia containing the Scleractinia or true stony corals (e.g., brain corals, staghorn

corals) (Barnes, 1984). The characteristics common to each are the capability to secrete a calcareous skeleton and functional autotrophy (self-production).

The Scleractinia are the reef builders; they are distinguished by their hard calcareous exoskeleton. Though many only grow several inches in diameter, larger forms are responsible for building the expansive reefs of the Florida Keys. The coral tissue inhabits only the external surface of the entire coral skeleton. New individuals accrete over dead skeletal material. Coral tissues play host to dinoflagellate zooxanthellale; (microscopic algae). These live symbiotically within the tissues of each coral cell. Zooxanthellae, like other plants, are capable of producing their own food sources. Using solar energy, they build protein, carbohydrates and other complex molecules out of basic components like CO_2 (carbon dioxide). These microscopic algae may provide enough energy to support coral growth. This makes corals functional autotrophs. The tentacles do, however, capture and supply supplemental food for the colony, especially at night (Yonge, 1940, 1973).

Though there are reef-like buildups as far north as Georgia, three dimensional reefs are restricted to the offshore area of the Florida Keys archipelago (Jaap, 1984). Following the prevailing topography, the reefs lie parallel to the Keys and have been referred to as the Florida Reef Tract (Vaughan, 1914). They lie in a region of ancient reef development, as has been discussed and can be visualized through a process of sea level rise and reef progradation (Hine and Neuman, 1977).

Four coral reef community types have been distinguished by Jaap (1984). These are: (1) the live bottom community, (2) the patch reef community, (3) the

transitional reef community, and (4) the bank reef community. These are communities unique to the Caribbean region and they do not correlate with the reef types in the Pacific and Indian oceans.

The character of the Florida Reef communities is largely determined by their physical environment. As a generality, the environment grades in depth, wave energy, sediment and other parameters from the inner to the outer shelf along lines parallel to the Keys.

a. Live Bottom

The live bottom communities lie close to shore, seaward of the intertidal zone, and occupy the subtidal hardground area described in the geology section. These are bare areas of Key Largo Limestone. They are not three dimensional reef building communities and, typically, they are surrounded by other communities such as those dominated by mud bottom, seagrass, or sponge. The fauna and flora associated with this community are highly variable, usually dominated by algae and invertebrate species such as soft corals, sponges, and small stony corals.

Stony corals commonly found in the shallow 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). In deeper areas three other species are often found, Knobby brain coral (Diploria clivosa), encrusting stinging coral (Millepora alcicornis), and eliptical star corals

(Dichocoenia stellaris). These species vary from a few inches to a foot in height. Voss (1982) reports several species of sponges prevalent in the hard ground area: Chicken liver sponge (Chondrilla nucula), vase sponge (Ircinia campana), cake sponge (I. strobilina), stinking sponge (I. felix), the little blue heavenly sponge (Dysidea etherea), the large loggerhead sponge (Spheciospongia vesparia), and Aplysima cauliformis. Gorgonians, such as the purple sea plume (Pseudopterogorgia acerosa), Pseudoplexaura flagellosa, and the sea whip (Pterogorgia anceps), are also prominent.

b. Patch Reefs

The patch reefs of Jaap (1984) may be compared to the dome patch reefs of Marszalek et al. (1977). Most patch reefs in the Keys exist in the Upper Keys, seaward of Elliot Key and Key Largo. Several, however, occur offshore from Big Pine Key and Key West. Most exist seaward of Hawks Channel.

The complexity of the patch reef community is much greater than that of the hard bottom areas. They are roughly dome shaped, varying in diameter from 100 to 1500 feet, and exhibiting topographical relief of 5-10 feet. Their characteristics are highly variable but can be defined on the basis of the age of each reef; thus, the nature of the community depends on its age. The evolutionary sequence follows four steps (Jaap, 1984):

1. Early stages of patch reef development are dominated by pioneering species such as clubbed finger coral (Porites porites), rose coral (Manicina areolata) and golfball coral (Favia fragum). These are

smaller, nonreef building species. Over time, these corals live, die, erode, and recolonize the hard bottom transforming it into a very different community. They will consolidate the hard bottom into a substrate dominated by coral and cemented coral skeletal material.

2. Frame builders dominate the next phase in patch reef development. Larger corals such as smooth starlet coral (Siderastrea siderea), the cavernous star coral (Montastraea cavernosa), smooth brain coral (Diploria strigosa), grooved brain coral (D. labyrinthiforms), giant brain coral (Colpophyllia natans) and common star coral (Montastraea annularis) will colonize the reef. These corals reach dimensions of up to 8 feet. As growth proceeds, reef borers, represented by worms (polychaetes), mollusks, and other species, begin a slow process of reef excavation. Weaknesses caused by the excavations collapse and fill in spaces within the reef. Coral death within the reef also provides new and more complex surface area for additional colonizers, including noncoral species. As the patch reef becomes more three dimensional, it provides an alluring habitat for reef fishes as well.

3. In the maturing patch reef, the reef continues growth upward and outward providing more surface area for secondary colonizers. As borers continue their excavation of the reef resulting in more reef collapse, an intricate maze of caves and passageways form, providing ideal hiding places for the more cryptic species of fish. As hollow spaces get larger, larger cryptic fish move into inhabit them.

4. In the fully mature patch reef, upward growth is limited by the sea's surface. Outward growth is all that remains possible. Reef collapse continues to the extent that rubble flats and mounds appear. These are often colonized by the non frame building stony corals and octocorals. If conditions are suitable, these rubble heaps may consolidate and new frame builders may colonize or the flats may alternatively take on the appearance of the live hard bottom communities.

Another feature commonly associated with patch reefs is a "halo" zone of sand and rubble surrounding the reef. It is created by coral grazing invertebrates and fish. The halo provides suitable substrate for reef expansion (Ogdon et al., 1973; Randall, 1965; Sammarco, 1972; Sammarco et al., 1974).

Though the preceding scenario is a probable scheme for reef development, the outcome is not determined or in any way guaranteed. The process is largely controlled by the ambient physical environment and random biological and climatological events, which are highly unpredictable. The composition of a reef is highly variable, determined by chance settling of particular coral larvae. Some patch reefs may be very diverse while others may be nearly monospecific. Even within highly diverse reefs, there may be areas of much lower diversity.

c. Transitional Reef

Transitional reef communities usually exist seaward of patch reef areas and

landward of the bank reefs. They may be described as embryonic bank-reefs, coalesced patch reefs (the linear patch reefs of Marszalek, et al., 1977) or very well developed hard ground communities that contain components of both patch reef and bank-reef environments. Large branching frame builders, such as elkhorn coral (Acropora palmata), grow at the seaward edge of transitional reefs.

d. Bank Reef

Major bank reef communities lie along a zone at the margin of the outer shelf and the margin shelf slope in the Keys. It is a zone of rapid change in depth seaward. The greatest percentage of bank reefs lie in depths of 5 to 30 feet, though they will extend to depths of 100 feet. Distinctive features of the bank reef are the presence of staghorn and elkhorn coral (Acropora cervicornis and A. palmata), coral zonation by depth and spur and groove formations oriented seaward. Bank reefs, like patch reefs, are highly variable, exhibiting differing degrees of development dependent on age, hard ground topography and hydrodynamics. A generalized bank reef area can be defined in terms of six different zones. From shallow to deep water they are: 1) the back reef/rubble zone, 2) the reef flat, 3) the shallow spur and groove zone, 4) the deep spur and groove zone, 5) the buttress or fore reef zone, and 6) the deep reef. Zonation is determined by water depth, degree of light penetration and wave energy. The reef flat is approximately five feet deep while the deep reef is at 100 feet or greater. The major reef builder here is elkhorn coral (Acropora palmata). It is found growing from the seaward edge of the reef flat to the deep spur and groove zone.

The spur and groove zone, characteristic of bank reef areas, has a fascinating development history. Spurs are raised, finger-like projections of reef extending seaward, composed primarily of dead and over growing colonies of elkhorn coral. Grooves are sandy bottom troughs between spurs. At shallow to mid depths these colonies orient away from the prevailing sea thus reducing wave resistance as tidal currents and waves pass over the growing reef. In the early stages of spur and groove development, oriented colonies of elkhorn coral may also grow seaward when in the lee of other colonies. In this way the colonies grow together and connect. Other colonies then grow in the lee of these and so on. This process produces a line of connected colonies oriented perpendicular to the prevailing wave direction. As growth continues, older sections die and new coral colonies attach to the upper surfaces. The spur grows upward. The unpopulated areas between spurs fill with sand which is unfavorable for coral colonization. The higher the spur grows, the more efficient the groove becomes as a sand trap. The process thus perpetuates itself. These areas may be seen quite easily from the air or while diving.

Other major reef builders include knobbey brain coral (Diploria clivosa) in the reef flat, and mountainous star coral (Montastraea annularis), smooth brain coral (Diploria strigosa), and giant brain coral (Colpophyllia natans) in the buttress or fore reef zone. The deep reef zone does not support large reef builders, but species like green cactus coral (Madracis mirabilis), fragile saucer coral (Agaricia fragilis) and saucer coral (Helioseris cucullata) are common.

A wide variety of other invertebrate and vertebrate species call the reef home. Kissling (1977) collected over 550 macrobenthic species from six sites

on nine reefs in the Lower Keys. Among these they identified 42 species of stony corals, 41 species of octocorals, and 21 species of brittle stars (Ophiuroids). He also speculated that well over 300 species of fish live on or use the reef.

Eiseman (1981), in a recent survey of the algae, identified over 60 species in Key Largo National Marine Sanctuary. Schmahl (1984) believes a conservative estimate of the number of sponge species occurring on the Florida reefs is 120. Many of these are boring sponges which play a major role in bioerosion. Polychaete worms are also important boring species. Grassle (1973) counted 1,441 individual polychaetes within a single 10 pound coral head. Vittor and Johnson (1977) have identified some 84 species of polychaets from Grand Bahama Island; the biology of the Keys should contain similar species.

Few vertebrate species other than fish occur on the reef with any frequency. Those that do include sea turtles such as the Atlantic Ridley turtle (Lepidochelys kempi), Atlantic hawksbill turtle (Eretmochelys imbricata), loggerhead turtle (Caretta caretta) and the green turtle (Chelonia mydas). Each is currently listed as endangered by Florida State and the Federal governments. The bottle nosed dolphin (Tursiops truncatus) is an occasional visitor. Coral reef fish species and other faunal species are listed in Appendix C.

The reef is an area of critical concern to those who are interested in continuing to preserve its beauty. The Endangered Biota of Florida series (Franz, 1982) lists six coral species as endangered and nine as threatened.

In addition, at least seven species of fish are unique to the Keys: small gobies (Lythrypnus phorellus and Gobiosoma oceanops); the purple reef fish (Chromis scotti); the mooneye cusk eel (Ophidon selenops); the blue hamlet (Hypoplectrus gemma); the wrasse bass (Liopropoma enkrines), and the Keys blenny (Starksia starcki). The latter is known only from Looe Key and is under consideration for federal listing as an endangered species. The coral reef is also home to several commercial species; the foremost of which is the spiny lobster (Panuluris argus).

e. Marine Grassbed Interaction

The importance of interactions between adjacent communities must also be underscored. Seagrass beds are important in the life cycle of coral reef fishes in that they provide nursery areas for some species. Juvenile reef fish species reported common in grassbeds in Tagne Bay, St. Croix by Ogden and Zieman (1977) include: juvenile spiny puffers (Diodon sp.), squirrelfish (Holocentrus ascensionis) yellowtail snapper (Ocyurus chrysarus), surgeonfish (Acantharus) and numerous species of wrasse (Halichoeres) were observed. The yellow goatfish (Mulloidicthys martinicus) and the spotted goatfish (Pseudupeneus maculatus) occur as juveniles in grassbeds off the Florida Keys (Munro, 1976; Springer and McErlean, 1962). Eight species of juvenile parrotfish were captured in grassbeds; all but one was considered a reef species. As these species grow too large to hide in the grassbeds, they migrate to the reef. Conversely many fish species utilize the reef for refuge as adults but feed in adjacent grassbeds and sand flats (Davis, 1967; Longley and Hildebrand, 1941; Odgen and Ehrlich, 1977; Ogden and Zieman, 1977; Randall, 1963; Starck and Davis, 1966).

f. Reef Sensitivity

Coral reefs are biologically and structurally sensitive systems. They are slow growing and vulnerable to structural damage. Shinn et al. (1977) estimated that the reefs of the Florida Keys began growth about 5000 to 7000 years ago, and have been growing at a rate of about 190 inches/1000 years (or 0.2 inches/year). Thus, structural damage to a reef can take years to rebuild. In addition, the reefs of the Florida Keys lie at the northern limit for reef growth. The reefs of the Florida Keys are susceptible to the colder water temperatures of this region. During recent cold snaps, reefs in the Dry Tortugas and near Plantation Key showed some mortality (Walker, 1981). The natural stresses of a climate more severe than in other areas in the Caribbean may be responsible for the slower coral accretion in the Keys. Adey (1977) noted reef growth rates at St. Croix, U.S. Virgin Islands were three times the maximal growth rates in the Keys (0.60 inches/year).

Though few patch or bank reef areas lie within state boundaries and therefore in the aquatic preserve, the Aquatic Preserve Program expresses concern for their continued health. They are an important human resource as well as a refuge for a large number of marine species. Presently, a large percentage of the reefs in the Florida Keys are under the jurisdiction of state and federal governments; John Pennekamp Coral Reef State Park, Key Largo and Looe Key National Marine Sanctuaries, Biscayne National Park, Key West National Wildlife Refuge and Fort Jefferson National Monument, respectively. The aquatic preserve will serve to protect coral habitats that are not protected by these other programs.

5. Marine Grassbeds

Marine grasses are submerged flowering plants which stabilize sediments, entrap silt, recycle nutrients by production of detritus, provide shelter, serve as important nursery grounds, and are important sources of food (Odum, 1974; Wood et al., 1969). Grassbeds also increase the surface area available to support epiphytic plants and animals and supply a suitable substrate for organisms that otherwise could not utilize a bare sand or mud bottom (Moore, 1963; Orth, 1977). The grassbeds are very productive, possibly the most productive habitat within the Florida Keys. These beds serve as a food source for the endangered manatee (Trichechus manatus) and the green sea turtle (Chelonias mydas), important nursery areas for juvenile forms of shellfish such as the pink shrimp (Penaeus duorarum) and the spiny lobster (Panulirus argus), and as substrate for many algal species eaten by invertebrates which are in turn eaten by the fishes. Many commercially important fishes (sea trout, jack, pompano, barracuda, mullet, cowfish and snapper) spend at least part of their lives in these grassbeds (Zieman, 1982).

Marine grassbeds act as an interface between mangrove and reef communities by allowing species from all three communities to interact, thereby creating an ecosystem and energy flow continuum. The three most common marine grasses found in the Florida Keys are turtle grass (Thalassia testudinum), manatee grass (Syringodium filiforme) and shoal grass (Halodule wrightii). There are also three species of Halophila; H. johnsonii, H. engelmanii, and H. decipiens, but they are not as prevalent. Varying bottom substrates also determine the distribution of the seagrasses and their associated fauna. The

three most common marine grasses mentioned above thrive in the fine calcareous mud bottoms found in the inner shelf margin associated with areas of restricted circulation (Schomer and Drew, 1982). Typically, this bottom type is found from Florida Bay seaward to the lee side of shelf edge sand shoals. Water depth is usually less than 8m. The fine mud is the product of the community inhabitants, most notably the green algal species like Halimeda opuntia, H. incrassata, Penicillus pyriformis, and P. capitatus. Other flora include red algae (Jania sp., and Amphiroa sp.); encrusting coralline algae (Melobesia membranacea and Fosliella farinosa); and the brown algae (Padina sp.).

Between Hawk Channel and the outer reef on the back-reef platform, large areas of the sea bottom are composed of calcareous sands. These sands do not contain the fine particles characteristic of the calcareous mud and the low turbidities permit grassbed growth at much greater depths. The grasses include Thalassia testudinum and Syringodium filiforme. Green algae dominate the algal community and the red alga, Melobesia membranacea, occasionally occurs. Many of the faunal species observed in the grass covered mud bottom habitat are common here as well. In areas where wave action is more vigorous, there is little or no grass growth.

Grassbeds in the Keys are also located in near shore areas near fine-grained and coarse-grained sand beaches, on man-made gravel beaches and rip rap, and less frequently on exposed tidal flats.

Thalassia is the largest and most abundant marine grass in the Keys. Its distribution is limited by seven factors: temperature, water depth, turbidity,

salinity, wave action, bottom composition and topography. Gaps in the distribution are due to one or more of these limiting factors. Because Thalassia flourishes best in shallow water, it is vulnerable to a variety of impacts including propeller damage (Zieman, 1976), sewage effluent (McNulty, 1970), excess sediment deposition and turbidity (Odum, 1963; Phillips, 1960), and thermal pollution (Roessler and Zieman, 1969; Zieman, 1970; Zieman and Wood, 1975). Damaged Thalassia beds typically take two to five years to initially recover (Zieman, 1976). Strong currents and severe weather, such as hurricanes, subject grassbeds to natural disturbances. During hurricanes, large amounts of rain reduce temperature and salinity in shallow water while increased runoff also dilutes salinity and wind-induced currents increase turbidity (Thomas et al., 1961). Phillips (1960) noted large amounts of leaf kill during these events.

There is little marine grassbed development near patch or fringing reefs due to grazing of grasses by herbivores (Randall, 1965). This zone of bare sand near reefs can be used as an indicator of reef development and herbivore population. The better developed the reef, the larger the fish population and the broader the sand zone.

Marine grassbeds are a primary vegetation community and will be used as a key indicator in measuring the natural condition of the aquatic preserve. Protection of marine grassbeds will be a major consideration in the field and in the administrative review of use proposals. Detailed mapping of marine grassbeds are in Appendix D (Resource Protection Area Mapping).

The invertebrate fauna and algal flora associated with these grassbeds can be

TABLE IV
ANIMAL LIFE FOUND IN MARINE GRASSBEDS
OR GENERALLY ASSOCIATED WITH THIS COMMUNITY

Mammals
Atlantic bottle-nosed dolphin
West Indian manatee

Birds
Great blue heron
Great white heron
Louisiana heron
Little blue heron
Great egret
Reddish egret
Roseate spoonbill
Willet
Double crested cormorant
White pelican (winter)
Crested grebe (winter)
Red breasted merganser (winter)
Osprey
Southern bald eagle
Brown pelican
Magnificent frigatebird
American coot
Herring gull
Forster's tern
Royal tern
Least tern
Caspian tern
Black skimmer
Belted kingfisher

Reptiles
Diamonback terrapin

Fishes
Bull shark
Nurse shark
Lemon shark
Bonnethead shark
Atlantic guitarfish
Southern stingray
Tarpon
Snook
Cobia
Ladyfish
Grey snapper
Schoolmaster snapper
Lane snapper
Mutton snapper
Yellowtail snapper

Fishes Continued
Bonefish
Crevalle jack
Spotted seatrout
Red drum
Jewfish
French grunt
Blue striped grunt
White grunt
Pigfish
Pinfish
Spot
Hogfish
Bigeye anchovy
Bay anchovy
Hardhead halfbeak
Halfbeak
Goldspot killifish
Rain Killifish
Longnose killifish
Gulf killifish
Sheepshead minnow
Sailfin molly
Reef silverside
Hardhead silverside
Spotfin mojarra
Silver jenny
Tidewater silverside
Silver Perch
Scaled sardine
Striped anchovy
Southern kingfish
Striped mullet
White mullet
Lined sole
Gag grouper
Banded blenny
Seaweed blenny
Clown goby
Notchtongue goby
Code goby
Emerald clingfish
Inshore lizardfish
Sea catfish
Gafftopsail catfish
Gulf toadfish
Sea bream
Sheepshead
Redfin parrotfish

Animal Life Associated with Marine Grassbeds Continued

Fishes Continued
Great barracuda
Sharptail eel
Goldspotted eel
Moray eel

Invertebrates
Spiny lobster
Pink shrimp
Hermit crabs
Long spined urchin
Sea cucumber
Bahamian starfish
Annelid worms
Bivalve mollusks
Queen conch
Sea hare
Octopus

rich and diverse, depending on the specific area. Table IV lists the animal life associated with this community. There is a need for more data on these animal associations.

6. Drift Algae.

The drift algae community includes several species of red, brown, and green algae, typically occurring interspersed throughout marine grassbeds, as well as the more pelagic forms such as Sargassum natans and S. fluitans. Primary productivity in southern seas is often influenced by such environmental factors as low nutrient concentrations, clear water, high solar radiation and shallow mixed layers in winter and the rapid recycling of nutrients and annual productivity rates greater than in the temperate waters (Ryther and Yentsch, 1958). Where algal growth is dense and abundant, it is capable of significantly influencing the area in a number of complex ways (Phillips, 1963). Floating algal mats contribute to the deposition of both organic detritus and inorganic sediments (Phillips, 1963); while photosynthesizing algae utilize ammonia from marine animal wastes (Beer, 1963). Kulczycki et al. (1981) indicated that drift algae provide food, habitat, and shelter for a variety of epiphytic algae and invertebrates and that the algal biomass is related to the local abundance of fish which often prey on its inhabitants. Conditions are favorable within the preserve boundaries for drift algal communities throughout the year. The highest concentration occurs from spring through fall in conjunction with prevailing easterly and southerly winds.

7. Tidal Flats

Due to the narrow tidal ranges typical of the Florida Keys, tidal flats are not a common habitat. Where they do occur, they consist of narrow bands fringed with mangroves and vegetated with sea grasses.

Two tidal flat habitats are distinguished in the Keys by Schomer and Drew (1982). Exposed tidal flats are characterized by high energy wave activity, tidal currents and carbonate sand sediments. Sand bars typically occur on the seaward side of these flats. Exposed tidal flats are generally located in open bays, in the lee of offshore islands and near tidal inlets.

Sheltered tidal flats, characteristic of interior island lagoons, typically have unconsolidated carbonate mud sediments in low energy wave and tidal current areas. Faunal diversity is generally lower than the exposed tidal flats but polychaete worms, land crabs, fiddler crabs and batillaria snails inhabit both community types. The most conspicuous predators in this habitat are the numerous shore and wading birds. Table V lists the animal species commonly associated with this community.

8. Deep Water Areas

These areas include natural and artificial inlets, channels, creeks and other deep water areas. These areas are important for tidal exchange between the Atlantic Ocean and Florida Bay. They are critical to the tidal flushing necessary for a healthy ecosystem. The deeper waters also allow predator fish

Tabe V
ANIMAL LIFE COMMONLY ASSOCATED WITH TIDAL FLATS
AND SPOIL ISLANDS

Invertebrates
Polychaetes
Land crabs
Fiddler crabs
Batillaria snails

Birds
Brown pelican
Great blue heron
Yellow-crowned night heron
White ibis
Roseate spoonbill
Semipalmated plover
Wilson's plover
Snowy plover
Piping plover
Ruddy turnstone
Spotted sandpiper
Greater yellowlegs
Lesser yellowlegs
Willet
Red knot
Least sandpiper
Dunlin
Western sandpiper
Sanderling
Short-billed dowitcher
Black-necked stilt
Herring gull
Ring-billed gull
Laughing gull
Forster's tern
Least tern
Royal tern
Sandwich tern
Caspian tern
American oystercatcher
Black skimmer
Double crested cormorant

Mammals
Raccoon

access to shallow water communities. The bottle-nosed dolphin and manatee are important mammals potentially found in these areas.

9. Spoil Islands

The construction and maintenance of the Intracoastal Waterway Channel resulted in the formation of spoil islands within the Florida Keys. These islands, formed by the deposition of the dredged material (spoil), usually parallel the channel alignment. Unless the dredging project is of a large scale, spoil islands tend to be fairly small in size and linear in shape. The original shape and placement of many islands has been modified by accretion and erosion from wind, currents, and boat wakes. The placement of spoil islands, in many cases, destroyed valuable seagrass and shallow water habitats.

Upland Vegetation on these islands is sparse and is generally dominated by exotics such as the Brazilian pepper. The shoreline, on the other hand, is usually vegetated with fringing mangroves and other types of native wetland plants which act as shoreline stabilizers. They also provide valuable habitat for fish and wildlife. Cormorants, pelicans, and gulls use the mangroves for breeding and loafing areas. Barren sandy areas on the islands are used as rookeries for such birds as snowy and piping plovers, least terns, and American oystercatchers. Table V lists animal species associated with this habitat.

10. Endangered Species.

Clearing for agriculture and development plus additional pressures from

collectors and exotic species invasion have endangered or threatened the survival of the native flora and fauna. Tamarindillo (Acacia choriophylla), mahogany mistletoe (Phoradendron rubrum), and yellowheart (Zanthoxylum flavum) are known from only a few isolated sites in the Keys. Lands within the aquatic preserve area contain forty-four species of endangered or threatened plants currently listed on the official Florida plant list (Section 581.185, F.S.).

Future research and field study will undoubtedly provide recommendations for the inclusion of additional species as natural and manmade encroachments continue to stress their capabilities for survival. Table VI lists the endangered and threatened flora.

Encroachments on vital habitat, hunting, collecting and pesticides have all contributed to the decline of many animal species in the Keys. Hunting pressures and egg collecting have drastically reduced marine turtles and the white-crowned pigeon. Plume collecting and nest destruction once brought several avian species to the brink of extinction. Their continued existence may still be imperiled by the filling of wetlands necessary to their survival and the introduction of pesticides in the food chain.

Collection and habitat destruction have extirpated eight subspecies of the Florida tree snail (Liguus sp.) from their former range in the Keys. The wide-banded and Florida Keys tree snails and several more species of Liguus are presently threatened or endangered.

TABLE VI
FLORAL SPECIES OF THE FLORIDA KEYS AQUATIC PRESERVE AREA THAT ARE CLASSIFIED AS ENDANGERED OR THREATENED

Scientific Name	Common Name	Status	
		FDA	FCREPA
Acacia choriophylla	Tamarindillo	-	E
Acrostichum aureum	Golden leather fern	T	R
Acrostichum danaeifolium	Giant leather fern	T	-
Asplenium serratum	Bird's-nest fern	T	E
Campyloneurum phyllitidus	Strap fern	T	-
Cassia keyensis	Big pine partridge pea	E	T
Catesbaea parviflora	Small-flowered lily-thorn	E	E
Catopsis berteroniana	Powdery catopsis	E	T
Cereus gracilis	Prickly apple cactus	E	T
Cereus pentagonus	Dildo cactus	T	-
Cereus robinii	Tree cactus	E	E
Chrysophyllum olivaeforme	Satin leaf	T	-
*Clusia rosea	Balsam apple	E	-
Coccothrinax argentata	Silver thatch palm	E	T
Cocos nucifera	Coconut palm	T	-
Cordia sebestena	Geiger tree	T	-
Cupania glabra	Cupania	E	E
Encyclia boothiana	Dollar orchid	E	E
Encyclia tampensis	Butterfly orchid	T	-
Eugenia confusa	Redberry ironwood	T	-
Guaiacum sanctum	Lignum vitae	E	T
Habenaria quinquesta	Michaux's orchid	T	-
Hippomane mancinella	Manchineel	T	T
Mallotonia gnaphalodes	Sea lavender	T	-
Microgramma heterophylla	Polypody fern	T	-
Optunia spinosissima	Semaphore cactus	T	-
Paltonium lanceolatum	Ribbon fern	T	-
Phoradendron rubrum	Mahogany mistletoe	-	T
Pseudophoenix sargentii	Buccaneer palm	-	E
Psilotum nudum	Whisk fern	T	-
Pteridium aquilinum	Bracken fern	T	-
Pteris longifolia	Ladder brake fern	T	-
Scaevola plumieri	Scaevola	E	-
Strumpfia maritima	Pride-of-Big-Pine	E	E
Suriana maritima	Bay cedar	E	-
Swietenia mahogoni	Mahogany	T	-
Thrinax sp.	Thatch palms (all species)	T	-
Tillandsia balbisiana	Wild pine or air plant	T	-
Tillandsia circinata	Wild pine or air plant	T	-
Tillandsia fasciculata	Wild pine or air plant	E	-
Tillandsia flexuosa	Wild pine or air plant	T	T
Tillandsia setacea	Wild pine or air plant	T	-

Floral Species (Endangered or Threatened)
of the Florida Keys Aquatic Preserve, Continued

Tillandsia utriculata	Wild pine or air plant	T	-
Tillandsia valenzuelana	Wild pine or air plant	T	-
Vanilla barbellata	Worm-vine orchid	T	T
Vittaria lineata	Shoestring fern	T	-
Zanthoxylum flavum	Yellowheart	-	E

Note:
E=Endangered; T=Threatened; R=Rare
FDA=Florida Department of Agriculture and Consumer Services: Preservation of Native Flora of Florida Act, Section 581.185 Florida Statutes. (Official State of Florida list.)
FCREPA=Florida Committee on Rare and Endangered Plants and Animals: Rare and Endangered Biota of Florida Vol. 5, Plants, D.B. Ward, ed; 1978.

* Believed to be extirpated except for cultivated plants in the Keys. FCREPA.

Collecting, boat groundings, treasure salvage and siltation have damaged or eliminated many coral patch reefs in nearshore marine environments. These impacts, coupled with natural stresses (storms, temperature fluctuation, disease, etc.) have prompted concern for this unique community. Uncontrolled collecting of marine fishes and other invertebrates may also prove threatening to the survival of those species.

The Key silverside, essentially a marine fish, has been classified as endangered. Development has encroached on an already restricted range for this species. Similar pressures have prompted the classification of several more marine fishes as species of special concern. Pesticide spraying has been implicated in the decline of common snook populations (EPA, 1981). The introduction of toxic chemicals into the marine system has the potential to be dispersed throughout the food web to other endangered or threatened fauna.

Endangered and threatened animal species are listed on Table VII. This list is compiled from the official State of Florida list, as designated by the Florida Game and Fresh Water Fish Commission. Inclusion of species from other lists are noted.

Although no amphibian species are presently listed, it is anticipated that future research and study of freshwater aquatic areas in the Keys may reveal morphologically or physiologically unique species.

C. Archaeological and Historical Resources.

In Florida, the Calusa and Tekesta Indians occupied the southern Gulf coast

TABLE VII

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

Endangered

Fishes	
Key Silversides	*Menidia conchorum*
Amphibians and Reptiles	
American crocodile	*Crocodylus acutus*
Leatherback turtle	*Dermochelys coriacea*
Atlantic green turtle	*Chelonia mydas mydas*
Atlantic hawksbill turtle	*Eretmochelys imbricata imbricata*
Atlantic ridley turtle	*Lepidochelys Kempii*
Key mud turtle	*Kinosternon bauri bauri*
Birds	
Wood stork	*Mycteria americana*
Peregrine falcon	*Falco pererinus*
Southeastern snowy plover	*Charadrius alexandrinus tenuirostris*
Mammals	
Key Largo woodrat	*Neotoma floridana smalli*
Key Largo cottonmouse	*Peromyscus gossypinus allapaticola*
Silver rice rat	*Oryzomys argentatus*
West Indian manatee	*Trichechus manatus latirostris*
Right whale	*Balaena glacialis*
Finback whale	*Balaenoptera physalus*
Sei whale	*Balaenoptera borealis*
Humpback whale	*Megaptera novaeangliae*
Sperm whale	*Physeter catodon*
Invertebrates	
Schaus' swallowtail butterfly	*Heraclides aristodemus ponceanus*
*Elkhorn coral	*Acropora palmata*
*Staghorn coral	*Acropora cervicornis*
*Staghorn coral	*Acropora prolifera*
*Pillar coral	*Dendrogyra cylindrus*
*Large flower coral	*Mussa angulosa*
*Flower coral	*Eusmilia fastigiata*

Threatened

Amphibians and Reptiles	
Atlantic loggerhead turtle	*Caretta caretta caretta*
Big Pine Key ringneck snake	*Diadophis punctatus acricus*
Florida brown snake (Lower Keys population only)	*Storeria dekayi victa*
Miami blackheaded snake	*Tantilla oolitica*
Eastern indigo snake	*Drymarchon corais couperi*
Florida ribbon snake (Lower Keys population only)	*Thamnophis sauritus sackeni*
Birds	
Eastern brown pelican	*Pelecanus occidentialis carolinensis*
Bald eagle	*Haliaeetus leucocephalus*
Roseate tern	*Sterna dougallii*
Least tern	*Sterna antillarum*
White-crowned pigeon	*Columba leucocephala*
Mammals	
Key Vaca raccoon	*Procyon lotor auspicatus*
Key deer	*Odocoileus virginianus clavium*
Invertebrates	
Stock Island tree snail	*Orthalicus reses*
*Lettuce coral	*Agaricia agaricites*
*Starlet coral	*Siderastrea siderea*
*Brain coral	*Diploria clivosa*
*Brain coral	*Diploria labyrinthiformis*
*Brain coral	*Diploria strigosa*
*Giant braincoral	*Colpophyllia natans*
*Small star coral	*Monastrea annularis*
*Large star coral	*Monastrea cavernosa*
*Brain coral	*Meandrina meandrites*

Species of Special Concern

Fishes	
Common snook	*Centropomus undecimalis*
Rivulus	*Rivulus marmoratus*
Key blenny	*Starksia starcki*
*Sheepshead minnow	*Cyprinodon cf variegatus*
*Southern gulf killifish	*Fundulus grandis saguanus*
*Longnose killifish (Keys subspecies)	*Fundulus similis*
*Rainwater killifish	*Lucania cf parva*
*Mangrove gambusia	*Gambusia rhizophorae*
*Sailfin molly	*Peocilia cf latipinna*
*Spottail goby	*Gobionellus stigmaturus*

Species of Special Concern Continued

Amphibians and Reptiles	
American alligator	*Alligator mississippiensis*
Florida Keys mole skink	*Eumeces egregius egregius*
Red rat snake (lower Keys population only)	*Elaphe guttata guttata*
Birds	
American oystercatcher	*Haematopus palliatus*
Little blue heron	*Egretta caerulea*
Snowy egret	*Egretta thula*
Reddish egret	*Egretta rufescens*
Tricolored heron or Louisiana heron	*Egretta tricolor*
Roseate Spoonbill	*Ajaia ajaja*
Limpkin	*Aramus guarauna*

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

*Rare and Endangered Biota of Florida. P.C.H. Pritchard, Series Editor. Vol. 1,2,3,4, and 6. University Presses of Florida, Gainsville, FL 1978.

and southern Atlantic coast, respectively. There is a considerable difference of opinion regarding the southern boundaries of these tribes and their occupation of the Florida Keys. Goggin (1971) believes that the political influence of the powerful Calusa tribe may have been felt in the Keys, but that it was the Tekesta tribe which actually resided there. Swanton (1979) generally places the Keys in the territory of the Calusa.

Goggin and Sommer (1949) divide the Tekesta tribes into smaller bands, of which the most important were the Matecumbe. In all likelihood, the Matecumbe and other natives of the Keys were relatively small groups, subject to the more powerful Calusa or Tekesta. The relative power of the latter two tribes and their control over the Keys probably changed frequently.

The natives utilized the rich food resources of the tropical coastal waters, consuming many species of fish, shellfish and marine reptiles and mammals. Upland animal species such as deer and raccoon, as well as wild plants probably supplemented their diet. Because there are no deposits of flint or hard stone in the limestone rock of South Florida, many tools were made from the heavier portions of conch shells (Goggin and Sommer, 1949). Archaeological evidence from numerous village sites, middens and burial mounds and early observations by Spanish explorers support these findings.

The Florida Straits directly off the Keys was a popular route for Spanish ships, and frequent wrecks on the reefs provided the Indians with a source of great wealth (Fontaneda, 1944).

The first recorded visit by the Spanish was made by Ponce de Leon in 1513.

The Spanish and English continued their exploration of south Florida and the Keys throughout that century and there are frequent reports of hostile encounters with the Indians. In 1755, the Indians reportedly killed as many as 400 Frenchmen on Lower Matecumbe Key. It was a common practice then to send the natives to Spain or Cuba to be slaves and interpreters.

The removal of the Spanish took place in 1763 when Florida was ceded to England in exchange for Havana, Cuba and all of the Spanish residents in Florida were given the opportunity to evacuate. Many did, taking most of the South Florida Indians with them (Goggin, 1949). The modern occupation of the Keys by the English began soon after the departure of the Spanish. There are few references to the natives in the Keys in the 1800's, except in 1838 when a band of Indians attacked the settlement on Indian Key. Any remaining Indians were probably incorporated into the Seminole tribes on the Florida mainland.

By the early 1800's, the valuable mahogany was timbered from the Keys and several naval stations were established. By 1862, Key West was an established naval base and Federal troops captured over forty-five confederate ships there during the Civil War.

Today, the Department of Natural Resources manages several properties in the Keys and on-site historical and archaeological resources are protected. Lignumvitae Key (including Shell Key) State Botanical Site protects midden and burial mounds and Indian Key State Historic Site contains many valuable artifacts. This area was important to the Indians because of the former abundant water supply and the location of the Indian Key Channel which offered easy passage into Florida Bay.

D. Water Resources.

In other aquatic preserve areas, water resources have been identified as fresh water sources associated with watersheds and drainage areas. In the Keys the primary water resource is the marine environment. Water resources in the Keys would include three separate natural areas: Florida Bay, channels and passages between the Keys, and the ocean side of the Keys (Hawks Channel, etc.). Unnatural water resources would include manmade canals and waterways.

The three natural environments noted above have been described in previous sections. Florida Bay is a shallow carbonate mud bottom area, affected by mainland freshwater runoff, tidal currents between Keys and ocean conditions emanating from the Gulf of Mexico. It is a turbid environment subject to fluctuations in temperature and salinity. Tidal channels are transitional areas affected primarily by tidal currents. The ocean-side environment is one of low turbidity, fewer extremes in temperature and salinity, and is affected by seaward increase in depth and wave energy. It is also the environment of the Florida Keys patch and bank reefs.

Several topics are important with regard to water resources and their continued high integrity. These topics concern impacts from used water resources in the Keys, such as reef use, commercial and sport fishing, prop dredging (improvement of navigational aids), sewage disposal, pump out facilities for "live aboard" boat owners, and other incidental impacts.

Water quality in the Keys is an important issue. There is a great deal of

information being generated through studies conducted by the Florida Department of Environmental Regulation (DER) but information is sparse in some areas. As a part of DER's 205(j) study, twelve sites in the Marathon-Key Vaca area are currently monitored for water quality (DER, 1984). The purpose of this project is to determine whether a water quality problem exists in that area, whether the problem stems from inadequate sewage treatment, and to identify significant biological and physiochemical indicators for use in future monitoring programs. The Department also maintains study areas, established to obtain baseline data, in several other areas in the Keys including John Pennekamp Coral Reef State Park and an area near Coupon Bight, Big Pine Key.

Examples of water quality problems include the Key West sewage collection system and outfall. The outfall discharges approximately 4 million gallons per day (mgd) of raw sewage into the Atlantic Ocean about 4,700 feet from the shoreline. Other water quality problems have occurred from commercial dock areas, seafood processing houses and an electric generating plant in the Keys.

In conjunction with DER's permitting process several projects have been required to monitor water quality in the areas they impact. These projects may be the source of additional water quality information. DER will also administer the Outstanding Florida Waters (OFW) program in the Keys if designated. This designation demands higher water quality standards and could require additional water quality monitoring. Though specific areas of interest may arise for water quality analysis, DER presently can provide a large body of data on existing water quality.

E. Cultural.

This section addresses the human influence and development of this area, and their effects on the aquatic preserve. The Florida Keys area has been the site of enormous subdivision and condominium development over the past years. Most of these developments are restricted to the Key Largo, Marathon, and Key West areas, but there is the potential for development in other areas. The 1980 U.S. Census population for Monroe County was 63,188, a 20 percent increase since 1970. Approximately 73.9 percent of the population lives in the three urban areas identified above. Key West and the Lower Keys hold 60.1 percent of the population according to the 1980 U.S. Census; 24,292 and 13,687 residents, respectively. The Middle Keys hold 16.2 percent and the Upper Keys holds 24 percent; 10,221 and 14,891 residents, respectively (Monroe County, 1982).

The North Key Largo area along County Road 905 typifies the massive developments planned within the aquatic preserve. At least 15 condominium, hotel, and luxury home projects have been planned, with a projected population impact of 25,000 to 45,000 new residents by the year 2,000 (Miami Herald, September 1982). The potential population increases associated with these developments are the major reasons why a viable aquatic preserve management plan is needed. Without water and wildlife resource management, the increase in population will increase the potential for environmental degradation.

Tourism and military operations play important roles in the dynamics of the Monroe County population. Approximately 9.5 percent of the population is

connected to military installations, with the majority of these individuals located in Key West. In 1981, approximately 1,006,020 tourists visited the Florida Keys, mostly during the winter months. Their major activities included fishing and diving. The large seasonal increases in population, associated with tourism, add more stress to utilities, services, and ecosystems that are already stressed.

Not only do the preserves have large population pressures to contend with, but other man-induced pressures must be addressed as well.

The issues of growth impacts are identified as:

1. Damage to coral reefs from boat anchors, boat groundings, diver-induced injury, and unpermitted specimen collection.
2. The elimination of mangrove areas and other marine and freshwater habitats by dredging, filling, and land clearing for the purpose of development.
3. Damage to grassbeds from boat propellers. [Bare spots in grassbeds do not heal rapidly and may increase in size during heavy storms (Patriquin, 1975)]
4. Water quality degradation from improper sewage disposal practices and stormwater runoff.
5. Aerial spraying of insecticides and the ditching and draining of wetlands for mosquito control purposes.
6. The replacement of mangroves and other native vegetation with exotic species such as Brazilian pepper, and Australian pine that do not offer the same shoreline stabilizing effects against erosion and storm surges.

Chapter V

RESOURCE MANAGEMENT

A. Introduction

The main objective of the resource management plan in the aquatic preserve is to protect the resources of the aquatic preserves for the benefit of future generations (Section 258.35, F.S.). This part of the management plan addresses the policies and procedures which both onsite and administrative personnel will pursue. The onsite management will involve DNR's field personnel assigned to the aquatic preserve. The administrative management will involve Division of Recreation and Parks' personnel (both in the field and in Tallahassee) and Division of State Lands' personnel, cooperating in the review of applications for use of state-owned lands and related activities surrounding the preserve. These personnel will be interacting with various government and non-government entities, interest groups, and individuals.

B. Onsite Management Objectives

The onsite management objectives are reflected in the activities that the field personnel become involved in (i.e., observation, research, public interaction, emergency responses, etc.) to protect and enhance the resources within the aquatic preserve. Other activities, such as the interaction with other government and non-government entities, are covered in more detail in Chapter VI (Management Implementation Network). The field personnel's duties

are, with respect to management of the various uses of the aquatic preserve, addressed in more detail in Chapters VII through XI. The field personnel will generally be involved in all management activities concerning the Florida Keys. This section is to be used as management guidelines for the field personnel in each of the noted areas.

1. Plant Communities

The communities of aquatic and wetland plants, described in more detail in Chapter IV, within the Preserve perform five major functions vital to the health and productivity of the system:

a. they tend to stabilize geologic features in the face of dynamic forces (i.e., currents, tides, winds, and waves), which often act in concert to both erode and deposit;

b. they create, from recycled nutrients and solar energy, the organic material that fuels the food web which supports the area's fisheries, endangered species, migratory waterfowl, colonial waterbird nesting colonies, raptors, marine mammals, and marine invertebrates;

c. they provide protected fisheries habitat for spawning and juvenile development;

d. they provide roosting and nesting habitat for birds; and,

e. they physically buffer adjacent waters from contaminated and channelized runoff from uplands within the watershed and the uplands from storm waves and winds.

The management objectives for plant communities will be to maintain and enhance these functions. Because these plant communities are critically important to the well-being of the Preserve, a program to work toward the protection and restoration of those communities now damaged or destroyed by human activities should be developed.

Management Policy

a. Field Familiarization and Documentation. Field personnel will become familiar with the plant species and communities present in the aquatic preserve, locations of their occurrences, and their condition.

b. Literature Familiarization. Field personnel will assemble a working library of existing pertinent literature concerning the species and communities present in the aquatic preserve. Staff will become familiar with the ranges, life histories, ecological requirements, productivity, importance to water quality, contribution to landform stabilization, wildlife habitat provision, fisheries habitat provision, and fisheries food production of the plant communities within the aquatic preserves.

c. Preparation of Guidelines and for Mapping the Management of Endangered Species. Field personnel, based on their field observations and literature

reviews, will develop maps (using 7.5 minute quadrangles) showing the locations of threatened and endangered plant species within and adjacent to the aquatic preserve. A set of management guidelines for each species, outlining the habitat requirements and the methods to sustain and/or restore these habitats will be developed. Field personnel, in the course of documenting the occurrence of threatened and endangered animals, will develop maps showing the locations and types of plant communities used by these animals for nesting, roosting, feeding, resting, spawning, etc. Literature information and personal observations will then be used to develop guidelines for maintaining (or restoring if necessary) the "critical habitat" required by each species.

d. Monitoring of Plant Communities for Changes. Field personnel will become familiar with the use of aerial photography and LANDSAT imagery, for the study and monitoring of plant communities, historically and at the present time, and will use this remote sensing in conjunction with field observations to monitor and document natural changes such as:

1. freeze damage to, and recovery of, mangrove communities:
2. wind and wave damage to mangrove communities from storms and hurricanes;
3. accretion-related seaward extension of mangrove communities;
4. erosion-related landward retraction of mangrove communities;
5. depositional burying of marine grassbed communities;
6. invasions of exotic plant species and revegetation by native species after exotic plant removal projects;

7. pathogen damage to and recovery of plant communities.

e. Identification of Areas and Communities in Need of Restoration. Field personnel will, as time permits, systematically survey the aquatic preserve to determine the location, nature, and extent of environmental damages from human activities and assess the possibility of restoring each of the sites according to whether the site is publicly or privately owned, and the cost and effort required.

f. Protection of Plant Communities. Field personnel shall protect the plant communities from the various uses of sovereign lands within the aquatic preserve according to the following guidelines.

1. Field personnel, in their biological, reports shall not recommend for approval any proposed use for sovereignty submerged lands when the plant communities in the proposed use area appear to be jeopardized.
   i. Pruning of mangroves shall only be permitted for access from the mean high water line to a dock or other approved uses. The destructive clearing of mangroves on sovereignty lands shall be strictly prohibited.
   ii. Marine grassbeds communities shall not be removed or shaded to such an extent as to cause the death of a significant area of the community. They shall not be subjected to unacceptable turbidity, decreased light penetration, propeller or net damage.

2. Field personnel shall be notified of applications for uses of submerged lands within the aquatic preserve by the Bureau of Environmental Land Management central office. No applications will be approved within Class 1 and 2 Resource Protection areas (see section (C) of this chapter) without a thorough review by the field personnel. The field personnel will inspect the site, assess the potential impacts to the plant communities, and then convey their recommendations to the central office as required.

3. Field personnel will, as time permits, initiate various educational programs and supplement existing educational programs designed to increase public awareness of the damage that recreational, private and commercial uses (i.e., propeller damage) can inflict on marine grassbed communities.

4. In cooperation with the South Florida Regional Planning Council, field personnel will familiarize themselves with the results of a study under the Coastal Energy Impact Program, in assessing the potential impacts of an oil tanker spill or drilling rig accident on the natural resources of the Florida Keys.

g. Restoration of Plant Communities. Field personnel will consult with professionals in the wetlands restoration/revegetation field to determine the advisability of using healthy beds of marine grasses as a stock source to restore damaged grassbeds. They will develop guidelines for restoring marine grassbeds in the aquatic preserve.

Field personnel will identify easily accessible mangrove communities within the aquatic preserve where a high density of mangrove seedlings could serve as a nursery stock source for transplanting to restoration sites. Field personnel will consult with professionals in the wetlands restoration/revegetation field concerning proven procedures for transplanting and nurturing mangroves, and will develop guidelines for restoring mangrove communities in the aquatic preserve.

In the event that plant restoration is required as the result of a permit application with DER, or as a result of any other process, the field personnel will be responsible for monitoring the restoration activity. This might include advising the individuals involved in the actual restoration work on the best techniques under the available restoration guidelines. The field personnel will monitor the success of the restoration project after the work is completed.

h. Identification of Research Needs. Field personnel will identify research needs concerning plant communities within the aquatic preserve with special emphasis given to data needs that would increase the capability of field personnel to manage plant communities under environmental stress, and to determine threshold tolerances for plant community health and diversity in relation to degraded environmental conditions.

i. Coordination with Other Researchers. Field personnel will become familiar with research projects being conducted within the aquatic preserve by state and federal agency biologists and non-government researchers. Water quality

research issues, as they affect plant communities, should also be closely followed. This familiarization should lead to a better understanding of both agencies' personnel and a better awareness of the data findings and uses. The research liaison will also be addressed in Chapter X (Scientific Research).

2. ANIMAL LIFE

The richness of the marine animal life of the Florida Keys is important to the designation of the aquatic preserve. The corals, fish, lobster, shrimp, and crabs within the aquatic preserve are valuable resources on which recreational and commercial fisheries depend. The large areas of undisturbed adjacent wetlands are critical to the future survival of these resources. These wildlife include an extensive list of endangered species, migratory waterfowl, colonial waterbirds, invertebrates and vertebrates.

The management objective for animal life within the aquatic preserve will be the protection through preservation of habitats and living conditions in the most natural condition possible.

MANAGEMENT POLICY

a. Field Familiarization and Documentation. Field personnel will become familiar with the major animal species in each habitat in the aquatic preserve. This identification process will include the location, number, time of sighting, weather conditions and any other factors which may be

necessary to build a working knowledge of the species, and their interaction and occurrence in the aquatic preserve. This familiarization will be particularly focused on the various coral communities within the Keys.

b. Literature Familiarization. The field personnel will assemble a working library of existing literature concerning the major animal species and communities within the aquatic preserve. The field personnel will become familiar with life histories, ecological requirements, position in the community, habitat and other factors necessary for sound management.

c. Preparation of Guidelines for the Management of the Endangered Species Within the Aquatic Preserve. The field personnel will become familiar with the guidelines of the Florida Game and Fresh Water Fish Commission, U. S. Fish and Wildlife Service, Department of Natural Resources' Division of Marine Resources, National Marine Fisheries Service and any other applicable agencies and non-government organizations involved in the management of endangered species. These guidelines will be used in conjunction with the field familiarization, documentation, and mapping to develop management guidelines for each endangered species within the aquatic preserve. Special guidelines shall be developed and implemented for the management of areas within the aquatic preserve that are identified as critical habitat for endangered species.

d. Manatee Management. When applications for use of submerged lands within the preserves are within a manatee sanctuary or manatees are known to use the area, field personnel will notify the State Manatee Coordinator. These

applications will require his authorization and approval before those applications are recommended by BELM. Field personnel will also work with the manatee coordinator in gathering manatee siting data within the preserves and establishing new sanctuaries, if necessary.

e. Monitoring of Animal Populations for Changes. Field personnel will study and monitor changes in animal species that are caused by natural phenomena, such as:

i. freezes;
ii. storms and hurricanes;
iii. changes in habitat due to changes in plant types;
iv. changes in habitat due to water quality changes; and
v. geologic or hydrologic changes including erosion, estuarine current flow changes, and any other physical changes.

f. Protection of Animal Life From Human Uses of the Aquatic Preserve. Field personnel, during the process of resource impact analysis in the review of use applications in or affecting the preserve, shall consider the protection of animal species. The review shall also consider the potential effects of the proposed use on the plant communities as they function as habitat for the animal life and uses that may cause a disturbance in the natural activities and functions of the animal life (e.g., prop scars, anchor damage to corals, excessive noise or bright lights affecting a bird rookery). The field personnel should be notified of any proposed activities (e.g.,

seismic testing, mammal capture by permit) within the aquatic preserve that might affect the well-being of animal life and should be involved in planning the activity so as to cause the least amount of stress on animal life.

g. Coral Management. The various types of coral and coral habitat, as described in Chapter IV, are in a balance between natural and man-induced changes in the environment. The Coral Reef Report to the Governor and Cabinet (Skinner and Jaap, 1984) in January 1984 described many factors affecting the coral reef communities off Key Largo. Those reefs are presently within federal sanctuary or State Park boundaries. The extensive reef communities in the aquatic preserve are receiving much the same pressures as described in that report, to a greater or lesser degree depending on location and use. The field personnel will identify problems in these reef communities (e.g., anchor damage, water quality problems) and coordinate with other agencies and organizations for solutions. Public education in correct anchoring techniques, channel marking and other methods are examples of some solutions. The field personnel will also observe and document any other problems that may need more extensive solutions (e.g., water quality sources) (Section 370.114, F.S.)

h. Identification of Research Needs. The field personnel in the course of their duties shall identify research needs required to improve the management of animal life in the aquatic preserve. This identification process is more fully described in Chapter XII (Identified Program Needs).

i. Coordination with Other Researchers. Field Personnel will become familiar with research projects conducted within the aquatic preserve by state and

federal agency biologists and non-government researchers. This familiarization should lead to a better understanding of both agencies' personnel and a better awareness of the data findings and uses. The research liaison will also be addressed in Chapter X (Scientific Research).

3. GEOLOGIC FEATURES

The management of geologic features will require that the field personnel become aware of the natural geologic features and the changes, both human and natural, which affect these features within the aquatic preserve to better enable a review of applications for state-owned land uses that might affect these features. These geologic features will include passes, islands, shoals, shorelines, embayments, and channels. The overall objective of the management of these features is to allow the naturally dynamic system to operate without man's influence or interference. Active management in this area shall include the review of proposed uses that might affect the geologic features within the aquatic preserve. The majority of these reviews will probably concern bulkheads, bridges and channels as they might affect state-owned lands. The objective in the placement of bulkheads on lands upland of the aquatic preserve shall be that the natural contour and drainage be altered to the least amount practicable. The use of rip rap with mangrove or other suitable native plantings would be preferable to bulkheads within the preserve. Bulkheads are not allowed within the preserve, except as stated in Sections 258.42(2), and 258.44 F.S. and in accordance with the management objectives of the preserve.

Existing bridges within the Keys have resulted in losses of grassbeds and mangroves. Bridges can restrict natural flushing and create unnatural circulation patterns. Future proposed bridge locations will be reviewed in light of these potential impacts.

Maintenance dredging of existing channels should also be carefully studied to remove conditions that require perennial maintenance and chronic environmental disturbances. New channels also have the potential to cause major adverse impacts to the aquatic preserve, with varying influences depending on channel location.

The field personnel shall also be involved in the review of project proposals submitted to other agencies, such as the U.S. Army Corps of Engineers, Department of Transportation or Water Management Districts, and shall formally review and comment on any permit application that impacts the aquatic preserve. These projects shall be reviewed jointly with those agencies' personnel whenever possible. The field personnel will review these projects on behalf of the aquatic preserve and its resources.

4. ARCHAEOLOGICAL AND HISTORICAL SITES

Archaeological and historical sites have several characteristics which must be recognized in a resource management program.

i. They are a finite and non-renewable resource.

ii. Each site is unique because individually it represents the tangible remains of events which occurred at a specific time and place.

iii. While these sites uniquely reflect localized events, these events and the origin of particular sites are related to conditions and events in other times and places. They also preserve traces of past biotic communities, climate, and other elements of the environment that may be of interest to other scientific disciplines.

iv. These sites, particularly archaeological sites, are very fragile because their significance is derived not only from the individual artifacts within them, but especially from the spatial arrangement of those artifacts in both horizontal and vertical planes.

Administering Agency.

The management of the archaeological and historical sites is authorized and administered by the Division of Archives, History and Records Management (DAHRM) in the Florida Department of State. The management authority for this area of management is presented in Chapter II (Management Authority).

Management Policy.

The management policy presented here is one of conservation, as recommended by the DAHRM and subject to that agency's changes. Their policy is as follows:

1. The field personnel and all other agencies planning activities within the aquatic preserve shall coordinate closely with DAHRM in order to prevent any unauthorized disturbance of archaeological and historical sites that may exist on the affected tract. DAHRM is vested with the title to archaeological and historical resources abandoned on state lands and is responsible for administration and protection of such resources (Section 267.061(1)(b), F.S.). It is illegal to destroy or otherwise alter sites on state lands without a permit from DAHRM (Section 267.13, F.S.). Therefore, agencies planning activities should coordinate their plans with DAHRM at a sufficiently early stage to preclude inadvertent damage or destruction to these resources.

2. The nature of these sites' fragility and vulnerability to looting and other destructive forces requires that the location of these sites not be widely known, if the location is known at all. In many instances DAHRM will have knowledge of the known and expected site distribution in an area. Special field surveys for unknown areas may be required by DAHRM to identify potential endangerment of a proposed activity to these archaeological and historical sites. This will be especially necessary in the case of activities contemplating ground disturbance over large areas.

3. In the case of known sites, activities that are expected to alter or damage these sites shall alter their management or development plans as necessary, or make special provisions so as not to disturb or damage such sites prior to professionally acceptable and authorized mitigation.

4. If in the course of a management activity, or as a result of development or the permitting of dredge/fill activities, it is determined that valuable historic or archaeological sites will be damaged or destroyed, DAHRM reserves the right to require salvage measures to mitigate the destructive impact of such activities on such sites (Section 267.061(1)(b), F.S.). Such salvage measures shall be accomplished before DAHRM would grant permission for site destruction.

5. Excavation of archaeological sites in the near future is discouraged. Archaeological sites within the aquatic preserve should be left undisturbed for the present, with particular attention devoted to preventing site looting by "treasure hunters".

6. Field personnel will note suspected sites for future surveys by DAHRM. Cooperation with other agencies in this activity is also encouraged by DAHRM. The DAHRM will help inform the field personnel about the characteristics and appearance of these sites.

7. Any discovery of instances of looting or unauthorized destruction of these sites will be reported to the DAHRM so that appropriate action

may be initiated. The Florida Marine Patrol and other enforcement personnel of DNR shall provide enforcement assistance to DAHRM and make arrests or investigate cases of looting or other unauthorized destruction of archaeological sites. The field personnel will follow the above management policy and become familiar with the personnel involved with this task in DAHRM and their procedures for identifying suspected sites.

5. WATER RESOURCES

Responsible management of water resources for the protection of human health and recreational enjoyment of aquatic preserve waters, as well as for the protection and enhancement of the preserve's plant and animal communities is, without a doubt, the most critical aspect of aquatic preserve management. Research to understand how human activity can alter or detrimentally affect the dynamic characteristics of the preserve's various habitats can be approached confidently after monitoring data has been used to model the effects of naturally occurring variations on the same habitat. Only a single toxic substance may be necessary to initiate irreparable ecological damage and change in the water resources of the aquatic preserve estuarine ecosystem.

Management Policy

The successful management of the water resources of the aquatic preserve depends heavily on other government agencies (i.e., DER, the South Florida

Water Management District) charged with regulating water quality and quantity or activities that could effect water quality. The objective of the water resources management shall be to maintain the naturally high water quality and to enhance or restore water quality in degraded areas. Sources of water resources data include state and federal agencies, colleges, universities, scientific foundations and private consultants working in the Keys. These various entities have interests at many different levels and areas within the marine system. The aquatic preserve management program will manage the water resources through coordination with these various entities. The field personnel will not have the ability to do water sampling, but through the review of these data from other entities and from their own field observations, they will be able to identify water resource problems in the aquatic preserve.

a. Familiarization with the Jurisdiction, Personnel, and Monitoring Programs of Government Agencies and Other Entities. Field personnel will become thoroughly familiar with the jurisdiction, personnel and monitoring programs of other agencies, institutions and corporations involved in studying, monitoring, regulating and managing water resources within the aquatic preserve and the drainage basins which provide fresh water to this preserve. Those agencies known to be working or having potential activities affecting the preserve are listed below; others may be added as they are identified.

1. Florida Department of Environmental Regulation
2. Monroe County
3. South Florida Water Management District

4. National Oceanic and Atmospheric Administration (NOAA)
5. U. S. Geological Survey
6. U. S. Fish and Wildlife Service
7. South Florida Regional Planning Council
8. Florida Game and Fresh Water Fish Commission
9. Florida Department of Natural Resources Marine Research Laboratory
10. University of Miami
11. Florida Institute of Technology
12. Florida State University
13. U. S. Environmental Protection Agency
14 Newfound Harbor Marine Institute
15. Harbor Branch Foundation

b. Monitoring of Water Resources by Cooperative Data Collection and Review. Field personnel will: 1. promote coordination among involved agencies in planning monitoring programs and in evaluating monitoring data; and 2. monitor water resources within the preserve by reviewing the data collected and compiled by those agencies as it applies to the aquatic preserve and its resources.

c. Review of Permit and Lease Application for Aquatic Preserve Uses and Watershed Activities that would affect the Preserve Water Resources. Field personnel will review sovereign land lease applications, development of regional impact reviews, and DER/COE permit applications in cooperation with other agencies as necessary, and as outlined in Chapter V (C) for their potential impact on the water resources of the aquatic preserve.

d. Familiarization with and Monitoring of Activities and Users which Regularly Contribute Pollutants to Preserve Waters. Field personnel will become familiar with the activities and users which regularly or potentially contribute pollutants to the waters of the aquatic preserve. This monitoring will be accomplished directly by field observations and indirectly by review of other entities' water resources data. Field personnel will encourage and coordinate with other agencies involved with water resources monitoring to consider more detailed field monitoring in areas of the preserve where the incidence of polluting activities is found to be high.

These activities will also be applicable to Chapter X (Scientific Research), and the coordination through Chapter VI (Management Implementation Network). The field personnel's onsite presence will be complemented by their reliance on other agencies and entities for data and regulation. The field personnel will have the ability to visually monitor water resource crises and phenomena as they occur and when they affect other resources.

6. CUMULATIVE IMPACT ANALYSIS

Cumulative Impacts are the sum total of major and minor changes or effects upon a natural system. Taken singularly these effects may not constitute a notable change in the condition of the natural system, but as these single changes or uses accumulate, their combined impact may result in a substantive environmental disturbance or degradation of the natural system.

The review of proposed uses in the aquatic preserve from the perspective of cumulative impact analysis requires a thorough knowledge of the natural system

and the various interactions and dynamics within that system. This aquatic preserve management program will initiate development of a cumulative impact analysis program. The evaluation of cumulative impacts shall include the following criteria from Chapter 16Q-20, F.A.C.:

"(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 preserve, 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."

The availability of onsite staff who are familiar with the distinctive characteristics of this marine environment, coupled with their ability to access LANDSAT imagery and mapping, and other data sources, is the key to development of a successful cumulative impact analysis program. As cumulative impacts are identified for specific areas and/or resources, they will become an integral part of the project analysis and decision-making process.

7. MANAGEMENT OF ENCROACHMENTS

The management of encroachments in the preserve will concern the unauthorized placement of structures or other illegal uses in the aquatic preserve. These encroachments might also include illegal activities associated with an approved use (e.g., extension of a dock, construction of boat houses, extension of an approved channel).

The management policy for the field personnel, after identification of a suspected illegal encroachment, will involve a reporting procedure and the monitoring of the remedial action. After a field identification of suspected encroachments, field personnel will notify the central office to verify the title of the property and research the possibility of the use being an approved activity. Due to the extensive area involved in the aquatic preserve, this will be a progressive activity depending on the field personnel's eventual familiarization with the preserve and the approved uses.

The potential for unauthorized activities in such an extensive area may possibly require some type of mapping and recording system to assist the field personnel in their monitoring.

The management action for verified illegal encroachment will be developed by the agencies specifically involved (i.e., DNR, DER). The field personnel will assist, as necessary, with field evaluations or other support activities. The final action will be monitored by the field personnel, at the direction of the Trustees to the central office. The procedures followed in these applications will be decided on a case by case basis.

The major encroachment issues in the Florida Keys-Monroe County Aquatic Preserve are: individuals living on moored boats for long periods of time, dredging and filling, and the building of artificial reefs without permits. The points of these issues are concerned with private individuals using public lands and submerged bottoms for activities that have a high potential for water quality degradation. Not only do these activities degrade water quality but they are also navigational hazards (e.g., boats anchored without displaying light and unmarked debris dumped in shallow water and canals to attract fish and lobsters). The presently ongoing use of Loggerhead and Raccoon Keys for raising of monkeys for medical research purposes will be accommodated, so long as the operators of these facilities take adequate steps to minimize the impact of their operations on the aquatic preserve. New requests or expansion of such uses in the preserve will be prohibited.

Illegal dredging and filling are the main impacts on the ecosystems in the Florida Keys. These activities can affect both upland and marine systems

within the area by increasing turbidity, impounding or draining hardwood and mangrove systems thereby changing their water movement, and destroying mangrove, hardwood, or seagrass areas. Once the activity is determined to be illegal, and there is proof that certain individuals are responsible for these activities, a method of removal conducted at the individual's expense, will be developed, given the conditions of each site.

C. RESOURCE MAPPING AND RESOURCE PROTECTION AREAS

The efficient description and location of resources within such a large area requires the use of remote sensing techniques. This work will be done in conjunction with DNR's Marine Research Laboratory's Habitat Assessment Team. Marine Research Laboratory personnel have developed resource and habitat identification mapping through the use of LANDSAT (satellite) imagery and aerial photography.

The vegetation and land use mapping done in this study will become the basis for the development of a Resource Protection Area management system in the aquatic preserves. This mapping system will identify and classify various resource and habitat types within the aquatic preserve that require protection by the management program. This mapping system will also give acreage totals for each land use and vegetation classification in the preserves. The vegetation portion of the mapping will be augmented over time by wildlife and fisheries information (endangered species, bird rookeries, etc.), archaeolog archaeological and historical site information and other resource factors deemed crucial to the continued health and viability of the aquatic preserve.

The onsite managers will supplement this mapping with the above information to develop and update a Resource Protection Area (RPA) mapping program. The RPA mapping system is based on three levels of resource classification. The Class 1 level will contain resources of the highest quality. Uses proposed for these areas will receive the most rigorous review. The Class 1 level will include the following: hard and soft corals; marine grassbeds; mangrove swamp; archaeological and historical sites (upland and submerged); endangered species habitat; colonial waterbird nesting sites; and other appropriate factors.

The Class 2 areas will be defined as those areas containing the resources of Class 1, but in a transitional condition compared to Class 1. These resources will either be building toward Class 1 status or declining to Class 3 status. Class 2 areas will require careful field review as to the specific area's sensitivity to each proposed use. In some respects, these areas may be as sensitive or more sensitive to disturbances than Class 1 areas. The resources of Class 2 will include: hard bottoms; marine grassbeds; mangroves in scrub condition or colonizing new lands; saltwater vegetation colonizing new lands; and other resources of Class 1 type that fit in the Class 2 condition.

Class 3 areas will be characterized by the general absence of the attributes of the above two classes. Class 3 areas may have small localized Class 1 or 2 areas within them. Class 3 areas will generally have deep water areas or areas with no significant vegetation or wildlife attributes. Nearshore and bottom areas significantly modified by man will be designated as Class 3.

These RPA maps will require periodic revisions as the onsite managers learn more about the resource's reactions to man's uses. Scientific research and

other data additions may also require modification of this system. Natural changes will also require modification of this classification system. Periodic checking by LANDSAT satellite imagery will become useful for remote sensing monitoring as its use is more fully developed.

The RPA maps will become a planning tool for both onsite and central office staff. More detailed field review will still be required to supplement this information on a case by case basis, as necessary.

The initial development, as well as periodic review, will require the support and assistance of the many other resource regulating and managing agencies, as well as local and regional government entities. Support will also be requested from the colleges, universities, foundations, other interest groups and individuals.

The RPA mapping will use the USGS 7.5 minute quadrangle map format for vegetation and these maps, after public notice and opportunity for public review and comment, will be located in Appendix D of the aquatic preserve management plan. It is recognized that mapping at this scale may not adequately define small areas which do not qualify for the RPA class level assigned to a general area.

D. ADMINISTRATIVE MANAGEMENT OBJECTIVES

This section of the chapter addresses the role of the central office in the aquatic preserve management planning and implementation process. The central

office's role is generally interpreted within the context of coordinating activities with the field personnel. This coordination linkage is important to many program aspects, including project review and evaluation, local contact initiation, administrative rule development, contractual services and conflict resolution, not to mention the routine support (payroll, operating expenses, etc.) usually extended by the central office to the onsite managers. All program activities identified within this context are designed to protect and enhance the environmental, educational, scientific, and aesthetic qualities of the natural systems of the aquatic preserve.

1. Objectives

Specifically, the following administrative objectives are an essential part of the aquatic preserve management program.

a. To ensure a comprehensive, coordinated review and evaluation of proposed activities potentially affecting the environmental integrity of the aquatic preserve.
b. To serve as the link between aquatic preserve field personnel and state agencies and programs which originate in Tallahassee.
c. To serve as the primary staff in the development of administrative rule additions, deletions, and revisions.
d. To serve as the administrative staff for contractual agreements and services.
e. To establish and maintain a conflict resolution process.

f. To review all existing and past activities as to their affect on the environmental integrity of the aquatic preserve.

2. Project Review and Evaluation

A major element in the administration of an aquatic preserve management system is the establishment of a thorough project review process. It is the program intent that the central office staff review all proposed activities requiring the use of state-owned lands within the preserve.

Sections 258.42 through 258.44, F.S. establish the legal context within which all proposed uses of the aquatic preserve must be evaluated.

Essentially, these sections require that projects be basically water dependent or water-enhanced, not contrary to the lawful and traditional uses of the preserve, and not infringing upon the traditional riparian rights of the upland property owner.

The primary mechanism through which proposed uses are reviewed is accomplished by participation in the state lands management process as established by Chapter 253, F.S., and modified by Chapter 258, F.S. The central office was administratively designated, on October 4, 1982, as an agent of the Trustees, for the purposes of evaluating the environmental consequences of proposed uses of state-owned lands within aquatic preserves.

In conducting the environmental evaluations, the central office staff will rely heavily upon the most current, readily available data such as Department of Transportation (DOT) aerial photography, LANDSAT imagery, DER biological reports, and other data resources (see Appendices C and D). If a proposed activity is legally consistent with the maintenance criteria outlined in Section 258.42 F.S. and Chapter 16Q-20, F.A.C., and is generally of negligible environmental concern, then the project review will likely be conducted in its entirety by the central office staff, utilizing the generalized environmental data.

The field personnel will be requested to conduct a more detailed environmental assessment of the project if the central office staff, during the course of the preliminary application review, determines that the requested use of state-owned lands may have a significant effect upon the environmental integrity of the preserve. Copies of all applications received will be provided to the field personnel for project monitoring and assessment of the possible cumulative impacts.

Field personnel will be encouraged to establish direct communication links with the various regulatory and management agencies for purposes of obtaining advance notification of projects potentially affecting the preserve. All environmental review and assessments, however, will be channeled through the central office unless other arrangements have been previously cleared with the central office.

While the State Lands Management Program authorized by Chapters 253 and 258, F.S. and Chapters 16Q-20 and 16Q-21, F.A.C. is expected to be the primary

management implementation vehicle for the aquatic preserve, it is by no means the only vehicle. Section 253.77, F.S. as amended, and the December, 1982 Memorandum of Understanding between the COE, DER and DNR provide direct access to DER's permitting process for DNR. The Development of Regional Impact (DRI) and other regional or state level review processes represent other implementation mechanisms. The basic review approach and the evaluation relationship between the field personnel and the central office staff will be the same as the case involving the State Lands Management program.

One aspect of the aquatic preserve review and evaluation program is the identification of proposed activities that are either generally or specifically prohibited. Immediately upon review of such project applications, the central office staff will notify the Division of State Lands (or other program managers) that the proposed activity is legally unapprovable for the stated reasons. For those proposals which are subject to denial due to their adverse environmental impacts, even though the activity may be permissible, Section 258.42, F.S., specifically provides that:

"(1) No further sale, lease, or transfer of sovereignty submerged lands shall be approved or consummated by the trustees except when such sale, lease, or transfer is in the public interest.

(2) The trustees shall not approve the waterward relocation or setting of bulkhead lines waterward of the line of mean high water within the preserve except when public road and bridge construction projects have no reasonable alternative and it is shown to be not contrary to the public interest.

(3) (a) No further dredging or filling of submerged lands shall be approved by the trustees except the following activities may be authorized pursuant to a permit:

1. Such minimum dredging and spoiling as may be authorized for public navigation projects.

2. Such minimum dredging and spoiling as may be authorized for creation and maintenance of marinas, piers, and docks and their attendant navigation channels.

3. Such other alteration of physical conditions as may, in the opinion of the trustees, be necessary to enhance the quality or utility of the preserve or the public health generally.

4. Such other maintenance dredging as may be required for existing navigation channels.

5. Such restoration of land as authorized by s. 253.124(8).

6. Such reasonable improvements as may be necessary for public utility installation or expansion.

7. Installation and maintenance of oil and gas transportation facilities, provided such facilities are properly marked

with marine aids to navigation as prescribed by federal law.

(b) There shall, in no case, be any dredging seaward of a bulkhead line for the sole or primary purpose of providing fill for any area landward of a bulkhead line.

(c) There shall be no drilling of gas or oil wells. However, this will not prohibit the state from leasing the oil and gas rights and permitting drilling from outside the preserve to explore for oil and gas if approved by the board.

(d) There shall be no excavation of minerals, except the dredging of dead oyster shells as approved by the Department of Natural Resources.

(e) There shall be no erection of structures within the preserve, except:

1. Private docks for reasonable ingress or egress of riparian owners;
2. Commercial docking facilities shown to be consistent with the use or management criteria of the preserve; and
3. Structures for shore protection, approved navigational aids, or public utility crossings authorized under subsection (3)(a).

(f) No wastes or effluents shall be discharged into the preserve which substantially inhibit the accomplishment of the purposes of this act.

(g) No nonpermitted wastes or effluents shall be directly discharged into the preserve which substantially inhibit the accomplishment of the purposes of this act."

Generally, applicants desirous of appealing staff recommendations will have to follow those appellate procedures outlined in the appropriate authorizing statutes. In the case where applications requesting the use of state-owned lands are denied, three appellate procedures are available to the applicant. Depending upon the type of application submitted, an applicant may:

a. Ask the Governor and Cabinet to overturn an application decision rendered by the Executive Director of Department of the Natural Resources (or his designee) under a delegation of authority;
b. Request an Administrative Hearing under the procedures outlined in Chapter 120, F.S.; or
c. Appeal the action of the Board of Trustees of the Internal Improvement Trust Fund to the District Court of Appeals.

3. Liaison Between Field Personnel and Other Interested Parties

One of the most important aspects of the field personnel's job is to establish a mutually beneficial communication link with pertinent interest groups. The central office staff will assist in identifying and contacting governmental bodies, special interest groups and interested individuals requiring aquatic preserve program coordination.

When requested by the onsite managers, the central office staff will assist in arranging for specialized management expertise not generally available locally. This may include, for example, such things as arranging for DAHRM to conduct a detailed cultural resource assessment for certain areas of the the preserve.

CHAPTER VI

MANAGEMENT IMPLEMENTATION NETWORK

This chapter of the management plan will address the various relationships of aquatic preserve management to the different government agencies and programs, non-government entities, interest groups, and individuals within the aquatic preserve area. The activities of both field personnel and central office staff as they relate to these other organizations will be presented.

A. FEDERAL

Many federal agencies have property interests, land and wildlife management programs, research activities, construction activities, and regulation programs existing or potentially existing within the aquatic preserves. The objective of the aquatic preserve management program will be to complement the various activities wherever possible. The field personnel will assist those federal agencies in areas where they have common goals. The field personnel and central office staff will also review the federal activities as to their effect on the objectives of the aquatic preserve management. This review shall be coordinated through the DER's Office of Coastal Management for the purposes of enforcing the provisions of the Federal Coastal Zone Management Act of 1972, as amended.

1. United States Fish and Wildlife Service. The aquatic preserve program will be involved in the review of proposed preserve uses in conjunction with the Fish and Wildlife's Division of Ecological Services in Vero Beach. This division reviews dredge and fill requests and other federal level permitting under the Fish and Wildlife Coordination Act.

Another management program in which the field personnel could possibly interact with the Fish and Wildlife Service is the protection and recovery of endangered species and bird rookeries within the aquatic preserve. Field personnel will become involved in using available recovery techniques for this purpose, as necessary.

2. U.S. Army Corps of Engineers. The U.S. Army Corps of Engineers (COE) is charged with providing technical guidance and planning assistance for the Nation's water resources development. The COE also provides supervision and direction to many engineering works such as harbors, waterways and many other types of structures. Their major responsibility, as it applies to the aquatic preserve, is the protection of navigable waters, pollution abatement and maintaining water quality and the enhancement of fish and wildlife.

The COE activities in the Keys include their involvement with the DER in the dredge and fill permitting process, technical oversight of channel, inlet and canal maintenance, and evaluating requests for new channels, canals and other such public works projects. The field personnel will become familiar with the various programs, policies and procedures as they apply to the aquatic preserve.

The field personnel and central office staff will also review activities proposed by the COE for conformance to the objectives of the aquatic preserve management plan. This involvement should begin in the early stages of project planning in order to facilitate the best protection of the aquatic preserve possible.

3. U.S. Geological Survey. The U.S. Geological Survey (USGS) under the Department of the Interior has the responsibility to perform surveys, investigations, and research pertaining to topography, geology, and the mineral and water resources of the United States. USGS also publishes and disseminates data relative to those preceding activities.

In the past the USGS has conducted only one study in the Florida Keys. This was the Hansen Report on fresh water lenses on Big Pine Key. The field personnel and central office staff will familiarize themselves with this report as it applies to their management authorities and will encourage more USGS participation in researching water quality degradation.

4. U.S. Environmental Protection Agency. The U.S. Environmental Protection Agency (EPA), in cooperation with state and local governments, is the federal agency responsible for the control and abatement of environmental pollution. The six areas of pollution with which the EPA is concerned are air, water, solid waste, noise, radiation and toxic substances. The DER is the state agency responsible for handling most of these programs on a state level in lieu of a federal program. Within the aquatic preserve, the field personnel will assist the EPA in activities where there are common goals.

5. U.S. Coast Guard. The U.S. Coast Guard is the federal agency involved in boating safety, including search and rescue when necessary. The Coast Guard is also charged with the permitting of structures which affect navigation and boating safety. These structures include bridges, causeways, aerial utilities and other structures which may be in conflict with navigational uses. The field personnel, in conjunction with the central office staff, will also review projects which the Coast Guard may be evaluating for permits.

6. National Marine Fisheries Service. The National Marine Fisheries Service (NMFS) under the U.S. Department of Commerce is active in the Florida Keys area in recording commercial fish landings. The NMFS also has enforcement officers in the area checking for illegal fish landings.

The NMFS has completed an extensive reef fish inventory in the Looe Key National Marine Sanctuary. The field staff will familiarize themselves with the results of this study and others as they apply to their management activities.

Some common goals held by the Aquatic Preserve and NMFS staff are:

1. Maintain complete inventory of all species within preserve boundaries.

2. Maintain a list of species which have commercial and recreational value.

3. Investigate and document those species using marine grassbeds and mangroves for nursery areas and juvenile protection areas.

4. Investigate any fishing activities which adversely impact marine grassbeds and mangroves.

5. Enforcement against illegal fishing activities within the preserve boundaries.

B. STATE

Many state agencies have programs which affect the resources or regulate activities within the aquatic preserve. There are also other DNR programs that are within or affect the Florida Keys-Monroe County Aquatic Preserve. This section will describe the interactions and relationships of these various agency programs and how they relate to aquatic preserve management.

1. Department of Environmental Regulation. The Department of Environmental Regulation (DER) holds principle responsibility for air and water quality regulation. To this end DER, through its permitting process (DER 17-4, 17-12 F.A.C.), permits dredge and fill activities and dock, boat ramp, sea wall and other forms of construction where applicable. Permitting for dredge and fill, specifically, is initiated in a three way permit review process in conjunction with the U.S. Army Corps of Engineers (ACOE) and the DNR. The overall importance of each type of permitting activity and its positive effect on water quality makes DER of primary importance to implementation of the aquatic

preserve program. The DER also regulates other forms of pollution, such as noise, wastewater, solid waste and hazardous waste, each of which might affect the integrity of the aquatic preserve.

DER oversees designated Outstanding Florida Waters (OFW). The standards for maintaining water quality within an OFW are more stringent than those other wise considered in other Class III designated waters (waters for recreation, and management and propagation of fish and wildlife.) All waters of Monroe County are presently designated Class III while several preserve areas are already OFW's. Currently the Aquatic Preserve program staff are working with DER in its process to designate Monroe County, the entire Florida Keys, as an OFW . Such status will complement the goals of the aquatic preserve management plan.

The DER, Office of Coastal Management is charged with coordinating activities related to coastal management in the state and reviewing federal actions for consistency with the State Coastal Management Program, Section 380.20, F.S. The central office staff will maintain a close relationship with the Office of Coastal Management for assistance in the review of federal actions, data and research needs, and other program support.

2. The Department of Natural Resources (DNR)

The aquatic preserve management program is associated with several other Department of Natural Resource (DNR) programs in the Florida Keys. Under the Division of Marine Resources, the St. Petersburg Marine Research Laboratory

conducts research statewide. The Marine Laboratory's Habitat Assessment Team has developed the Resource Protection Area (RPA) mapping, which will be used in the management of this aquatic preserve. This RPA mapping was created through interpretation of aerial photography, LANDSAT satellite imagery and other data sources. The Marine Laboratory also maintains a field laboratory in Marathon, which is active in lobster and blue crab research. The Laboratory also has active studies on coral reef ecology and other related areas. Information available through these research facilities may be important for evaluating potential impacts within the aquatic preserve. The field personnel will become familiar with these studies and programs, and will consult the marine laboratory for their data needs whenever necessary. The Division of Marine Resources is also responsible for collection permitting for certain marine species (primarily shrimp, lobster and oysters). The field and central office staff will become familiar with this permitting process within the aquatic preserve.

The Division of Beaches and Shores is responsible for carrying out Chapter 161, F.S., the Beach and Shore Conservation Act. The powers of the Division include drawing coastal construction setback lines for counties under consideration. The law does not apply, however, to the shores of inland waters or other non-sand (e.g., mangrove) shorelines. For this reason the Division's concerns in the Keys have been limited to date. However, there are several beach areas within the Florida Keys. If threats to these areas become apparent, interaction with the Division of Beaches and Shores personnel may be helpful. Currently, the county and the state offer little protection to these beaches.

The Division of Recreation and Parks, in addition to administering the Aquatic Preserve Management Program under the Bureau of Environmental Land Management, manages 2 State Recreation Areas , 2 state historic sites, 1 state park and 1 state botanical preserve within the Florida Keys. John Pennekamp Coral Reef State Park, managed in conjunction with the Key Largo Coral Reef National Marine Sanctuary, exists as a major marine resource in the Keys. Over the years of the park's existence, many very informative studies have been carried out within its boundaries. Looe Key National Marine Sanctuary is managed in conjunction with Bahia Honda State Recreation Area and has also been involved in important studies. Future studies will continue to provide much valuable information about the Florida Keys and the marine environment. John Pennekamp, Long Key, Bahia Honda, Lignumvitae Key and Indian Key also provide protection and public access to unique and beautiful regions. Within the boundaries of each of these recreation, historic and botanical areas, unique upland and aquatic habitats are preserved. This is important for the maintenance of the habitats themselves and their preservation as examples of unique environments in Florida and the United States.

Two aquatic preserves and part of another presently exist within the Florida Keys; Lignumvitae Key, Coupon Bight and Biscayne Bay (portion within Card Sound). These preserves or portions of preserves are small and insular, but have been important in protecting their respective resources.

The Division of State Lands within the DNR is charged with overseeing uses, sales, leases or transfers of state-owned lands. The aquatic preserve staff will interact with State Lands in all transactions concerning submerged lands within the aquatic preserve. These would include the potential acquisition of

privately titled submerged lands or contiguous uplands important to the integrity of the preserve. This relationship is more fully described in Chapter V(C). The Marine Patrol, under DNR's Division of Law Enforcement, also operates in the Florida Keys. Although most of their enforcement efforts are drug related, they have increased their environmental enforcement cases in the last year (primarily lobster trapping issues). The field personnel will become familiar with their programs and operation, and will call on the marine patrol for law enforcement support as required.

3. Marine Fisheries Commission (MFC)

The MFC was established as a rulemaking authority pursuant to Section 370.027, F.S. The seven members are appointed by the governor and are delegated full rulemaking authority over marine life (subject to approval by the Trustees). with the exception of endangered species. This authority covers the following areas: a) gear specifications, b) prohibited gear, c) bag limits, d) size limits, e) species that may not be sold, f) protected species, g) closed areas, h) quality control codes, i) seasons, and j) special consideration related to eggbearing females and oyster and clam relaying. The field personnel and central office staff will become familiar with and enforce the rules of the MFC.

The MFC is also instructed to make annual recommendations to the Trustees regarding marine fisheries research priorities. The field and central office staff will use these recommendations to direct research efforts within the aquatic preserve.

4. Florida Game and Fresh Water Fish Commission (GFWFC)

The GFWFC administers the Endangered Species Program in Florida. A significant percentage of the species listed by the state as either, rare, threatened, or endangered reside in the Florida Keys. Many of these species, including mammals, invertebrates, birds, and reptiles live in or periodically use the aquatic preserve. The GFWFC will play a strong role in assisting in the preservation of these species, and will work closely with the field personnel and central office staff in developing program needs in this area.

The GFWFC's Environmental Services office in Vero Beach sends biologists into the area to review projects which may have potential impacts on local fish and wildlife habitat as necessary. The central office will use the GFWFC's assistance in their review process, when possible, and in developing fish and wildlife management for the aquatic preserve.

The GFWFC has enforcement officers working in this area. The field personnel will interact with these officers where there are common goals.

5. Department of Community Affairs (DCA)

The DCA is responsible for reviewing Developments of Regional Impact (DRI) and for administration of the Areas of Critical State Concern (ACSC). Presently the DRI process is not in effect due to the ACSC status in the Keys. DRI's are major developments that have impacts on a scale which is greater

than the county level and require a regional review from neighboring local governments and state agencies. Both the central office staff and field personnel of the aquatic preserve program will be involved in reviewing DRI's. The field personnel should receive notice of a DRI through the central office staff and then proceed with the field review. The central office staff will coordinate the field review findings and work with the other state agencies in the review of the DRI.

The Governor and Cabinet designated the Florida Keys as an Area of Critical Concern on April 15, 1975. A prime objective of the designation and regulations (principles) 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. The County has enacted ordinances and refined several existing ordinances to better address the complex growth management issues within the Florida Keys. DCA has the authority to approve the comprehensive plan and implement land use regulation within the ACSC.

6. The Department of Health and Rehabilitative Services (HRS)

The HRS provides many services to the public. Of interest to the Aquatic Preserve Program are the HRS's programs of septic tank regulation and locally implemented mosquito control. Septic tank usage has become a major issue in the Keys. Violations in or incorrect septic tank use affect the water quality within the preserve. Although mosquito control serves a useful public function, the effects of pesticides (adulticides and larvacides) in the waters of the preserve are a primary concern.

7. The Department of State

The Division of Archives, History and Records Management (DAHRM) in the Department of State will have a close working relationship with the field personnel and central office staff in the protection of archaeological and historical sites. The field personnel will be directed by DAHRM, through the central office, in any activities or management policy needs for these sites.

8. The Department of Transportation

The DOT maintains state highways and bridges. The DOT is currently renovating old bridges and working on several highway projects in the Keys. The field personnel and central office staff will work with the resident engineer on anticipated projects having possible impacts on the aquatic preserve. The field staff will review any major highway or bridge projects as they may affect the aquatic preserve.

C. REGIONAL

The regional level of the management implementation network as it applies to the aquatic preserve will include the South Florida Water Management District, and South Florida Regional Planning Council. These organizations have activities that are broader than the local government, but are on a smaller scale than the state level.

1. Water Management District. The district boundaries of the South Florida

Water Management District (SFWMD) contain the Monroe County area. The water management district administers permitting programs for the local consumable use of water, stormwater discharges, and some dredge and fill type activities. The types of water uses they permit in Monroe County are very limited at this time. The field personnel will become familiar with the review and permitting procedures as they might apply to water supply and stormwater in the Keys. The water management district is also involved in various studies on water supply and management, and other related research that may be of use to aquatic preserve management.

2. South Florida Regional Planning Council. The South Florida Regional Planning Council (SFRPC) serves as a regional planning body for the local governments of Monroe County as well as cities within the Keys and other southeast Florida counties. Among its duties, the SFRPC:

a. aids local governments with planning expertise;

b. is the regional representative for the Development of Regional Impact (DRI) review process (when this process resumes after the ACSC designation is removed);

c. serves as a regional clearinghouse for state and federal projects and programs; and

d. conveys information from the local governments to the state and federal levels.

The field personnel will become familiar with the various projects, programs, and data sources that the SFRPC has within its administration that may effect or prove useful to the aquatic preserve program.

The DRI review of projects which affects the aquatic preserve will be reviewed by the central office staff, with the field personnel's field review, when necessary. DRI's for large marinas, large subdivisions on the uplands above the preserve, and commercial or industrial developments will require a field review by the field personnel as to their effect on the aquatic preserve.

D. Local Governments and Special Districts.

Incorporated areas in the Keys include the towns of Key Colony Beach, Layton, and the City of Key West. These areas are governed by city commissions. They are, as are the remainder of the Keys, designated as Areas of Critical State Concern.

The remainder of the unincorporated area of the Keys is governed by the Monroe County Commission. The five members of the commission are nominated and elected "at large" to administer county affairs. Special districts include Monroe County Mosquito control, which is administered by the Department of Health and Rehabilitative Services (HRS). The Monroe Airport District (19-283, M.C.C) administers Key West, Marathon, and Port Largo airports in conjunction with DOT and the Federal Aviation Administration. An appointed Airport Site Selection Committee is currently reviewing proposed sites for an airport in the Upper Keys.

Field personnel will be available to these local entities to assist them in modifying their policies and practices to conform to the aquatic preserve management plan, and to exchange information for mutual benefit.

1. Relationship to local management plans. All local governments are required by the Local Government Comprehensive Planning Act (LGCPA) of 1975 (Section 163.3161, F.S.) to have a comprehensive management plan to assure long range plans for orderly and balanced growth for cities and counties. Prior to the LGCPA, there was minimal county regulation of activities in environmentally sensitive areas within Monroe County. Private and public lands were cleared of vegetation, dredged, filled and developed with little regard for long term impacts or planning needs. Concern for the loss of natural features, uncontrolled growth and lack of a comprehensive plan prompted the state to designate the Keys as an Area of Critical State Concern in 1975.

A comprehensive County plan was drafted in 1977 and revised in 1979. The Coastal Zone Protection and Conservation Element (CZPCE) addressed conflicts in land use and established goals, objectives and policies for resource management. Marine Resource Areas of Particular Concern (APC) include Lignumvitae Key and Coupon Bight Aquatic Preserves, John Pennekamp Coral Reef State Park and Key Largo Coral Reef National Marine Sanctuary. The CZPCE also contained management policies for generic categories (sea grasses, coral reefs and shoreline mangroves). Policies for these areas were intended to provide stringent regulations for adjacent development.

With the assistance of the Department of Community Affairs, Monroe County embarked upon a concerted effort to draft a new comprehensive plan in 1983. The new plan and map will conform to the "Principles for Guiding Development in the Keys Area of Critical State Concern", adopted by the Governor and Cabinet by resolution in July, 1984. The plan elements are nearing completion

and it is anticipated that the plan and map will be in place by March or April, 1985. The county commission recently resolved to extend a major development moratorium until the planning process is completed for the County.

A notice of a proposed rule to approve the Land Development Regulations for the City of Key West was issued September 21, 1984. This document will be proposed for adoption in January, 1985.

Key Colony Beach and Layton are currently formulating similar management plans for those areas.

Aquatic preserve personnel will become familiar with the county comprehensive plan and assist local planning staff and state agencies to identify and resolve possible conflicts or inconsistencies with aquatic preserve management objectives. Field personnel and central office staff will assist local planning officials in preparing marina elements, as required in Chapter IX-3(i) of the Keys Aquatic Preserve management plan.

2. Relation to local development codes. Present county ordinances that affect natural resources within the aquatic preserve include Chapters 4, 18 and Sections 19-101, 19-108 and 19-111 of the Monroe County Code (MCC).

> Chapter 4, also known as the Shoreline Protection Zone (SPZ) ordinance, establishes a fifty foot zone that extends laterally upland from fringing mangrove communities. Specified uses and special uses are delineated. This ordinance does not address nor protect rocky shorelines for sand/shell beaches and berms.

Chapter 18, known as the Trees and Vegetation ordinance, provides guidelines for the protection of native vegetation. This chapter may be used in conjunction with Chapter 4 to regulate the clearing of vegetation within the SPZ.

Section 19-101 regulates permitting and length of residential docks but ports are not addressed.

Section 19-108 is intended to regulate live-aboard vessels in canals and offshore waters and specifies that live-aboards berth only at those marinas with sewage pump-out facilities. This portion of the code is not currently enforced in the county.

Section 19-111 establishes criteria for county permitting for excavation and dredging/filling of tidal or submerged lands.

Other chapters of Monroe County Code specify zoning, building, subdivisions, planned unit development and major development regulations that may potentially affect the aquatic preserve management goals and objectives.

Additional or revised ordinances will be forthcoming after the adoption of the new comprehensive plan. Field personnel will become familiar with local building and zoning codes to identify those areas that may be in conflict with aquatic preserve management objectives. Field personnel and central office staff will assist local planning and zoning officials in revision of present

codes and in formulating new codes or ordinances to conform to the preserve management plans if required.

3. Suggested policies and practices in support of Aquatic Preserve Management. This section will address any other policy or practice not covered in the two preceding sections. These policies and practices might include local government mangrove ordinances; recreation problems where a local park is in or near an aquatic preserve, or any other preserve problem as it might relate to local government. The field personnel will offer assistance or information to local officials or coordinate with other agencies to help solve these problems as they occur. The field personnel will also comment, through the central office, on any local practice that is identified as endangering the well-being of the aquatic preserve.

4. Special Districts (Drainage and Mosquito Control). These districts may not have an official comprehensive management plan, but they do have management policies and program statements that are similar to such a plan. The field personnel will become familiar with these policies and the activities of these districts and will monitor their effect on the aquatic preserve. For example, the field personnel might recommend identifying areas that should not receive mosquito spraying or other alternative management because of remoteness to inhabited areas and possible, but unnecessary damage to the resources of the aquatic preserve; or drainage districts might be asked not to use certain types of herbicides or to use them only at certain times of the year.

E. Other Entities

This section will apply to the numerous entities that have an interest in the aquatic preserve but are non-governmental agencies. This will include, but not be limited to, the environmental interest groups (i.e., Audubon Society, Izaak Walton Leagure, Sierra Club), the scientific organizations, the fishing and sports interest groups (i.e., Organized Fishermen of Florida), the universities that may have research activities in the preserve (i.e., University of Miami, University of Florida,) and any other interest groups or individuals. The relationship of these entities to aquatic preserve management might include the coordination of activities, such as scientific research, environmental education, management of rookeries or other natural areas, or numerous other possible activities. A worthwhile aquatic preserve management process will depend on the continued support and help of these interest groups in all of the aquatic preserves. The field personnel will be active in communicating the aquatic preserve management process and activities to the various groups and consulting with them for their help in their areas of expertise.

Chapter VII

PUBLIC USES

This chapter addresses the public use of the aquatic preserve. The public in this case shall refer to the general public or those persons without riparian rights. The "Florida Aquatic Preserve Act of 1975" (Section 258.35, F.S.) allows for the lawful and traditional public uses of the aquatic preserve, such as sport fishing, boating and swimming (as adapted from Section 258.43(1), F.S.). These and other traditional uses that do not involve a commercial intent or the use of a riparian right to place a structure in the preserve, and do not degrade or otherwise destroy the preserve will be considered public uses. This section will be further divided into consumptive and non-consumptive uses as applicable to each resource.

A. Consumptive Uses.

Consumptive uses involve the removal of resources from the preserve. These uses include fishing, shellfishing, shell and fish collecting, and other related activities. They also include the unintentional removal of resources by propeller and anchor damage to grassbeds and corals. The management of these uses (see Chapter V. Resource Management, Section B: Onsite Management Objectives) will include the observation and monitoring

of the effects of these uses on the resources. The field personnel will periodically assess the impacts through the use of the Marine Research Laboratory's LANDSAT capabilities for identifying habitat losses or disturbances in the area plus any other studies or data sources that might become available. This management will also include the protection of the resources from unlawful or excess practice of these uses. The legality of these uses will be controlled by existing applicable state laws and local ordinances. Field personnel will, for example, become familiar with and will enforce rules adopted by the Marine Fisheries Commission. These will include regulations on fishing gear, bag and size limits, closed areas, seasons, etc.

Traditional uses will also be monitored for their effect on other resources (e.g., bird rookeries, marine grassbeds, archaeological and historical sites). The field personnel will also be sensitive to additional enforcement needs (i.e., the need for additional enforcement staff during nesting seasons).

B. Non-consumptive Uses.

These uses are those which do not generally remove resources from the preserve. Examples of these uses include swimming, diving, boating, bird-watching, and other related activities. Although boating and diving are usually considered as non-consumptive uses, they can become consumptive when boat operators carelessly place anchors in coral or seagrass beds or navigate into waters that are too shallow for their boats.

The management practices involved with these uses will be the same as those previously described under Section A, except that these uses are not generally controlled by law. The guiding principle in these cases will be whether or not the activity causes a disruption of the preserve's resources (e.g., destroys marine grassbeds, damages corals, disturbs rookeries). Some of these uses may possibly be involved in environmental educational (Chapter XI) programs.

Chapter VIII

PRIVATE NON-COMMERCIAL USES

This section will apply to those private, non-commercial, uses which are derived from riparian rights (e.g., docks, piers). The management of the aquatic preserve recognizes the rightful and traditional uses of those near-shore sovereignty lands lying adjacent to upland property. This right of ingress, egress, boating, swimming, fishing, and other incidental uses of sovereignty lands normally allows for the placement of certain structures, such as docks, within the preserve. This right, however, can only be exercised with the prior consent of the Board, and does not include approval of activities that destroy or damage areas of environmental significance. The review of these will require the interaction of the Resource Protection Area mapping with administrative and possible field review and later monitoring by field personnel as projected by Chapter V., Section B.

Private non-commercial uses shall be designed to avoid critical Resource Protection Areas (Class 1 and 2) and shall be designed to reduce the use's impact to the preserve in general. Individual applications for these private non-commercial uses shall be reviewed by the applicable Resource Protection Area Map and criteria. In addition, private dock proposals will

be reviewed by the criteria set forth in Sections 16Q-21.05 and 16Q-21.041, F.A.C. and the following criteria as to specific design and location:

a. private dock structures shall have a maximum width of 4 feet,

b. the dock decking design and construction will insure maximum light penetration, with full consideration of safety and practicality,

c. the dock will extend out from the shoreline to a maximum depth of 4 feet (mean low water),

d. when the water depth is 4 feet at an existing bulkhead the maximum dock length from the bulkhead shall be 25 feet, subject to modifications accommodating shoreline vegetation overhang,

e. 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.

f. maximum terminal platform size shall be 160 square feet, not exceeding 8 feet in width.

g. maximum dock length will be 500 feet or 20% of the subject waterbody, whichever is less.

h. dredging to obtain navigable water depths is not normally approved in conjunction with private dock applications.

i. exceptions to these guidelines may be considered, but only upon demonstration by the applicant that such exceptions are necessary to ensure reasonable riparian ingress and egress.

j. the above criteria shall be modified by local zoning requirements if found to be more restrictive.

Bulkheads should be placed, if allowed, in such a way as to be the least destructive and disruptive to the vegetation and other resource factors in each area. Approved uses which do disrupt or destroy resources on state-owned lands will require mitigation. This mitigation will include restoration by the applicant or other remedy which will compensate for the loss of the affected resource to the aquatic preserve.

Dredging within the aquatic preserve shall be held to a minimum. Dredging proposals shall be reviewed according to the procedures in Chapter V depending on the location of the proposed activities within the RPA. Proposals within Class 1 areas (Chapter V (B)[6]) will be scrutinized to the maximum extent in order to find the best practicable method of development and location if that use is acceptable in that particular area of the preserve. The mitigation of lost or disturbed resources shall be required. There shall be no dredging allowed in Class 1 or 2 areas or in nearby areas if it will adversely impact these areas.

The location of proposed multiple docking facilities, such as for condominium developments, shall be based on the marina siting criteria described in Chapter IX, because their impact is generally the same as marinas. No multiple docking facilities shall be located in Class 1 or 2 resource protection areas; provision for reasonable riparian ingress and egress shall be specifically allowable. The multiple docking facility designation will include any multiple docking facility for multiple unit developments, subdivision facilities or other non-profit operation. In evaluating

applications for such facilities, and the criteria set forth in Sections 16Q-21.03 and 16Q-21.041, F.A.C., the following criteria shall be utilized:

a. The preempted area of sovereignty submerged land shall not exceed square footage amounting to ten times the waterfront footage of the applicant, or the square footage attendant to providing a single dock in accordance with the criteria for private single family residential docks, whichever is greater;

b. Water depths adjacent to and within the facility shall insure that a minimum of one foot of clearance is provided between the deepest draft of a vessel and the bottom;

c. Dredging and/or filling in conjunction with the construction of the docking facility and access channel shall be prohibited in Class 1 or 2 Resource Protection Areas, except as allowed pursuant to Sections 258.42-44 F.S.;

d. No dock shall extend waterward more than 500 feet or 20 percent of the subject waterbody, whichever is less;

e. Main access docks and connecting or cross walks shall not exceed six feet in width;

f. Terminal platforms shall not exceed eight feet in width;

g. Finger piers shall not exceed three feet in width, and 25 feet in length;

h. Pilings may be utilized as required to provide adequate mooring capabilities.

i. The Trustees may also stipulate the number, lengths, drafts and types of vessels allowed to utilize the proposed facility.

j. Exceptions to these guidelines may be considered, but only upon demonstration by the applicant that such exceptions are necessary to ensure reasonable riparian ingress and egress.

Authorization of such facilities will be conditioned upon receipt of documentation evidencing the subordination of the riparian rights of ingress and egress for the remainder of the applicant's shoreline for the life of the proposed docking facility.

Boat ramps and travel lift platforms or other similar launching facilities, with associated temporary mooring facilities, will be encouraged over permanent wet storage facilities. Non-residential docking facilities (commercial) are addressed in Chapter IX.

The use of seaplanes within this preserve is seen as a non-traditional use. Applications for seaplane use within the preserve will be reviewed on a case by case basis. These uses will only be recommended where such use will not affect resource protection areas or natural values of the preserve, not affect endangered species habitat, can be utilized in a safe manner, and will not preempt traditional uses within the proposed use area.

CHAPTER IX

COMMERCIAL USES

This section addresses the variety of traditional and non-traditional (i.e., new uses in this area) commercial uses which might occur within the aquatic preserve. Among the traditional uses in the Florida Keys area are utility crossings, powerplants,marinas and yacht clubs, commercial fishing, and other types of boats (e.g., sport fishing, diving) for hire. Non-traditional uses in this area include: aquaculture, and seaplanes.

A. TRADITIONAL COMMERCIAL USES.

1. Utility Crossings. There are, at the present time, both aerial and underwater utility crossings in the aquatic preserve. Future proposals should be designed so the preserve is crossed by the least destructive method in the least vulnerable areas according to the RPA maps (see Chapter V[B]). Increased or additional use of existing utility crossings is preferable, if their condition at the time of the proposal is acceptable. The field personnel should eventually develop a utility crossing plan for all areas with anticipated utility crossing needs to allow advance planning,for placement of these crossings in the best environmental location possible. The utility crossing plans, when completed, will become a part of this plan. Crossings should be limited to open water areas to minimize disturbance to marine grassbeds, corals, mangroves or other critical habitat areas.

2. Commercial Fishing. The management of the aquatic preserve shall not include the direct management of commercial fishing activities. Field personnel will monitor these activities and assess their affects on the preserve only in conjunction with the Division of Marine Resources as part of a cooperative effort with that division. The field personnel will also notify the requisite authority in the event of illegal activities (Chapter 370, F. S. or by special act). For example, the State of Florida has enacted closed seasons for crawfish and stone crabs. During this time all traps are to be out of the water. Traps that are found in the water during closed season should be confiscated and sold at an auction or the owner should be notified and fined a fixed amount per trap. The State of Florida has enacted a law prohibiting the use of certain types of fishing procedures, such as fish traps. The field personnel will notify the appropriate authorities in the event these laws are broken. The field personnel, along with other agencies and the Divisions' programs and studies, will monitor fishing activities within the aquatic preserve with respect to the need to manage access of boats in certain areas, prevention of marine grassbed destruction and other needs of the aquatic preserve as they are associated with commercial fishing activities. After problems in commercial fishing are identified and documented, the findings will be presented to the Marine Fisheries Commission. It is within their authority and the Florida Legislature to regulate commercial fishing.

Issues of trap storage and reworking facilities along with commercial tropical fish collecting by chemical use need to be addressed also. The problem of trap storage and trap reworking facilities should be a main concern of the

aquatic preserve management staff. The majority of lobster and stone crab traps are made of wood dipped in oil or diesel fuel to prolong trap use. Because commercial lobstering and crabbing is important throughout the Keys and most of the dipping is done close to the water, the impact from oil and fuel contaminated runoff is great, and it affects a significant area of the preserve. The management staff should work in conjunction with other agencies present in the preserve in order to centralize and minimize the number of trap storage and reworking areas. The use of centralized commercial fishing villages or zones that are properly sited and designed will relieve many of the above problems. The use of chemicals in fish collecting is regulated under Section 370.08 F.S. There is some evidence that excessive and negligent use of chemicals has caused damage to coral and other organisms. Additional data is necessary to document the extent of this problem.

3. Marinas. The locating of marinas and their related uses will be a major concern of the Florida Keys Aquatic Preserves management. Marinas represent a use with many potential impacts on the preserve's resources. The siting policy of the Blue Ribbon Marina Committee (Final Report-January, 1983), as adopted by the Governor and Cabinet, and as modified by Sections 16Q-21.03 and 16Q-21.041, F.A.C., shall be used for siting marinas in the aquatic preserve. This policy will be that:

a. marinas shall only be located in or near well flushed, deep water areas,

b. the design of the marina should not rely on dredge or fill activities in Class 1 or 2 resource protection areas, except as allowed pursuant to Sections 258.42-44, F.S.,

c. the marina shall not be located in Class 1 or 2 resource protection areas, except for provision of required riparian ingress and egress through shoreline vegetation,

d. the site location shall also take into account the access of the boat traffic to avoid marine grassbeds in the surrounding areas,

e. the location of new facilities within the preserve shall be secondary to the expansion of existing facilities within the preserve,

f. 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.

g. new facilities shall be discouraged in any previously undisturbed location within the boundaries of the preserve and shall be allowed only in Class 3 resource areas, and then only where the local governments have a marina element and after careful review and approval by the Board,

h. marinas should be specifically sited outside state designated manatee sanctuaries and ingress and egress channels shall be posted with appropriate speed limits,

i. field personnel will work with local governments (see Chapter VI) on location of marinas close to demand areas and in areas with sufficient uplands to support activity needs, and

j. field personnel will work with local government in finding marina sites that meet the above policies and that are protected from hurricanes.

4. Deep Water Port Facilities. The only port of this type within the Florida Keys is the Port of Key West. New activities and maintenance work there will be reviewed as to their effect on the preserve. New port facilities, including terminal facilites within the preserve boundary shall be prohibited.

5. Other Docking. Any other type of commercial docking, such as associated with fish houses, fish processing plants or other commercial uses, will follow the marina siting policy as stated in Section A(3) of this Chapter. Size dimensions are highly variable due to individual use needs and will be reviewed on a case by case basis consistent with the environmental resources and the criteria outlined in Sections 16Q-21.03 and 16Q-21.041, F.A.C.

6. Power Plants. The Key West City Electric Company has two power plants located in the vicinity of the Aquatic Preserve. One is on Stock Island; the other is in Key West. Both plants have primary intakes and discharges in commercial boat basins. The potential is there for causing changes in air quality, water quality, and plant and animal life in aquatic preserve waters adjacent to these plants. For these reasons, additional power plants are incompatible with the purposes of the aquatic preserve. Field personnel will monitor water quality in areas adjacent to these power plants for impacts which might be caused by heated or contaminated effluent. Presently the City Electric system is negotiating a merger with Florida Power and Light. If this occurs, the power plants in Key West will be used for additional and emergency power while Florida Power and Light will be the main power source.

B. NON-TRADITIONAL COMMERCIAL USES

1. Aquaculture. The vast area of the Florida Keys and its relatively stable environmental parameters (temperature, salinity, etc.) could potentially be used for aquaculture development. These uses may include floating or submerged structures, impoundments, or other new techniques now being used in aquaculture. The location and type of impacts to the resources will require careful examination. If there is not sufficient data for valid evaluation, a small scale test of the use might be possible in a selected area. Aquaculture practices now being used are impoundments and above ground tanks to culture pink shrimp (Panaeus duorarum), and submerged tile sponge culture, although not on a commercial basis at this time.

2. Seaplanes. Uses of this sort, which cause high noise levels, high speed disturbances, or constant activity over a standard route or landing area will require careful placement in areas that will not disturb wildlife, affect marine grassbeds, or otherwise degrade the natural conditions of the aquatic preserve. There are approximately four seaplane bases in the Florida Keys. Seaplane activity is not seen as a common means of travel or a traditional use, therefore no new seaplane areas will be allowed in the aquatic preserve. The field personnel should be involved in the planning, time of operation scheduling, and the monitoring of these seaplane activities in conjunction with the central office staff.

3. Other Uses. Any other use that qualifies as a commercial use of state-owned submerged lands not mentioned above will require a review for its

anticipated impact on the aquatic preserve and the best location for the activity compatible to the resource protection areas within the preserve.

Chapter X

SCIENTIFIC RESEARCH

More than most aquatic preserve areas, the Florida Keys are the focus of a wide variety of scientific studies. The primary interest of the Aquatic Preserve Program is that communication be maintained with all entities carrying out research in the Keys. It will be valuable for the staff of the aquatic preserve to keep abreast of the ecological problems investigated by researchers. Further, staff should be able to direct concerns to identified knowledgeable individuals and groups as data and research needs become apparent.

One of the largest problems for aquatic preserve staff in the Keys will be identifying all organizations currently doing research in the area. As the Florida Keys environments are unique to the United States, groups from all over the country carry out work here. One of the identified needs of the program will be to make contact with as many of these groups as possible, especially out-of-state groups.

The University of Miami carries out a wide range of biological and geological projects, through The Rosenstiel School of Marine and Atmospheric Science. Much of the current knowledge concerning the Keys has come from this institution. In addition, the University has, in the past, promoted marine

education through its marine laboratory facility on Pigeon Key, below Marathon. The Florida Keys Community College, as well as other universities throughout Florida and other states, also provide much research knowledge concerning the Keys.

Groups providing non-collegiate education in the Keys are Florida Keys Marine Institute, Marine Training Program and Newfound Harbor Marine Institute, associated with Sea Camp. The last group also carries out active marine research in biology, geology and oceanography. Harbor Branch Foundation, Inc. also has a unit doing research in the Big Pine Key area.

State and federal agencies which conduct or support research in the Florida Keys include DNR's Marine Research Laboratory (Marathon), The National Oceanographic and Atmospheric Administration (NOAA), Key Largo and Looe Key National Marine Sanctuaries, The National Park Service (Everglades National Park and Fort Jefferson National Monument), and the U.S. Fish and Wildlife Service (Key Deer and Crocodile Refuges) studies on rare, threatened or endangered species.

Non-profit and private firms conducting marine related research include Sea World (Shark Institute, Long Key), Walt Disney World's EPCOT Center (currently investigating potential collecting sites in the Keys), Dolphin Research Center and Aqualife Research Corp. Sea World's Shark Institute is currently doing research in animal husbandry and supports active research from individuals, groups and universities.

The Aquatic Preserve Program will strive to encourage responsible research in the Keys, and the staff will maintain active contact with groups doing research.

CHAPTER XI

ENVIRONMENTAL EDUCATION

The aquatic preserve should be used to encourage and enhance environmental educational programs at every opportunity. The goal of maintaining the aquatic preserve for the benefit of future generations can be realized in part, through the use of aquatic preserves for environmental education. Through education, the people living in and visiting Monroe County can acquire a knowledge of the natural systems and an appreciation for the aquatic preserve program. Such appreciation helps to ensure the future protection and support of the aquatic preserve.

The field personnel will, through their normal activities in the aquatic preserve, select good examples of habitats and resources within these aquatic environments for use during educational group tours. This might include the development of environmental educational boat or canoe tours in the preserve. Other educational activities might also include prepared presentations for specific interest or user groups such as sport (boating, diving, fishing, etc.), civic and conservation groups and the development of a brochure outlining the major points of management within the preserve. These brochures could then be circulated to the various user groups.

The field personnel should also prepare programs on the value of management activities of the aquatic preserve for presentation to interested groups of all ages. Educating the public about aquatic preserve management is the key to the success and future of the preserve.

CHAPTER XII

IDENTIFIED PROGRAM NEEDS

This chapter of the management plan will address the various internal program needs that are expected to be identified as the management program evolves. Meeting these needs will correct or generally relieve some stress on the preserve or the personnel involved in the management of the aquatic preserve. These needs may, in some cases, require legislative or administrative rule changes or acquisition of critical areas by the state. The need to identify problem areas and adjust the management plan in a manner that will positively address these problems and management needs is an essential element of any good management program. Both field personnel and central office staff will continually monitor the management plan implementation process and specifically identify observed program needs and problems. The areas to be considered include, but are not limited to:

A. acquisition of additional property,
B. boundary problems,
C. legislative needs,
D. administrative rule changes,
E. data needs,
F. resource protection capabilities, and
G. funding and staffing needs.

Staff will annually develop an implementation status report that will contain a summary of identified management needs and suggested measures to be taken in meeting these needs.

A. Acquisition of Additional Property

There are areas both within and upland of the aquatic preserve that are in public ownership under the jurisdiction of various local, state and federal agencies. Many of these lands contain important resources, such as bird rookeries, archaeological or historical sites, and endangered species habitat. The protection of these areas is necessary to the wilderness preserve designation areas. Formal management agreements, memoranda of understanding, etc., that will ensure the compatible management of these areas will be developed. The Department of the Interior's U.S. Fish and Wildlife Service has continuing acquisition programs to enhance the Key Deer and Crocodile Refuges in the Lower Keys and upper Key Largo. In addition there may be other acquisitions of critical habitat for newly listed endangered species. The status of several species is presently under review in the Keys. The efforts in acquiring additional environmentally significant lands will complement the goals of the aquatic preserve. The Conservation and Recreation Lands Program (CARL) has been instrumental in the acquisition of these lands. This statewide program has been charged with identifying lands of critical concern for protection and prioritizing monies for their acquisition.

Of primary concern to the Florida Keys Aquatic Preserve are submerged lands held in private ownership. The acquisition, where feasible, under the

authority contained in Section 253.02(4), F.S. could be possible. Private agencies such as The Nature Conservancy and Trust for Public Land may be involved in land acquisition of these lands in the Keys. The acquisition of these lands might act as a buffer to critical resources, prevent development of sensitive areas, allow the restoration of areas adversely affected by previous development or allow removal of disrupting uses within the preserve.

The field personnel, during normal management activities, should be aware of significant upland areas and sovereign land conveyances which, if developed, would compromise the integrity of the aquatic preserve. The field personnel will keep a running record of these areas and will prioritize these areas for possible public acquisition. The directed efforts of other agencies and the Aquatic Preserve Program toward acquiring uplands, wetlands and marine bottom lands should complement one another in protecting the Keys' environment.

B. Boundary Problems and Systems Insufficiencies

The boundaries of the aquatic preserve are often artificial delineations of the natural systems within and surrounding the preserves. A variety of scientific studies are presently being conducted both within and outside of the preserve boundaries, and their results could conceivably suggest a change in these boundaries. These changes may include the extension of the present boundaries in some areas or the exclusion of other areas. The field personnel, in their normal management activities, will be sensitive to the possible need for boundary modifications. Potential boundary changes and

acquisition projects might include areas upstream of the present boundary in the streams flowing into the preserves, previously conveyed sovereign lands, or other areas not presently within the preserve. Any boundary change will require legislative approval.

C. Legislative Needs

Management needs could conceivably involve changes in the legislation pertaining to aquatic preserves or changes in the other statutes upon which aquatic preserve management is based. These changes may include boundary realignments or the strengthening of certain management authorities.

D. Administrative Rule Changes

Administrative rules are statements addressing the organization, procedures and practices used in the implementation of aquatic preserve management plans and policies. This process includes identifying problems within the Department of Natural Resources, as well as other agencies, that affect the management of the preserve.

E. Data (Information) Needs

Staff will identify data needs as they arise, and will be in contact with appropriate state and federal agencies as concerns from the staff and Keys citizens are identified. Staff should be responsible for promoting research

on environmental issues through public agencies and private institutions, such as major universities.

In addition, further knowledge of water quality studies currently carried out or proposed for the Keys will be most helpful in evaluating the health of the Keys area. Information regarding all impacts within the aquatic preserve is being collected and shall continue to be as a basis for environmental evaluation.

F. Resource Protection and Enforcement Capabilities

In addition to field personnel, the protection of the preserve's resources depends on the Florida Marine Patrol's enforcement authority. These protection needs might also require additional enforcement support from local government or other state agencies. The need for additional manpower, authority, equipment or vehicles for this task will be identified.

The field personnel will become familiar with the staff capabilities of both the Department of Natural Resources and the other agencies with enforcement responsibilities in the preserve. Annually, staff should fully assess the effectiveness of the protective and enforcement capabilities of these combined agencies.

G. Funding and Staffing Needs

In order for the management program proposed in this plan to function and succeed, the program must have its own funding and staffing. The workload required by this program is too much for an interim staff to handle even with limited assistance from other agencies. Funding and staffing needs are critically important to the success of the aquatic preserve program.

The management of the Florida Keys-Monroe County Aquatic Preserve will be integrated into the management programs and needs of other BELM programs in the area. A proposed staffing of the Keys would be designed around three management zones; the Upper, Middle, and Lower Keys. The proposed staff would include a preserve manager, three biologists, four rangers and a secretary. A proposed budget given these needs for the first year has been estimated at $265,306 for staff, equipment, office and expenses.

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