Vol. 1

final environmental statement

general management plan

september 1978

FES 78-35

BISCAYNE



NATIONAL MONUMENT / FLORIDA

ON MICROFILM

UNITED STATES DEPARTMENT OF THE INTERIOR

FINAL

ENVIRONMENTAL STATEMENT

for

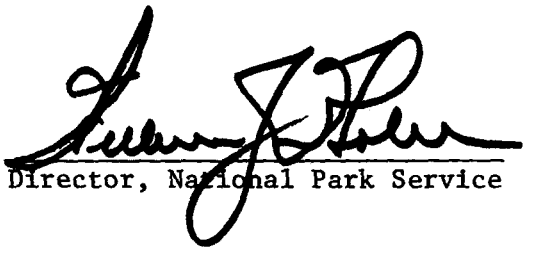
GENERAL MANAGEMENT PLAN

BISCAYNE NATIONAL MONUMENT

FLORIDA

FES 78-35

Prepared by
Denver Service Center
National Park Service



Director, National Park Service

SUMMARY

( ) Draft (X) Final Environmental Statement

United States Department of the Interior, National Park Service, Southeast Region

1. Type of action: (X) Administrative ( ) Legislative

2. Brief description of action: A General Management Plan to guide the future management and development of Biscayne National Monument proposes (1) no acquisition of land on north Key Largo for a visitor-contact site as authorized in the enabling legislation; (2) a public transportation system to increase the monument's accessibility; (3) additional visitor facilities at island development sites on Elliott and Adams Keys; (4) increased diversity of recreational and interpretive opportunities; and (5) enhanced protection of natural and cultural resources.

3. Summary of environmental impacts and adverse environmental effects:

(1) Land on Key Largo will not be acquired for development of a visitor-contact facility.

(2) Implementation of a tour-boat system will make the monument's resources accessible to non-boating visitors and will increase visitation.

(3) The new visitor facilities at Elliott and Adams Keys will improve visitor information services and overall interpretation of the monument's resources. Minor short-term environmental losses will result from the construction activities.

(4) The natural resources of the monument will be made available for public use through a variety of water-oriented recreational activities. The monument's natural values will be interpreted to ensure that the environmental features will be appreciated and respected.

(5) Protection of natural and cultural resources will ensure their preservation for the enjoyment of future generations.

4. Alternatives considered: Alternative visitor-contact sites at Wednesday Point and Steamboat Creek; a no-action alternative to island development sites; individual boat rental and no-action alternatives to a public transportation mode; alternative access and circulation routes via Wednesday Point and Steamboat Creek and a no-action alternative to establishing designated routes; a no-action interpretation alternative; and alternative resource classification considerations.

5. Comments have been requested from the following: (See following page.)

6. Date statement made available to EPA and the public:
Draft - November 2, 1977.
Final - NOV 30 1978

5. Comments have been requested from the following:

(Continued from preceding page.)

Federal Agencies

Advisory Council on Historic Preservation
Department of Agriculture
    Soil Conservation Service
Department of Commerce
    National Oceanic and Atmospheric Administration
        National Marine Fisheries Service
Department of Defense
    Department of the Air Force
    Department of the Army
        Corps of Engineers
Department of Housing and Urban Development
Department of the Interior
    Bureau of Land Management
    Bureau of Outdoor Recreation
    Fish and Wildlife Service
    Geological Survey
Department of State
    Office of Environmental Affairs
Department of Transportation
    Coast Guard
        Marine Protection Branch
    Federal Aviation Administration
Environmental Protection Agency
Water Resources Council

State Agencies

Florida Historic Preservation Officer
John Pennekamp Coral Reef State Park, Director
State of Florida
    State Clearinghouse

C O N T E N T S

I. Description of the Proposal 3
A. Preface 3
B. Legislative History and Resultant Planning Constraints and Commitments 4
C. Significant Concerns of the General Management Plan 8
1. Recreational Development and Use of Existing Areas 8
a. Elliott Key Harbor 12
b. Adams Key Complex 13
2. Interpretation 13
3. Access and Circulation Modes and Routes 14
a. Harbor and Dock Facilities 15
b. Channels for Tour-Boat Passage 16
c. Access and Circulation Routes 16
4. Management Zone Classification 16
a. Natural Zone 17
b. Historic Zone 22
c. Park Development Zone 22
5. Resource Uses 22
6. Interrelationships with Other Agencies and Projects 25
a. Other Federally Administered Areas 25
b. U.S. Department of Commerce, Coast Guard 27
c. Florida Department of Natural Resources 27
d. Dade County Parks and Recreation Department 27
e. Key Largo Coral Reef Marine Sanctuary 27
f. Florida Coastal Zone Management 28
g. U.S. Department of Defense, Department of the Air Force 28
h. Community Associations of Biscayne National Monument 29

II. Description of the Environment 33
A. Introduction 33
B. Natural Environment 37
1. Geomorphology 37
2. Coastal Processes and Shoreline Change 40
3. Climate 42
4. Hurricanes 43
5. Hydrologic Resources and Water Quality 55
6. Air Quality 60
7. Marine Ecosystems Within the Monument 62
a. Thalassia Community 62
b. Algae Community 65
c. Sand-Bottom Community 65

d. Coral Community 66
e. Intertidal Community 66
8. Marine Fauna 68
a. Marine Turtles 68
b. Octopuses 69
c. Shrimps 69
d. Spiny Lobsters 69
e. Fishes 69
9. Terrestrial Plant Communities 70
10. Terrestrial Fauna 76
a. Reptiles and Amphibians 76
b. Birds 76
c. Mammals 77
11. Endangered Species 77
a. Florida Manatee 78
b. Hawksbill, Ridley, and Leatherback Sea Turtles 79
c. Brown Pelican 79
d. Bald Eagle 79
e. American Crocodile 80
12. Plants and Animals of Economic Importance 80
a. Plants 80
b. Sponges 80
c. Alcyonarians 80
d. Corals 81
e. Mollusks 81
f. Crustaceans 81
g. Echinoderms 82
h. Fishes 82
C. Socioeconomic Environment 84
1. Regional Analysis 84
2. Visitation 87
a. Potential Visitors 90
b. Potential Visitation 92
c. Existing Recreational Use 92
3. Existing Facilities 93
a. Elliott Key Harbor 93
b. Adams Key Complex 93
c. Convoy Point 94
4. Cultural Resources 97
D. Probable Future Environment Without the Proposal 100
1. Trends in Development and Land Use 100
2. Trends in the Natural Environment 101
3. Trends in the Socioeconomic Environment 101

III. Environmental Impacts of the Proposed Action 105
A. Natural Environment 105
1. Vegetation 105
2. Water Quality 106
3. Air Quality 109

4. Noise 109
5. Soils 110
6. Wildlife 110
7. Fisheries 112
B. Socioeconomic Environment 115
1. Regional Trends 115
2. Recreational Opportunities 115
3. Visitation Trends 117
4. Visitor Experience and Aesthetic Quality of the Monument 117
C. Cultural Resources 118

IV. Mitigating Measures Included in the Proposed Action 123
A. Natural Environment 123
B. Socioeconomic Environment 124
C. Cultural Resources 124

V. Adverse Impacts That Cannot Be Avoided Should the Proposal Be Implemented 129
A. Natural Environment 129
B. Socioeconomic Environment 131
C. Cultural Resources 131

VI. The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity 135

VII. Irreversible or Irretrievable Commitments of Resources That Would Be Involved in the Proposed Action Should It Be Implemented 139

VIII. Alternatives to the Proposed Action 141
A. Alternative Visitor-Contact Sites 141
1. Wednesday Point 141
2. Steamboat Creek 152
B. No-Action Alternative to Island Development Sites 161
C. Alternative Access and Circulation Modes 164
1. Individual Boat Rental 165
2. No Action 166
D. Alternative Access and Circulation Routes 171
1. Wednesday Point 171
2. Steamboat Creek 175
3. No Action 180
E. No-Action Interpretation Alternative 182
F. Alternative Management Zone Classification Considerations 184
1. Environmental Protection Subzone 184
2. Outstanding Natural Feature Subzone 186
3. Natural Environment Subzone 187
4. Historic Zone 187

5. Development Zone 188
6. No Action 189
G. Alternative Resource Uses Considered 189

IX. Consultation and Coordination With Others 193

Appendixes 199

Bibliography 349

Study Team 354

T A B L E S

1.	Access/Circulation Routing Scheme	15
2.	Resource Uses in Biscayne National Monument	24
3.	National Park Service Holdings on Spits and Barrier Islands	26
4.	Tropical Storms and Hurricanes	48
5.	Tropical Cyclone Probability	50
6.	Record Hurricane Storm Tides	54
7.	Typical Average Analyses of Water Samples	58
8.	Air Quality Monitoring Data, Perrine, Florida	61
9.	Air Quality Monitoring Data, Homestead, Florida	61
10.	Record tree Specimens Within the Monument	76
11.	Federal Endangered Species Within the Monument	78
12.	Major Fishes of Economic Importance Within the Monument	83
13.	Population Metropolitan Dade County	85
14.	Dade County Area Population Percentage Increases	86
15.	Dade County Area Population Statistics	86
16.	Biscayne National Monument Annual Visitation	87
17.	Biscayne National Monument Monthly Visitation	89
18.	Monument Visitation and Capacity Implications	89
19.	Access/Circulation Alternative Routing Schemes	171

M A P S

Region	5
General Development	9
Management Zone Classification	19
Boundary	35
Hurricane Frequency	45
Tracks of Notable Hurricanes	47
Point of Entry for Tropical Cyclones	49
Coastal Segments for Table 5	51
Tracks of Hurricanes Causing Record Storm Surges	53
Marine Habitat	63
Vegetation Habitat (two maps)	73/75
State and Federal Outdoor Recreation Areas, Southern Florida	88
Existing Development	95
Alternative Visitor-Contact Sites	145
Easement	209

PROPOSAL

I. DESCRIPTION OF THE PROPOSAL

A. PREFACE

Biscayne National Monument is one of the largest marine preserves in the National Park System. It is situated about 25 miles (40 km) south of Miami, Florida (see Region map), and contains within its authorized boundaries approximately 103,701 acres (41,984 ha) of prime marine habitat, keys, and coral reef. Water covers more than 95 percent of the monument.

During the 1960s, there was a growing realization in south Florida that the natural setting of the Florida Keys and the surrounding marine habitat might disappear as development progressed to accommodate the expanding tourist industry as well as the increasing population of the state. The alarm of local residents over this prospect was soon supported by national concern. A proposal was made to preserve the unique biologic community of the keys and a large protected water area as a unit of the National Park System.

On October 18, 1968, Public Law 90-606 (see appendix A) authorized the establishment of Biscayne National Monument "to preserve and protect for the education, inspiration, recreation, and enjoyment of present and future generations a rare combination of terrestrial, marine, and amphibious life in a tropical setting of great natural beauty."

At the present time, this mandate remains only partially fulfilled. While the monument boundaries and interim management policies have served in large measure to preserve and protect the resource, visitor enjoyment continues to be restricted principally to the local boat-owning populace because of the lack of other use facilities. A general development plan for the monument is needed to correct this inequality in visitor use.

In addition, a definitive management framework is needed to deal with the monument's resources management problems. Certain conditions that existed prior to the establishment of the monument have continued to contribute to the deterioration of the natural and historic resources of the area. Commercial fishing, spearfishing, illegal fishing practices, tropical fish collecting, and archaeological salvage are examples of resource uses that continue to raise concern over the monument's effectiveness in preserving and protecting the area's natural resources.

Other problems are an outgrowth of the rapid expansion of the Miami metropolitan area with its attendant demands for utilities, space, and shelter, and the increasing volume of municipal sewage effluent discharged into Biscayne Bay. Particularly critical to Biscayne National Monument is the growing threat of rapid development of the shoreline along south Biscayne Bay for both residential and

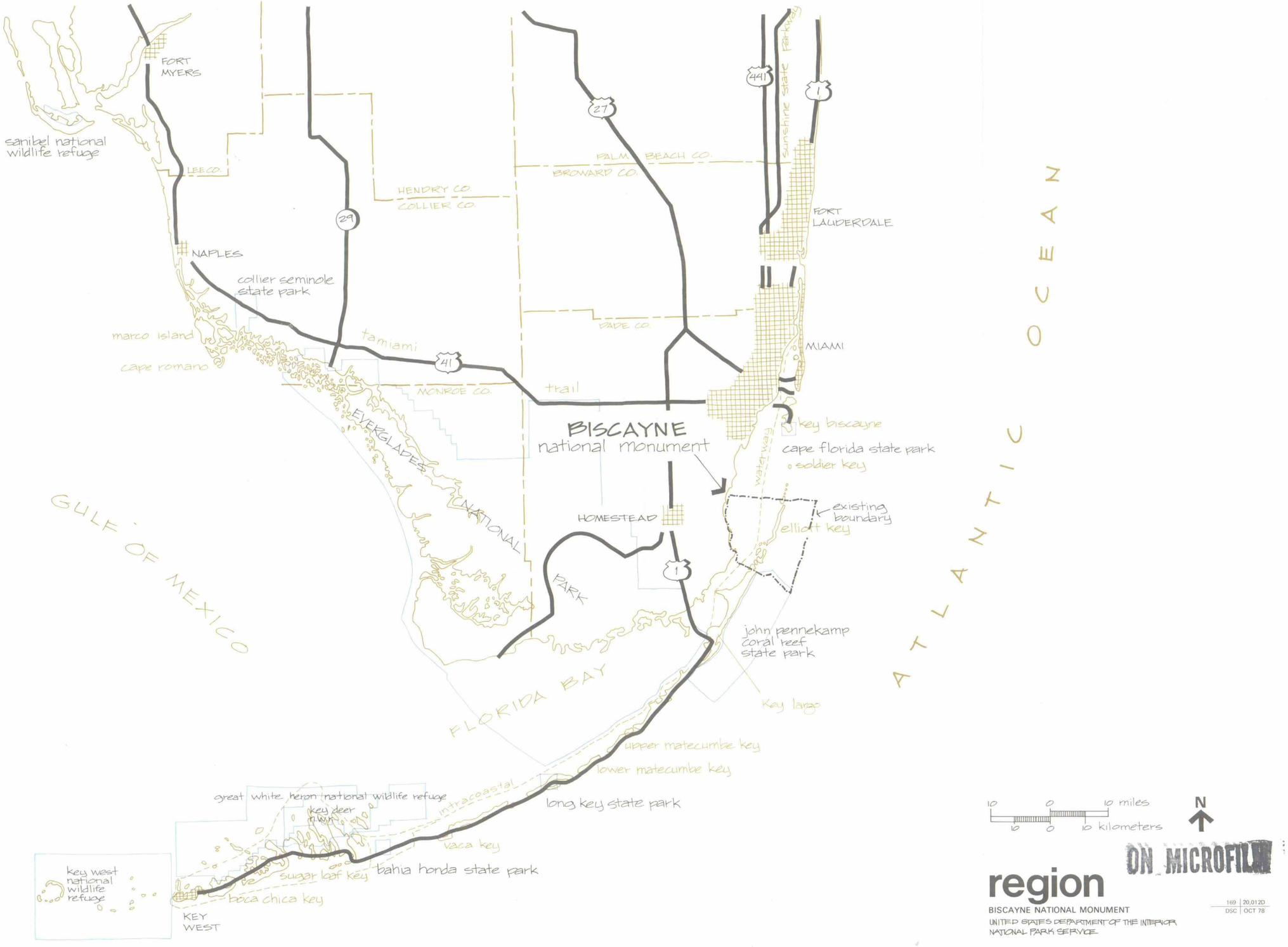
industrial purposes. For example, thermal pollution from nuclear generators at the Florida Power and Light Company's Turkey Point station along the western boundary of the monument threatened to severely damage bay-bottom communities within the monument; as a result, a massive, self-contained, channelized cooling system was constructed to maintain the integrity of the bay waters. Other threats posed to the monument from outside developments and activities include oil spills, sewage and industrial wastewater pollution, and dredge and fill operations that increase turbidity and reduce water clarity.

The National Park Service has prepared a General Management Plan for Biscayne National Monument in accordance with applicable policies and procedures to provide the framework for managing the monument. The plan and this Final Environmental Statement are intended to guide the future management, development, interpretation, and use of the resources of this unit of the National Park System. During its effective life, the plan may be revised to reflect changing conditions. Revisions entailing potentially significant environmental impacts will be evaluated in an environmental statement that will indicate the nature of those impacts and will be sent to involved governmental agencies and to the public for review and comment. Any future action plans issued to implement the provisions of the General Management Plan will likewise be subject to environmental assessment, and environmental statements will be prepared if significant impacts are identified that have not been addressed in this environmental statement.

B. LEGISLATIVE HISTORY AND RESULTANT PLANNING CONSTRAINTS AND COMMITMENTS

The monument's authorizing act (October 18, 1968) placed the following restrictions on land acquisition within the monument:

> The Secretary may . . . acquire . . . not more than eighty acres of land or interests therein on the mainland for a headquarters site, and not more than forty acres of land or interests therein on Key Largo for a visitor contact site.
>
> Lands and interests in land owned by the State of Florida or Dade County may be acquired solely by donation, and the Secretary shall not declare the Biscayne National Monument established until the State has transferred or agreed to transfer to the United States its right, title and interest in and to its lands within the boundaries of said national monument.



ON MICROFILM

region

BISCAYNE NATIONAL MONUMENT

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

169 | 20,012D
DSC | OCT 78

By resolution (May 20, 1969) the trustees of the Florida Internal Improvement Trust Fund did "reaffirm their support of the Biscayne National Monument and [did], accordingly, agree to the valuation of the said State lands [within the monument] at the sum of $1.00." In accordance with this resolution, the trustees executed an Offer to Sell Real Property stipulating that "the United States of America will acquire the State-owned lands within the designated boundary of Biscayne National Monument . . . [and] the purpose of this agreement is to formally agree to the value to be paid for said land at the sum of $1.00."

On August 6, 1969, representatives of the then "City of Islandia" filed a petition to "enjoin and restrain the [trustees of the Internal Improvement Trust Fund] from taking any further action . . . to transfer or divest itself of title to any lands owned by the State of Florida within . . . Biscayne National Monument." The state subsequently filed a motion to dismiss the complaint, but in December 1969, a circuit court judge ordered that the "motion to dismiss the complaint in this case is denied." The judge ruled "that there was no statutory authority for the Trustees to execute the contract in question."

In June 1970, a bill was passed by the Florida State Legislature to amend state laws to authorize the trustees to convey lands to the United States for the establishment of Biscayne National Monument and the right of the federal government to immediate possession of state-owned lands within the monument. The bill became state law July 1, 1970.

On November 25, 1975, a final judgment from the U.S. District Court transferred the state's interest in the submerged lands lying within the original 95,064-acre boundary of the monument to the United States. The fastlands within the original boundary were transferred at an earlier date. The portion of these submerged lands that extends eastwardly beyond the 3-mile limit to the 60-foot-depth curve line (10-fathom line) is still under the administrative and jurisdictional control of the Bureau of Land Management (BLM). Presently there are no BLM-issued oil drilling leases or permits for activities that might affect the environmental quality of these submerged lands. Similarly, the National Park Service has no plans for permits or leases of these lands for development or other detrimental activities, but intends to preserve the area in its natural state. Application is being made to the Secretary of the Interior for administrative transfer of the BLM-managed area to the National Park Service.

Legislation restricts revision of the monument's boundaries and states that "no boundary shall be revised outward or in such a manner as to obstruct any seaport channel which may be hereafter constructed outside the boundaries" (16 U.S.C. 450). There is also a restriction on the government not to expend more than $24,575,000

for land acquisition and $2,900,000 for development of the monument (16 U.S.C. 450-4). The land acquisition limit was increased to $28,350,000 by 10 U.S.C. 450-4; the same legislation adjusted the original boundary southward to incorporate Swan and Gold Keys, adding approximately 8,738 acres of land and water to the monument.

Because commercial and sport fishing are established and traditional uses of the monument's water resources, the authorizing act states that fishing in monument waters shall continue in conformity with Florida state laws. However, the Secretary of the Interior may prohibit, limit, or otherwise regulate species that may be caught, methods that may be used, and areas and times within which fishing is permitted in the interest of sound conservation or in order to achieve the purposes for which the national monument was established (16 U.S.C. 450-3). Commercial fishing will not be expanded beyond the level at the time of the monument's authorization.

The state of Florida reserved to itself or to Dade County six 150-foot-wide navigation channels in Biscayne Bay's submerged lands (appendix B). Of these six channels, the Turkey Point Barge Channel is the only one currently in operation.

C. SIGNIFICANT CONCERNS OF THE GENERAL MANAGEMENT PLAN

The General Management Plan provides for the use of the monument through a variety of visitor-oriented programs rather than through the development of a large number of physical facilities. Preliminary identification of the most significant issues of the management plan is prerequisite to understanding the plan and its environmental statement. These issues are summarized below to direct readers to the principal concerns of the plan.

1. Recreational Development and Use of Existing Areas

The Park Service will develop and maintain facilities for those types of public recreation that are compatible with continued preservation of the relatively unspoiled natural features of the monument. To attain this goal, the several natural resources of this barrier island complex will be made available to the public for limited use and enjoyment, and the islands' natural values will be interpreted in order to ensure that the environmental features and values the Park Service seeks to preserve will be appreciated and respected.

The recreational uses that the Park Service proposes will provide alternative experiences to the automobile-accessible state and county beach activities near Biscayne. Homestead Bayfront County Park and John Pennekamp Coral Reef State Park are designed to accommodate large crowds of daytime visitors. The fact that Biscayne's resources can only be reached by boat will encourage



	EXISTING	PROPOSED
1	administrative headquarters visitor information / orientation maintenance and storage boat dock parking employee residences	
2	boat harbor visitor-contact pavilion picnicking swimming (unprotected) employee residences concession services camping	interpretive trail maintenance area
3	boat dock employee residences	interpretive facility interpretive trail interpretive tower picnicking research station

- development zone
- tour-boat access / circulation route
- existing monument boundary
- existing state park boundary

miles
kilometers
N

general development

BISCAYNE NATIONAL MONUMENT
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

169 | 40,011B
DSC | JULY 78

ON MICROFILM

visitation by people seeking a change from the more accessible neighboring community or beach parks. Visitors willing to make the extra effort to reach developments within the monument will be rewarded by a unique recreational experience available throughout the year.

The Park Service recognizes its responsibility to make the resources of Biscayne National Monument available to a broader section of the public. Priority will therefore be placed on day-use areas rather than on marina development for additional large craft accommodation. The existing mainland administrative headquarters and visitor-contact site at Convoy Point will provide orientation and tour-boat access to the development sites.

While the Park Service accepts its responsibility to make the resources of the monument available to the public, it has never been its intention to construct buildings or develop the areas it administers to the maximum extent necessary to meet peak visitation demands. Rather, temporary congestion or occasional use of "overflow" areas is considered preferable to adversely impacting natural settings with facilities or developments that will rarely be used to capacity. Based on this premise, the monument will be developed over a period of years (as funding becomes available and as public demand increases) to adequately satisfy visitor needs in a manner that is sensitive to the natural resources. (See "Description of the Environment," C.?., for current and projected visitation data.)

The legislation establishing Biscayne National Monument provided for the development of a visitor-contact site on Key Largo not to exceed 40 acres in size, the purpose being to provide additional administrative facilities, a visitor-contact and orientation station, and facilities for boat embarkation to the monument and its resources. However, the National Park Service has determined that this acquisition is no longer feasible for the following reasons:

Development would require removal and filling of native mangrove vegetation, dredging operations for marina and channel construction, and other environmental damage.

Boat access to the monument, necessarily using the Intracoastal Waterway, would offer no advantage in terms of distance or navigational protection from inclement weather afforded by the island shoreline.

Major access from the south would be inconsistent with the pristine natural marine environment of the southern portion of the monument.

A site on Key Largo might duplicate services already offered to the visiting public at nearby John Pennekamp Coral Reef State Park.

The longer overland travel time required to reach a site at this location would necessitate additional energy expenditure.

The administrative headquarters site at Convoy Point can accommodate the present visitor loading. The site is large enough for expansion of facilities should visitation increase appreciably in the future, therefore negating the need for a separate visitor-contact site.

As a result of these findings, the land on Key Largo will not be acquired for the development of a visitor-contact site.

All development proposed in the General Management Plan will take place at previously developed areas on Elliott and Adams Keys. These island development sites will provide visitors with points of entry into the terrestrial portions of the monument. A visitor-contact pavilion will provide interpretation, information, and orientation about day-use activities and camping facilities for visitors interested in remaining on the islands overnight. From a debarkation site, visitors will be encouraged to filter out into other developed and undeveloped portions of the islands via hiking, nature, and interpretive trails.

a. Elliott Key Harbor. Development at Elliott Key Harbor will require the commitment of approximately 13 to 15 acres of land, portions of which have been previously disturbed. Elliott Key is approximately 2,022 acres in size. In addition to the services already provided (see section on existing conditions for Elliott Key), development will include a new concessions pavilion to replace the present concessions trailer, a comfort pavilion to replace the existing public restrooms, four housing units for employees, and necessary utilities. An approximate 8-mile nature/hiking/interpretive trail will supplement and provide access to Adams Key with its natural and cultural points of interest. Drinking water and sewage treatment facilities at Elliott Key will be capable of handling the maximum projected visitor loading and will comply with all applicable Environmental Protection Agency (EPA), state, and local regulations. Potable water for public consumption will be supplied by a well with a 160-gallon per minute (gpm) flow and a reverse-osmosis desalinization system.

The sewage treatment and disposal system on Elliott Key will employ a septic tank system followed by an above grade intermittent sand filter. The septic tanks will be provided with a wet well to receive effluent, which will then be pumped alternately to two sand filter beds. The filter will occupy an area

approximately 50 feet square. All necessary permits from the Army Corps of Engineers will be acquired prior to development implementation.

b. Adams Key Complex. The Adams Key site will be a prime interpretive center for the monument. Docking facilities to accommodate tour-boat craft and a maximum of 8 private craft will be provided. The existing wood-framed ''Casino'' will be utilized as an interpretive/concession facility. An interpretive tower will be built and will serve several purposes: orientation (visitors will be able to observe the entire monument); interpretation (the mosaic of differently colored bottom communities is visible only when vertical height is achieved); and safety (an immediate survey can be made of almost all boats in the monument from such a device).

An 800-1,200 square foot research station will be constructed. This field research station will provide facilities to monitor and inventory park resources as an aid to management, evaluate potential adverse encroachment, and provide interpretive support. Research topics include research on commercial and sport fishery harvest within the monument, juvenile spiny lobster dynamics in the bay, the impact of visitors on coral reefs, and the monitoring of water quality in the bay. Analysis of fish population dynamics on the reef tract, identification and evaluation of terrestrial organisms on the keys, and the establishment of a control benthic community area to gather baseline data in order to monitor long-term changes in water quality are some of the objectives of future research projects to be undertaken.

A ½-mile interpretive trail will be located on the north end of Adams Key and will join with the south end of the trail on Elliott Key to provide direct exposure to various natural communities: tidal creeks, tropical hammocks, and associated bird and marine life. In conjunction with this trail, a crossing such as a pontoon bridge or boardwalk will be constructed over the shallow waterway that separates Adams and Elliott Keys, allowing visitors an interpretive experience and free access between the keys.

All necessary permits from the Army Corps of Engineers will be acquired prior to development implementation.

2. Interpretation

The basic goals of interpretation in Biscayne National Monument are to provide knowledge of the monument's natural resources; to foster a basic understanding of the bay, key, and reef ecosystems and the environmental interrelationships that sustain them; to create an awareness of the fragile network of life vulnerable to disruption if any component is changed; to convey potential environmental threats and their impacts (for example, incompatible uses in life-

supporting estuaries along the coast, sewage and industrial waste from nearby populated areas, exploitation by commercial interests); to illustrate man's relationship to this tenuously balanced system by examining historical uses of the area and suggesting reasons for success or failure; and finally, to build a responsible attitude in the visiting public that a natural balance be maintained and thus ensure support for environmental management of the monument.

The diverse, relatively undisturbed natural systems of Biscayne National Monument offer an opportunity to develop a principal interpretive theme of environmental awareness, with a strong secondary emphasis on cultural resources. Recreational activities are an acknowledged major attraction of the monument. Therefore, interpretive programs will be designed and coordinated with recreational use, thus fostering deeper visitor involvement with the resources.

Information and orientation to the monument's resources and interpretive activities will occur at Convoy Point before visitors embark for island destinations. The Elliott Key development site, the traditional recreational focus for local boaters, will remain oriented to recreational pursuits and will also provide interpretation in the form of a brief overview of the ecological system. The Adams Key development site will be the main interpretive hub and will convey the natural and human history stories in depth.

3. Access and Circulation Modes and Routes

Biscayne National Monument is approximately 13 miles in length and 12 miles in width, and the islands within the monument are about 7 miles from the mainland. Thus all access to the resources of Biscayne National Monument is, by necessity, over water. The mainland administrative headquarters and visitor-contact facility at Convoy Point, accessible from U.S. 1 and North Canal Drive, will provide the public with a limited tour-boat transportation service into the monument. While the majority of visitors may continue to use their own boats, there will be a demand by non-boat-owning visitors to use the tour-boat mode. The tour boat will be Park Service owned or leased with a user fee and will offer controlled-capacity access to the monument's resources. It will operate primarily to the developed sites on Elliott and Adams Keys.

A transportation study to devise or select a transportation system that will provide an extension of the recreational experience while affording efficient access for non-boat-owning visitors to Biscayne National Monument is currently underway. The study will include, as appropriate, the analysis and evaluation of a tour-boat service with its associated boat capacities, craft types and schedules, and preliminary comparative cost estimates based

on visitor demands and resource capacities and limitations. All of the requirements will depend upon the number of passengers to be transported and the distance to be traversed. Thus, neither the General Management Plan nor the Final Environmental Statement will analyze the access and circulation mode or routes in detail.

A future interpretive shuttle service to expose visitors to other aspects of the aquatic environment in the monument (i.e., the offshore reef area) is considered in the General Management Plan. If such a service is combined with the tour-boat system, craft design criteria, costs, and scheduling will have to be evaluated, and anchorage buoys will be provided to preclude damage to the reefs.

a. Harbor and Dock Facilities. The harbor requirements for the mainland and island development sites will vary according to distances and times required to commute between them (see table 1). A short round-trip travel time requires fewer boats to transport visitors, and therefore less harbor space.

Table 1

ACCESS/CIRCULATION ROUTING SCHEME

Routing Scheme		Distance	Travel Time
(From) Mainland Visitor-Contact Site	(To) Island Development Sites	(Nautical Miles)	Round Trip (Minutes)
Convoy Point	Elliott Key and Return	15.5	62
	Adams Key and Return	14.0	56
	Elliott Key, Adams Key, and Return	18.4	73

Assuming that a vessel with a capacity of 30 to 50 passengers is used, and assuming the hours of operation are at times of less than peak traffic demands, the docking space required will be approximately 100 linear feet. This requirement is based on the assumption that some boats will be stored at the

island terminals and some at the loading and maintenance docks at the mainland administrative headquarters and visitor-contact site at Convoy Point.

b. Channels for Tour-Boat Passage. Water access routes to the keys are defined and regulated by existing water depths. Tour-boat craft will be designed for these existing water depths and channel widths. Boat design will be used to preclude the necessity of dredging operations.

c. Access and Circulation Routes. The purpose of a proposed general routing scheme is to identify a physical corridor that tour boats will need to follow in order to adequately distribute visitors throughout the keys as well as provide an efficient and environmentally sensitive transportation system between the embarkation site at Convoy Point and the island development site terminals.

The location of the mainland headquarters site with respect to the island development sites (see General Development map) is extremely important to a public transportation system because the overwater distance and travel time between these points will determine the number of boats needed to transport visitors and the total hours of operation required for a tour-boat system. The travel time to and from the mainland for the individual boat owner will be similarly affected.

The travel time between sites will also be affected by the speed at which the boats travel. In computing trip distances (table 1), routes were based upon the shortest navigable, environmentally sensitive distances between the points to be serviced. Trip times were based on an average operating speed of 25 miles per hour in open water and 6 to 10 miles per hour in the shallow natural channels (USDI, NPS 1974b).

The longest route distance is 18.4 nautical miles for a round trip between Convoy Point and Elliott and Adams Keys. Transportation will be concentrated entirely within southern Biscayne Bay, utilizing existing natural channels. Average channel depths here range from 2½ to 8 feet. The Intracoastal Waterway will be transected twice with each round trip from the mainland to the islands. All activity will be entirely within monument waters.

4. Management Zone Classification

A generalized system of management zone classification for all National Park Service areas was developed in 1978 (see appendix H) in order to provide for consistent management throughout the National Park System.

In general, four major zones are recognized - natural, historic, park development, and special use. Where sufficient diversity of resources exists within one of these major zones, special subzones may be designated to indicate in greater detail what specific management is to be adopted.

The dominant theme of Biscayne National Monument, as indicated by the tone and content of the enabling legislation, is the preservation of the natural systems of the inner bay, the keys, and the offshore reef tract. However, the legislation also indicated that public recreation and resource use (fishing) would be acceptable activities within the monument to the extent that such activities do not substantially alter the continued functioning and health of the natural systems. In addition, the area contains substantial cultural resources in the form of a multitude of 18th- to 20th-century shipwrecks and aboriginal culture sites. Basic resource surveys conducted subsequent to monument legislation have identified certain habitats (e.g., Jones Lagoon and the Arsenicker Keys) and endangered species circumstances (e.g., nesting bald eagles) that require special land use constraints. Therefore, the actual form and extent of management zoning proposed for Biscayne National Monument has taken into account this variety of natural resource conservation, recreation, and historic preservation goals.

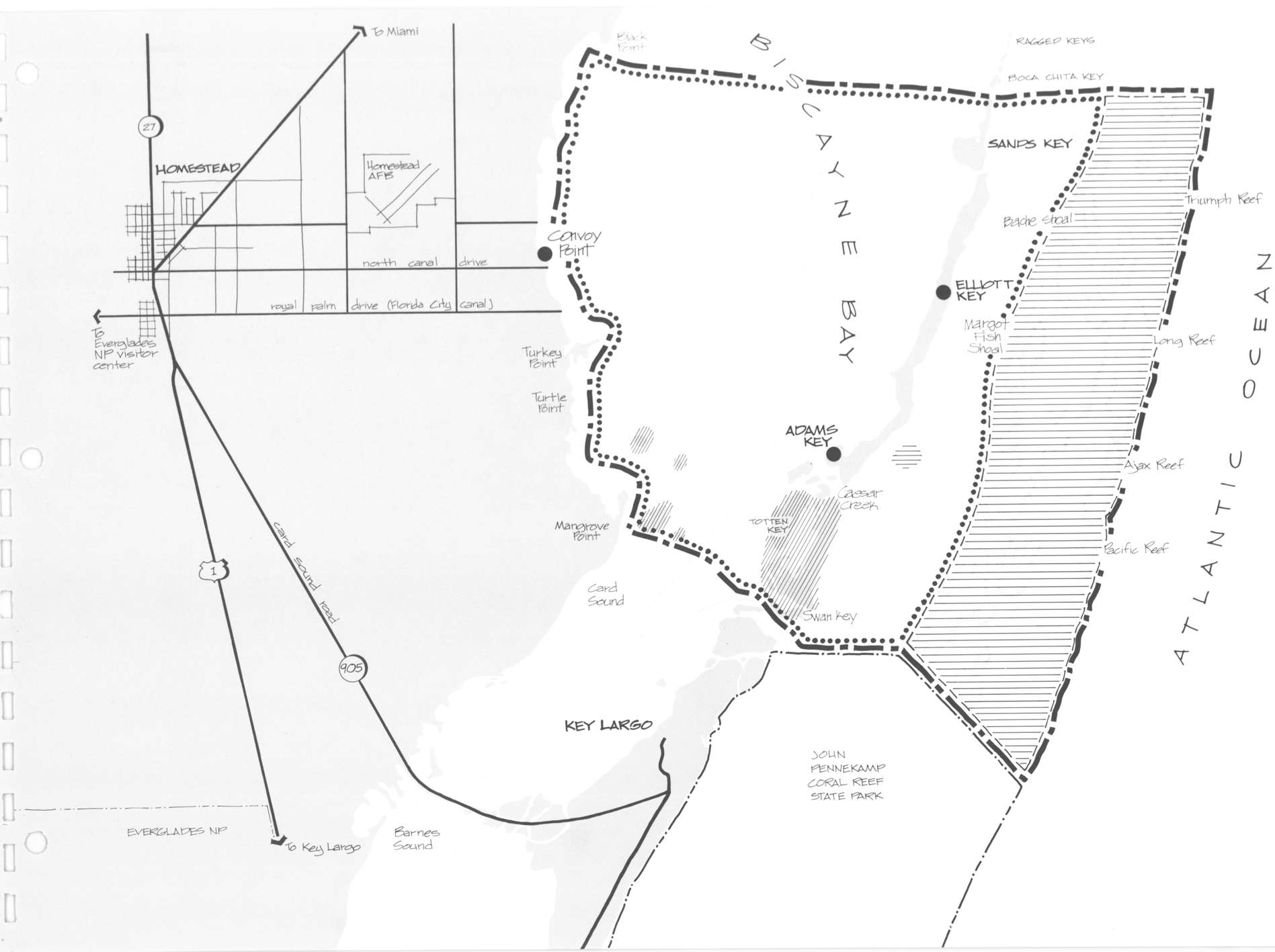
The proposed classification scheme satisfies the above constraints. The various zone types were analyzed individually, along with associated impacts of subsequent management, and this final classification system was constructed from the different zone possibilities.

The Management Zone Classification map illustrates the proposed classification scheme for the fastland and waters within the existing monument boundary.

a. Natural Zone. Consistent with the dominant theme of natural area preservation stated in the enabling legislation, virtually all of the monument is proposed for classification within the several subzones of the broad natural zone category.

(1) Environmental Protection Subzone. All of the Arsenicker Keys, Totten Key, Old Rhodes Key, Jones Lagoon, and the keys south of the lagoon to the boundary of the monument are proposed for this subzone.

For the Arsenicker Keys, this classification is in recognition of the importance of this area as nesting and feeding habitat for the endangered bald eagle, as well as nesting or roosting habitat for a variety of seabirds including the endangered brown pelican. The Totten-Rhodes complex is proposed



natural environment subzone

outstanding natural feature subzone

environmental protection subzone

historic zone

park development zone

existing monument boundary

existing state park boundary

0 1 miles

0 1 kilometers

N

management zone classification

ON MICROFILM

BISCAYNE NATIONAL MONUMENT
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

169 | 40,014
DSC | JULY 78

in this classification in recognition of the substantial importance of these areas in the long-term study and preservation of prime examples of little disturbed vegetation patterns, associations, and specimen trees. Jones Lagoon is singled out for its uniqueness in illustrating a pristine shallow, fully saline lagoon habitat, and because its fragile benthic ecosystem cannot tolerate uncontrolled visitation.

Specific management regulations governing research and public use in the environmental protection subzone will be formulated in later documents (e.g., the resources management plan).

It is also anticipated that the future resources management plan will analyze and propose several additional environmental protection subzones to serve as research/control units. These would be reserved principally for the purpose of long-term analysis of the impact of visitor or commercial resource uses. Neither the extent nor the precise location of these additional units can be stated at present because these decisions must be based on future resource studies. These units would require reclassification from either of the other natural subzones proposed below.

(2) Outstanding Natural Feature Subzone. The entire offshore reef tract within monument boundaries is proposed as an outstanding natural feature subzone because of the geological and biological significance of the reef and its contribution to the recreational attractiveness of the monument.

Certain urgently needed regulations concerning visitor use in this subzone are discussed under "Resource Uses" on the following page. However, as with other subzones, further analysis of specific management policy needs will be made in a future resources management plan.

The fact that most of the historic shipwrecks lie on the outer reef tract has led to a concurrent classification of this same area as a historic zone.

(3) Natural Environment Subzone. The bulk of the remaining monument fastland and water is proposed as a natural environment subzone. This includes all other submerged lands in the bay and Hawk Channel, as well as Sands, Elliott, and Adams Keys and several smaller keys immediately south of Adams Key.

This classification is proposed because within this area there are no presently known outstanding, unique, or critical habitats. However, the areas so classified are unquestionably of high natural value and are to be managed in such a way that

public use is environmentally compatible with preservation of that high value.

b. Historic Zone. The entire offshore reef area, and one small area in Hawk Channel, are proposed for classification as a historic zone. This classification is a direct consequence of the nomination of the reef tract as a historic district to the National Register of Historic Places. The Hawk Channel site has also been nominated to the National Register.

Protection of historic resources within this zone of the monument presents certain management problems unique in the National Park System. Many of the specific wreck sites are reasonably well known to the public and are therefore potentially subject to either vandalism or unauthorized salvage efforts. The National Park Service is obligated to provide the maximum degree of protection to sites listed on the National Register. Specific regulations designed to limit or prevent visitation of wreck sites would be one option if disturbance of the sites becomes a problem. However, since the wreck sites are in areas of prime recreational (diving and fishing) interest, prohibition of visitor use of these areas would preclude legitimate recreational uses. The dual cultural and natural resource value of the reef tract area has been recognized, and for this reason a concurrent classification of outstanding natural feature subzone is proposed.

c. Park Development Zone. Three discrete park development zone areas are proposed: Convoy Point, central Elliott Key, and a part of Adams Key. Each of these areas currently supports some physical developments that existed prior to establishment of the monument; no currently undeveloped areas are proposed for development zone classification. The actual extent of the zone at the three proposed units cannot be specified at this time, pending specific site development planning. However, it is not anticipated that an area much in excess of the currently developed areas would be required in any instance. The conceptual nature of proposed development at these units has been described in other sections.

5. Resource Uses

A careful reading of the enabling legislation and departmental testimony make it clear that the intent of Congress was to continue to allow both commercial and sport fishing within the monument in conformity with Florida state laws. Such continuance was, however, made subject to regulation and management by the Secretary of the Interior "in the interest of sound conservation or in order to achieve the purposes for which the national monument is established" (P.L. 90-606 Sec. 4). In addition to fishing activities, other resource uses including boating and diving have been considered permissible due to the recreational mandate for the monument.

Table 2 summarizes the resource uses that have been permitted in the monument prior to the publication of any special regulations. The exact nature of such future special regulations cannot be specified in the current General Management Plan. A forthcoming resources management plan will address the possible need for modification of federal or Florida laws that are currently applied in the monument. Until that time, the information in table 2 and the following discussion constitute the resource use policy of the monument. A comprehensive discussion of the various resource uses summarized in the table is contained in appendix J.

As indicated in the table, most commercial and sport fishing activities are governed by Florida law. Certain activities that have come under more stringent control upon establishment of the monument due to federal jurisdiction and/or general management policies of the National Park Service are designated by an asterisk in the table and are clarified and discussed below.

The private or commercial taking of juvenile or adult fish of any species for aquarium use (''tropicals''), by any capture means, is currently prohibited in monument waters. Authority for this proposed regulation is derived from 36 CFR Section 2.20 and from general policies of the National Park Service.

Commercial or private taking or harassment of any species of sea turtle or its eggs is prohibited in the monument due to the status or pending status of all sea turtles as endangered species. Further, specific provisions of recent Florida state law have extended protection to all sea turtles in waters or on beaches within Florida's jurisdiction.

Coral collection for private or commercial use, by any means, is now prohibited within the monument. This restriction applies to all living or dead hard corals and soft corals (gorgonians), whether attached or not. Such prohibition is consistent with general National Park Service policies prohibiting the taking of natural objects from park areas, and with recent Florida legislation prohibiting coral collection in state waters.

Since the establishment of the monument, spearfishing has been allowed because it has been considered to be a permissible activity under general state of Florida regulations. However, this situation is an anomaly because spearfishing is not allowed in John Pennekamp Coral Reef State Park immediately to the south. Recognizing that certain resource uses, such as spearfishing, would pose potential conflicts with other uses, the enabling act included a provision directing the Secretary of the Interior to institute management regulations that would provide for conservation of the full range of monument values. To this end, it is anticipated that some restrictions on spearfishing will be proposed in the subsequent resources management plan. In particular, consideration will be given to the designation

Table 2

RESOURCE USES IN BISCAYNE NATIONAL MONUMENT

Resource-Use Activity	Current Status and Regulation
Commercial fishing	
hook and line finfishing	virtually none; Florida laws
baitfishing, by net	common in bay; Florida laws
stone crab, by traps	extensive in bay; Florida laws
blue crab, by traps	extensive in bay; no license required
spiny lobster, by traps	extensive on reef; Florida laws
sponges, by hooking	extensive in bay and off keys; Florida laws
pink conch, by diving	occasional in bay; Florida laws
*aquarium fish collection	prohibited under federal regulation
*turtle fishing	prohibited by Florida and U.S. laws
shell collection	prohibited under federal regulation
*coral collection	prohibited under federal regulation and Florida laws
Sport fishing	
hook and line finfishing	extensive in bay, offshore; Florida laws
*spearfishing	common offshore; Florida laws
blue crab, by traps	occasional in bay; Florida laws
spiny lobster, by diving	common offshore and near keys; Florida laws
*aquarium fish collection	prohibited under federal regulation
Boating	
motorboating (fishing, diving, or pleasure)	extensive throughout; Florida and U.S. laws
water-skiing	common in bay; Florida and U.S. laws
sailing (pleasure)	common near keys; Florida and U.S. laws
Diving	
skin diving (snorkeling)	near keys and reefs; permitted under federal regulation
scuba diving	offshore keys; permitted under federal regulation
Shoreline and lagoon	
exploring	occasional near keys, lagoons; permitted under federal regulation

*See discussion.

of certain zones where spearfishing would be allowed under circumstances where effective supervision could be exercised, and where minimum interference would occur with nonconsumptive activities such as observation and photography.

6. Interrelationships With Other Agencies and Projects

a. Other Federally Administered Areas. The barrier islands of the eastern United States provide a topographic continuum for observing the ecological transition from the cold temperate climate of northern New England to the subtropical climate of Florida and the Gulf of Mexico. As one of the longest chains of major barrier islands in the world, this dynamic system is of global importance.

About 21 percent of the total barrier-island mileage of the United States is managed by the federal government. Over 400 miles of the barrier-island system are administered by the National Park Service in nine national seashores and monuments (see table 3), the largest of which is 80-mile-long Padre Island National Seashore in Texas. Most other federal lands on barrier islands are managed as wildlife refuges by the U.S. Fish and Wildlife Service.

Table 3

NATIONAL PARK SERVICE HOLDINGS ON SPITS AND BARRIER ISLANDS OF THE EAST AND GULF COASTS OF THE UNITED STATES
(listed in order of approximate oceanfront shoreline mileage)

Area	State	Approximate Oceanfront Shoreline Miles	Gross Acreage as of June 30, 1976
Padre Island National Seashore	Texas	80	133,918
Gulf Islands National Seashore	Florida/ Mississippi	75	142,009
Cape Hatteras National Seashore	North Carolina	70	30,326
Assateague Island National Seashore	Maryland/ Virginia	33	39,630
Cape Cod National Seashore[1]	Massachusetts	31	44,600
Fire Island National Seashore	New York	26	19,356
Canaveral National Seashore	Florida	20	57,627
Cumberland Island National Seashore	Georgia	20	36,876
Biscayne National Monument	Florida	12	103,701

[1] Cape Cod National Seashore contains glacial deposits that provide material for many barrier islands and spits. Total oceanfront shoreline including non-barrier landforms equals about 52 miles.

Federal barrier-island holdings are scattered rather uniformly from Massachusetts to Texas. If these islands were managed as a continuous and dynamic ecological system under provisions of an ecologically compatible management program, perpetuation of the ecological diversity of the system would be virtually assured. If, on the other hand, different management programs were adopted on different islands (for instance, some stabilized to protect development, others allowed to evolve totally in response to natural forces of change), the continuity of the entire system - and therefore much of its value - would be jeopardized. All federal barrier-island lands, as well as other preserved tracts in the chain under non-federal ownership, are therefore affected by management programs adopted at Biscayne National Monument, just as Biscayne is affected by the ways other seashores and monuments are managed.

b. U.S. Department of Commerce, Coast Guard. Licensing of tour boats, inspection of marina facilities, patrolling, and search and rescue operations by the Coast Guard will continue within the monument in Biscayne Bay and seaward of the keys. Direct communication with the National Park Service will continue to be of major importance.

c. Florida Department of Natural Resources. As defined in Public Law 92-583, the state of Florida must, in cooperation with federal and local governmental entities, develop an effective management program for the use of the lands and waters of the coastal zone. National Park Service management decisions and resulting actions at Biscayne National Monument affect the coastal zones adjacent to the monument. Thus, the monument staff will cooperate with the state of Florida in developing an appropriate general management plan for those coastal-zone areas that will be affected by actions taken at Biscayne.

d. Dade County Parks and Recreation Department. Dade County operates a high-density recreation and boat-launching facility at Homestead Bayfront County Park immediately south of Convoy Point on North Canal. The Homestead Bayfront boat-launching hoist is heavily used by the boat-owning public to gain access to the monument and surrounding waters. An undeveloped tract composed of filled and mangrove-covered land owned by Dade County is situated on the western periphery of the Convoy Point administrative headquarters site. Although park improvement is planned at Homestead Bayfront Park, the undeveloped tract of land to the west is expected to remain in its present status.

e. Key Largo Coral Reef Marine Sanctuary. Pursuant to Title III of the Marine Protection, Research, and Sanctuaries Act of 1972, a recreational and scenic area encompassing corals and associated flora and fauna was established in December 1975

(see State and Federal Outdoor Recreation Areas map in the "Description of the Environment" section). The area is managed to protect and conserve the coral and coral reef ecosystems, to regulate uses thereof to the health and well being of the coral and associated flora and fauna, and to make available the continual opportunity for the aesthetic and recreational enjoyment that healthy reefs afford the American people. The area is adjacent to but excludes the John Pennekamp Coral Reef State Park, beginning at the 3-mile territorial limit and extending seaward to the 300-foot isobath. Included in the area is the Key Largo Coral Reef Preserve.

The Florida Department of Natural Resources' Division of Recreation and Parks administers the marine sanctuary pursuant to an agreement between the governor of Florida and the administrator of the National Oceanic and Atmospheric Administration. This office is assisted in administration by an advisory board consisting of representatives of the National Park Service, the U.S. Coast Guard, the Department of Justice, the National Marine Fisheries Service, and the Florida Division of Marine Resources' Division of Marine Law Enforcement and Department of Environmental Regulation. Pursuant to 14 U.S.C. Section 89, the U.S. Coast Guard has the responsibility for surveillance and enforcement of the rules and regulations promulgated for the marine sanctuary.

The National Oceanic and Atmospheric Administration has responsibility under this legislation to require that the office of Coastal Zone Management review, comment, and approve any activity that takes place pursuant to the adopted rules and regulations.

f. Florida Coastal Zone Management. The Bureau of Coastal Zone Management of the Department of Natural Resources, created pursuant to the National Coastal Zone Management Act of 1972, has the responsibility of developing a comprehensive plan for the development, protection, and rational management of Florida's coastal area while providing coordination of federal, state, and regional planning and management activities in the coastal zone. In an attempt to minimize the gap between information generators and information users, the Florida Regional Coastal Zone Management Atlas has been prepared by the bureau and will be released in the future. The atlas identifies areas worthy of consideration by all concerns involved in planning, management, and utilization of Florida's coastal resource. All National Park Service planning and management will be sensitive to the criteria set forth in the atlas in an effort to recognize the long-term importance of maintaining the integrity of the coastal zone.

g. U.S. Department of Defense, Department of the Air Force. Homestead Air Force Base, a permanent facility considered critical to the national defense, is located approximately 6 miles

due east of Homestead and 27 miles southwest of Miami. The eastern boundary of the base is approximately 4 miles from Convoy Point. The mission of the base is to provide operations and maintenance facilities for several components of the Air Force, including a fighter interceptor detachment, a tactical fighter wing, three tactical fighter squadrons, an Army logistic support group, and miscellaneous Navy, Air Force, and Army units. As a result, its principal assigned aircraft include F-106, C-121, and the high performance F-4.

It is Air Force policy to promote good relationships between air installations and neighboring concerns and planning processes by means of compatible land use planning.

h. Community Associations of Biscayne National Monument. The Biscayne National Monument managers and staff frequently communicate with members of community associations in attempts to integrate community needs and National Park Service objectives for protection and perpetuation of the natural marine system. Regulations imposed by the national monument management have a direct influence on the lives of community residents and regular monument users. Thus, continued cooperation and consultation between the monument staff and groups representing Biscayne communities will increase the effectiveness of regulatory measures and will ensure that park management takes into account the legitimate concerns of the communities and the impacts of National Park Service plans upon them.

ENVIRONMENT

II. DESCRIPTION OF THE ENVIRONMENT

A. INTRODUCTION (Voss 1969)

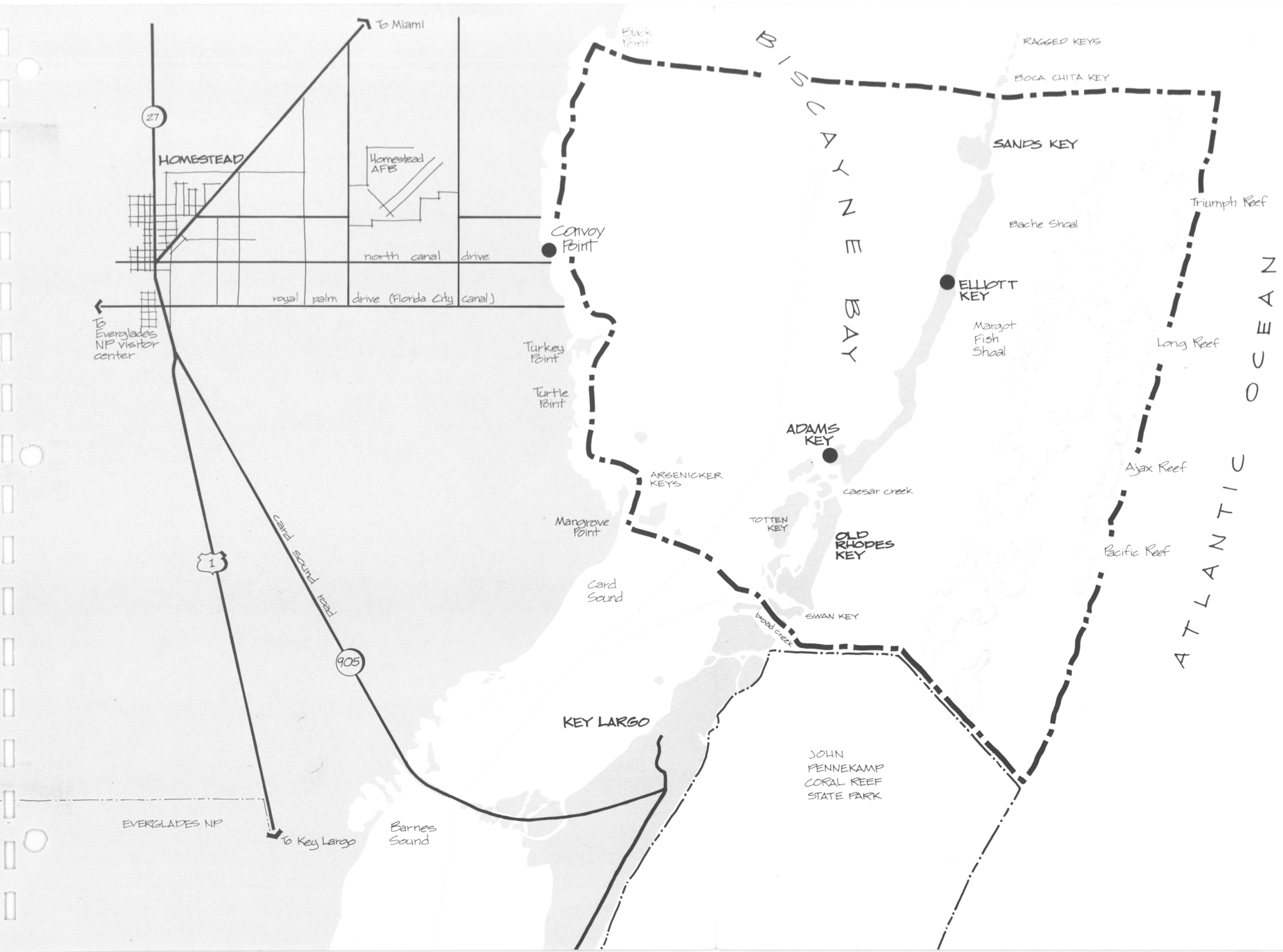
Biscayne National Monument (see Boundary map) is situated in the southern portion of Dade County, Florida, and consists of the waters of the south end of Biscayne Bay, the extreme north portion of Card Sound, and the eastern bordering line of the Florida Keys and the waters of the Hawk Channel and associated reefs seaward to the 10-fathom curve. The monument, shown on Coast and Geodetic Survey Chart No. 1249, extends from north to south between latitude 25°31'N and 24°17.5'N. The total area is 103,701 acres, 99,398 acres of which are submerged.

The land areas contained within the monument consist of about 29 islands or keys. The larger keys are, in the order of their size, Elliott Key, Old Rhodes Key, Sands Key, Totten Key, Long Arsenicker Key, Swan Key, and Adams Key; these keys range in size from about 2,022 to 77 acres. The smaller keys are West Arsenicker and Arsenicker on the west side of the bay, and the Rubicon, Meigs, Reid, and Porgy Keys in the inner entrance to Caesar Creek; other smaller keys are not named on the chart. The total land area is approximately 4,303 acres.

The waters of Biscayne Bay are very shallow, averaging about 8 to 10 feet (2.4 to 3 m) in the deeper middle portion, and shoaling to shallow banks on each side with an average depth of 3 to 6 feet (1 to 2 m) at mean low water. Bayside access into the monument from the north is by the narrow dredged channel through Featherbed Bank; access from the south is by a similar channel through Cutter Bank; access from the seaside is through natural channels such as Caesar Creek between Adams and Totten Keys.

Passage into the open waters of Hawk Channel for small craft with drafts of less than 2½ feet may be had through Lewis Cut between Boca Chita and Sands Keys and through Sands Cut between Sands and Elliott Keys. At low water, both passes are difficult to navigate because of coral rock outcrops and shoals. Passage for vessels drawing 3 to 5 feet (0.9 to 1.5 m) may be had through Caesar Creek, which has a controlling depth of about 4 to 6 feet (1.2 to 1.8 m). Larger craft can also pass through Broad Creek between Broad Key and Swan Key, but the depth at both ends is only about 4 to 5 feet (1.2 to 1.5 m) at mean low water.

To the east of the keys, the bottom shelves gradually slope seaward to the navigable waters of Hawk Channel with an average depth of approximately 15 to 18 feet (4.6 to 5.5 m), while the open waters of Hawk Channel itself have an average depth of about 20 to 30 feet (6.1 to 9.1 m). East of Hawk Channel, the main features are numerous large patch reefs and associated banks



existing development zone
existing monument boundary
existing state park boundary

miles
kilometers

N

boundary

ON MICROFILM

BISCAYNE NATIONAL MONUMENT
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

169 | 20016C
DSC| OCT 76

designated (from north to south) Bowles Bank, Bache Shoal, and Margot Fish Shoal.

The outer boundaries of the monument are essentially defined by the edge of the continental shelf with its line of associated outer coral reefs. These consist of coral rubble, live coral, and sand. Triumph Reef, the long and narrow Long Reef, the live coral Ajax Reef, and Pacific Reef are more or less discrete reef complexes that lie just within the monument's eastern boundary. Just north of Triumph Reef is the main entrance to Legare Anchorage, important as a safe harbor during sailing days.

Seaward of the reef line lies the Florida Current, which is a portion of the Gulf Stream system lying between Florida and the Bahamas and extending northward to Cape Hatteras, where it joins with the Antilles Current to form the Gulf Stream.

B. NATURAL ENVIRONMENT

1. Geomorphology

The most obvious geological feature of the monument is the outcropping of Key Largo coral limestone that forms the foundation beneath much of the region. For an understanding of these underlying rocks and their origin, a brief general survey of the geology of the Florida Keys is necessary.

The Florida Keys form a crescent chain of small limestone islands extending from near Miami on the north to Key West on the south and west, a total of about 150 miles (240 km). They are bounded on the convex side of the crescent by the Florida Current and on the concave side by Biscayne Bay, Florida Bay, and adjoining waters. Basically they consist of two main formations of Pleistocene age - the Key Largo limestone and the Miami limestone. The former is an elevated coral reef rock and the latter an oolitic limestone. The Key Largo limestone is the surface rock of the upper keys, and the Miami limestone covers the lower keys. Actually, the Key Largo limestone covers the entire length of the Florida Keys, but in the lower keys it is overlain by the Miami limestone beginning near the east end of Big Pine Key.

The Key Largo limestone first appears at the surface near its northern boundary at Soldier Key just north of the Ragged Keys and forms the basis of the main keys contained within Biscayne National Monument. It is especially conspicuous as eroded ragged rock along the Old Rhodes Channel. It also forms the hard, smooth floor of several of the passes where the tidal current keeps sediments scoured away.

According to drillings investigated by Hoffmeister and Multer (1968), this limestone rests upon a quartzose calcareous sand base. The limestone is of varying thickness; near the northern end of Key Largo it is 145 feet (44 m) thick; 10 miles (16 km) further south, 75 feet (60 m). It is typical organic reef composed of wave-resistant elements, the most important of which are hermatypic corals. These form the framework of the structure and are responsible for the trapping of large amounts of calcaranite in which they are now embedded. The formation is composed of (in order of decreasing abundance) calcaranite, coralline limestone, and calcilutite:

> Calcaranite. This rock consists of varying amounts of molluscan debris, calcareous fragments of the algae Halimeda, coralline algae, foraminifera, bryozoans, and coral and rock fragments bonded by microcrystalline and sparry calcite. Minor constituents include pellets, echinoid spines, sponge spicules, ooliths, and worm tubes.
>
> Coralline limestone. Large masses of coral, recrystallized to calcite, occur either in growth position or as detached fragments. The principal corals are Montastrea annularis, Diploria strigosa, D. labyrinthiformis, and several species of Porites (principally P. asteroides). This limestone can be porous or dense, commonly with burrows of boring mollusks, the cavities often lined with drusy calcite or filled with varying amounts of sand-size debris. About 30 percent of the Key Largo limestone is made up of this coral rock of which Montastrea makes up about half. Acropora cervicornis, Montastrea cavernosa, and Siderastrea radians are also found in lesser amounts. All of these corals are found living today within the monument boundaries.
>
> Calcilutite. This dense rock made up of well-cemented silt-clay carbonate commonly displays pinpoint- to finger-size holes. Limited amounts of skeletal hash are often present.

Where exposed, the coral rock has a thin cap of very hard rock overlaying it, formed either by aerial exposure or microbial activity. It is extensively quarried for use in decorative walls, floors, and patios in south Florida. Below the hard cap, the material is soft, and well-drilling points pierce it easily. Upon lengthy exposure it becomes very hard and durable. Quarries are found throughout the keys.

The method of formation of the Florida Keys themselves has been a matter of controversy. Some scientists claim that the present keys represent the limits of a former outer coral reef of Pleistocene times; others claim that they were formed from lagoon patch reefs in the back reef area when the outer reef was located some distance inshore of its present position. Studies by Hoffmeister and Multer (1968) point to the latter hypothesis:

> During the last interglacial period, about 95,000 years ago, the coral reefs which today make up the Key Largo Limestone of the Florida Keys were flourishing as a line of patch reefs in the back-reef area of a broad-reef platform similar to the Florida reef tract of today. Seaward of them the platform was occupied by parallel lines of other patch reefs and edged by an outer reef.
>
> Subsequent marine and subaerial erosion following the withdrawal of the sea during the Wisconsin, possibly accompanied by a structural downward tilting or faulting of the area, or both, resulted in the lowering of the platform to a depth of about 75 feet (23 m) at its seaward edge and progressively less farther inland. With the return of the sea, new reef growth began on the eroded platform and continued to the present.
>
> Some of the main observations upon which it is concluded that the Key Largo Limestone of the Keys originated as a line of patch reef in a back-reef environment are the following. (1) The species of corals and other organisms found fossil in the old reef are identical with those of the living patch reefs. (2) There is an absence of Acropora palmata, a coral species found commonly in the clear turbulent waters of living outer reefs. (3) There is a favorable proportion of other species common in all zones. (4) Since the community of coral species found in the Key Largo requires an environment of low-level energy and since it was determined that the water in which the corals grew was shallow, it becomes clear that they must have developed in the protected area of a back-reef zone. (5) The discovery of Acropora palmata in the Key Largo Limestone, underlying the more recent material of the outer reef, demonstrates its presence at the time the Keys were being formed and indicates that its absence in the rocks of the Keys is due to the unfavorable environment of a back reef. Its presence also indicates the existence of an outer reef at the edge of the platform during Key Largo time. (6) The elongated crescentic shape of the Keys, running

approximately parallel to the outer edge of the platform, is similar to the alignment of present day patch reefs.

The soil overlying the Key Largo limestone is of organic origin, originally from materials trapped in the outcroppings but now mainly muck or humus from the hardwood hammocks and mangrove peat.

Offshore, the ocean bottom is underlain by Key Largo limestone with a layer of post-Pleistocene Key Largo limestone overlying the older rock and increasing in thickness seaward. Upon this is a layer of calcium carbonate sediments. The outer reef base is the post-Pleistocene Key Largo limestone formation overgrown in large areas by stands of living coral. The reef area is thickly interspersed with patch reefs such as those forming Bache Shoal, Margot Fish Shoal, and the reefs behind Long Reef.

Shoreward of the keys, the bottom is formed of Key Largo limestone overlain by soft calcium carbonate mud or ooze. In the western areas of Biscayne Bay, Key Largo limestone interfaces with the coastal oolitic formations of the mainland.

2. Coastal Processes and Shoreline Change

Coastal processes, erosional forces, and vegetation involved in shoreline dynamics have been considered in many scientific and popular publications describing areas in the United States and other parts of the world. However, this useful information cannot be applied in its entirety to south Florida because of physical and environmental differences of the land.

The southern tip of Florida is a warm, semitropical area where land formations and geologic history are based on coral reef growth and oolitic limestone development under recent rise and fall of warm, shallow seas. The landscape is extremely flat, overland water flow slow, and typical coastal deposition of river sediments nonexistent. Land areas within Biscayne National Monument consist of a string of islands forming part of the Florida Keys. The greater part of the keys project only 2 to 4 feet (0.6 to 1.2 m) above high tide. The highest known points lie 9 to 10 feet (2.8 to 3.1 m) above sea level.

The southernmost of the sedimentary barrier islands upon which some of Florida's famous beaches are found lie north of the monument. Currents along the shore carrying sediments from the north (typical littoral drift of northern regions) encounter the Key Largo limestone formation emerging in the area east of Miami. Upon reaching this submerged barrier, current velocity is lost and sediment loads are dropped. Therefore, sand beaches along the keys to the south are few and of limited extent. Those

that do occur are found chiefly on the Atlantic side and consist of sand created locally from broken shell fragments, crushed coral, and calcareous algae.

Mangroves line the edges of many of the keys and thus give the impression that the land is much larger in area than it really is. Intertidal flats bordering the islands are shallow-water areas, barely covered at low tide, which gradually slope into deeper water. The keys are afforded much protection from the forces of the open sea by an offshore, outer reef tract and a series of several inner patch reefs. The major erosional force working on the exposed shoreline of the keys is one of slowly dissolving limestone bedrock. This material is either dissolved or transported in suspension to areas of quiet waters, such as Biscayne Bay, where it settles out as unconsolidated sedimentary material or precipitates out as a lime mud.

The single most important concern in perpetuating the coastal processes along the subtropical islands of the bay is preservation of the island mangrove fringes. Mangroves are important shoreline stabilizers and/or land builders (Carlton 1974, Metropolitan Dade County Commission 1974, and Florida Department of Natural Resources 1972). The tree species constituting the mangrove flora of Florida are the red mangrove (Rhizophora mangle), black mangrove (Avicennia nitida), and white mangrove (Laguncularia racemosa). The unique features of mangroves, especially the prop roots of the red mangrove and the pneumatophores of the black, and their ability to grow in salt water have enabled them to play a major role as a geologic agent.

Mangroves also play an important role in the detritus-nutrient cycle through leaf litter (Heald 1971). Amphipods and crabs are important feeders on mangrove litter and are responsible for breaking large pieces into smaller ones. Bacteria and fungi as well as an array of invertebrates, fish, birds, and other higher animals utilize detrital material directly or indirectly.

The mangrove community, below mean high water, contributes approximately 3.9 tons (3,541 kg) of litter per acre per year to the nutrient cycle (Metropolitan Dade County Commission 1974). As mangrove litter is converted to detritus, there are soluble organic and inorganic materials produced that may be used directly by microorganisms or be absorbed on particles. In addition, the bits of plant material are eaten by herbivores or serve as substrates for the growth of bacteria, fungi, yeasts, and other organisms. These organisms form the basis of a close-knit food chain. Actions that would disrupt mangrove communities would eliminate the detrital nutrient source at the rate indicated as well as expose coastal limestone bedrock to the erosional forces of seawater and wave action.

In considering development and management actions that could ultimately affect adjacent mangrove communities, an analysis of growth requirements and mangrove ecology is necessary. Red and black mangroves, which comprise over 85 percent of the outer mangrove community, grow prolifically in the intertidal zone from mean low water to slightly above the mean high water lines, wherever enough soft substrate is available to allow establishment. Like all terrestrial plants, mangroves require a supply of mineral nutrients and other elements in their growth. The lack of developed soils on most upland areas adjacent to mangrove communities in Biscayne Bay indicates that the majority of the required nutrients are obtained from tidal waters, debris washed ashore, and reabsorption of nutrients dissolved from decaying leaf litter (Metropolitan Dade County Commission 1974). This theory is supported by the growth pattern observed for mangroves bordering Biscayne Bay.

Therefore, upland developments immediately adjacent to mangrove communities that would alter the nutrients entering the mangrove area would not be expected to greatly affect shoreline processes. However, actions altering volume or direction of overland water flow, currents, and tidal flow or actions directly removing or destroying the mangrove trees themselves would result in substantial impacts to the shoreline and associated marine organisms.

3. Climate

Biscayne National Monument generally experiences subtropical climatic conditions, partially due to the southerly latitude of the area and partially due to the Florida Current, which flows along the eastern margin of the park. The latter exerts a warming influence on the monument area through the prevailing easterly winds warmed by the current and occasional meandering current waters coming over the reef and into inshore areas.

Rainfall varies throughout the year: May through October is the "rainy season," and November through April is the "dry season." The rainy season has a double peak in precipitation, the first reaching a maximum in the month of June, with rainfall dropping somewhat during July and August and reaching a second, higher peak in September. Summer thundershowers form over the Florida Current and move inshore during the hottest part of the day; they usually last only an hour or two but may dump more than an inch of rain at a time. Because of this, rainfall may vary markedly between two relatively close points within the bay.

September is the wettest month with a normal rainfall of 7.36 inches (18.7 cm), but the record of 18.87 inches (47.9 cm) was collected in June 1968. February generally records the least amount of precipitation and holds the minimum record of 0.01 inch (0.02 cm) in 1944. The average yearly rainfall for

the area is 46.26 inches (117.5 cm), but this figure varies greatly between wet and dry years.

The mean annual temperature for the area is 76.2°F (24.6°C), while the mean maximum and minimum are 80.9°F (27.2°C) and 71.4°F (21.9°C). August is the hottest month, with maximum and minimum normals of 86°F (29.9°C) and 77.3°F (25.2°C), and January is the coolest with extreme normals of 74.2°F (23.4°C) and 63.9°F (17.7°C). August 1958 recorded the hottest monthly average of 98°F (36.7°C), and December 1957 experienced the record low average of 35°F (1.7°C). Extreme temperatures are somewhat moderated by prevailing easterly breezes, which act to cool this coastal area during the summer and warm it with the influence of the Florida Current in the winter. Frequent early afternoon thundershowers during the summer also help to cool afternoon temperatures.

The winter and early spring months have the longest number of clear, sunny days. As summer approaches, cloudiness increases, with the percentage of partly cloudy skies reaching a maximum in September and October. Most clouds are formed over the straits of Florida and are carried westward over the monument area by predominant easterly and southeasterly breezes. Although the prevailing winds are from the east, a slight north-south shift in wind direction occurs between the winter and summer months. Wind velocity is generally equal in intensity from all directions throughout the year. April is the windiest month with the highest winds averaging between 10 and 15 miles per hour. Winds decrease during the summer months with July and August wind speeds averaging 5 miles per hour. July also has the largest percentage of calm days.

4. Hurricanes (Gleason 1974)

September and October are the major hurricane months in southeastern Florida. South Florida is particularly vulnerable to hurricanes because it is exposed to the Atlantic on the east, the Caribbean on the south, and the Gulf of Mexico on the west. South Florida coasts are subjected to hurricanes more often than any other equal-sized area of the United States, and coastal areas such as south Dade County are especially sensitive because the point of hurricane entry from the ocean is generally the area of greatest damage (see Hurricane Frequency and Tracks of All Notable Hurricanes maps and table 4). Hurricanes or tropical storms have struck southern Florida 50 of the past 100 years. The winds and the storm surge of hurricanes do great damage to property, trees, and other plants, and the coastline as well as take human lives. The rains associated with hurricanes may bring either much needed water or unwelcome floods, depending on the circumstances.

FORT MYERS
sanibel national wildlife refuge
LEE CO.
HENDRY CO.
COLLIER CO.
29
NAPLES
collier seminole state park
marco island
cape romano
tamiami
41
trail
MONROE CO.
EVERGLADES
NATIONAL
PARK
GULF OF MEXICO
FLORIDA BAY
27
PALM BEACH CO.
BROWARD CO.
441
1
sunshine state parkway
FORT LAUDERDALE
DADE CO.
MIAMI
BISCAYNE
national monument
key biscayne
cape florida state park
soldier key
waterway
1 1 1 1
2
3 HOMESTEAD
6
existing boundary
elliott key
1
john pennekamp coral reef state park
Key largo
upper matecumbe key
lower matecumbe key
long key state park
great white heron national wildlife refuge
key deer nwr
intracoastal
vaca key
bahia honda state park
sugar loaf key
boca chica key
KEY WEST
key west national wildlife refuge
ATLANTIC OCEAN

Note: The figure in each of the segments is the number of hurricanes since 1886 whose paths were in that segment.

Source: U.S. Department of the Interior, Geological Survey, 1973

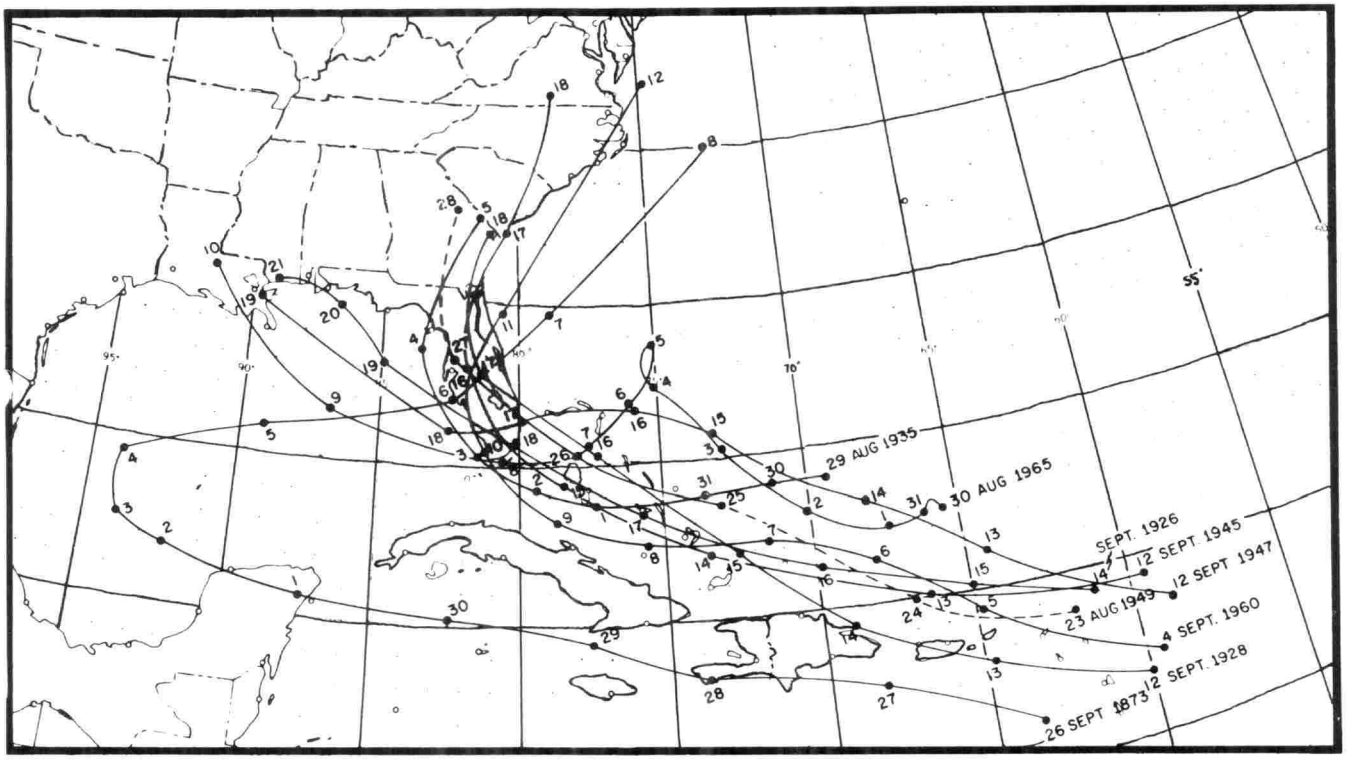
10 0 10 miles
10 0 10 kilometers
N

hurricane frequency

BISCAYNE NATIONAL MONUMENT
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

160 | 40,004C
DSC | OCT 78

ON MICROFILM



TRACKS OF ALL NOTABLE HURRICANES THAT HAVE AFFECTED SOUTH FLORIDA SINCE 1873

Source: *Environments of South Florida: Past and Present,* edited by Patrick J. Gleason, Miami Geological Society, 1974

Table 4

TROPICAL STORMS AND HURRICANES IN AND NEAR SOUTH DADE COUNTY AND BISCAYNE NATIONAL MONUMENT

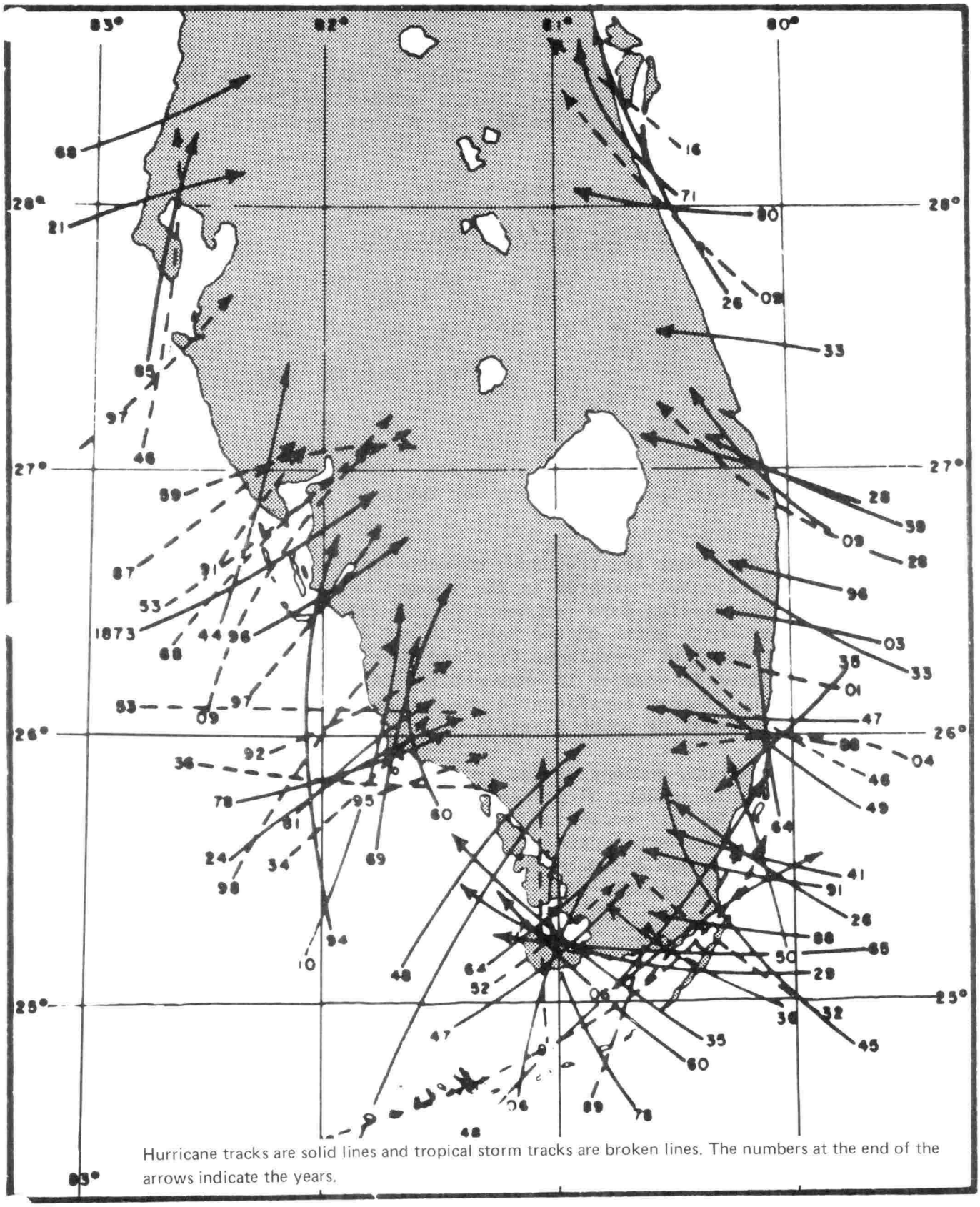
	Tropical Storm	Hurricane	Great Hurricane
Wind velocity	38-74 mph	74-125 mph	over 125 mph
Number since 1886	14	13	4
Average return interval	6 yrs	7 yrs	22 yrs
Potential damage from one hurricane		$1-30 million	over $300 million

Source: U.S. Department of the Interior, Geological Survey, 1973

A hurricane is a tropical cyclone having winds 74 miles (119 km) per hour or higher. These storms occur in the Atlantic Ocean, Caribbean Sea, and the Gulf of Mexico primarily in summer and fall. They are essentially identical with the typhoons of the western Pacific and other tropical cyclones that appear in various oceans of the world. They originate over warm waters (usually in the tropics) and have low-pressure centers with counterclockwise wind circulation (in the northern hemisphere) around these centers. A tropical cyclone with winds less than 74 miles per hour but with closed circulation and maximum winds greater than 38 miles (61 km) per hour is called a tropical storm. Weaker circulations of the tropics are referred to as "tropical depressions" or "tropical disturbances."

While only about 100 years of records on hurricanes are available, it is probable that they have significantly affected the ecology of southern Florida since this part of the continent was formed. (See Point of Entry for Tropical Cyclones map.)

Using the frequency of occurrence of tropical cyclones (hurricanes and tropical storms), it is possible to calculate the probability of one affecting any portion of the United States coastline. Simpson and Lawrence (U.S. Department of Commerce 1971) have used the hurricane frequency data for the period 1886 through 1970 to calculate the tropical cyclone probabilities for approximate 50-mile (80-km) segments of the coast from Texas around Florida through Maine. The segments for which they made calculations in south Florida are indicated by the dots and numbers



Hurricane tracks are solid lines and tropical storm tracks are broken lines. The numbers at the end of the arrows indicate the years.

POINT OF ENTRY FOR TROPICAL CYCLONES STRIKING SOUTH FLORIDA 1871-1973

Source: *Environments of South Florida: Past and Present,* edited by Patrick J. Gleason, Miami Geological Society, 1974

in the figure Coastal Segments for Table 5. Table 5 gives the annual probability (percentage) that a tropical cyclone, hurricane, or great hurricane will strike in each of these segments.

Table 5

TROPICAL CYCLONE PROBABILITY

Coastal Sector*	23	24	25	26	27	28	29
Tropical Storms (%)	12	21	19	18	16	20	20
Hurricanes (%)	5	9	13	13	12	16	15
Great Hurricanes (%)	1	2	4	2	5	7	7

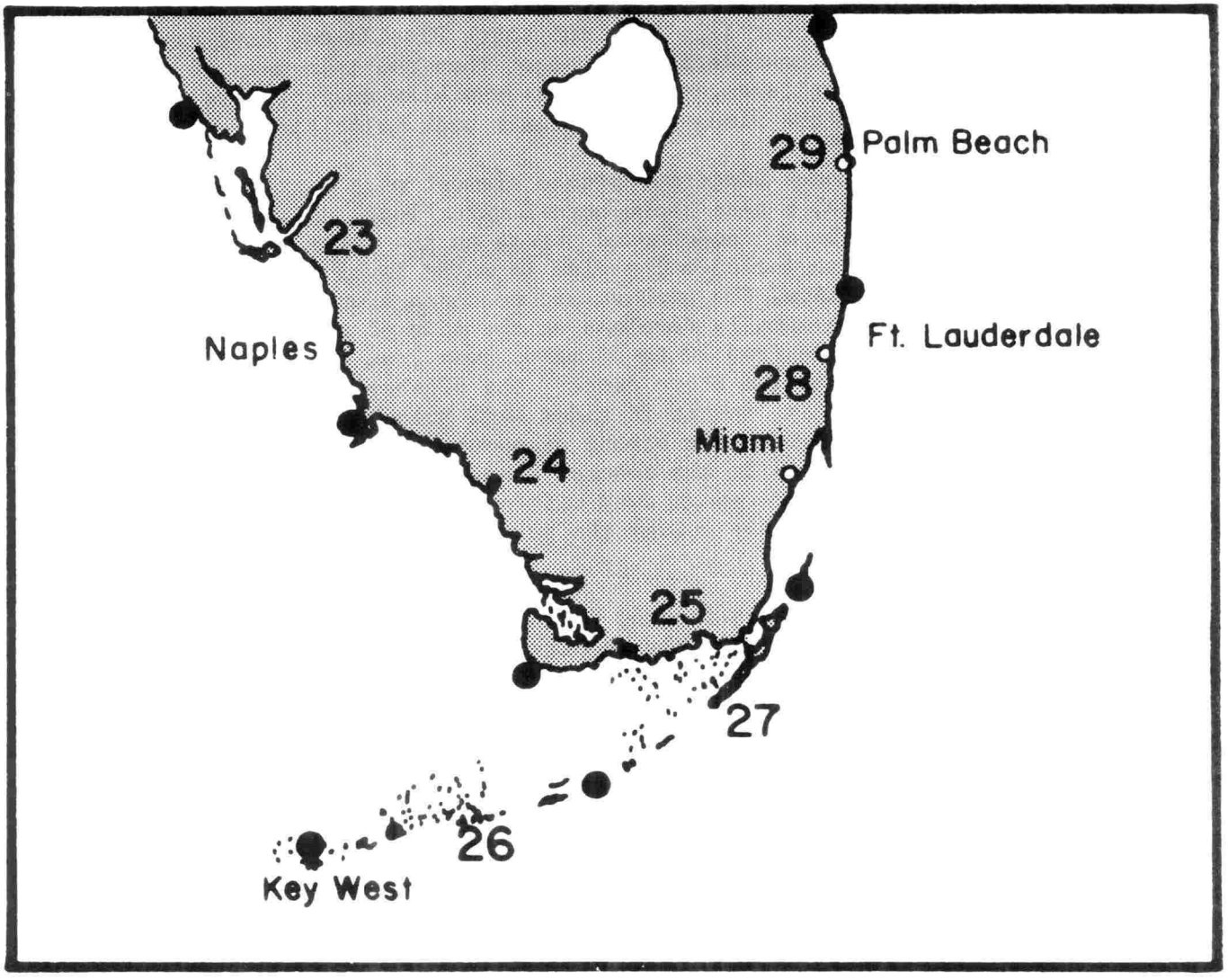
*Refer to figure Coastal Segments for Table 5.

Note that the frequency of occurrence of all tropical cyclones is slightly greater in the segment between Everglades City and the Florida Keys (segments 24 and 25) and in the segments on the east coast north of the keys (28 and 29), than on the west coast north of Everglades City and over the keys. The frequency for hurricanes is greater in segments 25, 26, 28, and 29, and for great hurricanes considerably greater on the east coast than on the west coast of south Florida.

Sixteen percent of the tropical cyclones that affect Florida come in August, 31 percent in September, and 31 percent in October. The rest occur in June, July, and November. Storms in August and September come primarily from the Atlantic. Most of the early-season and October storms come from the south, forming in the western Caribbean Sea, the Gulf of Mexico, or the straits of Florida.

Four major forces contribute to the damage caused by hurricanes: the winds, the storm surge, the waves, and the rains.

The intensity of a hurricane is frequently characterized by the strength of the maximum winds observed in the storm. By definition, a tropical cyclone is not called a hurricane until the maximum wind is at least 74 miles (119 km) per hour. There have been hurricanes with winds up to 198 miles (320 km) per hour. The force exerted by the wind goes up with the square of the wind speed. That is, a 93 mile (150 km) per hour wind exerts



COASTAL SEGMENTS FOR TABLE 5

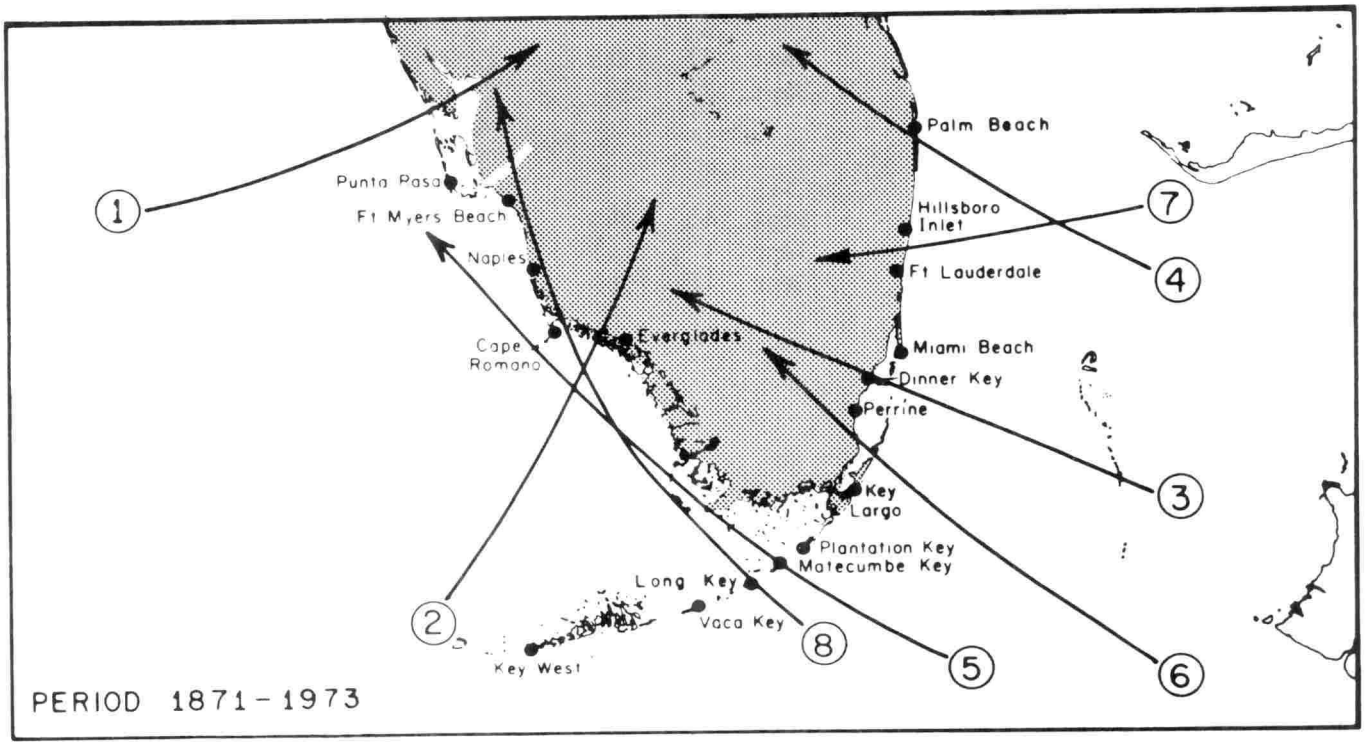
Source: *Environments of South Florida: Past and Present,* edited by Patrick J. Gleason, Miami Geological Society, 1974

four times as much force as a 47 mile (75 km) per hour wind, and a 186 mile (300 km) per hour wind exerts 16 times as much force as a 47 mile per hour wind. This becomes quite significant in light of the fact that south Florida has more great hurricanes per unit length of coast than any other area in the United States.

The strongest hurricane winds measured in south Florida were 155 miles (249 km) per hour at Hillsboro Lighthouse near Pompano on September 17, 1947. But south Florida may have experienced winds that were considerably stronger than that; in many of the more severe hurricanes, wind instruments blew away or were otherwise damaged before the winds reached their peak velocities.

The most dangerous single element of a hurricane is the storm surge, a rise above normal water level on the open coast due to the action of wind stress on the water surface. Storm surge also includes the rise in water level due to atmospheric pressure reduction. The highest and most dangerous portion of the storm surge usually develops on the side of the onshore winds and often extends from 20 to 50 miles away from the center. On the other side of the storm center, the offshore winds may, but do not necessarily, result in tides well below normal. This difference in water height generates strong along-shore currents that frequently cause great erosion in the coastal areas. At times, sandbars, even sand dunes, are swept away within a few hours. New inlets to bays are frequently cut by the action of these currents and the storm surge.

Storm surges ranging up to 16.4 feet (5 m) above mean sea level have been reliably reported in connection with Florida hurricanes. The highest, about 18 feet (5.5 m), occurred with the 1935 "Labor Day" hurricane in the Florida Keys. Other historical storm surges in Florida include one up to 14.1 feet (4.3 m) above mean sea level in Tampa Bay in 1848, 13.1 feet (4 m) near Miami in 1926, and 13.8 feet (4.2 m) at Perrine in 1945. However, the greatest toll in lives taken by one of these storms occurred in 1928 when the water from Lake Okeechobee was blown over the levee, flooding several communities south of the lake and drowning nearly 2,000 persons. Since then, protective dikes have been constructed around the lake.



TRACKS OF HURRICANES CAUSING RECORD STORM SURGES IN SOUTH FLORIDA

Source: *Environments of South Florida: Past and Present,* edited by Patrick J. Gleason, Miami Geological Society, 1974

Table 6

RECORD HURRICANE STORM TIDES IN SOUTH FLORIDA

Storm (see Tracks of Hurricanes Causing Record Storm Surges map)	Date	Maximum Tides (meters)	Location
1	Oct. 6, 1873	4.3	Punta Rasa
2	Oct. 17, 1910	3.1	Everglades
3	Sept. 18, 1926	4.0	Dinner Key (Miami)
		3.8	Ft. Lauderdale Beach
		3.3	Miami Bay Front
4	Sept. 17, 1928	3.0	Palm Beach
5 (Labor Day Storm)	Sept. 2, 1935	5.5	Matecumbe Key
		4.9	Long Key
		4.6	Plantation Key
		4.3	Key Largo
6	Sept. 15, 1945	4.2	Perrine
7	Sept. 17, 1947	3.0	Hillsboro Inlet
8 (Donna)	Sept. 10, 1960	3.6	Cape Romano
		3.5	Naples
		3.2	Ft. Myers Beach
		2.9	Vaca Key

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, 1969

Areas exposed to the open sea usually will be subjected to strong wave action, reaching higher than the storm surge height. It is primarily this wave action, and the strong currents accompanying the differential rise in sea level, that batter down and float away buildings, undermine seawalls, and in many cases alter the shape of the coastline.

A wave is a ridge, deformation, or undulation that is generated in the ocean when wind blows across the water surface. The height and period of the waves are a function of the wind intensity and duration, the water depth, and the extent of open water over which the wind is blowing from a given direction (fetch). Swells are wind-generated waves that have traveled beyond their originating area.

Waves, in association with storm surges and currents, produce the greatest effects on the nearshore environments (Hays 1967); the sediment loss caused by severe storm waves is a spectacular geologic feature.

Waves entering shallow water peak up and eventually break, expending their energy on beaches or structures. During hurricanes, enormous waves are generated offshore in deep water and may enter bays and harbors along the coast through deep water inlets and channels. Long-period swells sent out radially ahead of a hurricane contain a large volume of water and, when breaking in the shallow nearshore areas, can produce an added rise of 1 foot (0.3 m) or more in water levels along the shore. In areas where the offshore bottom profile steepens rapidly seaward, that effect is at a maximum. Conversely, where the bottom slope is gradual, that effect becomes less pronounced. Serious damage to low-lying dwellings along the Florida coast and keys has been caused during past hurricanes by waves breaking on those structures.

Heavy damage to roads and beaches has occurred from the erosive action of waves. Studies of wave action and its effect on beach slopes, based on beach profiles taken before and after hurricanes, indicated that steep beach slopes were flattened by wave wash during hurricanes to stable slopes, and that beach erosion was due primarily to strong littoral currents moving along the coast, rather than direct action of the waves. In areas where offshore sandbars existed, wave action during the hurricanes carried part of that sand to the beaches, and in many cases deposited it on roadways along the beach (U.S. Army, Corps of Engineers 1965).

The rains associated with hurricanes and other tropical cyclones can be both beneficial and destructive. In some areas (occasionally in south Florida), the rains from tropical cyclones make the difference between a bountiful and an inadequate supply of water. At other times, excessive rainfall from tropical cyclones causes severe flooding. This was true in 1947 and 1948 in southern Florida. But in general, flooding from hurricane rains is more severe in regions where mountains rise not far from the coast, and the terrain of southern Florida is very flat (Gleason 1974).

It is not unusual for tropical cyclones to give 4.9 to 9.8 inches (12.5 to 25 cm) of rain, and some of the heaviest rainfalls have occurred in connection with comparatively minor tropical storms. The heaviest rainfall in Florida occurred 31 miles (50 km) west of Gainesville in October 1941, when 34.7 inches (88.9 cm) fell in a 48-hour period as a weak tropical disturbance moved slowly northward. By contrast, a severe hurricane in 1926 gave only 7.8 to 9.8 inches (20 to 25 cm) as the center passed over the Miami area.

5. Hydrologic Resources and Water Quality

Biscayne National Monument can be divided into two areas according to hydrographic conditions: Biscayne Bay proper and the area between the keys and the eastern margin of the monument. The

former is a relatively enclosed body of water with limited exchange with the offshore area; it is largely affected by local atmospheric conditions and thus experiences certain seasonal changes, particularly in temperature and salinity. The offshore area, on the other hand, fluctuates to a much lesser extent because of the constant influence of relatively stable Florida Current waters flowing along its eastern margin (Voss 1969).

Because of the overall shallow depth of Biscayne Bay, heat is absorbed or lost rapidly by the water, and corresponding fluctuations in bay temperatures are recorded. In very shallow inshore areas where relatively little water exchange takes place, temperature variation is at its extreme. The middle and eastern portions of the bay, on the other hand, exhibit reduced temperature fluctuations due to the influence of tidal flushing and mixing with offshore water. Sheltered areas in the eastern bay such as the midwestern edge of Elliott Key may also show some extreme temperature variation because of poor water circulation. Still other areas receive tidal flow from mangroves and extensive shallow water flats, which may modify otherwise expected temperature conditions. In the offshore waters, temperature fluctuation decreases from the keys to the outer reef. Along the outer reefs and the eastern edge of the monument, influence from Florida Current waters reduces normal yearly temperature changes to less than 9°F (5°C). In any case, temperatures rarely drop below 68°F (20°C) or exceed 89°F (32°C). Although patch reefs situated approximately midway between the outer reefs and the keys experience as much as 18°F (9.9°C) annual changes in temperature, this is still much below those found within the bay (Jones 1963). Diurnal changes are usually 2°F (1.1°C) and 4°F (2.2°C). Along the outer reefs there are often abrupt changes in water temperature with changes in depth, particularly below 30 feet (10 m); these may be attributed to reverse currents or movements of water masses from other, often deeper areas.

Salinity is similarly modified by atmospheric conditions in the bay, and primary influencing factors are precipitation and evaporation. During the particularly wet months of the spring and late summer, the direct result of heavy rains and terrestrial runoff is a dilution of the bay waters and a drop in salinity. This is particularly evident in the Convoy Point and Black Point areas where water is shallow and drainage effluents are great. During the dry season, solar evaporation and evaporation associated with the increased winds initiate a rise in salinity (Voss 1969). In the middle and eastern portions of the bay, salinity fluctuations are greatly reduced. Since evaporation as well as precipitation is involved in salinity variation, many of the factors affecting temperature change may also apply to salinities. In the offshore waters, salinity remains virtually constant with a slight temporary

change due to heavy precipitation or extremely concentrated periods of direct sunlight.

Dissolved oxygen is relatively stable, but in areas such as the bay where temperatures and salinity fluctuations affect the primary productivity, amounts of dissolved oxygen are also affected. Thus, in some of the bay areas a decrease in primary productivity during the winter brings about some decrease in dissolved oxygen. In other areas pollution and offshore water influence may affect dissolved oxygen.

Water clarity varies within the park and is strongly dependent on wind conditions and precipitation. Fundamentally, underwater visibility offshore is much greater than in the bay, occasionally reaching 50 to 200 feet (45 to 60 m) along the outer reef. Turbidity increases in inshore areas as the influence of tidal flushing increases. Within the bay, water clarity generally increases from the north to the south (Voss 1969).

Seasonally, water turbidity is at its peak during the extremely windy late winter and early spring months and at its lowest point during the calm summer period. Although more than a week is often required before conditions return to normal within the bay following climatic disturbances, water on the outer rubble reefs may clear rapidly.

The flushing rate in lower Biscayne Bay is very low, due to the natural physiographic conditions: narrow passes through Cutter Bank to the south and Featherbed Bank to the north.

The population of south Florida draws 100 percent of its water from wells. In the Miami Springs well field of the Miami Waterworks System, wells 60 to 95 feet deep are capable of yielding as much as 6 million gallons per day (gpd) per well. The total drawdown in the cone of depression around this group of wells amounts to 3 or 4 feet when all wells are being pumped at an average rate of 3.5 million gpd. The area has a vast supply of brackish groundwater in the Biscayne aquifer, an area of 3,500 square miles. Approximately 1,500 square miles lie in Dade County and the remainder in Broward County. Much of the water entering the aquifer in Broward County is also available to Miami.

The Miami-Dade Water and Sewer Authority operates three water treatment plants: the Hialeah Plant, the Alexander Orr, Jr., Plant, and the Johnny Preston Plant. For 1975 the estimated use was 223 million gpd, and for 1980 the estimate is 244.4 million gpd. Table 7 illustrates the typical average analysis of water samples taken at the three plants during 1973 and 1974.

Table 7

TYPICAL AVERAGE ANALYSES OF WATER SAMPLES
1973-1974

	HIALEAH AND PRESTON PLANTS				ORR PLANT			
	Well Water		Treated Water		Well Water		Treated Water	
Alkalinity ($CaCO_3$)								
Phenolphthalein	0.0	ppm*	4.00	ppm*	0.0	ppm*	3.00	ppm*
Methyl Orange	230.0	ppm	40.00	ppm	210.0	ppm	35.00	ppm
Hardness ($CaCO_3$)								
Non-Carbonate	20.0	ppm	35.00	ppm	36.0	ppm	40.00	ppm
Total	250.0	ppm	75.00	ppm	246.0	ppm	75.00	ppm
Carbon Dioxide, Free (CO_2)	25.0	ppm	0.00	ppm	22.0	ppm	0.00	ppm
Chlorine Residual (Cl_2) at Plants	0.0	ppm	3.00	ppm	0.0	ppm	2.00	ppm
Nitrates (NO_3)	0.5	ppm	0.40	ppm	0.4	ppm	0.40	ppm
Chlorides (Cl)	42.0	ppm	58.00	ppm	24.0	ppm	28.00	ppm
Fluorides (F)	0.2	ppm	1.00	ppm	0.2	ppm	1.00	ppm
Sulfates (SO_4)	24.0	ppm	24.00	ppm	36.0	ppm	36.00	ppm
Calcium (Ca)	88.0	ppm	23.00	ppm	92.0	ppm	24.00	ppm
Iron (Fe)	0.8	ppm	0.02	ppm	0.5	ppm	0.01	ppm
Magnesium (Mg)	7.0	ppm	4.20	ppm	4.0	ppm	3.60	ppm
Sodium and Potassium (as Na)	31.0	ppm	32.00	ppm	15.0	ppm	18.00	ppm

	HIALEAH AND PRESTON PLANTS				ORR PLANT			
	Well Water		Treated Water		Well Water		Treated Water	
Silica (SiO_2)	8.0	ppm	9.00	ppm	5.0	ppm	6.30	ppm
Turbidity	Nil		Nil		Nil		Nil	
Total Solids	350.0	ppm	205.00	ppm	320.0	ppm	150.00	ppm
Electrical Conductivity (EC x 10^6 @ 25^oC) (Micromohs per centimeter)	580.0		305.00		530.0		250.00	
Color	50.0		6.00		5.0		2.00	
pH	7.3		9.00		7.3		8.80	

*ppm = parts per million

Source: Miami-Dade Water and Sewer Authority: Hialeah and Preston Plants, P.O. Box 6, Hialeah, Florida; Alexander Orr, Jr., Plant, 6800 SW 87th Ave., Miami, Florida

Operating under an umbrella of federal, state, and county governments, metropolitan Dade County has instituted a forceful policy designed to preserve its water supply and has instructed its pollution control officer to strictly enforce the state's stringent air and water pollution ordinance. This ordinance sets stiff penalties for violators up to and including court-ordered shutdown of offending operations. Thus, metropolitan Miami is aware of the ever present danger of water pollution and is making adequate strides to ensure that future generations will have available a safe, clean, potable supply of water.

To combat saltwater intrusion, the Corps of Engineers' Central and Southern Florida Flood Control District is building salt dams in the canals directly connected to saltwater access. Test drillings have shown that the salt front is being drawn back by this technique. Area communities are cooperating with the program.

6. Air Quality

Biscayne National Monument is located in the Southeast Florida Intrastate Air Quality Control Region established by the Environmental Protection Agency (42 CFR 481.91). This region includes the counties of Dade, Broward, Monroe, Martin, Okeechobee, Indian River, Palm Beach, and St. Lucie. There are no air-pollution monitoring stations within the actual monument boundary. However, there are two stations close to the monument operated by the Dade County Department of Natural Resources. Tables 8 and 9 list air-quality data collected at these stations from 1971 to 1974. These levels are well below the National Ambient Air-Quality Standards (see appendix C).

The atmosphere in south Dade County becomes polluted when certain meteorologic conditions occur simultaneously with gasoline engine exhaust and smoke from fires in the Everglades, dump fires, and land burning of sugar cane at Lake Okeechobee. Such incidents occurred in July 1970, April 1971, and May 1972. The metropolitan Miami area experiences smog conditions that, while small compared to most cities, are steadily worsening. The source of most pollution is from the industrialized northwest section of the area, especially Hialeah (Voss 1969).

In general, the concentration of pollutants in the south Dade County airshed is less than that over other large metropolitan areas. However, the significant increase in oxidants, oxides of nitrogen, sulfur oxides, and a noted increase in airborne lead near expressways in 1972 indicate a deteriorating air quality for the region in the future (USDI, Geological Survey 1973).

Table 8

AIR QUALITY MONITORING DATA
PERRINE, FLORIDA[1]

YEAR	POLLUTANT							
	PARTICULATE MATTER[2]		LEAD[2]		SULFUR DIOXIDE[3] (Taken July 1974)		NITROGEN DIOXIDE[3] (Taken July 1974)	
	Annual Geometric Mean	Maximum 24-Hour Reading	Geometric Mean	Maximum 24-Hour Reading	Annual Geometric Mean	Maximum 24-Hour Reading	Average 24-Hour Concentration Taken Every 6 Hours	Maximum 24-Hour Reading
1971	69.4	175.7						
1972	62.3	117.3						
1973	70.1	240.2						
1974	56.8	133.8	0.9	2.6	7.57	20.7	15.06	63.63

1. Station is located at 1966 East Fern Street, Perrine, Florida (south Dade County)
2. Expressed in micrograms per cubic meter (ug/m^3)
3. Expressed in parts per million (ppm)

Source: Dade County Department of Natural Resources, Evaluation and Planning Department, 1975

Table 9

AIR QUALITY MONITORING DATA
HOMESTEAD, FLORIDA[1]

YEAR	POLLUTANT	
	PARTICULATE MATTER[2]	
	Annual Geometric Mean	Maximum 24-Hour Reading
1971	48.3	160.8
1972	43.1	82.7
1973	57.0	115.2
1974	48.3	86.7

1. Station located at 325 NW 2nd Street, Homestead, Florida (south Dade County), approximately 10 miles north-northwest of the monument
2. Expressed in micrograms per cubic meter (ug/m^3)

Source: Dade County Department of Natural Resources, Evaluation and Planning Department, 1975

Noise from aircraft using Homestead Air Force Base has been extant since before the establishment of the monument. No change in the existing air traffic activity is anticipated unless a national emergency arises.

Noise abatement procedures are currently adhered to in the control of air traffic into and out of the base. A southeast traffic pattern is required due to the presence of downtown Homestead and congested residential areas. As a result, aircraft pass over a portion of the monument.

The day-night average sound level (L_{dn}) is the method employed by the Air Force and the Environmental Protection Agency to describe the noise environment. By this method, assessment of exposure to aircraft noise and prediction of community response to various levels of exposure is possible. L_{dn} values (a weighted average sound level expressed in decibels) for the portion of the monument affected by aircraft flyover from the base ranges from 65 to 75 decibels. These levels are subject to change with any significant operational change but would have to comply with the National Environmental Policy Act, which would require the preparation of an environmental statement (U.S. Department of the Air Force 1975).

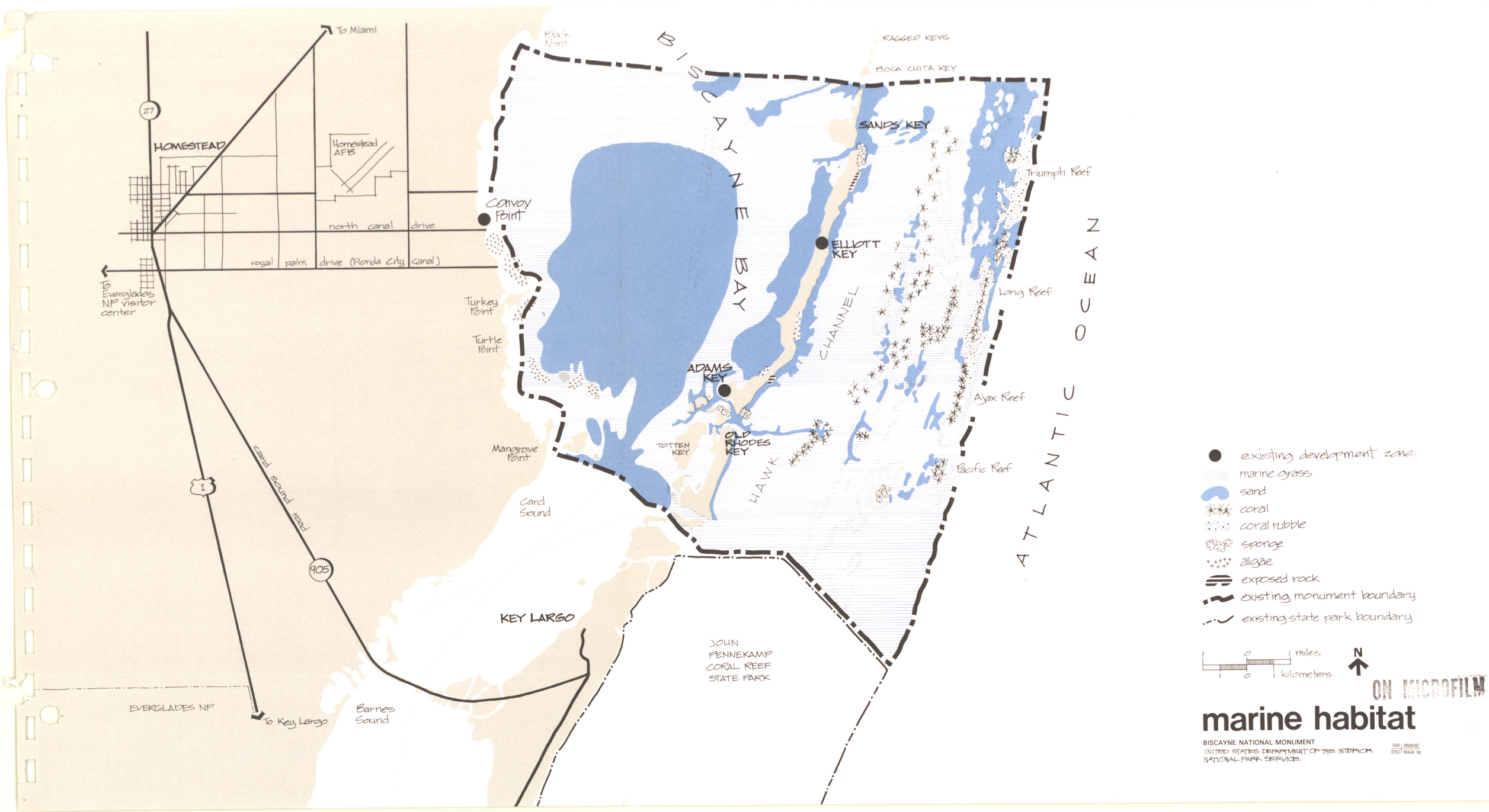
7. Marine Ecosystems Within the Monument

The marine communities within the monument are extremely rich and varied (see Marine Habitat map). Sharp boundaries between communities often do not exist; intergrading of communities is more commonly the rule. (A complete listing of marine plant and invertebrate species is found in appendix D.)

Biscayne Bay is essentially a semi-closed system with restricted tidal flushing; it has a variable freshwater input from drainage canals and experiences extremes in temperature and salinity. The bay bottom is covered with silt and sand layers of varying depths that greatly influence the occurrence of community types.

a. Thalassia Community. The most extensive bay-bottom community is turtle grass (Thalassia testudinum) with subcomponents of manatee grass (Syringodium filiforme) and shoal grass (Diplanthera wrightii). These grasses form dense mats, their rhizomes penetrating the bottom for 18 inches (45 cm) or more. Their leaves greatly increase the available surface for the attachment of filamentous algae, diatoms, and various bivalve mollusks. The long leaves also function as a trap for fine sediments and assist in maintaining water clarity.

The productivity of this community is one of the highest of any marine type. It is the nursery ground for commercial



ON MICROFILM

marine habitat

BISCAYNE NATIONAL MONUMENT
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

169 | 35003C
DSC | MAR 76

shrimps and lobsters, as well as for many species of bay fishes. The principal organisms grazing on these grass beds are sea urchins and certain parrot fishes in the vicinity of patch reefs, but a great variety of other species depend indirectly on the shelter of substrate niches.

b. Algae Community. Algae also invade the grass beds. The most common forms are Pencillus and Halimeda. These occur along with Laurencia on the western shore of the bay. Although some algae are found in deeper water mixed in with the grasses, the dominant algae community is generally restricted to the shallow waters. Algae occur in belts adjacent to the shore of the mainland and on the ocean side of Elliott Key.

c. Sand-Bottom Community. Much of the deeper portion of the bay and the eastern shore against the keys is composed of a soft calcium carbonate sediment overlaying the rock substrate. This calcium sand is in places very shallow, and the whole region must be classed as hard bottom.

The most conspicuous growth forms in this region are the various sponges, especially the commercial sponges (Hippiospongia gossypina, H. lachne, Spongia barbara, S. cheiris, and S. graminea), the loggerhead sponge (Spheciospongia vesparia), and the vase sponge (Ircinia campana); the corals (Porites porites, Siderastrea siderea, S. radians, and Solenastrea hyades); and the sea feathers of the genus Plexaurella and Pterogorgia anceps. This is not an area of high productivity, and most of the enrichment is gained from the adjacent Thalassia beds and mangrove fringe. A considerable number of organisms live within the canals of the sponges; they vary in size from the large worm Eunice spongicola to thousands of snapping shrimp. This area is important in the life history of the spiny lobster Panulirus and is one of the major habitats for the stone crab, Menippe mercenaria.

In the area to the east of the islands, between the thick Thalassia beds and the outer coral reefs, a region of isolated sand patches occurs. These patches range in size from a few meters to several kilometers in length. They are usually clearly defined by a sharp undercut border between the sand and bordering grasses. Sand in these patches is fairly coarse and generally devoid of vegetation.

A third type of sandy area (not shown on the Marine Habitat map) is the sandy halo that surrounds the coral patch reefs. This halo is usually a narrow belt immediately adjacent to the patch reef and is considered to be the result of grazing by reef fauna.

Sponges and alcyonarians are widespread over much of the sandy areas of the monument. Dense stands occur in the cuts between the islands, where swift currents flow. Sparse growths are found around the islands themselves and throughout the bay as well. Sponges and alcyonarians, especially the latter, are also important components of the coral patch reefs.

d. Coral Community

(1) Lagoon Patch Reef. Although some corals such as Porites and Siderastrea are scattered throughout the monument, large coral patches are found seaward of Hawk Channel. To the east of the keys is an area of dense but discontinuous coral reef patches. These are found around Bache Shoal, Margot Fish Shoal, and the back of Triumph, Long, and Ajax Reefs (Voss 1968, Jones 1963, and Ebbs 1966). Commonly the patch reef is a structure formed of living masses of coral rising directly from the bottom in 10 to 20 feet (3 to 6 m) of water. They have nearly perpendicular sides and rise to within 3 feet (1 m) of the surface. The bottom around a patch reef is usually flat and covered with turtle grass except for a ring of clear sand several feet wide caused by the grazing of various fishes. The patch reefs in the monument range in size from individual coral heads to masses up to 160 feet (50 m) across.

The main body of these patch reefs is often dissolved and eroded by wave action and seawater to form caverns and chambers that are filled with a large number and variety of reef fishes, both day feeders and night feeders (Starck 1968, Randall 1968, and Voss 1968).

(2) Outer Reef. The outer reefs fringing the seaward side of the patch reef zone consist of dead coral rubble. Live corals lie mostly along the seaward edge of the outer reef platform immediately adjacent to deep water and the Florida Current. Two main outer reef types, represented by Long Reef and Ajax Reef, occur in the monument waters. The former is a long, low, shallow structure formed by loose coral rock and sheets of dead Acropora. Within this reef structure and beneath the rock slab exists a wealth of marine life. Ajax Reef is a coral reef largely made up of live stinging (Millipora) coral colonies. The invertebrate communities of these reefs are not rich, but numerous fish species are found.

e. Intertidal Community. The east side of the keys is mainly rocky in the intertidal zone. This region is divided into the upper platform (from the line of land vegetation to the sea edge) and the lower platform, which extends from the sea edge out to the reef flat (Stephenson 1950). These areas are further subdivided into color zones based upon exposure, weathering, algal mats, and other factors. From the land out,

these are upper platform (white, grey, black, and yellow) and lower platform (no color zones given). Voss and Voss (1955) in their study of Soldier Key did not use this color zonation but divided the intertidal into upper platform, platform face, and lower platform; all are features that can be seen easily in most seaward areas in the monument.

(1) Upper Platform. The white zone is the actual meeting place of land and sea. It is bleached white by salt spray, and no fully marine animals or marine plants live in it. Animals specific to this zone are the hermit crab Coenobita, the isopod Ligia, the crabs Sesarma and Cyclograspus, and the snails Tectarius, Truncatella, and Detracia.

The grey zone lies between the white and the black zones. Plants specific to this zone are Sesuvium, Batis, Salicornia, and others. The animals specific to this zone are the gastropods Littorina ziczac, Tectarius muricatus, T. tuberculosus, Echinus nodulosus, Nerita peloronta, and N. versicolor, as well as the same animals found in the white zone.

The black zone is wetted by the high spring tides. Its black color is derived from the coloring effects of certain blue-green algae (Entophysalis, Brachytrichia) and the dry mats of Bostrychia. Animals specific to this zone include most of those mentioned above with the addition of a snail (Planaxis lineatus), and the common snail (Batillaria minima), which may occur in extensive mats.

The platform face is occupied by the yellow zone, which is the true intertidal zone of the inshore. The characteristic color is given by the wet mats of algae, primarily such forms as Anadyomene stellata, Cladophoropsis membranacea, Catanella repens, Centroceras clavulatum, Ceramium fastigiatum, and Polysiphonia howei. Higher up, Bostrychia and Valonia are dominant. All of these algae form dense mats that offer refuge to numerous small animals.

The animals specific to the yellow zone usually include large numbers of the barnacles Chthamalus stellatus and Tetraclita squamosa; the worm-like mollusk Spiroglyphus; the false limpets Siphonaria pectinata and S. alternata; various fissurellids, especially Diadora listeri; the snails Batillaria minima, Thais rustica, Cantharus tinctus; the true limpet Acmaea; the slug Onchidium floridanum; the large chiton Acanthopleura granulata; the mussel Mytilus exustus; the oysters Isognomon alata and I. chemitziana; and many others.

(2) Lower Platform. The lower platform is difficult to separate from the so-called reef flat. It begins at the bottom of the platform face. It is often distinguished by the somewhat steeper slope, the very rough eroded stone floor, and the presence of the yellowish-green carpet of Laurencia papillosa and associated green and red algae. Dominant here are the sea urchin Achinometra lucunter and the mussels Arca barbata and A. umbonata. Several anemones are found here (Phymanthus crucifer, Aiptasia annulata, and Condylactis gigantea), and many species of crabs are found under rocks in this area.

8. Marine Fauna

a. Marine Turtles. Four (possibly five) species of sea turtles occur in the monument area. The hawksbill (Eretmochelys imbricata), the Atlantic loggerhead (Caretta caretta), the Atlantic Ridley (Lepidochelys kempii), and the leatherback (Dermochelys coriacea) have been recorded in the area; the herbivorous Atlantic green turtle (Chelonia mydas) occasionally frequents the areas of submerged vegetation in monument waters. Of these, only the hawksbill and green are common, although the loggerhead is often seen floating at the surface in the deeper water off the reef. The hawksbill frequents areas of submerged vegetation. The scarcity of suitable sand beaches makes it unlikely that the monument would become a particularly important sea turtle nesting area.

Federal and state laws concerning capture of sea turtles in Florida waters are somewhat complex. The three marine turtles officially listed as endangered (hawksbills, Atlantic Ridley, and leatherback) are totally protected throughout all United States waters and beaches. The green turtle, although recently proposed for official "threatened" status, has not yet been so designated. Certain statutes actually do give total protection to the green turtle throughout Dade County, so this species is also fully protected within the monument. The Atlantic loggerhead, like the green, does not yet appear on the federal threatened list but is protected by Florida law.

In summary, all sea turtles are totally protected in the monument. It is not known to what extent the protected species are illegally being taken in other U.S. waters. The extent of unnatural mortality due to permitted or illegal taking of these turtles outside U.S. waters (in the Bahamas or Cuba, for example) is also unknown. Since virtually all of these species have life cycles that expose them to legal or illegal fishing pressure outside U.S. jurisdiction, it is clear that simple protection within Biscayne National Monument is only one element of a needed conservation program.

b. Octopuses. Adult octopuses within the monument move offshore during the summer to depths of 15 to 30 feet (5 to 10 m), but in winter and spring they come inshore to spawn and to find warm water. They are common in depths of less than 10 feet (3 m) during the period from March to May when they are caring for their eggs under old coral heads and rock slabs.

c. Shrimps. Lower Biscayne Bay and Card Sound are important nursery grounds for the pink shrimp (Penaeus duorarum). Spawning takes place in deep water offshore. In March the larval shrimp begin to appear in the bay, where they live in shallow water of 2 feet (0.6 m) in depth or less. They grow rapidly in this nursery and by September have reached a size large enough to move out into deeper bay waters, where they are fished for bait. These shrimp remain in the bay until they attain a considerable size. About the end of December, depending upon the weather conditions and moon phase, the juvenile shrimp move into the ocean. This movement is first northward in the bay, and then the majority of the shrimp pass out through Cape Florida Channel, Bear Cut, and Government Cut to reach the ocean (Voss 1969). Despite these migrations, there are always juvenile shrimp in the bay, to the extent that the bait shrimp fishery flourishes. For some reason not now understood, there is a migration into the bay of the Caribbean brown shrimp (Penaeus brasiliensis) in the summer, when for several months it accounts for up to 40 percent of the bait catch. It is not found in the bay during the rest of the year.

d. Spiny Lobsters. The Florida spiny lobster (Panulirus argus) larvae hatch out as phyllosomes and remain drifting passively in the plankton for up to 5 to 6 months. After metamorphosis, juvenile spiny lobsters are found in the grass beds of shallow bay water. When half grown, they are found in deeper water in the bay living under sponges, particularly the loggerhead sponge. As adults, they are found in water 3 feet (1 m) or greater depth, living in rocky holes, under rocky or coral ledges, and in various other sheltered situations.

e. Fishes. There is extensive movement and migration of fishes within the monument. Daily migrations are practiced by many of the reef fishes and are usually associated with nocturnal feeding activities in the grass beds or sand areas. Most grunts and snappers undergo such migrations.

There are two types of seasonal migrations. One is associated with spawning and involves the estuarine, bay, and reef species that move offshore to spawn. Migrants of this type include the mullets, the jackknife fish, and the black grouper. The second group of seasonal migrants are fall and winter visitors from the north (the smooth hammerhead shark, blacktip shark, certain rays, bluefish, and Spanish mackerel).

Ontogenetic migrants are those that spend their juvenile life within the area, moving with growth into offshore water or to a different habitat within the monument. Representative fish species include the king mackerel, gray snapper, and striped mojarra (Voss 1969).

A complete listing of fish species in the Biscayne National Monument area is found in appendix E.

9. Terrestrial Plant Communities

The mangrove community is one of the most important in tropical waters due to the fact that it stabilizes the shoreline, filters land runoff, and contributes organic nutrients through its leaf fall and associated organisms. (See "Coastal Processes and Shoreline Changes" section.) This community is characterized by the three mangroves: red mangrove (Rhizophora mangle), black mangrove (Avicennia nitida), and white mangrove (Laguncularia racemosa). Associated with these but more landward is the buttonwood (Conocarpus erectus). The plant communities of this area have been described by Davis (1940) and Craighead (1964).

On the bay side of the keys, the mangroves attain their maximum development in the monument. The most conspicuous organisms related to the mangrove community are those attached to the mangrove root props, trunks, and pneumatophores, which often double the diameter of the root props themselves. These consist of the alga Bostrychia, numerous hydroids such as Lytocarpus phillippinus, encrusting sponges, the coon or mangrove oyster (Crassostrea rhizophorae), the pearl oyster (Pinctada radiata), and several species of barnacles and snails.

The flora of the monument's keys also include many West Indian species and represent in many respects the best remnants of the tropical forests of southern Florida. There are several species of tropical plants on Sands Key, Totten Key, south Old Rhodes Key, and Elliott Key that are not protected in Everglades National Park. With protection from fire and other disturbances, these hammocks will continue their progression toward natural restoration.

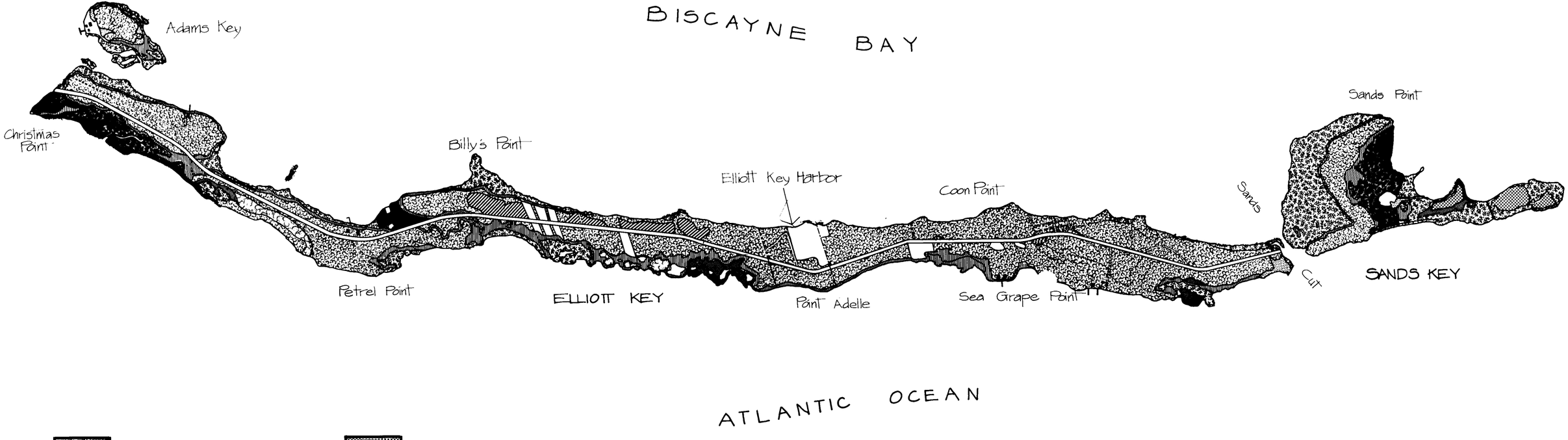
Several rare species deserve mention. On some of the large old mahoganies that survived cutting (especially on Sands Key), the tropical mistletoe (Phoradendrom rubrum) was collected for the first time in the United States. The hog-palm or Sargent's palm (Pseudophoenix sargenti) was apparently once abundant on Elliott Key; it was thought to have been extirpated until it was recently rediscovered at several locations on the key. These sites contain the only "native" Pseudophoenix (as opposed to ornamental planting) on the west side of the Florida Current;

the species is also found in the Bahamas. The ribbon fern (Paltonia spp.) was collected in 1883 from Elliott Key, but has not been found since except on north Key Largo. The possibility remains, however, that careful search may locate this rare fern in the monument. The more impenetrable hammocks also display a wide variety of epiphytic plants (bromeliads and orchids) that by their existence are evidence of little recent human disturbance such as commercial collecting.

Edaphic soil factors are critical in delineating the various terrestrial and semi-aquatic (mangrove) vegetation patterns. Red mangrove margins trap and hold the carbonate sediments prevalent along the bay shore and in tidal creeks. The substrate is alkaline (average pH 8.8) and saline. Where there is only gradual topographic relief, a salt marsh vegetation zone occurs just inland of the mangrove fringe. This zone, typified by a variety of salt-tolerant plant species, is a particularly harsh environment with highly saline deposits and little available fresh water. A slight rise in elevation (6 to 10 inches) above mean high tide may produce a radical alteration of vegetative composition. The organic litter of the hammocks creates a somewhat acid (pH 6.8) substrate as the vegetation develops. Although in the subtropical growing season these materials can accumulate rapidly, there has been little soil development over the limestone substrate; root penetration into the rock is not particularly successful. Obviously fire in such a situation restarts the natural plant succession by removing the highly organic root covering.

The exotic Australian pine (Casuarina), planted on the keys during the later periods of settlement, has made a conspicuous colonization of disturbed areas (Adams and Sands Keys) and bay shorelines. The net effect is to exclude the native hammock hardwoods where Australian pines exist.

The American Forestry Association has recognized eight tree specimens on Totten Key, within the monument boundary, that are the largest of their species in the United States (see table 10).



- mangrove - red
- mangrove - black and red
- mangrove and buttonwood
- buttonwood
- buttonwood prairie
- buttonwood and hardwood
- hardwood
- hardwood - burned
- sargent's palm
- Cleared area

1 0 1 miles

1 ½ 0

N

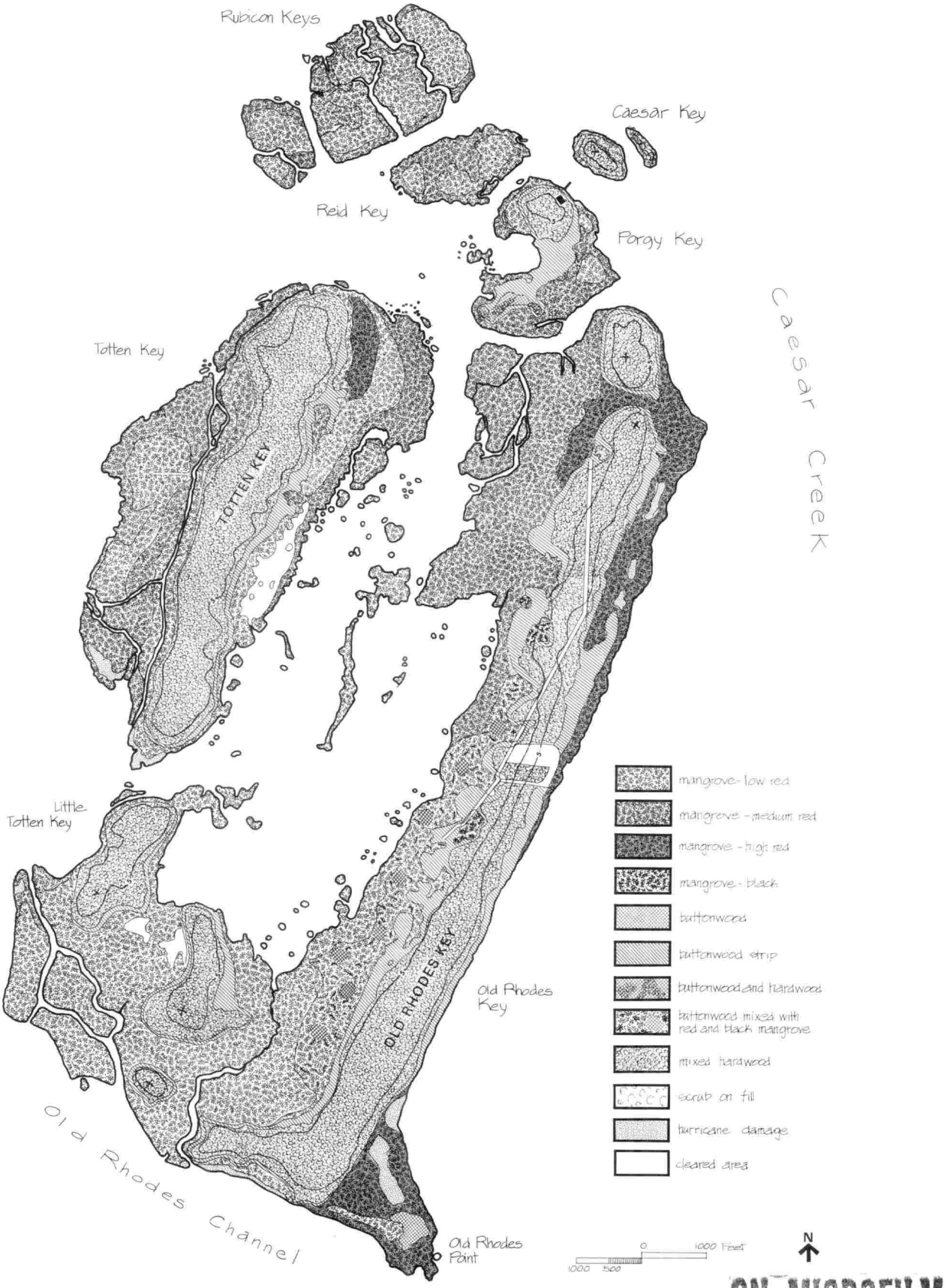
vegetation habitat

BISCAYNE NATIONAL MONUMENT

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

169 | 35,005B
DSC | JULY 78

ON MICROFILM



vegetation habitat

ON MICROFILM

BISCAYNE NATIONAL MONUMENT
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

168 | 35,007A
DSC | APRIL 76

Table 10

RECORD TREE SPECIMENS
WITHIN BISCAYNE NATIONAL MONUMENT

Common Name	Scientific Name	Statistics		
		Circumference (Inches)	Height (Feet)	Crown Spread (Feet)
Sea Amyris	Amyris elemifera	12	24	13
Lignumvitae	Guaiacum sanetum	53	32	35
Seven-Year-Apple	Genipa clausiaefolia	11	25	10.5
Milkbark	Drypetes diversifolia	36	37	17
Canella	Canella winterana	19	29	18
Black Ironwood	Krugiodendron ferreum	42	34	24.5
Tallowwood	Ximenia americana	40	25	20.5
Inkwood	Exothea paniculata	52	45	31

A current listing of terrestrial flora species in Biscayne National Monument is found in appendix F.

10. Terrestrial Fauna

Like the terrestrial plants, the fauna of the monument's keys has not been thoroughly researched. There is the possibility that West Indian animal species not yet recorded on the Florida mainland may be found in the relatively undisturbed hammocks. Also, because the monument keys have not had a recent land connection with the rest of Florida, non-flying West Indian animals established there might not have spread further. (A checklist of terrestrial mammal, amphibian, reptile, and avian species occurring in Biscayne National Monument may be found in appendix G.)

a. Reptiles and Amphibians. The past range of the American crocodile included the monument waters. Although it has been several years since crocodiles have been seen in the immediate vicinity, complete protection coupled with management offers the opportunity to reestablish the species. (See "Endangered Species" section for discussion of habitat for reintroduction.)

The greenhouse frog (Eleutherodactylus ricordi planirostris) and green treefrog are the only amphibians so far recorded on the monument keys (Elliott Key).

b. Birds. The resident bird life of the monument is relatively predictable, although there is little detailed information available. Unlike the less mobile animals, new and unusual West Indian birds are unlikely to be "discovered" on the keys of the monument alone. However, several species (e.g.,

white-crowned pigeon, Cuban golden warbler, and great white heron) are found to have their northernmost breeding sites here. It is known that the red-breasted woodpecker, the screech owl, and the boat-tailed grackle all nest within the monument. A number of monument species are considered rare and have limited ranges - the reddish egret, the swallow-tailed kite, and the short-tailed hawk. The latter species, one of the rarest in the United States, is regularly seen on north Key Largo.

The Arsenicker Keys deserve special notice as multi-species, water bird nesting sites. These small keys have no high ground and are covered with a dense red and black mangrove swamp. There are few rookeries of comparable size and significance along the south Atlantic coast. Most of the more common water birds seen in the monument or surrounding area nest on these keys. Development or activities should avoid disturbing these keys or the related feeding areas along the mainland shoreline and the shallow flats on the lee side of the monument's keys.

c. Mammals. It is unlikely that any larger land mammals exist within the monument at the present time. Of the smaller carnivores, the raccoon is the only species of definite occurrence. Three distinct subspecies of rodents (Eastern gray squirrel, cotton mouse, and Eastern wood rat) are found on north Key Largo and therefore are likely to be found within the monument's boundaries. The Mexican red-bellied squirrel (Sciurus aureogaster), introduced on Elliott Key by J. Arthur Pancoast, has established thriving populations there and has also been sighted on Adams Key.

11. Endangered Species

There are 25 endangered or otherwise threatened wildlife species in south Florida. These include 9 species or subspecies of birds, 8 mammals, 6 reptiles, and 2 insects (USDI, Fish and Wildlife Service 1977). Pursuant to the Endangered Species Act of 1973 (P.L. 93-205), 21 south Florida species or subspecies are officially classified as endangered. Those wildlife species that inhabit or otherwise utilize the monument resources for species habitat and/or perpetuation and are classified as endangered are listed in table 11.

Table 11

FEDERAL ENDANGERED SPECIES WITHIN
BISCAYNE NATIONAL MONUMENT

Common Name	Scientific Name
Florida Manatee	Trichechus manatus latirostris
Atlantic Ridley Turtle	Lepidochelys kempii
Hawksbill Turtle	Eretmochelys imbricata
Leatherback Turtle	Dermochelys coriacea
Brown Pelican	Pelecanus occidentalis
Bald Eagle	Haliaeetus leucocephalus
American Crocodile	Crocodylus acutus

Three south Florida species currently classified as threatened occur in the monument. These include the Bahama swallowtail butterfly, Schaus swallowtail butterfly, and the eastern indigo snake. Another threatened species, the American alligator, occurs in adjacent areas but has not been reported as inhabiting the monument.

The Wildlife Code of the State of Florida (Florida Game and Fresh Water Fish Commission 1977) has a list of 31 endangered and 54 threatened species. These species were adopted from the list recommended by the Florida Committee on Rare and Endangered Plants and Animals. Of those species on the endangered list, the Atlantic green turtle, Atlantic hawksbill turtle, Atlantic Ridley turtle, American crocodile, wood stork, and Key Largo wood rat occur or probably occur in the monument.

Examination of the most recently published list of endangered or threatened vascular plants (Federal Register, Vol. 40, No. 127, July 1, 1975) indicates that no plant species currently known to inhabit the monument are endangered or threatened.

a. Florida Manatee. The critical habitat of this species is essentially the entire monument. Manatee are observed in the area near the channels connecting the outer reef tract with the bay, throughout the bay, in the shallow waters surrounding the keys, and in the mangrove creeks of the mainland immediately west of the monument's west boundary. The Florida Marine Patrol reports a few generalized sightings of manatee in the monument but does not have an estimate of exact numbers. The manatee in this area are known to occur primarily in the northern portion of Biscayne Bay between north Miami and Hollywood. It is postulated that individuals occurring within a given population are likely

to be widely dispersed throughout their habitat. That is, based on the limited sighting data available, they do not occur in concentrated groupings (Irving 1976).

b. Hawksbill, Ridley, and Leatherback Sea Turtles. Although all three of these species have been seen in the monument, only the hawksbill would appear to be consistently utilizing the shallow, grass-bottomed bay waters as a critical feeding habitat. A critical nesting habitat for all three species is available in very limited amounts in the form of restricted sections of sandy shoreline on both the bay and ocean sides of Elliott and Sands Keys. The current nesting success or frequencies of sea turtles on these restricted shorelines in the monument is not known. Reintroduction of these turtles, particularly the hawksbill, through the technique of hatchling release on the monument's limited beaches (with hopes of increased future natural nesting) is a theoretical possibility. However, the success of this or other turtle management practices is very much dependent upon factors like the degree of protection the adults receive outside the monument, the general water quality in areas of critical feeding habitat, and other elements beyond the control of the National Park Service. (The above discussion also applies to the green sea turtle, although the critical feeding habitat for this species would be principally on the reef tract.)

c. Brown Pelican. Both critical feeding and nesting habitats for this species occur within the monument's shallow waters and on the smaller mangrove-fringed keys (e.g., the Arsenicker Keys). Again, it is not known whether this habitat is being fully utilized or whether any additional sites would be considered suitable nesting habitat by the birds themselves. As with most other mobile species, the success of populations within the monument is to a large degree related to external and broad-scale factors (e.g., the foreign chemical residues in food species that are known to affect the viability of pelican eggs).

d. Bald Eagle. A single nest of this species has been observed on Arsenicker Key for approximately 15 years. However, it has been active only four or five times, and only one adult bird (a presumed female) is consistently seen in the area and on the the nest. No recent successful hatchings at the nest have been observed, although it is known that at least one egg was laid in 1975. It is not known whether this egg was infertile, or whether it was fertile but failed to hatch for other reasons - poor care by the female, thin shell, etc. (Robertson 1976). It is assumed that other isolated Arsenicker Keys would provide suitable nesting habitat for eagles. More careful study of the requirements of the species, plus an understanding of the factors leading to poor-to-zero success of the existing nest, would have to be undertaken before consideration was given to possible reintroduction.

e. American Crocodile. The status of the American crocodile in the monument is unknown. Sightings of this species have very occasionally been made as far north as Miami, and recent sightings have occurred 3 to 4 miles south of the monument waters (Robertson 1976). It is fairly well established that the original recent range of the crocodile came as far north as Biscayne Bay and therefore the monument. Critical habitat both for nesting and feeding is presumed to be such areas as Jones Lagoon, around the Arsenicker Keys, and the limited sandy (nesting) beaches on Elliott and Sands Keys. Some other non-sandy key shorelines might also be appropriate for nesting if the fringing vegetation were sparse enough to allow access to the nesting female.

12. Plants and Animals of Economic Importance

Numerous marine animals and plants inhabiting waters of the monument are of some economic importance as commercial food products or as tourist souvenirs. The list below is not intended to be exhaustive but rather to indicate those plants and animals in the monument waters or adjacent areas that have been or are now being taken for food or for sale.

a. Plants. No algae or grasses found in the area are of commercial importance at this time. Some attempts have been made to utilize Thalassia as both a fertilizer and a cattle food, and Sargassum has been used as a cattle food additive. Harvesting of either species is not practical or commercially feasible at this time. The vast beds of Thalassia are directly related to fishery industries, as they constitute nursery grounds for commercial shrimp, spiny lobsters, and numerous food fishes during at least part of their life cycles. However, Thalassia is also the primary food requirement of the Florida manatee. The turtle grass beds that lie within the monument boundary also lie within the critical habitat for the Florida manatee (see "Endangered Species" section).

b. Sponges. The commercial sponges in the monument waters are primarily Hippiospongia gossypina (velvet sponge) and Spongia graminea (key grass sponge). They are found mainly in the bay region behind Elliott and Sands Keys. The loggerhead sponge Sphecio-spongia has generated intermittent interest as a possible rich source of iodine.

c. Alcyonarians. The sea feathers, sea fans, and sea whips have been of considerable value in the tourist trade, but most of those sold in Florida come from the Bahamas. There is a Florida law that prohibits the taking of all Gorgonians from Florida waters. The species usually found in curio stores are the sea fans (Gorgonia flabellum and G. ventalina), mostly harvested in the Bahamas, and the sea feather (Pseudopterogorgia acerosa and related species). The denuded axis of various species (unidentifiable in that condition) may be sold as curios, occasionally

under the name "black coral." Genuine black coral, widely sought by divers, lives chiefly on deep outer reef slopes and hence probably does not occur within the monument - certainly not in commercial quality or quantity.

d. Corals. There have been heavy demands by curio and shell stores for local elkhorn (Acropora palmata), flower (Eusmilia fastigiata), and lettuce coral (Agaricia agaricites), as well as various kinds of finger coral. These were often collected indiscriminately, mainly in what is now the John Pennekamp Coral Reef State Park, using hammers, crowbars, dynamite, and small barges. The corals were soaked in bleach, washed, sun-dried, and then sold by the truckload. Although certain of these branched corals grow faster than was previously thought, the ruthless commercial harvesting caused much damage to reefs. A large part of the coral sold in Florida curio shops is now imported from the Bahamas, but some commercial collecting still goes on in public waters. A 1975 Florida law prohibits the possession or sale of more than 5 pounds of fresh coral without proof that it has been legally imported. There is a Florida law that prohibits the taking of live hard corals from Florida waters.

e. Mollusks. Few mollusks are of significant economic importance in the monument waters. Although small numbers of coon oysters (Crassostrea rhizophorae) are eaten locally by a few people, they are of no commercial significance. A few people eat the large bleeding-tooth snails (Nerita spp.), the pen shell (Atrina rigida), and clam (Asaphis deflorata). Both the shell and meat of the pink conch (Strombus gigas) are of commercial importance. These mollusks are found mainly in the grass beds on the seaward side of the keys. Formerly, they were abundant in the keys, but the tourist trade demand for the brightly colored shell caused such heavy over-collecting that they have almost disappeared from Florida waters. The dealers then turned to the Bahamas, and conchs were imported by the shipload until the Bahamian government passed a law forbidding the selling of the shells unless a hole had been made in the upper shell to show that it had been originally collected for food, a staple part of the diet in the Bahamas and the West Indies.

f. Crustaceans. Three species of commercially important shrimp, Penaeus duorarum (pink shrimp), P. brasiliensis (Caribbean brown shrimp), and P. aztecus (brown shrimp), are found in monument waters, but only the first two are present in commercial quantities. The fishery is for bait shrimp sale or use and the individual catch is for home consumption.

The spiny lobster (Panulirus argus) occurs abundantly in monument waters, but is heavily fished by a widespread and

lucrative industry. Most lobsters of this species are harvested once they reach the legal size limit. The habitat and solitary nature of the animal prohibit mass harvesting methods. Capture is effected by traps, the design of which is regulated by law, so the fishing is largely on an individual fisherman basis.

The Spanish or slipper lobster (Scyllarides aequinoctialis) is not related to the spiny lobster but is occasionally taken in the pots set for it along the Hawk Channel and outer reef. Scyllarides is very hard-shelled. Almost all specimens captured are eaten by the fishermen themselves and do not appear on the market.

The stone crab (Menippe mercenaria) occurs in the monument, and considerable numbers are taken because their claws bring a high price in the seafood markets.

g. Echinoderms. The large starfish (Oreaster reticulatus) was formerly common in the waters eastward of the keys and in the passes and channels. Because of its large size and attractive shape, it has been heavily collected privately and commercially for preparation as a souvenir and is now rather uncommon.

Two of the sea urchins, Tripneustes esculentus and Lytechinus variegatus, are locally abundant. The first is the well-known commercial food species of the Caribbean, the "sea egg." During the spawning period, most of the internal spaces of female urchins are filled with the enormously enlarged ripe ovaries. This roe-like material is considered a delicacy. At present, there is no commercial exploitation, but both species are gathered for food by some of the local population.

h. Fishes. The major fishes of economic importance found in the monument, along with their uses, are listed in table 12.

Table 12

MAJOR FISHES OF ECONOMIC IMPORTANCE OCCURRING IN THE BISCAYNE NATIONAL MONUMENT AREA

Species	Economic Significance (g=game, f=food, b=bait)
bonefish	g
gulf flounder	f
blue runner	b
crevalle jack	g
greater amberjack	f,g
pompano	f
permit	f,g
snook	f,g
scaled sardine	b
ladyfish	g
tarpon	g
ballyhoo	b
yellowfin mojarra	f
hogfish	f
mutton snapper	f
gray snapper	f
yellowtail snapper	f
vermilion snapper	f
striped mullet	f,b
white mullet	f,b
bluefish	f,g
cobia	f,g
blue parrotfish	f
silver perch	f
spotted seatrout	f
red drum	f,g
little tuna	f,g,b
king mackerel	f,g
Spanish mackerel	f,g
cero (Florida mackerel)	f,g
sand perch	f
red grouper	f
Nassau grouper	f
gag	f
black grouper	f,g
great barracuda	g

Source: Voss 1969

C. SOCIOECONOMIC ENVIRONMENT

1. Regional Analysis

Biscayne National Monument adjoins one of the fastest growing population centers in the country. Thirty years ago, 75 percent of Dade County's population lived in the city of Miami. Since that time, Miami's population has more than doubled, but it has still been outdistanced by the 27 municipalities that have grown up around it to a current total of 730,665 compared to Miami's 334,859. The unincorporated area has grown even faster, now accounting for 537,127, which was 42.3 percent of metropolitan Dade County's population of 1,267,792 in 1970 (tables 13 and 14).

The United States Census figures for 1970 show that the working-age group (18-64) makes up 57.2 percent of Miami's population, compared to the national figure of 55.9 percent (table 15).

The consistent growth in population is tied intimately to the many resources of southern Florida: the tropical climate, ample fresh and salt water, beautiful vegetation, abundant sunshine, a vital economy, farmlands, a colorful history, and an almost unlimited array of recreational opportunities. However, there appears to be a growing consensus in both public and private sectors that serious degradation of these resources is occurring because of poorly planned and unwise development.

Florida's outdoor resources hold great appeal for visitors from other states. The state's beach and water areas are famous, and many localities depend on this drawing power for much of their prosperity. However, in southern Florida where many of the best beaches are backed by private property, the general public is denied access to the water for recreation; therefore, the resource that most contributes to the tourist demand is in serious shortage, in spite of efforts by government and private interests to acquire beachfront property for public use.

Existing public recreation facilities in addition to the monument include Everglades National Park; John Pennekamp Coral Reef and Cape Florida State Parks; Crandon, Homestead Bayfront, and Matheson Hammock County Parks; and several commercial enterprises such as Miami Seaquarium, Parrot Jungle, and Serpentarium.

Of these, John Pennekamp Coral Reef State Park is most important to the monument. This park, 21 miles (34 km) long and 3½ miles (5.6 km) wide, is situated in the Atlantic Ocean off Key Largo adjacent to the southern boundary of the monument.

Table 13

POPULATION
METROPOLITAN DADE COUNTY, FLORIDA

The 27 Municipalities	1960 U.S. Census	1970 U.S. Census	June 1975 (Estimated)
Miami	291,688	334,859	380,160
Hialeah	66,972	101,728	115,200
Miami Beach	63,145	87,072	97,920
Coral Gables	34,793	42,494	47,520
North Miami	28,708	34,768	38,880
North Miami Beach	21,405	30,833	34,560
Miami Springs	11,229	13,279	14,400
Opa-Locka	9,810	12,505	12,960
Homestead	9,152	13,674	14,420
South Miami	9,846	11,780	12,760
Miami Shores	8,865	9,425	10,656
West Miami	5,296	5,494	6,192
Florida City	4,114	5,133	5,760
Biscayne Park	2,911	2,717	3,024
Surfside	3,157	3,614	4,032
Bay Harbor Islands	3,249	4,619	5,184
El Portal	2,079	2,068	2,304
Virginia Gardens	2,159	2,524	2,736
North Bay Village	2,006	4,831	5,472
Bal Harbour	727	2,038	2,301
Sweetwater	645	3,357	3,744
Golden Beach	413	852	864
Hialeah Gardens	172	492	740
Medley	112	351	354
Pennsuco	117	74	76
Indian Creek	60	82	84
Islandia	——	8	10
Incorporated Area Totals	582,830	730,665	822,813
Unincorporated Area Totals	352,217	537,127	617,187
DADE COUNTY TOTAL	935,047	1,267,792	1,440,000
STATE OF FLORIDA	4,951,560	6,789,443	8,248,851
UNITED STATES	179,323,175	203,165,699	211,700,000

Source: U.S. Bureau of the Census, Office of Economic Development

Table 14

DADE COUNTY AREA POPULATION
PERCENTAGE INCREASES
1960-1970

Unincorporated Areas	52.5%	Miami Springs	18.1%
Miami	14.7%	Opa-Locka	27.5%
Miami Beach	38.0%	Homestead	49.4%
Hialeah	53.0%	South Miami	22.2%
Coral Gables	23.5%	Miami Shores	6.8%
North Miami	21.4%	West Miami	3.8%
North Miami Beach	46.6%		

Source: Bureau of Vital Statistics, Miami, Florida

Table 15

DADE COUNTY AREA POPULATION STATISTICS (1970)

Age Group	United States	Metropolitan Miami
Under 5 years	10.4%	8.3%
6-17	23.8%	20.9%
18-21	7.0%	4.5%
22-44	28.3%	29.6%
45-64	20.6%	23.1%
65 and over	9.9%	13.6%

Source: Bureau of Vital Statistics, Miami, Florida

The management strategy for this state park provides a degree of protection to monument lands and complements the monument's recreation opportunities.

A master plan prepared by the Metropolitan Dade County Planning Department has proposed several new parks and preserves. The locations of the most important state and federal outdoor recreation sites in south Florida are shown on the State and Federal Outdoor Recreation Areas map.

2. Visitation

Since the monument is a relatively new area (established August 1972), visitation trends have yet to be firmly established. Accurate estimation of the number of visitors is difficult because much of the visitation is by boat, entering the monument from the north or south or at the Homestead Bayfront Park marina. One economic study of the monument proposal projects future annual visitation at 750,000 (Menke 1968).

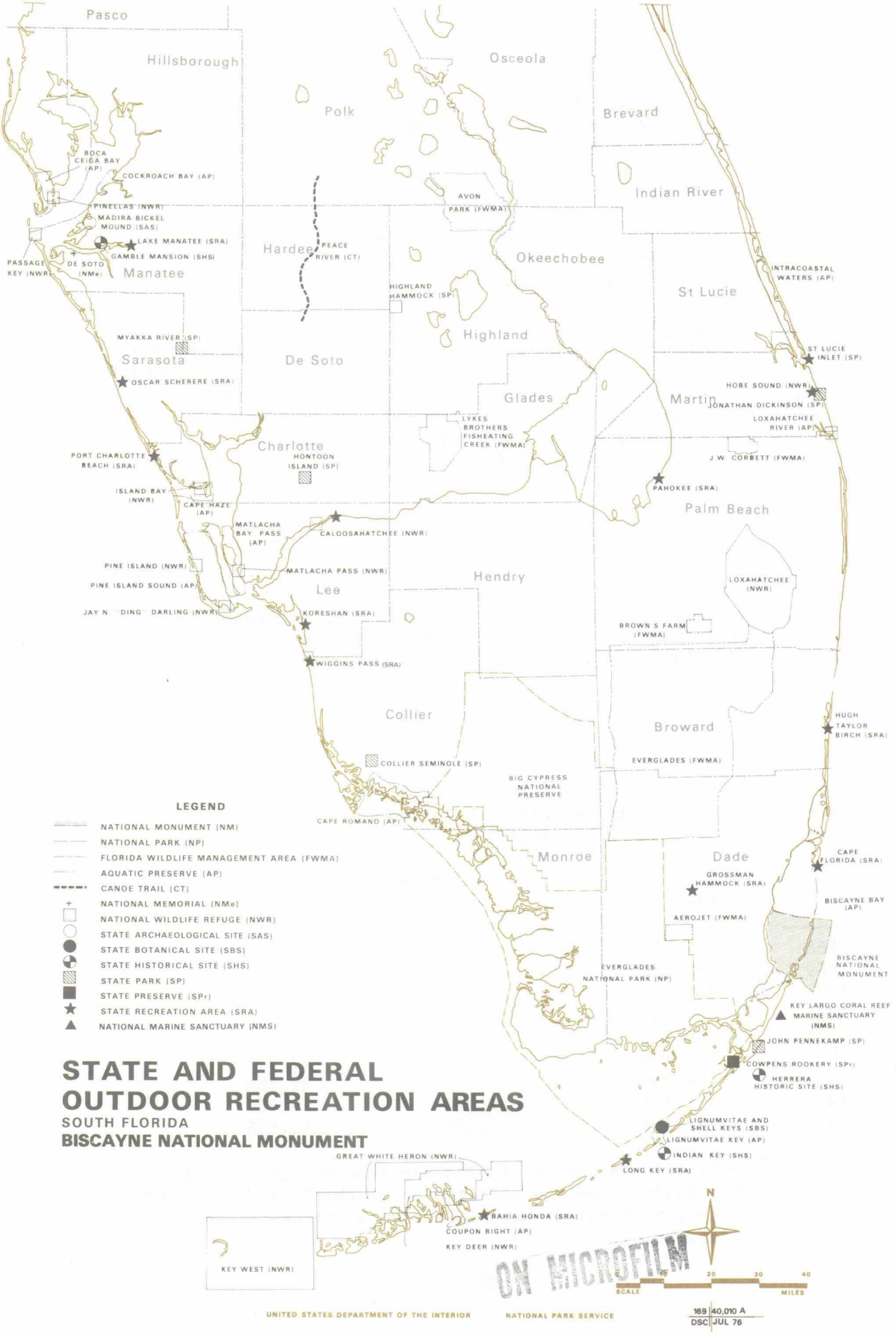
The annual park visitation for 1968 through 1976 is illustrated in table 16. Figures for the period 1968-1972 represent visitors to the area when it was Elliott Key State Park. In 1973, the National Park Service began compiling visitation figures with an overnight campground and boat visitation breakdown to aid in identifying the types of visitors and their consistent use patterns. Table 17 is a monthly breakdown of park visitation for 1977.

Table 16

BISCAYNE NATIONAL MONUMENT
ANNUAL PARK VISITATION
1968-1976

Year	Total Visits	Overnight	
		Campground	Boats
1968	53,522	-	-
1969	68,584	-	-
1970	106,227	-	-
1971	54,188	-	-
1972	78,148	-	5,751
1973	243,106	2,714	17,822
1974	409,705	3,712	22,368
1975	351,516	6,336	9,663
1976	339,148	5,224	41,536

Note: 1968-1972 visitation figures are from county records, when Elliott Key was operated under the Dade County Park System. Methodology used to arrive at these figures is undefined.



STATE AND FEDERAL OUTDOOR RECREATION AREAS

SOUTH FLORIDA

BISCAYNE NATIONAL MONUMENT

ON MICROFILM

UNITED STATES DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE

169 | 40,010 A
DSC | JUL 76

Table 17

BISCAYNE NATIONAL MONUMENT
MONTHLY PARK VISITATION
1977

Month	Total Visits	Overnight	
		Campground	Boats
January	11,504	360	1,428
February	17,668	388	2,324
March	17,236	550	1,063
April	16,800	584	3,396
May	25,208	512	5,296
June	24,032	84	4,348
July	31,516	324	8,668
August	15,112	36	4,116
September	14,728	68	3,928
October	12,160	96	9,188
November	10,092	164	3,136
December	9,816	204	3,656

The following table illustrates the current peak-day visitation levels and predicted future capacities of the various units of the monument. The methodology used to arrive at these figures is explained in appendix K.

Table 18

MONUMENT VISITATION
AND CAPACITY IMPLICATIONS

Area	Current Visitation	Future Capacity
Total Monument	1,920[1]	4,050
Convoy Point	660[2]	800
Elliott Key	660[3]	1,000[4]
Adams Key	-	200[5]

1 Boat count at 2 p.m. including launches from the Convoy Point ramp (4 people per boat)

2 Boat trailer count in parking area at noon, plus 10% for turnover rate (4 people per boat)

3 Private craft utilizing slips at a turnover rate of 2½ hours

4 Private craft utilizing slips at a turnover rate of 2 hours; 6 tour-boat trips (30 passengers each) per day

5 Minimal private boat use of 10 available slips; 6 tour-boat trips (30 passengers each) per day

a. Potential Visitors. Visitors to Biscayne National Monument consist of local residents and vacationers; the majority are drawn from the surrounding five-county region (Dade, Monroe, Broward, Collier, and Palm Beach), which has a population of 2.5 million. For purposes of analysis, visitors are separated into three categories: local residents, vacationers, and school groups (Menke 1968).

(1) Local Residents. The traditional users, and the largest category of anticipated future users, are local residents. Research has shown that the average park visitor can be typified as a resident of an urban area who is above the national average in income, education, and occupational status (Menke 1968). Miami population statistics indicate an ample supply of such potential park visitors. Additionally, people living in south Florida have been attracted to that section of the country partly because of climate and the year-round activities it offers. This fact lends more weight to the probability that local residents will utilize the monument for outdoor recreation.

Another important factor is boat use. For the 1973-1974 season, some 54,417 pleasure boats were registered in Dade (31,983), Broward (17,634), and Monroe (4,800) Counties (Florida Department of Natural Resources 1975). Boat registration has been increasing over the past 5 years.

Intensive use is now concentrated on weekends and holiday periods in the late spring to early fall months. This basic pattern will probably continue, regardless of additional attractions offered. Much of the use is family (or at least multi-age group) oriented. This applies to both campers (at Elliott Key and John Pennekamp Coral Reef State Park) and non-campers.

Local use is continually rising. This is illustrated by 1967 and 1970 aerial counts of boats in Biscayne Bay and visitor statistics from Homestead Bayfront, Elliott Key, and other nearby parks (comparative increase by percent). Considering the observed rate of increase in recreational use, and the size, composition, and rate of growth of the resident population, it may be postulated that the numbers of local visitors will increase.

(2) Vacationers. The second major category of potential monument users is vacationers. In 1974, Florida received approximately 24.5 million vacationers, both by air and automobile. The typical vacationer who flies to Florida is between the ages of 35 and 49, has an average annual income of over $20,000, and usually travels in a party of two. Most vacationers (71 percent) elect to drive to Florida. The typical driving vacationer is about 35 years old and married, is traveling in a party of three persons, and has an annual income of approximately $14,500.

Most driving vacationers originate from Georgia, Alabama, Tennessee, Mississippi, New York, Pennsylvania, Ohio, and Michigan. The driving vacationer stays approximately 17 nights and spends $497 for his entire trip. The flying vacationer spends $485 during a visit that lasts, on an average, 9.7 days.

Approximately 80 percent of Florida's visitors are repeaters and are considered to be the mainstay of the tourist industry. In 1973, a record 25.5 million vacationers visited the "Sunshine State." It is predicted that in 1976, 26 million tourists will visit Florida (The Miami Herald 1975).

(a) Summer Visitors. Summer visitors come during the months of June, July, and August and represent the heaviest monument use by vacationers. Summer visitors, on the average, spend less money and stay approximately 2 weeks (a shorter length of time than winter visitors). People coming to Florida in the summer are typically availing themselves of the cheaper summer rates and enjoying a beach vacation.

Taking these factors into account, a typical summer visitor would be from a closer area geographically, would arrive by auto, would be family-oriented, would be more youthful, and would take advantage of the lower costs during that season.

The summer visitors are the people to whom the monument will extend the greatest appeal. If they bring boats, they can use the monument for fishing, snorkeling, observing marine life, etc. If they do not bring boats, they are still likely to want a novel outing (a tour-boat trip across Biscayne Bay) with the fringe benefits of environmental interpretation for themselves and their children.

(b) Non-Summer Visitors. This visitor group is usually composed of out-of-state trailer campers. Using area camping statistics (Everglades National Park, John Pennekamp Coral Reef State Park, and Dade County Parks and Recreation Department), this group arrives in force December through March. They are generally older, are not traveling with children and fixed-time constraints, and are often repeated seasonal north-south campers. Biscayne National Monument could attract this group if access were convenient. As a group, these people exhibit sociological characteristics associated with park-going (higher income, education, etc.) and might well be attracted to a novel day's outing.

(3) School Groups. The final category of monument users is a special group of local residents - student groups. Biscayne National Monument has a variety of environmental and ecological lessons to teach, coupled with challenging possibilities for innovative teaching.

For example, one can learn about marine life and experience snorkeling at the same time. Because of the activity and skill required to view the marine environment in this manner, it can have particular appeal for junior high and high school classes. Opportunities for the elementary school groups to safely explore the marine and terrestrial environments can also be provided (e.g., natural interpretive trails). Everglades National Park attracts mainly elementary school groups concentrated to overflow capacity in March, April, and May. With publicity of the programs available to the schools, use of the monument could be spread through all school-age groups and through the fall and winter weekdays when the regular use of the monument is at its minimum.

b. Potential Visitation. For the purpose of estimating expected visitation, potential monument users have been divided into two categories: boat owners and those without boats.

Most of the existing boat use originates from Homestead Bayfront County Park and Matheson Hammock State Park, but a sizable portion of private boaters launch their boats from marinas all along the coast south of Miami. New planned marinas south of Miami will place an even greater burden on Biscayne National Monument as a destination for boaters. The capacity of the existing mainland marinas, those marinas to be constructed, and that percent of boats launched from points further to the north (Miami) and south (Key Largo) within convenient running time from the monument will determine the private boater visitation. It is estimated that in 1975 the maximum number of private boats per day that can be launched from these mainland facilities will be 850. With an estimated average of four persons per boat, the daily private boater visitation could be 3,400 persons.

The number of visitors without boats (local or tourist) who may eventually visit the monument will depend on the attractiveness of the resource as well as the capacity of the monument transport system. This capacity will be increased or decreased in proportion to demand, consistent with the continued preservation of monument resources and in accordance with energy conservation consciousness and cost/benefit effectiveness.

c. Existing Recreational Use. Traditional recreational use has been concentrated primarily west of Elliott Key on the bay side of the monument. Presently almost all activities are water-related, with boat use originating from marinas and private harbors along the coast south of Miami, primarily from Homestead Bayfront Park, Matheson Hammock Park, and Convoy Point.

Water activities include pleasure boating, sailing, swimming, snorkeling, sunbathing, bird-watching, water-skiing, and fishing. Local boat users have been enjoying the monument's waters and keys for years and are knowledgeable of navigable routes, good fishing areas, sand coves, and colorful reef patches.

Recreational use of the monument's land area has been restricted essentially to Elliott Key due to the lack of facilities and/or interpretive programs on the other keys. Natural factors such as heat and insects also affect use of the land areas. Camping and picnicking facilities and a modest developed swimming area exist at Elliott Key Harbor. These facilities are used extensively on weekends and holidays throughout the year.

Sandy coves, ideal for picnicking and swimming, and other areas suitable for beachcombing and bottle-hunting have always attracted monument users in the past and should continue to do so in the future.

3. Existing Facilities

a. Elliott Key Harbor. As previously discussed, activities in the monument are primarily oriented toward the aquatic environment. Land-oriented activities center around the facilities at Elliott Key and Homestead Bayfront County Park at Convoy Point. The harbor is situated on the western side of Elliott Key on Biscayne Bay approximately 8 nautical miles from Convoy Point on the mainland. The largest of the monument's keys, Elliott Key, lies entirely within monument boundaries. The Elliott Key Harbor, administered as a park by Dade County until 1972, was acquired under the park's enabling legislation and is now under full jurisdiction of the National Park Service. The area is currently being utilized as the primary island contact point for all visitors. It includes the following facilities in its present development scheme: a ranger station/residence, a visitor-contact pavilion, a maintenance and utility area; a government utility dock; two trailers; a small concessions trailer; a public harbor with 66 boat slips; a picnic area; a camping area (35-sites); and utilities (electricity by generator and sewage disposal by septic tank with no provision for public water supply).

b. Adams Key Complex. The complex is situated on the southwestern shore of Adams Key, a partially man-made island at the confluence of Caesar Creek and south Biscayne Bay. There are currently six structures on the island: two employee residences, a wood-frame building known as the "Casino," a pumphouse, a generator house, and a 60,000-gallon cistern. The major structure on Adams Key, the historic Cocolobo Club, burned to the ground in December 1974. A short, L-shaped pier extending approximately

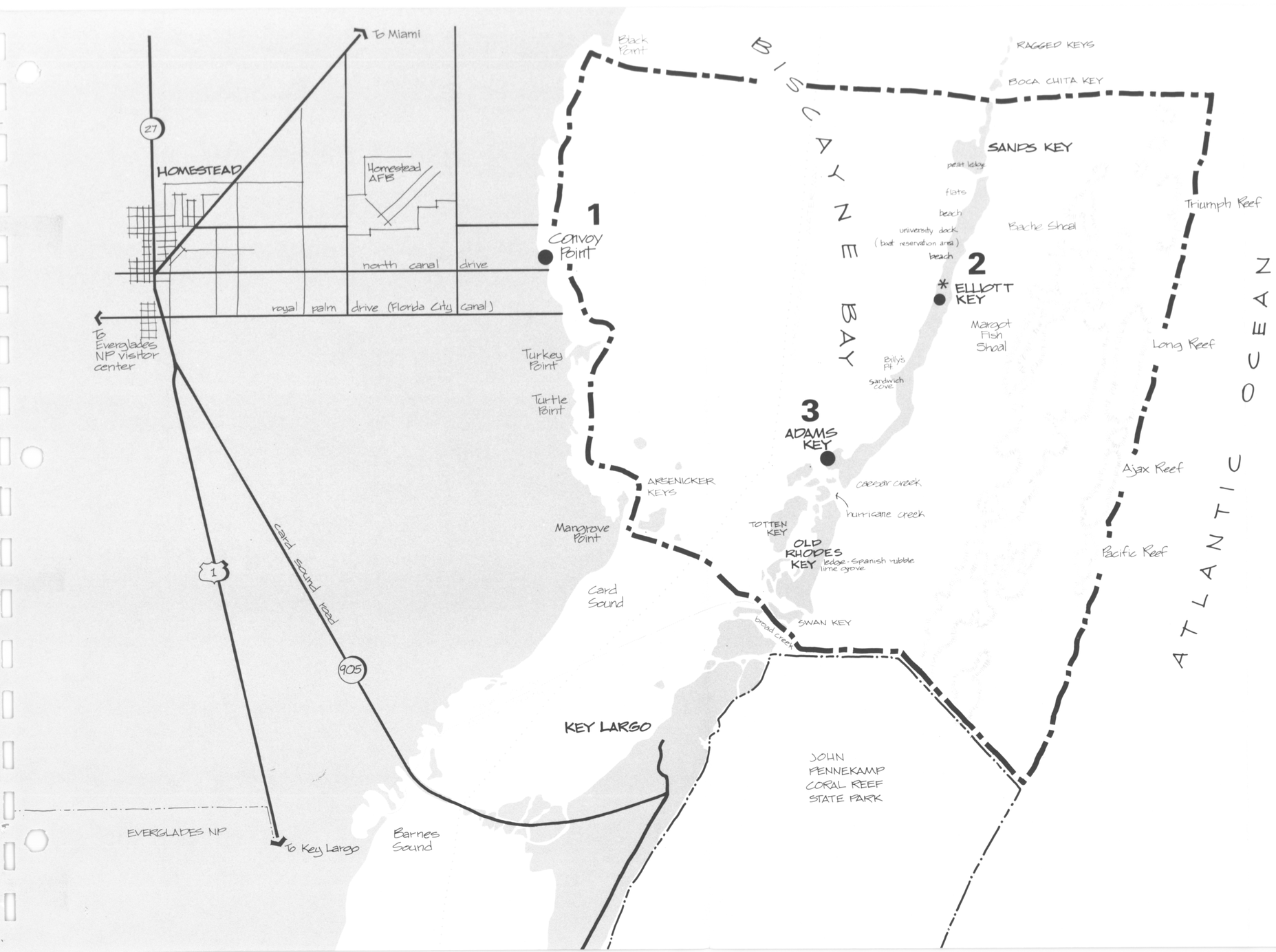
50 feet from shore toward the deep channel of Caesar Creek is the only docking facility available at the site. Sewage treatment is by a septic tank system and potable water is available for employees only.

c. Convoy Point. The monument headquarters site is located on approximately 10 acres of a 60-acre tract of land north of Homestead Bayfront Park, which was donated to the Park Service in 1973 by Dade County. The site, Convoy Point, serves as the main administrative and support complex for the entire monument. The 10-acre developed area is composed of dredge and fill land. The remaining 50 acres consist of natural mangrove wetlands. The site is bounded on the south by the Homestead Bayfront Park Channel, or North Canal, on the west by Dade County Park and Recreation land, on the east by Biscayne Bay, and on the north by Mowry Canal. Currently sewage treatment and disposal is handled by septic tank system. Potable water is piped in from the Homestead, Florida, area.

Existing development on the site includes an administrative office/temporary visitor-contact building; a comfort station; a trailer serving as research, protection, and maintenance headquarters; a maintenance warehouse and yard; two residence trailers; two parking lots of 77- and 74-vehicle capacity; a public boat-launching ramp that handled 8,150 boats from July 1975 to January 1976; a 240- by 150-foot Park Service marina that is dredged to a depth of 5 feet mean low water; an abandoned 640-foot canal that is blocked at its western terminus by road fill material; and associated lawn-covered grounds supporting scattered coconut palm trees that surround the complex.

Marine vegetation in the marina and launch ramp area is either sparse and/or opportunistic or nonexistent. It consists of assorted species of sea grasses, primarily Diplanthera. The common fish inhabiting these bodies of water are small grunts and juvenile mangrove snappers. Aquatic birds utilizing the mangroves for roosting or nesting include brown pelicans, cormorants, herons, and ibises. The birds that nest and live mainly within the mangrove vegetation include clapper rails, mangrove cuckoos, black-whiskered vireos, yellow warblers, and prairie warblers. These birds may be found in the mangroves immediately adjacent to the cleared administrative area but do not depend upon the site for subsistence.

The soils of the Convoy Point site are a significant element of the natural environment. The underlying sedimentary limestone rocks provide the parent material from which the indigenous soils have developed. This limestone bedrock in south Florida generally constitutes a significant mineral resource and is



1 LAND
- administrative headquarters
- visitor information
- maintenance & storage
- boat dock
- parking
- boat ramp

2 LAND
- picnicking
- swimming (unprotected)
- employee residences
- harbor with utilities & concession services
- visitor contact pavilion

3 LAND
- utility support services
- boat dock
- employee residences

● existing development zone

* group camping area

existing monument boundary

existing state park boundary

1 0 1 miles
1 0 1 kilometers

N

existing development

BISCAYNE NATIONAL MONUMENT
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

169 | 20,005M
DSC | JULY 78

ON MICROFILM

used as a base material for roads and airport runways and as construction aggregate in the manufacture of cement. Perhaps the most important environmental factor of the limestone bedrock is its capacity to hold and translocate great quantities of water. The limestones near the surface are coarse-grained shell rocks that contain numerous cavities. The entire area from Miami southward is underlain at a shallow depth by limestone or calcareous rock. Most of the surface rock is the Miami oolite. It is this mineral that has previously been dredged and deposited on the land surface for berms or fill to build the site up to its present level above high tide. Any previous natural environment on the 10-acre area, or along the adjacent shoreline that was donated by the county, has been altered for the establishment of the existing complex.

There is no record of historical or archaeological surveys on the 60-acre deeded land area. Logically, all traces of possible prehistoric activity on the 10-acre developed site would have been obliterated by the dredge and fill operations.

Present access to Convoy Point is gained by taking Lucy Street east from U.S. 1 at Florida City, Florida, to North Canal Drive, a two-way, all-weather, paved county road. The distance from U.S. 1, a major north-south artery, to the existing park headquarters site is approximately 9 miles.

The Intracoastal Waterway lies approximately 5.3 statute miles due east of the Convoy Point site and averages approximately 7 feet in depth at mean low water. Water depths throughout Biscayne Bay range from 1 to 9 feet. The eastern extremity of North Canal affords water access into the Convoy Point marina and the Homestead Bayfront Park marina.

4. Cultural Resources

The monument area is rich in an exciting history of Indians, Spanish explorers, pirates, sunken ships, buried treasure, rum-running, alien-smuggling, and secret military training. Other important historical themes include logging, shipwreck-salvaging, sponging, turtling, bird-pluming, pineapple and lime plantations, hideaway millionaire clubs, and hurricanes. All of these themes provide human interest and scale to natural resource interpretive themes.

The monument area was first occupied by groups of Indians of the Glades tradition, who inhabited the area almost 2,000 years ago. They subsisted by fishing, hunting land and marine animals, collecting plant foods, and gathering shellfish.

Juan Ponce de Leon, the first European to visit Florida, sailed in 1513 along the coastal reefs marking the eastern boundary

of the monument. A Spanish mission was established to the north at the mouth of the Miami River in the latter half of the 16th century, but Tequesta hostility soon forced its abandonment. The following century saw little European contact in the area, and the Spanish maintained only a nominal rule.

In 1733, a Spanish fleet, bound from the Caribbean to Europe, wrecked along the keys. Two of the fleet vessels still lie within monument waters.

Diseases, slave raids, and pressures from white and Creek Indian settlers gradually reduced the numbers of the Tequesta Indians until the group became nonexistent in the keys, probably by about the end of the 18th century. During this same period, sailors came into the monument area from the Bahamas to collect turtles, harvest the giant mahogany trees, and salvage shipwrecks.

Spain ceded her Florida lands, including the monument area, to England in 1763 in exchange for the return of Cuba. During the English period, several surveys were made of the coastal area of the monument, and some of the monument keys were given their present names. When the American Revolution began, England traded Florida back to Spain for the Bahamas, reinstituting Spanish control over the monument area. The United States purchased Florida from Spain in 1821 for $5 million and immediately set up a territorial government.

Salvaging of shipwrecks along the Florida Keys became big business, and Key West became a major center in south Florida, with the salvagers, or "wreckers," plying their trade throughout the keys, including the area within the monument.

Pirates used the Florida Keys as a headquarters for centuries, and the monument area was no exception. A wealth of legend exists about Black Caesar, who had his headquarters at the south end of Elliott Key.

The waters of the monument have been exploited for centuries, first by the Indians and later by white fishermen, spongers, and turtlers. Late in the 19th century, plantations were established on the keys, and soon great crops of pineapples and limes were being produced and shipped north to New York and Boston. The vicious hurricane of 1906 and competitive pressure from Cuba and Hawaii dealt a death blow to the plantations on Totten and Elliott Keys, ending this intensive use of the islands for agriculture.

During the prohibition era, the islands of the monument were used as staging areas for rum-runners carrying illegal spirits to Miami. At about the same time, aliens were smuggled into the United States from Cuba by using Elliott Key as a transfer point.

Adams Key was developed in the 1920s as the Cocolobo Club, a haven for rich sportsmen who wanted to fish for bonefish in seclusion. The club was later sold to other private owners and continued to be used by wealthy and famous guests. Presidents Harding, Johnson, and Nixon are among those who have visited the Cocolobo Club on Adams Key. The main structure of the complex burned to the ground in 1974.

During the 1950s and early 1960s, the landowners pushed hard for some form of connection with the mainland so they could develop their property on the keys. A Dade County municipality, Islandia, was chartered for the monument area for the express purpose of developing mainland access. However, during the 1960s an effort was begun to incorporate Islandia into the National Park System. After years of embittered controversy, Congress passed enabling legislation, and President Johnson signed Biscayne National Monument into existence in October 1968. (For a more detailed discussion of the monument's history, see USDI, NPS 1975b and 1975c.)

A historical studies plan has been prepared, and all structures within the monument will be evaluated to determine their historical significance and eligibility for nomination to the National Register of Historic Places. An April 16, 1976, memorandum from the regional director of the Southeast Region stated that the following structures had been assessed and did not meet National Register criteria:

Ledbury Lodge - Elliott Key
Higgs House - Elliott Key
Sir Lancelot Jones Residence - Porgy Key
Cocolobo Club Structures - Adams Key

It was suggested that the remaining structures of the Cocolobo Club complex and the Jones house be retained by the park for adaptive use rather than as historic structures.

An archaeological survey has been completed for all the keys in the park and the offshore reef area. Several significant terrestrial sites were identified. These sites have been evaluated and determined ineligible for inclusion on the National Register of Historic Places. However, portions of the reef area east of Elliott Key that contain innumerable underwater shipwrecks do meet the criteria and have been nominated to the National Register of Historic Places. These districts include a ½-acre site 300 to 400 meters off the southeastern shore of Elliott Key where the commercial English vessel Hubbard sank in 1769, and the area east of Hawk Channel to the eastern monument boundary that includes all the area between the north and south boundaries.

The latter area consists of a number of historic shipwrecks in various states of preservation that are located on the offshore reefs of hard and soft coral. These wrecks represent commercial and military ships of Spanish, English, and American registry from the 17th through the late 19th centuries. Historical research and non-scientific archaeological investigations have produced evidence of possibly as many as 42 shipwrecks in this district.

The Florida state historic preservation officer was contacted and requested to identify any additional properties that may qualify for or are in the process of nomination to the National Register. The response indicates that the area contains no additional properties that qualify for nomination to the National Register (see appendix I).

D. PROBABLE FUTURE ENVIRONMENT WITHOUT THE PROPOSAL

1. Trends in Development and Land Use

The existing federal development would be maintained and modified in minor ways to improve recreational activities, interpretation, and other park functions. Most of the visitor pressure on existing facilities, natural resources, and park staff would continue to be concentrated in the existing developments on the western side of Elliott Key and at Convoy Point. Much of Elliott Key and all of Adams Key would remain largely unused. If the visitation to the keys increased, facilities would become more difficult to maintain at an acceptable standard, and disturbance of the sensitive natural resources would increase. As south Florida continued to gain in population and tourism, and as more visitors placed demands on existing facilities, natural resources, and park staff, restrictions on the number of visitors to be accommodated in existing areas probably would have to be implemented.

The park's ability to provide for unique or unusual recreational and interpretive opportunities would become progressively more limited. Camping, hiking, natural history interpretation, and environmental education opportunities would be unavailable, or largely restricted to existing areas.

Public pressure on non-federal agencies to provide more recreational development probably would also increase. It would continue to be difficult to coordinate the development of public recreational facilities by many governmental agencies so that duplication of facilities, adverse environmental impacts, and land use incompatibilities could be minimized.

Development of presently undeveloped lands in the surrounding communities would continue, and federal involvement in controlling land use would remain minor. No resource classification plan would be issued, and no provisions for visitor safety or the quality of the visitor experience or of the natural resources would be formulated.

Therefore, without a general management plan, there would be no overall framework governing the role of the National Park Service in the future management of the waters and lands within the authorized boundary of the monument. Non-federal landowners could assume a relatively more substantial role in land use and development, with the result that the National Park Service could lose opportunities for improving environmental quality and providing unique recreational opportunities.

2. Trends in the Natural Environment

Protection of certain important natural environments would be uncertain. The outstanding natural area of Jones Lagoon would not receive the extra measure of protection such a resource requires.

Continued and unmanaged use of fragile environments (unique botanical and sensitive geologic and marine features) would gradually deteriorate these areas. Not acquiring the important natural habitats and scenic areas on lands now proposed for acquisition might result in their deterioration or loss.

3. Trends in the Socioeconomic Environment

Arriving visitors would receive orientation to the park but they would not be given adequate information about island accommodations, park attractions, and directions.

Failure to implement a public transportation system would prevent many visitors from having a monument experience.

Offshore mooring of private boats in undeveloped portions of Biscayne Bay would increase as congestion near major island developments increased. Use of these undeveloped lands would become more random, less well supervised, and potentially more damaging to the natural environment.

Because the capacity of existing park facilities would not be substantially increased to help provide for the increased regional population and visitation, the park's cultural and natural experiences would become progressively less available to local and other interested people.

IMPACTS

III. ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

A. NATURAL ENVIRONMENT

1. Vegetation

The Elliott Key Harbor complex will be located on the western portion of 2,022-acre Elliott Key in the area previously occupied by the 90-acre Elliott Key County Park. The boat basin, visitor-contact pavilion, comfort pavilion, concessions pavilion, maintenance and storage building, 35-site campground, ranger housing, and necessary utilities will require commitment of approximately 13 to 15 acres of land. Due to the historic use of the area as a county park, habitat disturbance has already occurred. Thus, the proposed development will not necessitate the removal of any additional native mixed-hardwood vegetation from Elliott Key. However, it is plausible that surface scarring of the trunks of some of the residual native mixed hardwood and palm trees located throughout the site will occur from the operation of heavy construction equipment for facility development. This should not cause tree mortality and thus should not exert a significant impact upon the vegetation.

The proposed Adams Key development site is situated on an existing 2- to 3-acre site on the southwestern shore of Adams Key. The key is approximately 77 acres in size, partially man-made, and covered with native subtropical mixed hardwood, buttonwood, mixed mangrove, and exotic Australian pine vegetation. The site presently supports several coconut palm trees and is underlain by an annual grass cover. Since implementation of the proposal at the developed site will not require removal of additional vegetation, no environmental impact to vegetation will occur.

It is plausible that with an increase in visitation to Elliott and Adams Keys, physical damage to vegetation typically associated with visitor use will occur at the developed sites and to a lesser extent throughout the keys. Wounds to trees and tree limbs inflicted by such instruments as hand axes and knives, the breakage of limbs resulting from tree climbing, and the trampling of ground cover vegetation are examples of such damage. The magnitude of such an impact is presently unquantifiable.

The proposed allowable resource uses (see table 2) are primarily water-oriented. Shoreline and lagoon exploring are principally land-oriented but will not have a direct impact on terrestrial vegetation. Indirect impacts from visitor use pressure, such as those previously mentioned, will occur with increased participation in recreational activities (e.g., hiking, camping) and from indiscriminate exploration along mangrove shorelines on the mainland and keys.

Shallow turtle, manatee, and shoal grass beds and indigenous algae species inhabiting the shallow bay waters and Jones Lagoon will continue to be scarred by propellers of power boats engaged in commercial and sport fishing, pleasure motorboating, water-skiing, and diving activities. It is plausible that the frequency of scarring will increase with implementation of a limited tour-boat service to Adams and Elliott Keys and with any increase in the use of the bay waters by private and commercial craft. Boat anchorage over the shallow grass beds in Biscayne Bay and Jones Lagoon will cause minor unmatting of the beds, but this will be of less magnitude than that caused by propeller scarring.

The development of approximately 8 miles of trail on Elliott Key and ½ mile of trail on Adams Key (see General Development map), and the accompanying placement of benches for resting and leisure seating and development of interpretive waysides, will enhance the visitors' monument experience. The trail alignment on Elliott Key will follow a 100- to 125-foot-wide swath that was bulldozed in 1968 and is presently naturally revegetating, primarily to Australian pine. Thus, trail placement will occur on a previously disturbed site where the exotic Australian pine has become established, and no native vegetation will be removed. Approximately 100 to 300 feet of the trail will pass through a native mixed mangrove area on the southern end of Elliott Key. The trail alignment at this point will be designed and aligned so that a minimal number of the mangroves will be destroyed. Trail construction at this location will incorporate a raised platform design and be located above the mean high water level. The trail alignment on Adams Key will pass through approximately 1,300 to 2,600 feet of mixed native and exotic vegetation and will necessitate the removal of the vegetation along this route.

At present, only limited use is made of Adams Key, due to the minimal public facilities. The increased use by visitors proposed for the key will expose the natural mixed hardwood, buttonwood prairie, and red and black mangrove communities to previously unexposed pressures associated with such use (soil compaction, limb breakage, trampling by foot traffic). Although the impacts should be localized at the developed area on the southwest portion of the key and along the trail corridor on the northern portion of the key, it is plausible that if the projected peak-day visitation of 200 people is frequently realized at the developed site, damage to the vegetation will be physically evident and a visual intrusion into the natural scene.

2. Water Quality

The completion of island development at the Elliott Key Harbor and the Adams Key complex sites, and the concomitant increase in peak-day visitor capacity to 1,000 and 200, respectively,

will proportionately increase the demand for potable water. The well supply (160 gpm), with adequate storage, should meet peak demands. The brackish Floridian aquifer which supplies the existing well is located 900 to 1,400 feet below sea level and extends from the islands of Miami Beach southward under the keys beyond Key Largo. Several wells already drilled into this aquifer from the Miami Beach and Key Largo areas provide reasonable assurance that an ample future supply of artesian brackish water can be obtained from this strata. The population of south Florida draws 100 percent of its water from wells. In the Miami Springs well field of the Miami Waterworks System, wells 60 to 95 feet deep are capable of yielding as much as 6 million gallons per well per day. The total drawdown in the cone of depression around this group of wells amounts to 3 or 4 feet when all wells are being pumped at an average rate of 3.5 million gallons per day. The area has a vast supply of brackish groundwater in the Biscayne aquifer, an area of 3,500 square miles; approximately 1,500 square miles lie in Dade County and the remainder in Broward County. Thus, although the demand created by development on Elliott Key will further tax the Floridian aquifer, no significant drawdown impact will occur.

Water clarity varies within the monument and is strongly dependent on wind conditions and precipitation. Typically, underwater visibility offshore is much greater than in the bay, occasionally reaching 50 to 200 feet (15 to 60 m) along the outer reef. Turbidity increases in inshore areas as the influence of tidal flushing increases. Within the bay, water clarity generally increases from the north to the south. Seasonally, water turbidity is at its peak during the extremely windy late winter and early spring months and at its lowest point during the calm summer period. Although more than a week is often required before conditions return to normal within the bay following climatic disturbances, water on the outer reefs clears more rapidly. It is plausible that an unquantifiable amount of increased sediment loading from surface runoff will occur in the aquatic areas of the bay immediately adjacent to the Elliott Key Harbor and Adams Key complex development sites during actual construction. This will temporarily reduce water clarity and increase turbidity in the affected aquatic areas. However, as previously mentioned, clarity will be restored and turbidity reduced with normal tidal fluctuations and wave action. Thus, the impact on these water quality parameters will be negligible.

Turbidity plumes from boat activity in shallow water areas depend upon water depth, motor power, operational time, and type and nature of sediment deposits. In shallow lakeshore areas with water depths less than 5 feet, physical changes in turbidity and floating matter at the surface were observed within

less than 5 minutes of boating activity. Therefore, turbidity plumes in the shallow water areas of the bay, although unquantifiable, will be in proportion to the depth of the drafts of the tour boats and private craft, their motor sizes and the frequency of trips from Convoy Point to Elliott and Adams Keys, and the duration of activity in shallow water areas. This factor combined with the use of the same areas by private craft and tour boats will serve to temporarily reduce water clarity and increase turbidity in the bay and along navigable channels.

It is plausible that gases such as water vapor, carbon monoxide, and oxides of nitrogen and sulfur from the boat motors' combustion chambers and hydrocarbons and lead compounds in unburned fuel mixtures will be introduced into the aquatic environment of the bay and ocean by the tour boats and small private motorboats in unquantifiable amounts. The amount will be proportional to the frequency that the proposed tour-boat route is traveled and will increase as the projected peak-day visitation of 850 to 925 boats on monument waters is realized. Release of unburned fuel, primarily hydrocarbons and engine oil, from the operation of two-cycle outboard motors is a recognized inherent feature, especially from improperly tuned engines. This type of water pollution has occurred in the past in monument waters, and it is plausible that it will continue in the future. However, quantification of the impact of such water pollution is impossible at this time because it is not known what, if any, ecological impact has occurred from existing and historical motorboat activity levels.

Bottom scarring from propellers will increase in shallow bay water areas such as Featherbed Bank, Cutter Bank, the shallow banks near Arsenicker Key and West Arsenicker Key, and Jones Lagoon from tour-boat use and with any future increase in private boat use of the monument. This is due to the increased probability of craft wandering out of the natural channels into these shallow areas.

It is plausible that the bottom scars will serve as barriers to the normal movement of fauna associated with the submerged grass beds, that faster circulation into previously poorly flushed areas will be afforded by the scar corridors, and that additional sources of easily disturbed fine sediment will be exposed to tidal scouring and transported to adjacent areas where smothering of biota will occur.

Repetitious visitor activity (motorboating, fishing, etc.) in the fragile Jones Lagoon area will tend to keep bottom sediments agitated and disturbed, break root mats of attached grasses, and kill or disrupt certain benthic fauna (e.g., sea urchins, sponges).

Where overnight anchoring of sail or motor craft occurs off Elliott Key and in sheltered locations at other sites inside the keys and away from sanitary facilities, undetermined amounts of untreated human sewage will continue to be discharged into monument waters. This is a typical problem in aquatic recreational areas and has historically occurred in the monument. It is not possible to quantify the specific impact of this inevitable practice on water quality at this time because it is not known what, if any, ecological impact has occurred in the past.

The approximately 300 feet of bulkheading necessary to stabilize the fill shoreline of Adams Key for boat docking purposes and avoid or minimize losses of shallow water and/or wetlands habitat will temporarily disrupt benthic organisms and other aquatic life forms in the vicinity.

3. Air Quality

There will be a temporary localized increase in air pollution (fugitive dust, hydrocarbons, oxides of nitrogen and sulfur, and carbon monoxide) from operation of internal combustion engines of equipment during construction activities at the Elliott Key and Adams Key development sites. However, adequate information (e.g., type of equipment, operation time) is not available to quantify these impacts at this time.

The increased use of motorized tour boats and private boats in marinas and monument waters will increase levels of carbon monoxide, hydrocarbons, nitrogen oxides, and other exhaust pollutants. However, because the vast majority of outboards have underwater exhaust, emission measurement and pollution concentration projections are very difficult. In order to estimate potential concentrations of air pollutants from outboard motors, either total fuel use or work output (horsepower hour) must be known. Since neither of these parameters is available for motorboat use in Biscayne National Monument, it is not possible to quantify the impact upon air quality occurring from this activity. However, since an almost continual air-sea wind regime is present to disperse such local sources of air pollution, it is plausible that the implementation of this plan will have no significant effect on ambient air quality.

4. Noise

Wind, wave activity, and occasional air traffic from Homestead Air Force Base are and will continue to be the major sources of noise at Biscayne National Monument. However, the increased use of motorized tour boats in marinas and monument waters will increase noise levels in the surrounding area and particularly along the proposed tour-boat route in the bay. This

increase in relation to the tour-boat service will be in direct proportion to craft motor size and frequency of route travel. These design parameters for tour-boat craft will be defined and quantified in the forthcoming transportation study.

Noise associated with resource uses will be principally that created by motorboats. Locations where the noise will be most evident include the Intracoastal Waterway, the west coast of Elliott Key, and Caesar Creek. If boat use in the proposed environmental protection subzone at Jones Lagoon is limited, it is plausible that the level of motorboat noise will decrease in that location.

The relatively noisy boat operations typically associated with water-skiing will exert an auditory intrusion upon the natural marine setting of the monument. This activity has historically taken place in Biscayne Bay and will continue to be centered in the bay area in the future. Thus, any auditory intrusion from this activity will be concentrated in this area.

There will be a temporary increase in noise levels from construction machinery operation during development at Elliott Key Harbor and the Adams Key complex sites.

5. Soils

Compaction of the shallow Key Largo limestone soils on Adams Key will occur when the site is officially opened to increased visitor use.

If the natural soils of the keys are used as filtering agents for sewage-treatment systems, it is plausible that pollutants associated with sewage effluent (suspended solids, BOD, etc.) will be partially retained in the soil complex.

Temporary soil erosion in the vicinity of the development areas at Elliott Key Harbor and the Adams Key complex will occur due to the activity of heavy construction machinery.

6. Wildlife

The critical habitat of the Florida manatee encompasses essentially the entire monument. Manatee have been observed in the area near the channels connecting the outer reef tract with the bay, throughout the bay proper, in the shallow waters surrounding the keys, and in the mangrove creeks of the mainland immediately west of the monument's west boundary. The Florida Marine Patrol has reported a few generalized sightings of manatee in the monument but does not have an estimate of exact numbers. The manatee in this area are known to occur primarily in the northern portion of Biscayne Bay between north Miami and Hollywood. It is postulated

that individuals occurring within a given population are likely to be widely dispersed throughout their habitat. That is, based on the limited sighting data available, they do not occur in concentrated groupings (Irving 1976). However, it is plausible that the regular schedule assumed by a tour-boat service and an increase in individual recreational boating activity in the monument will increase the opportunity for disturbance and/or injury to the endangered manatee because the tour-boat routes and boating activity will occur entirely within this critical habitat.

A single pair of nesting bald eagles has been observed on Arsenicker Key for approximately 15 years. However, during this period the nest has been active only four or five times and only one adult bird is consistently seen in the area and on the nest. No recent successful hatchings at the nest have been observed, although it is known that at least one egg was laid in 1975. It is assumed that the other keys of the isolated Arsenicker group would provide suitable nesting habitat for bald eagles. The tour-boat route will pass along the Intracoastal Waterway approximately 1 mile from Arsenicker Key. The endangered bald eagles on the key should not be disturbed by this activity because they have apparently become accustomed to the present traffic of larger craft in this area.

Temporary disruption of resident terrestrial wildlife species inhabiting the Elliott Key Harbor area and the Adams Key complex site will occur during construction activities.

Birds inhabiting the areas around the Elliott Key Harbor and the Adams Key complex site will be temporarily frightened away by construction noise. As they seek other areas, they will be forced to compete with existing resident populations for available food and cover. This will place a temporary stress on affected species until a suitable niche can be reestablished.

With peak-day visitation projections increasing to 1,000 on Elliott Key and 200 on Adams Key, an area previously closed to visitor use, the resident wildlife species may seek suitable habitat in other portions of the monument if they are unable to adapt to human intrusion.

The critical feeding and nesting habitats for the endangered brown pelican occur within the shallow waters of the monument and on the smaller mangrove-fringed keys (e.g., the Arsenicker Keys). Currently it is not known whether this habitat is being fully utilized, or whether any additional sites would be considered suitable nesting habitat by the birds themselves. Generally,

the success of the existing populations within the monument is to a large degree related to external and broad-scale factors (e.g., the chemical residues in food species that are known to affect the viability of pelican eggs). Although areas for certain recreational activities will be designated, if activities such as water-skiing are attempted in the narrow mangrove channels or around any of the keys noted as avian areas, it is plausible that harassment of birdlife will occur. This is especially significant in the case of the endangered brown pelican because it is plausible that disturbances of this nature will preclude any nesting or future inhabitance of the monument by this species.

The shallow, grass bottom areas of Biscayne Bay serve as a critical feeding habitat for the endangered hawksbill sea turtle. A critical nesting habitat for the hawksbill and leatherback sea turtles is available in limited amounts on the sandy shores on the bay and ocean sides of Elliott and Sands Keys. The current nesting success and frequency of these turtles on the shore is not known. It is plausible that the regular schedule assumed by a tour-boat system and an increase in individual recreational boating activity in the future will increase the opportunity for disturbance and/or injury primarily to the endangered hawksbill turtle as it feeds in the bay.

Direct damage to coral reefs through visitor vandalism or inadvertent breakage can be expected in the monument, particularly on those reefs that are being specifically identified and interpreted.

It is plausible that anchor damage to coral reefs - principally attributed to sport divers, fishermen, and pleasure boaters because commercial fishing operations are largely limited to non-reef areas - will occur from continued motorboat use.

Deliberate vandalism and inadvertent damage to coral reefs by diving visitors and their anchored craft will continue to occur with this monument activity. It is plausible that this type of reef damage will be concentrated in those reef areas identified and recommended for underwater viewing.

7. Fisheries

Sport and commercial fishing within monument waters will continue to have a variety of impacts upon the fish and fisheries of the monument. It is plausible that continued lobster fishing and spearfishing will result in decreased size and dispersed distribution of adult populations: Lobster fishing will affect the reproductive potential by removing the larger specimens from the breeding population; and spearfishing is likely to result in avoidance behavior by various finfish species, making it difficult for other divers to observe or photograph interesting subjects. The quantification of these impacts with specific

reference to the monument is a goal of the monument's research and resources management program. In general, it is plausible that the following impacts will occur.

Currently there is very little commercial hook and line finfishing within monument waters (see appendix J, section 1). However, should this technique become more extensively practiced in the future, it would result in larger catches of fish, and the impact on certain species would then have to be specifically assessed. Natural population dynamics of reef species (especially size distribution, territory size, population numbers) would be altered with increased commercial hook and line finfishing pressure. However, with non-reef species (e.g., pelagic sharks or transient schooling fishes) as targets of this technique, the impact would be less obvious.

Commercial activities for harvesting live shrimp species for bait are common in the bay waters of the monument. Observations by the monument staff indicate good compliance by shrimp fishermen to the requirement to throw back incidentally caught organisms such as seahorses, juvenile tropical fish, and lobsters. Such organisms also appear to survive well after their return, but it is plausible that a few will continue to be injured or killed in the process. Benthic disturbance due to deploying the nets is still not adequately assessed either in the monument or in other Florida waters. Shrimping takes place outside reef areas, and therefore little hard bottom disturbance is noted. The impact of fishing on total numbers of the shrimp population is not known. Indications are that the catch is below sustainable yield levels because (1) the industry has been operating in the area for many years without significant changes in shrimp abundance, and (2) the fishery is strictly based on daily market demand for fresh unfrozen bait shrimp, and that demand appears to be met without expansion of the fishery.

Commercial mullet fishing in the monument presently is at such a low level that no estimate of impact is possible (see appendix J, section 1).

Stone crab and blue crab are commercially harvested from the bay waters of the monument. Florida law requires that only the claws of stone crabs may be taken; the living clawless crabs must then be released. A fairly high mortality results either when the claws are removed, shortly after due to shock, or indirectly due to later inability to feed properly. Although the claws eventually regrow, the entire behavior (feeding, territorial, sexual) of a clawless crab may be radically different. The resulting impact on stone crab population dynamics is not known at this time because catch data specific to the monument do not exist for either stone or blue crabs.

Catch statistics of spiny lobsters specific to the monument are available only for the 1976-1977 season (120,000 lbs.). Although this is only a small portion of the total recorded Dade County catch (5,386,515 lbs. in 1973), it is relatively more significant to those 50 or so fishermen who utilize the monument as a frequent fishing area. It is plausible that boat traffic, anchorage in the bay, trawling for shrimp, or gill-net setting for mullet will alter the benthic environment of the bay and therefore adversely impact the juvenile lobster population. This type of impact has not been quantified for the monument.

Commercial sponging, principally for grass, sheepswool, and yellow sponges, is and will continue to be a common activity in the monument. Due to the technique employed, a certain mortality of attached or commensal invertebrate animals (worms, amphipods, gastropods) will continue and increase proportionately with increased sponge harvest. No complete statistics exist to determine historic changes in the frequency of sponging, but the impressions of the monument staff are that a significant increase has taken place over the past 3 or 4 years. It is possible that this increase will become significant in the future, especially during the March-August period when lobstering is closed and those fishermen turn to sponging.

Fishing for sea turtles is prohibited within the monument; therefore, no direct impacts will be exerted upon existing population numbers with implementation of the plan. No specific information is available on the extent to which continued motorboat activities and other water uses in the monument may incidentally affect sea turtles or their feeding habitat in shallow inshore waters. Nesting habitat is found in very few sections of the monument, none of which would become more accessible or be altered by the proposals in the plan.

Hook and line finfishing for private recreation and consumption is extensive throughout the monument. The current sport hook and line finfishing intensity in the monument has aroused suspicion of depletion in population numbers or alteration of dynamics of certain species. This is a general observation and has not been documented for the monument either by specific counts of fish removed or by studies of the populations under hook and line pressure, and its impact is not quantifiable at this time.

Spearfishing pressure will continue to remove the largest and most conspicuous fish from bay waters. These species include groupers, snappers, barracuda, and even smaller species such as damselfish.

The impact of sport lobster fishing has not specifically been demonstrated for Biscayne waters, but National Park Service biologists at Fort Jefferson have noted that lobsters respond to the heavy pressure of sport divers by quickly dispersing so that the average number per den drops significantly. The overall result of this sport-diver pressure is quick reduction in the population numbers and average size of individuals.

B. SOCIOECONOMIC ENVIRONMENT

1. Regional Trends

Biscayne National Monument adjoins one of the fastest growing population centers in the country. Florida's outdoor resources hold great appeal for both its inhabitants and visitors from other states. The state's beach and water areas are famous, and many localities depend on this drawing power for much of their prosperity. However, in southern Florida where many of the best beaches are backed by private property, the general public is denied access to the water for recreation; therefore, the resource that most contributes to the tourist demand is in serious shortage, in spite of efforts by government and private interests to acquire beachfront property for public use. An accessible and efficient tour-boat system will encourage use of the national monument by more people who do not own or have access to private boats. Such increases in use may serve to diversify the monument's geographic region of influence and points of visitor origin as well as increase the diversity in the socioeconomic characteristics of park visitors.

2. Recreational Opportunities

Visitors to Biscayne National Monument consist of local residents and vacationers; the majority are drawn from the surrounding five-county region (Dade, Monroe, Broward, Collier, and Palm Beach), which has a population of 2.5 million. Use of the monument's resources is continually rising. This is illustrated by 1967 and 1970 aerial counts of boats in Biscayne Bay and visitor statistics from Homestead Bayfront, Elliott Key, and other nearby parks (comparative increase by percent). Considering the observed rate of increase in recreational use by vacationers, and the size, composition, and rate of growth of the resident population, it may be postulated that the numbers of local visitors and vacationers will increase in the future. The existing development at Convoy Point can support approximately 660 visitors on a peak day, and it is plausible that such a level of visitation will be frequently realized due to the increased recreational facilities proposed by the General Management Plan for Elliott Key.

The development of an administrative/visitor-contact center at Convoy Point with a maximum daily capacity of approximately

800 visitors will enhance visitor awareness of the monument and its resources. This improved orientation and interpretation offered on the site will further serve to eliminate the aimless wandering and ignorance of specific opportunities that commonly accompany first-time visits and thus enhance the visitor experience.

The number of people without boats (local or vacationers) who may eventually visit the monument will depend on the attractiveness of the resource as well as the capacity of the monument tour-boat system. This capacity will be increased or decreased in proportion to demand, consistent with the continued preservation of monument resources and in accordance with energy conservation consciousness and cost/benefit effectiveness. Therefore, the provision of tour-boat access into the monument from Convoy Point for non-boating visitors will increase public awareness of the national monument's existence. There will be an increase in the number of local residents and other visitors utilizing the outlying keys, waters, and visitor-service facilities.

In the 1973-1974 season, some 54,417 pleasure boats were registered in Dade (31,983), Broward (17,634), and Monroe (4,800) Counties (Florida Department of Natural Resources 1975), and boat registration has been increasing over the past 5 years. It is plausible that the implementation of the tour-boat system will discourage the use of monument waters by some private boat owners and/or disrupt traditional local user patterns.

Traditional recreational use in the monument has been concentrated primarily west of Elliott Key on the bay side of the monument. Presently almost all activities are water-related, with boat use originating from marinas and private harbors along the coast south of Miami, primarily from Homestead Bayfront Park, Matheson Hammock Park, and Convoy Point. The adoption of a tour-boat service will make available to day-use, non-boating visitors expanded recreational facilities on Adams and Elliott Keys, expose them to the complete natural system of the monument, and contribute to the overall quality of the visitor experience.

Because the degree of interest in different activities varies, the Adams Key site, which will be developed for more than one purpose, will be convenient to visitors interested in multiple experiences (e.g., interpretation and recreation).

Despite zoning to separate incompatible recreational uses of the monument, it is plausible that conflicts between various types of users (e.g., water-skiers and snorkelers) will increase as visitation increases.

Recreational use of the monument's land area has been restricted essentially to Elliott Key due to the lack of facilities

and/or interpretive programs on the other keys. Natural factors such as heat and insects also affect use of the land areas. Camping and picnicking facilities and a modest developed swimming area exist at Elliott Key Harbor. These facilities are used extensively on weekends and holidays throughout the year. If overnight camping demand on Elliott Key increases to the capacity of the existing 35-site campground, the proposal not to expand this facility will have the effect of denying a segment of the public a monument camping experience. However, interest in commercial campgrounds in the region will be promoted. The former aspect of this impact will preclude the prospect of the disruption of the natural barrier island resource by further development; the latter will boost the local economy.

The provision of approximately 8 miles of trail on Elliott Key and ½ mile of trail on Adams Key for nature walks, hiking, and interpretive purposes, and the provision of a campground on Elliott Key, will increase visitor exposure to such natural safety hazards as insect bites and intense heat and sun present primarily during the summer months.

3. Visitation Trends

It is plausible that the cost for the use of the limited tour-boat service by people without boats will be a prohibitive factor to certain potential visitors.

The postulated peak-day visitation increase on Elliott Key from 600 to 1,000 visitors and on Adams Key to 200 visitors will increase the probability of damage to physical structures and interpretive devices due to vandalism and normal visitor pressures.

4. Visitor Experience and Aesthetic Quality of the Monument

The interpretive tower at Adams Key will be a visual intrusion because of its height. However, the height will facilitate an easy survey of a large portion of the monument waters, thus aiding visitor safety as well as interpretation.

The presence of markers placed to identify navigable channels will be a visual intrusion to the natural environment.

Orientation and interpretive information disseminated at Convoy Point and Elliott and Adams Keys will benefit visitors by assisting them in planning their visit and understanding the monument's resources.

The visitor experience will be improved by interpretation relating to the terrestrial and aquatic ecosystems, the cultural resources within the park at points along the trail on Elliott

and Adams Keys, the developed site on Adams Key, and the Convoy Point developed area.

Physical installation of interpretive devices (signs, chickees, etc.) will temporarily detract from the visitor experience at Convoy Point, Elliott Key, and Adams Key.

Bottom scarring will continue as motorboats pass through overly shallow water, especially through shallow grass beds in the bay. When viewed from above, these scars will constitute a long-lived aesthetic intrusion into the natural continuum of the grass beds.

Safety hazards, primarily to boating visitors, will increase with any increase in the number of inexperienced or uninitiated boat operators engaged in recreational boating activities (e.g., water-skiing). Actual hazards include higher frequencies of running aground or actually colliding with submerged features or objects. Also, rapidly moving ski boats are extremely dangerous to small anchored boats, snorkelers, scuba divers, or sail-powered vessels, and it is plausible that the probability of accidents associated with these incompatible uses will increase with any increase in these activities.

It is plausible that a social benefit will be derived through the exposure to and verbal interaction between visitors with diverse backgrounds during the tour-boat ride.

C. CULTURAL RESOURCES

A historical studies plan was prepared in March 1975, and all structures within the monument have been evaluated for their historical significance and eligibility for nomination to the National Register of Historic Places. On April 16, 1976, a memorandum from the regional director of the Southeast Region stated that the following structures were determined not to meet the National Register criteria:

Ledbury Lodge - Elliott Key
Higgs House - Elliott Key
Sir Lancelot Jones Residence - Porgy Key
Cocolobo Club Structures - Adams Key

It was suggested at that time that the residual structures of the Cocolobo Club complex and the Jones house be retained by the park for adaptive use rather than as historic structures. Therefore, there will be no impact exerted upon historical structures with the implementation of this proposal.

An archaeological survey was completed for all the keys in the park and the offshore reef areas. Approximately 11 significant terrestrial sites were identified. These sites were evaluated and determined ineligible for nomination to the National Register of Historic Places. Portions of the reef area east of Elliott Key contain approximately 42 identified underwater shipwrecks. The shipwreck sites meeting National Register criteria include a ½-acre site 300 to 400 meters off the southeastern shore of Elliott Key where the commercial English vessel Hubbard sank in 1769, and the area east of Hawk Channel to the eastern monument boundary that includes all the area between the north and south boundaries. The latter area consists of a number of historic shipwrecks in various states of preservation that are located on the offshore reefs of hard and soft coral. These wrecks represent commercial and military ships of Spanish, English, and American registry from the 17th through the late 19th centuries. It is plausible that the estimated increased visitor use of the ocean waters east of Elliott Key will exert additional pressure on these submerged cultural remains in the form of artifact hunting and vandalism.

MITIGATING MEASURES

IV. MITIGATING MEASURES INCLUDED IN THE PROPOSED ACTION

A. NATURAL ENVIRONMENT

To minimize the visual intrusion imposed by new structures, all proposed facilities on Elliott and Adams Keys will have architectural designs that are compatible with the natural landscapes and atmosphere of Biscayne National Monument. At these island development sites, previously disturbed lands will be used for construction of new facilities to minimize visual intrusion and eliminate the loss of native vegetation.

Areas of high ecological value, such as tidal creeks and certain areas of the reef tract, will be left undisturbed, except for the construction of a boardwalk for interpretation and access between Elliott and Adams Keys. All pedestrian crossings of this area will be on elevated boardwalks to minimize damage to the ecosystem from trampling. Railings will be used along the boardwalk and other sections of the trail that pass through fragile ecological areas in order to confine visitor movements to the trail itself and minimize damage to natural resources.

The hiking trail will generally follow the existing road cut on Elliott Key. Where the trail passes through native mangroves, an elevated walkway will be provided, and the route will be so aligned as to minimize or eliminate the need to remove any trees.

In implementing the tour-boat system, limitation of vessel size and draft will greatly reduce overall impacts on the natural environment. Designated routes will ensure proper water depths in the vicinity of tour-boat operation. Routing will be as far away as possible from the Arsenicker Keys to minimize disruption of birdlife. Noise abatement will be considered in selecting boats so that significant reduction of noise from boats - probably the most objectionable noise source for most visitors - will be achieved.

Adequate signing of channels will decrease the likelihood of propeller scarring. Tour-boat speeds will be regulated in sensitive areas.

Informing visitors of administrative and regulatory policies will decrease destructive activities, thus aiding in the protection of the area's resources.

Wastewater-treatment facilities at both island development sites will be designed in compliance with all applicable federal, state, and county standards. Any discharge into the bay from

sewage-treatment facilities will conform with state and Environmental Protection Agency standards. Malfunctions of sewage-treatment systems will be minimized by rigid adherence to standards of operation and maintenance.

Conservative use of water resources at island development sites and at Convoy Point will be encouraged.

To mitigate the impact of increased visitation on the monument, the form and extent of that visitor use will be channeled and managed so as not to exceed the capacity of any portion of the system or to cause irreversible damage to the resource. Determination of this capacity will be made in future resource management planning.

Research will be continually conducted to provide information that will promote the enhancement of environmental quality and the preservation of natural resources. Research findings will allow the known present and potential adverse impacts of the plan to be reduced and the beneficial impacts to be optimized.

B. SOCIOECONOMIC ENVIRONMENT

Informing visitors of environmental hazards will increase safety.

Informing visitors of administrative and regulatory policies will decrease destructive activities, thus aiding the monument's policing efforts.

Restricting use in designated areas to one or more user groups will help prevent conflicts between various types of users in any given area.

The railings used along the boardwalk and other sections of the trail that pass through fragile ecological areas will minimize visitor safety hazards. The design of the tower will also incorporate safety features: railings, fencing, etc.

Research will be continually conducted to provide information that will promote the enhancement of socioeconomic conditions. Research findings will allow the known present and potential adverse impacts of the plan to be reduced and the beneficial impacts to be optimized.

C. CULTURAL RESOURCES

No direct adverse impacts on historical and archaeological resources are indicated in the analysis presented in this Final Environmental Statement.

The designation of the historic districts and the inherent protection afforded by this classification will lessen impacts on submerged archaeological resources.

A competent archaeologist will be available to monitor activities (such as construction) that might uncover archaeological artifacts. This action will be implemented whenever construction involving subsurface disturbance or excavation is planned.

Research will be continually conducted to provide information that will promote the preservation of cultural resources.

UNAVOIDABLE ADVERSE IMPACTS

V. ADVERSE IMPACTS THAT CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

A. NATURAL ENVIRONMENT

Approximately 13 to 15 acres of land on the western shore of Elliott Key and 2 to 3 acres of land on the southern shore of Adams Key will be committed for development of visitor-contact sites at the Elliott Key Harbor and the Adams Key complex.

Approximately 4 to 6 acres of land along the previously bulldozed swath running down the center of Elliott Key will be committed for development of the 8-mile hiking, nature, and interpretive trail. Approximately 0.5 to 1.0 acre of land along the northwestern portion of Adams Key will be committed for development of the interpretive trail that will connect with the southern terminus of the trail on Elliott Key.

Surface scarring of the trunks of some of the residual mixed hardwood and palm trees located throughout the partially open Elliott Key Harbor site will be unavoidable with the operation of heavy construction equipment for facility development.

Loss of habitat for small mammals and other wildlife species inhabiting the Elliott Key Harbor and Adams Key complex sites is unavoidable with the commitment of the areas for such development and the regular visitor use that will occur with the provision of the facilities. However, none of these species is listed as endangered.

A temporary stress will be placed on bird species that are residents of or live in close proximity to the Elliott Key Harbor and Adams Key complex sites, as they will be frightened away from their customary habitat by the noises and construction activity. Thus, they will be forced to compete with existing populations elsewhere for food and cover.

Wildlife species that are socially intolerant or unable to adjust to regular human presence from increased visitation will be unavoidably forced to seek habitat elsewhere on the keys.

The increase in sediment loading in the bay from surface runoff during construction of the Elliott Key Harbor and Adams Key complex sites will temporarily reduce water clarity and increase turbidity in those aquatic areas near the sites.

The continued release of hydrocarbons and engine oils into the water from the operation of outboard motors is unavoidable.

An increase in bottom scarring from propellers, especially in the shallow water areas of the bay, is unavoidable with any increase in boat activity in the future.

The disruption and destruction of benthic organisms and other resident or opportunistic aquatic life from the bulkheading of 300 feet of the existing fill shoreline on southern Adams Key for boat dock and stabilization purposes is unavoidable.

Minor disturbance of marine birdlife (cormorants, pelicans, etc.) by a scheduled tour-boat system is unavoidable with the regular plying of the bay and docking activities at Elliott Key Harbor, the Adams Key complex site, and Convoy Point.

With increased boating activity introduced by a limited tour-boat service and an increase in private boat owner use, an increase in the probability of disturbance and/or injury to the endangered manatee will be unavoidable.

Any unavoidable adverse effects of the tour-boat service will be positively identified and defined upon selection of a specific craft. However, it is known that boat-induced water turbidity plumes and unquantifiable air pollution from the boat motors will be unavoidable.

The impacts upon vegetation (see "Impacts" section) from increased visitor use of Elliott and Adams Keys are unavoidable. These include disturbance of vegetation near campsites and the hiking trail.

The temporary localized increase in air pollution (fugitive dust, hydrocarbons, oxides of nitrogen, and carbon monoxide) from operation of internal combustion engines of heavy equipment during construction activities on Adams and Elliott Keys is unavoidable.

The short-term increase in noise levels from heavy equipment operation in the immediate vicinity of the Elliott Key Harbor and Adams Key complex sites during construction activities is unavoidable.

The noisy boat operation typically associated with water-skiing and its auditory intrusion upon the natural marine setting of the monument will unavoidably continue.

Temporary erosion of the soils at the Elliott Key Harbor and Adams Key complex developed areas will be unavoidable during the operation of construction equipment for proposal implementation.

Although recreational use areas will be designated, if activities such as water-skiing are attempted in narrow mangrove channels, tidal creeks, or around any of the keys recognized as rookeries or avian areas (Arsenicker Keys), harassment of resident birdlife will be unavoidable.

Direct damage to coral reefs through visitor vandalism or inadvertent breakage, particularly on reefs being specifically identified, is unavoidable.

B. SOCIOECONOMIC ENVIRONMENT

An increase in littering and in demand on existing facilities and monument resources will unavoidably occur with the introduction of visitors to Adams Key and the increase in visitors to Elliott Key.

Visitor inconvenience and disenchantment will unavoidably occur if visitation levels reach a proportion that cannot be adequately accommodated by the proposed development.

Despite zoning to separate incompatible recreational uses of the monument, conflicts between various types of users will unavoidably increase with an increase in visitation.

The increase in the probability of damage to physical structures and interpretive devices due to vandalism and normal visitor-use pressures will be unavoidable with the increase in visitation.

The detraction from the natural scene and disruption of visitor experiences caused by the installation of facilities and interpretive devices (signs, chickees, etc.) is unavoidable.

The visual intrusion of the interpretive-observation tower on Adams Key at the development site is unavoidable.

C. CULTURAL RESOURCES

Cultural resources, especially subsurface remains, may be unavoidably disturbed by construction activities on Elliott and

Adams Keys in spite of surveys and on-site archaeological consultation.

Increased visitation and recreational use of ocean waters in the area of the historic shipwrecks could result in looting and further removal of artifacts from the sites.

SHORT-TERM/LONG-TERM RELATIONSHIPS

VI. THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Lands within the monument will provide for activities oriented to the natural and/or cultural environment, such as interpretation, camping, fishing, picnicking, and hiking. These activities will be accommodated within the capacity of the natural environment to support them without unacceptable damage. The various proposals for use and management will ensure the long-term perpetuation of the national monument's resources and a gradual enhancement of environmental quality. The proposed development at Elliott and Adams Keys, and the management and recreational use of the monument's resources, will result in an improvement of natural environmental conditions, as well as greatly increased opportunities for a diverse spectrum of recreational activities that are presently unavailable or in short supply elsewhere in the region.

Minor short-term environmental losses will result from construction of new facilities, modification of existing ones, or modification to grounds at island development sites. The long-term benefits derived from these actions will be improved visitor information services and overall interpretation of the monument's resources.

The provision of island development sites will allow long-term utilization of the islands by visitors. Long-term enhancement of the visitor experience will result as more people are able to visit the monument and enjoy a greater variety of activities. Overnight camping will allow visitors the time to develop an in-depth appreciation of the islands. As a result, some disruption of the natural environment will occur. Over the short term, construction activities will temporarily disturb natural systems by accelerating erosion rates, noise levels, and air pollution. Over a long period of time, there will be a continual effect on the natural values of the developed area from high-density public use. Evidence of human use will spread into previously undisturbed natural areas.

Although land will be committed to recreational uses, it could be allowed to revegetate through disuse and be returned to a natural state.

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS

VII. IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES THAT WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

The proposed management zoning plan prescribes use and development within the monument. Once prescribed uses are provided for in designated zones, alternative uses of the land - and the economic or social benefits that might be derived therefrom - will be irretrievably lost for as long as the management zoning plan is in effect.

Except for limited use of concrete and other materials in construction of bulkheads and structures, the General Management Plan proposes no consumptive use of non-renewable natural resources, and hence no irreversible commitments of natural resources.

The expenditure of capital, energy, and manpower for island development site construction and operation of the tour-boat service will be an irretrievable commitment of resources.

ALTERNATIVES

VIII. ALTERNATIVES TO THE PROPOSED ACTION

A. ALTERNATIVE VISITOR-CONTACT SITES

The enabling legislation for Biscayne National Monument provided for the establishment of a visitor-contact site on Key Largo not to exceed 40 acres in size. The purpose of the site was to provide additional administrative facilities, a visitor-contact and orientation station, and facilities for boat embarkation to the monument and its resources. Initial planning efforts identified two alternative sites on the leeward side of north Key Largo: Wednesday Point and Steamboat Creek. If either were selected for development as a visitor-contact site, it would be operated concurrently with the Convoy Point headquarters site, serve primarily as an embarkation point for boating and non-boating visitors from the mainland, and be classified as a development zone in the resource classification scheme.

1. Wednesday Point

a. Description

(1) Existing Conditions. Located 5 statute miles south of the monument (see Alternative Visitor-Contact Sites map), the area is covered primarily with native vegetation except for a stand of exotic Casuarina on the northwest side of an existing 2-acre, water-filled boat basin. A 1-acre skeet range, an access road running south from the Key Largo Anglers Club, and an additional 2 acres of filled and landscaped land comprise the site under consideration. The area is bounded on the north by the Key Largo Anglers Club, on the east by Florida Route 905, on the south by privately owned property, and on the west by Card Sound.

(2) Soils and Vegetation. Vegetation on this site is primarily native red and black mangrove and buttonwood in their typical natural setting. Casuarina is found along the northwest tip of Wednesday Point. The skeet range and the area immediately surrounding the boat basin northward to the Key Largo Anglers Club complex is comprised of filled and landscaped terrain.

(3) Cultural Resources. There have been no archaeological or historical surveys conducted on this site because of physical inaccessibility. However, this site was rejected on the basis of environmental degradation prior to reaching that point of the planning process where cultural surveys were to be initiated.

(4) Road Access. Present access to Wednesday Point on north Key Largo is afforded by Florida 905 from U.S. 1 approximately 3 miles south of Homestead, Florida. This paved, two-way state road crosses the Card Sound Bridge ($.60 toll one

way for vehicles with two axles) and continues for approximately 8 miles northward up Key Largo to the northern extremity of the key at the Ocean Reef Yacht Club. The site is situated approximately 0.25 mile south of the yacht club on the west side of Florida 905. Actual road access into the site from the state road does not exist at this time and would have to be provided should this site be selected.

(5) Water Access. The Intracoastal Waterway lies approximately 3 statute miles west of the Wednesday Point site and averages approximately 7 feet in depth at mean low water (mlw) in this vicinity. Water depths throughout Card Sound range from 1 to 11 feet mlw. Access to the monument would be northward via the Intracoastal Waterway. In the immediate area of the existing boat basin, the water depth is approximately 10 feet. The Key Largo Anglers Club operates a private marina approximately 0.2 mile north of the site, which is also accessible from Card Sound and the Intracoastal Waterway.

(6) Required Development. The existing development at the Wednesday Point alternative visitor-contact site is minimal. However, with modification the site could meet the physical standards required for the level of development inherent in such a facility. The following were identified as development requirements at the Wednesday Point site:

Since no structures are currently located on the site, construction of the visitor-contact/administrative-support center, the residential complex, and the parking area would be necessary.

Approximately 1 mile of access and circulatory roadway would also have to be constructed for adequate access into and throughout this site.

The existing 2-acre boat basin would have to be enlarged to a minimum of 3 acres to accommodate future traffic loading from increased visitation, official National Park Service use, and implementation of alternative access and circulation modes.

(7) Land Status. Approximately 20 to 25 acres of this 40-acre site are presently owned by the Key Largo Anglers Club. The land is all privately owned and is taxed at $2,500 to $4,500 per acre.

b. Impacts

(1) Natural Environment

(a) Vegetation. The 40-acre Wednesday Point site is covered primarily with native buttonwood and mangrove vegetation except for a stand of exotic Australian pine located



existing development zone
visitor-contact site
existing monument boundary
existing state park boundary

miles
kilometers
N

alternative visitor-contact sites

ON MICROFILM

BISCAYNE NATIONAL MONUMENT
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

169 | 400058
DSC | JUL 76

on the northwest side of the existing 2-acre boat basin. The skeet range and the area immediately surrounding the boat basin northward to the Key Largo Anglers Club complex is comprised of filled and landscaped terrain.

Removal of approximately 12 to 16 acres of exotic Australian pine and natural mangrove and buttonwood vegetation would be necessary for the construction of a visitor-contact/administrative-support center, residential complex, parking area, and access and circulation road system at this location. Bulkheading the fill shoreline of the boat basin at the docking slips for stabilization purposes would temporarily disrupt benthic organisms and other aquatic life.

Visitor use of this area would have an unquantifiable impact on the vegetation remaining after development. Impacts would include wounds to tree trunks and limbs inflicted by such instruments as hand axes and knives, the breakage of limbs and mangrove roots by climbing, and trampling of ground cover vegetation.

No natural mangrove or buttonwood vegetation would have to be removed to modify and enlarge the existing boat basin and access channel to meet the requirements of a visitor-contact facility at this location.

(b) Water Quality. The existing 2-acre boat basin would have to be dredged for deepening and enlargement to 3 to 4 acres. The spoil from the dredging operation would be a disposal problem and a potential water pollution problem.

Heavy boat traffic into and out of the boat basin with resulting wakes and prop wash would combine with natural forces (such as tidal action and storm waves) to increase erosion rates of the unprotected marina and access channel shoulders. If the shoulders were left unprotected, slumping and erosion would contribute sediment to channel and marina bottom, necessitating more frequent maintenance dredging.

This alternative would involve removal and disturbance of indigenous aquatic organisms and bottom life in the existing boat basin by maintenance dredging.

The general ecological impacts of dredging to deepen and widen channels and marinas are increased siltation and turbidity; reduced photosynthesis of phytoplankton and decreased primary productivity; burial of bottom-dwelling organisms by silt; oxygen depletion; and direct removal of shellfish and finfish habitat. However, these impacts are unquantifiable for the boat basin at Wednesday Point.

The installation of a visitor-contact/administrative-support complex with attendant employee residences would necessitate the provision of potable water at an area where water has not been previously provided. The brackish Floridian aquifer is located 900 to 1,400 feet below sea level and extends from the Miami Beach area to beyond Key Largo. Several wells already drilled into this aquifer from the Miami Beach and Key Largo areas indicate that an ample supply of artesian brackish water can be obtained from this strata. This would necessitate the drilling of a well at this site and the installation of a desalinization plant to render the water potable for human consumption. It is impossible to quantify the impact of such a well on the Floridian aquifer at this time.

There would be an unquantifiable amount of increased sediment loading from surface runoff in the aquatic areas of Card Sound immediately adjacent to the Wednesday Point site during construction for facility installation. This would temporarily reduce water clarity and increase turbidity in such affected areas. However, clarity would be restored and turbidity reduced with normal tidal fluctuation and wave action because most of the material to be dredged would be pure sand, or sand and shell with little or no organic material. Such materials have rapid settling rates, which would reduce the amount of time material would remain in suspension and rapidly dissipate turbidity plumes.

Turbidity plumes from motorboat operation in shallow water areas of Card Sound would occur and vary according to water depth, motor power, operational time, and type and nature of sediment deposits. In shallow lakeshore areas with water depths less than 5 feet, physical changes in turbidity and floating matter at the surface have been observed within less than 5 minutes of boating activity. Therefore, it is plausible that turbidity plumes in shallow water areas of the bay would occur in proportion to the depth of boat draft, the craft's motor size, the frequency of trips from Wednesday Point to Convoy Point to Elliott and Adams Keys, and the level of general activity in the sound.

It is plausible that gases such as water vapor, carbon monoxide, and oxides of nitrogen and sulfur from the combustion chambers and hydrycarbons and lead compounds in unburned fuel mixtures would be introduced into the aquatic environment by the tour boats and small private motorboats in unquantifiable amounts. These amounts would be proportional to the frequency that the proposed tour-boat route is traveled and would increase as the projected peak-day visitation of 850 to 925 boats on monument waters was realized. Release of unburned fuel, primarily hydrocarbons and engine oil, from the operation

of two-cycle outboard motors would be a recognized inherent feature, especially from improperly tuned engines. This type of water pollution has occurred in the past in monument waters from the operation of such motors, and it is plausible that it would continue in the future. However, quantification of the impact of such water pollution is impossible at this time because it is not known what, if any, ecological impact has occurred from existing and historical motorboat activity levels.

Bottom scarring from propellers would increase in shallow bay and sound water areas such as Featherbed Bank, Cutter Bank, the shallow banks near Arsenicker Key and West Arsenicker Key, and along other navigable routes with any future increase in private boat use of the monument. This would be due to the increased probability of craft wandering out of the natural channels into shallow areas. For the same reason, turbidity, the reduction of water clarity, and injury to benthic organisms would increase within the general area of the designated channels and existing marina with increased boat use.

It is plausible that the bottom scars would serve as barriers to the normal movement of fauna associated with the submerged grass beds, that faster circulation into previously poorly flushed areas would be afforded by the scar corridors, and that additional sources of easily disturbed fine sediment would be exposed to tidal scouring and transported to adjacent areas where smothering of biota would occur.

The construction of a parking lot would increase the runoff into Card Sound during periods of heavy rainfall. This runoff would carry unquantifiable amounts of additional pollutants into the sound.

(c) Air Quality. There would be a temporary localized increase in air pollution (fugitive dust, hydrocarbons, oxides of nitrogen, and carbon monoxide) from internal combustion engines of equipment during construction activities at Wednesday Point on Key Largo. However, adequate information is not available to quantify these impacts at this time.

The increased use of motorized tour boats in marinas, Card Sound, and monument waters would increase levels of carbon monoxide, hydrocarbons, nitrogen oxides, and other exhaust pollutants. However, an almost continual air-sea wind regime would rapidly disperse such local sources of air pollution. The forthcoming transportation study would provide frequency of travel information from which air pollution could be quantified.

The addition of a visitor-contact facility on Key Largo would supply additional air pollution to the relatively clean atmospheric conditions indigenous to the island.

Although ambient levels of carbon monoxide have not been monitored in the vicinity, the additional concentrations created by the development of a visitor-contact site would probably not exceed the national ambient air-quality standards. Monitoring prior to the establishment of a parking lot would be necessary to accurately predict the impact of the parking lot on air quality.

(d) Noise. There would be a temporary increase in noise levels from construction machinery operation during development at the Wednesday Point site. However, the increased use of motorized tour boats in the boat basin, northern Card Sound, and monument waters would increase noise levels in the surrounding area and particularly along the proposed tour-boat route. This increase in relation to the tour-boat service would be in direct proportion to craft motor size and frequency of route travel.

The establishment of facilities at this site, combined with an increase in park visitation, would increase vehicular noise in the immediate area.

(e) Soils. Stabilization of eroding banks would be necessary along the marina because prop wash and wake would increase erosion rates.

(f) Wildlife. The regular schedule assumed by a tour-boat system to and from Wednesday Point would increase the opportunity for disturbance and/or injury to the endangered manatee because the critical habitat for the manatee encompasses essentially the entire monument and northern Card Sound.

An increase in the traffic volume on Florida Route 905 would occur because it is the main vehicle artery to the site. With such an increase, it is plausible that an unquantifiable increase in the road kill frequency of small mammals would be inherent.

This site is near the critical habitat of the threatened Key Largo wood rat (Florida Game and Fresh Water Fish Commission 1977). Establishment of the visitor-contact site in this area could bring about the migration of this species to another portion of the island. If no other suitable habitat site existed, possible eradication of the species could occur. If the species were able to coexist with the development, road kills might serve to further reduce its number.

Construction of an access road and development of the site would remove approximately 10 to 15 acres of native vegetation and wildlife habitat. Furthermore, the filling required to establish a foundation for necessary buildings and structures could exert a secondary effect on the marine habitat and its associated wildlife species.

It is plausible that construction activities, noise, removal of vegetation, and visitor use would cause indigenous wildlife species to seek habitat in areas outside the site. If sufficient compatible habitat did not exist at other locations on Key Largo, it is plausible that unquantifiable numbers of certain species might be reduced and possibly eradicated.

All boat traffic originating from Wednesday Point would pass through the critical habitat of the American crocodile. With increased boat usage in the area, the frequency for injury to the crocodile would increase.

Birds would be temporarily frightened away by construction noise. As they sought other areas they would be forced to compete with existing populations for available food and cover. This would place a temporary stress on affected species.

(2) Socioeconomic Environment

(a) Regional Trends. There is an absence of lodging accommodations and food and vehicle service facilities in the immediate area surrounding Wednesday Point. The nearest services of this nature are approximately 8 to 10 miles south of the site via Florida 905. Therefore, there would be a possibility for commercial development in the immediate vicinity to provide such services to monument visitors.

Utility systems capable of accommodating an influx of visitors to a previously undeveloped area would have to be installed.

A $1.20 toll (round trip) for utilization of the Card Sound Bridge would be incurred by visitors approaching from the north for road access from U.S. 1 and Florida 905. With the provision of a visitor-contact facility in this location and the attendant generation of visitation, it is plausible that an unquantifiable increase in revenue from the Card Sound Bridge toll would be realized.

(b) Visitor Experience and Aesthetic Quality of the Monument. Currently there are no lodging accommodations or food services located in the north Key Largo area in the general vicinity of Wednesday Point. The nearest services of

this nature are approximately 8 to 10 miles south via Florida 905. This immediate unavailability of such services would cause visitor inconvenience.

It is plausible that persons intending to visit the monument via a tour-boat service embarking from Wednesday Point might be disenchanted by interruptions in schedules caused by inclement weather, mechanical repair to vessels, or other related factors.

Adequate diversionary programs and facilities to entertain visitors (interpretive presentations, picnic areas, etc.) while they waited for tour-boat services would be required at this site.

Physical development would occur in a natural area. This development would be an unnatural intrusion.

(c) Management and Administration. The Wednesday Point site is not located on a major highway artery and would necessitate a 36-mile round trip from U.S. 1 for visitors utilizing the existing Florida 905 as a road access. Furthermore, a $1.20 toll (round trip) for the Card Sound Bridge would be imposed on visitors approaching the site from the north.

Wednesday Point is approximately 20-25 road miles from the administrative headquarters at Convoy Point. It is approximately 5 nautical miles from the southern boundary of the monument. The logistics of a facility at this location would necessitate support facility establishment for management, protection, and visitor services purposes. Nevertheless, boat and/or vehicle commuting into the monument or to the main headquarters at Convoy Point would require additional operational funds and an unquantifiable expenditure of energy and manpower.

(3) Cultural Resources. The 40-acre area is currently privately owned and has never been surveyed for historical or archaeological resources. However, the extreme environmental degradation that would occur with development of this primary natural area for a visitor-contact facility was recognized and the site rejected prior to reaching the point in the planning process where cultural surveys would have been programmed.

2. Steamboat Creek

a. Description

(1) Existing Conditions. Steamboat Creek is situated south of Card Sound approximately 2 statute miles east of the Card Sound Bridge on the west side of Key Largo, about 6 miles south of the present monument boundary (see Alternative

Visitor-Contact Sites map). This site is entirely undeveloped and conveys a natural marine setting. The only man-made intrusion into the natural scenery is the bridge over which Florida 905 passes. The site is bounded on the north by Card Sound, on the south by Florida 905, and on the east and west by privately owned, naturally vegetated land.

(2) Soils and Vegetation. The vegetation on this site is comprised entirely of native red and black mangrove. There is no land present that would support physical development, since mangrove communities typically establish in a semi-aquatic environment to satisfy physiological requirements of the species. The soil is of the same origin as that on Elliott Key and is composed of Miami oolite. There is no fill material on the site other than that placed to serve as foundation for the bridge abutment.

(3) Cultural Resources. There is no record of any historical or archaeological survey of this site.

(4) Road Access. Present access to Steamboat Creek is gained by taking Florida 905 south from U.S. 1, approximately 3 miles south of Homestead, Florida. This two-way, state-maintained highway crosses the Card Sound Bridge ($.60 toll one way for vehicles with two axles) and continues northward up Key Largo for approximately 8 miles to the northern extremity of the key at the Ocean Reef Yacht Club.

The proximity of the highway to the area would satisfy the need for site access. However, construction of circulatory roads to adequately service the facilities at the site would be necessary.

(5) Water Access. The site is adjacent to the east and west shoreline of Steamboat Creek, a 150-foot-wide tidal channel approximately 2.5 statute miles south of the Intracoastal Waterway. The bridge supporting Florida 905, about 0.1 mile from the mouth of the creek, is approximately 10 feet above the water surface at mean low water and is approximately 41 feet in width. The water level fluctuates about 2 feet with the tides, but the depth of the creek decreases as it penetrates southeasterly into the key from Card Sound.

(6) Required Development. The following were identified as development requirements at the Steamboat Creek site:

> Since no structures are currently located on the site, construction of the visitor-contact/administrative-support center, the residential complex, and the parking area would be necessary.

Approximately 1 mile of access and circulatory roadway would also have to be constructed for adequate access into and throughout this site.

A minimum 3-acre boat basin would be required to accommodate future traffic loading from increased visitation, official National Park Service use, and implementation of alternative access and circulation modes.

(7) Land Status. All land at this site is privately owned and is taxed at $1,900 to $2,300 per acre.

b. Impacts

(1) Natural Environment

(a) Vegetation. The 40-acre Steamboat Creek site is entirely undeveloped and conveys a natural marine setting. Vegetation in the area is comprised entirely of native red and black mangrove. There is no existing land present that would support physical development (mangrove communities typically establish in a semi-aquatic environment to satisfy physiological requirements of the species).

Since no structures are currently located on the site, development of the visitor-contact/administrative-support center, residential complex, 1 to 2 miles of access and circulation roads, parking lot, and a minimum 3-acre boat basin would require the removal of approximately 12 to 16 acres of native mangrove vegetation. The entire area would then be filled in order to accommodate the physical structures.

It is plausible that visitor use of this area would have a minor impact on the vegetation remaining after development. Wounds to tree trunks and limbs inflicted by such instruments as hand axes and knives, the breakage of limbs and mangrove roots from climbing, and trampling of ground cover vegetation are examples of such damage. The magnitude of such an impact is presently unquantifiable.

Approximately 3 to 5 acres of natural mangrove vegetation would be removed to construct a boat basin and access channel to meet the requirements of a visitor-contact facility at this location.

(b) Water Quality. There is no current provision for a marina and boat basin at the Steamboat Creek site. Therefore, dredging of a 3- to 5-acre area would be required for a marina and boat basin to meet the tour-boat requirements and private boat use demands. The spoil from the dredging operation would create a disposal and potential water pollution problem.

The channel cut into Steamboat Creek for boat access would require initial dredging of approximately 200 to 300 feet and regular maintenance dredging as natural filling occurred.

Heavy boat traffic into and out of the marina site with resulting wakes and prop wash would combine with natural forces (such as tidal action and storm waves) to increase erosion rates of the unprotected marina and access channel shoulders. If the shoulders were left unprotected, slumping and erosion would contribute sediment to channel and marina bottom, necessitating more frequent maintenance dredging.

Removal of an unquantifiable number of aquatic organisms and bottom life from Steamboat Creek would occur with dredging for access channels and a marina boat basin.

In general, the ecological impacts of dredging to deepen and widen channels and the marina would be increased siltation and turbidity, reduced photosynthesis of phytoplankton and decreased primary productivity, burial of bottom-dwelling organisms by silt, oxygen depletion, and direct removal of shellfish and finfish habitat. These impacts are unquantifiable at present.

Water circulation patterns in Steamboat Creek would change with the deepening of the channel and construction of a marina, and erosion along creek margins would be accelerated. Furthermore, sediment layer types would be altered by the change in channel depth and water velocity.

Existing water circulation patterns within the sound would not be altered with the selection of this alternative.

The installation of a visitor-contact/administrative-support complex with attendant employee residences would necessitate the provision of potable water at an area where water has not been previously provided. The brackish Floridian aquifer is located 900 to 1,400 feet below sea level and extends from the Miami Beach area to beyond Key Largo. Several wells already drilled into this aquifer from the Miami Beach and Key Largo areas indicate that an ample supply of artesian brackish water can be obtained from this strata. This would necessitate the drilling of a well at this site and the installation of a desalinization plant to render the water potable for human consumption. It is impossible to quantify the impact of such a well on the Floridian aquifer at this time.

Sediment loading from surface runoff would increase in the aquatic areas of Card Sound immediately adjacent to the Steamboat Creek developed area during construction for facility installation. This would temporarily reduce water clarity and increase turbidity in such affected areas. Clarity would be restored and turbidity reduced with normal tidal fluctuation and wave action because most of the material to be dredged would be pure sand, or sand and shell with little or no organic material. These materials have rapid settling rates, which would reduce the amount of time material would remain in suspension and rapidly dissipate turbidity plumes.

Turbidity plumes from motorboat operation in shallow water areas around the site depend upon water depth, motor power, operational time, and type and nature of sediment deposits. For example, in shallow lakeshore areas with water depths less than 5 feet, physical changes in turbidity and floating matter at the surface have been observed within less than 5 minutes of boating activity. Therefore, it is plausible that turbidity plumes in shallow water areas of the sound would occur in proportion to the depth of the boat draft, the craft's motor size, and the duration of use and activity in the area. This factor combined with the additional use of the same areas by tour boats would temporarily reduce water clarity in the sound along navigable channels and in areas immediately adjacent to Steamboat Creek.

It is plausible that gases such as water vapor, carbon oxides, nitrogen, and sulfur from the combustion chambers and hydrocarbons and lead compounds in unburned fuel mixtures would be introduced into the aquatic environment by the tour boats and small private motorboats in unquantifiable amounts. This amount would be proportional to the frequency that the proposed tour-boat route was traveled and would increase as the projected peak-day visitation of 850 to 925 boats on monument waters was realized. Release of unburned fuel, primarily hydrocarbons and engine oil, from the operation of two-cycle outboard motors would be a recognized inherent feature, especially from improperly tuned engines. This type of water pollution has been extant in the past in monument and sound waters from the operation of such motors, and it is plausible that it would continue in the future. However, quantification of the impact of such water pollution is impossible at this time because it is not known what, if any, ecological impact has occurred from existing and historical motorboat activity levels.

Bottom scarring from propellers would increase in shallow bay and sound water areas such as Featherbed Bank, Cutter Bank, the shallow banks near Arsenicker Key and West Arsenicker Key, Jones Lagoon, and along the selected tour-boat routes with any future increase in private boat use of

the monument. This would be due to the increased probability of craft originating from Steamboat Creek wandering out of the natural channels and the Intracoastal Waterway into shallow areas of the sound. For the same reason, turbidity and injury to benthic organisms would increase within the general area of the designated channels and the proposed marina with increased boat use.

It is plausible that the bottom scars would serve as barriers to the normal movement of fauna associated with the submerged grass beds, that faster circulation into previously poorly flushed areas would be afforded by the scar corridors, and that additional sources of easily disturbed fine sediment would be exposed to tidal scouring and transported to adjacent areas where smothering of biota would occur.

The provision of a parking lot to serve the facility would increase the runoff into Card Sound during periods of heavy rainfall. This runoff would carry additional pollutants such as oil residue, rubber particles from tire wear, and gas leakage by-products into the sound.

(c) Air Quality. There would be a temporary localized increase in air pollution (fugitive dust, hydrocarbons, oxides of nitrogen, and carbon monoxide) from internal combustion engines of equipment during construction activities at Steamboat Creek on Key Largo. However, adequate information is not available to quantify these impacts at this time.

The increased use of motorized tour boats to the marina, Card Sound, and monument waters would increase levels of carbon monoxide, hydrocarbons, nitrogen oxides, and other exhaust pollutants. However, an almost continual air-sea wind regime would rapidly disperse such local sources of air pollution. The forthcoming transportation study would provide frequency of travel information from which air pollution could be quantified.

The addition of a visitor-contact facility on Key Largo would introduce additional air pollution from vehicular traffic (carbon monoxide, hydrocarbons, oxides of nitrogen) to the relatively clean atmospheric conditions indigenous to the island.

Although ambiant levels of carbon monoxide have not been monitored in the vicinity, the additional concentrations created by the development of a visitor-contact site would probably not exceed the national ambient air-quality standards. Monitoring prior to the establishment of a parking lot would be necessary to accurately predict the impact of the parking lot on air quality.

(d) Noise. There would be a temporary increase in noise levels from construction machinery operation during development at the Steamboat Creek site. However, the increased use of motorized tour boats in the marina, Card Sound, and monument waters would increase noise levels in the surrounding area and particularly along the proposed tour-boat route. This increase in relation to the tour-boat service would be in direct proportion to craft motor size and frequency of route travel.

The establishment of facilities at this site, combined with an increase in park visitation, would increase vehicular noise in the immediate area.

(e) Soils. Stabilization of eroding banks would be necessary along the marina because prop wash and wake would increase erosion rates.

Since the entire area to be developed would have to be filled, and if the fill material were used as a filtering agent for future sewage-treatment purposes, it is plausible that pollutants associated with sewage effluent (suspended solids, BOD, etc.) would be partially retained in the fill or transmitted into the waters of the sound.

The soil is of the same origin as that on Elliott Key and is composed of Miami oolite. There is no fill material on the site other than that placed to serve as foundation for the bridge abutment.

(f) Wildlife. An increase in the traffic volume on Florida 905 would occur because it is the main vehicle artery to the site. With such an increase, it is plausible that an unquantifiable increase in the road kill frequency of small mammals would be inherent.

This site is near the critical habitat of the threatened Key Largo wood rat (Florida Game and Fresh Water Fish Commission 1977). Establishment of the visitor-contact site in this area could bring about the migration of this species to another portion of the island. If no other suitable habitat site existed, possible eradication of the species could occur. If the species were able to coexist with the development, road kills might serve to further reduce its number.

Construction of access and circulation roads and development of the site would remove approximately 10 to 15 acres of native mangrove vegetation and wildlife habitat because filling of this total acreage would be required to establish a foundation to accommodate necessary buildings and structures.

It is plausible that construction activities, noise, removal of vegetation, and visitor use would cause indigenous wildlife species to seek habitat in areas outside the site. If sufficient compatible habitat did not exist at other locations on Key Largo, it is plausible that unquantifiable numbers of certain species might be reduced and possibly eradicated.

All boat traffic originating from a visitor-contact site at Steamboat Creek would pass through the critical habitat of the American crocodile. With increased boat usage in the area, the frequency for injury to the crocodile would be increased.

Birds would be temporarily frightened away by construction noise. As they sought other areas, they would be forced to compete with existing populations for available food and cover. This would place a temporary stress on affected species.

Potential for increased disturbance and injury to the endangered manatee would occur with the establishment of a visitor-contact site at this location because the tour-boat route and Intracoastal Waterway pass through its critical habitat.

(2) Socioeconomic Environment

(a) Regional Trends. There is an absence of lodging accommodations and food and vehicle service facilities in the immediate area surrounding Steamboat Creek. The nearest services of this nature are approximately 10 to 12 miles away. Therefore, there would be a possibility for commercial development in the immediate vicinity to provide such services to visitors.

Utility systems capable of accommodating an influx of visitors to a previously undeveloped area would have to be installed.

A $1.20 round trip toll for utilization of the Card Sound Bridge would be incurred by visitors approaching from the north for road access from U.S. 1 and Florida 905. With the provision of a visitor-contact facility in this location and the attendant generation of visitation, it is plausible that an unquantifiable increase in revenue from the Card Sound Bridge toll would be realized.

(b) Visitor Experiences and Aesthetic Quality of the Monument. Currently there are no lodging accommodations or food services located in the north Key Largo area in the general vicinity of Steamboat Creek. The nearest services of this nature are approximately 10 to 12 miles south via Florida

905. This immediate unavailability of such services would cause visitor inconvenience.

It is plausible that persons intending to visit the monument via a tour-boat service embarking from Steamboat Creek might be disenchanted by interruptions in schedules caused by inclement weather, mechanical repair to vessels, or other related factors.

Adequate diversionary programs and facilities to entertain visitors (interpretive presentations, picnic areas, etc.) while they waited for tour-boat services would be required at this site.

Physical development would occur entirely in a natural area and would be a visual intrusion into the marine setting.

(c) Management and Administration. The Steamboat Creek site is not located on a major highway artery and necessitates a 24-mile round trip from U.S. 1 for visitors utilizing the existing Florida 905 as a road access. Furthermore, a $1.20 toll (round trip) for the Card Sound Bridge would be imposed for visitors approaching the site from the north.

Steamboat Creek is located approximately 15 to 20 road miles from the administrative headquarters at Convoy Point. It is approximately 6 nautical miles from the southern boundary of the monument. The logistics of a facility at this location would necessitate support facility establishment for management, protection, and visitor services purposes. Nevertheless, boat and/or vehicle commuting into the monument or to the main headquarters at Convoy Point would require additional operational funds and an unquantifiable expenditure of energy and manpower.

(3) Cultural Resources. The 40-acre area is currently privately owned and has never been surveyed for historical or archaeological resources. However, the extreme environmental degradation that would occur with development of this primarily natural area for a visitor-contact facility was recognized and the site rejected prior to reaching the point in the planning process where cultural surveys would have been programmed.

B. NO-ACTION ALTERNATIVE TO ISLAND DEVELOPMENT SITES

1. Description

The previously developed areas on Elliott and Adams Keys are the only areas proposed as island development sites because any other potential sites on these keys or any other keys within the monument would necessitate dredging and filling and the concomitant removal of native mangrove vegetation. Therefore, the only alternative considered to the proposed island development sites was a no-action alternative.

Under this alternative the existing island development sites at Elliott and Adams Keys would continue to function in their present roles at their present capacities. No change or modification of the existing facilities would be made to accommodate possible increases in future visitation to Elliott Key, nor would provisions be made for visitation and interpretation on Adams Key. Also, no accommodations would be provided for the implementation of a tour-boat system to service these island development sites. In summary, both sites would maintain their current status, and Elliott Key would remain accessible only to private boat owners because public transportation access would not be provided at the harbor.

2. Impacts

a. Natural Environment

(1) Vegetation. With no action, land-oriented recreational activities would continue to be centered around the existing facilities at Elliott Key and Homestead Bayfront Park at Convoy Point. The existing facilities (see Existing Development map) at these developed areas would continue with no provisions made for increased visitation and/or updating. Therefore, since no further development would occur, there would be no removal or commitment of additional natural vegetation under the no-action alternative.

(2) Water Quality. The existing public harbor with two piers, a loading dock, and 64 boat slips would continue to serve the Elliott Key island development site. The two employee residences, the "Casino," a small storage shed, and a generator house would remain on the Adams Key developed site, with the short, L-shaped pier providing access only for official Park Service use since the island would not be opened to public use under the no-action alternative.

It is plausible that with any increase in visitation, overtaxing of the existing septic tank sewage-treatment facility would occur. This would introduce the possibility of water pollution (suspended solids, BOD, etc.) from wastewater effluent.

No increase in sediment loading from surface runoff into the bay waters would occur because no construction activities would take place.

The existing well supply with a sufficient storage capacity should adequately meet peak demands. The brackish Floridian aquifer that supplies the existing well is located 900 to 1,400 feet below sea level and extends from the islands of Miami Beach southward under the keys beyond Key Largo. Several wells already drilled into this aquifer from the Miami Beach and Key Largo areas provide reasonable assurance that an ample future supply of artesian brackish water could be obtained from this strata. Although any increased demand would further tax the aquifer, no significant impact would occur.

Water circulation patterns in existing canals and natural channels would not be altered by maintenance dredging and/or filling for marina construction at Elliott Key or channel access to the Elliott Key Harbor and/or the Adams Key island development sites.

The bulkheading of approximately 300 feet of the fill shoreline of Adams Key for stabilization for boat docking purposes would not occur. Therefore, no disruption of benthic organisms and other aquatic life forms in the vicinity would occur.

(3) Air Quality. There would be no temporary localized increase in air pollution (fugitive dust, hydrocarbons, oxides of nitrogen, and carbon monoxide) from internal combustion engines of equipment during construction activities on Elliott and Adams Keys.

The overall ambient air quality of the monument would not change with the no-action alternative.

(4) Noise. There would be no temporary increase in noise levels from construction machinery operation for development at Elliott Key Harbor and the Adams Key sites.

(5) Soils. No compaction of the shallow soils on Adams Key would occur because the site would not be officially opened to visitor use.

Temporary soil erosion in the vicinity of the development areas at Elliott Key Harbor and the Adams Key complex would not occur from the activity of heavy construction machinery because no construction would take place under this alternative.

(6) Wildlife. No disruption of resident wildlife species inhabiting the Elliott Key Harbor area and the Adams Key site would occur because construction activities for site development would not take place.

Birds would not be frightened away by construction noise on Elliott and Adams Keys.

b. Socioeconomic Environment. The monument resource would be managed for low-intensity visitor use, and no development would take place to provide accommodation for any increase in visitation.

Better management of visitor use would be achieved because no expansion over the islands would occur.

Visitors would continue to be concentrated at the existing developed area on Elliott Key.

Any increased number of visitors at Elliott Key would overload the present visitor facilities and the existing septic tank system.

The no-action alternative would restrict the number of non-boating visitors who would be able to have a Biscayne National Monument experience. Furthermore, it would limit potential diversity of the experience that was available, especially with respect to the Adams Key complex.

Recreational opportunities in the unique communities of these diverse barrier islands would remain unavailable to a portion of the non-boating public.

Without both island development sites, restriction on the tour-boat system and proposed routing would have to be imposed because of the limited physical access (i.e., Adams Key would remain unavailable for visitor use).

Implementation of a reservation system might be necessary when the capacity of the present facilities was reached. This would limit island visitation and might inconvenience park visitors, but it might enhance the visitor experience.

The monument would not provide for expanded interpretive and recreational facilities that were regionally unavailable to visitors.

There would be no visual intrusion from the 70-foot interpretive tower on Adams Key.

No information would be disseminated at Convoy Point and Elliott and Adams Keys to assist visitors in planning their visit and understanding the monument's resources.

The visitor experience would not improve by interpretation relating to the terrestrial and aquatic ecosystems and the cultural resources within the park because points along the trail on Elliott and Adams Keys, at the developed site at Adams Key, and at the Convoy Point developed area would not be provided.

It is plausible that no provision for expansion of overnight camping on Elliott Key beyond the capacity of the existing 35-site campground would deny a segment of the public a monument camping experience. However, interest in commercial campgrounds in the region would be promoted. The former aspect of this impact would preclude the prospect of the disruption of the natural barrier-island resource by further development; the latter would stimulate the local economy.

Increased visitor exposure to such natural safety hazards as insect bites and intense heat and sun in the summer months would not occur.

The provision of approximately 8 miles of trail on Elliott Key and ½ mile of trail on Adams Key, primarily for nature walks, hiking, and interpretive purposes, would not be possible.

The increased probability of damage to physical structures on Elliott and Adams Keys from increased visitor use would not occur because the postulated peak-day increase from 600 to 1,000 visitors on Elliott Key and 0 to 200 visitors on Adams would not be realized.

Physical installation of interpretive devices (signs, chickees, etc.) would not detract from the visitor experience.

c. Cultural Resources. There would be no impacts on the cultural resources of Elliott and Adams Keys with this alternative.

C. ALTERNATIVE ACCESS AND CIRCULATION MODES

Two alternatives to the proposed access and circulation mode were considered before the tour-boat system for public transportation within the monument was selected.

1. Individual Boat Rental

a. Description. A boat rental service providing craft designed for safe bay and/or offshore operation that could be rented and operated primarily by visitors without boats would afford private visitor access to offshore reefs and bayside fishing, as well as access to interpretive and other service facilities on Elliott and Adams Keys.

Schedules, routes, and the identification of boat systems were not deemed to be necessary for this alternative at the time of the Environmental Assessment preparation. A sufficient fleet of craft would be available commensurate with projections for future visitor demands, and personnel would be available to log the boats in and out.

The construction of a marina at the mainland administrative and headquarters visitor-contact site (specifically for boat rental operation) and additional docking facilities at Elliott and Adams Keys would be needed.

b. Impacts

(1) Natural Environment

(a) Vegetation. It is plausible that bottom scarring from propellers would increase in shallow bay water areas such as Featherbed Bank, Cutter Bank, and the shallow banks near Arsenicker Key, West Arsenicker Key, and Jones Lagoon and would increase with any future increase in private boat use of the monument. This would be due to the increased probability of craft wandering out of the natural channels into shallow areas. For the same reason, turbidity and injury to benthic organisms would increase within the general area of the designated channels and existing marina with individual boat rental and increased private boat use.

It is plausible that the bottom scars would serve as barriers to the normal movement of fauna associated with the submerged grass beds, that faster circulation into previously poorly flushed areas would be afforded by the scar corridors, and that additional sources of easily disturbed fine sediment would be exposed to tidal scouring and transported to adjacent areas where smothering of biota would occur.

Due to the number of craft introduced into the monument, the number of inexperienced boaters renting the boats, and the impossibility of supervising all boating activity, it is plausible that the tidal creeks around Old Rhodes and Totten Keys and fragile marine lagoons (Jones Lagoon) would receive increased visitation and disturbance from motorized craft. This would disrupt marine habitat and pristine portions of the monument.

(b) Water Quality. Turbidity plumes from motorboat activity would continue to reduce water clarity and increase turbidity in the bay. The degree of clarity reduction would vary according to water depth, motor power, operational time, and the composition of bottom sediment deposits.

Unquantifiable amounts of gases such as water vapor, carbon oxides, nitrogen, and sulfur from combustion chambers, and hydrocarbons and lead compounds in unburned fuel mixtures, would continue to be introduced into the aquatic environment of the bay and ocean by small private motorboats. This amount would increase as boat visitation on monument waters increased. Release of unburned fuel, primarily hydrocarbons and engine oil, from the operation of two-cycle outboard motors would be a recognized inherent feature, especially from improperly tuned engines. This type of water pollution has occurred in the past in monument waters from the operation of such motors, and it is plausible that it would continue in the future. However, quantification of the impact of such water pollution is impossible at this time because it is not known what, if any, ecological impact has occurred from existing and historical motorboat activity levels.

Accommodation of a service of this nature would require additional development at the headquarters site. This would be in the form of additional dredging and bulkheading, which would remove additional benthic marine habitat.

Any additional dredging and spoil disposal would contribute to local increases in turbidity, disturbance of benthic habitat, and increased levels of nutrients and other pollutants released when bottom sediments were disturbed.

Large numbers of boats carrying visitors to shallow water areas for recreational purposes would have a disruptive effect on fragile marine organisms' life cycles.

(c) Air Quality. Motorboat activity related to individual boat rental would result in increased levels of exhaust pollutants. However, because the vast majority of outboards have underwater exhausts, emission measurement is very difficult. In order to estimate potential concentrations of air pollutants from outboard motors, either total fuel use or work output (horsepower hour) must be known. Since neither of these parameters is available for an individual boat rental service in Biscayne National Monument, it is not possible to quantify the impact upon air quality.

The increased use of motorized craft inside marinas and nearshore waters would increase levels of carbon monoxide and other pollutants in these areas. However,

the constant air-sea wind regime should aid in rapidly dissipating this additional pollution.

(d) Noise. Noise associated with this alternative would be principally that created by the motorboats. Locations where the noise would be most evident include the Intracoastal Waterway, the west coast of Elliott Key, and Caesar Creek.

The increased number of motorized craft on monument waters would elevate noise levels above those that currently exist. This would be greatest during periods of peak visitation.

(e) Wildlife. Uncontrolled access to Arsenicker Key could result in the disturbance of the bald eagles that currently nest there. Further disturbance of other avian species nesting on the Arsenicker Keys would occur with this alternative.

This action would increase the opportunity for injury from propellers and/or disturbance of the manatee because its critical habitat covers the whole monument.

Repetitious visitor activity (motorboating, fishing, etc.) in the fragile Jones Lagoon area would tend to keep bottom sediments disturbed and kill or disrupt certain benthic fauna (e.g., sea urchins).

(2) Socioeconomic Environment. Development of this alternative would limit the non-boating public's awareness of the monument to the capacity of the craft available for rental.

The increase in the number of local residents and other visitors utilizing the resources on the keys, waters, and visitor-service facilities would be limited with this action. Therefore, visitor impact upon the environment would be proportionate to the number of visitors afforded access by this alternative.

Transportation that would directly meet the needs of individual park visitors would be made available with this action. Therefore, visitors desiring to visit offshore reefs or to fish in the waters of the bay could be accommodated without schedules, routes, or boat systems.

Costs to individual visitors and energy expenditure would be greater than the costs of a mass visitor conveyance system.

Potential non-boating visitors who were unfamiliar with the operation of small watercraft would be precluded from the monument experience.

Serious safety implications would be inherent in this alternative if the boats were in the hands of inexperienced operators.

Less control of boat users and monument visitors by management would be associated with this alternative.

Bottom scarring would continue as motorboats passed through overly shallow water, especially through turtle grass beds. When viewed from above, these scars would exert a long-lived aesthetic intrusion into the normal natural continuum of the grass beds.

Safety hazards, primarily to boating visitors, would increase with any increase in the number of inexperienced or uninitiated boat operators engaged in recreational activities such as water-skiing. Actual hazards would include higher frequencies of running aground or actually colliding with submerged features or objects. Also, rapidly moving ski boats would be extremely dangerous to small anchored boats, snorkelers, scuba divers, or sail-powered vessels, and it is plausible that the probability of accidents associated with these incompatible uses would increase with any increase in these activities.

(3) Cultural Resources. No impact would be exerted upon the cultural resources in the monument.

2. No Action

a. Description. With the implementation of a no-action alternative, no mode of access and circulation for the non-boating public would be provided. Small private boats would continue to be the major means of circulation between the monument and private lands outside the monument's boundary.

b. Impacts

(1) Natural Environment. Where overnight anchoring of private motor craft occurred off Elliott Key and in sheltered locations at other sites inside the keys away from sanitary facilities, undetermined amounts of untreated human sewage would be discharged into monument waters. This is a typical problem in all aquatic recreational areas and has historically occurred in the monument. It is not possible to quantify the specific impact of this inevitable practice on water quality at this time because it is not known what, if any, ecological impact has occurred in the past.

If private craft were utilized, the relatively noisy boat operation typically associated with such sports as water-skiing would continue to exert an auditory intrusion upon the natural marine setting of the monument. This activity takes place primarily in the bay area; thus, any auditory intrusion would be concentrated in this area.

The private boat use in marinas and monument waters would continue to generate carbon monoxide, hydrocarbons, nitrogen oxides, and other exhaust pollutants.

Backwater and fragile marine lagoons would remain in a pristine state because they would be visited by a relatively minor number of visitors in the future. These areas are not easily found and are accessible only by very shallow-draft boats.

Additional docking space would not be provided with this alternative; therefore, no additional disturbance and disruption of benthic marine organisms would occur.

Although areas for certain recreational activities would be designated if individual boating activities such as water-skiing were attempted in the narrow mangrove channels or around any of the keys noted as avian areas, it is plausible that harassment of birdlife would occur. This would be especially significant in the case of the endangered brown pelican and the nesting bald eagles on Arsenicker Key. It is plausible that disturbances of this nature would preclude any nesting or future inhabitance of the monument by this species.

Deliberate vandalism and inadvertent damage to coral reefs by diving visitors and their anchored craft would continue to occur with this monument activity. It is plausible that this type of reef damage would be concentrated on reefs identified as especially attractive and recommended for underwater viewing.

Shallow benthic turtle, manatee, and shoal grass beds and certain algae species inhabiting the shallow bay waters and Jones Lagoon would continue to be impacted by propeller scarring from individual motorboats engaged in sportfishing, pleasure motorboating, water-skiing, and diving.

Bottom scarring from propellers would increase in shallow bay water areas such as Featherbed Bank, Cutter Bank, the shallow banks near Arsenicker Key and West Arsenicker Key, Jones Lagoon, and along the selected tour-boat routes with any future increase in private boat use of the monument. This would be due to the increased probability of craft wandering out of the natural channels into shallow areas. For the same reason,

turbidity and injury to benthic organisms would increase within the general area of the designated channels and existing marina with increased boat use.

It is plausible that the bottom scars would serve as barriers to the normal movement of fauna associated with the submerged grass beds, that faster circulation into previously poorly flushed areas would be afforded by the scar corridors, and that additional sources of easily disturbed fine sediment would be exposed to tidal scouring and transported to adjacent areas where smothering of biota would occur.

Turbidity plumes in shallow water areas depend upon water depth, motor power, operational time, and type and nature of sediment deposits. In shallow lakeshore areas with water depths less than 5 feet, physical changes in turbidity and floating matter at the surface were observed within less than 5 minutes of boating activity. Therefore, it is plausible that turbidity plumes in shallow water areas of the bay would occur in proportion to the depth of the tour boat's draft, the craft's motor size, and the frequency of trips from Convoy Point to Elliott and Adams Keys. This factor combined with the additional use of the same areas by private craft would temporarily reduce water clarity in the bay along navigable channels.

(2) Socioeconomic Environment. Enjoyment of the monument's resources would continue to be available to only a small segment of the total population (i.e., private boat owners).

Under the no-action alternative, no organized access and circulation plan would be selected. No access for visitors without private boats would be afforded.

People without boats would have to rent them in order to visit the monument, making their visits more costly.

Despite zoning to separate incompatible recreational uses of the monument, it is plausible that conflicts between private boaters and other types of users (e.g., water-skiers and snorkelers) would increase as visitation increased.

(3) Cultural Resources. The accessibility to the ocean waters east of Elliott Key by private boaters would exert additional pressure on the submerged remains of historic shipwrecks.

D. ALTERNATIVE ACCESS AND CIRCULATION ROUTES

In an effort to offer public transportation service from Convoy Point to the island development sites on Elliott and Adams Keys and the alternative visitor-contact sites on Key Largo, several alternatives to the Convoy Point scheme were considered. The purpose was to offer services that would adequately distribute visitors throughout the islands as well as provide an efficient transportation system between the mainland embarkation point and the terminals on the keys. The transportation services would not be required by all visitors, and there would be certain limited-capacity demands that would not warrant direct service.

Table 19 illustrates the travel time between these sites based upon the shortest navigable, environmentally sensitive routes between the sites to be serviced. Trip times are based on an average operating speed of 25 miles per hour in open water and 6 to 10 miles per hour in the shallow natural channels.

Table 19

ACCESS/CIRCULATION ALTERNATIVE ROUTING SCHEMES

Routing Scheme		Distance	Travel Time
(From) Mainland Visitor-Contact Site	(To) Island Development Sites	(Nautical Miles)	Round Trip (Minutes)
Wednesday Point	Elliott Key and Return	24.0	96
	Adams Key and Return	16.0	64
	Adams Key, Elliott Key, and Return	24.5	98
Steamboat Creek	Elliott Key and Return	25.5	96
	Adams Key and Return	18.0	72
	Adams Key, Elliott Key, and Return	27.7	111

1. Wednesday Point

a. Description. Situated on the leeward side of north Key Largo, the Wednesday Point alternative would be initiated from the central portion of Card Sound, approximately 5 miles south of the monument boundary. The longest distance associated with this alternative would be the 24.5-mile round trip between Wednesday Point and Adams and Elliott Keys. Channel depths range from 6 to 10 feet MLW between Wednesday Point and Adams Key, and 3 to 8 feet between Adams and Elliott Keys.

b. Impacts

(1) Natural Environment

(a) Vegetation. No impact would occur to terrestrial vegetation with the implementation of this alternative action.

Shallow turtle, manatee, and shoal grass beds and algae species inhabiting the shallow waters of northern Card Sound would be scarred by motorboat propellers from commercial and sport fishing, pleasure motorboating, water-skiing, and diving activities. It is plausible that the frequency of scarring would increase with the implementation of a tour-boat service to Wednesday Point and with the attendant increase in the use of the sound waters by private craft.

(b) Water Quality. No new channel dredging would be required with an access/circulation route servicing a visitor-contact site at Wednesday Point because existing channels would be utilized in the transportation process.

Water circulation patterns in existing natural channels would not be altered by maintenance dredging.

Maintenance dredging and sloughing of access channels to Wednesday Point would result in temporary degradation of water quality by increasing turbidity and decreasing clarity due to unquantifiable amounts of bottom sediment suspended in the bay waters by the dredge cutterhead. The sediment in the water would temporarily reduce the light needed for marine flora photosynthetic processes. Furthermore, any organic sediment resuspended would result in an increased demand for oxygen from the immediately surrounding waters, thus causing a decrease in available dissolved oxygen. However, most of the material to be dredged would be pure sand, or sand and shell with little or no organic material. These materials have rapid settling rates, which would reduce the amount of time material would remain in suspension and rapidly dissipate turbidity plumes.

It is plausible that gases such as water vapor, carbon oxides, nitrogen, and sulfur from the combustion chambers and hydrocarbons and lead compounds in unburned fuel mixtures would be introduced into the Card Sound aquatic environment in unquantifiable amounts by the tour boats and small private motorboats. These amounts would be proportional to the frequency that the proposed tour-boat route was traveled and would increase as the visitation on monument and sound waters was realized. Release of unburned fuel, primarily hydrocarbons and engine oil from the operation of two-cycle outboard motors, would be a recognized inherent feature, especially from improperly tuned engines. This type of water pollution has occurred in the past in monument

waters from the operation of such motors, and it is plausible that it would continue in the future. However, quantification of the impact of such water pollution is impossible at this time because it is not known what, if any, ecological impact has occurred from existing and historical motorboat activity levels.

Bottom scarring from propellers would increase in shallow bay water areas such as Card Sound Bank, Cutter Bank, the shallow banks near Arsenicker Key and West Arsenicker Key, and along the selected tour-boat route with any future increase in private boat use of the monument. This would be due to the increased probability of craft wandering out of the natural channels into shallow areas. For the same reason, turbidity and injury to benthic organisms would increase within the general area of the designated channels and existing marina with increased boat use.

It is plausible that any bottom scarring in the shallow water areas of the sound would serve as barriers to the normal movement of aquatic fauna associated with submerged grass beds, that faster circulation into previously poorly flushed areas would be afforded by the scar corridor, and that additional easily disturbed fine bottom sediment would be exposed to tidal scouring and transported to adjacent areas where smothering of biota would occur.

(c) Air Quality. The increased use of motorized tour boats along selected access/circulation routes in the sound waters would increase levels of carbon monoxide, hydrocarbons, nitrogen oxides, and other exhaust pollutants. The forthcoming transportation study would provide frequency of travel information from which air pollution could be quantified. In general, the implementation of this plan should have no significant effect on air quality.

Motorboat activity related to permitted uses would result in increased levels of exhaust pollutants similar to those produced by tour boats. However, because the vast majority of outboards have underwater exhausts, emission measurement is very difficult. In order to estimate potential concentrations of air pollutants from outboard motors, either total fuel use or work output (horsepower hour) must be known. Since neither of these parameters is available for motorboat use in Biscayne National Monument and/or Card Sound, it is not possible to quantify the impact upon air quality.

(d) Noise. The increased use of motorized tour boats in marinas and sound waters would increase noise levels in the surrounding north Key Largo area and particularly along the proposed tour-boat route.

Locations where the noise would be most evident include the Intracoastal Waterway and the west coast of Key Largo.

(e) Soils. No impact to soils would occur with the implementation of this alternative action.

(f) Wildlife. The tour-boat route originating from Wednesday Point would pass along the Intracoastal Waterway approximately 1 mile from Arsenicker Key. The nesting endangered bald eagles on the key should not be disturbed by this activity because they have apparently become accustomed to the traffic of larger craft which presently exists in this area. However, if individual boats were used, disturbance of birdlife and the nesting bald eagles on Arsenicker Key would be possible.

The regular schedule assumed by a tour-boat system would increase the opportunity for disturbance and/or injury to the endangered manatee because the critical habitat for the manatee encompasses essentially the entire monument.

(2) Socioeconomic Environment. Wednesday Point is located approximately 5 miles south of the monument boundary. As detailed in table 19, round trip distances from Wednesday Point to Elliott Key, to Adams Key, and to Adams and Elliott Keys are approximately 24.0 miles, 16.0 miles, and 24.5 miles, respectively. Due to the distances involved and the remoteness of the Wednesday Point site from the monument's boundary, an unquantifiable increase in transportation operational costs (i.e., fuel, manpower, maintenance) would be inherent with the alternative action.

An access/circulation scheme such as that mentioned above and in table 19 would offer services that would adequately distribute visitors throughout the monument as well as provide an efficient transportation system between Convoy Point and the terminals on the keys.

The provision of tour-boat access into the monument from Wednesday Point for non-boating visitors would supplement the general public's awareness of the national monument's existence. There would be an increase in the number of local residents and other visitors utilizing the outlying keys, waters, and visitor-service facilities.

The Wednesday Point site is located approximately 1 to 2 miles south of the Ocean Reef Yacht Club and the Key Largo Anglers Club on north Key Largo. Due to the frequency of boat use at these private facilities and the general boat activity in the immediate north Key Largo vicinity, a potential for navigational

safety hazards would exist in areas simultaneously utilized by members of the Ocean Reef Yacht Club and the Key Largo Anglers Club because any route to Adams and Elliott Keys would have to pass near these developed areas.

It is plausible that the visitor experience would deteriorate as boat congestion increased.

It is plausible that the close proximity of the access route to the keys would reduce navigational and visitor safety hazards imposed by adverse weather conditions or high land-sea breezes.

Channel markers would be provided to designate channel access into the Wednesday Point site and the island development nodes in the monument. It is plausible that the presence of these markers would be a visual intrusion to the natural environment.

Bottom scarring would continue as motorboats passed through overly shallow water, especially through turtle grass beds. When viewed from above, these scars would exert a long-lived aesthetic intrusion into the normal natural continuum of the grass beds.

Regardless of access/circulation route designation, it is plausible that safety hazards, primarily to boating visitors, would increase with any increase in the number of inexperienced or uninitiated boat operators engaged in recreational activities such as water-skiing. Actual hazards would include higher frequencies of running aground or actually colliding with submerged features or objects. Also, rapidly moving ski boats would be extremely dangerous to small anchored boats, snorkelers, scuba divers, or sail-powered vessels, and it is plausible that the probability of accidents associated with these incompatible uses would increase with any increase in these activities.

(3) Cultural Resources. There would be no impact on cultural resources with the implementation of this alternative action.

2. Steamboat Creek

a. Description. The Steamboat Creek plan would also be initiated from the leeward side of north Key Largo, on south Card Sound approximately 6 miles south of the monument boundary. The longest distance associated with this alternative would be the 27.7-mile, round-trip distance between Steamboat Creek and Adams and Elliott Keys. Channel depths along the proposed route range from 3 to 11 feet MLW.

b. Impacts

(1) Natural Environment

(a) Vegetation. No impact would occur to terrestrial vegetation with the implementation of this alternative action.

Shallow turtle, manatee, and shoal grass beds and indigenous algae species inhabiting the shallow waters of Card Sound would be scarred by motorboat propellers from commercial and sport fishing, pleasure motorboating, water-skiing, and diving activities. It is plausible that the frequency of scarring would increase with implementation of a tour-boat service to Adams and Elliott Keys from Steamboat Creek and with any increase in the use of the sound waters by private and commercial craft. Boat anchorage over shallow grass beds in Card Sound would create a temporary disturbance of less magnitude than that caused by propeller scarring.

(b) Water Quality. No new channel dredging would be required for an access route to service a visitor-contact site at Steamboat Creek because existing channels would be utilized in the transportation process. However, dredging would be required at the Steamboat Creek marina site proper for circulation purposes and actual construction of the marina.

Water circulation patterns in existing canals and natural channels would not be altered by maintenance dredging and/or filling for marina construction or channel access.

Maintenance dredging and sloughing of access channels to Steamboat Creek would result in temporary degradation of water quality by increasing turbidity and decreasing clarity due to unquantifiable amounts of bottom sediment suspended in the bay waters by the dredge cutterhead. The sediment in the water would temporarily reduce the light needed for marine flora photosynthetic processes. Furthermore, any organic sediment resuspended would result in an increased demand for oxygen from the immediately surrounding waters, thus causing a decrease in available dissolved oxygen. However, most of the material to be dredged would be pure sand, or sand and shell with little or no organic material. These materials have rapid settling rates, which would reduce the amount of time material would remain in suspension and rapidly dissipate turbidity plumes.

It is plausible that gases such as water vapor, carbon oxides, nitrogen, and sulfur from the combustion chambers and hydrocarbons and lead compounds in unburned fuel mixtures would be introduced in unquantifiable amounts into the Card Sound aquatic environment by the tour boats and small private motorboats. These amounts would be proportional to the frequency

that the proposed tour-boat route was traveled and would increase as the visitation on sound and monument waters was realized. Release of unburned fuel, primarily hydrocarbons and engine oil, from the operation of two-cycle outboard motors would be a recognized inherent feature, especially from improperly tuned engines. This type of water pollution has occurred in the past in monument waters from the operation of such motors, and it is plausible that it would continue in the future. However, quantification of the impact of such water pollution is impossible at this time because it is not known what, if any, ecological impact has occurred from existing and historical motorboat activity levels.

Bottom scarring from propellers would increase in shallow bay water areas such as Card Sound Bank, Cutter Bank, the shallow banks near Arsenicker Key and West Arsenicker Key, and along the selected tour-boat route with any future increase in private boat use of the monument. This would be due to the increased probability of craft wandering out of the natural channels into shallow areas. For the same reason, turbidity and injury to benthic organisms would increase within the general area of the designated channels and existing marina with increased boat use.

It is plausible that the bottom scars would serve as barriers to the normal movement of fauna associated with the submerged grass beds, that faster circulation into previously poorly flushed areas would be afforded by the scar corridors, and that additional sources of easily disturbed fine sediment would be exposed to tidal scouring and transported to adjacent areas where smothering of biota would occur.

Most permitted resource uses would be associated with commercial or private motorboat use. It is impossible to predict specific impacts on water quality, but they would probably include such things as hydrocarbon pollution from unburned fuel and oil expelled in exhausts, accidental fuel spills, and turbidity associated with boat operation in excessively shallow water.

(c) Air Quality. The increased use of motorized tour boats along selected access/circulation routes in the sound waters would increase levels of carbon monoxide, hydrocarbons, nitrogen oxides, and other exhaust pollutants. The forthcoming transportation study would provide frequency of travel information from which air pollution could be quantified. In general, the implementation of this plan should have no significant effect on air quality.

Motorboat activity related to permitted uses would result in increased levels of exhaust pollutants similar

to those produced by tour boats. However, because the vast majority of outboards have underwater exhausts, emission measurement is very difficult. In order to estimate potential concentrations of air pollutants from outboard motors, either total fuel use or work output (horsepower hour) must be known. Since neither of these parameters is available for motorboat use in Biscayne National Monument and/or Card Sound, it is not possible to quantify the impact upon air quality.

(d) Noise. The increased use of motorized tour boats in marinas and monument waters would increase noise levels in the surrounding area and particularly along the proposed tour-boat route. This increase in relation to the tour-boat service would be in direct proportion to craft motor size and frequency of route travel.

The locations where such noise would be most evident are along the Intracoastal Waterway and along the western shore of north Key Largo.

(e) Soils. No impact to soils would occur with the implementation of the alternative action.

(f) Wildlife. The tour-boat route originating from Steamboat Creek would pass along the Intracoastal Waterway approximately 1 mile from Arsenicker Key. The nesting endangered bald eagles on the key should not be disturbed by this activity because they have apparently become accustomed to the traffic of larger craft which presently exists in this area. However, if individual boats were used, disturbance of birdlife and the nesting bald eagles on Arsenicker Key would be plausible.

The regular schedule assumed by a tour-boat system would increase the opportunity for disturbance and/or injury to the endangered manatee because the critical habitat for the manatee essentially encompasses the entire monument.

Disturbance of wildlife utilizing the mangrove habitat would be unavoidable with the use of this routing plan due to the location of the marina on this previously undeveloped creek.

(2) Socioeconomic Environment. Steamboat Creek is located approximately 6 miles south of the monument boundary. As detailed in table 19, round trip distances from Steamboat Creek to Elliott Key, to Adams Key, and to Elliott and Adams Keys is approximately 25.5 miles, 18.0 miles, and 27.7 miles, respectively. Due to the distances involved and the remoteness of the Steamboat Creek site from the monument's boundary, an unquantifiable increase in transportation operational costs (i.e.,

fuel, manpower, maintenance) would be inherent with this alternative action.

An access/circulation scheme such as that mentioned above and detailed in table 19 would offer services that would adequately distribute visitors throughout the monument as well as provide an efficient transportation system between Convoy Point and the terminals on the keys.

The provision of tour-boat access into the monument from Steamboat Creek for non-boating visitors would increase the general public's awareness of the national monument's existence. There would be an increase in the number of local residents and other visitors utilizing the outlying keys, waters, and visitor-service facilities.

The Steamboat Creek site is located approximately 2 to 3 miles south of the Ocean Reef Yacht Club and the Key Largo Anglers Club on north Key Largo. Due to the frequency of boat use at these private facilities and other general existing boat activity in the immediate area (i.e., commercial and private use of the Intracoastal Waterway), a potential for navigational safety hazards would exist in areas that were simultaneously utilized by the Ocean Reef Yacht Club and the Key Largo Anglers Club because any route to Adams and Elliott Keys would have to pass close to these developed areas.

It is plausible that the visitor experience would deteriorate as boat congestion in the vicinity of the Ocean Reef Yacht Club and the Key Largo Anglers Club increased.

Card Sound Bank spans the width of Card Sound from the mainland to north Key Largo and divides Card Sound on the north from Little Card Sound on the south. The bank lies approximately 0.6 mile northwest of the Steamboat Creek site. This close proximity to the bank would increase navigational hazard to boaters and tour boats en route to and from a visitor-contact site at this location.

It is plausible that the close proximity of the access route and Intracoastal Waterway to the keys would lessen the navigational and visitor safety hazards imposed by adverse weather conditions and/or high land-sea breezes.

Channel markers would be provided to designate channel access into the Steamboat Creek site and the island development nodes inside the monument. It is plausible that the presence of these markers would be a visual intrusion to the natural environment.

Bottom scarring would continue as motorboats passed through overly shallow water, especially through turtle grass beds. When viewed from above, these scars would exert a long-lived aesthetic intrusion into the normal natural continuum of the grass beds.

Regardless of access/circulation route designation by signing and zoning, it is plausible that safety hazards, primarily to boating visitors, would increase with any increase in the number of inexperienced or uninitiated boat operators engaged in recreational activities such as water-skiing. Actual hazards would include higher frequencies of running aground or actually colliding with submerged features or objects. Also, rapidly moving ski boats would be extremely dangerous to small anchored boats, snorkelers, scuba divers, or sail-powered vessels, and it is plausible that the probability of accidents associated with these incompatible uses would increase with any increase in these activities.

(3) Cultural Resources. There would be no impact on cultural resources with the implementation of this alternative action.

3. No Action

a. Description. Under this alternative, no improved channel marking along designated routes would be provided. The selected access/circulation mode would probably follow commonly used corridors, but deviation from them would be likely.

b. Impacts

(1) Natural Environment. With the no-action alternative, there would be no provision of channel markers to indicate access and circulation routes to be utilized by individual and tour-boat craft operating in monument waters and/or Card Sound. Therefore, it is plausible that pollution of these waters from boat fuel and exhaust would be more widely disseminated over the total area as opposed to being concentrated in the vicinity of marked access and circulation corridors.

It is plausible that turbidity and a reduction of water clarity would be noted throughout monument waters rather than being localized by access/circulation corridor designation.

Shallow turtle, manatee, and shoal grass beds and indigenous algae species inhabiting the shallow bay and sound waters would continue to be impacted by propeller scarring from power boats engaged in commercial and sport fishing, pleasure motorboating, water-skiing, and diving. Bottom scarring from propellers would increase in shallow bay water areas such as Featherbed Bank, Cutter Bank, the shallow banks near Arsenicker

Key and West Arsenicker Key, and along the selected tour-boat routes with any future increase in private boat use of the monument. This would be due to the increased probability of craft wandering out of the natural channels into shallow areas.

It is plausible that the bottom scars would serve as barriers to the normal movement of fauna associated with the submerged grass beds, that faster circulation into previously poorly flushed areas would be afforded by the scar corridors, and that additional sources of easily disturbed fine sediment would be exposed to tidal scouring and transported to adjacent areas where smothering of biota would occur.

Inadvertent boater access to the Arsenicker Keys would increase without designated routes. Concomitantly, disturbance of avian species utilizing the keys as a rookery would increase.

Gases such as water vapor, carbon oxides, nitrogen, and sulfur from the combustion chambers, and hydrocarbons and lead compounds in unburned fuel mixtures, would continue to be introduced into the aquatic environment in unquantifiable amounts by the tour boats and small private motorboats. These amounts would be proportional to the frequency that the proposed tour-boat route is traveled and would increase as visitation on monument waters increased. Release of unburned fuel, primarily hydrocarbons and engine oil, from the operation of two-cycle outboard motors would be a recognized inherent feature, especially from improperly tuned engines. This type of water pollution has occurred in the past in monument waters from the operation of such motors, and it is plausible that it would continue in the future. However, quantification of the impact of such water pollution is impossible at this time because it is not known what, if any, ecological impact has occurred from existing and historical motorboat activity levels.

Although areas for certain recreational activities would be designated if activities such as water-skiing were attempted in the narrow mangrove channels or around any of the keys noted as avian areas, it is plausible that harassment of birdlife would occur. This would be especially significant in the case of the endangered brown pelican and nesting bald eagles. It is plausible that disturbances of this nature would preclude any nesting or future inhabitance of the monument by this species.

(2) Socioeconomic Environment. With no provision of an access/circulation routing scheme, it is plausible that adequate distribution of visitors throughout the monument as well as provision for an efficient transportation system between Convoy Point and the terminals on the keys would not occur.

It is plausible that the safety of those visitors utilizing the tour-boat system would be jeopardized should no routing scheme be established and designated. In the case of any type of operational problem or craft malfunction, determination of craft location would be difficult.

The potential for navigational hazards in the areas simultaneously utilized by the Key Largo Anglers Club would be increased without a designated route through this heavily used area.

An orderly and complete exposure of visitors to resources in the monument would be precluded without a predetermined routing system.

There would be no visual intrusion to the natural environment by the presence of channel markers because they would not be provided with the implementation of the no-action alternative.

Under the no-action access/circulation alternative, bottom scarring would continue as motorboats passed through overly shallow water, especially through turtle grass beds. When viewed from above, these scars would exert a long-lived aesthetic intrusion into the normal natural continuum of the grass beds.

Safety hazards, primarily to boating visitors, would increase with any increase in the number of inexperienced or uninitiated boat operators engaged in recreational activities such as water-skiing. Actual hazards would include higher frequencies of running aground or actually colliding with submerged features or objects. Also, rapidly moving ski boats would be extremely dangerous to small anchored boats, snorkelers, scuba divers, or sail-powered vessels, and it is plausible that the probability of accidents associated with these incompatible uses would increase with any increase in these activities.

(3) Cultural Resources. There would be no impact on cultural resources with the implementation of this alternative action.

E. NO-ACTION INTERPRETATION ALTERNATIVE

1. Description

Because of the relative newness of the monument, interpretive programs have been developed only to a minimal degree. Information and a monument minifolder are available on request at the Convoy Point headquarters office.

Most interpretive/information services are located at the Elliott Key Harbor area. Daily contact is made with boaters in the harbor by the ranger on duty. Occasional unscheduled evening campfire talks and a night glass-bottom boat trip are available for interested campers. A short trail with a limited botanical interpretive theme traverses Elliott Key.

The reef is interpreted to a limited extent by a self-guiding tour handout. Occasional contact is made with boaters on monument waters while rangers are on patrol.

Off-site programs in the form of slide shows or informal talks are frequently given to interested groups such as boating clubs, sport fishermen, and civic groups.

If the no-action alternative were selected, interpretive programs and facilities would function at the present level. No action would be taken to provide additional interpretiation or to alleviate what is perceived to be inadequate interpretation of the monument's resources.

2. Impacts

(a) Natural Environment. The existing short trail beginning at the Elliott Key Harbor, which currently offers a limited botanical interpretive theme, would continue to supply the only interpretation on the key. Therefore, none of 8 miles of trail on Elliott Key or the ½ mile of trail on Adams Key would be committed for interpretive purposes.

Visitors would continue to be subjected to natural safety hazards such as intense heat and sun and biting insects, primarily in the summer months, as they explored the resources of Elliott and Adams Keys. With the no-action interpretation alternative, inadequate information concerning such environmental hazards would be available, and visitor safety would continue to be threatened.

The interpretive tower would not be built on Adams Key. Therefore, no additional ground cover would be committed for its erection.

b. Socioeconomic Environment. It is plausible that with implementation of the no-action interpretation alternative, visitors to Convoy Point, Elliott Key, and Adams Key would not be given necessary and logically presented information to properly orient themselves or to fully experience and enjoy the monument's resources.

No information would be disseminated at Convoy Point, Elliott Key, and Adams Key to assist visitors in planning

their visit and understanding the monument's resources. This would deny them many opportunities to learn about this fragile environment, resulting in a less-than-total visitor experience.

With the unavailability of information concerning National Park Service administrative and regulatory criteria for the monument which would occur with the no-action alternative, it is plausible that destructive activities by visitors could lead to degradation of the monument's resources.

Without evolving interpretive programs, any future increase in visitor use in the monument would have no logically planned dispersal pattern.

It is plausible that the no-action interpretation alternative would appeal to those visitors who prefer low-intensity use areas.

The interpretation of limited specific areas that now exists on Elliott Key could lead to increased use and possible overuse of those specific areas.

c. Cultural Resources. There would be no impacts on the cultural resources in the monument with the implementation of this alternative.

F. ALTERNATIVE MANAGEMENT ZONE CLASSIFICATION CONSIDERATIONS

The alternative management zone classification schemes considered involved possible expansions or contractions of the various zones and subzones proposed. The following sections discuss these zones individually, but do not attempt to separately analyze the large number of total packages that might have resulted when these zones were combined. Because the no-action alternative deals with a situation in which the extent of area in these various zones is essentially minimal and undesignated, impacts of minimal extent are treated in that section. Because the General Management Plan defers the formulation of concise management regulations to the development and approval of a resource management plan, it is not possible to state exactly what regulations would be implemented in the various zones, and consequently what precise impacts might result from different classifications.

1. Environmental Protection Subzone

a. Description. The designation of specific units on the offshore reef and in the bay as research control units was a major expansion of this subzone that was considered. Also considered was inclusion of an area north of the Elliott Key Harbor where an aggregation of Sargent's palm is located.

A further alternative was to include only Totten Key (not Jones Lagoon and Old Rhodes Key) in that complex, with the latter two areas as an outstanding natural feature subzone.

b. Impacts

(1) Natural Environment. This alternative action considers the designation of specific areas on the offshore reef tract and certain areas of Biscayne Bay for research control units. The establishment of such control areas for research purposes would permit continuous monitoring of visitor and/or external pollution impacts on the resources in the selected areas. As a result, more comprehensive and conservative management policies could be formulated for various visitor-use areas (e.g., the reef tract). This would result in better protection and enhancement of the long-term health of these resources.

An area north of the Elliott Key Harbor upon which a stand of Sargent's palms is established was considered for designation as an environmental protection subzone under this alternative action. Such a designation would place a priority on protecting the standing specimen trees from damages normally associated with visitor use (chopping of trunks with hand axes or knives, etc.). Furthermore, use of interpretive trails and organized interpretive group visitation would be closely scrutinized to determine their compatibility with the healthy perpetuation and protection of the trees. It is plausible that with controlled access and successful protection, the vigor and reproduction success of the trees would be solely a function of natural processes.

Another alternative management zone classification scheme was considered which included only Totten Key in an environmental protection subzone and placed Jones Lagoon and Old Rhodes Key in the outstanding natural features subzone. Excluding Jones Lagoon and Old Rhodes Key from the protection afforded by the strict environmental protection subzone designation would lessen the control over visitor and/or research group access. Uncontrolled access to these areas would disturb benthic organisms and loosen grass mats in Jones Lagoon. Disturbance of natural vegetation understory and compaction of soils on Old Rhodes Key would occur from the random trail establishment inherent with uncontrolled access.

(2) Socioeconomic Environment. With the implementation of this management zone classification alternative, free visitor movement through the Sargent's palm area would be restricted as the need for tree protection warranted.

It is plausible that curtailment of sport or commercial fishing and/or boat anchorage over research control areas on the reef tract would remove those areas from visitor

or commercial use. This would result in an unquantifiable loss of income to commercial users.

The exclusion of Jones Lagoon and Old Rhodes Key from the environmental protection subzone classification would open the areas to more liberal visitor use.

(3) Cultural Resources. No cultural resources would be affected by this alternative action.

2. Outstanding Natural Feature Subzone

a. Description. The inclusion of Old Rhodes Key and Jones Lagoon in this category was considered. Also considered was a classification in which only those portions of the offshore reef that did not contain significant cultural resources would be an outstanding natural feature.

b. Impacts

(1) Natural Environment. By policy, the outstanding natural feature category places a higher priority on visitor use of the area than the environmental protection subzone classification. Therefore under this alternative, less stringent restrictions would be placed on using Jones Lagoon and Old Rhodes Key in order to facilitate interpretation and visitor access. This action would result in potential disturbance of benthic organisms (sponges, algae, etc.) and shallow aquatic grass communities in Jones Lagoon. Destruction of natural vegetation understory and compaction of soils on Old Rhodes Key would occur with random trail establishment inherent with relaxed control of visitor use and access.

Under this alternative action, only those portions of the offshore reef that did not contain significant cultural resources would be classified outstanding natural features. Excluding shipwreck sites from this subzone would place a priority on historical resource preservation, with a consequent emphasis on restriction or close supervision of visitor use near wreck sites. In effect, natural features in the wreck site would be afforded increased protection from anchor damage and inadvertent or deliberate visitor damage to reef structure or biota.

(2) Socioeconomic Environment. Depending on the specific regulations developed concerning historic areas on the reef, visitor use of major portions of the offshore reed area would be restricted. If those restrictions extended to sport or commercial fishing, an unquantifiable economic loss would result.

(3) Cultural Resources. The cultural resources occurring in the areas designated as historic zones (excluded from outstanding natural feature subzone classification) would be afforded increased protection.

3. Natural Environment Subzone

a. Description. Various interchanges between the environmental protection and outstanding natural feature subzones and the historic zone were considered for the proposal, but in no case would there have been substantially more natural environment subzone (i.e., more of the least restrictive natural area category). However, one major alternative - the no-action alternative - would have perpetuated essentially the whole monument in that generalized natural area category.

b. Impacts

(1) Natural Environment. This resource classification alternative proposes various interchanges of environmental protection and outstanding natural feature subzone classifications. Therefore, it is plausible that a classification scheme that did not specifically designate any area as an environmental protection subzone might occur. In this case, no special provision for protection of the record-sized tree specimens on Old Rhodes, Totten, and Elliott Keys or the endangered bald eagles nesting on Arsenicker Key would be afforded.

(2) Socioeconomic Environment. There would be no impact upon the socioeconomic environment with the alternative action.

(3) Cultural Resources. There would be no impact upon historical and/or archaeological resources with this alternative zone.

4. Historic Zone

a. Description. The major alternatives considered for historic zone designation ranged from discrete several-acre parcels surrounding each of the identified shipwreck sites to large general units encompassing whole blocks of reef where multiple wreck sites are known. No historic zone was considered for any known cultural resources on the fastlands because no sites there have been determined to be of national significance.

b. Impacts

(1) Natural Environment. No impact would occur to the natural environment under this resource classification alternative.

(2) Socioeconomic Environment. No impact would occur to the local and regional socioeconomic environment with the implementation of this management zone classification alternative. However, enforcement of any subsequent prohibitive regulations that applied only to these individual sites would probably require physical marking of large numbers of sites, drawing further attention to unprotected wrecks. Extremely large

commitments of manpower and funds would have to be made in this instance, including increased ranger patrol, high-speed patrol craft, possible aerial reconnaissance, and frequent searches of boats in adjacent waters.

(3) Cultural Resources. The alternatives considered for historic zone classification range from parcels surrounding each shipwreck site to large units encompassing blocks of the reef where multiple wreck sites are known.

It is plausible that the individual site method of designation would favor increased levels of vandalism and unauthorized salvage because exact locations would be known to the public. If such levels were allowed to continue, substantial disturbance and degradation of the archaeological value of the sites would be unavoidable.

Large-unit historic zones encompassing many different wreck sites would avoid drawing attention to individual sites and would avoid increased levels of casual visitor impact. This would also mean, however, that many interspersed natural features would be included in a zone that placed a higher priority on preservation of historic resources than on visitor use of natural resources. The extent to which visitors were actually prevented from visiting natural features within the historic zone would depend upon specific regulations formulated for protecting the historic wrecks.

5. Development Zone

a. Description. Location of development zones is directly related to other phases of planning concerning development of visitor facilities. The three development areas contained in the actual proposal - Convoy Point, Elliott Key Harbor, and Adams Key - were the only areas within the monument that were considered for development intense enough to warrant development zone classification. Two areas on north Key Largo - Wednesday Point and Steamboat Creek - were analyzed for alternative visitor-contact sites and would have required development zone classification if they had been selected for development.

b. Impacts. The development zone classification was considered for the developed areas at Convoy Point, Elliott Key Harbor, the Adams Key complex site, and the potential visitor-contact nodes at Wednesday Point and Steamboat Creek on north Key Largo. The two visitor-contact sites were subsequently dropped from consideration when the decision was made not to develop a visitor-contact site on north Key Largo. However, had either site been chosen and classified as a development zone, it would have allowed physical development in predominantly natural areas. Therefore, the environmental impact would be

the same as that previously discussed under the alternatives pertaining to visitor-contact sites subsection.

Since the developed sites at Convoy Point, Elliott Key Harbor, and Adams Key have been previously disturbed, classification of these sites as development zones would exert no impact on the natural, socioeconomic, or cultural environments.

6. No Action

a. Description. Under the no-action alternative, the majority of the monument would be considered as natural environment zone and the reef areas as outstanding natural feature subzones.

b. Impacts

(1) Natural Environment. Under a no-action alternative pertaining to management zone classification, the entire monument would be classified as a natural environment zone and areas of the offshore reef tract as outstanding natural feature subzones. There would be no designation of fragile areas (e.g., Jones Lagoon, Arsenicker Key) as environmental protection subzones. Therefore, no added protection of such areas afforded by such classification would be possible.

Currently there is no protection of the endangered bald eagles or the record-sized specimen trees on Arsenicker, Totten, or Elliott Keys afforded by a management zone classification scheme. Even though special protection of these areas is recognized by park management and would result as long as adequate staffing, patrol craft, and funding were available, it would not be officially afforded with the no-action management zone classification alternative.

(2) Socioeconomic Environment. There would be no impact on the socioeconomic environment under this alternative.

(3) Cultural Resources. There would be no impact on cultural resources with this alternative.

G. ALTERNATIVE RESOURCE USES CONSIDERED

The enabling legislation made it clear that both commercial and sport fishing, as well as recreational diving and boating, were to be legitimate activities in the monument as long as they did not interfere with preservation of the resources. The only alternatives feasible in regard to these resource uses involve the possible zoning and restriction (but not prohibition) of certain activities (e.g., spearfishing) for resource protection and public safety. Such zoning and restriction is of such a specific nature that it has not been considered in the General Management Plan and will be a part of later resource management planning.

CONSULTATION AND COORDINATION

IX. CONSULTATION AND COORDINATION WITH OTHERS

A. CONSULTATION AND COORDINATION IN THE DEVELOPMENT AND PREPARATION OF THE DRAFT ENVIRONMENTAL STATEMENT

1. Early Planning Efforts

The National Park Service produced a Draft Master Plan for Biscayne National Monument in 1971. Since that time, some of the management objectives that were identified then have been modified to conform with current visitation levels, research findings, and visitor service needs. Due to subsequent changes in management, development, and visitor use brought about by changing conditions, and an increased awareness of the dynamic nature of the barrier islands, an Environmental Assessment was prepared in conformance with the National Environmental Policy Act of 1969 (NEPA) in May 1976 to serve as a planning guide for a current general management plan.

2. Present Planning Effort

A public meeting held in June 1976 at Homestead, Florida, on the Environmental Assessment for the General Management Plan and a subsequent environmental review in July 1976 by the Southeast Regional Office of the National Park Service in Atlanta, Georgia, produced the current proposal.

Public meetings were held in Miami and Homestead, Florida, on January 25 and 26, 1978, on the Draft Environmental Statement and the Draft General Management Plan for the purpose of providing the public with another opportunity to comment or otherwise provide input into the planning process. The final documents reflect those concerns that had applicability as well as the written comments, which are appended.

The following organizations were also consulted to assist in the development of the proposal, or to provide substantial information for the draft documents; their areas of principal concern are indicated.

Card Sound Road and Toll Bridge Authority, Key Largo (vehicle demand and loading on Card Sound road and bridge)

Dade County Cooperative Extension Service, Homestead (soil classification for Dade and Monroe Counties)

Florida Department of Natural Resources, Tallahassee (boat registration, Florida manatee population data, current legislation on marine turtle protection, and coastal zone classification)

Florida Historic Preservation Officer, Tallahassee (identification of additional National Register properties)

Florida State Parks Commission, Tallahassee (visitation statistics and facility description of south Florida parks)

Florida Power and Light Company, Miami (effects of Turkey Point Power Plant on resources of Biscayne Bay contained in Florida Power and Light Company's environmental report supplement on Turkey Point Plant Units 3 and 4)

John Pennekamp Coral Reef State Park, Key Largo (park visitation, general use, and concessions)

Metropolitan Dade County, Bureau of Vital Statistics, Miami (current regional census data)

Metropolitan Dade County Parks and Recreation Department, Miami (relation of future plans for Dade County parks to planning efforts for Biscayne National Monument)

Metropolitan Dade County Planning Department, Miami (identification of interrelated planning efforts and projects with Metropolitan Dade County Master Plan and the specific studies being conducted in Biscayne Bay)

Metropolitan Dade County Water and Sewer Board, Miami (water quality and municipal facilities)

Monroe County Clerk's Office, Key West (land valuation and ownership)

University of Miami, Miami (current environmental research studies and resource data on Biscayne Bay and surrounding areas)

U.S. Coast Guard (boat use of the Intracoastal Waterway)

U.S. Department of Commerce, National Marine Fisheries Service, Miami (commercial fishery harvest data)

U.S. Department of Defense, Department of the Air Force (noise data from Homestead Air Force Base)

U.S. Department of the Interior, Fish and Wildlife Service (Florida manatee range)

B. COORDINATION IN THE REVIEW OF THE DRAFT ENVIRONMENTAL STATEMENT

Copies of the draft environmental statement were sent to the following for review:

Federal Agencies
Advisory Council on Historic Preservation
Department of Agriculture
    Soil Conservation Service
Department of Commerce
    National Oceanic and Atmospheric Administration
        National Marine Fisheries Service
Department of Defense
    Department of the Air Force
    Department of the Army
        Corps of Engineers
Department of Housing and Urban Development
Department of the Interior
    Bureau of Land Management
    Bureau of Outdoor Recreation
    Fish and Wildlife Service
    Geological Survey
Department of State
    Office of Environmental Affairs
Department of Transportation
    Coast Guard
        Marine Protection Branch
    Federal Aviation Administration
Environmental Protection Agency
Water Resources Council

State Agencies
Florida Historic Preservation Officer
John Pennekamp Coral Reef State Park, Director
State of Florida
    State Clearinghouse

Informational copies were sent to the following:

Local Agencies
Dade County Parks and Recreation Department
Metropolitan Dade County Planning Department
South Florida Regional Planning Council

Private Businesses and Organizations
Florida Audubon Society
Florida Marine Aquarium Society
Forida Power and Light Company
Florida Sierra Club
Florida Skin Divers Association
Florida Wildlife Federation
Greater Miami Chamber of Commerce
Greater Miami Marine Council
Izaak Walton League of America, Florida Chapter
National Audubon Society
Salt Water Fisheries Advisory Council
Sport Fishing Institute
The Nature Conservancy
Tropical Audubon Society, Inc.

APPENDIXES/BIBLIOGRAPHY/STUDY TEAM

APPENDIXES

A:	LEGISLATION	200
B:	CHANNEL EASEMENTS IN BISCAYNE NATIONAL MONUMENT	208
C:	NATIONAL AMBIENT AIR-QUALITY STANDARDS	211
D:	MARINE PLANTS AND ANIMALS OF BISCAYNE NATIONAL MONUMENT	213
E:	FISHES OF BISCAYNE NATIONAL MONUMENT	240
F:	TERRESTRIAL FLORA SPECIES OF BISCAYNE NATIONAL MONUMENT	265
G:	SPECIES CHECKLIST OF MAMMALS, AMPHIBIANS, REPTILES, AND BIRDS OF BISCAYNE NATIONAL MONUMENT	270
H:	NATIONAL PARK SERVICE MANAGEMENT ZONE CLASSIFICATION GUIDELINES	277
I:	REPONSE FROM FLORIDA HISTORIC PRESERVATION OFFICER	280
J:	ANALYSIS OF RESOURCE-USE ACTIVITIES IN BISCAYNE NATIONAL MONUMENT	284
K:	MONUMENT VISITATION AND IMPLICATIONS FOR CAPACITY	300
L:	PUBLIC COMMENTS AND NATIONAL PARK SERVICE RESPONSES	304

A: LEGISLATION

Public Law 90-606
90th Congress, H. R. 551
October 18, 1968

An Act

To authorize the establishment of the Biscayne National Monument in the State of Florida, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That, in order to preserve and protect for the education, inspiration, recreation, and enjoyment of present and future generations a rare combination of terrestrial, marine, and amphibious life in a tropical setting of great natural beauty, the Secretary of the Interior may establish the Biscayne National Monument within so much of the area in the State of Florida as generally depicted on the drawing entitled "Biscayne National Monument Boundary Map," numbered NM-BIS 7101, and dated May 1966, which drawing is superimposed on a photographic reproduction of a portion of Coast and Geodetic Survey Chart Numbered 1249 (eighth edition, December 20, 1965, correction numbered 22, dated May 28, 1966) as lies north of the north boundary of the channel easement shown thereon. The drawing shall be on file and available for public inspection in the offices of the National Park Service, Department of the Interior. The Secretary may revise the boundaries of the national monument from time to time, but the total acreage of the national monument shall not exceed ninety-six thousand three hundred acres and no boundary shall be revised outward or in such a manner as to obstruct any seaport channel which may be hereafter constructed outside the boundaries hereinbefore referred to.

Biscayne National Monument, Fla. Establishment.

SEC. 2. (a) Within the boundaries of the Biscayne National Monument, the Secretary of the Interior may acquire lands, waters, or interests therein by donation, purchase with donated or appropriated funds, or exchange. The Secretary may in addition acquire by any of the above methods not more than eighty acres of land or interests therein on the mainland for a headquarters site, and not more than forty acres of land or interests therein on Key Largo for a visitor contact site.

Land acquisition.

(b) When acquiring property by exchange the Secretary may accept title to any non-Federal property within the boundaries of the national monument, and outside of such boundaries within the limits prescribed in subsection (a) of this section, and in exchange therefor he may convey to the grantor of such property any federally owned property under his jurisdiction in the State of Florida which he classifies as suitable for exchange or other disposal. The values of the properties so exchanged either shall be approximately equal, or if they are not approximately equal the values shall be equalized by the payment of cash to the grantor or to the Secretary as the circumstances require.

82 STAT. 1188
82 STAT. 1189

SEC. 3. Notwithstanding any other provision of this Act, lands and interests in land owned by the State of Florida or Dade County may be acquired solely by donation, and the Secretary shall not declare the Biscayne National Monument established until the State has transferred or agreed to transfer to the United States its right, title and interest in and to its lands within the boundaries of said national monument. The Secretary shall not acquire any other lands or interests in land pursuant to this Act except by donation or with donated funds until the State has made or obligated itself to make the aforesaid transfer: *Provided*, That nothing contained in this sentence shall preclude the Secretary from acquiring options for the purchase of lands and interests in land, other than lands and interests in land held by the State of Florida or Dade County, which are to be acquired pursuant to this Act and, upon the State's transferring or obligating itself to

transfer as aforesaid, he shall proceed as expeditiously as possible to acquire the other lands and interests in land which are necessary to carry out the purposes of this Act.

Administration.

SEC. 4. The Secretary of the Interior shall preserve and administer the Biscayne National Monument in accordance with the provisions of the Act of August 25, 1916 (39 Stat. 535; 16 U.S.C. 1–4), as amended and supplemented. The waters within the Biscayne National Monument shall continue to be open to fishing in conformity with the laws of the State of Florida except as the Secretary, after consultation with appropriate officials of said State, designates species for which, areas and times within which, and methods by which fishing is prohibited, limited or otherwise regulated in the interest of sound conservation or in order to achieve the purposes for which the national monument is established.

Fishing.

Appropriation.

SEC. 5. There are authorized to be appropriated such sums as may be necessary to carry out the provisions of this Act, but not to exceed $24,575,000 for land acquisition and $2,900,000 for development.

Approved October 18, 1968.

LEGISLATIVE HISTORY:

HOUSE REPORT No. 1789 (Comm. on Interior and Insular Affairs).
SENATE REPORT No. 1597 (Comm. on Interior and Insular Affairs).
CONGRESSIONAL RECORD, Vol. 114 (1968):
Sept. 16: Considered and passed House.
Oct. 4: Considered and passed Senate.

Public Law 93-477
93rd Congress, H. R. 14217
October 26, 1974

An Act

To provide for increases in appropriation ceilings and boundary changes in certain units of the National Park System, to authorize appropriations for additional costs of land acquisition for the National Park System, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

National Park System. Appropriation ceilings increase; boundary changes; appropriation authorization.

TITLE I—ACQUISITION CEILING INCREASES

SEC. 101. The limitations on appropriations for the acquisition of lands and interests therein within units of the National Park System contained in the following Acts are amended as follows:

(1) Biscayne National Monument, Florida: Section 5 of the Act of October 18, 1968 (82 Stat. 1188, 1189) is amended by changing "$24,575,000" to "$28,350,000"; 10 USC 450qq-4.

(2) Colonial National Historical Park, Virginia: Section 4 of the Act of July 3, 1930 (46 Stat. 856), as amended (16 U.S.C. 81f) is amended by changing "$2,777,000" to "$10,472,000";

(3) Cumberland Gap National Historical Park, Kentucky and Tennessee: For the acquisition of lands authorized in subsection 301(2) of this Act, there are authorized to be appropriated such sums as may be necessary, but not more than $427,500; 16 USC 266.

(4) Fort Necessity National Battlefield, Pennsylvania: Section 5 of the Act of August 10, 1961, (75 Stat. 336), is amended by changing "$115,000" to "$722,000"; 16 USC 430tt.

(5) Independence National Historical Park, Pennsylvania: Section 6 of the Act of June 28, 1948 (62 Stat. 1061, 1062), as amended (16 U.S.C. 407r), is amended by changing "$11,200,000." to "$12,792,000.";

(6) Indiana Dunes National Lakeshore, Indiana: Section 10 of the Act of November 5, 1966 (80 Stat. 1309, 1312; 16 U.S.C. 406u-9) is amended by changing "$27,900,000" to "$35,526,000";

(7) Moores Creek National Military Park, North Carolina: The Act of September 27, 1944 (58 Stat. 746) is amended by adding the following new section: 16 USC 422a-1.

"SEC. 2. There are authorized to be appropriated such sums as may be necessary to carry out the purposes of this Act, but not more than $243,000 shall be appropriated for the acquisition of lands and interests in lands and not more than $325,000 shall be appropriated for development."; Land acquisition, appropriation. 16 USC 422a-2.

(8) Morristown National Historical Park, New Jersey: Section 3 of the Act of September 18, 1964 (78 Stat. 957) is amended by changing "$281,000" to "$2,111,000"; 16 USC 409g note.

(9) Rocky Mountain National Park, Colorado: For the acquisition of lands authorized in subsection 301(6) of this Act, there are authorized to be appropriated not more than $2,423,740 and for development of such lands there are authorized to be appropriated not more than $318,000;

(10) Virgin Islands National Park, Virgin Islands: Section 4 of the Act of October 5, 1962 (76 Stat. 748; 16 U.S.C. 398f) is amended by changing "$1,250,000" to "$12,250,000";

(11) Apostle Islands National Lakeshore, Wisconsin: Section 8 of the Act of September 26, 1970 (84 Stat. 880) is amended by deleting "$4,250,000" and inserting in lieu thereof "$5,250,000"; 16 USC 460w-7.

(12) Lake Mead National Recreation Area, Arizona and 16 USC 460n-9.

16 USC 460n-9. Nevada: Section 10 of the Act of October 8, 1964 (78 Stat. 1039) is amended by deleting "$1,200,000" and inserting in lieu thereof "$7,100,000"; and

(13) Sleeping Bear Dunes, Michigan: Section 15 of the Act of
16 USC 460x-14. October 21, 1970 (84 Stat. 1075) is amended by deleting "$19,800,000" and inserting in lieu thereof "$57,753,000".

TITLE II—DEVELOPMENT CEILING INCREASES

SEC. 201. The limitations on appropriations for development of units of the National Park System contained in the following Acts are amended as follows:

(1) Channel Islands National Monument, California: For the purposes of development of the administrative site and visitor facilities authorized by section 401 of this Act, there are authorized to be appropriated $2,936,000;

(2) Cumberland Gap National Historical Park, Kentucky and Tennessee: In addition to any funds heretofore appropriated for said national historical park, there are hereby authorized to be appropriated not more than $160,000 for development; and

(3) International Peace Garden, North Dakota: Section 1 of the Act of October 25, 1949 (63 Stat. 888), as amended (68 Stat. 300 and 72 Stat. 985), is amended by changing "$400,000" to "$1,702,000".

TITLE III—BOUNDARY CHANGES

SEC. 301. The Secretary of Interior shall revise the boundaries of the following units of the National Park System:

(1) Biscayne National Monument, Florida: To add approximately 8,738 acres of land and water, including all of Swan Key and Gold Key;

16 USC 267. (2) Cumberland Gap National Historical Park, Kentucky and Tennessee: Notwithstanding the provisions of the Act of June 11, 1940 (54 Stat. 262), as amended (16 U.S.C. 261-265), the Secretary of the Interior is authorized to acquire by donation, purchase with donated or appropriated funds, or exchange not to exceed 60 acres of land or interests in land located in Bell County, Kentucky, and Claiborne County, Tennessee, for addition to and inclusion in the said national historical park which, upon acquisition, shall become a part of the Cumberland National Historical Park subject to the laws, rules, and regulations governing such park;

(3) Fort Necessity National Battlefield, Pennsylvania: To add approximately 411 acres;

(4) Independence National Historical Park, Pennsylvania: To add approximately 4.67 acres, which shall include the area bounded by Chestnut Street, Front Street, Walnut Street, and Second Street, to be known as Project F: *Provided*, That the authority of the Secretary of the Interior to acquire property by condemnation under this Act shall be suspended with respect to all property within the boundaries of the area known as Project F during the time the city of Philadelphia shall have in force and applicable to such property a duly adopted, valid zoning ordinance approved by the Secretary: *And provided further*, That no zoning ordinance or amendment of a zoning ordinance shall be approved by the Secretary which (1) contains any provision which he may consider adverse to the preservation and develop-

ment of the Independence National Historical Park, or (2) fails to have the effect of providing that the Secretary shall receive notice of any variance granted under and any exception made to the application of such ordinance or amendment;

(5) Lava Beds National Monument, California: To add approximately 321.58 acres and to delete approximately 60.12 acres, which additions and deletions shall comprise only federally owned lands, and lands deleted from the monument shall be administered by the Secretary of the Interior in accordance with the Federal reclamation laws;

(6) Morristown National Historical Park, New Jersey: The Act of September 18, 1964 (78 Stat. 957) is amended changing "two hundred and eighty-one acres" in both places in which it appears in the first section to "465 acres" and change the period to a colon and insert "*Provided*, That title to the property known as the Cross estate may not be accepted until the property is vacant." and 16 USC 409g.

(7) Rocky Mountain National Park, Colorado: To add approximately 1,556.21 acres.

TITLE IV—MISCELLANEOUS PROVISIONS

Ventura Marina, Calif., land donation for use in Channel Islands National Monument.

SEC. 401. The Secretary of the Interior is authorized to accept the donation of the fee simple title of not to exceed five acres of land and submerged land within the Ventura Marina, Ventura County, California; and to develop, operate, and maintain thereon administrative and visitor facilities to be used as a mainland headquarters for the Channel Islands National Monument: *Provided*, That no lands or any interests therein may be accepted by the Secretary until a mutually satisfactory agreement has been executed which shall include, among other things, an agreement on the design for such facilities, a reasonable timetable for their construction, and an agreement concerning public use of and access to such facilities. Any property accepted under the provisions of this Act shall be administered as a part of the national monument. Administration.

16 USC 422a-1.

SEC. 402. The Act of September 27, 1944 (58 Stat. 746), providing for the Moores Creek National Military Park is amended by changing the words "accept in behalf of the United States donations of" to "acquire by donation, purchase, or exchange", and by changing "to be accepted" to "acquired".

San Juan National Historic Site, P.R., damage studies.

Transmittal to Congress.

SEC. 403. (a) The Secretary of the Interior, in cooperation with the Secretary of the Army, shall cause to be conducted such studies as they deem reasonable and necessary to determine the causes and extent of the damage to the foundations of the historic structures of the San Juan National Historic Site and shall transmit to the Congress, as soon as possible, but no later than one year after the date of the enactment of this Act, the alternative courses of action, together with their recommendations, which might be taken to assure the historical integrity of such structures and the safety of the visiting public. Pending the submission of such recommendations, the Secretary of the Interior shall take every reasonable precaution to assure the public safety and the maximum public enjoyment of the historic site.

Appropriation.

(b) To carry out the purposes of this section, there are authorized to be appropriated such sums as may be necessary, but not more than $100,000.

Ohio and Erie Canal, Ohio, study.

SEC. 404. (a) The Secretary of the Interior is authorized and directed to undertake a study of the most feasible and suitable means of preserving and interpreting for the benefit of the public the historic and natural resources of the Ohio and Erie Canal in the State of Ohio,

together with associated and related lands. In carrying out the study the Secretary shall consider existing and proposed State and local highway plans, land-use plans, outdoor recreation plans, and related plans for the preservation of historic and natural resources. Not later than one year from the date of enactment of this Act the Secretary shall submit to the Congress a report of such study, including his recommendations as to the means of protecting, interpreting, and developing the resources of the Ohio and Erie Canal and adjacent lands.

Report to Congress.

Appropriation.

(b) To carry out the purposes of this section, there are authorized to be appropriated such sums as may be necessary, but not more than $40,000.

Additional appropriations.

42 USC 4603.

SEC. 405. (a) In all instances where authorizations of appropriations for the acquisition of lands for the National Park System enacted prior to January 9, 1971, do not include provisions therefor, there are authorized to be appropriated such additional sums as may be necessary to provide for moving costs, relocation benefits, and other expenses incurred pursuant to the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646; 84 Stat. 1894). There are also authorized to be appropriated not to exceed $8,400,000 in addition to those authorized in Public Law 92-272 (86 Stat. 120) to provide for such moving costs, relocation benefits, and other related expenses in connection with the acquisition of lands authorized by Public Law 92-272.

42 USC 4601 note.

16 USC 459f-10.

Waiver.

(b) Whenever an owner of property elects to retain a right of use and occupancy pursuant to any statute authorizing the acquisition of property for purposes of a unit of the National Park System, such owner shall be deemed to have waived any benefits under sections 203, 204, 205, and 206 of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (84 Stat. 1894), and for the purposes of those sections such owner shall not be considered a displaced person as defined in section 101(6) of that Act.

42 USC 4623-4626.

42 USC 4601.

Cape Lookout National Seashore, N. C.

SEC. 406. The Act of March 10, 1966 (80 Stat. 33; 16 U.S.C. 459g) providing for the establishment of Cape Lookout National Seashore in the State of North Carolina is amended as follows:

16 USC 459g.

(1) Section 1 is amended by deleting " 'Proposed Boundaries—Proposed Cape Lookout National Seashore', dated April 1964, and numbered NS-CL-7101-B," and substituting in lieu thereof " 'Boundary Map, Cape Lookout National Seashore', dated March 1974, and numbered 623-20,009," and by changing the colon to a period and deleting the remainder of the section.

Non-Federal land acquisition.

16 USC 459g-1.

(2) Subsection 2(a) is amended by deleting the third sentence and inserting in lieu thereof the following "Lands owned by the State of North Carolina or any political subdivision thereof may be acquired only by donation, but the Secretary may, subject to the provisions of section 7 of this Act, acquire any other non-Federal lands, marshlands, waters, or interests therein which are located within the boundaries of the seashore by donation, purchase with donated or appropriated funds, or exchange. Notwithstanding any other provision of law, the Secretary may accept any lands donated by the State of North Carolina subject to a provision for reversion to the State conditioned upon continued use of the property for national seashore purposes.".

Post, p. 1449.

16 USC 495g-2.

(3) Section 3 is amended by revising the first sentence to read as follows: "When title to lands and interests in lands in an amount sufficient to constitute an efficiently administerable unit for the purposes of this Act is vested in the United States, the Secretary shall declare the establishment of the seashore by publication of notice thereof in the Federal Register.".

Publication in Federal Register.

(4) Section 7 is amended to read as follows: Report to President.

"SEC. 7. On or before January 1, 1978, the Secretary shall review the area within the seashore and shall report to the President, in accordance with section 3 (c) and (d) of the Wilderness Act (78 Stat. 891; 16 U.S.C. 1132 (c) and (d)), his recommendations as to the suitability or nonsuitability of any area within the seashore for preservation as wilderness, and any designation of any such areas as a wilderness shall be accomplished in accordance with said subsections of the Wilderness Act." 16 USC 459g-6.

(5) Add a new section 8 to read as follows: Appropriation.

"SEC. 8. There are hereby authorized to be appropriated such sums as may be necessary to carry out the purposes of this Act, not to exceed $7,903,000 for acquisition of lands and interests therein, of which no more than $1,000,000 may be expended for acquisition of lands owned by Core Banks Club Properties, Incorporated. For development of essential public facilities there are authorized to be appropriated not more than $2,935,000. On or before January 1, 1978, the Secretary shall develop and transmit to the Committees on Interior and Insular Affairs of the United States Congress a final master plan for the full development of the seashore consistent with the preservation objectives of this Act, indicating— 16 USC 459g-7. Master plan, transmittal to congressional committees.

"(1) the facilities needed to accommodate the health, safety and recreation needs of the visiting public;

"(2) the location and estimated cost of all facilities; and

"(3) the projected need for any additional facilities within the seashore."

Approved October 26, 1974.

LEGISLATIVE HISTORY:

HOUSE REPORT No. 93-1286 (Comm. on Interior and Insular Affairs).
SENATE REPORT No. 93-1232 (Comm. on Interior and Insular Affairs).
CONGRESSIONAL RECORD, Vol. 120 (1974):
Aug. 19, considered and passed House.
Oct. 8, considered and passed Senate, amended.
Oct. 16, House concurred in Senate amendments with an amendment; Senate concurred in House amendment.

GPO 33-139

B: CHANNEL EASEMENTS IN BISCAYNE NATIONAL MONUMENT



easement

BISCAYNE NATIONAL MONUMENT
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

169 | 20015B
DSC MAR 76
ON MICROFILM
ON MICROFILM

C: NATIONAL AMBIENT AIR-QUALITY STANDARDS

National Ambient Air-Quality Standards in the United States

Substance	Air-Quality standard, ug/m^3	
	Primary Public Health Endangered)	Secondary Public Welfare Endangered)
Sulfur dioxide		
Annual arithmetic mean	80	60
24-hour max[a]	365	260
3-hour max[a]	--	1,300
Particulate matter		
Annual geometric mean	75	60
24-hour max[a]	200	150
Carbon monoxide		
8-hour max[a]	10,000	10,000
1-hour max[a]	40,000	40,000
Oxidant		
1-hour max[a]	160	160
Nitrogen oxides (e.g., NO_2		
Annual arithmetic mean	100	100
Hydrocarbons		
3-hour max (6-9 a.m.)	160	160

[a] Not to be exceeded more than once per year.

Source: Environmental Protection Agency

D: MARINE PLANTS AND ANIMALS OF BISCAYNE NATIONAL MONUMENT

Marine Plants and Animals of Biscayne National Monument*

The following list of marine organisms contains the name of about 1,400 species considered to live within the confines of Biscayne National Monument. This is one of the largest lists to be compiled for any area of similar size within the waters of the United States and its possessions. Even so, it is very incomplete for some groups, particularly the algae, the smaller and less well known animal groups, and especially the polychaetous annelids.

Studies of the marine organisms of the monument and nearby waters have been conducted by the staff and students of the Institute of Marine and Atmospheric Sciences beginning immediately after World War II and continuing to the present, and numerous collections have been made for the area. These collections are housed in the research collections and reference collections at the Institute, most of the species having been identified by acknowledged specialists in the particular group. The list of species was compiled from the catalogs of the collections, pertinent published papers, personal field notes and records of staff members, and personal knowledge of specialists working in the area. Not all of the records are directly from monument waters; those that are not come from immediately adjacent areas (Soldier Key, Ragged Keys, and Key Largo Dry Rocks) and therefore will certainly occur within the monument itself.

Persons unacquainted with the richness of fauna and flora may wonder at the large number of species listed, especially as they are mostly tropical West Indian species. It is not commonly understood that south Florida is actually tropical in the marine habitat and is included in the West Indian Marine Province. The tropical marine fauna of the keys has been derived by way of the Yucatan Channel and the north coast of Cuba; as a result it contains the major elements of both the Antillean fauna and the continental South and Central American fauna. The Bahamas, on the other hand, have apparently derived their fauna mainly from the Antilles with a resultant smaller number of species.

A habitat code is given for both the invertebrates and the vertebrates, and in all cases known, the code number or numbers and other pertinent data are given for each species. Used in conjunction with the descriptions of the communities, this will assist in identification of community components.

---

*Voss 1969.

Occurrence Code for Plants and Invertebrates

1 -- oceanic; swept ashore or into Bay by winds and currents.

2 -- rocks; pilings; seawalls.

3 -- grass beds

4 -- sponges and alcyonarian beds

5 -- open sand

6 -- outer reefs

7 -- lagoon patch reefs

8 -- mangroves

9 -- hard bottom with silt cover

10 -- Porites coralline zone, offshore of keys

11 -- mud or sandy mud

a -- supratidal

b -- intertidal

c -- under rocks

d -- inside Bay

e -- seaward of Keys

ALGAE OF BISCAYNE NATIONAL MONUMENT

Brown Algae

Scientific Name	Common Name	Occurrence
Avrainvillea nigricans Decaisne		2, 9
Castagnea zozterae (Mohr) Thuret		3
Dictyota bartayresii Lamouroux		6, 9
D. dichotoma (Hudson) Lamouroux		6, 9
D. divaricata Lamouroux		6, 9
D. indica Sonder		6, 9
Padina sanctae-crucis Børgesen		2, 6
P. vickersii Hoyt		
Sargassum filipendula Agardh	Sargasso weed	9, winter visitor
S. polyceratium Montagne	Sargasso weed	1
S. pteropleuron Grunow	Sargasso weed	9
Turbinaria turbinata (Linnaeus) Kuntze		6
Stypopodium zonale (Lamouroux)		9

Green Algae

Acetabularia crenulata Lamouroux	Mermaid's wine glass	2d, 9
Acicularia schenckii (Moebius) Solms		2d, 9
Anadyomene stellata (Wulfen) C. Agardh		3, 4
Batophora oerstedi J. Agardh		2, 3, 9, 10
Bryopsis pennata Lamouroux		2, 9
B. plumosa (Hudson) C. Agardh		2, 9 winter ephemeral
Caulerpa ashmeadii Harvey		soft, thick silt
C. cupressoides (West) C. Agardh		5
C. lanuginosa J. Agardh		9
C. mexicana (Sonder) J. Agardh		5, silt
C. paspaloides (Bory) Greville		silty, rich bottom d, e
C. prolifera (Foerskal) Lamouroux		5
C. racemosa (Foerskal) J. Agardh		2, 9
C. sertularoides (Gmelin) Howe		all bottons,d, e
C. verticillata J. Agardh		8, silt & mud
Chaetomorpha gracilis Kützing		2, 3, 4
Cladophora fuliginosa Kützing		3
C. gracilis (Griffiths) Kützing		2, 3, 4
Cladophoropsis macromeres Taylor		
C. membranacea (Agardh) Børgesen		3, or in hollows in rocks & sponges
Dasycladus vermicularis (Scopoli) Krasser		2, 9
Dictyosphaeria cavernosa (Foerskal) Børgesen		9, strong current

Scientific Name	Common Name	Occurrence
Green Algae (cont.)		
Enteromorpha flexuosa (Wulfen) J. Agardh		9, strong current
E. prolifera (Mueller) J. Agardh		2, 9
Ernodesmis verticillata (Kützing) Børgesen		9
Halimeda discoidea Decaisne		10
H. incrassata Lamouroux		3, d
H. monile (Ellis & Solander) Lamouroux		3, d
H. opuntia (Linnaeus) Lamouroux		10
Monostroma oxyspermum (Kützing) Doty		8, d
Neomeris annulata Dickie		2, 9, e
Penicillus capitatus Lamarck		3, d
P. dumetosus Blainville		3, d, silty
P. lamourouxii (Decaisne) Kützing		3, d
Rhipocephalus oblongus (Decaisne) Kützing		3, d
Udotea conglutinata (Ellis & Solander) Lamouroux		3
U. flabellum (Ellis & Solander) Howe		5, e
Ulva lactuca (Linnaeus)		2, 9
Valonia ocellata Howe		9, e
V. ventricosa J. Agardh		10
Red Algae		
Amphiroa sp.		3
Bostrychia tenella Vahl (J. Agardh)		8, 2, e
Digenia simplex (Wulfen) C. Agardh		silty, d
Goniolithon strictum Foslie		10
Janea capillacea Harvey		3 (probably extinct)
Laurencia poitei (Lamouroux) Howe		3, d
Lithothamnion sp.		6, 10 on shells, e
Eucheuma isoforme (C. Agardh) J. Agardh		4e, 6, 7
Marine Spermatophytes		
Halodule wrightii Aschers		3
Syringodium filiforme Kützing	Manatee grass	3
Thalassia testudinum Koening	Turtle grass	3

PROTOZOA

Foraminifera

Scientific Name

Amphistegina lessonii (d'Orbigny)
Archais angulatus (Fichel & Moll)
A. compressus (d'Orbigny)
Borelis pulchra (d'Orbigny)
Clavulina tricarinata (d'Orbigny)
Discorbis mira (Cushman)
Elphidium advenum (Cushman)
E. poeyanum (d'Orbigny)
E. sagrum (d'Orbigny)
Homotrema rubrum (Lamarck)
Peneroplis pertusus (Forskal)
P. proteus (d'Orbigny)
Planorbulina mediterranensis (d'Orbigny)
Pyrgo denticulata (H. B. Brady)
P. subsphaerica (d'Orbigny)
Quinqueoculina agglutinata (d'Orbigny)
Q. bidentata (d'Orbigny)
Q. columnosa (Cushman)
Q. funafutiensis (Cushman)
Q. lamarckiana (d'Orbigny)
Q. pœyana (d'Orbigny)
Q. tricarinata (d'Orbigny)
Rotalia rosea (d'Orbigny)
Sorites marginalis (Lamarck)
Textularia candeiana (d'Orbigny)
T. floridana (Cushman)
T. mayori (Cushman)

Triloculina carinata (d'Orbigny)
T. circularus (Bornemann)
T. linneiana (d'Orbigny)
T. planciana (d'Orbigny)
T. quadrilateralis (d'Orbigny)
T. rotunda (d'Orbigny)
T. suborbicularis (d'Orbigny)
T. trigonula (Lamarck)
Valvulina ovidoiana (d'Orbigny)
Vertebralina cassis mucronata (d'Orbigny)

Scientific Name	Common Name	Occurrence
Aaptos aaptos (Schmidt)		2, 4, 9
Acarnus innominatus Gray		4
Agelas sp.		6
Anthosigmella varians (Duch. & Mich.)		2, 3, 4, 9
Aulena columbia Laubenfels		7
Axinella polycapella Laubenfels	Finger sponge	6
Callyspongia plicifera (Lamarck)	Plicate vase sponge	6, 7
C. procumbens (Carter)		6, 7
C. vaginalis (Lamarck)	Tube sponge	4, 6, 7
Chondrilla nucula Schmidt	Chicken liver sponge	2, 3, 4, 6, 7, 9, 10
Chondrosia collectrix (Schmidt)		2, 4, 7
Cinachyra cavernosa (Lamarck)		4, 7
Cliona spp.	Boring sponges	widespread
Cryptotethya crypta Laubenfels		4, 9
Darwinella mulleri Max Schulze		7
Dasychalina cyathina Laubenfels		6, 7
Desmacella sp.		4
Dysidea etheria Laubenfels	Heavenly blue sponge	2, 3, 4
Fibulia massa Carter		6
Geodia gibberosa Lamarck		2, 3, 4, 9
Halichondria melanadocia Laubenfels		3, 4, 9
Haliclona molitba Laubenfels		4, 8, 9
H. permollis (Bowerbank)		4, 8, 9
H. rubens (Duch. & Mich.)		2, 4, 7, 9
H. subtriangularis (Duch. & Mich.)		4, 7
H. variabilis (Dendy)		4, 7
Higginsia strigilata (Lamarck)		6
Hippiospongia gossypina (Duch. & Mich.)	Velvet sponge	4d
H. lachne Laubenfels	Wool sponge	4d
Ianthella ardis Laubenfels		6, 7
Iotrochota birotulata (Higgin)		
Ircinia campana (Lamarck)	Vase garlic sponge	2, 3, 4, 7, 9
I. fasciculata (Pallas)	Finger garlic sponge	2, 3, 4, 7, 9
I. strobilina (Lamarck)	Cake garlic sponge	2, 3, 4, 7, 9
Lissodendoryx isodictyalia (Carter)		2, 4, 7
Microciona juniperina (Lamarck)		6, 7
Mycale angulosa (Duch. & Mich.)		6, 7
Myriastra kallitetilla Laubenfels		4, 7, 9
Neopetrosia longleyi Laubenfels		3, 4, 9
Placospongia melobesiodes Cray		2, 4, 7
Spheciospongia vesparia (Lamarck)	Loggerhead sponge	3, 4, 6, 7, 9
Spirastrella sp.		6, 7
Spongia barbara Duch. & Mich.	Yellow sponge	4d

Scientific Name	Common Name	Occurrence
S. cheiris Laubenfels & Storr	Glove sponge	4d
S. graminea Hyatt	Key grass sponge	4d
Tedania ignis (Duch. & Mich.)	Fire sponge	2, 3, 4, 7, 9
Terpios fugax Duch & Mich.		2, 4d
Tethya sp.		2, 3, 4, 8
Unimia trisphaera Laubenfels		6
Verongia longissima (Carter)		4, 7
Xestospongia muta (Schmidt)		

C N I D A R I A

HYDROZOA

Campanularia marginata (Allman)	Hydroid	2
Eudendrium carneum Clarke	Hydroid	2
E. distichum (Clarke)	Hydroid	2
Lytocarpus philippinus (Kirchenpauer)	Stinging hydroid	2, 8
Millepora alcicornis Linné	Stinging coral; sea ginger	4, 6, 7
Pennaria tiarella (Ayres)	Hydroid	2, 8
Sertularia inflata (Versluys)	Hydroid	2, 8
Thyroscyphus ramosus (Allman)	Hydroid	2, 8

(And many other species not specifically reported.)

SCYPHOZOA

Aurelia aurita (Linné)	Moon jelly	1
Cassiopea frondosa (Pallas)	Jellyfish	semi-stagnant areas
C. xamachana R. P. Bigelow	Jellyfish	" "
Linuche unguiculata (Eschscholtz)	Thimble jelly	1
Pelagia noctiluca (Foerskal)	Luminous jellyfish	1
Stomolophus meleagris L. Agassiz	Jellyfish	1
Tamoya haplonema (F. Mueller)	Box jelly; sea wasp	1

ANTHOZOA

(Alcyonaria)

Briareum asbestinum (Pallas)	Dead men's fingers	4,6, 7
Eunicea asperula (Milne Edwards & Haime)	Sea whip	4,7
E. calyculata (Ellis & Solander)	Sea whip	4,6,7
E. knighti Bayer	Sea whip	4,7
E. mammosa (Lamouroux)	Sea whip	4,6,7
E. palmeri Bayer	Sea whip	4,7
E. tourneforti Milne Edwards & Haime	Sea whip	4,6,7

Scientific Name	Common Name	Occurrence
Erythropodium caribaeorum (Duch. & Mich.)	Sea mat	7
E. polyanthes Duch. & Mich	Sea mat	7,10
Gorgonia ventalina Linné	Sea fan	6,7
Muricea atlantica (Kuekenthal)	Prickly sea whip	4,6,7
M. elongata Lamouroux	Prickly sea whip	4,6,7
M. muricata (Pallas)	Prickly sea whip	4,6,7
Muriceopsis flavida (Lamarck)	Rough sea feather	4,7
Plexaura flexuosa Lamouroux	Sea rod	4,6,7
P. homomalla (Esper)	Black sea whip	4,6,7
Plexaurella dichotoma (Esper)	Sea rod	4,7
P. fusifera Kunze	Sea rod	4,7
P. nutans (Duch. & Mich.)	Sea rod	4,7
P. vermiculata (Lamarck)	Sea rod	4,7
Pseudoplexaura porosa (Houttuyn)	Sea rod	4,7
P. ramosa (Moser)	Sea rod	4,7
P. wagennaari (Stiasny)	Sea rod	4,7
P. americana (Gmelin)	Slimy sea feather	4,7
Pseudoterogorgia acerosa (Pallas)	Sea feather	4,6,7
P. bipinnata (Verrill)	Small sea feather	7
Pterogorgia anceps (Pallas)	Three-cornered sea whip	4,7,9
P. citrina (Esper)	Yellow sea whip	4,7,9
Telesto riisei Duch. & Mich.		2
(Actiniaria)		
Aiptasia pallida (Verrill)	Brown sea anemone	2bd ,3,8
Bunodosoma cavernata (Bosc)	Warty sea anemone	2,4,9
Condylactis gigantea (Weinland)	Giant sea anemone	all zones, subtidal
Lebrunia danae (Duch. & Mich.)	Stinging sea anemone	7
Phyllactis conquilegia (Duch. & Mich.)	Sand anemone	5bd
Phymanthus crucifer (Lesueur)	Red-beaded anemone	2,6,7
	Reef anemone	7
(Corallimorpharia)		
Rhodactis sanctithomae (Duch. & Mich.)		
Ricordea florida Duch. & Mich.	False coral	7
(Zoantharia)		
Palythoa mamillata (Ellis & Solander)	Sandy sea mat	2e,6,7
Zoanthus sociatus (Ellis & Solander)	Green sea mat	
(Madreporaria)		
Acropora cervicornis (Lamarck)	Staghorn coral	7
A. palmata (Lamarck)	Elkhorn coral	6

(Madreporaria) cont.

Scientific Name	Common Name	Occurrence
Agaricia agaricites (Linnaeus)	Lettuce coral	6,7
A. agaricites crassa Verrill	Lettuce coral	6,7
Cladocora arbuscula Lesueur	Tube coral	3,9,10
Dichocoenia stokesii Edwards & Haime	Star coral	6,7
Diploria clivosa (Ellis & Solander)	Brain coral	7,9e
D. labyrinthiformis (Linnaeus)	Brain coral	6,7
D. strigosa (Dana)	Common brain coral	6,7
Eusmilia fastigiata (Pallas)	Flower coral	7
Favia fragum (Esper)	Star coral	10
Isophyllia sinuosa (Ellis & Solander)	Cactus coral	2,4,7,9
Manicina areolata (Linneaus)	Common rose coral	4,5,9,10
Montastrea annularis (Ellis & Solander)	Common star coral	6,7
M. cavernosa (Linnaeus)	Large star coral	7
Mussa angulosa (Pallas)	Large flower coral	7
Mycetophyllia lamarckana (Edwards & Haime)	Large cactus coral	7
Oculina diffusa (Lamarck)	Ivory bush coral	2,7,8
Porites astreoides Lamarck	Porous coral	7
P. divaricata Lesueur	Small finger coral	10
P. furcata Lamarck	Finger coral	10
P. porites (Pallas)	Clubbed finger coral	4,9
Siderastrea siderea (Ellis & Solander)	Starlet coral	2,3,4,7,9,10
S. radians (Pallas)	Starlet coral	2,3,4,7,9,10
Solenastrea hyades (Dana)	Lobed star	4,9

C T E N O P H O R A

Beroe ovata Chamisso & Eysenhardt	Pink comb-jelly	1
Coeloplana sp.	Creeping comb-jelly	2
Mnemiopsis gardeni L. Agassiz	Comb jelly	1
M. leidyi A. Agassiz	Common comb-jelly	1
Vallicula multiformis Rankin	Creeping comb jelly	2,3,8

N E M E R T I N E A

(Corrêa (1961) reported 22 species of nemertean worms from adjacent regions of Biscayne Bay and the Florida Keys. All of these may be expected to occur in waters of the monument.)

P L A T Y H E L M I N T H E S

TURBELLARIA

Pseudoceros crozieri Hyman	Zebra flatworm	2,8, in ascidians
P. texanus Hyman	Texan flatworm	2,9,10c
Thysanozoon nigrum Girard	Warty flatworm	3,3b
Stylochus oculiferus (Girard)	Spotted flatworm	10, in Halimeda clumps

(Also numerous species not specifically identified)

A N N E L I D A

POLYCHAETA

Scientific Name	Common Name	Occurrence
Aglaurides diphyllidia Schmarda		
A. fulgida Savigny		
Amphinome jamaicensis Schmarda		All zones, subtidal, under rocks
Branchioma nigromaculata (Baird)		8
Chloeia viridis Schmarda	Bristle worm; fire worm	3,5,9
Cistenides gouldii Verrill	Golden crown worm	5
Diopatra cuprea Bosc		
Eunice cariboea Grube		2,4,7,10
E. longicirrata Webster		2,4,7,10
E. longisetis Webster		2,4,7,10
E. mutilata Webster		2,4,7
E. rubra Grube		2,4,7,10
E. schemacephala Schmarda		2,4,7
E. spongicola Treadwell		4, in sponges
Eurythoe complanata (Pallas	Bristle worm; fire worm	6,7
Glycera dibranchiata Ehlers		5
Harmothoe aculeata Andrews		
Herm nia verruculosa Grube		
Hermodice carunculata Pallas	Bristle worm; fire worm	
Hesione picta Mueller		2,3,4,7,9,10
Lepidonotus variabilis Webster		10
Loimia medusa (Savigny)		
Notopygos crinita Grube		10
Polynoe granulata Ehlers		2,10
Pomatostegus stellatus (Abildgaard)Morch		3,4,7 in coral heads
Pomatocerus triqueter Linné		3,4,7 in coral heads
Pontogenia chrysocoma Baird		
P. sericoma Ehlers		
Sabellastarte magnifica (Shaw)	Fan worm	7,8

(And many other species not specifically recorded.)

HIRUDINEA

Pontobdella muricata Linné	Fish leech	Parasitic

B R Y O Z O A

Bugula flabellata (Thompson)	Sea moss	2,8
B. neritina (Linné)	Sea moss	2,8
Membranipora tuberculata Bosc		2
Schizoporella unicornis Johnston		3,4,8
Zoobotryon pellucidum Ehrenberg		2,8

MOLLUSCA

AMPHINEURA

Scientific Name	Common Name	Occurrence
Acanthochitona hemphilli Pilsbry		2,4,7,10c
A. spiculosa Reeve		2,4,7,10c
Acanthopleura granulata Gmelin		2b
Cryptoconchus floridanus Dall		2,4,7,10c
Ischnochiton erythronotus Adams		2,4,7,10c
I. floridanus Pilsbry		2,4,7,10c
I. limaciformis Sowery		2,4,7,10c
I. papillosus C. B. Adams		2,4,7,10c

GASTROPODA

Acmaea pustulata Helbling	Blister limpet	2,4,6,7
Acteocina candei d'Orbigny		5
Alvania auberiana d'Orbigny		5
Amphithalamus vallei		6
Anachis avara Say	Greedy dove-shell	2,3
Aplysia dactylomela Rang	Ringed sea-hare	3,5
A. morio Verrill	Black sea-hare	3,5
Aspella paupercula C. B. Adams	Little aspella	2,6,7
Astraea tecta americana Gmelin	American star-shell	2,3,6,7
A. caelata Gmelin	Rough star-shell	6,7
A. phoebia Roeding	Long-spined star-shell	3
Bailya parva C. B. Adams		
Balcis conoidea Kurtz & Stimpson		
B. intermedia Cantraine		Parasitic on holothurian
Batillaria minima Gmelin		3b, 5b
Bittium varium Pfeiffer		3,5
Bulla occidentalis A. Adams	Common bubble-shell	3,5
B. striata Bruguière	Grooved bubble-shell	3,5
B. umbilicata Roeding	Perforated bubble-shell	3,5
Bullata ovuliformis d'Orbigny	Teardrop marginella	5
Bursa cubaniana d'Orbigny	Granular frog-shell	6
B. thomae d'Orbigny	Purple-mouthed frog-shell	6
Bursatella plei Rang	Ragged sea-hare	3,5
Buscycon contrarium Conrad	Left-handed whelk	3,5
B. spiratum Lamarck	Pear whelk	3,5
Caecum floridanum Stimpson		3,5,6,7
C. imbricatum Carpenter		5,6
C. pulchellum Stimpson		3,5
C. plicatum Carpenter		5,6
Calliostoma javanicum Lamarck	Chocolate-lined top-shell	4,6,7
C. jujubinum Gmelin	Common top-shell	6,7

Scientific Name	Common Name	Occurrence
Cantharus multangulus Philippi	Angular drill	2,3,9
Cassis flammea Linné	Flame helmet-shell; Princess conch	6
C. madagascariensis Lamarck	Queen helmet-shell; Queen conch	3,5
C. tuberosa Linné	King helmet-shell; King conch	3,5,6
Cerithiopsis emersoni C. B. Adams		
Cerithium algicola C. B. Adams	Horn shell	3
C. auricoma Schwengel	Golden horn-shell	6,7
C. eburneum Bruguière	Ivory horn-shell	3
C. semiferrugineum Lamarck	Rusty horn-shell	6
C. litteratum Born	Spotted horn-shell	3,5,6,7
C. muscarum Say	Fly specked horn-shell	3d
C. variabile C. B. Adams	Variable horn-shell	3b,5b
Colubraria testacea Morch	False triton	6,7
Columbella mercatoria Linne	Common dove-shell	2,3,6,7
C. rusticoides Heilprin	Rusty dove-shell	3d
Conus caribbaeus Clench	Caribbean cone	7
C. daucus Hwass	Carrot cone	6
C. flavescens Sowerby	Bahama cone	4e
C. floridanus Gabb	Florida cone	3,5,9
C. floridanus burryae Clench	Burry's cone	3,5,9
C. granulatus Linné	Granulated cone	6
C. jaspideus Gmelin	Jasper cone	5
C. mus Hwass	Mouse cone	2,6,7
C. regius Gmelin	Crown cone	6
C. spurius atlanticus Clench	Atlantic alphabet cone	3,5
C. verrucosus Hwass	Warty cone	6
Coralliophila abbreviata Lamarck	Stubby coral snail	4e,6,7
C. caribaea Abbott	Caribbean coral snail	4e,6,7
C. mansfieldi McGinty	Spiny coral snail	2, 4e, 6,7
Crassispira fuscescens Reeve		3
C. leucocyma Dall		3
C. nigrescens C. B. Adams		3
C. ostrearum Stearns		3
C. sanibelensis Bartsch & Rehder		3
Crepidula aculeata Gmelin	Thorny slipper limpet	2
C. convexa Say	Convex slipper limpet	3
C. convexa glauca Say		3
C. fornicata Say	Common slipper limpet	2
C. maculosa Conrad	Spotted slipper limpet	2
Cymatium caribbaeum Clench & Turner	Dog-head Triton	
C. femorale Linné	Angular triton	3,7
C. labiosum Wood	Thick-lipped triton	6
C. muricinum Roeding	Knobby triton	2,3,6

Scientific Name	Common Name	Occurrence
C. nicobaricum Roeding	Gold-mouthed triton	2,6,7
C. pileare Linné	Hairy triton	2,6,7
C. sarcostomum Reeve	Rare dog-head triton	7
Cyphoma gibbosa Linné	Flamingo tongue	4e,6,7
C. mcgintyi Pilsbry	Purple flamingo tongue	4e,6,7
C. signata Pilsbry	Finger-print flamingo tongue	4e,6,7
Cypraea cervus Linné	Deer cowry	2,4,6,7,8
C. cinerea Gmelin	Gray cowry	2,4,6,7
C. spurca acicularis Gmelin	Yellow cowry	2,4,6,7
C. zebra Linné	Measled cowry	2,4,6,7,8
Cypraecassis testiculus Linné	Baby's bonnet	6,7
Detracia bulloides Mont.	Mangrove bubble	8a
Diodora cayenensis Lamarck	Keyhole limpet	2,4,6,7
D. listeri d'Orbigny	Common keyhole limpet	6,7
D. minuta Lamarck	Dwarf keyhole limpet	2,6,7,10
Drillia thea Dall		3
Drupa nodulosa C. B. Adams	Mulberry rock-shell	2,6,7
Echininus nodulosus Pfeiffer	False prickly winkle	2a
Emarginula cancellata Philippi	Slit limpet	6,7
Enaeta cylleniformis Sowerby	Dwarf volute	4e,6,7
Epitonium echinaticostum d'Orbigny	Wentletrap	2,3,4,6,7 with sea anemones
E. foliaceicostum d'Orbigny	Wentletrap	
E. lamellosum Lamarck	Wentletrap	
E. unifasciatum Sowerby	Wentletrap	
Fasciolaria hunteria Perry	Banded tulip shell	3d, 5d
F. tulipa Linné	Tulip shell	2,3,4,5,6,7,8,10
Fissurella nodosa Born	Keyhole limpet	6,7
Grastropteron rubrum Rafinesque	Red dwarf sea-hare	3
Haminoea elegans Gray	Paper bubble	3
Heliacus bisulcatus d'Orbigny	Orbigny's sundial	2,6,7, Parasitic on zoanthids
Hyalina avenacea Deshayes	Little oat marginella	3,5
H. tenuilabra Tomlin	Thin-lipped marginella	3,5
Janthina janthina Linné	Common violet snail	1
J. pallida Thompson	Pale violet snail	1
J. prolongata Blainville & d'Orbigny	Globose violet snail	1
J. umbilicata	Small violet snail	1
Lamellaria pellucida Verrill	Glassy snail	2,4,6,7
Latirus mcgintyi Pilsbry	McGinty's latirus	2,6,7
Leucozonia nassa Gmelin	Chestnut latirus	2,6,7
Litiopa melanostoma Rang	Sargassum snail	1 on Sargassum weed

Scientific Name	Common Name	Occurrence
Littorina angulifera Lamarck	Angulate periwinkle	2a, 8a
L. ziczac Gmelin	Zebra periwinkle	2a
Lucapina sowerbii Sowerby	Keyhole limpet	2,6,7,10
L. suffusa Reeve	Keyhole limpet	2,6,7
Lucapinella limatula Reeve	Keyhole limpet	6,10
Macromphalina floridana Moore		5,7
Mangelia quadrilineata C. B. Adams		3
Marginella aureocincta Stearns	Gold-banded marginella	3,5,7
M. denticulata Conrad	Toothed marginella	3,5,7
M. guttata Dillwyn	Spotted marginella	2,6,7
Meioceras nitidum Stimpson		3,6,7
Melampus coffeus Linné	Cofee shell	8a
Melongena corona Gmelin	Common crown shell	3d, 5d
Microtralia occidentalis Pfeiffer		
Mitra barbadensis Gmelin	Barbados mitre	6c, 7c
M. florida Gould	Florida mitre	6c, 7c
M. floridana Dall	Little Florida mitre	6c, 7c
Mitrella lunata Say	Lunate dove-shell	3, 10c
Modulus modulus Linné	Button shell	3
Murex cellulosus Conrad	Pitted murex	3,5
M. florifer Reeve	Lace murex	2,3,4,5,9
M. mcgintyi M. Smith	McGinty's murex	6,7
M. pomum Gmelin	Apple murex	2,3,4,6,7,9
M. recurvirostris rubidus F. C. Baker	Rose murex	3,5,9
Muricopsis oxytatus M. Smith	Hexagonal murex	2,6,7
M. ostrearum Conrad	Oyster drill	3d, 8d
Nassarius albus Say	Light dog-whelk	5
N. vibex Say	Common eastern dog-whelk	3bd,5bd
Natica canrena Linné	Tiger eye; striped moon snail	5
Nerita peloronta Linné	Bleeding tooth	2ab
N. fulgurans Gmelin	West Indian nerite	2ab
N. tessellata Gmelin	Baby's tooth	2ab
N. versicolor Gmelin	Calico baby's tooth	2ab
Neritina virginea Linné	Virgin nerite	3bd
Nitidella ocellata Gmelin	Spotted dove-shell	2b
Ocenebra intermedia C. B. Adams	Frilly dwarf murex	6c
Odostomia canaliculata C. B. Adams	Channeled dwarf auger	
O. laevigata d'Orbigny	Smooth dwarf auger	3,7
Olivella mutica Say	Variable dwarf olive	5
O. perplexa Olsson	Puzzling dwarf olive	5
Parviturbo comptus Woodring	Neat little top shell	2, on algae
P. weberi Pilsbry & McGinty	Weber's little top shell	2, on algae
Peristichia agria Dall	Dwarf auger	3,7
Persicula catenata Montagu	Chain marginella	2,4c
P. lavalleana d'Orbigny	Snowflake marginella	2,4c,6

Scientific Name	Common Name	Occurrence
Phenacolepas hamillei Fischer	Dwarf limpet	6c
Pisania auritula Link	Common cantharus	6c, 7c
P. pusio Linné		6c
P. tincta Conrad	Painted cantharus	2cd
Pleurobranchus areolatus Mörch	Warty sea slug	2,4,6,7,10
Pleuroploca gigantea Kiener	Horse conch	3,4,5,6,7,9
Polinices hepaticus Roeding	Brown moon snail	5
P. lacteus Guilding	Milky moon snail	5
Prunum apicinum Menke	Coffee shell; gold shell	3d, 5d
P. carneum Storer	Orange marginella	3,4,5,6,7
Pusia albocincta C. B. Adams	White-banded mitre	3,4,6,7
P. hanleyi Dohrn	Hanley's mitre	6,7
P. gemmata Sowerby	Little gem mitre	6,7
Retusa candei d'Orbigny	Channeled barrel-bubble	5
Rissoina bryerea Montagu		3,6,7
R. chesneli Michaud		3
P. multicostata C. B. Adams		2,7
Scyllaea pelagica Linné	Sargassum slug	1
Seila adamsi H. C. Lea		2,6,7
Simnia acicularis Lamarck	Sharp shuttle shell	6,7, on sea fans
S. uniplicata Sowerby	Single-folded shuttle shell	6,7, on sea fans
Siphonaria alternata Say	Ribbed false limpet	2a
S. pectinata	Striped false limpet	2a
Strombus alatus Gmelin	Florida fighting conch	5
S. costatus Gmelin	Milk conch	3,5,6
S. gallus Linné	Rooster conch	6
S. gigas Linné	Pink conch	3,5,6
S. raninus Gmelin	Hatchet conch	3,5
Tectarius muricatus Linné	Beaded periwinkle	2a
Tegula fasciata Born	Banded tile shell	2,3,4,6,7,10
Teinostoma crytospira Verrill		2,3,5
Terebra hastata Gmelin	Shiny atlantic auger	5e
T. glossema Schwengel	Slender auger	5
Thais deltoidea Lamarck	Deltoid rock shell	2,6,7
T. haemastoma floridana Conrad	Florida rock shell	2d
T. patula Linné	Wide-mouthed rock shell	6
T. rustica Lamarck	Rustic rock shell	2,6,7
Tricolia affinis C. B. Adams	Spotted pheasant shell	2,3
T. bella M. Smith	Pretty pheasant shell	3,6,7
Tridachia crispata Mörch	Frilly sea slug	2,3,6,7
Triphora nigrocincta C. B. Adams		2,3, 4, in sponge
T. turristhomae Holten		2,3,4,6 in sponge

Scientific Name	Common Name	Occurrence
Triptychus niveus Mörch		3,5
Trivia suffusa Gray	Pink coffee-bean	2,4,6,7, often with ascidians
T. pediculus Linné	Brown coffee-bean	2,4,6,7, often with ascidians
T. quadripunctata Gray	Four spotted coffee-bean	2,4,6,7, often with ascidians
Turbo canaliculatus Hermann	Channeled turban	6,7
T. castaneus Gmelin	Chestnut turban	2,3
Typhis cancellatus Sowerby	Cancellate smoke shell	6
Urosalpinx perrugata Conrad	Oyster drill	8
Vasum muricatum Born	Common vase shell	3,9
Vermicularia spirata Philippi	Worm shell	4,9
Zebina browniana d'Orbigny		3,6,7

PELECYPODA

Abra lioica Dall		3
Arcopagia fausta Pulteney	Faust tellin	3,5,7
Aequipecten acanthodes Dall	Prickly scallop	3
A. muscosus Wood	Mossy scallop	3,4
Americardia media Linné	Triangular cockle	3,5
Anodontia alba Link	Buttercup clam	3,5
Anomalocardia cuniemeris Conrad	Pointed clam	3,5
Anomia simplex d'Orbigny	Jingle shell	2,3,5,8, attached to solid objects
Antigona listeri Gray	Princess venus	2,3,5,7
Arca imbricata Bruguière	Umbonate ark	2,7
A. zebra Swainson	Turkey wing	2,7,9
Arcopsis adamsi Dall	Adam's ark	2,7
Argopecten irradians Lamarck	Bay scallop	3d
A. nucleus Born	Nut scallop	3
Atrina rigida Solander	Rough pen shell	3,5
Bankia fimbriatula Moll & Roch	Frilly shipworm	in submerged wood
Barbatia cancellaria Lamarck	Brown bearded ark	2,7
B. candida Helbling	White bearded ark	2,7
B. domingensis Lamarck	White miniature ark	2,7
Botula fusca Gmelin	Brown mussel	2,3
Brachidontes exustus Linné	Scorched mussel	2d
Cardita dominguensis d'Orbigny	Domingo cardita	5
C. floridana Conrad	Broad-ribbed cardita	3
Chama congregata Conrad	Little jewel box	2,4,6,7
C. florida Lamarck	Florida jewel box	6,7

Scientific Name	Common Name	Occurrence
C. macerophylla Gmelin	Leafy jewel box	2,4,6,7
C. sarda Reeve	Red jewel box	6
Chione cancellata Linné	Cross-barred venus	3,5
Chlamys imbricata Gmelin	Little knobby scallop	2,6,7
C. mildredae F. M. Bayer	Mildred's scallop	2,6,7
C. ornata Lamarck	Ornate scallop	2,6,7
C. sentis Reeve	Thorny scallop	2,6,7,10
Codakia orbicularis Linné	Tiger lucina	3,5
C. orbiculata Montagu	Dwarf tiger lucina	3,5
Corbula dietziana C. B. Adams	Basket clam	11
Crassostrea rhizophorae Guilding	Mangrove oyster	8
C. virginica Gmelin	Eastern oyster	2bd, 8bd
Cumingia antillarum d'Orbigny	Southern cumingia	4,6,7
Cardiomya costellata Deshayes	Ribbed dipper clam	5
Cyclinella tenuis Recluz	Atlantic cyclinella	5
Ervilia concentrica Gould	Concentric ervilia	5
Gastrochaena hians Gmelin	Coral-boring clam	2,4,6,7
G. ovata Sowerby	Coral-boring clam	2,4,6,7
Gemma gemma Totten	Gem clam	5
Gouldia cerina C. B. Adams	Waxy clam	5
Glycymeris pectinata Gmelin	Comb bittersweet	5
G. undata Linné	Wavy bittersweet	5
Isognomon alatus Gmelin	Flat tree oyster	2b, 8b
I. radiatus Anton	False pearl oyster	2,6,7
Laevicardium laevigatum	Egg cockle	5
L. mortoni	Little egg cockle	5
Lima lima Linné	Spiny file shell	2,6,7
L. pellucida C. B. Adams	Antillean file shell	2,3,4,6,7
L. scabra Born	Rough file shell	2,6,7
L. scabra form tenera Sowerby	Smooth file shell	2,6,7
Lithophaga antillarum d'Orbigny	Antillean date mussel	6,7, in rocks & coral
L. nigra d'Orbigny	Black date mussel	6,7, in rocks & coral
Lucina pensylvanica Linné	Fringed lucina	5
L. leucocyma Dall	Four-ribbed lucina	5
Lyropecten antillarum Recluz	Antillean scallop	2,3,4,7
L. nodosus Linné	Lion's paw	7
Mactra fragilis Gmelin	Fragile mactra clam	5
Modiolus americanus Leach	Tulip mussel	3
Musculus lateralis Say	Lateral mussel	2,3
Nucula proxima Say	Atlantic nut clam	5
Nuculana acuta Conrad	Pointed nut clam	5
Pecten ziczac Linné	Zigzag scallop	3
Petricola lapicida Gmelin	Yellowish boring clam	2,6,7
Phacoides muricatus Spengler	Spinose lucina	5
Pinctada radiata	Atlantic pearl oyster	2,3,4,7,8
Pitar fulminata Menke	Lightning clam	5

Scientific Name	Common Name	Occurrence
Pseudochama inezae F. M. Bayer	Inez's jewel box	6,7
P. radians Lamarck	Left-handed jewel box	2,7
Pteria colymbus Röding	Atlantic wing shell	4,6,7
Quadrans lintea Conrad	Square tellin	11
Semele proficua Pulteney	Pale semele	5
S. purpurascens Gmelin	Colorful semele	5
Spondylus americanus Hermann	American thorny oyster	6,7
S. ictericus Reeve	Rusty thorny oyster	2,6,7
Tagelus divisus Spengler	Little razor shell	11
Tellina radiata Linné	Sunset tellin	5e
T. similis Sowerby	Pink-rayed tellin	5,11
T. texana Dall	Texas tellin	11
T. versicolor Dekay	Varicolored tellin	11
Trachycardium egmontianum Clench & Smith	Rose cockle	3,5
T. muricatum Linné	Yellow cockle	3,5,11
Transennella conradina Dall		3,5,11
T. cubaniana d'Orbigny		3,5,11
T. stimpsoni Dall		3,5,11
Venericardia tridentata Say		5,11

SCAPHOPODA

Dentalium antillarum d'Orbigny	West Indian tooth shell	5,11
D. eboreum Conrad	Ivory tooth shell	5,11
D. semistriolatum Guilding	Shiny tooth shell	5,11
Cadulus quadridentatus Dall	Stubby tooth shell	11

CEPHALOPODA

Loligo plei Blainville	Arrow squid	1,6
Lolliguncula brevis (Blainville)	Bob-tailed squid	6,7de
Octopus briareus Robson	Common octopus	2,3,6,7
O. hummelincki Adam	Ocellated octopus	6
O. joubini Robson	Pigmy octopus; Joubin's octopus	3,4,9
O. macropus Risso	Grass octopus	3e, 6e
O. vulgaris Cuvier	Common octopus	2,3,9
Pickfordiateuthis pulchella Voss	Pickford's squid	3
Sepioteuthis sepioidea (Blainville)	Reef squid	6

A R T H R O P O D A

PYCNOGONIDA

Scientific Name	Common Name	Ocurrence
Ammothella rugulosa Verrill	Sea spider	2,4, in algae and hydroids
Endeis spinosa Montagu	Sea spider	2,4, in algae and hydroids
Pycnogonum Hedgpeth	Sea spider	4,9, on rose coral

CEPHALOCARIDA

Lightiella incisa Gooding		11

(Cirripedia)

Balanus (Membranobalanus) declivis Darwin		2,4,6,7, in sponges
Chthamalus stellatus		2b
Lepas ansifera Linné	Goose barnacle	1, on floating objects
L. anatifera Linné	" "	
L. pectinata Spengler	" "	
Lithotrya dorsalis Sowerby	Rock-boring barnacle	6,7,boring in rocks
Pyrgoma spp.	Coral barnacles	4,6,7,in living corals
Tetraclita squamosa stalactifera (Lamarck)		2

(Mysidacea)

Mysidium columbiae	Opossum shrimp	6,7
Taphromsis bowmani Bacescu		

(Isopoda)

Anilocra laticauda Milne Edwards	7
Cirolana parva Hansen	3,6
Cyathura carinata Krøyer	
Erichsonella floridana Benedict	9cd
Exocorallana antillensis Hansen	6
E. subtilis Hansen	
E. tricornis Hansen	6
Ligia baudiniana (Milne Edwards	2a
L. exotica (Roux)	2
Livoneca redmanni Leach	1,6
Paracercis caudata Say	7
Rocinela signata Schioedte & Meinert	2,6

(Tanaidacea)

Scientific Name	Common Name	Occurrence
Apseudes sp. A		11d
Apseudes sp. B		9
Heterotanais sp.		3d
Kalliapseudes sp.		3,5
Leptochelia sp.		3
L. dubia (Krøyer)		2,3
L. longimana Shiino		3b
L. savignyi (Krøyer)		2,3
L. rapax Harger		2,3
Pagurapseudes sp.		2c, 7c
Parapseudes latifrons (Grube)		4d
Paratanais brasiliensis (Dana)		6e
Pseudotanais sp.		3
Zeuxo sp.		2

(Amphipoda)

Grubia filosa Savigny		
Heterophlias seclusus Shoemaker		
Lysianassa cubensis Stebbing		
Leucothoe spinicarpa Abildgaard		
Melite fresnelii Audouin		

(Copepoda)

Acanthochondria galerita (Ratnbun)		1
Acartia spinata Esterly		Parasitic
Caligus praetextus Bere	Fish louse	Parasitic
Lepeophtheirus dissimulatus Wilson		Parasitic
Lernaeenicus longiventris Wilson		Parasitic
Naobranchia variabilis Brian		

(Stomatopoda)

Gonodactylus curacaoensis Schmitt	Mantis shrimp	2,4,6,7,10
G. oerstedii Hansen	" "	2,4,6,7,10
G. spinulosus Schmitt	" "	2,4,6,7,10
Lysiosquilla glabriuscula Lamarck	" "	3,5,11
Pseudosquilla ciliata Fabricius	" "	3,5,11
Squilla alba Bigelow	" "	3,5,11
S. prasinolineata Dana	" "	3,5,11

(Decapoda)

Actaea acantha (Milne Edwards)		2,4,6,7
A. palmeri Rathbun		2,4,6,7
A. rufupunctata nodosa Stimpson		2,4,6,7
Alpheus armatus (Rathbun)	Snapping shrimp	2e,6,7
A. armillatus (Milne Edwards)	" "	2d, 3d

Scientific Name	Common Name	Occurrence
A. peasei Armstrong	Snapping shrimp	6,7
A. formosus (Gibbes)	" "	2,4,6,7,10
A. heterochaelis Say	" "	2d, 3d
A. normanni Kingsley	" "	3
Anchistioides antiquensis (Schmitt)		
Aratus pisoni H. Milne Edwards	Mangrove crab; tree crab	2,8
Arenaeus cribrarius (Lamarck)	Speckled crab	5,6,7
Brachycarpus biunguiculatus (Lucas)		
Calappa angusta (Milne Edwards)	Box crab	6,7
C. flammea (Herbst)	" "	3,5,6,7,11
Calcinus tibicen (Herbst)	Hermit crab	2,4,7
Callianassa acanthochirus (Stimpson)		
C. branneri Rathbun		
Callinectes marginatus (A. Milne Edwards)		3, 5,11
C. ornatus (Ordway)		3, 5,11
C. sapidus (Rathbun)		3,5,11
C. similis		
Cardiosoma guanhumi Latreille	Land crab	8
Carpilius corallinus (Herbst)	Coral crab; Queen crab	6,7
Chlorodiella longimana (H. Milne Edwards)		2,6,7,10
Clibanarius antillensis Stimpson	Hermit crab	2,3
C. cubensis (Saussure)	" "	2,5
C. tricolor Gibbes	" "	2b
C. vittatus (Bosc)	" "	2,3,5,11
Coenobita clypeatus Herbst	Soldier crab	8a
Cronius ruber Lamarck		5
C. tumidulus Stimpson		5
Cyclograspus integer (Milne Edwards)	Marsh crab	2b, 11b
Cycloes bairdii (Stimpson)		5
Dardanus venosus H. Milne Edwards	Hermit crab	2,3,4,7
Dissodactylus calmani Rathbun		3e, 4e on Clypeaster
D. encopei Rathbun		5e, on Mellita
Dromidia antillensis (Stimpson)	Sponge crab	2,4
Epialtus dilatatus Milne Edwards	Spider crab	4,7
E. dilatatus forma elongata Rathbun	" "	4,7
E. longirostris Rathbun	" "	
Eriphia gonagra (Fabricius)	Calico crab	6,7
Eurypanopeus depressus (Smith)	Mud crab	2,3,11
Glyptoxanthus erosus (Stimlson)	Coral crab	6,7
Gnathophylloides mineri Schmitt		3, on Tripneustes
Gnathophyllum americanum (Guerin)	Banded shrimp	2,3,4,7,often on sea urchins
G. modestum Hay		4
Goniopsis cruentata (Latreille)	Mangrove crab; tree crab	2,8
Hepatus epheliticus (Linnaeus)	Calico crab; Dolly Varden crab	11

Scientific Name	Common Name	Occurrence
Heteractea ceratopus (Stimpson)		6,7
Hippolyte acuminata (Dana)		
H. pleuracantha (Stimpson)		2,3
Hippolysmata grabhami Gordon		2,4,7
H. wurdemanni (Gibbes)		2,4
Latreutes fucorum (Fabricius)		1, in floating Sargassum
L. parvulus (Stimpson)		4
Leander tenuicornis Say		1 on Sargassum, 2,3
Leptodius floridanus (Gibbes)		2,4,6,7
Lysmata intermedia (Kingsley)		
Macrocoeloma camptocerum (Stimpson)	Decorator crab	4
M. diplacanthum Stimpson	" "	2,3,4
M. trispinosum (Latreille)	" "	2,3,4
Menippe mercenaria (Say)	Stone crab	2,3,4,7,8,9
Micropanope granulimanus (Stimpson)		2,4
Microphrys bicornatus (Latreille)	Spider crab	3
Mithrax coryphe (Herbst)	" "	2,4,6,7
M. formosus (Milne Edwards)	" "	2,4,6,7
M. hispidus (Herbst)	" "	2,4,6,7
M. pleuracanthus Stimpson	" "	2,4,6,7
M. sculptus (Lamarck)	" "	2,4,6,7
M. spinosissimus Lamarck	" "	2,4,6,7
M. tortugae (Rathbun)		2,6,7
M. verrucosus (H. Milne Edwards)	Spider crab	2,6,7
Neopanope packardii Kingsley		3,4,11
N. texana (Stimpson)		3,4,11
Neopontonides beaufortensis (Borradaile)		4,6
Pachygrapsus transversus (Gibbes)		
Paguristes puncticeps (Benedict)	Hermit crab	2,3,4,7
P. tortugae (Schmitt)	" "	2,4,6,7
Pagurus annulipes (Stimpson)	" "	3,5
P. bonairensis (Schmitt)	" "	6,7
P. brevidactylus (Stimpson)	" "	2,3
P. marshi (Benedict)	" "	2,6,7
P. miamensis Provenzano	" "	2,6,7
P. pygmaeus (Bouvier)	" "	6
Palaemonetes intermedius Holthuis		3
Panopeus herbsti (A. Milne Edwards)		2,4,7,9,11
P. occidentalis Saussure		2,4,6,7,10
P. occidentalis serratus Saussure		2,4,6,7,10
Panulirus argus (Latreille)	Spiny lobster; Fla.	
P. guttatus (Latreille)	Spotted crawfish	2,3,4,6,7,8
P. laevicauda (Latreille)	Smooth crawfish	2,3,4,6,7,8
Parthenope fraterculus (Stimpson)		5,11
Pelia mutica (Gibbes)		2, 4
Penaeopsis goodei (Smith)		3,11

Scientific Name	Common Name	Occurrence
Penaeus aztecus Ives	Brown shrimp	3,11
P. brasiliensis Latreille	Caribbean brown shrimp	3,11
P. duorarum Burkenroad	Pink shrimp	3,11
Percnon gibbesi (Milne & Edwards)	Spray crab	6,7
Periclimenes americanus (Kingsley)		3,5
P. bermudensis (Armstrong)		1
P. longicaudatus (Stimpson)		
P. wilsoni Hay		4,7
P. yucatanicus (Ives)		6,7, on sea anemones
Petrochirus diogenes (Linnaeus)	Hermit crab	2,3,4,6,7
Petrolisthes armatus (Bosc)	Rock slider	2,6,7
P. galathinus (Bosc)	" "	2,6,7
Pilumnus caribaeus Desbonne & Schramm		2,6,7,10
P. dasypodus Kingsley		2,4,6,7,9, 10,11
P. gemmatus (Stimpson)		2,4,7
P. holosericus Rathbun		2,4,7
P. lacteus (Stimpson)		2,4
P. spinosissimus Rathbun		2,4,7
Pinnotheres serrei Rathbun		Commensal in Strombus
Pitho anisodon (Von Martens)	Spider crab	3
P. aculeata (Gibbes)	" "	3
P. quadridentata Miers	" "	3
Phymodius maculatus (Stimpson)		2,7
Platypodia spectabilis (Herbst)		2,6
Podochela riisei (Stimpson)	Spider crab	2
Porcellana sayana (Leach)	Porcelain crab	2
Portunus depressifrons (Stimpson)	Swimming crab	5
P. bahamensis Rathbun	" "	5,11
P. gibbesii (Stimpson)		3,5,11
P. ordwayi (Stimpson)		3,5,11
P. sayi (Gibbes)	Sargassum crab	1
P. sebae H. Milne Edwards		3,5,11
P. spinimanus Latreille		1 in Sargassum, 5,11
P. ventralis (A. Milne Edwards)		5,11
Processa bermudensis (Rankin)		3,4
Pylopagurus operculatus (Stimpson)	Hermit crab	2,4,6,7
Raninoides laevis (Latreille)	Mole crab	5
Rhynchocinetes rigens Gordon		2,7
Scyllarides aequinoctialis (Lund)	Slipper lobster; Spanish lobster	2,3,6,7
Scyllarus americanus (Smith)	Slippper lobster	2,3
Sesarma cinereum (Bosc)		2ab,8ab,11ab
Sicyonia edwardsi (Miers)		3,11

Scientific Name	Common Name	Occurrence
Stenopus hispidus (Olivier)	American flag shrimp; Banded coral shrimp	2,6,7
S. scutellatus (Rankin)		2,6,7
Stenorhynchus seticornis (Herbst)	Arrow crab	2,6,7,8
Synalpheus brevicarpus (Herrick)	Snapping shrimp	4,7 in sponge
S. minus (Say)	" "	4,7 in sponge
Thor floridanus Kingsley		3,4
T. paschalis (Heller)		3,4
Tozeuma carolinensis(Kingsley)		3,4,7
Typton tortugae (McClendon)		
Uca speciosa Ives	Fiddler crab	5a, 11a
Ucides cordatus Linné	White mangrove crab	8b
Upogebia operculata (Schmitt)		
Xanthodius denticulatus (White)		2,7

E C H I N O D E R M A T A

ECHINOIDEA

Arbacia punctulata Lamarck	Eastern sea urchin	2,3
Brissus brissus Leske	Heart urchin	5,6,7
Clypeaster rosaceus Linnaeus	Common sea biscuit	3,4,5
C. subdepressus	Flat sea biscuit	5e
Diadema antillarum Philippi	Black urchin	2,3,4e,6,7,8
Echinometra lucunter Linnaeus	Rock-boring urchin	2,6,7
E. viridis Agassiz	" " "	2,6,7
Echinoneus cyclostomus Leske	Little egg urchin	6,7, in sand under rocks
Encope michelini Agassiz	Sand dollar	5e
Eucidaris tribuloides Lamarck	Club-spined sea urchin	2,3,4,6,7
Lytechinus variegatus Leske	Common sea urchin	2,3,4,7
Mellita quinquiesperforata Leske	Keyhole sand dollar	5e
M. sexiesperforata Leske	" " "	5e
Meoma ventricosa Lamarck	Great heart urchin	3e, 5e
Moira atropos Lamarck	Heart urchin	11
Plagiobrissus grandis Gmelin	Giant heart urchin	5e
Tripneustes ventricosus	Edible urchin; sea-egg	2,3,4,5,6

ASTEROIDEA

Asterina folium Lütken	Little starfish	2,6,7
Astropecten duplicatus Gray	Bordered starfish	5
Echinaster sentus Say	Spiny starfish	5
Linckia guildingii Gray	Comet starfish	3,10
Luidia alternata (Say)	Banded starfish	5,11

Scientific Name	Common Name	Occurrence
Ophidiaster guildingii Gray	Reef starfish	6,7
Oreaster reticulatus Linnaeus	Cushion starfish	3,4e

CRINOIDEA

Nemaster rubiginosa (Pourtales)	Striped feather star	6
Tropiometra carinata (Lamarck)	Feather star	6

OPHIUROIDEA

Amphiodia pulchella (Lyman)	Brittlestar	3,11
A. planispina (von Martens)	"	3,5
Amphioplus abditus Verrill	"	3,11
A. coniortodes H. L. Clark	"	11
A. thrombodes H. L. Clark	"	3,11
Amphipholis januarii Ljungman	"	3,11
Amphiura palmeri Lyman	"	3,11
A. stimpsoni Lütken	"	3
Astrophyton muricatum Lamarck	Basket star	4,6,7e
Axiognathus squamatus (Delle Chiaje)	Brittlestar	3,11
Micropholis gracillima (Stimpson)	Brittlestar	3,11
Ophiocnida scabriuscula (Lütken)	"	3,11
Ophiocoma echinata (Lamarck)	"	2,6,7
O. pumila Lütken	"	2,6,7
O. riisei Lütken	"	2,6,7
Ophioderma appressum (Say)	"	2,3,6,7,10
O. brevispinum Lütken	"	3
O. cinereum Müller & Troschel	"	6,7
O. guttatum Lütken	"	6,7
O. rubicundum Lütken	"	6,7
O. squamosissimum Lütken	"	6,7
Ophiolepis paucispina (Say)	"	3,6,7,10
Ophiomyxa flaccida (Say)	"	6,7,10
Ophionema intricata Lütken	"	6
Ophionephthys limicola Lütken	"	11
Ophionereis reticulata (Say)	"	4,6,7,10
Ophiophragmus pulcher H. L. Clark	"	3, 10
Ophiopsila riisei Lütken	"	7,10
Ophiostigma isacanthum (Say)	"	7,10
Ophiothrix angulata (Say)	"	3,4,7,10
O. lineata Lyman	"	4
O. oerstedii Lütken	"	3,4,7,10
O. suensoni Lütken	"	4
Ophiozona impressa (Lütken)	"	3,7

HOLOTHUROIDEA

Scientific Name	Common Name	Occurrence
Astichopus multifidus Sluiter	Sea cucumber	3,11
Actinopyga agassizi Selenka	" "	3,5,7
Brandtothuria arenicola (Semper)	" "	3,11
B. impatiens Forskal	" "	6
Chriridota rotifera Pourtalès	" "	3,5
Eupta lappa Müller	" "	3,6,10c
Fossothuria cubana (Ludwig)	" "	4,7
F. princeps (Selenka)	" "	3
Isostichopus badionotus (Selenka)	" "	3,5,6,7
Leptosynapta multigranula H. L. Clark	" "	3,4,11
Ludwigothuria floridana (Pourtales)	" "	3,4,5,11
L. mexicana (Ludwig)	" "	3,4,5
Phyllophorus parvus Ludwig	" "	3,11
P. destichadus Deichmann	" "	3,11
Semperothuria surinamensis (Ludwig)	" "	3
Synaptula hydriformis Lesueuer	" "	3
Thyone briareus Lesueur	" "	3,11
T. surinamensis Semper	" "	3,11
T. cognata Lampert	" "	3,11
Thyoneria cognata (Lampert)	" "	3,11

C H O R D A T A

TUNICATA

Ascidia nigra (Savigny)	2,8
Didemnum candidum Savigny	2,3,4
Ecteinascidia turbinata Herdman	2,4,8,9
Polycarpa obtecta Traustedt	2,8
Pyura vittata (Stimpson)	2,7
Styela plicata (Lesueur)	2,8
Tridemnum savignii (Herdman)	2,8

(Numerous species , not individually reported, are common on various substrates in monument waters.)

E: FISHES OF BISCAYNE NATIONAL MONUMENT

FISHES OF THE BISCAYNE NATIONAL MONUMENT AREA

South Florida's fish fauna is very rich being composed largely of tropical continental species with lesser numbers of tropical insular, oceanic, and temperate continental species in that order. The monument probably contains at one time or another most species known from the Florida Keys even if many are as yet unrecorded. Those most likely not to occur are the species of the deeper reefs and rocks of the middle Keys.

In terms of numbers of species one finds the fewest in the mangroves and open areas of Biscayne Bay, the numbers then increasing in grass beds, around the offshore islands to the coral of the patch reefs and outer reefs. Clearly most species in the list below occur seaward of the offshore islands.

OCCURRENCE KEY[1]

1. Oceanic, (comes in pelagically to bay and inland areas -- vary with sea and wind conditions and water clarity, often only in early life stages
2. Rock, coral, seawalls
3. Grass beds and tidal flats
4. Sponge and alcyonarians
5. Open sand
6. Open water - surface inshore
7. Littoral
8. Mangrove
9. Estuarine

---

[1]These ecological subdivisions are based solely on experience with fishes in the monument area and in the adjacent Florida Keys. They are not necessarily applicable elsewhere. Also, they are intended to describe the general or usual occurrence of a species, not all occurrences.

FISHES OF THE BISCAYNE NATIONAL MONUMENT AREA

Scientific Name	Common Name	Occurrence
Acanthuridae		
Acanthurus bahianus Castelnau	Ocean surgeon	2,3
A. chirurgus (Bloch)	Doctorfish	2,3
A. coeruleus Bloch and Schneider	Blue tang	2
A. randalli Briggs and Caldwell	Gulf surgeonfish	2,3
Albulidae		
Albula vulpes (Linnaeus)	Bonefish	3,5
Anguillidae		
Anguilla rostrata (Lesueur)	American eel	8
Antennariidae		
Antennarius multiocellatus (Valenciennes)	Longlure frogfish	4
A. ocellatus (Bloch and Schneider)	Ocellated frogfish	4
A. pauciradiatus Schultz	Dwarf frogfish	4
A. radiosus Garman	Singlespot frogfish	4
A. scaber (Cuvier)	Splitlure frogfish	3,4
Histrio histrio (Linnaeus)	Sargassumfish	1
Apogonidae		
Apogon aurolineatus (Mowbray)	Bridle cardinalfish	3
A. binotatus (Poey)	Barred cardinalfish	2
A. conklini (Silvester)	Freckled cardinalfish	2
A. lachneri Böhlke	Whitestar cardinalfish	2
A. maculatus (Poey)	Flamefish	2
A. pigmentarius (Poey)	Dusky cardinalfish	2
A. planifrons Longley and Hildebrand	Pale cardinalfish	2
A. pseudomaculatus Longley	Twospot cardinalfish	2
A. townsendi (Breder)	Belted cardinalfish	2
Astrapogon alutus (Jordan and Gilbert)	Bronze cardinalfish	3
A. puncticulatus (Poey)	Blackfin cardinalfish	3
A. stellatus (Cope)	Conchfish	3
Ariidae		
Arius felis (Linnaeus)	Sea catfish	3,8,9
Bagre marinus (Mitchill)	Gafftopsail	3,8,9
Atherinidae		
Allanetta harringtonensis (Goode)	Reef silverside	6
Atherinomorus stipes (Müller and Troschel)	Hardhead silverside	6
Aulostomidae		
Aulostomus maculatus Valenciennes	Trumpetfish	2,4

Scientific Name	Common Name	Occurence
Balistidae		
Alutera schoepfi (Walbaum)	Orange filefish	1(yg),4
A. scripta (Osbeck)	Scrawled filefish	1(yg),2,4
Balistes capriscus Gmelin	Gray triggerfish	1(yg),3,8
B. vetula Linnaeus	Queen triggerfish	1(yg),2,8
Cantherines macrocerus (Hollard)	Whitespotted filefish	2,4
C. pullus (Ranzani)	Orangespotted filefish	1(yg),2,3,4
Canthidermis sufflamen (Mitchill)	Ocean triggerfish	1
Monacanthus ciliatus (Mitchill)	Fringed filefish	1(yg),3
M. hispidus (Linnaeus)	Planehead filefish	1(yg),3
M. setifer Bennett	Pygmy filefish	1(yg),3
M. tuckeri Bean	Slender filefish	1(yg),2,3
Batrachoididae		
Opsanus beta (Goode and Bean)	Gulf toadfish	3,8
O. tau (Linnaeus)	Oyster toadfish	3,8
Porichthys porosissimus (Valenciennes)	Atlantic midshipman	3
Belonidae		
Platybelone argalus (Lesueur)	Keeltail needlefish	1
Strongylura marina (Walbaum)	Atlantic needlefish	6
S. notata (Poey)	Redfin needlefish	6
timucu (Walbaum)	Timucu	6
Tylosurus acus (Lacépède)	Agujon	1,6
T. crocodilus (Peron and Lesueur)	Houndfish	1,6
Blenniidae		
Blennius cristatus Linnaeus	Molly miller	2
B. marmoreus Poey	Seaweed blenny	2
Chasmodes saburrae Jordan and Gilbert	Florida blenny	8
Entomacrodus nigricans Gill	Pearl blenny	2
Hypleurochilus aequipinnis (Günther)	Oyster blenny	2
H. bermudensis Beebe and Tee-Van	Barred blenny	2
Hypsoblennius hentzi (Lesueur)	Feather blenny	3
Ophioblennius atlanticus (Valenciennes)	Redlip blenny	2
Bothidae		
Bothus sp.		3,5
B. ocellatus (Agassiz)	Eyed flounder	3,5
Citharichthys cornutus (Günther)	Horned whiff	5
C. macrops Dresel	Spotted whiff	3,5
C. spilopterus Günther	Bay whiff	3,5
Paralichthys albigutta Jordan and Gilbert	Gulf flounder	3,8
Syacium micrurum Ranzani	Channel flounder	3
S. papillosum (Linnaeus)	Dusky flounder	3
Branchiostegidae		
Malacanthus plumieri (Bloch)	Sand tilefish	5

Scientific Name	Common Name	Occurrence
Brotulidae		
Gilbia cayorum Evermann and Kendall	Key brotula	2,3
Petrotyx sanguineus (Meek and Hildebrand)	Redfin brotula	2
Callionymidae		
Callionymus bairdi Jordan	Lancer dragonet	2
C. pauciradiatus Gill	Spotted dragonet	3
Carangidae		
Alectis crinitus (Mitchill)	African pompano	1
Caranx bartholomaei Cuvier	Yellow jack	1,2
C. crysos (Mitchill)	Blue runner	1,2,3,8
C. hippos (Linnaeus)	Crevalle jack	1,2,3,8
C. latus Agassiz	Horse-eye jack	1,2,3
C. ruber (Bloch)	Bar jack	1,2
Chloroscombrus chrysurus (Linnaeus)	Bumper	1,3
Decapterus macarellus (Cuvier)	Mackerel scad	1
D. punctatus (Agassiz)	Round scad	1
Elagatis bipinnulata (Quoy and Gaimard)	Rainbow runner	1
Hemicaranx amblyrhynchus (Cuvier)	Bluntnose jack	1,9
Naucrates ductor (Linnaeus)	Pilotfish	1
Oligoplites saurus (Bloch and Schneider)	Leatherjacket	2,3,5
Selar crumenophthalmus (Bloch)	Bigeye scad	1,3
Selene vomer (Linnaeus)	Lookdown	1,3
Seriola dumerili (Risso)	Greater amberjack	1,2
S. zonata (Mitchill)	Banded rudderfish	1
Trachinotus carolinus (Linnaeus)	Pompano	3,7
T. falcatus (Linnaeus)	Permit	3,7
T. goodei Jordan and Evermann	Palometa	3,7
Vomer setapinnis (Mitchill)	Atlantic moonfish	1,3
Carapidae		
Carapus bermudensis (Jones)	Pearlfish	3
Carcharhinidae		
Carcharhinus acronotus (Poey)	Blacknose shark	3
C. leucas (Valenciennes)	Bull shark	2,3,8,9
C. limbatus (Valenciennes)	Blacktip shark	1
C. springeri (Bigelow and Schroeder)	Reef shark	2
C. obscurus (Lesueur)	Dusky shark	2,3
Galeocerdo cuvieri (Peron and Lesueur)	Tiger shark	1
Hypoprion signatus Poey	Night shark	1,2
Mustelus canis (Mitchill)	Smooth dogfish	3
Negaprion brevirostris (Poey)	Lemon shark	3,5
Rhizoprionodon terraenovae (Richardson)	Atlantic sharpnose shark	3,5
Centropomidae		
Centropomus ensiferus Poey	Swordspine snook	8,9
C. parallelus Poey	Fat snook	8,9
C. pectinatus Poey	Tarpon snook	8,9
C. undecimalis (Bloch)	Snook	2,8,9

Scientific Name	Common Name	Occurrence
Chaetodontidae		
Chaetodon capistratus Linnaeus	Foureye butterflyfish	2,3,4
C. ocellatus Bloch	Spotfin butterflyfish	2,4
C. sedentarius Poey	Reef butterflyfish	2,4
C. striatus Linnaeus	Banded butterflyfish	2,3,4
Holacanthus ciliaris (Linnaeus)	Queen angelfish	2,4
H. bermudensis (Goode)	Blue angelfish	2,4
H. tricolor (Bloch)	Rock beauty	2,4
Pomacanthus arcuatus (Linnaeus)	Gray angelfish	2,4
P. paru (Bloch)	French angelfish	2,4
Cirrhitidae		
Amblycirrhitus pinos (Mowbray)	Caribbean hawkfish	2
Clinidae		
Acanthemblemaria aspera (Longley)	Roughhead blenny	2
A. chaplini Böhlke	Papillose blenny	2
Chaenopsis ocellata Poey	Bluethroat pikeblenny	3
Emblemaria bottomei (Stephens)	Midnight blenny	2
E. diaphana (Longley)	Glass blenny	2
Enneanectes altivelis Rosenblatt	Lofty triplefin	2
E. boehlkei Rosenblatt	Roughhead triplefin	2
jordani (Evermann and Marsh)	Mimic triplefin	2
E. pectoralis (Fowler)	Redeye triplefin	2
Hemiemblemaria simulus Longley and Hildebrand	Wrasse blenny	2
Labrisomus bucciferus (Poey)	Puffcheek blenny	2
L. guppyi (Norman)	Mimic blenny	2
L. haitiensis Beebe and Tee-Van	Longfin blenny	2
L. kalisherae (Jordan)	Downy blenny	2
L. nigricinctus Howell Rivero	Spotcheek blenny	2
L. nuchipinnis (Quoy and Gaimard)	Hairy blenny	2
Malacoctenus aurolineatus Smith	Goldline blenny	2
M. macropus (Poey)	Rosy blenny	2
M. triangulatus Springer	Saddled blenny	2
Paraclinus cingulatus (Evermann and Marsh)	Coral blenny	2
P. fasciatus (Steindachner)	Banded blenny	2,3
P. grandicomis (Rosén)	Horned blenny	2,4
P. marmoratus (Steindachner)	Marbled blenny	3
P. nigripinnis (Steindachner)	Blackfin blenny	2,3
Starksia ocellata (Steindachner)	Checkered blenny	2,3
Stathmonotus hemphilli Bean	Blackbelly blenny	2
S. stahli tekla (Evermann and Marsh)	Eelgrass blenny	2,3
Clupeidae		
Harengula humeralis Cuvier	Redear sardine	6
H. pensacolae Goode and Bean	Scaled sardine	6
Jenkinsia lamprotaenia (Gosse)	Dwarf herring	6
Opisthonema oglinum (Lesueur)	Atlantic thread herring	6
Sardinella anchovia Valenciennes	Spanish sardine	6

Scientific Name	Common Name	Occurrence
Congridae		
Ariosoma impressa (Poey)	Bandtooth conger	3
Conger oceanicus (Mitchill)	Conger eel	2,9
C. triporiceps Kanazawa	Manytooth conger	2,9
Paraconger caudilimbatus (Poey)	Margintail conger	3,5
Coryphaenidae		
Coryphaena equisetis Linnaeus	Pompano dolphin	1
C. hippurus Linnaeus	Dolphin	1
Cynoglossidae		
Symphurus plagiusa (Linnaeus)	Blackcheek tonguefish	3,8
Cyprinodontidae		
Adinia xenica (Jordan and Gilbert)	Diamond killifish	7,9
Cyprinodon variegatus Lacépède	Sheepshead minnow	7,9
Floridichthys carpio (Günther)	Goldspotted killifish	7,9
Fundulus grandis Baird and Girard	Gulf killifish	7,9
F. similis (Baird and Girard)	Longnose killifish	7
Rivulus marmoratus Poey	Rivulus	9
Dactylopteridae		
Dactylopterus volitans (Linnaeus)	Flying gurnard	1,2
Dactyloscopidae		
Dactyloscopus crossotus Starks	Bigeye stargazer	5
D. tridigitatus Gill	Sand stargazer	5
Gillellus greyae Kanazawa	Arrow stargazer	5
G. rubrocinctus Longley	Saddle stargazer	2
Dasyatidae		
Dasyatis americanus Hildebrand and Schroeder	Southern stingray	3,5
D. sabina (Lesueur)	Atlantic stingray	3,5
D. sayi (Lesueur)	Bluntnose stingray	3,5
Gymnura micrura (Bloch and Schneider)	Smooth butterfly ray	3,5
Diodontidae		
Chilomycterus antennatus (Cuvier)	Bridled burrfish	2,3
C. antillarum Jordan and Rutter	Web burrfish	3
C. atinga (Linnaeus)	Spotted burrfish	2,3
C. schoepfi (Walbaum)	Striped burrfish	3
Diodon holacanthus Linnaeus	Balloonfish	1,2,3,4
D. hystrix Linnaeus	Porcupinefish	1,2,3,4

Scientific Name	Common Name	Occurrence
Echeneidae		
Echeneis naucrates Linnaeus	Sharksucker	1,2
E. neucratoides Zuieuw	Whitefin sharksucker	1,2
Remora osteochir (Cuvier)	Marlinsucker	1
R. remora (Linnaeus)	Remora	1
Eleotridae		
Dormitator maculatus (Bloch)	Fat sleeper	9
Eleotris pisonis (Gmelin)	Spinycheek sleeper	9
Erotelis smaragdus (Valenciennes)	Emerald sleeper	8,9
Elopidae		
Elops saurus Linnaeus	Ladyfish	3,8,9
Megalops atlantica Valenciennes	Tarpon	1,2,3,8,9
Emmelichthyidae		
Emmelichthyops atlanticus Schultz	Bonnetmouth	2
Engraulidae		
Anchoa cayorum (Fowler)	Key anchovie	3
A. hepsetus (Linnaeus)	Striped anchovie	3
A. lamprotaenia Hildebrand	Bigeye anchovy	3
A. lyolepis (Evermann and Marsh)	Dusky anchovy	3
A. mitchilli (Valenciennes)	Bay anchovy	3
Anchoviella perfasciata (Poey)	Flat anchovy	3
Ephippidae		
Chaetodipterus faber (Broussonet)	Atlantic spadefish	2,4
Exocoetidae		
Chriodorus atherinoides Goode and Bean	Hardhead halfbeak	3
Cypselurus comatus (Mitchill)	Clearwing flyingfish	1
C. cyanopterus (Valenciennes)	Margined flyingfish	1
C. exsiliens (Linnaeus)	Bandwing flyingfish	1
C. furcatus (Mitchill)	Spotfin flyingfish	1
Exocoetus obtusirostris Günther	Oceanic two-wing flyingfish	1
Hemiramphus balao Lesueur	Balao	1,3
H. brasiliensis (Linnaeus)	Ballyhoo	1,3
Hirundichthys affinis (Günther)	Fourwing flyingfish	1
H. rondeleti (Valenciennes)	Blackwing flyingfish	1
Hyporhamphus sp.		3,8
H. unifasciatus (Ranzani)	Halfbeak	3,8
Parexocoetus brachypterus Richardson	Sailfin flyingfish	1
Prognichthys gibbifrons (Valenciennes)	Bluntnose flyingfish	1
Fistulariidae		
Fistularia tabacaria Linnaeus	Cornetfish	2,6

Scientific Name	Common Name	Occurrence
	Gerreidae	
Diapterus olisthostomus (Goode and Bean)	Irish pompano	9
D. plumieri (Cuvier)	Striped mojarra	9
Eucinostomus argenteus Baird and Girard	Spotfin mojarra	3,8,9
E. gula (Quoy and Gaimard)	Silver jenny	3,8,9
E. lefroyi (Goode)	Mottled mojarra	3
E. melanopterus (Bleeker)	Flagfin mojarra	3
E. pseudogula Poey	Slender mojarra	3
Gerres cinereus (Walbaum)	Yellowfin mojarra	3,5
	Gobiidae	
Barbulifer ceuthoecus (Jordan and Gilbert)	Bearded goby	2,7
Bathygobius curacao (Metzelaar)	Notchtongue goby	2
B. mystacium Ginsburg	Island frillfin	2
B. soporator (Valenciennes)	Frillfin goby	2
Coryphopterus dicrus Böhlke and Robins	Colon goby	2,5
C. eidolon Böhlke and Robins	Pallid goby	2,5
C. glaucofraenum Gill	Bridled goby	2,5
C. hyalinus Böhlke and Robins	Glass goby	2
C. lipernes Böhlke and Robins	Peppermint goby	2
C. personatus (Jordan and Thompson)	Masked goby	2
C. punctipectophorus Springer	Spotted goby	2
Evorthodus lyricus (Girard)	Lyre goby	8,9
Gnatholepis thompsoni Jordan	Goldspot goby	2,3,5
Gobionellus boleosoma (Jordan and Gilbert)	Darter goby	3
G. gracillimus Ginsburg	Slim goby	3
G. hastatus Girard	Sharptail goby	3
G. oceanicus (Pallas)	Highfin goby	3
G. smaragdus (Valenciennes)	Emerald goby	3,8
G. stigmaturus (Goode and Bean)	Spottail goby	3
Gobiosoma grosvenori (Robins)	Rockcut goby	2,3
G. macrodon Beebe and Tee-Van	Tiger goby	2,4
G. oceanops (Jordan)	Neon goby	2
G. robustum Ginsburg	Code goby	3,7,9
Ioglossus calliurus Bean	Blue goby	5
Lophogobius cyprinoides (Pallas)	Crested goby	3,8,9
Lythrypnus phorellus Böhlke and Robins	Convict goby	2
L. spilus Böhlke and Robins	Bluegold goby	2
Microgobius carri Fowler	Seminole goby	5
M. gulosus (Girard)	Clown goby	7,8,9
M. microlepis Longley and Hildebrand	Banner goby	3
Nes longus (Nichols)	Orangespotted goby	5
Quisquilius hipoliti (Metzelaar)	Rusty goby	2
	Gobiesocidae	
Acyrtops beryllina (Hildebrand and Ginsburg)	Emerald clingfish	3
Gobiesox strumosus Cope	Skilletfish	2
	Grammistidae	
Pseudogrammus gregoryi (Breder)	Reef bass	2
Rypticus bistrispinus (Mitchill)	Freckled soapfish	2
R. saponaceus (Bloch and Schneider)	Greater soafish	2
R. subbifrenatus (Gill)	Spotted soafish	2

Scientific Name	Common Name	Occurrence
Holocentridae		
Holocentrus ascensionis (Osbeck)	Squirrelfish	2
H. coruscus (Poey)	Reef squirrelfish	2
H. rufus (Walbaum)	Longspine squirrelfish	2
H. vexillarius (Poey)	Dusky squirrelfish	2
Myripristis jacobus Cuvier	Blackbar soldierfish	2
Istiophoridae		
Istiophorus platypterus (Shaw and Nadder)	Sailfish	1
Kyphosidae		
Kyphosus incisor (Cuvier)	Yellow chub	1,2
K. sectatrix (Linnaeus)	Bermuda chub	1,2
Labridae		
Bodianus pulchellus (Poey)	Spotfin hogfish	2
B. rufus (Linnaeus)	Spanish hogfish	2,3
Clepticus parrai (Bloch and Schneider)	Creole wrasse	2
Doratonotus megalepis Günther	Dwarf wrasse	3
Halichoeres bivittatus (Bloch)	Slippery dick	2,3,4
H. cyanocephalus (Bloch)	Yellowcheek wrasse	3
H. garnoti (Valenciennes)	Yellowhead wrasse	2,3
H. maculipinna (Müller and Troschel)	Clown wrasse	2,3,4
H. poeyi (Steindachner)	Blackear wrasse	3,4
H. radiatus (Linnaeus)	Puddingwife	2,3,4
Hemipteronotus martinicensis (Valenciennes)	Rosy razorfish	5
H. novacula (Linnaeus)	Pearly razorfish	5
H. splendens (Castelnau)	Green razorfish	5
Lachnolaimus maximus (Walbaum)	Hogfish	2,3,4
Thalassoma bifasciatum (Bloch)	Bluehead	2,3,4
Lobotidae		
Lobotes surinamensis (Bloch)	Tripletail	1
Lutjanidae		
Lutjanus analis (Cuvier)	Mutton snapper	2,3
L. apodus (Walbaum)	Schoolmaster	2,3,8
L. buccanella (Cuvier)	Blackfin snapper	2
L. griseus (Linnaeus)	Gray snapper	2,3,8,9
L. jocu (Bloch and Schneider)	Dog snapper	2,3
L. mahogani (Cuvier)	Mahogany snapper	2
L. synagris (Linnaeus)	Lane snapper	2,3
Ocyurus chrysurus (Bloch)	Yellowtail snapper	2,3
Rhomboplites aurorubens (Cuvier)	Vermilion snapper	2,3
Microdesmidae		
Microdesmus floridanus (Longley)	Pugjaw wormfish	7,8
M. longipinnis (Weymouth)	Pink wormfish	7,8

Scientific Name	Common Name	Occurrence
Mobulidae		
Manta birostris (Walbaum)	Atlantic manta	1
Moringuidae		
Moringua edwardsi (Jordan and Bollman)	Spaghetti eel	2
Mugilidae		
Mugil cephalus Linnaeus	Striped mullet	3,6,8,9
M. curema Valenciennes	White mullet	3,6,8,9
M. trichodon Poey	Fantail mullet	3,6,8,9
Mullidae		
Mulloidichthys martinicus (Cuvier)	Yellow goatfish	2,3,5
Pseudupeneus maculatus (Bloch)	Spotted goatfish	2,3,5
Muraenidae		
Anarchias yoshiae Kanazawa	Pygmy moray	2
Echidna catenata (Bloch)	Chain moray	2
Enchelycore nigricans (Bonnaterre)	Viper moray	2
Gymnothorax funebris Ranzani	Green moray	2
G. moringa (Cuvier)	Spotted moray	2,3
G. nigromarginatus (Girard)	Blackedge moray	3
G. vicinus (Castelnau)	Purplemouth moray	2,3
Muraena miliaris (Kaup)	Goldentail moray	2
Rabula sp.		2
Myliobatidae		
Aetobatus narinari (Euphrasen)	Spotted eagle ray	1
Rhinoptera bonasus (Mitchill)	Cownose ray	1
Ogcocephalidae		
Ogcocephalus cubifrons (Richardson)	Polkadot batfish	2,3,5
O. nasutus (Valenciennes)	Shortnose batfish	2,3,5
O. vespertilio (Linnaeus)	Longnose batfish	2,3
Ophichthidae		
Ahlia egmontis (Jordan)	Key worm eel	3,8,9
Bascanichthys teres (Goode and Bean)	Sooty eel	3,8
Letharchus velifer Goode and Bean	Sailfin eel	3
Myrichthys acuminatus (Gronow)	Sharptail eel	2,3
Myrichthys oculatus (Kaup)	Goldspotted eel	2,3
Myrophis punctatus Lütken	Speckled worm eel	3,8,9
Ophichthus gomesi (Castelnau)	Shrimp eel	3
O. ophis (Linnaeus)	Spotted snake eel	3
Sphagebranchus ophioneus (Evermann and Marsh)	Surf eel	5

Scientific Name	Common Name	Occurrence
Ophidiidae		
Lepophidium graellsi (Poey)	Blackedge cusk-eel	3
Ophidion beani Jordan and Gilbert	Longnose cusk-eel	3
O. grayi (Fowler)	Blotched cusk-eel	3
Parophidion schmidti (Woods and Kanazawa)	Dusky cusk-eel	3
Opistognathidae		
Opistognathus aurifrons (Jordan and Thompson)	Yellowhead jawfish	2,5
O. macrognathus Poey	Spotfin jawfish	3
O. maxillosus Poey	Mottled jawfish	2
O. whitehursti (Longley)	Dusky jawfish	2,3
Orectolobidae		
Ginglymostoma cirratum (Bonnaterre)	Nurse shark	2,3,4,5,8
Ostraciidae		
Lactophrys bicaudalis (Linnaeus)	Spotted trunkfish	2,3
L. quadricornis (Linnaeus)	Cowfish	2,3
L. trigonus (Linnaeus)	Trunkfish	3
L. triqueter (Linnaeus)	Smooth trunkfish	2
Pempheridae		
Pempheris schomburgki Müller and Troschel	Glassy sweeper	2
Poeciliidae		
Gambusia affinis (Baird and Girard)	Mosquitofish	7,8,9
G. rhizophorae Rivas	Mangrove gambusia	8,9
Poecilia latipinna (Lesueur)	Sailfin molly	7,8,9
Polynemidae		
Polydactylus octonemus (Girard)	Atlantic threadfin	3,5
P. oligodon (Günther)	Little-scale threadfin	3,8
P. virginicus (Linnaeus)	Barbu	5,7
Pomacentridae		
Abudefduf saxatilis (Linnaeus)	Sergeant major	1,2,3,4,8
A. taurus (Müller and Troschel)	Night sergeant	2
Chromis cyanea (Poey)	Blue chromis	2
C. enchrysurus Jordan and Gilbert	Yellowtail reef-fish	2
C. insolatus (Cuvier)	Sunshinefish	2
C. multilineata (Guichenot)	Brown chromis	2
C. scotti Emery	Purple reef-fish	2
Eupomacentrus fuscus (Poey)	Dusky damselfish	2,3,4
E. leucostictus (Müller and Troschel)	Beaugregory	2,3,4
E. partitus (Poey)	Bicolor damselfish	2,3
E. planifrons (Cuvier)	Threespot damselfish	2
E. variabilis (Castelnau)	Cocoa damselfish	2,3
Microspathodon chrysurus (Cuvier)	Yellowtail damselfish	2

Scientific Name	Common Name	Occurrence
	Pomadasyidae	
Anisotremus surinamensis (Bloch)	Black margate	2,3
A. virginicus (Linnaeus)	Porkfish	2,3
Haemulon album Cuvier	Margate	2,3
H. carbonarium Poey	Caesar grunt	2,3
H. chrysargyreum Günther	Smallmouth grunt	2,3
H. flavolineatum (Desmarest)	French grunt	2,3
H. macrostomum Günther	Spanish grunt	2,3
H. melanurum (Linnaeus)	Cottonwick	2,3
H. parrai (Desmarest)	Sailors choice	2,3
H. plumieri (Lacépède)	White grunt	2,3
H. sciurus (Shaw)	Bluestriped grunt	2,3
H. striatum (Linnaeus)	striped grunt	2,3
Orthopristis chrysopterus (Linnaeus)	Pigfish	3
Pomadasys crocro (Cuvier)	Burro grunt	3,8
	Pomatomidae	
Pomatomus saltatrix (Linnaeus)	Bluefish	6
	Priacanthidae	
Priacanthus curentatus (Lacépède)	Glasseye snapper	2
Pristigenys alta (Gill)	Short bigeye	1,2
	Pristidae	
Pristis pectinatus Latham	Smalltooth sawfish	3,5,8,9
	Rachycentridae	
Rachycentron canadum (Linnaeus)	Cobia	1,6
	Rajidae	
Raja texana Chandler	Roundel skate	3
	Rhinobatidae	
Rhinobatos lentiginosus (Garman)	Atlantic guitarfish	3
	Scaridae	
Cryptotomus roseus Cope	Bluelip parrotfish	2,3
Nicholsina usta (Valenciennes)	Emerald parrotfish	3
Scarus coelestinus Valenciennes	Midnight parrotfish	2,3
S. coeruleus (Bloch)	Blue parrotfish	2,3
S. croicensis Bloch	Striped parrotfish	2,3
S. guacamaia Cuvier	Rainbow parrotfish	2,3,8
S. taeniopterus Desmarest	Princess parrotfish	2,3
S. vetula Bloch and Schneider	Queen parrotfish	2,3
Sparisoma atomarium (Poey)	Greenblotch parrotfish	2,3
S. aurofrenatum (Valenciennes)	Redband parrotfish	2,3

Scientific Name	Common Name	Occurrence
chrysopterum (Bloch and Schneider)	Redtail parrotfish	2,3
S. radians (Valenciennes)	Bucktooth parrotfish	3
S. rubripinne (Valenciennes)	Redfin parrotfish	2,3
S. viride (Bonnaterre)	Stoplight parrotfish	2,3
Sciaenidae		
Bairdiella batabana (Poey)	Blue croaker	3
B. chrysura (Lacépède)	Silver perch	3,8,9
Cynoscion arenarius Ginsburg	Sand seatrout	3,5
C. nebulosus (Cuvier)	Spotted seatrout	3,8,9
C. regalis (Bloch and Schneider)	Weakfish	3
Equetus acuminatus (Bloch and Schneider)	High-hat	2,3
E. lanceolatus (Linnaeus)	Jackknife-fish	2,3,8
E. punctatus (Bloch and Schneider)	Spotted drum	2
E. umbrosus Jordan and Eigenmann	Cubbyu	3
Leiostomus xanthurus Lacépède	Spot	3,9
Menticirrhus americanus (Linnaeus)	Southern kingfish	3,7
Micropogon undulatus (Girard)	California corbina	3
Odontoscion dentex (Cuvier)	Reef croaker	2
Sciaenops ocellata (Linnaeus)	Red drum	3,8,9
Scombridae		
Euthynnus alletteratus (Rafinesque)	Little tuna	1
rda sarda (Bloch)	Atlantic bonito	1
Scomberomorus cavalla (Cuvier)	King mackerel	1,2,3
S. maculatus (Mitchill)	Spanish mackerel	3,6
S. regalis (Bloch)	Cero	2,3,6
Scorpaenidae		
Scorpaena albifimbria Evermann and Marsh	Coral scorpionfish	2
S. bergi Evermann and Marsh	Goosehead scorpionfish	2,3
S. brasiliensis Cuvier	Barbfish	2,3
S. calcarata Goode and Bean	Smoothhead scorpionfish	2,3
S. grandicornis Cuvier	Lionfish	3
S. plumieri Bloch	Spotted scorpionfish	2,3
Scorpaenodes tredecimspinosus (Metzelaar)	Deepreef scorpionfish	2
Serranidae		
Alphestes afer (Bloch)	Mutton hamlet	3
Cephalopholis fulva (Linnaeus)	Coney	2
Dermatolepis inermis (Valenciennes)	Marbled grouper	2
Diplectrum bivittatum (Valenciennes)	Dwarf sand perch	2,3
D. formosum (Linnaeus)	Sand perch	2,3
Epinephelus adscensionis (Osbeck)	Rock hind	2
E. drummondhayi Goode and Bean	Speckled hind	2
E. guttatus (Linnaeus)	Red hind	2
itajara (Lichtenstein)	Jewfish	2,3
morio (Valenciennes)	Red grouper	3
E. nigritus (Holbrook)	Warsaw grouper	2
E. niveatus (Valenciennes)	Snowy grouper	2

Scientific Name	Common Name	Occurrence
Epinephelus striatus (Bloch)	Nassau grouper	2,3
Hypoplectrus indigo (Poey)	Indigo hamlet	2
H. nigricans (Poey)	Black hamlet	2
H. puella (Cuvier)	Banded hamlet	2
H. unicolor (Walbaum)	Butter hamlet	2,3,5
Liopropoma eukrines (Starck and Courtenay)	Wrasse bass	2
L. rubre Poey	Peppermint bass	2
Mycteroperca bonaci (Poey)	Black grouper	2,3
M. microlepis (Goode and Bean)	Gag	2,3
M. phenax Jordan and Swain	Scamp	2,3
M. venenosa (Linnaeus)	Yellowfin grouper	2,3
Paranthias furcifer (Valenciennes)	Creole-fish	2
Petrometopon cruentatum (Lacépède)	Graysby	2
Serranus baldwini (Evermann and Marsh)	Lantern bass	2,3
S. tabacarius (Cuvier)	Tobacco fish	2
S. tigrinus (Bloch)	Harlequin bass	2
S. tortugarum Longley	Chalk bass	2
Soleidae		
Achirus lineatus (Linnaeus)	Lined sole	3,8,9
Trinectes inscriptus (Gosse)	Scrawled sole	3
T. maculatus (Bloch and Schneider)	Hogchocker	3,8,9
Sparidae		
Archosargus probatocephalus (Walbaum)	Sheepshead	3,8,9
A. rhomboidalis (Linnaeus)	Sea bream	3
Calamus arctifrons Goode and Bean	Grass porgy	3
C. bajonado (Bloch and Schneider)	Jolthead progy	2,3
C. calamus (Valenciennes)	Saucereye porgy	3
C. penna (Valenciennes)	Sheepshead porgy	3
Sphyraenidae		
Sphyraena barracuda (Walbaum)	Great barracuda	1,2,3,4,5, 6,8,9
S. borealis DeKay	Northern sennet	6
S. guachancho Cuvier	Guaguanche	6
Sphyrnidae		
Sphyrna lewini (Griffith and Smith)	Scalloped hammerhead	1
S. mokarran (Rüppell)	Great hammerhead	1
S. tiburo (Linnaeus)	Bonnethead	3
S. zygaena (Linnaeus)	Smooth hammerhead	6
Stromateidae		
Ariomma regulus (Poey)	Spotted driftfish	1
Nomeus gronowi (Gmelin)	Man-of-war fish	1
Psenes cyanophrys Cuvier	Freckled driftfish	1
Syngnathidae		
Corythoichthys albirostris Heckel	Whitenose pipefish	2,3
C. brachycephalus (Poey)	Crested pipefish	3

Scientific Name	Common Name	Occurrence
...ppocampus erectus Perry	Lined seahorse	3,4
H. zosterae Jordan and Gilbert	Dwarf seahorse	3
Microgнathus crinigerus (Bean and Dresel)	Fringed pipefish	3
M. crinitus (Jenyns)	Insular pipefish	3
M. ensenadae (Silvester)	Harlequin pipefish	2
M. vittatus (Kaup)	Banded pipefish	2,3
Oostethus lineatus (Kaup)	Opossum pipefish	2,3
Syngnathus dunckeri Metzelaar	Pugnose pipefish	3
S. elucens Poey	Shortfin pipefish	3
S. floridae (Jordan and Gilbert)	Dusky pipefish	3
S. louisianae Günther	Chain pipefish	3
S. pelagicus Linnaeus	Sargassum pipefish	1
S. scovelli (Evermann and Kendall)	Gulf pipefish	3,9
S. springeri Herald	Bull pipefish	3
Synodontidae		
Synodus foetens (Linnaeus)	Inshore lizardfish	3,5
S. intermedius (Agassiz)	Sand diver	2,3
S. synodus (Linnaeus)	Red lizardfish	2
Trachinocephalus myops (Forster)	Snakefish	3,5
Tetraodontidae		
Canthigaster rostrata (Bloch)	Sharpnose puffer	2
...hoeroides nephelus (Goode and Bean)	Southern puffer	3
S. spengleri (Bloch)	Bandtail puffer	2,3
S. testudineus (Linnaeus)	Checkered puffer	3
Torpedinidae		
Narcine brasiliensis (Olfers)	Lesser electric ray	3,5
Triglidae		
Prionotus pectoralis Nichols and Breder	Blackwing searobin	3
P. roseus Jordan and Evermann	Bluespotted searobin	3
P. scitulus Jordan and Gilbert	Leopard searobin	3
P. tribulus Cuvier	Bighead searobin	3,8
Uranoscopidae		
Astroscopus y-graecum (Cuvier)	Southern stargazer	3
Gnathagnus egregius (Jordan and Thompson)	Freckled stargazer	5
Urolophidae		
Urolophus jamaicensis (Cuvier)	Yellow stingray	2,3,4,5,8
Xenocongridae		
Kaupichthys hyoproroides (Strömann)	False moray	2,3

ECOLOGICAL ANNOTATION KEY

a Associated with sargassum, Physalia physalia, jellyfishes, or floating debri
b Occurs in area only in the young and juvenile stages
c Young often associated with larger fishes or sea turtles
d Mainly in deeper water situations, at edge of area
e Mainly in clearer water of the outer reefs
f Young common inshore around pilings and sea walls
g In pockets of coral rubble
h Burrows in sand associated with this type of area
i Juveniles found offshore, adults move inshore
j Inhabits live conch during the day
k Associated with sponges, isolated corals, shells, or obstructions in grass beds
l Usually near the surface in these areas
m Present during fall and winter months only
n Sandy beach, clear moving water (well oxygenated)
o Still protected water, often silty bottom
p Lives in sea cucumbers during the day
q May live in sponges

Oceanic Fishes

.strio histrio (a)	Alutera schoepfi (a)(b)	Alutera scripta (a)(b)
Balistes capriscus (a)(b)	Balistes vetula (a)(b)	Cantherines pullus (a)(b)
Canthidermis sufflamen	Monacanthus ciliatus (a)(b)	Monacanthus hispidus (a)(b)
Monacanthus setifer (a)(b)	Monacanthus tuckeri (a)(b)	Platybelone argalus
Tylosurus acus	Tylosurus crocodilus	Alectis crinitus
Caranx bartholomaei	Caranx crysos (c)	Caranx hippos (c)
Caranx latus (c)	Caranx ruber (a)	Chloroscombrus chrysurus (a)
Decapterus macarellus	Decapterus punctatus	Elagatis bipinnulata
Hemicaranx amblyrhynchus	Naucrates ductor (c)	Selar crumenophthalmus
Selene vomer	Seriola dumerili	Seriola zonata
Vomer setapinnis	Carcharhinus limbatus	Galeocerdo cuvieri
Hypoprion signatus	Coryphaena equisetis	Coryphaena hippurus
Dactylopterus volitans	Diodon holacanthus (c)	Diodon hystrix (c)
Echeneis naucrates (c)	Echeneis neucratoides (c)	Remora osteochir (c)
Remora remora (c)	Megalops atlantica	Cypselurus comatus
Cypselurus cyanopterus	Cypselurus exsiliens	Cypselurus furcatus
Exocoetus obtusirostris	Hemiramphus balao	Hemiramphus brasiliensis
.rundichthys affinis	Hirundichthys rondeleti	Parexocoetus brachypterus
Prognichthys gibbifrons	Istiophorus platypterus	Kyphosus incisor (b)
Kyphosus sectatrix (b)	Lobotes surinamensis	Manta birostris
Aetobatus narinari	Rhinoptera bonasus	Abudefduf saxatilis (a)(b)
Pristigenys alta (b)	Rachycentron canadum	Euthynnus alletteratus
Sarda sarda	Scomberomorus cavalla	Sphyraena barracuda
Sphyrna lewini	Sphyrna mokarran	Ariomma regulus (a)
Nomeus gronowi (a)	Psenes cyanophrys (a)	Syngnathus pelagicus (a)

Rock, Coral, Seawall Fishes

Acanthurus bahianus	Acanthurus chirurgus	Acanthurus coeruleus
Acanthurus randalli	Apogon binotatus	Apogon conklini
Apogon lachneri (d)	Apogon maculatus	Apogon pigmentarius
Apogon planifrons	Apogon pseudomaculatus	Apogon townsendi (e)
Aulostomus maculatus	Alutera scripta	Balistes capriscus
Cantherines macrocerus	Cantherines pullus	Monacanthus tuckeri (e)
lennius cristatus	Blennius marmoreus	Entomacrodus nigricans
Hypleurochilus aequipinnis	Hypleurochilus bermudensis	Ophioblennius atlanticus
Ogilbia cayorum	Petrotyx sanguineus	Calliomymus bairdi

Rock, Coral, Seawall Fishes--Continued

Caranx bartholomaei	Caranx crysos	Caranx hippos
Caranx latus	Caranx ruber	Oligoplites saurus
Seriola dumerili	Carcharhinus leucas	Carcharhinus springeri
Carcharhinus obscurus	Hypoprion signatus	Carcharhinus undecimalis
Chaetodon capistratus	Chaetodon ocellatus	Chaetodon sedentarius
Chaetodon striatus	Holacanthus ciliaris (f)	Holacanthus bermudensis (f)
Holacanthus tricolor	Pomacanthus arcuatus (f)	Pomacanthus paru (f)
Emblycirrhitus pinos (e)	Acanthemblemaria aspera (e)	Acanthemblemaria chaplini (e)
Emblemaria bottomei (e)	Emblemaria diaphana (e)	Enneanectes altivelis (e)
Enneanectes boehlkei (e)	Enneanectes jordani (e)	Enneanectes pectoralis (e)
Hemiemblemaria simulus (e)	Labrisomus bucciferus (e)	Labrisomus guppyi (e)
Labrisomus haitiensis (e)	Labrisomus kalisherae (e)	Labrisomus nigricinctus (e)
Labrisomus nuchipinnis	Malacoctenus aurolineatus (e)	Malacoctenus macropus
Malacoctenus triangulatus (e)	Paraclinus cingulatus (e) (g)	Paraclinus fasciatus
Paraclinus grandicomis (q)	Paraclinus nigripinnis	Starksia ocellata
Stathmonotus hemphilli (e)	Stathmonotus stahli tekla	Conger oceanicus
Conger triporiceps	Dactylopterus volitans	Gillellus rubrocinctus (e) (h)
Chilomycterus antennatus	Chilomycterus atinga	Diodon holacanthus
Diodon hystrix	Echeneis naucrates (c)	Echeneis neucratoides (c)
Megalops atlantica	Emmelichthyops atlanticus (a)	Chaetodipterus faber
Fistularia tabacaria	Barbulifer ceuthoecus	Bathygobius curacao
Bathygobius mystacium	Bathygobius soporator	Coryphopterus dicrus (e)
Coryphoterus eidolon (d)	Coryphopterus glaucofraenum	Coryphopterus hyalinus (d)
Coryphopterus lipernes (d)	Coryphopterus personatus (d)	Coryphopterus punctipectophorus
Gnatholepis thompsoni	Gobiosoma grosvenori	Gobiosoma macrodon
Gobiosoma oceanops	Lythrypnus phorelius (e)	Lythrypnus spilus (d)
Quisquilius hipoliti (e)	Gobiesox strumosus	Pseudogrammus gregoryi (e)
Rypticus bistrispinus (e)	Rypticus saponaceus	Rypticus subbifrenatus (e)
Holocentrus ascensionis	Holocentrus coruscus (e)	Holocentrus rufus
Holocentrus vexillarius	Myripristis jacobus (e)	Kyphosus incisor
Kyphosus sectatrix	Bodianus pulchellus (d)	Bodianus rufus
Clepticus parrai (d)	Halichoeres bivittatus	Halichoeres garnoti
Halichoeres maculipinna	Halichoeres radiatus	Lachnolaimus maximus
Thalassoma bifasciatum	Lutjanus analis	Lutjanus apodus
Lutjanus buccanella	Lutjanus griseus	Lutjanus jocu
Lutjanus mahogani	Lutjanus synagris	Ocyurus chrysurus
Rhomboplites aurorubens	Moringua edwardsi	Mulloidichthys martinicus

seudupeneus maculatus	Anarchias yoshiae	Echidna catenata
Enchelycore nigricans (e)	Gymnothorax funebris	Gymnothorax moringa
Gymnothorax vicinus	Muraena miliaris (e)	Rabula sp. (e)
Ogocephalus cubifrons	Ogocephalus nasutus	Ogocephalus vespertilio
Myrichthys acuminatus	Myrichthys oculatus	Opisthognathus aurifrons (h)
Opistognathus maxillosus (h)	Opisthognathus whitehursti (h)	Ginglymostoma cirratum
Lactophrys bicaudalis	Lactophrys quadricornis	Lactophrys triqueter
Pempheris schomburgki	Abudefduf saxatilis	Abudefduf taurus
Chromis cyanea	Chromis enchrysurus (d)	Chromis insolatus (d)
Chromis multilineata	Chromis scotti (e)	Eupomacentrus fuscus
Eupomacentrus leucostictus	Eupomacentrus partitus	Eupomacentrus planifrons
Eupomacentrus variabilis	Microspathodon chrysurus	Anisotremus surinamensis
Anisotremus virginicus	Haemulon album	Haemulon carbonarium
Haemulon chrysargyreum	Haemulon flavolineatum	Haemulon macrostomum
Haemulon melanurum	Haemulon parrai	Haemulon plumieri
Haemulon sciurus	Haemulon striatum	Priacanthus curentatus
Pristigenys alta	Cryptotomus roseus	Scarus coelestinus
Scarus coeruleus	Scarus croicensis	Scarus guacamaia
Scarus taeniopterus	Scarus vetula	Sparisoma atomarium (d)
Sparisoma aurofrenatum	Sparisoma chrysopterum	Sparisoma rubripinne
Sparisoma viride	Equetus acuminatus	Equetus lanceolatus (i)
Equetus punctatus	Odontoscion dentex	Scomberomorus cavalla (b)
Scomberomorus regalis	Scorpaena albifimbria	Scorpaena bergi
Scorpaena brasiliensis	Scorpaena calcarata	Scorpaena plumieri
Dermatolepis inermis	Cephalopholis fulva	Scorpaenodes tredecimspinosus
Diplectrum bivittatum	Diplectrum formosum	Epinephelus adscensionis
Epinephelus drummondhayi (d)	Epinephelus guttatus	Epinephelus itajara
Epinephelus nigritus (d)	Epinephelus niveatus (e)	Epinephelus striatus
Hypoplectrus indigo (e)	Hypoplectrus nigricans (e)	Hypoplectrus puella (e)
Hypoplectrus unicolor	Liopropoma eukrines (d)	Liopropoma rubre (d)
Mycteroperca bonaci	Mycteroperca microlepis	Mycteroperca phenax
Mycteroperca venenosa (d)	Paranthias furcifer	Petrometopon cruentatum
Serranus baldwini	Serranus tabacarius	Serranus tigrinus
Serranus tortugarum	Calamus bajonado (d)	Sphyraena barracuda
Xorythoichthys albirostris	Micrognathus ensenadae (g)	Micrognathus vittatus
Oostethus lineatus	Synodus intermedius	Synodus synodus
Canthigaster rostrata	Sphoeroides spengleri	Urolophus jamaicensis

Kaupichthys hyoproroides

Grass Bed and Tidal Flat Fishes

Acanthurus bahianus	Acanthurus chirurgus	Acanthurus randalli
Albula vulpes	Antennarius scaber	Apogon aurolineatus
Astrapogon alutus	Astrapogon puncticulatus (k)	Astrapogon stellatus (j)
Arius felis	Bagre marinus	Balistes capriscus
Cantherines pullus	Monacanthus ciliatus	Monacanthus hispidus
Monacanthus setifer	Monacanthus tuckeri (d)	Opsanus beta
Opsanus tau	Porichthys porosissimus	Hypsoblennius hentzi
Bothus sp.	Bothus ocellatus	Citharichthys macrops
Citharichthys spilopterus	Paralichthys albigutta	Syacium micrurum
Syacium papillosum	Ogilbia cayorum	Callionymus pauciradiatus
Caranx crysos	Caranx hippos	Caranx latus
Chloroscombrus chrysurus	Oligoplites saurus	Selar crumenophthalmus
Selene vomer	Trachinotus carolinus	Trachinotus falcatus
Trachinotus goodei	Vomer setapinnis	Carapus bermudensis (p)
Carcharhinus acronotus	Carcharhinus leucas	Carcharhinus obscurus
Mustelus canis	Negaprion brevirostris	Rhizoprionodon terraenovae
Chaetodon capistratus (k)	Chaetodon striatus (k)	Chaenopsis ocellata
Paraclinus fasciatus	Paraclinus marmoratus	Paraclinus nigripinnis
Starksia ocellata	Stathmonotus stahli tekla	Ariosoma impressa
Paraconger caudilimbatus	Symphurus plagiusa	Dasyatis americanus
Dasyatis sabina	Dasyatis sayi	Gymnura micrura
Chilomycterus antennatus	Chilomycterus antillarum	Chilomycterus atinga
Chilomycterus schoepfi	Diodon holacanthus	Diodon hystrix
Elops saurus	Megalops atlantica	Anchoa cayorum
Anchoa hepsetus	Anchoa lamprotaenia	Anchoa lyolepis
Anchoa mitchilli	Anchoviella perfasciata	Chriodorus atherinoides
Hemiramphus balao (l)	Hemiramphus brasiliensis (l)	Hyporhamphus sp. (l)
Hyporhamphus unifasciatus (l)	Eucinostomus argenteus	Eucinostomus gula
Eucinostomus lefroyi	Eucinostomus melanopterus	Eucinostomus pseudogula
Gerres cinereus	Gnatholepis thompsoni	Gobionellus boleosoma
Gobionellus gracillimus	Gobionellus hastatus	Gobionellus oceanicus
Gobionellus smaragdus (o)	Gobionellus stigmaturus	Gobiosoma grosvenori
Gobionellus robustum	Lophogobius cyprinoides	Microgobius microlepis

Grass Bed and Tidal Flat Fishes--Continued

Acyrtops beryllina
Bodianus rufus
Doratonotus megalepis
Halichoeres bivittatus
Halichoeres cyanocephalus (d)
Halichoeres garnoti
Halichoeres maculipinna
Halichoeres poeyi
Halichoeres radiatus
Lachnolaimus maximus
Thalassoma bifasciatum
Lutjanus analis
Lutjanus apodus
Lutjanus griseus
Lutjanus jocu
Lutjanus synagris
Ocyurus chrysurus
Rhomboplites aurorubens
Mugil cephalus
Mugil curema
Mugil trichodon
Mulloidichthys martinicus
Pseudupeneus maculatus
Gymnothorax moringa
Gymnothorax nigromarginatus
Gymnothorax vicinus
Ogcocephalus cubifrons
Ogcocephalus nasutus
Ogcocephalus vespertilio
Ahlia egmontis (h)
Bascanichthys teres (h)
Letharchus velifer (h)
Myrichthys acuminatus
Myrichthys oculatus
Myrophis punctatus (h)
Ophichthus gomesi (h)
Ophichthus ophis (h)
Lepophidium graellsi
Ophidion beani
Ophidion grayi
Parophidion schmidti
Opisthognathus macrognathus
Opistognathus whitehursti (h)
Ginglymostoma cirratum
Lactophrys bicaudalis
Lactophrys quadricornis
Lactophrys trigonus
Polydactylus octonemus
Polydactylus oligodon
Abudefduf saxatilis (k)
Eupomacentrus fuscus (k)
Eupomacentrus leucostictus (k)
Eupomacentrus partitus (k)
Eupomacentrus variabilis (k)
Anisotremus surinamensis
Anisotremus virginicus
Haemulon album
Haemulon carbonarium
Haemulon chrysargyreum
Haemulon flavolineatum
Haemulon macrostomum
Haemulon melanurum
Haemulon parrai
Haemulon plumieri
Haemulon sciurus
Haemulon striatum
Orthopristis chrysopterus
Pomadasys crocro
Pristis pectinatus
Raja texana
Rhinobatos lentiginosus
Cryptotomus roseus
Nicholsina usta
Scarus coelestinus
Scarus coeruleus
Scarus croicensis
Scarus guacamaia
Scarus taeniopterus
Scarus vetula
Sparisoma atomarium (d)
Sparisoma aurofrenatum
Sparisoma chrysopterum
Sparisoma radians
Sparisoma rubripinne
Sparisoma viride
Bairdiella batabana
Bairdiella chrysura
Cynoscion arenarius
Cynoscion nebulosus
Cynoscion regalis
Equetus acuminatus
Equetus lanceolatus (i)
Equetus umbrosus
Leiostomus xanthurus
Menticirrhus americanus
Micropogon undulatus
Sciaenops ocellata
Scomberomorus cavalla (b)
Scomberomorus maculatus (m)
Scomberomorus regalis
Scorpaena bergi
Scorpaena brasiliensis
Scorpaena calcarata
Scorpaena grandicornis
Alphestes afer (a)
Diplectrum bivittatum
Diplectrum formosum
Epinephelus itajara
Epinephelus morio
Epinephelus striatus
Hypoplectrus unicolor

Grass Bed and Tidal Flat Fishes--Continued

Mycteroperca bonaci	Mycteroperca microlepis	Mycteroperca phenax
Mycteroperca venenosa	Serranus baldwini	Achirus lineatus
Trinectes inscriptus	Trinectes maculatus	Archosargus probatocephalus
Archosargus rhomboidalis	Calamus arctifrons	Calamus bajonado (d)
Calamus calamus	Calamus penna	Sphyraena barracuda
Sphyrna tiburo	Corythoichthys albirostris	Corythoichthys brachycephalus
Hippocampus erectus	Hippocamus zosterae	Micrognathus crinigerus
Micrognathus crinitus	Micrognathus vittatus	Oostethus lineatus
Syngnathus dunckeri	Syngnathus elucens	Syngnathus floridae
Syngnathus louisianae	Syngnathus scovelli	Syngnathus springeri (d)
Synodus foetens	Synodus intermedius	Trachinocephalus myops
Sphoeroides nephelus	Sphoeroides spengleri	Sphoeroides testudineus
Narcine brasiliensis	Prionotus pectoralis	Prionotus roseus
Prionotus scitulus	Prionotus tribulus	Astroscopus y-graecum
Urolophus jamaicensis	Kaupichthys hyoproroides	

Sponge and Alcyonarian Fishes

Antennarius multiocellatus	Antennarius ocellatus	Antennarius pauciradiatus
Antennarius radiosus	Antennarius scaber	Aulostomus maculatus
Alutera schoepfi	Alutera scripta	Cantherines macrocerus
Chaetodon capistratus	Chaetodon ocellatus	Chaetodon sedentarius
Chaetodon striatus	Holacanthus ciliaris	Holacanthus bermudensis
Holacanthus tricolor	Pomacanthus arcuatus	Paraclinus grandicomis (q)
Diodon holacanthus	Diodon hystrix	Chaetodipterus faber
Gobiosoma macrodon	Halichoeres bivittatus	Halichoeres maculipinna
Halichoeres poeyi	Halichoeres radiatus	Lachnolaimus maximus
Thalassoma bifasciatum	Ginglymostoma cirratum	Abudefduf saxatilis
Eupomacentrus fuscus	Eupomacentrus leucostictus	Sphyraena barracuda
Hippocampus erectus	Urolophus jamaicensis	

Open Sand Fishes

Albula vulpes	Bothus sp.	Bothus ocellatus
Citharichthys cornutus	Citharichthys macrops	Citharichthys spilopterus
Malacanthus plumieri (d)	Oligoplites saurus	Negaprion brevirostris
Rhizoprionodon terraenovae	Paraconger caudilimbatus	Dactyloscopus crossotus (n)
Dactyloscopus tridigitatus (n)	Gillellus greyae (n)	Dasyatis americanus
Dasyatis sabina	Dasyatis sayi	Gymnura micrura

Open Sand Fishes--Continued

Gerres cinereus	Coryphopterus dicrus	Coryphopterus eidolon
Coryphopterus glaucofraenum	Gnatholepis thompsoni	Ioglossus calliurus
Microgobius carri	Nes longus	Hemipteronotus martinicensi
Hemipteronotus novacula	Hemipteronotus splendens	Mulloidichthys martinicus
Pseudupeneus maculatus	Ogcocephalus cubifrons	Ogcocephalus nasutus
Sphagebranchus ophioneus (n)	Opistognathus aurifrons	Ginglymostoma cirratum
Polydactylus octonemus	Polydactylus virginicus (n)	Pristis pectinatus
Cynoscion arenarius	Hypoplectrus unicolor	Sphyraena barracuda
Synodus foetens	Trachinocephalus myops	Narcine brasiliensis
Gnathagnus egregius	Urolophus jamaicensis	

Open Water - Surface Inshore Fishes

Allanetta harringtonensis	Atherinomorus stipes	Strongylura marina
Strongylura notata	Strongylura timucu	Tylosurus acus
Tylosurus crocodilus	Harengula humeralis	Harengula pensacolae
Jenkinsia lamprotaenia	Opisthonema oglinum	Sardinella anchovia
Fistularia tabacaria	Mugil cephalus	Mugil curema
Mugil trichodon	Pomatomus saltatrix (m)	Rachycentron canadum
Scomberomorus maculatus (m)	Scomberomorus regalis	Sphyraena barracuda
Sphyraena borealis	Sphyraena guachancho	Sphyrna zygaena (m)

Littoral Fishes

Trachinotus carolinus (n)	Trachinotus falcatus (n)	Trachinotus goodei (n)
Adinia xenica (o)	Cyprinodon variegatus (o)	Floridichthys carpio (o)
Fundulus grandis (o)	Fundulus similis (o)	Barbulifer ceuthoecus
Gobiosoma robustum (o)	Microgobius gulosus (o)	Microdesmus floridanus (h)
Microdesmus longipinnis (h)	Gambusia affinis (o)	Poecilia latipinna (o)
Polydactylus virginicus (n)	Menticirrhus americanus	

Mangrove Fishes

Anguilla rostrata	Arius felis	Bagre marinus
Balistes capriscus	Balistes vetula	Opsanus beta
Opsanus tau	Chasmodes saburrae	Paralichthys albigutta
Caranx crysos	Caranx hippos	Carcharhinus leucas
Centropomus ensiferus	Centropomus parallelus	Centropomus pectinatus
Centropomus undecimalis	Symphurus plagiusa	Erotelis smaragdus (o)

Elops saurus
Hyporhamphus unifasciatus(l)
Evorthodus lyricus
Microgobius gulosus
Microdesmus floridanus (h)
Mugil curema
Bascanichthys teres (h)
Gambusia affinis
Polydactylus oligodon
Pristis pectinatus
Cynoscion nebulosus
Achirus lineatus
Sphyraena barracuda
Megalops atlantica
Eucinostomus argenteus
Gobionellus smaragdus (o)
Lutjanus apodus
Microdesmus longipinnis (h)
Mugil trichodon
Myrophis punctatus (h)
Gambusia rhizophorae
Abudefduf saxatilis
Scarus guacamaia
Equetus lanceolatus
Trinectes maculatus
Prionotus tribulus
Hyporhamphus sp. (l)
Eucinostomus gula
Lophogobius cyprinoides
Lutjanus griseus
Mugil cephalus
Ahlia egmontis (h)
Ginglymostoma cirratum
Poecilia latipinna
Pomadasys crocro
Bairdiella chrysura
Sciaenops ocellata
Archosargus probatocephalus
Urolophus jamaicensis

Estuarine Fishes

Arius felis
Carcharhinus leucas
Centropomus pectinatus
Conger triporiceps
Floridichthys carpio
Dormitator maculatus
Elops saurus
Eucinostomus gula
Lophogobius cyprinoides
Mugil cephalus
Ahlia egmontis (h)
Poecilia latipinna
Cynoscion nebulosus
Achirus lineatus
Sphyraena barracuda
Bagre marinus
Centropomus ensiferus
Centropomus undecimalis
Adinia xenica
Fundulus grandis
Eleotris pisonis
Megalops atlantica
Evorthodus lyricus
Microgobius gulosus
Mugil curema
Myrophis punctatus (h)
Pristis pectinatus
Leiostomus xanthurus
Trinectes maculatus
Syngnathus scovelli
Hemicaranx amblyrhynchus (b)
Centropomus parallelus
Conger oceanicus
Cyprinodon variegatus
Rivulus marmoratus
Erotelis smaragdus
Eucinostomus argenteus
Gobiosoma robustum
Lutjanus griseus
Mugil trichodon
Gambusia affinis
Bairdiella chrysura
Sciaenops ocellata
Archosargus probatocephalus

F: TERRESTRIAL FLORA SPECIES OF BISCAYNE NATIONAL MONUMENT

Checklist of Plant Species Known to Occur in
Biscayne National Monument
Dated: March 4, 1976

Acrostichum danacaefolium	Leather Fern
Acrostichum aureum	Leather Fern
Agave decipiens	False Sisal
Alternanthera ramosissima	Chaff Flower
Amyris elemifera	Torchwood
Ardisia escallonioides	Marlberry
Argemone mexicana	Mexican poppy
Aristolochia pentandra	Birthwort vine
Atriplex arenaria	Sand atriplex
Atriplex pentandra	Crested atriplex
Avicennia nitida	Black Mangrove
Baccharis angustifolia	False Willow
Baccharis glomeruliflora	Groundsel Tree
Baccharis halimifolia	Saltbush
Batis maritima	Saltwort
Bidens pilosa	Spanish Needle
Boerhaavia diffusa	Red Spiderling
Boerhaavia erecta	Spiderling
Borrichia arborescena	Sea oxeye
Borrichia frutescens	Sea Daisies
Bougainvillea glabra	Bougainvillea
Bourreria ovata	Strongbark
Bourreria succulenta revoluta	Rough Strongbark
Bumelia celastrina	Saffron Plum
Bumelia spp.	Buckthorn
Bursera simaruba	Gumbo limbo
Caesalpinia bonduc	Yellow nickerbean
Caesalpinia crista	Grey nickerbean
Cakile spp.	Sea Rocket
Calyptranthes pallens	Pale Lidflower (Spicewood)
Canavalia maritima	Bay bean
Canella winterana	Wild Cinnamon
Capparis cynophallophora	Jamaica Caper Tree
Capparis flexuosa	Bay-leaved Caper
Capraria biflora	Capraria (Twin Flower)
Capsicum annuum	Cayenne Pepper
Carica papaya	Papaya
Cardiospermum halicacabum	Balloon Vine
Casasia clusiifolia	Seven-year Apple
Casuarina equisetifolia	Australian Pine
Catharanthus roseus	Madagascar Periwinkle
Cenchrus incertus	Sandbur grass
Cereas pentagonus	Dildoe Cactus
Chamaesyce hirta	Spurge
Chamaesyce hypericifolia	Spurge
Chamaesyce mesembryanthemifolia	Spurge
Chiococca alba	Snowberry
Chrysophyllum oliviforme	Satin Leaf

Chloris petraea	Finger grass
Citrus aurantifolia	Key Lime
Coccoloba diversifolia	Pigeon Plum
Coccoloba uvifera	Sea-Grape
Cocos nucifera	Coconut Palm
Colubrina asiatica	Colubrina
Conocarpus erecta	Buttonwood
Cordia sebestena	Geiger Tree
Cynodon dactylon	Bermuda Grass
Cyperus planifolius	Nutgrass
Dalbergia amerimnon	Dalbergia
Dicliptera assurgens	False Mint
Dipholis salicifolia	Willow Bustic
Diplanthera wrightii	Shoalgrass
Drypetes diversifolia	Milk Back
Drypetes lateriflora	Guiana Plum
Echites umbrellata	Rubber Vine
Eclipta alba	
Encyclia tampensis	
Eragrostis ciliaris	Love Grass
Eleusine indica	Yard Grass
Eugenia axillaris	White Stopper
Eugenia myrtoides	Spanish Stopper
Eugenia confusa	Red berry Stopper
ugenia rhombea	Red Stopper
ustoma exaltatum	Gentian
Eupatorium capillifolium	Fog fennel
Eupatorium odoratum	
Exostema caribaeum	Princewood
Exothea paniculata	Inkwood
Ficus aurea	Strangler Fig
Ficus citrifolia	Shortleaf (Banyan) Fig
Flaveria trinervia	
Galactia striata	Milkpea
Galactia spiciformis	Milkpea
Gouania lupuloides	Chew stick
Guaiacum sanctum	Lignum Vitae
Guettarda elliptica	Velvetseed
Guettarda scabra	Rough Velvetseed
Gymnanthes lucida	Crabwood
Heliotropium curassavicum	Seaside Heliotrope
Heliotropium angiospermum	
Herissantia crispa	Bladder Mallow
Hippocratea volubilis	Medicine Vine
Hymenocallis latifolia	Spider Lily
Ipomea alba	Moon Flowers
Ipomea acuminata	Morning Glory Vine
Ipomea tuba	Moon Vine
Ipomea pes-caprae	Railroad Vine
Iresine celosia	Bloodleaf
va imbricata	Marsh Elder

Jacquinia keyensis	Joewood
Krugiodendron ferreum	Black Ironwood
Laguncularia racemosa	White Mangrove
Lantana involucrata	Lantanas
Lepidium virginicum	Pepper grass
Lippia nodiflora	Capeweed
Lippia stoedchadifolia	Tall capeweed
Limonium carolinianum	Sea Lavender
Lycium carolinianum	Christmas Berry
Lysiloma bahamensis	Wild Tamarind
Manilkara zapota	Sapodilla
Manilkara bahamensis	Wild Dilly
Mastichodendron foetidissimum	Wild Mastic
Melanthera aspera	
Melothria crassifolia	Creeping Cucumber
Metopium toxiferum	Poisonwood
Mikania batatifolia	Hemp Vine
Mikania cordifolia	Climbing Hempwood
Monanthochloe litteralis	Key Grass
Morinda royoc	Indian Mulberry
Nectandra coriacea	Lancewood
Nerium oleander	Oleander
Paspalum ciliatifolium	Paspalum Grass
Paspalum notatum	Bahia Grass
Passiflora suberosa	Passionflower
Phoenix dactylifera	Date Palm
Piscidia piscipula	Jamaica Dogwood
Pisonia aculeata	Devil's Claw
Pithecellobium keyense	Blackbead
Pithecellobium unguis - cat	Cat Claw
Pluchea odorata	Marsh Fleabane
Poinsettia cyathophora	Poinsettia
Poinsettia heterophylla	Painted Leaf
Polypodium polypodioides	Resurrection Fern
Portulaca oleracea	Purslane
Portulaca pilosa	Pink Purslane
Prunus myrtifolia	Laurel Cherry
Pseudophoenix sargentii	Sargent's Palm
Psychotria undata	Wild coffee
Randia aculeata	White Indigo Berry
Reynosia septentrionalis	Darling Plum
Rhabdadenia biflora	Rubber Vine
Rhizophora mangle	Red Mangrove
Rivina humilis	Bloodberry
Salicornia bigelovii	Annual glasswort
Salicornia perennis	Perennial glasswort
Sansevieria thyrsiflora	Bowstring Hemp
Sapindus saponaria	Soapberry
Sarcostemma clausa	White Vine
Sesuvium portulacastrum	Sea Purslane

Setaria spp.	Foxtail Grasses
Sida acuta	
Simarouba glauca	Paradise Tree
Smilax auriculata	Greenbrier
Solanum bahamense	Bahamian Nightshade
Solanum erianthum	Potato Tree
Spartina spartinae	Cord grass
Sporobolus virginicus	Dropseed grass
Stachytarpheta jamaicensis	Blue Porterweed
Suaeda linearis	Sea Blite (Dondia)
Suriana maritima	Bay Cedar
Swietenia mahogoni	Mahogany
Syringadium filiformis	Manatee Grass
Thalassia testudinum	Turtle Grass
Thespesia populnea	Seaside Mahoe
Thrinax microcarpa	Key thatch Palm
Thrinax parviflora	Jamaica Thatch Palm
Tillandsia circinnata	
Tillandsia fasciculata	
Tillandsia flexuosa	Twisted Air Plant
Tillandsia recurvata	Ball Moss
Tillandsia usneoides	Spanish Moss
Tillandsia urtriculata	Giant air Plant
Torrubia discolor	Blolly
Tournefortia gnaphalodes	Sea Lavender
Tournefortia volubilis	
Urechites lutea	Wild Allamanda
Vallesia antillana	
Vitis rotundifolia	Muscadine Grape
Waltheria indica	Waltheria
Wedelia trilobata	
Ximenia americana	Tallow Wood
Zanthoxylum fagara	Prickly Lime Ash

G: SPECIES CHECKLIST OF MAMMALS, AMPHIBIANS, REPTILES, AND BIRDS OF BISCAYNE NATIONAL MONUMENT

MAMMALS

Known to occur:

Marsh Rabbit (Sylvilagus palustris)
Hispid Cotton Rat (Sigmodon hispidus)
Raccoon (Procyan lotor)
*Mexican Red-bellied Squirrel (Sciurus aureogaster)
Black Rat (Roof Rat) (Rattus rattus)

Manatee (Trichechus manatus)
Bottle Nose Dolphin (Tursiops truncatus) and others
Whales

Possibly occur (Known from adjacent Keys or coastal mainland):

Oppossum (Didelphis virginiana)
Least Shrew (Cryptotis parva)
Seminole Bat (Lasiurus semindus)
Brazilian Free-tailed Bat (Tadarida brasiliensis)
Mastiff Bat (Eumops glaucinus)
Gray Squirrel (Sciurus carolinensis)
Southern Flying Squirrel (Glaucomys volans)
Cotton Mouse (Peromyscus gossypinus)
House Mouse (Mus musculus)
Key Largo Woodrat (Neotoma floridana smalli)
Gray Fox (Urocyon cinereoargentatus)
Black Bear (Ursus americanus)
Striped skumk (Mephitis mephitis)
River Otter (Lutra canadensis)
Bobcat (Lynx rufus)
White tailed Deer (Odocoileus virginianus)

*Exotic Species introduced by man

AMPHIBIANS AND REPTILES

Known to occur:

Greenhouse frog (Eleutherodactylus ricordi planirostris)
Green treefrog (Hyla cinerea)
Reef Gecko (Sphaerodactylus notatus)
Green Anole (Anolis carolinensis)
*Giant Cuban Anole (Anolis equestris equestris)
Atlantic Loggerhead turtle (Caretta caretta)
Hawksbill turtle (Eretmochelys imbricata)
Green turtle (Chelonia mydas)
Atlantic leatherback turtle (Dermochelys coriacea)
Athentic Ridley turtle (Lepidochelys kempii)
Everglades Racer (Coluber constrictor paludicola)
Eastern Indigo snake (Drymarchon corais couperi)
Yellow rat snake (Elaphe obsoleta quadrivittata)
Eastern Diamondback rattlesnake (Crotalus adamanteus)

Possibly occur (known from adjacent Keys or coastal mainland):

Cuban treefrog (Hyla septentrionalis)
Squirrel treefrog (Hyla squirella)
Eastern Narrow-mouthed toad (Gastrophyrne carolinensis)
Striped Mud turtle (Kinosternon bauri palmarum)
Florida Box turtle (Terrapene carolina bauri)
Diamondback terrapin (Malaclemys terrapin rhizopherarum)
American crocodile (Crocodylus acutus)
Cuban brown anole (Anolis sagrei)
Six-lined Racerunner (Cnemidophorus sexlineatus)
Ground Skink (Lygosoma laterale)
Striped Red-tailed Skink (Eumeces egregious)
Southeastern Five-lined Skink (Eumeces inexpectatus)
Southern Ringneck snake (Diadophis punctatus)
Eastern Hosnose snake (Heterodon platyrhinos)
Rough Green snake (Opheodrys aestivus)
Corn snake (Elaphe guttata)
Florida crowned snake (Tantilla coronata wagneri)
Mangrove Water snake (Natrix sipedon compressicauda)
Eastern Coral snake (Micrurus fulvius)

*Exotic Species introduced by man

...own to occur:

Species	Comments
Common Loon	rare
Horned Grebe	uncommon
Pied-billed Grebe	stray from mainland
Brown Pelican	common winter (may nest)
White Pelican	Rare stray from FLa. Bay
Brown Booby	Rare Pelagic wanderer
Blue-footed Booby	Rare Pelagic wanderer
*Double-crested Cormorant	common
Anhinga	rare stray from mainland
Magnificent Frigatebird	common summer
*Great White Heron	common
*Great Blue Heron	common
Green Heron	uncommon
*Little Blue Heron	common
*Cattle Egret	common Arsenicker Keys
*Reddish Egret	uncommon
*Great (American) Egret	common
Snowy Egret	uncommon
*Lousiana Heron	common
Black Crown Night Heron	fairly common
Yellow Crown Night Heron	fairly common
ɔd Stork	rare stray from mainland
white Ibis	common summer
Roseate Spoonbill	rare stray from Fla. Bay
Lesser Scaup	uncommon winter
Red-breasted Merganser	common winter
Turkey Vulture	common
Black Vulture	common
Swallow-tailed Kite	rare stray
Sharp-shinned Hawk	winter migrant
Cooper's Hawk	rare winter migrant
Red-tailed Hawk	rare winter migrant
Red Shouldered Hawk	uncommon
Broad-winged Hawk	rare
Short-tailed Hawk	rare
*Bald Eagle	rare
Marsh Hawk	fairly common
Osprey	fairly common (may nest)
Pigeon Hawk	fairly common winter
Sparrow Hawk	common winter
Clapper Rail	uncommon
American Coot	occassional stray from mainland
Semipalmated Plover	fairly common winter
Wilson's Plover	fairly common
Killdeer	uncommon strays
Black-billied Plover	fairly common winter
Ruddy Turnstone	uncommon

Species	Comments
Sanderling	fairly common
Willet	uncommon
Least Sandpiper	common winter
Dunlin	common winter
Short-billed Dowitcher	uncommon winter
Western Sandpiper	uncommon spring
Herring Gull	common winter
Ring-billed Gull	common winter
Laughing Gull	common winter
Bonaparte Gull	uncommon winter
Forster's Tern	fairly common
Least Tern	common
Royal Tern	fairly common
Common Tern	fairly common
Caspian Tern	common winter
Black Skimmer	fairly common winter
White-crown Pigeon	common (may nest)
Ground Dove	uncommon on islands
Mangrove Cuckoo	rare (may nest)
Yellow-billed cuckoo	uncommon
Screech Owl	fairly common
Chuck-will's widow	strays from mainland
Belted Kingfisher	common winter
Yellow-shafted Flicker	uncommon
Red-bellied Woodpecker	fairly common
Eastern Kingbird	fall migrant
Gray Kingbird	uncommon
Great Crested Flycatcher	fairly common
Common Crow	occassionally seen
*Mockingbird	common
*Catbird	common
Robin	fairly common
Blue-gray Gnatcatcher	common winter
White-eyed Vireo	occasionally seen
Black-whiskered Vireo	fairly common summer
Black and white Warbler	occasionally seen
Yellow Warbler	occasionally seen
Prairie Warbler	fairly common
Palm Warbler	common winter
Yellow-throat	common
American Redstart	common winter transient
House Sparrow	occasionally seen
Bobolink	common transient
*Red-winged Blackbird	common
Boat-tailed Grackle	fairly common
Cardinal	common

*Birds known to nest within the Monument

Additional Species likely to occur:

Red-throated Loon
Red-necked Grebe
Sooty Shearwater
Gannet
Glossy Ibis
White-faced Ibis
Scarlet Ibis
American Flamingo
Canada Goose
Brant
Mottled Duck
Gadwall
Pintail
Green-winged Teal
Blue-winged Teal
American Widgeon
Shoveler
Wood Duck
Greater Scaup
Ruddy Duck
Swainson's Hawk
Rough-legged Hawk
Peregrine Falcon
Gora Rail
Common Gallinule
Piping Plover
Snowy Plover
Whimbrel
Spotted Sandpiper
Solitary Sandpiper
Greater Yellowlegs
Long-billed Dowitcher
Stilt Sandpiper
Semipalmated Sandpiper
American Avocet
Black-necked Stilt
Franklin's Gull
Gull-billed Tern
Roseate Tern
Sooty Tern
Sandwich Tern
White-winged Dove
Mourning Dove
Smooth-billed Ani
Barn Owl
Barred Owl
Whip-poor-will

Additional Species likely to occur:

Common Nighthawk
Ruby-throated Hummingbird
Pileated Woodpecker
Yellow-bellied Sapsucker
Western Kingbird
Scissor-tailed Flycatcher
Eastern Phoebe
Least Flycatcher
Tree Swallow
Barn Swallow
Cliff Swallow
Purple Martin
Blue Jay
Fish Crow
House Wren
Brown Thrasher
Hermit Thrush
Swainson's Thrush
Gray-cheeked Thrush
Ruby-crowned Kinglet
Cedar Waxwing
Loggerhead Shrike
Starling
Bahama Honeycreeper
Yellow-throated Vireo
Solitary Vireo
Red-eyed Vireo
Orange-crowned Warbler
Parula Warbler
Black-throated Blue Warbler
Black-throated Green Warbler
Yellow-throated Warbler
Blackpoll Warbler
Cuban Golden Warbler
Ovenbird
Northern Waterthrush
Louisiana Waterthrush
Yellow-breasted Chat
Eastern Meadowlark
Yellow-headed Blackbird
Spotted-breasted Oriole
Baltimore Oriole
Common Grackle
Rose-breasted Grosbeak
Blue Grosbeak
Indigo Bunting
Painted Bunting
American Goldfinch
Rufous-sided Towhee
Savannah Sparrow
Sharp-tailed Sparrow
Chipping Sparrow
White-crowned Sparrow
Swamp Sparrow

H: NATIONAL PARK SERVICE LAND MANAGEMENT ZONE GUIDELINES

(from Management Policies, U.S. Department of the Interior, National Park Service, 1978, pp. II-3 through II-4)

[c o p y]

MANAGEMENT ZONES

Park lands shall be zoned to designate where various strategies for management and use will best fulfill management objectives and achieve the purpose of the park. Such management zoning must be developed in consideration of capability of the land to support identified uses.

Four primary management zones will be recognized - natural, historic, park development and special use. Within this framework, subzones may be designated for any park where desirable to indicate in greater detail how the land or water will be managed. Management zoning (formerly termed ''land classification'') in existing plans shall remain valid until revised or superseded.

Natural Zone - Lands and waters in this zone will be managed to ensure that natural resources and processes remain largely unaltered by human activity. Developments will either be absent or limited to dispersed recreational and management facilities, such as picnic areas, interpretive displays, and small maintenance stations that are essential for management, use, and appreciation of natural resources.

Historic Zone - This zone includes all lands managed primarily to preserve cultural resources or to commemorate historical subjects. In most cases, lands on or eligible for the National Register of Historic Places will be zoned historic and shall not be rezoned without compliance with the Procedures for the Protection of Historic and Cultural Properties promulgated by the Advisory Council on Historic Preservation (36 C.F.R. Pt. 800). Certain lands not meeting the criteria for listing on the National Register, including local cemeteries and other minor historic sites worthy of protection and interpretation, may also be zoned historic.

Physical development in historic zones shall be the minimum needed for preservation and interpretation of cultural values. Activities in historic zones generally shall be limited to sightseeing and study of the cultural features. However, this limitation shall not preclude or discourage appropriate adaptive use of historic structures for utilitarian purposes or other uses permitted in these policies.

Park Development Zone - Lands in this zone will be managed to support nonhistoric park development and intensive public use which substantially alter the natural environment. Parking lots, public use roads, aggregations of buildings, and park utilities will be included in this zone. Developments permitted on other zones do not constitute a development zone. Development zones shall be restricted to the smallest area necessary to accommodate required major development and intensive use. New development zones will be designated only after considering alternative sites (including locations outside the park) and alternative levels of use, facilities, and services.

Special Use Zone - This zone includes lands and waters to be used by other agencies or interests for purposes not permitted in natural, historic, or development zones. Examples include reservoirs, private development, non-Federal open space, and areas supporting or proposed for mining, ranching, and lumbering.

[e n d c o p y]

I: RESPONSE FROM FLORIDA HISTORIC PRESERVATION OFFICER

Department of Administration

Division of State Planning

660 Apalachee Parkway - IBM Building

TALLAHASSEE

32304

(904) 488-1115

Reubin O'D. Askew
GOVERNOR

R. G. Whittle, Jr.
STATE PLANNING DIRECTOR

Wallace W. Henderson
SECRETARY OF ADMINISTRATION

February 7, 1978

Mr. James L. Bainbridge, Acting
Regional Director
Southeastern Region
National Park Service
1895 Phoenix Blvd.
Atlanta, Georgia 30349

Dear Mr. Bainbridge:

In reference to our February 2, 1978, letter of response to your General Management Plan and DEIS Biscayne National Monument Dade County, Florida SAI 78-1002E, we hereby transmit for additional consideration review comments by the Department of State.

We appreciate the opportunity to submit these additional comments and request that they be considered as part of our earlier response.

Sincerely,

R. G. Whittle, Jr.
Director

RGWjr/WOK/ba

Attachment

cc: Mr. L. Ross Morrell

STATE OF FLORIDA
Department of State
THE CAPITOL
TALLAHASSEE 32304

BRUCE A. SMATHERS
SECRETARY OF STATE

January 23, 1978

L. Ross Morrell,
Acting Director
DIVISION OF ARCHIVES, HISTORY, AND
RECORDS MANAGEMENT
(904) 488-1480

IN REPLY REFER TO:

Mr. Loring Lovell, Chief
Bureau of Intergovernmental Relations
Division of State Planning
660 Apalachee Parkway
Tallahassee, Florida 32304

Re: SAI 78-1002E
General Management Plan and DEIS
Biscayne National Monument
Dade County, Florida

Dear Mr. Lovell:

In accordance with the procedures contained in 36 C.F.R., Part 800 ("Procedures for the Protection of Historic and Cultural Properties"), we have reviewed the above referenced project for possible impact to archaeological and historical sites or properties listed, or eligible for listing, in the National Register of Historic Places. The authorities for these procedures are the National Historic Preservation Act of 1966 (Public Law 89-665) as amended by P.L. 91-243, P.L. 93-54, P.L. 94-422, and P.L. 94-458, and Presidential Executive Order 11593 ("Protection and Enhancement of the Cultural Environment").

It is the opinion of this office that the proposed management plan will have no adverse impacts on any properties listed, or eligible for listing, in the National Register of Historic Places if the following measures are taken as described in the documents:

1) During all construction involving subsurface disturbance, a professional archaeologist with the authority to stop construction should be present to observe work.

2) The large-unit historic zone alternative is utilized for the coral reef area. This would avoid drawing attention to individual wreck sites and facilitate other protective measures.

3) Strict enforcement of existing Park Service policies and legislation against the looting of historic sites.

4) Significant wreck sites should be monitored to determine if access to the historic zone leads to damage to the wrecks and if additional protective measures are necessary.

With these measures, we feel that the proposed management plan would involve no adverse impacts to any historic resources and, through education of the public, might even be beneficial to sites not afforded the protection of inclusion in a national monument.

The opportunity to comment is appreciated.

Sincerely,

L. Ross Morrell,
Deputy State Historic
Preservation Officer

LRM:Seh

J: ANALYSIS OF RESOURCE-USE ACTIVITIES IN BISCAYNE NATIONAL MONUMENT

The following sections from the Biscayne National Monument Environmental Assessment (USDI, NPS 1976) are a basic qualitative informational review of the status, characteristics, and environmental impact of various resource-use activities summarized in table 2 of the Description of the Proposal section. The factual data in this summary are derived principally from Voss 1969 and from observations by monument staff from 1970 through 1977. Prior to 1977, no specific catch or activity data were available for the specific area of the seashore. Recently, however, the management biologist has been able to collect some basic data, summarized in the Commercial Fishing Activity table included in this appendix.

1. Commercial Fishing

a. Hook and Line Finfishing. Little commercial hook and line fishing is done within monument waters. Only 5 to 6 men occasionally have been contacted, and no estimates of catch have been obtained. The technique used typically is a long (¼ mile), horizontally anchored line with some 200 separately baited hooks. The line is fished only 3 or 4 hours, not overnight. No trolling is done. Species taken include grouper, snapper, grunt, and yellowtail jack. The activity is exclusively done east of the keys and poses no particular physical threat to the habitat (i.e., to the reefs or grass beds). Should such techniques become more extensively used, the impact of such fishing on population numbers of target species would have to be assessed. If the targets were territorial reef species, there is the likelihood that natural population dynamics (especially size distribution, territory size, population numbers) would be altered. However, hook and line fishing, because of its nonspecificity, would have less obvious impact (e.g., on size) than highly selective pressures like spearfishing. With non-reef species as targets (e.g., pelagic sharks or transient schooling fishes), the impact of hook and line fishing would be even less obvious.

b. Baitfishing. Commercial activities for catching bait for later use or for sale to recreational fishermen are common in the bay waters of the monument. Principal targets are live shrimp (Penaeus duoarum and P. brasiliensis), which are fished in the shallow bay waters using trawl nets equipped with bottom rollers, as required by Florida law. The fishing technique itself is said to have no long-term adverse effects on benthic flora and fauna (a result of the required rollers), but this is not specifically documented for south Biscayne Bay (Voss 1969). No adequate figures exist for the catch and catch per unit effort of bait shrimp within the monument itself, but for Dade County as a whole, 1973 statistics show 32,470 pounds of dead shrimp and 22,132,250 live individuals landed with a total value of $664,667.

Other animal species (e.g., sea horses, tropical fishes, juvenile lobsters) are commonly brought up in baitshrimper nets, but fishermen are required to release them back into the bay. Observations by monument staff indicate good compliance with this requirement and good survival of the released organisms.

Commercial fishing for mullet using gill nets is common in Biscayne Bay north of the monument, but at least recently has not been pursued actively within monument waters. The technique involves searching for feeding schools and then deploying the net around or through the school. The technique avoids long gill-net sets (which would tend to impact non-target species) and is quite specific to mullet. The gill nets are not aggressively dragged across the bay bottom and therefore do not cause much benthic disruption. The feeding schools of mullet are responsible for much working over of bottom sediments, as evidenced by the turbid water by which schools are located.

c. Stone Crab Trapping. Stone crab (Menippe mercenaria), and to a lesser extent blue crab (Callinectes sapidus), are commonly fished by trapping in the bay waters of the monument. A commercial license is required to set stone crab traps, but not for blue crab trapping. Current Florida law requires that only the claws of stone crabs may be taken, meaning that claws are removed in the field, with the living clawless crab being released in the capture area. There is some debate over the significance of this management strategy, since a fairly high mortality results either when the claws are removed, shortly after due to shock, or indirectly due to later inability to properly feed. Although the claws eventually regrow, the entire behavior (feeding, territorial, sexual) of a clawless crab may be radically different, and the long-term impact on stone crab population dynamics is not well known. The use of the traps themselves has no obvious physical impacts on the benthic habitat, and the fishing vessel does not typically have to set anchors during operation.

Blue crab trapping, in which the whole animal is taken without limit, is less common at commercial levels than stone crab trapping. Since no commercial license is required to set traps for blue crabs - the traps are physically different from stone crab traps - the blue crab fishery is primarily an individual, private effort.

d. Spiny Lobster Fishing. Spiny lobster, Panulirus argus, is extensively trapped in areas of the bay where adult lobster habitat (i.e., shelter) is found, and more commonly offshore over the bottom and adjacent to the reefs. Minimum size and season closure are stipulated by Florida law.

The single season estimate in the following table is nearly 120,000 pounds (50,000 kg), which is only a few percent of the total catch reported in Dade County.

SUMMARY OF COMMERCIAL FISHING ACTIVITY WITHIN MONUMENT WATERS, 1976-1977

Activity	Techniques Used	Number of Fishermen	Amount of Harvest	Period of Harvest
Baitshrimping	nets	14	3.5 million shrimp (21,650 kg)	CY 1976
Ballyhood for bait	nets	2	1.6 million fish (156,740 kg)	CY 1976
Hook and line	multiple hooks on long line	5-6	N.A. - small	CY 1976
Mullet	nets	0-1	N.A. - very small	CY 1976
Spiny lobster	trapping	52	- - - - (49,450 kg)	1976-77 season
Stonecrab	trapping	17	- - - - (2,250 kg)	1976-77 season
Sponge	hooking	7	44,000 sponges (1,060 kg)	CY 1976

Source: Management Biologist Surveys, Biscayne National Monument.

Management practices and conservation in Florida's spiny lobster fishery are the subject of intensive research activities by Florida fish and wildlife personnel, National Park Service park biologists, and a variety of universities. There are two critical areas of the lobster fishery that relate to the monument: the actual take of legal-sized lobsters from the monument; and the function of the inshore bay as nursery and juvenile habitat.

(1) Fishery. Actual lobster fishing pressure on offshore monument waters is not known. However, the general debate over fishing techniques and what constitutes an appropriate legal minimum size is pertinent. If minimum legal size is set too low, individuals will be taken prior to sexual maturity, and the annual production of additional young lobsters will be affected. However, since lobsters produce large numbers of eggs which hatch into planktonic (i.e., floating) larvae that may not "settle out" for 3 to 6 months, the result of lowered egg production by females in one given area may have little effect on that particular area. That is, the lobsters settling out and growing to maturity in monument waters may actually have been spawned hundreds of miles away (the southern Florida Keys, Cuba, or the Bahamas). Research has not yet established which, if any, geographical areas are most important in providing larvae for the various important lobstering grounds in Florida, including the area off Biscayne Bay. Unless or until really critical production areas are identified, it is obvious that lobster fishery management must have very broad geographical extent, probably even international, in order to assure that all areas continue to receive adequate annual influxes of larvae.

At the present time it is not known if adult lobsters in monument waters play a critical role in providing larvae to the monument or to adjacent fishing grounds. Therefore, in terms of sustaining the lobster population of the monument itself, it is not yet known whether continued commercial lobstering in the monument has any direct adverse effects on recruitment into monument populations. However, it is well known that the size distribution of an exploited population will be kept predominantly concentrated near the minimum legal size, with relatively fewer large individuals in the local monument population. This is, of course, not a natural situation, and it may well affect the total breeding or genetic potential of the population by removing the larger adults that would ordinarily be the most successful breeders. These large individuals are also the most successful predators on the common food species, including the largest mollusks. The magnitude and significance of this impact is not yet well known.

Although a commercial trap fishery for lobsters does not have the specific traumatizing effects of a sport-diving fishery (see later), the maintenance of smaller populations of small-sized individuals makes simple observation by skin- or scuba-diving visitors much more difficult.

The closure of lobster fishing to U.S. fishermen in the Bahamas in 1975 may have a substantial impact on lobster fishing in Biscayne Bay. Some 20 to 30 U.S. lobstering boats ordinarily fishing the Bahamas have been added to the Florida fleet, and it appears that a large proportion of these boats will attempt to join in the exploitation of Biscayne Bay and adjacent reef tract lobster populations. This influx of lobster boats may indirectly create higher pressures on other allowed species (e.g., sponges) as the lobstermen seek other incomes during closed lobster seasons or seek to augment income from an over-exploited lobster fishery.

(2) Habitat. The second aspect of the monument's importance in the lobster fishery is the use of the inshore bay waters as juvenile habitat. The large expanse of turtle grass/ algae beds in the bay, the sheltered habitat provided by the mangrove-fringed keys, and the rubble or patch reef bottom provides for an extremely important part of the lobster's early life cycle. Conserving this habitat, and therefore perpetuating the annual supply (''recruitment'') of juveniles into breeding-age adults (minimum legal-sized individuals) is an extremely important contribution to the lobster fishery both inside and outside the monument.

The commercial lobster fishing is generally done in areas where juveniles are not located, and in any event, in a legal operation subadult individuals will be returned from the traps. The problem then is not so much direct removal of juveniles as indirect mortality due to degrading water quality or habitat destruction through channel dredging or shoreline alteration outside the monument. Since the turtle grass beds shelter the principal food items of juvenile lobsters (some algae and small mollusks), the general health of these beds is also important. It is possible, but only speculative, that boat traffic, anchorage in the bay, trawling for shrimp, or even gill-net setting for mullet could adversely affect the benthic environment of the bay and therefore the juvenile lobster carrying capacity. (See Sport Fishing.)

e. Sponge Fishing. Sponging, principally for grass (Spongia graminea), sheepswool (Hippiospongia lachne), and yellow (Spongia barbara) sponges is a common resource use in the monument. This is usually done by hooking with a long-handled sponge rake with or without the aid of a glass-bottomed bucket. Florida law requires a minimum sponge size of 5 inches in diameter. The hooking technique appears to be quite selective, and experienced fishermen do not often hook up other organisms or undersized sponges. A certain mortality of attached or commensal invertebrate animals - worms, amphipods, gastropods - is unavoidable.

No statistics exist to determine historic changes in the frequency of sponging, but local park staff impressions are that significant increases have taken place over the past 3 or 4 years. The increases due to closure of the Bahama lobster fishery may be significant in the 1975-1976 season, especially during the March-August period when lobstering is closed and those fishermen turn to sponging.

f. Conch Fishing. Fishing for pink or queen conch (Strombas gigas) is allowed by Florida law and does occur on the reef tract and offshore grass beds.

g. Aquarium Fish Collecting. Commercial collection of tropical reef fishes for aquarium sale is now prohibited in monument waters under the general authority of the superintendent. This practice, which involves such techniques as selective hand capture (''slurp guns''), anesthetics, and extremely destructive removal of chunks of live coral to expose sheltered dens, continues in some areas of the reef tract not protected by state or federal park regulation. The favored targets of such commercial collection (and of private collectors - see below) are predominantly juvenile specimens and adults of the smallest, most colorful reef fishes (see Voss 1969 for species list). These species are precisely those which constitute the principal viewing attraction for non-collecting, skin-diving visitors to the monument's reefs.

Selective removal of juveniles prevents those fish from ever breeding. Removal of small adult reef fishes, which are often strongly territorial, has substantial effects on the remaining population, which then must rebalance itself with new territories and new dominance relationships (see Spearfishing).

h. Turtle Fishing. Turtle fishing, which used to occur in waters now included in the monument, is currently prohibited by various state and/or federal laws. There is little, if any, appropriate sandy-beach nesting habitat in the monument, so turtles were probably caught here only by net or harpoon. Green turtles (Chelonia mydas) are no longer seen in this area; the hawksbill (Eretmochelys imbricata), seen regularly, is protected by virtue of its official endangered status. The loggerhead (Caretta caretta) is also seen in monument waters offshore; this species, like the green turtle, is under consideration for the official status of "threatened" by the Department of the Interior.

i. Shell and Coral Collecting. Commercial shell and coral collecting, earlier practices in this area, are not permitted by general National Park Service regulation (CFR Title 36) and are not considered specifically allowable under the enabling legislation's continuance of commercial fishing. Commercial collection, which may involve such devastating methods as dredging or breaking apart living coral rock, is clearly contrary to the mandate to provide for long-term conservation of the natural habitat in the monument. Likewise, collection of live coral involves physical destruction of the reef and, frequently, the impact is much more serious than simple removal of a particular branch or specimen. The freshly exposed remaining coral is often subject to severe attack by encroaching algae or various pathogens, leading to the eventual destruction of whole colonies. This danger, coupled with the slow growth rates of most corals, makes commercial harvest of coral extremely destructive and short-sighted.

2. Sport Fishing

a. Hook and Line Finfishing. Hook and line finfishing for private recreation and consumption is extensive throughout the monument. A large proportion of the motorboat traffic within monument waters on weekends or other common vacation days is involved with this activity. The principal fish species taken, at least in some adjacent areas where studies have been done, have already been presented (see Species of Economic Importance). Relatively little line fishing from the shore is practiced since there are few points of public access (piers) through the mangrove fringe of the monument's keys. Target species of the serious motorboat fishermen are often the more aggressive or fighting game fish such as barracuda, various jacks, and bonefish. Some

fishing goes on for a variety of reef fishes (various snappers apparently being the most commonly taken).

The current intensity, and the relatively non-selective nature of line fishing where the largest and most dominant or aggressive are not necessarily singled out, appears not to be causing serious depletions in population numbers or seriously affecting dynamics of the target species. This is, however, a very general observation and has not been documented for the monument either by specific counts of fishes removed or by studies of the populations under hook and line pressure.

Potential problems include the special preference of fishermen for the more aggressive, less abundant, top-of-the-web predatory fishes, which may have unexpected results on elements lower down in the food pyramid. Also, it turns out that such top predators tend to have greater concentrations of environmental pollutants (e.g., pesticide residues) or of the serious fish poison ciguatera in their tissues, making their consumption as human food less desirable. Removal of reef fishes tends to cause considerable short-term reshuffling of territories and dominance (see Spearfishing). At the present time, there are virtually no data on fish or fishermen on which to base a management strategy – closed seasons, minimum sizes, bag limits, protected species – differing from Florida law.

Indirect impacts of sport fishing of all types derive from the use of motorboats as transportation (see Boating).

b. Spearfishing. Spearfishing has been and continues to be permitted within monument waters, regulated by Florida law. To date, no specific constraints on this activity have been imposed by National Park Service special regulations. Spearfishing is not allowed within John Pennekamp Coral Reef State Park nor within the newly established marine sanctuary to the south of the monument.

Spearfishing, whether using a fixed hand-held spear or various projectile devices, is an extremely efficient and selective fishing technique when coupled with the mobility of a diver equipped with scuba gear (as allowed by Florida law). Certain target species – predominantly the largest of the reef fishes or the large, swift pelagic predators like sharks, barracuda, and some jacks – are sought out for the excitement, prestige, and danger of their capture. In an area just opened to spearfishing, these individuals will be removed first, and quite rapidly, since there are relatively few extraordinarily large specimens of a given species on a natural reef. Under continued spearfishing pressure, the next smaller individuals will become the favored catch, and so on until the usual targets can become virtually

any fish large enough or conspicuous enough (by color particularly) to be noticed. In the early stages of exploitation, the behavior of fish is relatively unaffected by the presence of a diver with or without a spear, and this favors easy spearing success. Success is also favored, in some instances, by the strong territorial defense behavior of reef fishes; an individual will often stay on its territory, allowing the spearfisherman to approach to point-blank range. In later stages of spearfishing pressure, the fishes become much more wary of divers and move away quickly in their presence.

Therefore spearfishing has two major effects: It removes the largest, most conspicuous fishes (often the ones most sought by non-spearing divers for observation and photography), which by virtue of size and dominance were probably the most successful breeders on the reef; and the remaining fishes become wary of any diver and quickly move out of spear (or even visual) range. The end result of both these impacts is reef fish populations with a predominance of the small, less conspicuous species, plus juvenile or subadult specimens of the larger target species. The behavior of these fishes is wary and secretive. The impact of this artificially imposed population or community structure on total reef dynamics and productivity is largely unknown. Less obvious effects are felt on the migratory or pelagic species, since different individuals are typically entering the area at all times.

The situation described above has been observed in many parts of the world where spearfishing is uncontrolled. It is most graphic where protected and exploited areas are relatively close to each other (e.g., the protected waters off the island of Bonaire contrasted with those off nearby Curacao, Netherlands Antilles). Experienced observers in the Florida Keys report dramatic differences in the fish size and behavior between Pennekamp waters and unprotected waters, including those in Biscayne National Monument.

c. Blue Crab Trapping. The impact of blue crab trapping by private individuals is not known. The trapping technique itself is not destructive to the habitat, and aside from the hazard of a buoyed trap to boaters, there appears to be no other direct physical impact on monument visitors or resource use.

d. Lobster Fishing. In general, spiny lobster fishing by private, individual divers may have a number of consequences. These consequences have not specifically been demonstrated for Biscayne waters, but recent work by National Park Service biologists in Fort Jefferson National Monument is quite pertinent (USDI, NPS 1975a). Programs designed to test for similar results in monument waters are needed.

Comments already made regarding lobster life history and commercial lobstering management (see Commercial Fishing section) are appropriate to this discussion. A major difference between trapping and diving techniques is that the diver seeks out lobsters during their quiet daytime period in sheltered dens, whereas the trap passively catches nocturnal individuals wandering on their feeding grounds. The diver selects the largest specimens to pursue, since it is difficult to quickly judge which of a group will prove to be of legal size. In this process, all the occupants of a given den (perhaps 5 to 7 or more in unpressured populations) are severely stressed, some to the extent of losing various appendages critical to defense or feeding. In some cases, the diver can take several, even all, occupants of the den (the bag limit being 12 per person per day, or 24 per boat). More often, uncaught individuals go much deeper into the den, or immediately disperse to other areas. The delayed reaction is to later disperse from that den to other, in many cases less favorable, dens. Such marginal dens provide less protection from predators and may be located at greater distances from feeding areas, requiring greater daily exposure to predators. In areas at Fort Jefferson where heavy pressure by sport divers was permitted experimentally, the lobsters did in fact quickly disperse, so that the average number per den dropped significantly. The overall result of this sport-diver pressure is quick reduction in the population numbers and average size. But in addition, the remaining lobsters are more widely dispersed in marginally protective dens. This makes it more difficult for the snorkeler or nonconsuming diver, who is observing or photographing the reef, to locate lobsters during the limited time available.

There is also some evidence that where areas are protected from sport and commercial lobstering, populations build rapidly to the extent that competition forces adult lobsters to move out into surrounding waters where space is available; here numbers are depleted by allowed fishing. This is the classic picture of a protected "seed-bed" providing recruits to a surrounding fishery. It is not that the protected area provides more eggs and larvae, but rather that it provides adults and near-adults directly into the fishermen's traps. This particular theoretical situation has not yet been demonstrated for Biscayne National Monument.

3. Boating

a. Motorboating. The extensive use of motorboats either for their direct recreational value or as transportation in the full range of commercial or sport fishing activities has a variety of consequences to monument resources.

Direct bottom disturbance occurs when power boats pass through overly shallow water, especially turtle grass areas. These bottom scars are aesthetically intrusive when viewed from above; more importantly, they may be extremely long-lived and even self-perpetuating. Their actual biological impact is not well understood, but an extreme situation can be envisioned, such as providing barriers to the movement of the fauna associated with the grass bed, opening up faster circulation into previously poorly flushed areas, or providing sources of easily disturbed fine sediment that may smother adjacent biota. To minimize such bottom scarring, visitor information programs must reach the boating population to inform them of the environmental consequences of this poor boating practice. Certain susceptible areas might have to be marked for avoidance, or even closed to motorboat traffic altogether (e.g., entrances to Old Rhodes Lagoon). What makes gaining the cooperation of boat operators so difficult is the fact that the operators can be relatively confident they are not causing permanent or expensive damage to their boats when they are operating over the generally soft, rock-free, turtle grass bottom.

Direct anchor damage in coral reef areas can be one of the dominant visitor impacts in a marine park area. Although most boaters will not choose to anchor directly on a reef (since it is often too shallow), they will typically go to the edge to anchor. If not done carefully, the anchor may lodge in living coral at the reef edge, or if not, the anchor chain will sweep across the reef causing extensive damage. Inexperienced boat handlers who do not pay out a sufficient length of anchor line and/or do not insure that the anchor is firmly set at the outset, may find their boat drifting and the anchor dragging until swaths of delicate coral have been damaged. As noted earlier, coral damage in areas of marginal or degrading water quality is especially grave, since algae infestation and subsequent spread to undamaged colonies is quite likely. Anchor damage in other habitat – especially turtle grass – does not appear to be a substantial problem since a properly set anchor does not cause much actual root breakage, and a dragging anchor does not generally cause a furrow.

Anchor damage in reef areas has been shown to be most severe adjacent to favored viewing reefs and/or those identified as nature trails or otherwise interpreted (USDI, NPS 1974a). For this reason, permanent anchor buoys may be required, along with visitor information cautioning boaters about the problem and suggesting the best anchor methods in unbuoyed zones. (An anchor should be set with adequate scope immediately down-current of the patch reef to be visited. This avoids damage to the reef as well as insuring that the snorkelers or divers swim up-current during their dive, which is a cardinal safety

rule to minimize the difficulty of returning to the dive boat after a tiring swim.)

Release of unburned fuel and engine oils from two-cycle outboard engines is a widespread water pollution problem. It is not yet known whether specific motorboat use occurring in the monument has brought about ecological damage through hydrocarbon pollution.

Motorboats, particularly those equipped with two-cycle engines (which require a gas-oil fuel mixture) are notoriously inefficient in terms of fully burning their fuel. Though figures vary considerably due to manufacturer, horsepower, speed, and tuning, an average of 10 to 20 percent (often as high as 40 to 50 percent) of an outboard's fuel is passed unburned directly into the water during the exhaust cycle. This means that for every 10 gallons of outboard fuel used in the monument, 1 or 2 gallons is injected into the water as raw fuel. This consists of volatile gasoline and about 2 percent heavier outboard-motor oil. In addition to raw fuel pollution, most older engines (1970 and earlier) pass condensed crankcase vapor (oil) directly out through the exhaust system. This heavy hydrocarbon may be even more harmful than the larger volume of raw fuel, although the oil's composition has been adjusted so as to be biodegradable. Fortunately, newer engines are being designed with a crankcase recycling system that puts the crankcase drainage oil back into the fuel mixture, but this can lead to complications, including reduced engine efficiency, which in turn increases the proportion of raw fuel passed into the water (Jackivicz 1973).

The actual biological impact of hydrocarbon pollution on aquatic life is an extremely complex subject that will not be reviewed here. The most difficult impacts to determine and quantify are those where pollution levels are relatively low but insidious (i.e., as presumed in the monument, deriving both from external sources as well as the motorboats under discussion). The organisms most likely to be first affected by low-level toxins would be the smallest, the animal and plant plankton. Since ultimately the majority of the monument's fauna - from coral polyp to barracuda - are dependent on productivity at the planktonic level, this potential impact takes on added concern. A hypothetical example, not immediately apparent to the non-specialist, relates to the lobster life cycle. The lobster larval stage is planktonic for 4 to 6 months, after which it ''settles out'' and begins its more recognizable lobster existence. If mortality in the planktonic stage is elevated even a few percent due to environmental pollution, this may have drastic impact on the eventual number of adults. Even more significant would be the situation where local environmental pollution somehow

completely precluded this settling out of the larvae, meaning an immediate reduction in the number of juveniles beginning their development in the bay.

As a means of providing perspective on the magnitude of the outboard pollution issue, the following statistics are provided (Jackivicz 1973): In 1970, throughout the United States as a whole, an estimated 1 billion gallons of outboard-motor fuel was consumed. This represents something on the order of 100 to 160 million gallons of raw fuel (2 percent oil) injected into U.S. waters.

The impact of overnight motorboat usage (possible human waste contamination) is discussed under sailboat use below.

b. Water-Skiing. Water-skiing is currently practiced in some protected areas of the bay inside the keys. It is uncommon for skiers to be found outside the keys where rough water usually precludes safe skiing. No special regulations or zoning are applied to this practice (except standard state and federal safety regulations). The direct impact of water-skiing on park resources consists principally of the aesthetic intrusion of fast-moving, relatively noisy boat operations. Competent boat operators would tend to avoid shallow water operation, but inexperienced or uninitiated operators might have a higher frequency of bottom scrapings or actual collisions with partially submerged features. If skiing were attempted in narrow mangrove channels or around any of the keys noted as bird areas, then substantial disturbance to bird life would occur. More urgent, however, is the relation between skiing and visitor safety. Fast-moving ski boats are extremely dangerous to small anchored boats, snorkelers, scuba divers, or sail-powered vessels. There seems little doubt that skiing is at least locally incompatible with these other visitor uses, and that further regulation, zoning, or outright prohibition are options that must be explored. The large size of the monument and the relatively few areas where conditions are physically suitable for skiing suggests that restricting skiers to those few areas would satisfy the needs of this element of the visiting public while protecting the safety of others. Disturbance to wildlife would have to be at a minimum in any such zones.

c. Sailing. Sailboat use of the monument is widespread in areas of adequate depth and some shelter from the heaviest chop on the ocean side. This is a very common day-use activity from as far away as downtown Miami marinas, where weekend boaters depart early in the morning, anchor off Elliott Key by noon, and return to their docks by evening. Some overnight sailboat use occurs either within the Elliott Key marina or in

sheltered locations inside the keys. Where sail or motor craft anchor overnight away from established sanitary facilities, it is assumed that a certain amount of human sewage is being released into monument waters. Currently, neither Florida nor federal law actually requires sewage-holding tanks on all vessels. The impact of this released sewage is not known, although no obvious human health hazards have been discovered. The relatively rapid flushing rates, and the fact that no common anchorages (except the marina) are in enclosed lagoons or channels, would not appear to favor buildup of very high concentrations of sewage wastes. Monitoring of the coliform bacteria in marine waters of the monument, especially on peak overnight weekends, is an important research need. It will also be important to distinguish, if possible, between coliform pollution from shoreline (external) sources and from monument boaters. When various federal regulations concerning boat holding tanks (or other approved methods) come into force, the monument will enforce such regulations.

4. Diving (USDI, NPS 1974a)

Deliberate vandalism to reefs by diving visitors does not seem to be a major problem either in the monument or in other National Park Service areas. Inadvertent coral damage by improper anchoring is probably the largest source of trouble (if uncontrolled), followed by inadvertent breakage by the hands, elbows, and flippers of novice snorkelers. Ill-fitting masks and snorkels creating discomfort or fear, plus a lack of appreciation for the fragileness of some coral types, lead many novices to stand or blunder among the corals, possibly breaking the tips of the branching forms or scouring the boulder-types. The offshore reefs of the monument probably receive fewer novice snorkeling visitors than parks with nearshore fringing reefs because no public transportation exists: The boating visitor is predominantly of local origin and has high probability of having snorkeled elsewhere before coming out to the reef tract.

Reefs that have been developed as underwater nature trails, or otherwise identified to the public as specially attractive, seem to receive the heaviest of this inadvertent damage. Four such reefs are in the process of identification in the monument's offshore waters, where a pamphlet rather than any fixed signs will guide visitors. Experience in other areas (Buck Island Reef National Monument) suggests that anchor buoys are essential in such a situation. Also of critical importance is the accurate survey and mapping of such areas, with particular reference to existing damage (and its presumed causes) prior to identification of the reef to the general public. Continued monitoring would also be required to assess future damage, but this would also necessitate selection of adequate closed or unidentified (non-visited) areas to serve as controls. There are an abundance of natural damage factors (e.g., hurricanes, disease) that will

continue independent of human visitation. It would be imperative to monitor these control areas to determine the extent of such natural damage so it would not be attributed to visitors.

If damage occurred that was clearly attributable to visitor use, it might be advisable to temporarily redirect visitation to other reefs, allowing a period of time for regrowth of the first area. The length of time required would vary according to the type of coral, the general health of the reef, and in particular whether or not massive algal infestation had occurred on wounded coral colonies.

Scuba divers (as opposed to surface snorkelers) are theoretically not novices and should know how to avoid inadvertent breakage. However, scuba operations in very shallow water should be discouraged, since wave action tends to toss the divers around, and tanks, fins, or gloved hands might accidentally cause damage. Allowing or encouraging both snorkelers and scuba divers to use the same area would lead to confusion and safety problems as well as damage. The opportunity for physical removal of collector's items like live coral or sea fans would be much greater for the scuba-equipped diver because he would be out of sight for long periods. In an area as large as the monument, prevention of such infractions would depend to a large extent on good public relations and education programs that would school the diving public on the long-term environmental consequences of reef disturbance.

5. Shoreline and Lagoon Exploring

A number of visitors, particularly those with special curiosity or appreciation for the exceptional beauty of lagoon or mangrove creek habitats, will continue to explore these areas by boat, snorkeling, or wading. While this can be an extremely rewarding visitor experience, the delicate nature of lagoon bottoms and the fauna of mangrove channels suggests that some controls and/or cautions would be required. Repetitive wading in such areas as Old Rhodes Lagoon would tend to keep the sediments disturbed, break apart the root mats of attached grasses, and kill or disrupt certain of the benthic fauna (e.g., sea urchins). Snorkelers going down mangrove channels might be enthralled at the variety of organisms attached to the mangrove roots, but such biota could be relatively easily dislodged by prying fingers or poking instruments (see Interpretation section).

K. MONUMENT VISITATION AND IMPLICATIONS FOR CAPACITY

The expectation of future visitation and the implications for monument capacity in Biscayne National Monument are based upon past, current, and estimated levels of peak daily or one-time use figures (i.e., visitor use to be achieved during the busiest day of the busiest season of the year.) These figures do not necessarily reflect the desired level of use during the remainder of the year. It must be noted that not only peak day use, but also the cumulative effects of varying visitation levels occurring during the remainder of the year, produce the effective impacts upon the environment.

At present, it is impossible to project with certainty how visitors will distribute their seasonal or daily visits. Furthermore, since there is no firm schedule for tour-boat access from Convoy Point to the two island development sites, additional difficulty in visitation estimation is encountered. Therefore, assumptions must be made in order to arrive at even a rough estimation of the number of visitors who will be transported to the keys by this access mode. Visitation projections and monument capacity estimations in terms of peak-day use simply provide a reference point from which only general, illustrative impacts may be postulated.

Capacity estimation falls short as an environmental impact assessment tool for Biscayne National Monument or any other area if it is considered the only basis for creating or avoiding human activities. For example, a picnic area can easily be provided and operated to satisfy almost all definitions of visitor capacity. Spacing the tables and rationing access to the picnic sites can guarantee the absence of visitor congestion. Periodically resting sites or replacing the ground cover can maintain a fresh, undamaged appearance. If demand exceeds supply, additional picnic sites can be provided to assure "satisfaction" without congestion (that is, the capacity could be increased). However, the effective decision, and the related impacts, lie in physically establishing the picnic area in the first place. A certain number of acres were given over to the activity, thereby arresting natural plant succession in those acres. As long as the picnic area is used, the ground cover will remain in grasses and young herbs. Over the long term, root systems of trees and shrubs might also be damaged. A commitment to related changes in vegetation composition is more implicit in the original decision to establish (or enlarge) a picnic area than in a decision to limit its use. Although the capacity of the picnic area might never be exceeded, this might be small comfort to those who had misgivings about the commitment of those acres for that purpose and who conceivably might also find the existence of the facility a visual affront - regardless of how well its use is restrained within the limits of its carrying capacity.

In terms of the social/psychological implication of projected visitation levels and monument capacity estimations, Held, Brickler, and Wilcox* stated the problem as "finding a mix of activities and levels of use that will satisfy the visitors and produce the greatest total satisfaction with the least sacrifice, present or future, of the attributes of the natural area that were intended to be protected when park status was assigned to them." Predicting "satisfaction" cannot be done until more is known of visitor expectations and reactions. In general, visitor expectations, interests, and pleasures are not homogeneous, and capacity should not be viewed as a fixed one-time use, daily, or annual figure that can be established apart from other variables (i.e., ease and speed of access to, from, and within the monument, visitor interests, and visitation patterns). In regard to congestion, what it is for one visitor is not necessarily what it is for another. Differing levels of visitation result in differing levels of impacts on the resources and the visitors themselves, and these can be examined in only general terms to form judgments on possible visitation restrictions.

Visitor expectations obviously play a major role in determining what is and is not congestion for a variety of activities. Most visitors in a visitor center auditorium do not consider their situation congested, although they are elbow-to-elbow with others. Similarly, users of passenger tour-boat services expect close quarters.

If many visitors are clustered at certain sites (picnic areas, campgrounds, beaches, docks), then more space will be available at other portions of the keys for visitors who hold expectations of opportunities for solitude.

There is no certainty that development appropriations will become available to provide the proposed access and support facilities required to serve higher levels of visitation, even if the higher levels fall within some feasible capacity range recognized for the monument. Nor is it certain that potential visitor interest will give rise to the levels of visitation that could be accommodated. The implications of these capacity estimations for the monument may turn out to be in excess of visitor interest or the Park Service's ability to accommodate visitor interest.

---

* Held, R. Burnell, Stanley Brickler, and Arthur T. Wilcox: A Study to Develop Practical Techniques for Determining the Carrying Capacity of Natural Areas in the National Park System; Colorado State University, Center for Research and Education; 1969.

Since the expectations and future visitation levels of prospective visitors to Biscayne National Monument are not definitely known at this time - and for the purpose of rough quantification of environmental impacts in this statement - general assumptions, generous in providing for spacing and maximum capacity of facilities, were made.

With these constraints and assumptions in mind, table 18 illustrates the current peak-day visitation levels and predicted future capacities of the various units of the monument.

L: PUBLIC COMMENTS AND NATIONAL PARK SERVICE RESPONSES

This letter and accompanying Draft Environmental Statement were sent to the Advisory Council on December 20, 1977. Since that date, the Advisory Council has indicated no response to proposals contained in the General Management Plan. The comment period for review of the Draft Environmental Statement has elapsed, but any comments received from the Advisory Council during the 30-day waiting period following public release of the Final Environmental Statement will be considered prior to plan approval and implementation.

Mr. Robert R. Garvey, Jr.
Executive Director
Advisory Council on Historic Preservation
1522 K Street
Washington, D.C. 20005

Dec. 20, 1977

Dear Mr. Garvey:

In compliance with Section 106 of the Historic Preservation Act of 1966 and Executive Order 11593, we are pleased to enclose a General Management Plan for the management and development of Biscayne National Monument, Florida, which includes sites that may be eligible for the National Register of Historic Places. In addition, we are enclosing a preliminary copy of a draft environmental impact statement which indicates the development of proposals and the consideration of alternative methods of management and development that resulted in the General Management Plan itself. We would appreciate your comments.

On July 26, 1976, we forwarded to the Florida State Historic Preservation Officer the above General Management Plan for comment. The State Historic Preservation Officer's office acknowledged receipt of the document in numerous telephone conversations during September, October and November and promised prompt replies in each of these conversations. To date we have received no reply. Therefore, after consultation with Mr. Holz of your office, we are forwarding this plan to you for comment without the usual accompanying comments from the State Historic Preservation Officer.

It is our conclusion that identifying an area with numerous shipwrecks as an "historic protection subzone" could probably be considered to have an effect, but we feel that the effect would be positive and not adverse.

Depending upon the date of receipt, your comments will be incorporated into the draft and/or final environmental impact statement when it is completed.

Thank you for your interest in the programs of the National Park Service.

Sincerely yours,

David G. Wright
Acting Regional Director
Southeast Region

Enclosures 3
Copy of Letter to SHPO
General Management Plan
Environmental Impact Statement

Please note that in the following letters document references such as page numbers or section headings relate to the Draft Environmental Statement; National Park Service responses are printed across from the paragraph they answer, and references in the responses are keyed to this Final Environmental Statement.

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230
(202) 377-3111

February 24, 1978

Mr. James L. Bainbridge
National Park Service
United States Department of the Interior
1985 Phoenix Boulevard
Atlanta, Georgia 30349

Dear Mr. Bainbridge:

This is in reference to your draft environmental impact statement entitled, "Proposed General Management Plan for Biscayne National Monument, Florida." The enclosed comments from the National Oceanic and Atmospheric Administration are forwarded for your consideration.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving five (5) copies of the final statement.

Sincerely,

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

Enclosures: Memos from Mr. William H. Stevenson
Regional Director
National Marine Fisheries Service

Mr. Douglas LeComte
Special Projects
Environmental Data Service

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Duval Building
9450 Koger Boulevard
St. Petersburg, FL 33702

JAN 30 1978

January 18, 1978

FSE61/JRH

TO: Director, Office of Ecology and Conservation, EC

JAN 30 1978

THRU: Assistant Director for Scientific and Technical Services, F5

FROM: William H. Stevenson
Regional Director

SUBJECT: Comments on Draft Environmental Impact Statement -- Biscayne National Monument, Florida (NPS (DEIS #7712.22)

The draft environmental Impact statement for Biscayne National Monument, Florida, that accompanied your memorandum of December 22, 1977, has been received by the National Marine Fisheries Service for review and comment.

The statement has been reviewed and the following comments are offered for your consideration.

General Comments

We are pleased that several recommendations forwarded in the Department of Commerce memorandum of June 22, 1976, to the National Park Service on the environmental assessment were included in the proposed management plans.

Specific Comments

II. Description of the Environment

B. Natural Environment

10. Terrestrial Fauna

a. Reptiles and amphibians (page 69). We suggest relocating this discussion of marine turtles to Marine Fauna (pages 61-62), and/or including all sea turtles within the Endangered Species section (pages 70-71). We further suggest that the discussion allude to the probability that it would be the herbivorous, green sea turtle frequenting areas of submerged vegetation with

307

RESPONSE:

The text of the environmental statement has been adjusted to reflect these comments.

the carnivorous hawksbill more commonly occurring on offshore reefs[1/].

C. Socioeconomic Environment

3. Existing Facilities

c. Convoy Point, pages 87-91. As stated previously, we are concerned that additional filling of mangroves for monument facilities such as parking would contravene the purpose of minimizing impacts on natural resources. Accordingly, the alternative of providing parking elsewhere with a shuttle service to Convoy Point from which visitors could depart should be considered. Additional dredging or filling of mangroves would require Federal permits and we would review such applications in the interest of eliminating or minimizing impact on fish habitat.

RESPONSE:

It is felt that the current parking capacity at Convoy Point is adequate to satisfy present and projected demands. If at such time the existing capacity is rendered inadequate, the suggestion of providing parking elsewhere with a shuttle service to Convoy Point, which would certainly be considered as an alternative solution.

III. Environmental Impacts of the Proposed Action

A. Natural Environment

2. Water Quality

Page 101, paragraph 3. In addition to impacts associated with maintenance dredging at Elliot Key Marina, Convoy Point, and the Adams Key-Cocolobo Club, disposal of dredged materials into shallow waters or vegetated wetlands can have serious adverse impacts. The draft should identify disposal sites and note that those least damaging to aquatic resources would lie on existing uplands. This discussion would also be appropriate in Part IV, pages 123-124, and Part VII, page 133.

RESPONSE:

There are no dredging operations proposed in the final General Management Plan.

Page 103, paragraph 5. The statement should note that the 300-foot bulkhead on Adams Key will be constructed to avoid or minimize losses of shallow water or wetland habitat.

RESPONSE:

The text of the environmental statement has been adjusted to reflect this comment.

6. Wildlife

Page 106, paragraph 2. It is improbable that the Atlantic Ridley sea trutle would nest on beaches in the Monument. Nesting activities of this species are confined almost entirely to remote beaches near Rancho Nuevo, Mexico.

RESPONSE:

The text of the environmental statement has been adjusted to reflect this comment.

It is requested that one copy of the Final EIS be sent to the Area Supervisor, Environmental Assessment Branch, NMFS, P.O. Box 4218, Panama City, FL 32401

cc:
F53 (3)
FSE613

1/ Personal communication, Larry H. Ogren, Fishery Biologist, NMFS, Panama City, Laboratory, Panama City, FL 32401

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
ENVIRONMENTAL DATA SERVICE
Washington, D.C. 20235

February 3, 1978

TO: William Aron
Office of Ecology and Environmental Conservation

FROM: Douglas LeComte
Special Projects

SUBJECT: DEIS 7712.22 - Biscayne, National Monument, Florida

The environmental statement presents an excellent discussion on hurricanes in south Florida. However, though the general effects of such storms on nearshore environments are given, the potential impacts on the specific project area are not examined. A description of the effect of a tropical storm or a hurricane striking Biscayne National Monument would be useful, with emphasis on the relationship of the general management plan to the consequences of such a storm.

309

RESPONSE:

While we agree with the intent of the comment, the ability to accurately identify, quantify and discuss impacts which will occur in the specific project area are possible only from extrapolating past effects of such storms on the area or by making various assumptions for future such storms (wave surge, wind speed direction, etc.) and superimposing them on the project area for effects. It is felt, therefore, that the general effects alluded to in the existing discussion are sufficient and that any attempt to further define specific impacts would be of no real benefit in the formulation of the General Management Plan

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32201

SAJEN-EE

1 February 1978

Mr. James L. Bainbridge
Acting Regional Director
Southeast Region
National Park Service
1895 Phoenix Blvd.
Atlanta, Georgia 30349

Dear Mr. Bainbridge:

In reference to letter L7617-SER-PP, the Jacksonville District of the U. S. Army Corps of Engineers has reviewed the draft environmental statement for the Biscayne National Monument. Specific comments are directed to the following portions of the text:

1. P. 10, paragraph C.1.a. Elliott Key Marina. The environmental statement should clearly state that a Department of the Army permit would be required. Pertinent drawings depicting the details of improvement should be provided. Additionally, a more comprehensive description of the environmental impact of the construction of the marina facilities should be furnished.

2. P. 10, paragraph C.1.b. Adams Key. Details of the additional docking facilities should be provided. The environmental statement should also state that a Department of the Army permit will be required at this location.

3. P. 101, last paragraph. Details and vegetation surveys of the proposed maintenance dredging should be furnished. Additionally the environmental statement should acknowledge the requirement for a Department of the Army permit.

4. P. 138, (6) Required Development. Plans for the enlargement of the boat basin should be provided. Department of the Army permits would be required for dredging and filling in waters associated with the development.

310

RESPONSE:

1. **In the Proposal section under Significant Concerns of the General Management Plan Elliott Key Harbor, the following sentence is added: "All necessary permits from the Army Corps of Engineers will be acquired prior to development implementation." Pertinent drawings depicting the details of improvement are a matter of public record and are on file at the Southeast Regional Office of the National Park Service.**

RESPONSE:

2. Details of the additional docking facilities are not available at this conceptual stage in the planning process. When development concept plans are prepared detailing the facilities they will be a part of the public record and available for inspection at the Southeast Regional Office, National Park Service.

In the same section under Adams Key is "A permit from the Department of the Army, Corps of Engineers will be necessary prior to proposed development implementation.

RESPONSE:

3. Any statement pertaining to maintenance dredging is inaccurate as **no such activity will occur. Textual changes have been made accordingly throughout the environmental statement.**

RESPONSE:

4. Also under Significant Concerns of the General Management Plan, it is pointed out that the National Park Service has determined that the acquisition of a 40-acre site on north Key Largo to provide additional administrative facilities, visitor contact and orientation station, and facilities for boat embarkation to the monument is no longer a feasible consideration. Additionally, the rationale for the decision not to acquire the authroized land on Key Largo is presented.

SAJEN-EE 1 February 1978

Mr. James L. Bainbridge

As a matter of additional information it should be mentioned that the authorized Canals C-106 and C-107 (see Inclosure 1), which have not been constructed to date, could impact on the Biscayne National Monument. These canals were designated to discharge into the Biscayne National Monument. In 1975 the proposed canals were deactivated. If the South Dade County authorized plan is ever reactivated, potential conflicts may evolve.

Thank you for the opportunity to review and comment on the draft environmental statement.

Sincerely yours,

for George Marsch
JAMES L. GARLAND
Chief, Engineering Division

1 Incl
Project Map 54-2

RESPONSE:

This potential problem is noted. However, since the canals are no longer proposed, there are no potential impacts on the Biscayne General Management Plan. If the proposal is reactivated, it would become the responsibility of the Corps of Engineers to identify the potential impacts.

In the future when the general management plan for Biscayne is revised and/or the South Dade County's authorized plan is reactivated, this problem will be addressed as appropriate.

A Corps of Engineers map - Facilities Proposed for Inactive Status - enclosed with this letter is available to the public at the National Park Service Southeast Regional Office in Atlanta.

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT. CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE. FLORIDA 32201

SAJEN-EE

10 February 1978

Mr. James L. Bainbridge
Acting Regional Director
Southeast Region
National Park Service
1895 Phoenix Blvd.
Atlanta, Georgia 30349

Dear Mr. Bainbridge:

In reference to letter L7617-Ser-PP, undated, and our initial SAJEN-EE response of 1 February 1978 on the Biscayne National Monument Draft Environmental Statement and General Management Plan, we offer the following additional comments.

312

Information presented on pages 18, 19, 20, and 21 of the Draft Management Plan indicates that this document would be more appropriately titled Management Objectives. To function as a plan, "specific areas for various recreational activities," should be designated and "regulatory actions necessary to insure preservation of resources" should be clearly established.

RESPONSE:
The comment is noted and appreciated.

Page 20 of the Draft Management Plan states that "a research study will be initiated to determine the feasibility of its (American crocodile) reintroduction in this area." Although Jones Lagoon is not delineated on maps presented, it would appear to be a foregone conclusion that human water contact recreational activities anywhere within the monument boundary would preclude the reintroduction of crocodile. The range of this specie in relation to other popular water contact recreation areas beyond the monument boundary would also tend to negate the need for such a feasibility study.

RESPONSE:
The comment is noted. The feasibility of the reintroduction of the American crocodile will be determined prior to any such attempts in the monument.

The Cultural Resource Management section (page 20) of the Draft Management Plan states that "none of the structures meet eligibility criteria of the National Register." However, in light of information presented on page 6, this statement is questioned. If the Cocoloba Club was constructed prior to 1928, it would appear to meet eligibility criteria (at least 50 years old).

RESPONSE:
The commenting agency's attention is directed to page 16 of the General Management Plan where it is stated that the Cocolobo Club was destroyed by fire in December 1974.

Again, thank you for the opportunity to review and comment on the Draft Environmental Statement and Management Plan.

Sincerely yours,

JAMES L. GARLAND
Chief, Engineering Division

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
REGIONAL OFFICE
PERSHING POINT PLAZA, 1371 PEACHTREE STREET, N.E.
ATLANTA, GEORGIA 30309

REGION IV

December 19, 1977

IN REPLY REFER TO:

Mr. James L. Bainbridge
Acting Regional Director
Southeast Region
U. S. Department of Interior
National Park Service
1895 Phoenix Boulevard
Atlanta, Georgia 30349

Dear Mr. Bainbridge:

We have forwarded the Draft Environmental Impact Statement (EIS) for General Management Plan, Biscayne National Monument, to the HUD Area Office in Jacksonville, Florida.

Functionally the HUD Area Offices are our reviewing body for activities within their respective states. They have been advised to send their comments directly to you.

Sincerely,

Leo J. Zuber
Director, Community Planning
and Management Division

RESPONSE:
No response required.

AREA OFFICES
ATLANTA, GEORGIA · BIRMINGHAM, ALABAMA · COLUMBIA, SOUTH CAROLINA · GREENSBORO, NORTH CAROLINA · JACKSON, MISSISSIPPI
JACKSONVILLE, FLORIDA · KNOXVILLE, TENNESSEE · LOUISVILLE, KENTUCKY
Insuring Offices
Coral Gables, Florida · Memphis, Tennessee · Nashville, Tennessee · Tampa, Florida

IN REPLY REFER TO

United States Department of the Interior

1793 (930)

BUREAU OF LAND MANAGEMENT

EASTERN STATES OFFICE
7981 Eastern Avenue
Silver Spring, Maryland 20910

FEB 10 1978

DES-77/35

Memorandum

To: Regional Director, Southeast Region, National Park Service

From: Director, Eastern States

Subject: Draft Environmental Statement for General Management Plan
Biscayne National Monument, Florida

We have reviewed the Draft Environmental Statement for the General Management Plan for Biscayne National Monument in Florida and offer the following comments for your consideration.

General Comments:

In general, this statement provided a very good identification of the biotic components of the existing environment and excellent assessment of the impacts the management plan would have on these components. The narrative is clearly and concisely written and the numerous maps are well done and informative.

Specific Comments:

Provisions were made throughout the document for mitigation of adverse impacts on birdlife; examples included designation of environmental protection subzones and special tour-boat routing. We were disappointed, however, in the lack of proposed mitigating measures to protect other species, particularly the endangered Florida manatee and hawksbill sea turtle. We are concerned not so much with the temporary disturbance during construction, but with the potential long-range effects (physical injury, harassment, habitat loss) due to the increases in motorboating, waterskiing and general use of the area. Inventories should be conducted to identify specific crucial sites that would be excluded from tour-boat routes or recreational boating areas. At a minimum, there should be some allowance for monitoring the effects the recreational activities encouraged in this management plan will have on these endangered species. Consultation with USFWS may lead to identification of more specific mitigating measures.

Thank you for giving us the opportunity to review your statement.

David P. Sodzenski
acting

314

RESPONSE:

It is the intent of the National Park Service to maintain a sensitivity toward endangered species as well as other wildlife species. The only action proposed in the General Management Plan which poses a possible threat to the manatee or the hawksbill turtle is the initiation of a limited visitor transportation and interpretive system. It is assured that the requirements of the operation of such a system will be sensitive towards the presence of these species and scheduling and routing will be flexible enough to be adjusted to conform with species food and habitat needs or other discoveries of on-going monitoring inventories or future research studies related to endangered as well as all other wildlife species.

United States Department of the Interior

BUREAU OF OUTDOOR RECREATION
SOUTHEAST REGIONAL OFFICE
148 Cain Street
Atlanta, Georgia 30303

IN REPLY REFER TO:

4100

JAN 27 1978

Memorandum

To: Regional Director, National Park Service, Southeast Region, Atlanta, Georgia

From: Regional Director, Bureau of Outdoor Recreation, Southeast Region, Atlanta, Georgia

Subject: Draft environmental impact statement on the proposed general management plan for the Biscayne National Monument, Florida

315

We have reviewed the subject draft environmental impact statement and have no comments.

for Robert M. Baker

RESPONSE:
No response required.

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

United States Department of the Interior
FISH AND WILDLIFE SERVICE
P. O. BOX 95067
ATLANTA, GEORGIA 30347

FEB 2 7 1978

DES-77/35

Memorandum

To : Regional Director, National Park Service
Atlanta, Georgia

From : Assistant Regional Director--Environment, Fish and
Wildlife Service, Atlanta, Georgia

Subject: Review of Draft Environmental Impact Statement on the Proposed
General Management Plan for Biscayne National Monument (DES-77/35)

By letter you requested our comments on the draft environmental impact statement and the general management plan for Biscayne National Monument. We have reviewed these documents and find that they are excellent and are very adequate in handling the impacts of your proposed projects for access to the monument. We also believe the design of your project is excellent. We feel that it should be noted here that if your agency determines that the "Proposed General Management Plan" may affect an endangered or threatened species (beneficially as well as detrimentally) then you should initiate consultation with the Regional Director, U.S. Fish and Wildlife Service, Region 4, Atlanta, Georgia. We have some technical comments on the endangered species section of the draft environmental impact statement, which is located on pages 70 through 73. The following are those specific comments.

316

Specific Comments

Page 70, Endangered Species

The paragraph should be altered as follows to reflect the 1977 Federal lists: "There are 24 endangered or otherwise threatened wildlife species in south Florida. These include nine species or subspecies of birds, eight mammals, five reptiles, and two insects (USDI, Fish and Wildlife Service, September 19, 1977). Pursuant to the Endangered Species Act of 1973 (Public Law 93-205), 21 south Florida species or subspecies are officially classified as endangered. Those wildlife species that inhabit or otherwise utilize the monument resources for species habitat and/or perpetuation and are classified as endangered are listed in table 11."

RESPONSE:

The text of the environmental statement has been adjusted to reflect this comment.

Page 71, first paragraph

This paragraph should be altered as follows: "Two (2) south Florida species currently classified as threatened, but not endangered, occur in the monument. These are the Bahama swallowtail butterfly and the Schaus swallowtail butterfly. The other threatened species, the American alligator, occurs in adjacent areas but has not been reported as inhabiting the monument."

Page 71, second paragraph

This should be altered as follows: "The Wildlife Code of the State of Florida (Florida Game and Fresh Water Fish Commission, 1977) has a list of 31 endangered and 54 threatened species. These species were adopted from the list recommended by the Florida Committee on Rare and Endangered Plants and Animals. Of those species on the endangered list, the Atlantic green turtle, Atlantic hawksbill turtle, Atlantic Ridley turtle, American crocodile, wood stork, and Key Largo woodrat occur or probably occur in the monument." Complete State of Florida and Federal endangered and threatened lists are enclosed.

Thank you for the opportunity to comment.

John W. Baumeister

Enclosures 3

RESPONSE:

The text of the environmental statement has been adjusted to reflect this comment.

RESPONSE:

The text of the environmental statement has been adjusted to reflect this comment.

STATE OF FLORIDA
1977 LIST

Threatened species—A species which may become an endangered species within the foreseeable future in all or a significant portion of its range in the state due to (1) destruction, drastic modification or severe curtailment of habitat, or (2) its over utilization for commercial or sporting purposes, or (3) effect of disease or pollution, or (4) other natural or man-made factors:

Atlantic Sturgeon (Acipenser oxyrhynchus)
River Redhorse (Moxostoma carinatum)
Cypress Minnow (Hybognathus hayi)
Speckled Chub (Hybopsis aestivalis)
Bluestripe Shinner (Notropis callitaenia)
Lake Eustis Pupfish (Cyprinodon variegatus hubbsi)
Saltmarsh Topminnow (Fundulus jenkinsi)
Rivulus (Rivulus marmoratus)
Crystal Darter (Ammocrypta asprella)
Harlequin Darter (Etheostoma histrio)
Southern Tessellated Darter (Etheostoma olmstedi maculaticeps)
Goldstripe Darter (Etheostoma parvipinne)
Cypress Darter (Etheostoma proeliare)
Stargazing Darter (Percina evaehitae)
Key Blenny (Starksia starcki)
Florida Gopher Frog (Rana areolata aesopus)
Key Mud Turtle (Kinosternon bauri bauri)
Suwannee Cooter (Chrysemys concinna suwanniensis)
Gopher Turtle (Gopherus polyphemus)
Atlantic Loggerhead Turtle (Caretta caretta caretta)
Florida Key Mole Skink (Eumeces egregius egregius)
Blue-tailed Mole Skink (Eumeces egregius lividus)
Sand Skink (Neoseps reynoldsi)
Big Pine Key Ringneck Snake (Diadophis punctatus acricus)
Red Rat Snake (Elaphe guttata guttata) (Lower Keys only)
Miami Black-headed Snake (Tantilla oolitica)
Eastern Indigo Snake (Drymarchon corais couperi)
Florida Brown Snake (Storeria dekayi victa) (Lower Keys only)
Florida Ribbon Snake (Thamnophis sauritus sackeni) (Lower Keys only)
American Alligator (Alligator mississippiensis)
Rothschild's Magnificent Frigatebird (Fregata magnificens rothschildi)
Osprey (Pandion haliaetus)
Southeastern Kestrel (Falco sparverius paulus)
Roseate Tern (Sterna dougallii)
Least Tern (Sterna albifrons)
White-crowned Pigeon (Columba leucocephala)
Florida Scrub Jay (Aphelocoma coerulescens coerulescens)
Louisiana Seaside Sparrow (Ammospiza maritima fisheri)
Bald Eagle (Haliaectus leucocephalus)
Brown Pelican (Pelecanus occidentalis carolinensis)
Audubon's Caracara (Caracara cheriway auduboni)
Great White Heron (Ardea herodius occidentalis)
Arctic Peregrine Falcon (Falco peregrinus turdrius)
Florida Sandhill Crane (Grus canadensis pratensis)
Sherman's Fox Squirrel (Sciurus niger shermani)
Choctawhachee Beach Mouse (Peromyscus polionotus allophrys)
Perdido Bay Beach Mouse (Peromyscus polionotus trissyllepsis)
Florida Mouse (Peromyscus floridanus)
Lower Keys Cotton Rat (Sigmodon hispidus exsputus)
Key Vaca Raccoon (Procyon lotor auspicatus)
West Indian Manatee (Trichechus manatus latirostris)
Everglades Mink (Mustela vison evergladensis)
Florida Black Bear (Ursus americanus floridanus)
American Oystercatcher (Haematopus palliatus)

Endangered species—A species which is in danger of extinction throughout all or a significant portion of its range in the State due to (1) destruction, drastic modification or severe curtailment of habitat, or (2) its over-utilization for commercial or sporting purposes, or (3) effect of disease or pollution, or (4) other natural or man-made factors:

Key Silverside (Menidia conchorum)
Okaloosa Darter (Etheostoma okaloosae)
Shortnose Sturgeon (Acipenser brevirostrum)
Pine Barrens Treefrog (Hyla andersoni)
Atlantic Green Turtle (Chelonia mydas mydas)
Atlantic Hawksbill Turtle (Eretmochelys imbricata imbricata)
Atlantic Ridley Turtle (Lepidochelys kempi)
Atlantic Salt Marsh Watersnake (Natrix fasciata taeniata)
Short-tailed Snake (Stilosoma extenuatum)
American Crocodile (Crocodylus acutus)
Wood Stork (Mycteria americana)
Florida Everglade Kite (Rostrhamus sociabilis plumbeus)
Cuban Snowy Plover (Charadrius alexandrinus tenuirostris)
Ivory-billed Woodpecker (Campephilus principalis)
American Peregrine Falcon (Falco peregrinus anatum)
Red-cockaded Woodpecker (Picoides borealis hylonomus)
Bachman's Warbler (Vermivora bachmanii)
Kirtland's Warbler (Dendroica kirtlandii)
Florida Grasshopper Sparrow (Ammodramus savannarum floridanus)
Dusky Seaside Sparrow (Ammospiza maritima nigrescens)
Cape Sable Seaside Sparrow (Ammospiza maritima mirabilis)
Gray Bat (Myotis grisescens)
Indiana Bat (Myotis sodalis)
Mangrove Fox Squirrel (Sciurus niger avicennia)
Goff's Pocket Gopher (Geomys pinetis goffi)
Cudjoe Rice Rat (Oryzomys undescribed species or subspecies)
Pallid Beach Mouse (Peromyscus polionotus decoloratus)
Key Largo Cotton Mouse (Peromyscus gossypinus allapaticola)
Florida Panther (Felis concolor coryi)
Key Deer (Odocoileus virginianus clavium)
Key Largo Woodrat (Neotoma floridana smalli)

ENDANGERED AND THREATENED SPECIES, AND DESIGNATED CRITICAL HABITATS

FLORIDA

Endangered

Mammals:	General Distribution (present or historic)
Bat, gray (*Myotis grisescens*)	Panhandle
Bat, Indiana (*Myotis sodalis*)	Panhandle
Deer, Key (*Odocoileus virginianus clavium*)	Lower Keys
Manatee, Florida (*Trichechus manatus*)	Coastal waters and streams
Panther, Florida (*Felis concolor coryi*)	Entire
Whale, blue (*Balaenoptera musculus*)	Coastal waters
Whale, finback (*Balaenoptera physalus*)	Coastal waters
Whale, humpback (*Megaptera novaeangliae*)	Coastal waters
Whale, sei (*Balaenoptera borealis*)	Coastal waters
Whale, sperm (*Physeter catodon*)	Coastal waters
Birds:	
Curlew, Eskimo (*Numenius borealis*)	Coast
Eagle, Southern bald (*Haliaeetus leucocephalus leucocephalus*)	Entire
Falcon, Arctic peregrine (*Falco peregrinus tundrius*)	Coast
Kite, Florida everglade (*Rostrhamus sociabilis plumbeus*)	South
Pelican, brown (*Pelecanus occidentalis*)	Coast
Sparrow, Cape Sable (*Ammospiza maritima mirabilis*)	Extreme Southwest
Sparrow, dusky seaside (*Ammospiza maritima nigrescens*)	Merritt Island, St. John's River
Warbler, Bachman's (*Vermivora bachmanii*)	Entire
Woodpecker, ivory-billed (*Campephilus principalis*)	Entire
Woodpecker, red-cockaded (*Dendrocopos borealis*)	Entire
Fishes:	
Darter, Oklaloosa (*Etheostoma okaloosae*)	Eglin Air Force Base
Sturgeon, shortnose (*Acipenser brevirostrum*)	Atlantic seaboard rivers
Reptiles:	
Crocodile, American (*Crocodylus acutus*)	Extreme south

Turtle, Atlantic ridley (*Lepidochelys kempii*)	Coastal waters
Turtle, hawksbill (*Eretmochelys imbricata*)	Coast
Turtle, leatherback (*Dermochelys coriacea*)	Coast

Threatened

Reptiles:

Alligator, American (*Alligator mississippiensis*)	Entire

Insects:

Butterfly, Bahama swallowtail (*Papilio andraemon bonhotei*)	Biscayne National Monument
Butterfly, Schaus swallowtail (*Papilio aristodemus*)	Biscayne National Monument, Key Largo, Lower Matecumbe Key

Critical Habitat

Florida Manatee:

The following areas (exclusive of those existing man-made structures or settlements which are not necessary to the normal needs or survival of the species) in Florida are critical habitat for the Florida manatee (*Trichechus manatus*): Crystal River and its headwaters known as King's Bay, Citrus County; the Little Manatee River downstream from the U. S. Highway 301 bridge, Hillsborough County; the Manatee River downstream from the Lake Manatee Dam, Manatee County; the Myakka River downstream from Myakka River State Park, Sarasota and Charlotte Counties; the Peace River downstream from the Florida State Highway 760 bridge, De Soto and Charlotte Counties; Charlotte Harbor north of the Charlotte-Lee county line, Charlotte County; Caloosahatchee River downstream from the Florida State Highway 31 bridge, Lee County; all U. S. territorial waters adjoining the coast and islands of Lee County; all U. S. territorial waters adjoining the coast and islands and all connected bays, estuaries, and rivers from Gordon's Pass, near Naples, Collier County, southward to and including Whitewater Bay, Monroe County; all waters of Card, Barnes, Blackwater, Little Blackwater, Manatee, and Buttonwood sounds between Key Largo, Monroe County, and the mainland of Dade County; Biscayne Bay, and all adjoining and connected lakes, rivers, canals, and waterways from the southern tip of Key Biscayne northward to and including Maule Lake, Dade County; all of Lake Worth, from its northernmost point immediately south of the intersection of U. S. Highway 1 and Florida State Highway A1A southward to its southernmost point immediately north of the town of Boynton Beach, Palm Beach County; the Loxahatchee River and its headwaters,

Martin and West Palm Beach Counties; that section of the intracoastal waterway from the town of Sewalls Point, Martin County to Jupiter Inlet, Palm Beach County; the entire inland section of water known as the Indian River, from its northernmost point immediately south of the intersection of U. S. Highway 1 and Florida State Highway 3, Volusia County, southward to its southernmost point near the town of Sewalls Point, Martin County, and the entire inland section of water known as the Banana River and all waterways between the Indian and Banana Rivers, Brevard County; the St. Johns River, including Lake George, and including Blue Springs and Silver Glen Springs from their points of origin to their confluences with the St. Johns River; that section of the Intra-coastal Waterway from its confluence with the St. Marys River on the Georgia-Florida border to the Florida State Highway A1A bridge south of Coastal City, Nassau and Duval Counties.

American Crocodile:

The following area (exclusive of those existing man-made structures or settlements which are not necessary to the normal needs or survival of the species) is critical habitat for the American crocodile (*Crocodylus acutus*): All land and water within the following boundary in Florida: beginning at the easternmost tip of Turkey Point, Dade County, on the coast of Biscayne Bay; thence southeastward along a straight line to Christmas Point at the southernmost tip of Elliott Key; thence southwestward along a line following the shores of the Atlantic Ocean side of Old Rhodes Key, Palo Alto Key, Anglefish Key, Key Largo, Plantation Key, Windley Key, Upper Matecumbe Key, Lower Matecumbe Key, and Long Key, to the westernmost tip of Long Key; thence northwestward along a straight line to the westernmost tip of Middle Cape; thence northward along the shore of the Gulf of Mexico to the north side of the mouth of Little Sable Creek; thence eastward along a straight line to the northernmost point of Nine-Mile Pond; thence northeastward along a straight line to the point of beginning.

Florida Everglade Kite:

Florida. Areas of land (predominantly marsh), water, and airspace, with the following components (Tallahassee Meridian): (1) St. Johns Reservoir, Indian River County: T33S R37E SW¼ Sec. 6, W½ Sec. 7, Sec. 18, Sec. 19; (2) Cloud Lake Reservoir, St. Lucie County: T34S R38E S½ Sec. 16, N½ Sec. 21; (3) Strazzulla Reservoir, St. Lucie County: T34S R38E SW ¼ Sec. 21; (4) western parts of Lake Okeechobee, Glades and Hendry Counties, extending along the western shore to the east of the levee system and the undiked high ground at Fisheating Creek, and from the Hurricane Gate at Clewiston northward to the mouth of the Kissimmee River, including all the Eleocharis flats of Moonshine Bay, Monkey Box, and Observation Shoal, but excluding the open water north and west of the

northern tip of Observation Shoal, north of Monkey Box, and east of Fisheating Bay; (5) Loxahatchee National Wildlife Refuge (Central and Southern Florida Flood Control District Water Conservation Area 1), Palm Beach County, including Refuge Management Compartments A, B, C, and D, and all of the main portion of the Refuge as bounded by Levees L-7, L-39, and L-40; (6) Central and Southern Florida Flood Control District Water Conservation Area 2A, Palm Beach and Broward Counties, as bounded by Levees L-6, L-35B, L-36, L-38, and L-39; (7) Central and Southern Florida Flood Control District Water Conservation Area 2B, Broward County, as bounded by Levees L-35, L-35B, L-36, and L-38; (8) Central and Southern Florida Flood Control District Water Conservation Area 3A, Broward and Dade Counties, as bounded by Florida Highway 84, Levees L-68A, L-67A (north of Miami Canal), L-67C (south of Miami Canal), L-29, and L-28, and a line along the undiked northwestern portion of the Area; (9) that portion of Everglades National Park, Dade County, within the following boundary: beginning at the point where the Park boundary meets Florida Highway 94 in T54S R35E Sec. 20, thence eastward and southwest along the Park boundary to the southwest corner of Sec. 31 in T57S R37E, thence southwestward along a straight line to the southwest corner of Sec. 2 in T58S R35E, thence westward along the south sides of Sec. 3, 4, 5, and 6 in T58S R35E to the Dade-Monroe county line, thence northward along the Dade-Monroe county line to the Park boundary, thence eastward and northward along the Park boundary to the point of beginning.

Dusky Seaside Sparrow:

Florida. Cordgrass (Spartina bakerii) savannas and associated land, water, and airspace within the following boundary, Brevard County: Beginning at the point where Florida Highway 528 intersects Interstate Highway 95; thence westward along Florida Highways 528 and 520 to the main channel of the St. Johns River; thence northward along said channel to Florida Highway 46; thence eastward along Florida Highway 46 to Interstate Highway 95; thence southward along Interstate Highway 95 to the point of beginning. Marshes and associated airspace within the mosquito control impoundments designated by the Brevard County Mosquito Control District as T-10-J and T-10-K, northwest of Florida Highway 406 on the Merritt Island National Wildlife Refuge, Brevard County.

Cape Sable Sparrow:

Florida. Areas of land, water, and airspace in the Taylor Slough vicinity of Collier, Dade, and Monroe counties, with the following components (Tallahassee Meridian): Those portions of Everglades National Park within T57S R36E, T57S R36½E, T57S R37E, T58S R35E, T58S R36E, T58S R37E, T58½S R35E, T58½S R36½E, T59S R35E, T59S R36E, T59S R37E. Areas outside of Everglades National Park within T55S R37E Sec. 36; T55S R38E Sec. 31, 32; T56S R37E Sec. 1, 2, 11-14, 23-26; T56S R38E Sec. 5-7, 18, 19; T57S R37E Sec. 5-8, T58S R38E Sec. 27, 29-32; T59S R38E Sec. 4.

March 6, 1978, Mr. Bonham of the U.S. Geological Survey stated there was no comment on the draft plan or draft statement.

RESPONSE:
No response required.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV
345 COURTLAND STREET
ATLANTA, GEORGIA 30308

February 22, 1978

Mr. James L. Bainbridge
Acting Regional Director
National Park Service
Southeast Regional Office
1895 Phoenix Boulevard
Atlanta, Georgia 30349

Dear Mr. Bainbridge:

We have reviewed the Draft Environmental Impact Statement on the proposed General Management Plan - Biscayne National Monument, Florida, and found it to be a comprehensive, well-written document with particularly excellent graphics. There were, however, several areas that we feel should be addressed more fully:

1. 1. A plan needs to be developed for the control of domestic wastes, especially from boat sources. We suggest that the concessionaire tour boats be required to have holding tanks and pump-out connections. Depending on future visitation levels and the assimilative capacity of Biscayne Bay, this equipment may be necessary for all boats using the park area if water quality is to be maintained.

2. The on-shore collection and waste water treatment system planned for the Monument should also be discussed in the Final Plan.

3. 2. A ban on all spear fishing should be considered within the Monument boundaries. The immediate adverse effects of this activity are obvious and the consequences could easily disrupt the long-term balance of this unique ecosystem. The special studies (Page 19) which are planned to examine this issue should be undertaken as soon as possible to allow NPS to make an informed decision.

On the basis of the above we have rated the plan LO-2, i.e., we have no environmental objections to it, but some additional information is requested. When the Final Plan is available we would appreciate five copies for our review. In the meantime, if we can be of further assistance, feel free to call on us.

Sincerely yours,

John E. Hagan III

John E. Hagan, III
Chief, EIS Branch

322

RESPONSE:

1. The comment is noted and appreciated. All visitor transportation craft will be required to conform with Section 312 of the Federal Water Pollution Control Act Amendments of 1972, Section 3.17 of Title 36 of the Code of Federal Regulations and any other applicable legislation or regulations regulating domestic wastes from boat sources.

RESPONSE:

2. A brief discussion of the proposed collection and treatment of sewage and waste water systems for Elliott Key is detailed in the environmental statement.

RESPONSE:

3. Research studies are currently underway to acquire the necessary information to regulate or prohibit this activity.

STATE OF FLORIDA

Department of Administration

Division of State Planning

660 Apalachee Parkway IBM Building

TALLAHASSEE

32304

(904) 488-1115

Reubin O'D. Askew
GOVERNOR

R. G. Whittle, Jr.
STATE PLANNING DIRECTOR

Wallace W. Henderson
SECRETARY OF ADMINISTRATION

February 2, 1978

Mr. James L. Bainbridge, Acting
Regional Director
Southeastern Region
National Park Service
1895 Phoenix Blvd.
Atlanta, Georgia 30349

Dear Mr. Bainbridge:

323

Functioning as the state planning and development clearinghouse contemplated in U. S. Office of Management and Budget Circular A-95, we have reviewed the draft environmental impact statement for the Biscayne National Monument, and Draft General Management Plan, SAI 78-1002E.

During our review we referred the environmental impact statement to the following agencies, which we identified as interested: Department of Agriculture and Consumer Services, Department of Environmental Regulation, Department of Natural Resources, Department of State, Department of Transportation, Game and Fresh Water Fish Commission, and the South Florida Regional Planning Council. Agencies were requested to review the statement and comment on possible effects that actions contemplated could have on matters of their concern. Letters of comment on the statement are enclosed from: Department of Agriculture and Consumer Services, Department of Environmental Regulation, Department of Natural Resources, and the Game and Fresh Water Fish Commission.

We have reviewed this document and the state agency comments thereon. Based upon this review, we find that the documents lack adequate discussion or identification of impacts and activities located in the immediate surrounding area of the National Monument. We further note a lack of communication between federal and state agencies regarding the development of the plan and therefore suggest the establishment of a working relationship with the Department of Natural Resources in developing management plans for the entire bay area.

RESPONSE:

The purpose of the General Management Plan is to set forth the framework to guide the future administration, development, resources management, visitor protection, and interpretation to achieve the purpose for which the monument was established.

In formulating the plan, over an approximately 5-7 year period, many agencies, individuals, special interest groups, etc., have been contacted for input and comment. The environmental statement is the Section 102 NEPA compliance document that accompanies the general management plan.

The commenting agency's attention is directed to the Proposal section, Interrelationships with Other Agencies and Projects, and to the Consultation and Coordination with Others section of the environmental statement. In addition, on January 25 and 26, 1978, further public meetings were held for public involvement on the environmental statement and proposed General Management Plan.

The agency's concern is noted and assurance is given that every effort will be made to maintain a working relationship with the Division of State Planning in the future on this and other National Park Service projects in the state of Florida.

In accordance with the Council on Environmental Quality guidelines concerning statement on proposed federal actions affecting the environment, as required by the National Environmental Policy Act of 1969, and U. S. Office of Management and Budget Circular A-95, this letter, with attachments, should be appended to the final environmental impact statement on this project. Comments regarding this statement and project contained herein or attached hereto should be addressed in the statement.

We request that you forward us copies of the final environmental impact statement and appreciate the opportunity to comment on these documents.

Sincerely,

R. G. Whittle, Jr.
Director

RGWjr/WOK/ba

Enclosures

cc: Mr. John Bethea
Mr. Charles Blair
Mr. Joseph W. Landers, Jr.
Mr. W. N. Lofroos
Mr. Loring Lovell
Mr. Harmon Shields
Mr. H. E. Wallace
Mr. Robert Williams
Mr. Walter O. Kolb

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION
2562 EXECUTIVE CENTER CIRCLE, EAST
MONTGOMERY BUILDING
TALLAHASSEE, FLORIDA 32301

REUBIN O'D. ASKEW
GOVERNOR

JOSEPH W. LANDERS, JR.
SECRETARY

Bureau of Intergovernmental Relations
JAN 13 1978
RECEIVED
SAI NO.

January 11, 1978

Loring Lovell, Chief
Bureau of Intergovernmental
Relations
Department of Administration
Division of State Planning
660 Apalachee Parkway
Tallahassee, Florida 32304

Dear Mr. Lovell:

Department of Interior, Draft Environmental Statement, General Management Plan for the Biscayne National Monument, Dade County, Florida, SAI No. 78-1002-E

325

The Department of Environmental Regulation has reviewed the above referenced environmental statement and management plan and submits the following comments:

1. The Draft EIS for Biscayne National Monument leaves several important questions unanswered. The "Unavoidable Adverse Impacts" section indicates that damage to grass beds and coral by boating activities (e.g., anchoring and propeller contact) will be "unavoidable." What areas are shallow enough to be subject to such damage? (A map designating such areas, could be provided.) Is it not possible to "rope off" such areas or otherwise designate that they are restricted from boating activities?

2. Enforcement procedures were not thoroughly addressed. What provisions have been made for patrolling the Monument area? Will rules and regulations be made clear to all visitors, then enforced? Who will do the enforcing and what authority will the enforcer have to prosecute? If fragile areas are restricted to boating, will these areas be regularly patrolled? Strict fines should be imposed on littering and enforced.

RESPONSE:

1. Areas especially vulnerable to propeller scarring are the shallow algae and marine grass beds occurring primarily in Biscayne Bay as depicted on the Marine Habitat map in the environmental statement. Areas such as channels through shallow areas have historically been delineated. Should ongoing monitoring reveal increased scarring in certain areas, measures will be taken to further protect the areas by restricting or eliminating such uses and/or activities.

RESPONSE:

2. The Monument is patrolled by commissioned federal law enforcement officers and local law enforcement officers. Presently the Park has eight qualified law enforcement persons enforcing 36 Code of Federal Regulations pertinent to this area. Our jurisdiction is "proprietary" and criminal activities not covered by 36 CFR are turned over to other law enforcement agencies. Proposals to Florida legislatures are underway to acquire "concurrent" jurisdiction, enabling the Monument to, additionally, enforce state laws.

Regulations are related to visitors by "posting" and verbal interpretation. A warning system is in effect to educate the visitor of unfamiliar regulations.

Fragile areas would always bring more attentive patrols, but present thrusts are in areas of highest visitor congestion.

Fines can be assessed up to $500 and/or 6 months in jail by the judicial courts, for 36 CFR infractions.

3. Another item of concern in the "Unavoidable Adverse Impacts" section, is habitat damage and loss anticipated on Elliott Key when the heavy equipment is brought in for construction of the visitors' facility. Has adequate thought been given to executing a facility design which will be compatible with the environment (e.g., minimizing the equipment needed and the actual alteration of the surroundings)? An extremely rustic facility would require a minimum of equipment and damage.

4. The construction of a marina facility will require permits from this department under Chapters 253 and 403, Florida Statutes. Water Quality Certification is required under Public Law 92-500. Early coordination with this department should be made to eliminate problems in the permitting process.

The questions and issues raised in the discussion above should be addressed in the Final Environmental Statement and Management Plan. We would like to review the final statement and plan when completed.

Sincerely,

Robin L. Fletcher

Robin L. Fletcher
Intergovernmental Programs
Review Section

RLF/mk

cc: Warren Strahm

RESPONSE:

3. As per National Park Service policy, the design of facilities at Elliott Key will be accomplished within the intent of the monument's purpose, will be consistent with the natural surroundings and will result in the commitment and disturbance of a minimum of the monument's natural resources while adequately providing for visitor use.

RESPONSE:

4. The contents of this comment are recognized and appreciated.

STATE OF FLORIDA

Department of Administration

Division of State Planning

660 Apalachee Parkway IBM Building

TALLAHASSEE

32304

(904) 488-2371

Reubin O'D. Askew
GOVERNOR

R.G. Whittle Jr.
STATE PLANNING DIRECTOR

Lt. Gov. J. H. "Jim" Williams
SECRETARY OF ADMINISTRATION

TO: Mr Marvin Shields
Department of Natural Resources
202 Blount Street, Crown Building
Tallahassee, Florida 32304

DATE: 12-22-77

DUE DATE: 1-6-78

FROM: Bureau of Intergovernmental Relations

SUBJECT: SAI: 78-1002E

The attached "Advance Notification" of intent to apply for federal assistance is being referred to your agency for review and comments. Your review and comments should address themselves to the extent to which the project is consistent with or contributes to the fulfillment of your agency's plans or the achievement of your projects, programs and objectives.

If further information is required, you are urged to telephone the contact person named on the notification form. If a conference seems necessary, or if you wish to review the entire application, contact this office by telephone as soon as possible. If you have no adverse comments, you may wish to report such by telephone. Please check the appropriate box, attach any comments on your agency's stationery, and return to this office or telephone by the above due date. If we do not receive a response by the due date, we will assume your agency has no adverse comments. In both telephone conversation and written correspondence, please refer to the SAI number.

Sincerely,

Loring Lovell, Chief
Bureau of Intergovernmental Relations

Enclosure

****

TO: Bureau of Intergovernmental Relations
FROM: Department of Natural Resources
SUBJECT: Project Review and Comments, SAI: _____

☐ No Comments ☒ Comments Attached

Signature: James R. Smith Date: Jan. 20, 1978

Title: Administrative Assistant

January 20, 1978

Department of Natural Resources
comments on
SAI: 78-1002E
by
Division of Resource Management
(Bureau of State Lands)

The staff of the Bureau of State Lands has reviewed the above-referenced proposal and offers the following comments.

Because the State of Florida's Department of Natural Resources has the responsibility for managing Aquatic Preserves and since the Biscayne National Monument is adjacent to aquatic preserves both in Biscayne Bay and the Atlantic Ocean, it is imperative that good communications be maintained in order to assure consistency between Federal and State management programs. We would therefore encourage the National Park Service to establish communication with the Department of Natural Resources for our mutual benefit in ongoing management programs for public lands.

RESPONSE:

Every effort will be made to establish and maintain on-going communication with the Department of Natural Resources for the mutual benefit and coordination of management efforts and programs for Biscayne National Monument and the adjacent aquatic preserve.

STATE OF FLORIDA

Department of Administration

Division of State Planning

660 Apalachee Parkway - 530 Building

TALLAHASSEE

32301

(904) 488-2371

Reubin O'D. Askew
GOVERNOR

R.G. Whittle, Jr.
STATE PLANNING DIRECTOR

Lt. Gov. J. H. "Jim" Williams
SECRETARY OF ADMINISTRATION

TO: Mr. H. E. Wallace
Game & Fresh Water Fish Commission
Bryant Building
Tallahassee, Florida 32304

DATE: 12-22-77

DUE DATE: 1-6-78

FROM: Bureau of Intergovernmental Relations

SUBJECT: SAI: 78-1002E

The attached "Advance Notification" of intent to apply for federal assistance is being referred to your agency for review and comments. Your review and comments should address themselves to the extent to which the project is consistent with or contributes to the fulfillment of your agency's plans or the achievement of your projects, programs, and objectives.

If further information is required, you are urged to telephone the contact person named on the notification form. If a conference seems necessary, or if you wish to review the entire application, contact this office by telephone as soon as possible. If you have no adverse comments, you may wish to report such by telephone. Please check the appropriate box, attach any comments on your agency's stationery, and return to BISR or telephone by the above due date. If we do not receive a response by the due date, we will assume your agency has no adverse comments. In both telephone conversation and written correspondence, please refer to the SAI.

Sincerely,

Loring Lovell, Chief
Bureau of Intergovernmental Relations

Enclosures

****

TO: Bureau of Intergovernmental Relations
FROM: Game & Fresh Water Fish Commission
SUBJECT: Project Review and Comments, SAI: 78-1002E

[xx] No Comments
[ ] Comments Attached

Reviewing Official:
Signature: Dan Dunford Date: Jan. 5, 1978

Title: Director, Office of Environmental Services

STATE OF FLORIDA

Department of Administration

Division of State Planning

660 Apalachee Parkway IBM Building

TALLAHASSEE

32304

(904) 488-2371

Reubin O'D. Askew
GOVERNOR

Lt. Gov. J. H. "Jim" Williams
SECRETARY OF ADMINISTRATION

R.G. Whittle, Jr.
STATE PLANNING DIRECTOR

DIVISION OF STATE PLANNING
Bureau Of
Intergovernmental Relations
JAN 4 1978
RECEIVED
SAI NO.

TO: Honorable Doyle Conner, Commissioner
Department of Agriculture and
Consumer Services
The Capitol
Tallahassee, Florida 32304

DATE: 12-22-77

DUE DATE: 1-6-78

FROM: Bureau of Intergovernmental Relations

SUBJECT: SAI: 78-1002-E

The attached "Advance Notification" of intent to apply for federal assistance is being referred to your agency for review and comments. Your review and comments should address themselves to the extent to which the project is consistent with or contributes to the fulfillment of your agency's plans or the achievement of your projects, programs, and objectives.

If further information is required, you are urged to telephone the contact person named on the notification form. If a conference seems necessary or if you wish to review the entire application, contact this office by telephone as soon as possible. If you have no adverse comments, you may wish to report such by telephone. Please check the appropriate box, attach any comments on your agency's stationery, and return to this office by the above date. If we do not receive a response by the due date, we will assume your agency has no adverse comments. In both telephone conversation and written correspondence, please refer to the SAI number.

Sincerely,

Loring Lovell, Chief
Bureau of Intergovernmental Relations

Enclosure

****

TO: Bureau of Intergovernmental Relations
FROM: Department of Agriculture and Consumer Services
SUBJECT: Project Review and Comments, SAI: _____

☐ No Comments ☐ Comments Attached

Signature: _____ Date: _____

Title: _____

STATE OF FLORIDA

Department of Administration

Division of State Planning

660 Apalachee Parkway IBM Building

TALLAHASSEE

32304

(904) 488-1115

Reubin O'D. Askew
GOVERNOR

Wallace W. Henderson
SECRETARY OF ADMINISTRATION

R.G. Whittle, Jr.
STATE PLANNING DIRECTOR

February 7, 1978

Mr. James L. Bainbridge, Acting
Regional Director
Southeastern Region
National Park Service
1895 Phoenix Blvd.
Atlanta, Georgia 30349

Dear Mr. Bainbridge:

In reference to our February 2, 1978, letter of response to your General Management Plan and DEIS Biscayne National Monument Dade County, Florida SAI 78-1002E, we hereby transmit for additional consideration review comments by the Department of State.

We appreciate the opportunity to submit these additional comments and request that they be considered as part of our earlier response.

Sincerely,

R. G. Whittle, Jr.
Director

RGWjr/WOK/ba

Attachment

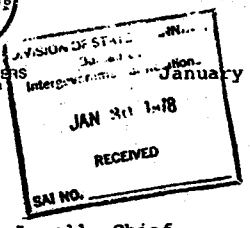
cc: Mr. L. Ross Morrell

STATE OF FLORIDA

Department of State

THE CAPITOL
TALLAHASSEE 32304

BRUCE A. SMATHERS
SECRETARY OF STATE



January 23, 1978

L. Ross Morrell,
Acting Director
DIVISION OF ARCHIVES, HISTORY, AND
RECORDS MANAGEMENT
(904) 488-1480

IN REPLY REFER TO:

Mr. Loring Lovell, Chief
Bureau of Intergovernmental Relations
Division of State Planning
660 Apalachee Parkway
Tallahassee, Florida 32304

Re: SAI 78-1002E
General Management Plan and DEIS
Biscayne National Monument
Dade County, Florida

Dear Mr. Lovell:

In accordance with the procedures contained in 36 C.F.R., Part 800 ("Procedures for the Protection of Historic and Cultural Properties"), we have reviewed the above referenced project for possible impact to archaeological and historical sites or properties listed, or eligible for listing, in the National Register of Historic Places. The authorities for these procedures are the National Historic Preservation Act of 1966 (Public Law 89-665) as amended by P.L. 91-243, P.L. 93-54, P.L. 94-422, and P.L. 94-458, and Presidential Executive Order 11593 ("Protection and Enhancement of the Cultural Environment").

It is the opinion of this office that the proposed management plan will have no adverse impacts on any properties listed, or eligible for listing, in the National Register of Historic Places if the following measures are taken as described in the documents:

1) During all construction involving subsurface disturbance, a professional archaeologist with the authority to stop construction should be present to observe work.

2) The large-unit historic zone alternative is utilized for the coral reef area. This would avoid drawing attention to individual wreck sites and facilitate other protective measures.

332

RESPONSE: The attention of the commenting agency is directed to the Mitigating Measures section, under Cultural Resources, where this mitigation is incorporated.

RESPONSE: In the Proposal section of the environmental statement, under Management Zone Classification, Historic Zone, is "the entire offshore reef area and one small area in Hawk Channel are proposed for classification as a historic zone."

3) Strict enforcement of existing Park Service policies and legislation against the looting of historic sites.

4) Significant wreck sites should be monitored to determine if access to the historic zone leads to damage to the wrecks and if additional protective measures are necessary.

With these measures, we feel that the proposed management plan would involve no adverse impacts to any historic resources and, through education of the public, might even be beneficial to sites not afforded the protection of inclusion in a national monument.

The opportunity to comment is appreciated.

Sincerely,

L. Ross Morrell
Deputy State Historic
Preservation Officer

LRM:Seh

RESPONSE:

Existing National Park Service protection enforcement and penalties for looting of historic sites will be strictly applied

RESPONSE:

Significant wreck sites will be monitored to determine if additional measures to protect the zone and its resources are necessary.

SINCE NINETEEN-HUNDRED "THE VOICE OF CONSERVATION"

January 24, 1978

Mr. James L. Bainbridge
Acting Regional Director
National Park Service
U.S. Dept. of Interior
1895 Phoenix Blvd.
Atalnta, GA 30349

Re: Proposed General Management Plan and Draft Environmental Impact Statement
Biscayne National Monument, Florida

Dear Mr. Bainbridge:

The Following comments and recommendations constitute the position of the Florida Audubon Society relative to the draft management plan for Biscayne National Monument.

334

GENERAL OBSERVATIONS

1. We heartily endorse the general management concept of providing for visitor use through an absolute minimum of structural improvements. This policy offers the best hope of preserving a variety of resources and unspoiled natural landscapes for future generations. In particular, we strongly endorse the abandonment of earlier plans to construct visitor facilities on the authorized 40 acre tract on north Key Largo. The construction of this facility would unnecessarily destroy important wetland habitat. Visitor access may be more effectively provided from other points of embarkation, such as convoy point on the western shore of Biscayne Bay, where considerable development and disturbance already exist.

RESOURCE CLASSIFICATION

2. The Florida Audubon Society generally endorses the proposed resource classification of the lands and waters within the Biscayne National Monument. We do recommend, however, the extension of the environmental protection subzone to incorporate portions of Elliot and Sands Keys which support the growth of West Indian hardwood hammock species and the Sargent's Palm (Pseudophoenix Sargenti). Elliot Key-Sands Key contain the largest expanses of West Indian

921 Lake Sybelia Drive • P. O. Drawer 7 • Maitland, Florida 32751
(305) 647-2615

RESPONSE:

1. The comment is noted and appreciated.

RESPONSE:

2. It is felt by the National Park Service that the West Indian hardwood hammock vegetation on Old Rhodes and Totten Keys comprise the best representations of this association in the monument. This area is currently classified as an environmental protection subzone and is afforded the protection pursuant to such classification. The Sargent's palms on Elliott Key typically occur in clumps on the northern end of the key, in an area of minimal visitor pressure. Since no development is proposed for this area it is felt that sufficient protection is afforded under the proposed natural land classification designation. Furthermore, all species of the palm family native to the State of Florida except the saw palmetto are protected pursuant to Section 865.06 of the Florida Statutes.

hardwood hammock under protection by the federal government in the Continental United States. These irreplacable and fragile terrestrial plant associations should be preserved with meticulous care, even if this means placing limitations on visitor use in some areas. In this regard, we strongly suggest that the unit management objectives described on pages 36 and 37 of the proposed plan be amended to include, under the topic "resource preservation" the "protection of unique West Indian hardwood hammocks, and other rare terrestrial plant species."

ADDITIONAL RECOMMENDATIONS

5. 1. While the descriptive portions of the proposed plan (p 4) reference the "... increasing threat of rapid development of the shoreline along South Biscayne Bay for both residential and industrial purposes..." and note the fact that" ... development of any kind below the mean high water line along the bay would virtually assure alteration of the life communities within the monument.", the plan contains no specific proposals to deal with or manage these threatening influences. Several possible courses of action exist, which singly, or in combination, would significantly lessen the threat to the monument from development encroachments. The Florida Audubon Society strongly recommends that the National Park Service amend the management plan for Biscayne National Monument to specifically incorporate the measures for protecting the monument from development. Suggested are the following:

A. Participation in Regulatory Proceedings as an Interested Party.

4. The National Park Service should institute a policy of seeking to intervene as a substantially interested party in state and federal permit proceedings concerning activities which may adversely impact the resources of the monument. The Park Service should actively oppose such encroachments before all available government forums, at the local, state and federal level. This practice has only been irregularly employed in National Park Service units in Florida in the past. We firmly believe that it should be institutionalized as a matter of standing policy.

B. Westward Expansion of the Monument Boundary and Acquisition of Additional Lands along the Western Shoreline of Biscayne Bay.

5. The period during which legislation establishing the Biscayne National Monument was proposed and ultimately approved by Congress (1965-1968) was a time of much speculation concerning the future of the southern portion of Dade County. Considerable interest in the development of the western shoreline of South Biscayne Bay for seaport, residential and commercial purposes caused the monument boundary to be drawn in such a way as to exclude this shoreline. Recognizing the considerable changes which have taken place since the time that

RESPONSE:

5.

Concerns of the Florida Audubon Society are appreciated, well taken, and potential problems noted. Management policies and procedures are difficult to assess in a plan directed to positive proposals, actions, and their impact on the environment. The National Park Service will continue active participation in planning phases on Dade County master plan zoning and development. They will also continue the practice of involvement in public hearings or proposed development that would affect the Monument and, where appropriate, will voice opposition to environmentally unsound proposals.

RESPONSE:

4. Policy of the National Park Service and Biscayne National Monument dictates active public involvement in all aspects of community actions which directly or indirectly affect operation and management of the area. This practice of reviewing all permits for the local area and taking action on that which may affect the monument will be continued as in the past.

However, in some cases the agencies of the Department of the Interior become involved in environmental problems. In this case, it is the Department's policy that one agency in the Department as designated by the Department, will serve as the spokesman for all involved Interior Department agencies. On occasion the Department may assume this role rather than delegating this responsibility to a particular agency.

As an example, the U.S. Fish and Wildlife Service speaks for all Interior agencies on Corps permits. The National Park Service reviews each permit and sends its comments to the Fish and Wildlife Service which then combines our comments with their own and those of other Interior Department bureaus and then sends one combined set of comments to the Corps.

RESPONSE:

5. The premise of the proposed plan to do with the management and conservation of the monument as it exists today. No boundary changes or extension of the monument or other legislative changes are contemplated or considered in this plan.

the act establishing the monument was first passed by Congress, (including the adoption of Dade County's comprehensive Land Use Plan) it may now be appropriate to consider seeking legislative authority to extend the boundary to encompass the western shoreline area. Much of the land required for such an extension lies below the mean high water mark, and hence, is owned by the State of Florida. The State's position on including this land in the national monument may today be considerably different than it was 10 or more years ago, when state policy actively promoted the development of such areas. Today, it is doubtful that permits for anything greater than marginal development of the western shoreline of Biscayne Bay could be obtained from the State Department of Environmental Regulation and the U.S. Army Corps of Engineers. For this reason, private interests which once would have vigorously opposed the inclusion of the western shoreline of the bay may have a different attitude, or level of concern. Approximately one third of the western shoreline of Biscayne Bay which fronts on the monument boundary (the area from Turtle Point south to Card Sound) has been quit-claimed by the Florida Power and Light Corporation to the State of Florida for management under the state wilderness system. The inclusion of this area within the monument boundary would be a logical first step toward placing the critical western shoreline area under National Park Service jurisdiction to facilitate the comprehensive management of the resources of South Biscayne Bay.

C. Elimination of Navigation Channel Easements

6. At the time that the state conveyed its interest in the submerged lands of Biscayne Bay to the federal government, 6 channel easements were reserved by the state in anticipation of future development along the Bay's western shoreline. In addition, the original legislation establishing Biscayne National Monument limited the extension of boundaries to exclude then proposed seaport channels, at the northern and southern extremities of the monument. With the exception of the navigation channels serving the Florida Power and Light Corporation's facility at Turkey Point, and the Park Service's Convoy Point complex (identified as #'s 3 and 4 on the easement map, p.201 of the draft environmental statement), these easement reservations are anachronisms which should be expeditiously eliminated. Similarly, reference to seaport channels in the monument's authorization legislation should be eliminated, since active consideration of seaport development in South Biscayne Bay has long since ceased and would in fact be inconsisent with the comprehensive Land Use Plan of Dade County.

7. 2. The subjects of spearfishing, and the collection of tropical fish in monument waters are briefly mentioned in the plan, but little firm direction is provided toward the control of these potentially harmful activities. We strongly urge the National Park Service to take prompt action to eliminate

RESPONSE:

6. An easement for a seaport channel south of the monument was eliminated when the boundary extension of 1974 extended monument boundaries south to form a common line with John Pennekamp Coral Reef State Park.

The existing plan has to do with the management and conservation of the park as it exists today. The channels referred to on page 201 of the draft statement are in that section describing existing legislative and legal guidelines, regulations, and restrictions on park management.

While there is merit in the suggested changes, seeking legislative changes is a time-consuming and expensive process to both our agency and the Congress. Since we do not find these references in the legislation causing administrative or management problems at this time, we do not choose to seek remedial legislation at this time. If and when remedial legislation is considered necessary for any reason, we will also examine language revision to bring the authorizing legislation up-to-date.

RESPONSE:

7. Enabling legislation clearly states that fishing activities can be restricted or discontinued if research studies demonstrate adverse impacts. Research studies are currently underway to acquire the necessary information to regulate or prohibit this activity.

The collecting of tropical fish from within the boundary of Biscayne National Monument is prohibited pursuant to Section 2.20 of Title 36 of the Code of Federal Regulations.

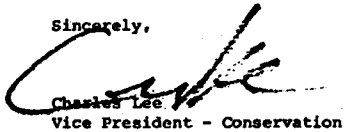
spearfishing and enforce restrictions against tropical fish collection within monument waters. The harmful effects of spearfishing are widely known and documented. While spearfishing is not universally condemned, it is certainly not an appropriate activity for waters under the jurisdiction of the National Park Service. Similarly, tropical fish collection for either personal or commercial purposes is a use of the monument which can only act to deprive the majority of the public of the enjoyment of the beauty of monument waters.

8 3. The aquatic resources of Biscayne National Monument are fragile in nature, and easily disturbed by high intensity recreational activities. The highest and best use of these resources is passive enjoyment by the public, and preservation for future generations. Water based recreation activities which can just as easily be accommodated in areas where fragile resources are less prominent should be actively discouraged by the National Park Service, and prohibited where necessary.

In particular, the operation of high speed motorboats in shallow waters is a subject of concern. Propeller scars not only diminish the biological productivity of grass beds, but also threaten the unique clarity of the waters of South Biscayne Bay by exposing fine particulate matter to currents and wave action. Water skiing, and other activities which threaten fragile bottom environments should not be permitted in the vicinity of shallow water and grass flats. As monument waters become more crowded, strict regulation of motorboat operation will be necessary to the safety and enjoyment of the public in the monument in addition to the protection of the environment. Steps taken now to educate the public and gradually phase in regulations concerning motorboat use may be more easily accepted and understood by boaters than harsher controls which would be necessary should use of monument waters be allowed to grow steadily beyond manageable proportions.

In conclusion, we would like to commend the National Park Service for an overall excellent plan. With consideration of the recommendations outlined above, we are confident that the resources of the monument will be protected for the enjoyment of the public in perpetuity.

Sincerely,



Charles Lee
Vice President - Conservation

rd

cc: Senator Lawton Chiles
Senator Richard Stone
Representative Dante Fascell

337

RESPONSE:

8. Areas especially vulnerable to propeller scarring are the shallow algae and marine grass beds occurring primarily in Biscayne Bay as depicted on the Marine Habitat map in the environmental statement. Areas such as channels through shallow areas have, historically, been delineated. Should ongoing monitoring reveal increased scarring in certain areas, measures will be taken to further protect the areas by restricting or eliminating such uses and/or activities.

Florida Marine Aquarium Society

MUSEUM OF SCIENCE 3280 SOUTH MIAMI AVE. MIAMI, FLA. 33129

February 21, 1978

Mr. James L. Bainbridge
Southeast Regional Office
National Park Service
1895 Phoenix Boulevard
Atlanta, Georgia 30349

Dear Sir:

In regards to the recent proposed General Management Plan for the Biscayne National Monument, the Florida Marine Aquarium Society feels that the collection of tropical marine fishes by private individuals for their own personal use should be allowed in the Monument waters. It is our belief that this sort of activity does not produce any long term effect on the fish populations in the Monument. Since there is apparently no evidence that private collection damages the fish populations, we feel that the law should be changed.

We would like to add that at a public hearing concerning the Monument which was held on January 25th, Mr. Gerard Loisel was the only person in attendance who was authorized to represent the Florida Marine Aquarium Society. The statement which he made reflects the views of our club and was the same statement which we made at a public hearing approximately 2 years ago.

Our club has objected to the laws concerning tropical fish collecting in the Monument since the Monument's inception and our position remains unchanged. We hope that you will consider our position in finalizing the General Management Plan for the Monument.

Sincerely,

FLORIDA MARINE AQUARIUM SOCIETY

Mrs. C. Smith, President

CS:jb

338

RESPONSE:

The collecting of tropical marine fishes from within the boundary of Biscayne National Monument is prohibited pursuant to Section 2.20 of Title 36 of the Code of Federal Regulation.

METROPOLITAN DADE COUNTY • FLORIDA
80 S. W. 32ND ROAD
MIAMI, FLORIDA 33129
PHONE 854-3530
PARK & RECREATION DEPARTMENT

January 6, 1978

Mr. James L. Bainbridge, Acting Regional Director
National Park Service, Southeast Regional Office
1895 Phoenix Boulevard
Atlanta, Georgia 30349

Re: L7617-SER-PP

Dear Mr. Bainbridge:

We have reviewed the Draft Environmental Statement and the General Management Plan for Biscayne National Monument. I would like to state that we greatly appreciate the opportunity to provide our comments and thoughts into the planning process. We feel there are a couple of pertinent points that must be made in regard to the property which Dade County deeded to the National Park Service. In your draft and management plan, this area is referred to as Convoy Point which currently has an information center, an operations center, parking lot and public boat ramp. Currently this is the only facility, in both Homestead Bayfront Park and the mainland center for Biscayne National Monument, where a person can launch his boat off of his trailer. As your plan stated, the County is in the planning stage of the expansion of Homestead Bayfront Marina. However, no determination has been made as to whether boat ramps will be provided in our expansion plans. This raises a question which must be resolved between the two agencies as to who will provide this service.

If in the County planning efforts it is determined that boat ramp facilities will not be provided, the closing of the boat ramp at Convoy Point would limit access to the Monument. Two things could result from this: (1) visitation would be reduced, probably significantly or (2) the concession boat service to the various areas would probably increase in expected users, causing a need for additional parking facilities at Convoy Point. The exact number, size and type of facilities to be provided in the improvements at Homestead Bayfront Park have not been determined. The development schedule is unsure because of limited funding. Once final plans have been completed, it would be advisable for the National Park Service and representatives from Dade County to discuss operations strategies in order to eliminate the duplication of services.

Your plan alludes to but does not address the fact that Dade County currently is planning to develop or improve other areas along Biscayne Bay, which could potentially impact Biscayne National Monument. Black Point Park abutts

339

RESPONSE:

Negotiations on transfer of a portion of Homestead Bayfront Park to the National Park Service resulted in the creation of a Memorandum of Agreement. This agreement states in part that the National Park Service shall "...assume control of and operate and maintain the existing boat launching ramp facility and adjacent parking area for use of the visiting public in accordance with policies and regulations of the Park Service until such time as Dade County, Florida, constructs a replacement ramp facility in the Homestead Bayfront Park.

Proposed management actions in the plan reflect adherence to this commitment.

the northern boundary of the monument and Chapman Field is approximately 6 miles north of the monument. It is pointed out that many of the current visitors boat from Matheson Hammock to the monument area. Once the two new County marinas are opened additional opportunities will be available for the boating public to utilize the area. We do not believe your impact statement addresses this consideration in depth. Although there will probably be no impact created within the next three to five years, we feel that it merits further exploration.

The ecosystems of the marine environment are fragile and it is difficult to assess man's impact or potential impact on them. We would like to take this opportunity to say that we find your environmental impact statement well done. If our Department can be of any assistance in the future, please feel free to contact us.

Sincerely,

Bill Bird, Director
Park & Recreation Department

DI:cw

RESPONSE:

The intent of this General Management Plan is to provide the framework to guide the administration, development, resource and visitor protection and interpretation for Biscayne National Monument. The typical effective life of such a plan is 8-10 years. However, at any point when the plan's effectiveness becomes substandard or is rendered obsolete by the introduction of factors heretofore not addressed (i.e., exterior boating pressures from recently opened park or marina), it will then be updated and the additional factors considered."Potential development" outside the monument cannot be addressed,as specifics are needed for identification and quantification purposes. As new marinas are constructed and rendered operational and as other park activities and influences change in the future, determination will be made if the effects on the General Management Plan in force are of sufficient magnitude to necessitate revising the existing management framework and objective.

south florida regional planning council
1515 n.w. 167th street, suite 429, miami, florida 33169 305/621-5871

January 3, 1977

David D. Thompson, Jr.
Regional Director, Southeast Region
National Park Service
1895 Phoenix Blvd.
Atlanta, Georgia 30349

RE: SFRPC No. 77-1237 - Biscayne National Monument

Dear Mr. Thompson:

We have reviewed the draft General Management Plan and Environmental Statement for Biscayne National Monument in accordance with areawide clearinghouse procedures specified in U.S. Office of Management and Budget Circular A-95.

Providing for access to and use of public open space is desirable. We would suggest that greater attention be devoted to the matter of the sustained volume of use that can be borne by the Monument prior to adoption of a management plan. The documents show a projected visitation increase of 2.5 times the 1975 level to 750,000 visitors. It would seem to be potentially less awkward for the National Park Service to determine whether the resource will support 3/4 of a million visits, and incorporate that level in the management plan, rather than have to reduce the use of the facility in a few years.

Please attach a copy of this letter to your application to assure compliance with the guidelines of OMB Circular A-95.

Sincerely yours,

M. Barry Peterson, AIP
Executive Director

MBP/rnh

cc: Bureau of Intergovernmental Relations,
Division of State Planning
The Honorable Rose Gordon
The Honorable Wm. Ray Hodges
The Honorable Clara Oesterle
The Honorable William Oliver
The Honorable Harvey Ruvin
The Honorable Jerry Hernandez
The Honorable Jerome Shipley

341

RESPONSE:

The concept of carrying capacity has historically been a difficult one to address due to such parameters as intangible human values and, in this case and many National Park Service units, the myriad of ecological systems and their inherent complexities and sensitivities. In the case of Biscayne National Monument superimposed on these considerations are the facts that no baseline data is available and no management framework is extant to guide future development, administration, protection and interpretation of the monument and its resources. Accordingly, the National Park Service is moving forward with the preparation of this general management plan but is also implementing such studies as necessary to identify and evaluate those parameters which will define allowable visitation levels considering resource sensitivity, visitor demand, and the purpose for which the monument was established.

16 February 1978; -10°C

Regional Director
Southeast Region
National Park Service
1895 Phoenix Blvd.
Atlanta, GA 30349

Dear Mr. Bainbridge:

Thank you for sending me copies of the draft General Management Plan and associated draft Environmental Statement for Biscayne National Monument, as per my request. I have reviewed both documents and find them well-done, comprehensive, and in accordance with NEPA and CEQ guidelines. Your professional staff and the Denver Service Center team are to be congratulated. My comments follow:

Draft General Management Plan

1. Regarding Access and Circulation, page 13; Why should the cost of the proposed tour-boat fee be "at a level that is comparable with other similar services in the Keys..?" Are you dealing with a competitive market? The federal government is not a profit-making operation and there should be no reason why the fees cannot be substantially less that similar fees nearby to promote visitation and use of the tour-boat as opposed to private boats. Keeping prices similar to other operations in the Keys sounds like price-fixing and is unnecessary.

2. Regarding Land Acquisition, page 13; Exactly what steps to acquire control of waters immediately east of the reef zone will be undertaken? The Bureau of Land Management will not be eager to surrender these lands. The Continental Slope begins within a few kilometers of the outer reef zone and some demarcation of authority is required as soon as possible.

342

3. Regarding Development (Adams Key), page 17; While I do not wish to spend time on correcting grammar, saying "It is immediately adjacent to the 15- to 30-foot-deep naturalchannel..." is awful. "Immediately adjacent" is redundant. Something is either adjacent, or it isn't. Adjacent means "next to", so you are saying "next to next to". The grammar throughout the Plan and Statement is generally excellent.

4. Regarding Recreational Use Areas, page 18; Both the Plan and Statement imply that damage to the coral and reef areas from anchors is a real concern. What mitigating measures will be taken? Have permanent mooring buoys or sea-anchor type anchors been considered? More comment should be addressed to this very real problem. The Plan should be more specific.

Draft Environmental Statement

5. Access and Circulation Modes and Routes, page 12; The Statement notes that a transportation study will be undertaken to determine the best routes for public transit within the Monument. The Environmental Statement is the place to denote those routes for consideration. Route selection will have a significant effect on resource use and misuse, and this important issue should have been addressed in the Statement.

6. Regarding Resource Uses (spearfishing), page 21; While the enabling legislation says that traditional uses of the Monument area should continue, spearfishing can be very detrimental to living coral communities. The projectile can strike the rock at great speed, even after passing through a fish, and many decades of growth destroyed. The Park Service should consider some sort of control over spearfishing if it is demonstrated that this use has a deleterious impact on the coral resource.

RESPONSE:

1. As pointed out under Access and Circulation in the General Management Plan, the programmed transportation study will determine the operational details of the transportation system. It is not the intent of the National Park Service to condone or operate "price-fixing" activities. In this case, the intent is to make such an operation financially attractive while keeping the cost to potential users from being prohibitive.

RESPONSE:

2. The National Park Service is sympathetic to the tone and intent of the comment. Plying normal legal and bureaucratic channels will be necessary before jurisdictional transfer is consummated. The National Park Service recognizes this under Land Acquisition in the General Management Plan and is making every effort to achieve this end expeditiously.

RESPONSE:

3. The text of the general management plan has been adjusted to reflect this comment.

RESPONSE:

4. Temporary mooring buoys are currently being experimented with at selected locations in the reef area to determine applicability.

While more comment could be addressed to this problem, due to the early experimental phase of the research project, further discussion is not possible at this time.

RESPONSE:

5. While precise alignment of transportation corridors has not been defined, the nature of bay, its attendant water depth and bottom compositions coupled with the ultimate intent of the enabling legislation for the monument dictated the level of analysis presented in the environmental statement. Assuming "worst case" conditions, it is felt these parameters allowed adequate discussion of potential impacts which could occur from the implementation of this facet of the proposal.

RESPONSE:

6. The comment is noted. In the Proposal section of this document under Significant Concerns of the General Management Plan, Resource Uses, it is stated: "Recognizing that certain resource uses, such as spearfishing, would pose potential conflicts with other uses, the enabling act included a provision directing the Secretary of the Interior to institute management regulations that would provide for conservation of the full range of monument values." Further attention is directed to the response to the comment by the Environmental Protection Agency on this subject.

7. As you obviously know by now, the key to the legend on the map of vegetation habitat on Old Rhodes Key is missing, opposite page 69.

8. Regarding endangered species, page 70; The eastern indigo snake has just been listed as endangered, and I believe its habitat includes the Monument's mainland areas. This reptile should be added to the list of endangered species found in or near the Monument and management objectives structured accordingly. Also, the land hermit crab, also found in and near the Monument, is the target of collectors for sale in pet stores. Park Service policy prohibits collection, but the Monument management should work with Florida state officials to protect this animal in its habitats near the Monument.

9. Regarding Existing Recreational Use, page 86; Water skiing is popular and on-going in the Monument. But due to the shallowness of the waters, the scarring of the coral by boat propellers, and the intrusion of this form of recreation on other recreation seekers, this form of recreation should either be restricted to certain areas of the monument or
10. prohibited entirely. Discharges from private boats (human wastes) should also be prohibited and posted on Monument boundary signs. The effects
11. of noise from underwater exhaust of motor boats should also be addressed in the Statement, although the impact of this phenomenon may be impossible to quantify. Does the noise affect fishes? Fracture coral? Can sea
12. anchors be required so steel hook anchors will not damage coral? Perhaps a fabric anchor could be rented at Monument visitor contact stations for use within Monument waters. Sea anchors use water held in inverted parachute-shaped cones for ballast and may work in shallow water as they do in deeper ocean waters.

343

Thank you for the opportunity to comment on these documents. I support the General Management Plan in principle but desire to see more cooperation among Biscayne National Monument, Everglades National Park, and John Pennekamp Coral Reef State Park to "steer" recreation seekers towards the different types of recreation and resources to be found in the three parks. In this manner, park resources can best be protected.

Sincerely,

David L. Schein

David L. Schein

5219 N. Reserve
Chicago, Illinois 60656

RESPONSE:
7. **The graphic has been adjusted to reflect this comment.**

RESPONSE:
8. **It is the intent of the National Park Service management to achieve the goals of and comply with the Endangered Species Act of 1973 as well as meet the purposes for which the monument was established, "to preserve and protect for the education, inspiration, recreation and enjoyment of present and future generations, a rare combination of terrestrial, marine and amphibious life in a tropical setting of great natural beauty."**

To this end, adequate consideration will be given to wildlife protection.

The eastern indigo snake has been designated as a threatened species by the U.S. Fish and Wildlife Service.

RESPONSE:
9. **Water skiing activities occur primarily in the bay removed from the oceanside coral communities and is concentrated in this area. If use of the bay for this activity conflicts with other recreational pursuits, appropriate regulations and restrictions will be applied.**

RESPONSE:
10. **Attention is directed to the previous response to the comment on the same subject by the Environmental Protection Agency. It is felt that such information is readily available to boater owners and operators and posting on monument boundary markers is not necessary.**

RESPONSE:
11. **The commenting individual's attention is directed to Section III.A.4, page 104 of the draft environmental statement for a discussion of the impacts of noise.**

RESPONSE:
12. **At present, the use of sea anchors and temporary mooring buoys can only be encouraged until actual steel hook damage to corals is substantiated.**

B I B L I O G R A P H Y

CARLTON, J.M.
1974 "Land-Building and Stabilization by Mangroves," Environmental Conservation, Vol. 1, No. 4, pp. 285-294.

CRAIGHEAD, F.C.
1964 "Land, Mangroves and Hurricanes," Bulletin of the Fairchild Tropical Gardens, Vol. 19, No. 4, pp. 1-28.

DADE COUNTY BUREAU OF VITAL STATISTICS
1975 "Population Data for Dade County, Florida," personal communication with unidentified employee, December. Miami, FL.

DAVIS, J.H.
1940 "The Ecology and Geologic Role of Mangroves in Florida," Papers of the Dry Tortugas Lab, Vol. 32, No. 16, pp. 307-409. Carnegie Institute.

DAVIS, W.P.
1941 "The Ecology of Vegetation and Topography of the Sand Keys of Florida," Papers of the Dry Tortugas Lab, Vol. 33, pp. 113-195. Carnegie Institute.

DOLAN, R., AND R. GLASSEN
1972 "Oregon Inlet, North Carolina: A History of Coastal Change," Southeastern Geographer, Vol. 13, No. 1, pp. 14-15.

DUNN, G.E., AND E.I. MILLER
1960 Atlantic Hurricaner. Baton Rouge, LA: Louisiana State University Press.

EBBS, N.K.
1966 "The Coral Inhabiting Polychaetes of the Northern Florida Reef Tract. Part I - Aphroditidae, Polynoidae, Amphinomidae, Eunicidae, Lepartidae," Bulletin of Marine Science, Vol. 16, No. 3, pp. 485-555. Miami, FL: University of Miami.

FLORIDA DEPARTMENT OF NATURAL RESOURCES
1972 Florida Mangroves as Shoreline Stabilizers, by T. Savage, Professional Paper Series No. 19. St. Petersburg, FL: Marine Research Laboratory.

FLORIDA DEPARTMENT OF NATURAL RESOURCES, BUREAU OF BOAT REGISTRATION
1975 "Boat Registration, Florida," personal communication, November 10. Tallahassee, FL.

FLORIDA GAME AND FRESH WATER FISH COMMISSION
1975 "Florida's Endangered Wildlife Conservation Plan," May 13 rev. Tallahassee, FL.

GLEASON, PATRICK J., ed.
1974 Environments of South Florida, Past and Present, Memoir No. 2. Miami, FL: Miami Geological Society.

HAYS, M.O.
1967 Hurricanes as Geological Agents: Case Studies of Hurricanes Carla, 1961, and Cindy, 1963, Rep. Invest. 61, Austin, TX: University of Texas, Bureau of Economic Geology.

HEALD, E.J.
1971 The Production of Organic Detritus in a South Florida Estuary, Sea Grant Technical Bulletin No. 6. Miami, FL: University of Miami.

HOFFMEISTER, R., AND MULTER, H.G.
1968 Geology and Origin of the Florida Keys, Geological Society of America Bulletin 79.

INBODEN, DENNIS
1975 Personal communication, September 18. Planner, Metropolitan Dade County Parks Department, Miami, FL.

IRVING, BLAIR
1976 Personal communication, May 17, with biologist for U.S. Fish and Wildlife Service.

JACKIVICZ, R.P., AND L.M. KUZMINSKI
1973 "A Review of Outboard Motor Effects on the Aquatic Environment," Journal of the Water Pollution Control Federation, Vol. 45, No. 8, pp. 1759-1770.

JONES, J.A.
1963 "Ecological Studies of the Southeastern Florida Patch Reefs. Part I - Diurnal and Seasonal Changes in the Environment," Bulletin of Marine Science, Vol. 13, No. 2, pp. 282-307. Miami, FL: University of Miami.

MENKE, C.R.
1968 Economic Study of the Biscayne National Monument. Gainesville, FL: University of Florida, College of Business Administration, Bureau of Economic and Business Research.

METROPOLITAN DADE COUNTY COMMISSION
1974 Mangroves of Biscayne Bay, special report by H.J. Teas. Miami, FL.

METROPOLITAN DADE COUNTY, MIAMI-DADE WATER AND SEWER AUTHORITY
1974 "Typical Average Water Analysis Hialeah, Preston Plants, 1973-74." Miami, FL.

METROPOLITAN DADE COUNTY, OFFICE OF ECONOMIC DEVELOPMENT
1975 Economic Survey of Metropolitan Dade County, April rev. ed. Miami, FL: Planning Department.

PIERCE, J.W.
1970 "Tidal Inlets and Washover Fans," Journal of Geology, Vol. 78, pp. 230-234.

RANDALL, J.E.
1968 Caribbean Reef Fishes. Jersey City, NJ: T.F.H. Publications.

ROBERTSON, W.B.
1976 Personal communication, May 17. Everglades National Park.

ROBINSON, ALAN H.
1975 "Marine Parks: Planning for Recreation, Interpretation, and Environmental Education," Trends, July-August-September issue, pp. 9-22. Washington, D.C: National Society for Park Resources. (Available from National Park Service Division of Federal, State, and Private Liaison.)

SCHMITZ, HANS
1975 Personal communication, September 18. Chief, Evaluation and Planning Department, Dade County Department of Natural Resources, Miami, FL.

STARCK, W.A.
1968 "A List of the Fishes of Alligator Reef, Florida," Undersea Biology, Vol. 1, No. 1, pp. 1-40.

STEPHENSON, T.A., AND A. STEPHENSON
1950 "Life Between the Tide Marks in North America: The Florida Keys," Journal of Ecology, Vol. 38, No. 2, pp. 354-402.

THE MIAMI HERALD
1975 "Our Tourist, A Look at Mr. Average," December 10 issue.

U.S. DEPARTMENT OF THE AIR FORCE, HOMESTEAD AIR FORCE BASE
1975 "Air Installation Compatible Use Zone (AICUZ), a Report to the Governments and Citizens of the Homestead Air Force Base Environs, March 1975." Homestead Air Force Base, FL.

U.S. DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS

1965 Outer Banks Between Virginia State Line and Hatteras Inlet. Wilmington, NC: Wilmington District.

U.S. DEPARTMENT OF COMMERCE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

1969 "The Hurricane Storm Surge in South Florida," unpublished report by R.H. Simpson, N.L. Frank, and R.L. Carrodus. Miami, FL: National Hurricane Center.

1971 Atlantic Hurricane Frequencies Along the U.S. Coastline, by R.H. Simpson and M.B. Lawrence, Technical Memorandum SR-58. Fort Worth, TX: National Weather Service.

U.S. DEPARTMENT OF THE INTERIOR, FISH AND WILDLIFE SERVICE

1973 "Threatened Wildlife of South Florida," by D.P. Rodgers and J.P. Croeder, appendix for South Florida Ecological Study.

1977 Endangered and Threatened Wildlife and Plants. Washington, D.C.: Federal Register, Vol. 40, No. 188, September 26.

U.S. DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY

1973 Resource and Land Information for South Dade County, Florida, Investigation I-850. Reston, VA: National Center.

U.S. DEPARTMENT OF THE INTERIOR, NATIONAL PARK SERVICE

1963 "Vegetation of Islandia, Dade County, Florida," unpublished report by F.C. Craighead. Homestead, FL: Biscayne National Monument.

1973 An Archaeological Survey of Biscayne National Seashore (sic), by W.H. Sears and A.J. McGregor, Florida Atlantic University. Homestead, FL: Biscayne National Monument.

1974a Natural Versus Visitor-Related Damage to Shallow Water Corals, by Alan H. Robinson. Denver, CO: Denver Service Center.

1974b Transportation Study, Cumberland Island National Seashore. Denver, CO: Denver Service Center.

1975a "Impact of Sport Harvest on a Spiny Lobster Population, Fort Jefferson National Monument," in press, journal unknown. Key West, FL: Fort Jefferson National Monument.

1975b Preliminary Archaeological Assessment, Biscayne National Monument, by George R. Fisher. Tallahassee, FL: Southeast Archaeological Center.

U.S. DEPARTMENT OF THE INTERIOR, NATIONAL PARK SERVICE

1975c Preliminary Historical Studies Plan, Biscayne National Monument, by T. Stell Newman. Denver, CO: Denver Service Center.

1976 Biscayne National Monument Environmental Assessment for the General Management Plan. Atlanta, GA: Southeast Regional Office.

VOSS, G.L., AND N.A. VOSS

1955 "An Ecological Survey of Soldier Key, Biscayne Bay, Florida," Bulletin of Marine Science, Gulf and Caribbean, Vol. 5, No. 3. Miami, FL: University of Miami.

VOSS, G.L., AND F.M. BAYER

1968 "Ecology and Dynamics of Coral Reef Populations, Florida," Natural Geographic Research Reports, 1963 year report, pp. 225-230. Washington, D.C.: National Geographic Society.

VOSS, G.L., et al.

1969 The Marine Ecology of Biscayne National Monument. Miami, FL: University of Miami, Institute of Marine Sciences.

STUDY TEAM

Alex R. Carter, Team Captain, Environmental Specialist, Denver Service Center

Bonnie M. Campbell, Interpretive Planner, Denver Service Center

James W. Todd, Superintendent, Biscayne National Monument

James Tilmant, Research Biologist, Biscayne National Monument

CONSULTANTS

Donald Weir, Former Chief Ranger, Biscayne National Monument

Gary Davis, Research Biologist, Everglades National Park

R. Gerald Wright, Systems Ecologist, Alaska Task Force

Alan H. Robinson, Marine Biologist, Denver Service Center

Publication services were provided by the graphics and editorial staffs of the Denver Service Center. NPS 1215A

As the nation's principal conservation agency, the Department of the Interior has basic responsibilities to protect and conserve our land and water, energy and minerals, fish and wildlife, and parks and recreation areas, and to ensure the wise use of all these resources. The department also has major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

☆U.S. GOVERNMENT PRINTING OFFICE: 1978—777-094/52