ASMFC
FILE COPY
DO NOT REMOVE

Special Report No. 31
of the
The Atlantic States Marine Fisheries Commission

ATLANTIC COAST MARINE ARTIFICIAL REEF HABITAT:

PROGRAM AND POLICY GUIDELINES FOR

COMPREHENSIVE STATEWIDE PLANNING AND MANAGEMENT

December, 1993

SH
157.85
.A7
G6
1993
no.31

Gordon, William R.

ATLANTIC COAST MARINE ARTIFICIAL REEF HABITAT:

PROGRAM AND POLICY GUIDELINES FOR

COMPREHENSIVE STATEWIDE PLANNING AND MANAGEMENT.

SH157.85.A7G6 1993 no.31

Prepared for:

The Atlantic States Marine Fisheries Commission

Submitted by:

William R. Gordon, Jr., Ph.D.
Department of Marine Affairs
University of Rhode Island
Kingston, Rhode Island 02881

December, 1993

ACKNOWLEDGEMENTS

Existing state plans and information from members of the Artificial Reef Committee were used extensively in preparation of this document. In addition, Dr. Gordon has incorporated an exhaustive review of the literature into developing recommendations to enhance ongoing programs. Opinions expressed are those of the author and are not intended to represent a consensus of the ASMFC Artificial Reef Committee, or any policy positions of the Commission as a whole.

The Commission would like to acknowledge the diligent efforts of Dr. Gordon and the contributions of the Artificial Reef Committee in preparation of this timely document. In addition, special thanks goes to the U.S. Fish and Wildlife Service for providing critical funding for this project through a grant agreement (grant no. 14-48-0009-93-1256) between the Atlantic States Marine Fisheries Commission and the U.S. Fish and Wildlife Service Federal Aid in Sport Fish Restoration Program.

Richard T. Christian
Recreational Species Coordinator

EXECUTIVE SUMMARY

The National Fishing Enhancement Act of 1984 (33 U.S.C.A. 2103, et seq.) was enacted to provide guidance to coastal states in the preparation of state artificial reef plans. The National Marine Fisheries Service (NMFS) was given the responsibility for implementing the Act. In 1985, NMFS (Department of Commerce) exercised this responsibility by publishing the National Artificial Reef Plan (National Plan). This document focused on the procedures that coastal states should undertake to plan for the development of artificial reef structures or complexes in the marine environment. The completion of the National Plan was an essential first step towards achieving a nationwide approach to artificial reef planning.

In 1987, the Atlantic States Marine Fisheries Commission identified the need to develop a comprehensive coastwide planning guide to assist states in preparing and implementing state artificial reef programs. Lacking a comprehensive, coastwide guide from which to develop individual state plans, many states have borrowed from a few existing plans developed to meet state-specific needs. The following guide goes beyond the scope of most of these parochial plans and provides a broad overview of planning components, as well as specific recommendations to guide the development of a state artificial reef plan policy. A list of these recommendations follows:

State Plan Policy Guidance Should Include:

- A comprehensive statement on how policy elements are identified and implemented within the State Plan. This statement should also reflect on when and how a review and modification of procedures would be undertaken.

- The identification of all possible and realistic application goals of artificial reefs. Provide associated background discussion that explains supportive "why," "how," "where," and by "whom" elements.

- An inventory of all unacceptable applications, with supportive justification.

- A basis of citizen input or participant in the creation and review of any policy statements.

- A periodic review of goals to accommodate any temporal changes in philosophy or approach to the development and management of artificial reefs.

- The solicitation of public comments and participation in the artificial reef planning process to the maximum extent practicable. Realistic opportunities must be provided.

- Public participation in reef construction and deployment activities, noting liabilities to personal injury or damages for providing labor and/or equipment to support these reef activities.

- Soliciting economic contributions to state artificial reef programs.

- Assisting in any support services to the state artificial reef program.

- Assisting in organizing and implementing fishing tournaments or rodeos, with proceeds benefiting state artificial reef program activities.

- An inventory process which evaluates shore-based access infrastructure (fishing piers, jetties, waterfront locations or other shore-based access locations) should be undertaken to identify respective quantity, distribution, condition and related safety considerations. Support infrastructure for parking should also be assessed in this process.

- Functional plans for the enhancement of fishing piers, jetties, waterfront locations or other shore-based access locations by effectively utilizing artificial reefs. Plans should also address support infrastructure needs.

- An assessment of the number of existing sport divers, shore-based and offshore recreational anglers should be undertaken to assess present demand as well as to identify the growth potential and subsequent needs within these various user groups.

- An assessment of sport and professional tournament activity should be undertaken to identify potential conflicts with existing recreational and commercial fishing activity. As noted, an effective use of artificial reefs can distribute fishing activity over a wide area, allowing formal or informal zoning or allocation of existing and planned reef resources. The

development of sportfishing tournaments may be a means of enhancing local and state tourism economies.

- An identification of potential applications to use artificial reef development to enhance commercial fishing opportunities in state waters. This planning effort should identify likely stocks to be enhanced, including preferred and underutilized species. A coordinated effort is recommended for planning artificial reef deployment in federal jurisdictions. This may be accomplished by consulting with federal officials at NMFS and regional fishery management councils. This consultation will also facilitate any planning for economic relocation of commercial fishermen to other sectors of the commercial fishery.

- An outline of artificial reef design considerations which note particular type(s) of desired habitat to be enhanced.

- An effort to examine the demand for artificial reef deployment by charter and party boat operators. It is this industry that is usually most vocal in its support of reef development programs.

- The determination of the effective range of operators in offshore waters. Managers should note where charter operators observe a decline in the number of private recreational craft. This area of decline may offer an appropriate point to begin seaward deployment of reef materials for the party and charter boat industry.

- Research to determine the capacity for relocating economically impacted commercial fishermen into the party and charter boat industry.

- A policy to promote the use of artificial reefs as refuge where commercial or recreational fishing would be prohibited. Managers may want to investigate dedicating reef sites as Special Management Zones.

- A means of providing strict enforcement or compliance through reporting of violations by offshore participants. Proper reporting of violations is essential to ensure the success of a refuge program. This may be facilitated by (1) dedicating a portion of any collected fines to those who report the violations, and (2) attaching accountability protection guidelines to enforcement components of the state plans.

- Conducting meetings with state artificial reef program managers and federal marine sanctuary authorities (for those sanctuaries situated directly off a state's coastline), to determine if there are any applications or benefits to derived from placing artificial reefs within sanctuary boundaries.

- Identification of uses for small scale reef structures to be deployed in the shallow water areas of estuarine resources. Reef structures may be pre-fabricated structures or made from materials that have a high ratio of interstitial space, to provide maximum cover for juvenile fishes.

TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS i
EXECUTIVE SUMMARY ii
TABLE OF CONTENTS vi
LIST OF FIGURES ix

I. INTRODUCTION: THE NEED FOR COMPREHENSIVE ARTIFICIAL REEF PLANNING 1

A. Atlantic States Marine Fisheries Commission 1
1. Basis of involvement 1
B. Habitat Typology 2
1. Artificial reefs 3
2. Fish aggregating devices (FADs) 3
C. History of the Artificial Reef Planning Process 4
D. Locational Considerations 5
1. State marine waters 5
2. Federal marine waters 5
E. The Need for Comprehensive and Systematic Planning 6
1. Site aspects 7
2. Regional and state level planning 7
F. The Importance of Policy Guidance to this Process 7

II. STATE PROGRAM GOALS AND OBJECTIVES 8

A. The Need for Goals and Objectives 8
B. Program Goals for Marine Recreational Fisheries 9
C. Program Goals for Marine Sport Diving 10
D. Program Goals for Marine Commercial Fisheries 10
E. Program Goals for Marine Resources/Sanctuaries 10
F. Management Tool for Reef Stocks 11

III. PLANNING FRAMEWORKS 12

A. National Fishing Enhancement Act of 1984 12
1. National Artificial Reef Plan (National Plan) 12
B. Introduction to Statewide Planning of Marine Artificial Reef Habitat 13
C. Generic Elements in Planning 13
1. Plan development 15

D. The Need for Plans to be Operational 16
E. Comprehensive and Systematic Planning 16
1. State 19
2. Regional 21
F. Site Based Planning 21
1. Single reef units 21
2. Clustered reef units 21
G. Implementation 22
H. Planning Time Frames 22
I. Citizen Participation 23

IV. APPLICATIONS OF MARINE ARTIFICIAL REEF HABITAT 24

A. Section Overview: Clients of the Process 24
B. Targeting Client Groups 25
C. General Recreational Applications 26
1. Angling 26
2. Diving 26
D. Fishing Tournaments 26
E. Subsistence Fishing 28
F. Commercial Utilization of Reefs 31
1. Finfish 31
2. Lobster 32
3. Party and charter boat operations 33
a. economic relocation tool 34
G. Artificial Reefs as Refuge 35
H. Protected Area Management 36
1. Uses in marine sanctuaries 36

V. JURISDICTIONAL CONSIDERATIONS 37

A. Jurisdictions for Offshore Planning Zones 37
B. Federal Agency Jurisdictions 37
1. The National Marine Fisheries Service 37
2. The United States Army Corps of Engineers 38
3. The United States Coast Guard 38
4. Environmental Protection Agency 38
5. The United States Department of Commerce,
Office of Coastal Resource Management,
Marine and Estuarine Management Division,
Marine Sanctuaries Program 38
C. Regional Jurisdictions 39
1. Interstate Marine Fisheries Commissions 39
2. Regional Fishery Management Councils 39
D. State Agency Jurisdictions 40
1. Legislative 40

2. Rulemaking 40
E. County Jurisdictions 40
F. Municipal Jurisdictions 41
H. Environmental Planning of Onshore Activities and Offshore Impacts 42

VI. FEDERAL CONSISTENCY AND PROGRAM CONSIDERATION 42

A. The Dilemma of Federal Consistency with State Artificial Reef Plans (State Plans) 42
B. Federal Consistency under the Coastal Zone Management Act 43
1. Variations in CZM approaches 44
C. Other Federal Linkages to State Artificial Reef Programs 44
1. NEPA requirements 45
D. Special Management Concerns 45
1. Mitigation banking and artificial reef habitat 46
2. Habitat restoration 47
a. micro-estuaries 47
b. coastal lagoons and salt ponds 48
3. Coral reef management 49
4. Special management zones (SMZs) 50

VII. REFERENCES 51

APPENDIX I. NATIONAL FISHING ENHANCEMENT ACT 64

APPENDIX II. RESOLUTIONS OF THE ATLANTIC STATES MARINE FISHERIES COMMISSION RELATIVE TO ARTIFICIAL REEF DEVELOPMENT 72

LIST OF FIGURES

Page

Figure 1. Comprehensive Planning for Aquatic Habitat Development and Management 20

I. INTRODUCTION: THE NEED FOR COMPREHENSIVE ARTIFICIAL REEF PLANNING

A. Atlantic States Marine Fisheries Commission

The Atlantic States Marine Fisheries Commission (Commission) was established in 1942 to represent collectively the marine fisheries needs and interests of all Atlantic coast states from Maine to Florida, including Pennsylvania. Over its fifty-year existence, the Commission has attempted to identify and respond to those commercial and recreational fishery management issues warranting state, regional, and national attention. The Commission's Artificial Reef Committee is one example of this commitment to Atlantic coast fishery management.

The Commission has been involved in assisting Atlantic coast member states with artificial reef management issues since 1987, when it created the Artificial Reef Advisory Committee. The Commission has issued several reports which address the needs of artificial reef management along the eastern seaboard. McGurrin et al. (1988, 1989a) in a Commission study of Atlantic artificial reef development acknowledged the need to develop systematic regional, state, and local artificial reef plans. The Commission further recognized the priority need for artificial reef planning in Murray's (1989) assessment of Southeast and Mid-Atlantic Artificial Reef Programs, along with Reeff et al.'s 1990 recommendations on state artificial reef management.

1. Basis of involvement

The National Fishing Enhancement Act (NFEA) of 1984 (33 U.S.C.A. 2103, et seq.) was enacted to provide guidance to coastal states in the preparation of state artificial reef plans. The National Marine Fisheries Service (NMFS) was given the responsibility for implementing the NFEA. In 1985, NMFS (Department of Commerce 1985) exercised this responsibility by publishing the National Artificial Reef Plan (National Plan). This document focused on the procedures that states should undertake to plan for the deployment of artificial reef structures or complexes. The completion of the National Plan was an essential first step towards achieving a nationwide approach to artificial reef planning. Since publishing the National Plan in 1985, NMFS has provided minimal guidance for the development of artificial reef plans by coastal states. Yet, the need exists for coastal states to be able to secure reliable planning guidance from federal or regional sources.

According to Reeff et al. (1990), of the fourteen Atlantic coastal states, eleven have a documented record of artificial reef development activity, while only nine

have sponsored programs. It has become apparent since issuance of the National Plan that some Atlantic coast states have had various difficulties in preparing their respective state plans. This observation is made because some states still do not have a plan. The obstacles to preparation are usually because of insufficient funding to support program development, or from a lack of expertise in the preparation of a plan. There is a significant degree of variation amongst the topics addressed for some Atlantic coast states that have a plan in progress, or completed (New York, New Jersey, Delaware, North Carolina, South Carolina, and Florida). The levels of planning guidance provided for in these documents varies as well. The Commission is responding to the need for planning guidance for two essential reasons: (1) to provide a document that provides topical and procedural guidance to states in the preparation or revision of state plans; and (2) to advance the level of planning activities to involve a comprehensive or systematic approach to state and regional artificial reef planning activities.

B. Habitat Typology

This guide is essentially directed at the development of artificial reefs. The use of fish aggregating devices (FADs) is discussed briefly. The language of the NFEA of 1984 identified both artificial reefs and FADs as being "structures," and as noted by McGurrin et al. (1988), "they remain part of reef technology."

One of the basic concerns reflected by various participants in state artificial reef development (McGurrin et al. 1988) is that artificial reefs may be too effective as fish aggregators. The attraction of fish to a single location provides an easier opportunity to harvest these fish in greater numbers than nature might otherwise offer. Without a clear biological understanding of the harvest pressure that some species presently experience, the artificial reef process might create a setting for overfishing, therefore contributing to a further decline of fishery resources.

It is a clear responsibility that faces fishery managers, especially in light of the demise of the New England groundfish fishery, that efforts must be taken to understand the results of U.S. fishing pressures. The need exists to carefully monitor fishing activities to ensure that stocks are not suffering irreparable declines. Management by state and federal agencies, as well as by regional fishery management councils, must be sensitive to the acquisition of reliable data to provide guidance in the management of finite aquatic resources. Regulatory bodies must be able to respond quickly to the need to allocate or restrict particular fisheries with gear restrictions, or with size and creel limits. The jurisdictional conflict (as discussed in detail later in this guide) that arises when states plan and deploy

artificial reef materials in federal waters, but have no regulatory authority in the federal exclusive economic zone (EEZ), heightens the need for clear and effective communications between all manager and participant groups involved.

1. Artificial reefs

Marine artificial reefs consist of man-made or natural materials that are deployed in coastal and marine waters to attract or enhance various species of sessile, vagrant and pelagic marine organisms. Artificial reefs may be developed as bottom or benthic reefs. Reef materials also can be designed as mid-profile structures which are intended to attract both demersal and pelagic species, or may be designed to penetrate the entire water column. Generically, artificial reefs provide multiple resource opportunities, including: (1) enhancing production of fish and epifauna, (2) serving as an attractor within the marine environment, and (3) contributing to marine biodiversity. Artificial reefs also provide protective settings for marine animals.

The issue of production is variable, depending upon the location of a reef. For example, the biological productivity of an artificial reef situated within the shallow confines of an estuary will differ from reef materials sited in an open marine setting. It is generally accepted that marine artificial reefs serve as an effective attractor of numerous fish species. Food sources are provided by epifauna which attach to the reef, as well as by upwelled flows that are generated by the structure. In the latter situation, nutrients are lifted off bottom sediments into the surrounding water column, providing food for fish situated leeward (down-flow) of the artificial reef.

As artificial reefs extend off the ocean floor into the water column, they create disruptions within passing ocean currents. Klima and Wickham (1971) and Ranasinghe (1981) proposed a thigmotrophic value of artificial reefs. These authors noted that artificial reefs provide a focus or point of aggregation because fish are attracted to structures for orientation or navigation purposes. Alevizon and Gorham (1989) suggested another reason for attraction that "rapid redistribution of adult fishes to colonize newly deployed artificial reefs occurs primarily because some reef fishes have a strong innate tendency to disperse, combined with a strong innate behavioral preference for reef-like habitats with low fish density." In other words, some fish prefer less crowded conditions.

2. Fish aggregating devices (FADs)

Fish aggregating devices consist of single or multiple floating structures (Samples and Hollyer 1989) that are connected to the ocean floor by ballast or anchors. FADs are designed to provide surface area at a designated height above the oceans floor, or below the ocean's surface (depending upon ocean depth at the

location where the FADs are deployed). Usually prefabricated, FADs are designed to attract pelagic species (Klima and Wickham 1971, Parker et al. 1974). Deployment can be in pre-arranged alleys (rows) or in random patterns (Beets 1989, Rountree 1989).

Although FADs have had varying levels of success in near and offshore applications, they have been effective in attracting pelagics (Foster and Fowler 1992). However, FADs are not entirely free of criticism. Conflicts with other bottom or mid-depth uses are possible and should be considered. Another major criticism is that FADs are usually constructed of materials that have a short survival time once deployed (Foster and Fowler 1992).

C. History of the Artificial Reef Planning Process

Artificial reefs have been used in the United States for more than a century (Stone 1985, McGurrin et al. 1989a). The utility of materials deployed as artificial reefs became a fisheries management issue during the mid-1960s (Carlisle et al. 1964, Turner et al. 1969). It was not until the mid-1970s that the first real examination of artificial reef planning considerations took place (Parker et al. 1974). Site selection criteria became the focus of planning efforts during the early 1980s (Mathews 1979, Mathews 1981, Myatt 1981). Until this time, artificial reef development was essentially a grassroots effort promoted by local fishing clubs and private individuals, with minimal or non-existent guidance from state or federal authorities. Recent research has identified various process elements, including state program strengths and weaknesses, that are useful in understanding reef planning needs (McGurrin and the Commission's Artificial Reef Committee 1988, Murray 1989).

The body of literature which addresses the artificial reef planning process is rather limited. The passage of the NFEA, the development of the National Plan (Department of Commerce 1985) and the Sport Fishing Institute's Artificial Reef Planning Guide (Ditton and Burke 1985) established a more formalized approach to artificial reef planning. In 1986, Gordon and Ditton provided an overview to project-level planning. In another 'planning' discussion, Bell (1986) identified the need for long-range planning by stating that "in most cases, long-term planning and attempts to manage artificial reef utilization have been nonexistent." Bohnsack and Sutherland (1985) also noted the lack of comprehensive planning strategies up until this period of time. Internationally, Grove et al. (1989) provided a useful discussion of reef planning applications in Japan. According to Gordon (1994), "there have been no substantive discussions since the mid-1980s which build upon these initial

planning contributions."

D. Locational Considerations

The placement of marine artificial reefs in the United States has traditionally been undertaken with little regard for optimal siting. Optimal siting requirements can be separated into two classes: (1) human uses; and (2) designating a reef site as a sanctuary or refuge to benefit either marine species at that reef site, or at natural or artificial sites which are located in immediate proximity.

Artificial reefs designated for human use can be broken down into several sub-groups which include (1) recreational anglers, (2) recreational divers, (3) party/charter boat anglers, (4) commercial fishermen. The location of deployment for artificial reefs should also be based on (1) minimizing conflict between user groups, (2) enhancing natural systems whenever possible, (3) deploying structures based upon factors of safety, where (a) natural systems are located at minimal risk from the placement, and (b) user safety is assessed based upon levels of: user experience, marine capabilities of their craft, onshore access infrastructure, and safety response capabilities. Placement of artificial reef materials in either state or federal waters requires similar federal scrutiny from those federal agencies identified in Section V.: Jurisdictions.

1. State marine waters

State marine waters traditionally extend from the low water mark to a distance of three nautical miles from shore. This delineation was granted under provisions of the Submerged Lands Act of 1953 (43 U.S.C.A. 1301 et seq.). The Florida West Coast has a state offshore boundary of three marine leagues or nine nautical miles from shore (10.2 statute miles, based upon Spanish submerged lands law, and recognized under provisions of the Submerged Lands Act). Features of the state marine environment may include "internal waters," such as large and small estuaries or embayments, micro-estuaries and barrier island lagoons, as well as offshore waters situated adjacent to the seaward coast of barrier islands. Demographically, these waters may be situated adjacent to rural areas of a state's shoreline as well as along urban waterfronts.

2. Federal marine waters

Various provisions of the NEFA, as highlighted in the National Plan, provided an incentive for coastal states and private parties to plan the development of artificial reefs on nearshore areas of the federal Outer Continental Shelf (OCS). This relationship represents an opportunity for states to operate in what has

otherwise been an exclusive federal domain (Outer Continental Shelf Lands Act of 1953, as amended in 1978, 43 U.S.C.A. 1331 et seq.). The essential drawback of the NFEA to states locating artificial reefs on the OCS is that, although they can plan and execute the deployment of reef materials, they have no inherent authority to manage the fishery resources that are attracted to or produced on these artificial aquatic habitats.

The federal government maintains the right of management of these waters for economic reasons. The Exclusive Economic Zone (EEZ) extends seaward from three nautical miles from shore to a distance of two hundred nautical miles. This demarcation was established under provisions of the Magnuson Fishery Conservation and Management Act of 1976, as amended, (16 U.S.C.A. 1801-1882). The federal control of this offshore region is exercised primarily for reasons relating to fishing, mineral extraction and rights of navigational passage. Management of the fisheries resources of this area falls under the purview of the Regional Fishery Management Councils established by the Act.

E. The Need for Comprehensive and Systematic Planning

In a review of artificial reef planning literature, Gordon (1994) concluded that state-level artificial reef planning has been primarily a site-specific process. Although planning beyond site conditions has been recognized by many (Parker et al. 1974, Mathews 1981, Myatt 1981, Bohnsack and Sutherland 1985, Ditton and Burke 1985, U.S. Department of Commerce 1985, Bell 1986, Gordon and Ditton 1986, and Grove et al. 1989), there has been little effort to provide a comprehensive and systematic approach to this marine resource management issue.

The irony to date is that the incremental placement, site by site, of designated reef materials results in artificial reef deployments having statewide or regional dimensions. Yet, the level of planning devoted to many of these efforts emphasizes the viability of single or multiple reef sites, rather than providing a comprehensive planning framework where statewide or regional habitat implications are emphasized. Management issues within artificial reef research typically focus on reef site biology, user profiles, economic assessments, etc., often failing to address broader dimensions. A broader analysis in this case would include (1) the typology and quantity of materials to be placed off state coastlines, (2) the nature of systematic benefits to aquatic habitat and human users, and (3) delineating the potential liabilities of this approach when optimal ecological and user benefits are not achieved. Effective management tools are available to facilitate systematic or comprehensive approaches to artificial reef planning and management. Systems-

wide management can be accommodated by the use of Geographical Information Systems (GIS) technology and program evaluation methodologies (Gordon 1994).

The value of site or project-based planning is not abandoned in a comprehensive framework. Emphasis is placed on the utility of site-based planning within a broader, comprehensive context. In this application, the incremental results of site-by-site deployments are considered up front, and not as an afterthought to the process. Site-based and comprehensive/systematic planning are intended to complement one another, rather than compete for pre-eminence with each other.

1. Site aspects

During the 1980s a significant effort was devoted to addressing site planning requirements for artificial reef development. A planning framework emphasizing a project-level approach to artificial reef development was developed by Ditton and Burke (1985) and Gordon and Ditton (1986). This approach was modified from an environmental planning framework developed by Erickson (1979). The Ditton and Burke (1985), Sport Fishing Institute publication provided the first real in-depth guidance for those planning issues related to site-specific deployments of reefs. Gordon and Ditton (1986) reviewed the implications of site or project planning from a broader fisheries management perspective. They noted that planning for artificial reef development generally consists of a project approach at all levels of government.

2. Regional and state-level planning

The Atlantic coast states of New York, New Jersey, North Carolina, South Carolina, and Florida each have a state plan. There is little consistency between these respective efforts. An argument can be made that reef planning efforts should represent a consistent approach as many of the species that enter each state's waters are transboundary and may be adversely impacted by a lack of coordinated planning and management. A regional approach may be warranted in some instances where oceanic conditions (colder northern waters versus warmer southern waters) may result in reef management needs by the respective species that inhabit these waters.

F. The Importance of Policy Guidance to this Process

This guide is organized into separate topical headings, with each containing a discussion of an artificial reef program element. A policy guidance statement is also provided highlighting those policy elements or considerations that should be addressed in most state plans. The policy statement is an important means of

implementing those elements that are presented and discussed in a state plan. Most importantly, this requires states to make an operational interpretation of the topical issue and to provide guidance on how this topic will be addressed in respective planning efforts. As discussed in greater detail in Section III. C., most state plans provide anecdotal or encyclopedic background on topical application experiences in other states. These discussions usually do not provide the necessary substantive guidance, nor provide a basis for comprehensive or applied understanding, on how various topics should operate within a state plan. Without direction, plans become mere static reports, lacking the dynamic elements that are often required to allow planning to be a rational choice over future actions. The exercise of planning facilitates the decision-making process, but does not always guarantee that sound decisions will be made. This inherent weakness is attributable to the political vagaries of the decision-making process.

Recommended State Plan Policy Guidance Should Include:

- A comprehensive statement on how policy elements are identified and implemented within the state plan. This statement should also reflect on when and how a review and modification of procedures would be undertaken.

II. STATE PROGRAM GOALS AND OBJECTIVES

A. The Need for Goals and Objectives

In planning, goals usually represent desired or intended conditions. It is generally accepted that artificial reefs serve as important habitat for sessile and mobile marine species, providing social, economic and environmental benefits to various user groups. Value or outcome statements are often used in establishing planning goals. Delineating a precise value of importance for an artificial reef is a variable, and ultimately debatable, undertaking. Dependent upon location, it is difficult to resolve a reef's ability to attract marine species versus its ability to produce (enhance) marine life. Furthermore, intended levels of biological and socio-economic success may be adversely impacted from overfishing by conflicting user groups, etc. (Reeff et al. 1990).

A goal statement for benefits derived by users or the marine ecosystem should be broad in context and have an enduring temporal quality. Goal statements in any plan, no matter how broad or idealistic, provide necessary guidance for interpreting the intent of the plan. This guidance can facilitate decision-making opportunities related to the plan, provide a basis of interpretation should any of the plan elements be challenged, and establish guidelines for subsequent evaluation of biological or program success.

Artificial reefs should facilitate the opportunity to:

(1) enhance fishery resources for recreational and commercial users;
(2) distribute fishing pressure within the near and offshore environment, therefore reducing potential use conflicts;
(3) provide recreational and commercial access to fishery resources;
(4) be a tool to conserve or protect fishery resources;
(5) minimize environmental risks to users and the environment.

Finally, the goals for developing artificial reefs may include economic incentives that are based on user and habitat values. Evander (1985) noted that the community of Freeport, Texas identified artificial reef development as a means to diversify their local economy. These individuals, without outside assessment, recognized direct linkages between the volume of recreational fishing trips and related tourism benefits. The development of artificial reefs was identified as a means of directing new monies into their community.

B. Program Goals for Marine Recreational Fisheries

State plans should address the divergent needs of the marine recreational fishing community. Plans should address enhancing the opportunities for shoreline access in both urban and rural settings, noting safety and water quality concerns. Plans must also address the needs of nearshore (0 to 3 miles), inshore (3 to 10 miles), and offshore (greater than 10 miles from shore) anglers. Program goals should meet the multiple needs of inexperienced as well as experienced anglers, the needs of casual versus avid participants, as well as the specialized needs of tournament angling (Christian and Trimm 1985, Gordon 1993, Gordon 1994). Conservation of fishery resources, access and safety considerations, and ability to secure conflict resolution are often goals associated with artificial reef development intended for marine recreational angler benefits.

C. Program Goals for Marine Sport Diving

State plans should address the needs of the sport diving community to enhance diving opportunities for enthusiasts of varying experience levels. Sport diving can represent a significant expenditure into a local tourism-based economy and should represent a thoughtful effort in considering the needs of a resident and non-resident diving community. Assigned reef locations can provide a safe or low-risk environments, promote access, and minimize conflicts with other users, while offering various levels of challenge for divers who spearfish, engage in underwater photography or dive for sport or pleasure purposes only. Local and state economic benefits may be derived from the growth of a local sport diving industry. Sport diving is an essential source of demand for many artificial reef development activities (Schwartz 1980).

D. Program Goals for Marine Commercial Fisheries

Although commercial fishery applications are more adequately addressed in foreign settings, declining U.S. stocks should provide impetus for state and federal authorities to examine the use of artificial reefs as a tool for commercial fishing. In northern states, state plans can address the potential for designing benthic lobster habitat to provide a safe haven for juveniles, while allowing commercial harvest of appropriately sized lobsters. Harvests for mussels, oysters, and urchins, as well as targeting for underutilized species could also be associated with the development of artificial reefs for commercial applications.

A final commercial fisheries goal might include the assessment and enhancement of artificial reefs within a planned offshore area to accommodate the growth of the party and charter boat industry. With proper marketing, additional demand for access to marine recreational fisheries may provide an alternative source of employment for individuals displaced from other sectors of commercial fisheries because of restrictions, allocations, closures and economic conditions. Proper assessment of this industry's growth capacity (party and charter boat) would be required to ensure that additional activity would not displace current entrants and place this fishery at risk because of overfishing.

E. Program Goals for Marine Resources/Sanctuaries

To date, the utility of artificial reef development as a management tool within federal marine sanctuaries has not been recognized (U.S. Department of

Commerce 1992, 1991, 1980). The use of pre-designed, pre-fabricated artificial reefs which complement the natural aquatic setting could be used to mitigate impacts to natural reef sites from hook and line fisheries, such as accumulation of terminal gear (lost lures, line, etc.). Impacts to natural reefs from boat anchoring could be reduced by deploying artificial reefs that have attachment capabilities (anchoring buoys). Artificial reefs could provide additional enhancement or recruitment to natural reefs located in sanctuaries having a ban on all fishing activities.

F. Management Tool for Reef Stocks

Artificial reef development can be a useful tool in managing various fish stocks. Sport and commercial fishing pressure on natural reefs, such as coral reef structures, can be redistributed to artificial structures deployed nearby. Inshore nurseries situated within estuarine confines, can be restored or enhanced by the design and placement of structures intended solely for habitat use by juvenile fishes (with all fishing banned). The development of artificial habitat to augment natural fisheries productivity must be realized in inshore settings, as well as near and offshore environments. Artificial reefs can be used as an effective tool for in-kind and out-of-kind mitigation (impacts to reefs and other habitats such as wetlands, respectively). This requires careful consideration of why and how artificial reefs should be used as a mitigative alternative.

Recommended State Plan Policy Guidance Should Include:

- The identification of all possible and realistic application goals of artificial reefs. Provide associated background discussion that explains supportive "why," "how," "where," and by "whom" elements.
- An inventory of all unacceptable applications, with supportive justification.
- A basis of citizen input or participant in the creation and review of any policy statements.
- A periodic review of goals to accommodate any temporal changes in philosophy or approach to the development and management of artificial reefs.

III. PLANNING FRAMEWORKS

A. National Fishing Enhancement Act of 1984

The National Fishing Enhancement Act (NEFA) of 1984 (33 U.S.C.A. 2103, et seq.), contained in Appendix 1, represented a milestone in the planning of artificial reefs in the United States. Elements recognized in Section 202 (a)(5) include:

(1) the importance of using artificial reefs to enhance aquatic habitat and biodiversity of fishery resources to meet the public demand for a declining resource;
(2) the importance of enhancing recreational and commercial fishing opportunities;
(3) the need to increase the production of fishery products for economic gain;
(4) the need to increase energy efficiency of recreational and commercial craft as they fish upon marine waters by conserving fuel through the thoughtful placement (spatial efficiency) of artificial habitat.

Section 203 placed an emphasis on using the best scientific information available, where "artificial reefs shall be sited and constructed, and subsequently monitored and managed in a manner which will --

(1) enhance fishery resources to the maximum extent practicable;
(2) facilitate access and utilization by United States recreational and commercial fishermen;
(3) minimize conflicts among competing uses of waters covered under this title and the resources in such waters;
(4) minimize environmental risks and risks to personal heaLth and property; and
(5) be consistent with generally accepted principles of international law and shall not create any unreasonable obstruction to navigation."

These two sections present a comprehensive range of concerns. Yet, the language of the Act uses the action term "shall" to infer its intent and meaning, implying that states are to implement this process to the best of their ability. There are no guarantees that a state will even enter into such a planning process or devote critical attention to accomplishing the noted tasks.

1. National Artificial Reef Plan (National Plan)

The NEFA assigned responsibility to the NMFS to implement the provisions of the Act. The preparation of the National Plan was one of the primary directives of the legislation (U.S. Department of Commerce 1985). This document was written to provide general guidance on planning, siting, designing, permitting, installing and maintaining artificial reefs. Gordon (1994) suggested that the National Plan is

most useful as a site or project planning document. The directives to USACE involvement in permitting are beneficial to provide a consistent level of review for regional offices. This language specified the range of USACE inquiry and involvement.

B. Introduction to Statewide Planning of Marine Artificial Reef Habitat

This planning guide is not intended to address the adequacy or consistency of respective state plans. However, a cursory comparison of state plans reveals a lack of consistency between planning efforts. Much of this can be attributed to the absence of formal or operational planning expertise by state artificial reef program managers or consultants, as well as from limited funding to support state artificial reef planning activities.

Although some state plans address many of the issues dealt with in this planning guide, there is an inconsistent treatment as to the depth to which plans are operationally explained. Most of the state plans completed to date have focused primarily on site or project-level planning and are vague on program outcomes. Few plans coordinate the needs of offshore artificial reef planning with necessary onshore support infrastructure, noting deadline requirements. Gordon (1994) observed that "even more vague are the means to accomplish the outcomes." None of the state programs examined during the preparation of this guide were explicit on issues such as plan implementation, time management, and means of evaluating program outcomes. The need exists for states to review their respective plans periodically and amend them accordingly.

C. Generic Elements in Planning

There are five fundamental steps in a generic planning process, which include (1) identifying the planning needs, (2) collecting relevant information and data, (3) developing a plan, (4) implementing the plan, and (5) evaluating the success of the plan. The following discussion reviews each of these planning elements.

STEP 1: In those situations where the planning environment is not familiar, the first step can be deceiving to the planner. The planning of artificial reefs is an effective example of the difficulties involved. For example, it is important to understand the various goals that may be associated with planning and deploying artificial reefs. Although goal statements may seem to be oversimplified, there is

the need to establish a broad vision of what outcomes or conditions are desired at a future point in time. Another concern is that if goals statements are not inclusive of all possibilities for planning, then it is almost certain that some potential user group may be overlooked for their future needs. It is at this juncture where the planning process needs to establish a proactive approach, as opposed to a reactive posture (Gordon and Ditton 1986). It is often difficult to retrofit a program to meet needs that should have been considered early on.

STEP 2: The second step, identifying the planning problems associated with establishing artificial reef habitat requires: 1) the determination of specific user needs; 2) an assessment of the various topical processes and related considerations involved; and 3) the identification of those management and administrative requirements that may be unique to artificial reef planning. A review of the topics contained in the table of contents of this document should provide basic insight into the complexity of undertaking a comprehensive approach to artificial reef planning.

The need to collect relevant information or data to support the development of an artificial reef plan is also of critical importance. The overall success of a plan is often dependent upon the thoroughness of the information upon which it is based. Often, this information or data is available from existing sources. The NMFS, the U.S. Fish and Wildlife Service, the NOAA National Ocean Survey, state coastal zone management agencies or authorities, state marine fishery divisions and departments of economic development have information that is relevant to the creation or revision of a state plan. This guide provides sources of information and discusses various techniques where original or firsthand data may be required.

STEP 3: The third step of planning, plan development, can be threatened by creating a document that is too narrowly-focused or limited in its useful time frame. By using this guide as a reference, an individual should be able to review the basis of artificial reef planning elements, noting essential functional and operational characteristics. It is not expected that state plans should mirror one another, as is often done in various planning activities. Sometimes the planning staff does not have adequate time to plan "creatively" and is placed in a situation where it examines other plans to obtain guidance. This 'borrowing' process has inherent risks, especially when planning elements unique to one state may have no application in another. This guide is intended to reduce much of the start-up time that may be required of a staff in preparing an thorough and adequate state plan.

STEP 4: One of the most critical steps in planning involves the implementation of a plan. This is where planning often fails miserably. Confusion often exists as to what exactly is being implemented, and how it is to be implemented. Other confusing aspects include the jurisdictional responsibility of who administers the plan and operational program, and the spatial boundaries of where the program operates. Again, this guide addresses these elements.

STEP 5: Finally, the planning question should be posed as to whether or not respective planning goals were met. This element is often missing in planning efforts. In the application of artificial reef planning, the issue of program success has often been muddled by monitoring or regulatory requirements, or has been justified solely on an economic or biological basis. Most state plans are directed to site or project-level activities, where economic, biological and monitoring assessments are appropriate. The generic steps in planning do not address the level at which planning occurs. This guide challenges the traditional applications of artificial reef planning to a higher level of sophistication where issues are considered within a systematic and comprehensive framework. Correspondingly, evaluation capabilities must be able to determine whether the reef system located off a state's coastline is successfully meeting the multiple, and often complex program goals. The use of program evaluation methodologies are presented to address the needs of justifying the success of specific program elements as well as understanding the overall measures of success for an entire artificial reef program.

Another step typically omitted in the planning process is the objective periodic review of a plan. During this review process, constructive input is provided to the planner to facilitate a thorough and equal treatment of planning elements. This input is gained by implementing the public participation elements that are included in the planning process. This allows program participants and observers to identify issues needing further consideration or review. The weakness in this strategy is that participants may have a limited knowledge of planning issues or elements other than those that directly affect them. Often, these issues are not brought to the attention of the planner, when in fact they should have been.

Although, an outside review may be necessary to involve other artificial reef planners, the use of outside consultants is cautioned. These individuals may lack expertise or available time to conduct a thorough review. A careful review of consultant qualifications is recommended. Most artificial reef planning to date has been conducted within state agencies, with only a limited number of consultants being involved.

1. Plan development

The development of a plan often represents a formalized reaction to a given problem. Although usually applied in a reactive setting, the utility of planning is the proactive ability to foresee potential problems (Gordon and Ditton 1986). Plan development should be an ongoing dynamic process. The development of a plan is dependent upon sound and site-specific data. Plenty of time, funding and appropriate staff should be made available to ensure that the planning process is timely and efficient. As the events that often initiate the development of a plan or

sub-plan change, the plan should be periodically revisited to examine and update any sections that require modification. Although the worst possible aspect about planning is putting together an incomplete or inadequate plan, it is nearly as bad to have a plan that is outdated. Although certain plan elements, such as goals, may not be become immediately outdated, many program elements can change quickly, requiring frequent review.

D. The Need for Plans to be Operational

A common weakness in most artificial reef plans is the lack of operational guidance. Specific guidance should be included in state plans to clearly identify the means by which plans will be implemented. Most plans contain background discussions on the importance of those planning elements that should be addressed in the state plan. The need for operational elements raises one of the principal dilemmas in planning: are plans merely procedural in their treatment of the topics at hand, or do they provide substantive guidance in the interpretation and application of plan elements? The discussion should concentrate on those functional elements contained in the plan, as opposed to a questionable dialog of what elements the plan should contain or dismiss, without sufficient treatment or justification. Often, the planning process does not provide insight into how these functional elements should be operationalized. In other words, are the issues that the plan addresses clearly stated in terms of their importance and reason for treatment, and is there sufficient information provided on how respective elements will be set into motion? This issue is addressed further in the implementation section below.

E. Comprehensive and Systematic Planning

Most state plans are adequate in addressing site specific questions regarding artificial reef deployment, but these plans (with exception of language in the New Jersey plan; New Jersey Department of Environmental Protection 1987) never expand the planning horizon beyond site or project requirements. Gordon (1994) made the initial presentation that a broader planning framework must be developed to include comprehensive and systematic elements. Gordon and Ditton (1986) noted that "there has been little, if any, recognition that planning activities vary, or can vary, within local, state and federal levels of government."

Gordon (1994) stated that an essential weakness in state artificial reef planning is its reliance on a reactionary and opportunistic process that is only implemented when reef construction materials become available. Materials of opportunity are still the most popular source of reef construction supplies in the United States (Phillips 1988, McGurrin et al. 1989b, Murray 1989). In a study of state artificial reef programs, Bell (1986) concluded that reef programs are predominately dependent upon using discarded scrap materials. Bell (1986) also observed that "long range planning and accomplishment of specific design goals for reefs or systems of reefs are next to impossible, as the availability and quality of suitable scrap materials is unpredictable." An analysis of alternative reef deployment locations should be considered during the creation or review of state reef programs, according to a pre-determined classification of likely and acceptable reef materials. Gordon (1994) concluded that this proactive element is currently missing in aquatic habitat development.

The following steps in the artificial reef planning process are modified from Gordon's (1994) adaptation of Catanese and Snyder's (1979) generic urban planning framework:

(1) "Aquatic habitat problems are identified and a statement of goals and objectives (desired future conditions or outcomes) is produced.
(2) Inventories and analyses of existing natural and artificial habitats are undertaken. Conflicts of use are identified and noted spatially. Additional research to support constraint analysis and priority zone allocation is completed.
(3) Alternative scenarios or problem solutions are devised.
(4) The artificial reef plan and supportive management program is drafted, noting budgeting and implementation strategies.
(5) The state plan is implemented.
(6) Plan review and subsequent program evaluations of plan impacts or results are conducted."

In defining the application of concepts such as 'comprehensive' and 'systematic' in planning artificial reefs, Gordon (1994) concluded that these terms have been misused in the context of artificial reef planning. Gordon relied on Branch's (1983) definition that: "comprehensive planning is planning for the totality rather than for one or several of its constituent parts." Branch (1983) noted that a systems approach can be applied in comprehensive planning; where the system, rather than a subsystem, considers the full range of its components and identifies those that are most important. In contrast, a subsystem plan would address several closely interdependent components. An artificial reef site plan as traditionally undertaken would represent a subsystem planning process.

Branch (1983) broke comprehensive planning into two forms of planning, which include functional and operational plans. Functional plans (a sub-plan) as applied to comprehensive artificial reef development would be designed to treat a single constituent element or functional activity, such as:

- interagency coordination plan
- mitigation banking plan
- shoreline access plan
- coral reef impact plan
- funding plan
- program marketing plan
- material acquisition plan
- reef design plan
- subsistence reef plan
- client use plan
- permitting plan
- tournament fishing plan
- special area management plan
- federal consistency plan
- onshore infrastructure plan
- priority use or zoned plan
- comprehensive evaluation plan
- environmental impact plan
- research requirements plan
- habitat restoration plan
- citizen participation plan

This random list represents some of the functional topics that are presented and discussed in this document. Each of these program issues are deserving of a functional plan. Operational planning components are lesser in scope as they provide the specific and detailed guidance, which is necessary to implement functional planning elements. These operational planning elements can be included at the end of each functional plan. It is the responsibility of the artificial reef planner to manage the multiple subcomponents of the comprehensive plan in a rational and analytical approach (Catanese and Snyder 1979). Gordon (1994) stated that "the comprehensive plan should address planning at the system, sub-system and project-levels; as well as identify the functional or operational aspect of respective planning efforts."

Gordon (1994) adapted a programmatic planning schematic from Chapin and Kaiser (1979), to create a comprehensive planning paradigm which incorporated systematic concerns involving state or regional artificial reef development as a programmatic effort (Fig. 1). This hierarchical approach also emphasized the dynamics of planning, deployment, management and evaluation of artificial reefs as a holistic endeavor. McGurrin and Reeff (1986) noted the "social and economic benefits derived from the marine recreational fishing industry often go beyond the local community and bring prosperity to the region as a whole, it is important that reef siting plans reflect a state-wide (or even coast-wide) approach." This broadened approach should include onshore infrastructure and user considerations as well (Ditton, 1981; Gordon and Ditton, 1986). According to Gordon (1994) "it is the onshore infra-structural resource which provides and supports the opportunity for offshore reef development."

1. State

A statewide approach to artificial reef planning requires a comprehensive strategy to identify and plan reef opportunities within inshore waters. These waters include bays, estuaries, micro-estuaries, coastal ponds that are connected to the ocean, and other brackish or marine water environments. The inshore setting is distinguished by shoreline access from urban waterfronts, jetties, piers, fishing piers, bridges, and other accessible shoreline features. Near and offshore settings include those areas beyond three nautical miles from shore, which is typically under federal jurisdiction. Access to offshore artificial reefs is accommodated only by private craft, or by commercial party and charter boat operations. The cumulative total of artificial reefs deployed in these waters represents the state's "system" of artificial reef infrastructure. In this case, infrastructure refers to all deployed reef materials.

Onshore access and support infrastructure is also very important in the development of a systematic approach to artificial reef development. Access infrastructure refers to all means of access including the shoreline access features, as well as all public and private boat ramps, and private boat-hoist facilities, which are usually located at marinas. Highways or coastal roadways are important in establishing access to coastal fishing destinations (Ditton and Graefe 1978, Ditton and Auyong 1984, Gordon 1987, Gordon 1993). Parking facilities for individuals who trailer their craft are also an important component of access infrastructure. The size of parking lots or facilities is becoming an increasingly important consideration in many areas as shoreline access fishermen are often competing for parking spaces with their offshore counterparts. It is one thing to anticipate crowding conflicts on the water, yet it is somewhat unexpected for many areas to experience similar crowding issues on land. This essential management issue is addressed further in the subsistence fishery section.

Onshore support infrastructure is another important element in the success of a statewide artificial reef system. This type of infrastructure also supports offshore fishing activities through the availability of restaurants, groceries, hotels or other overnight accommodations, boat repair, fueling and pumpout facilities, marinas, bait and tackle, hospitals and medical clinics, as well as other important land-based services. Local tourism attractions are also beneficial to those family members visiting the coast that are not participating in fishing activities. It is the existence and type of onshore access and support infrastructure which facilitates or determines the success of the coastal and offshore artificial reef infrastructure.

Figure 1. Comprehensive Planning for Aquatic Habitat Development and Management.

Inputs to Aquatic Habitat Planning:

- Commercial Fishermen
- Marine Recreational Fishermen
- State Fish and Wildlife Agencies
- State Artificial Reef Programs
- Interstate Marine Fishery Commissions
- Regional Fishery Management Councils
- National Marine Fisheries Service
- Non-Governmental Organizations (NGO)
- Legislative Inputs
- Judicial Mandates

Planning Frameworks:

	Spatial Aspect	**Programmatic Aspect**
Systematic -> Planning	Regional or State Applications	Habitat System Management - Program Level Planning - Program and Socioeconomic Evaluation - GIS Applications (20-25 year horizon)
Subsystematic -> Planning	Bay, Estuary or Sub-State Area	Operational Planning: Program and Socioeconomic Evaluation - Biological Assessment - Program Amendments - GIS Applications (3-5 year horizon)
Project -> Planning	Local or Site Planning Applications	Functional Planning: Deployment with On-site Biological Assessment of Single and Multiple Reef Structures - GIS Applications (annual horizon)

source: Gordon, 1994.

2. Regional

Regional comprehensive planning would be undertaken by establishing cooperative agreements between respective adjoining coastal states. This would involve the joint management of deployed reefs in a boundary area delimiting state waters. This is especially important for those states that have either limited coastlines or extensive marine recreational fishing populations. This proactive arrangement is useful in avoiding any jurisdictional or site-based management conflicts. The three Interstate Marine Fisheries Commissions provide the most effective fora for such cooperative planning efforts.

F. Site-Based Planning

Gordon (1994) defined project or site-specific planning to involve the planning, deployment, management and subsequent assessment of materials used to develop single or multiple artificial reefs. As mentioned, site planning is synonymous with project-level planning. One of the more useful resource documents for site planning guidance can be secured from Ditton and Burke's (1985) Artificial reef development for recreational fishing: A planning guide. This guide provides a useful discussion of project-level planning, including advance planning, location and design considerations, permitting procedures, construction and deployment activities, operation and maintenance needs and project evaluation recommendations.

1. Single reef units

Single reef units may be placed within priority zones, as determined by the methods included in Section VII. The deployment of single reefs allows the distribution of available materials over a larger area, therefore avoiding possible crowding by recreational boat traffic over reef structures. Individual reef units should be pre-conceived in terms of what acceptable materials will be used, as well as the uniformity or homogeneity of selected materials. Profiles of individual reefs may be similar or irregular to attract selected or multiple fish species. Distances separating reefs should be at least 750 to 1,000 m. This is a maximum distance value where reef fish are able to migrate between submerged structures (Grove et al. 1989). These distances also allow widespread distribution of materials, if there are no conflicts with other bottom uses. Multiple deployments of single reef structures can also reduce surface crowding of recreational craft over submerged reefs.

2. Clustered reef units

Clustered reef units provide multiple fishing destinations within a common deployment area or priority zone. Minimum distances from associated reef structures should be at least 150 m., with maximum values at 300 m. This distance

of separation will distribute boat crowding as well as generate optimal unrestricted movement between reefs in the cluster (Grove at al. 1989). Although recruitment will occur within single reef deployment distances of 1,000 m. (Grove et al. 1989), closer distance values allows more effective aggregation of fish between the clustered reef sites. The intended profiles, selection of materials, and respective size of deployed reefs should also be considered to maximize use potential within deployment zones.

G. Implementation

Implementation elements are very important within a comprehensive planning framework. It is not unusual to find operational or implementation elements missing from most project-level planning efforts. The value of a plan is not exclusive to the range of treated topics, but also addresses how these considerations are to be realized. These action elements are addressed in this publication by the inclusion of policy guidance statements at the bottom of selected functional planning elements. Implementation components may also be accommodated by use of interagency memoranda of agreement, state or federal legislative requirements, or most likely by the use of agency rulemaking or regulatory authority. Although brief in treatment, being able to identify the means by which program or plan elements are to be implemented cannot be over-emphasized.

H. Planning Time Frames

Planning time frames vary according to the type or level of planning involved. Traditional urban planning utilizes both short and long-term planning horizons (Chapin and Kaiser, 1979). The comprehensive plan typically involves a time frame of up to 20 or 25 years. Periodic evaluation is scheduled to identify and implement any program adjustments necessary as reflected at the systematic or sub-systematic level (Gordon 1994). Any program amendments derived from evaluative criteria (biological, social/economic or program-based) can be implemented on an operational planning horizon of three to five years. Similarly, a three to five year horizon is recommended for sub-systematic or local level planning. Annual review cycles can also be used for reef program management as need occurs.

I. Citizen Participation

Client and citizen participation is highly recommended in artificial reef development planning. Important inputs can be derived from initial client involvement, but this process must be carefully managed so as to avoid needless confrontation. Baseline data collection and surveys of targeted clientele should be undertaken with minimal involvement of the general public. This intentionally avoids generating multiple dialogues, yet provides an essential feedback process early on by those individuals most directly affected by artificial reef development activities. Surveys of recreational anglers, sport divers, charter and party boat operators, commercial finfish and lobster fishermen can provide valuable insight into client needs (Green et al. 1991). This also allows the reef planner to identify early on any potential for conflict between user groups, allowing the identification and implementation of strategies to resolve potential or existing user conflicts (including refuge or sanctuary considerations).

Surveys are most effective when administered in person, by conducting either workshops or site visits to dock locations, and provide a means of identifying client needs as well as delimiting where conflicts are likely to occur. (Data generated from this research is then applied in the constraint or exclusion mapping process discussed in Section VII). The overall emphasis is to minimize opposition as much as possible by involving client groups as stakeholders in the comprehensive planning process. When general public participation activities (hearings) are finally announced at the conclusion of (a) survey and workshops, and (b) priority zone planning activities involved in the constraint mapping process, it is anticipated that the process will be met with little public opposition. The two most beneficial issues to convey to the public during this process are the ecological and tourism-based economic components of artificial reef development activities.

In developing or amending a state plan, it is important to focus on individual or specific functional planning components that are maintained within the broader comprehensive framework. Relating the benefits of artificial reef development to the fishing and non-fishing public should be an ongoing activity in all coastal states. Reef developers in New Jersey, Florida, Louisiana, and Texas have effectively utilized television and press coverage to promote artificial reef development activities. The development of effective public information programs is essential in promoting citizen participation and accomplishing successful program development. Spencer and Spangler (1992) noted that "communication of ideas between fisheries managers and the public remains a crucial part of effective management."

Recommended State Plan Policy Guidance Should Include:

- Solicitation of public comments and participation in the artificial reef planning process to the maximum extent practicable. Realistic opportunities must be provided.
- Public participation in reef construction and deployment activities, noting liabilities to personal injury or damages for providing labor and/or equipment to support these reef activities.
- Soliciting economic contributions to state artificial reef programs.
- Assisting in any support services to the state artificial reef program.

IV. APPLICATIONS OF MARINE ARTIFICIAL REEF HABITAT

A. Section Overview: Clients of the Process

There are two basic client groups which are affected by artificial reef development: human, and natural users. Human users can be broken down further by gear type and motivation into recreational and commercial activities (Hahn 1991). Recreational users include sport and tournament anglers as well as sport and tournament divers. Sport classes involve those casual and avid participants who undertake the recreation for personal satisfaction (Holland and Ditton 1992). Tournament classes involve those individuals, divers and anglers, who are participating in sport and professional tournament fishing (Christian and Trimm 1985). Tournament fishermen generally have a higher level of motivation for catching larger fish than recreational anglers and divers (Loomis and Ditton 1987).

Commercial fishing activities include two basic groups: (1) charter, party or headboat fishing, and (2) commercial finfish and lobster fishermen. Although party and charter boat anglers are recreational in scope, the operation of the vessel is a commercial activity and can generate enough fishing pressure from one outing to severely deplete the fish resources of a specific artificial reef site. The management of reef resources may focus on the level of fishing pressure generated by recreational versus commercial activities. Commercial fishing also includes lineboats that target reef species or trawlers that work the periphery of a reef. Trap fisheries such as lobster and crab fisheries may also be included.

Fish and other sessile organisms are natural reef users. Because of present overfishing in many areas, there is a need to develop reef habitat for (1) recruitment, or (2) absolute refuge or sanctuary purposes. Reefs as habitat may allow the natural system to recharge itself from human use pressures. This action may assist in the productivity of reefs designated for human use, by directing fish migrants to targeted reef locations. Alternatively, reefs as sanctuaries may be planned so as to preclude any migration or recruitment to nearby structures used by humans.

Often, reef siting exercises intended for human use result in poorly utilized deployments. Targeted species and reef uses are best determined early in the planning process, and should not be a de facto or post hoc rationalization for explaining the failure of a reef, when inadequately sited for human use (Gordon and Ditton 1986). Suitable materials for reef construction are often difficult to acquire, so improper placement can result in a significant loss of potential habitat, especially when targeted for human use. Although an improperly targeted reef would result in benefits to the natural system as refuge, placement may not be optimal for sanctuary or recruitment purposes. The clients and their respective goals for the artificial reef planning process may at times appear to be contradictory to one another. The ecological and economic benefits attributable to each group varies and are a significant consideration when planning the allocation and placement of reef materials for human and natural reef users.

B. Targeting Client Groups

The planning and design of artificial reefs can vary in terms of the number client groups using these reef structures. In any reef planning exercise, effort must be undertaken to identify prospective users (Ditton 1981, Myatt and Ditton 1986, Gordon and Ditton 1986) Artificial reefs may be deployed for use by recreational anglers, sport divers, and by party/charter boat operations, as well as various combinations of these user groups
(Fedler and Ditton 1986). The distinction to be made in all cases is the need to reduce potential conflict.

Artificial reefs have been identified for their utility in reducing conflict between user groups (Phillips 1988, Samples 1989, Gordon 1994) as well as for distributing fishing pressure (Gordon 1994). Although methodological guidance in identifying the locational requirements of respective groups is presented and discussed in Section VII, the following discussion highlights those needs that may be investigated by the artificial reef planner when conducting supportive background research necessary for state plan development or revision.

C. General Recreational Applications

Marine recreational anglers and divers participate in their respective sports for various personal reasons (Moeller and Engelken 1972, Fedler 1984, Fedler and Ditton 1986, Matlock et al. 1991, Holland and Ditton 1992, Spencer and Spangler 1992, Spencer 1993). The following subsections establish some of the client needs represented by recreational anglers and sport divers.

1. Angling

Marine recreational angling should be targeted for users having: (1) means of access to artificial reef opportunities, (2) levels of experience and related safety considerations, (3) target species requirements, as well as (4) types of motivation including tournament versus non-tournament sportfishing needs. These requirements are pursued at length with the subsequent discussions of shore-based subsistence fishing, and tournament angling and diving.

2. Diving

Over the past thirty years, reefs have grown in importance as preferred diving destinations (Schwartz 1980, Gulf of Mexico and South Atlantic Councils 1982, Roberts and Thompson 1983, Milon 1989b, Stanley and Wilson 1989). Sport diving can represent a significant expenditure into a local tourist economy (Milon 1989b), and should be given adequate attention in the planning process. Artificial reefs, when intended for use by divers, should be designed and deployed according to (1) safety of design to avoid trapping or injury by the reef, (2) safe depths to consider decompression needs or standards, (3) water clarity or visibility, (4) water quality. Safety from other divers is a consideration with regards to regulating, limiting or banning the use of spearguns in harvesting reef fish.

D. Fishing Tournaments

In recent decades, tournament fishing has represented a significant expenditure of money by marine recreational anglers, divers and commercial interests within the marine recreational fishing industry. According to Gordon (1993), the marine recreational travel behavior (distance travelled on water) exhibited by tournament anglers is significantly greater than that of the 'typical' marine recreational angler. Recreational and professional tournaments can have a significant impact on the distribution and population of fish caught within the fishing range of the tournament. This pressure is often dependent upon (1) the number of fishing tournaments hosted within a coastal state, (2) their frequency of occurrence, (3) the range of species targeted, (4) the disposition of fish (harvested or released), and (5) the general location of tournaments (situated near urban or rural

population centers). Although definitive biological research is lacking which describes the extent of impacts occurring from tournament activity, one anticipated result is that tournaments can reduce or relocate recreational fish stocks from commonly used fishing grounds.

Tournaments represent significant expenditures into local economies by participants and families (Christian and Trim 1985). Therefore, state artificial reef planning activities should take into consideration (1) the needs and demands of current state tournaments, and (2) plan for the future needs of this marine recreational activity. The use of artificial reefs can be an important tool in mitigating the potential conflict between daily users of a fishery resource and the infrequent intensive use represented by tournaments. Sport fishing tournaments can be used as a means of providing economic support to a state artificial reef program.

Artificial reefs should be used to distribute recreational (angling and diving) and tournament fishing pressure within a states coastal and offshore waters, thus minimizing potential conflict between these two major sportfishing activities. Although typical offshore travel distances of twenty to thirty miles offshore in the Gulf of Mexico have been identified for recreational anglers by various researchers (Ditton and Graefe 1978, Ditton and Fedler 1983, Myatt and Ditton 1985, Gordon and Ditton 1986, Gordon 1987, Gordon 1993), it is realistic to expect that many of the recreational anglers in the mid-Atlantic and especially the New England states travel a shorter distance offshore in pursuit of their fishing activity. This shorter travel distance would be attributable to a greater variation of water depth to distance offshore the Atlantic coast, in contrast to the general condition in the Gulf of Mexico where depth slowly increases with greater distances offshore.

Reefs deployed closer to shore generally will meet the habitat requirements of the recreational angler. Most existing artificial reef plans in the Atlantic States region accommodate this user group. None of the plans effectively addressed reef deployment for tournament divers and anglers. In a tournament application, artificial reef structures should be placed either (1) farther offshore, or (2) closer to rural coastlines that are situated farther away from urban centers. Gordon (1993) found that tournament anglers will travel significantly greater marine distances in pursuit of 'trophy' size fish. Placement of artificial reef materials for tournament versus non-tournament anglers is recommended. It is likely that traditional angler may not make the extra effort to travel farther by car or by boat, especially if they know their original (closer) destinations will provide them some level of fishing success.

The motivation of the tournament angler is to seek less frequented locations so that the likelihood of catching a trophy size fish will increase (because of a lack of

fishing pressure). Placing reef materials in remote areas can also provide refuge to those fish when tournament or avid anglers are not present. Finally, from an economic perspective, deployment of artificial structures can provide the necessary conditions for successful tournaments, generating fishing satisfaction amongst participants, and economic satisfaction with the local business community.

E. Subsistence Fishing

Shore-based subsistence fishing is becoming an increasingly important topic on the state fisheries management agenda. For years a certain level of subsistence fishing has taken place along coastal waters where economically disadvantaged individuals have used their fishing as a means of providing food for their households. In the last decade, recent immigrants from Southeast Asia have provided a new dimension to subsistence fishing. To the Southeast Asian family, the catch has both a cultural and nutritional importance. These combined subsistence fishing pressures in urban and rural contexts place a need for creative response from the artificial reef planning community.

Section 203 of the NEFA addressed the issue of recreational fishing access to fishery resources as an important consideration in the artificial reef planning process. Shore-based recreational fishing access is accommodated by the existence of bridges, jetties, urban waterfronts, legal ways of access to the shoreline, or by the development of fishing piers. The existence of piling supports or rip-rap structures for some of these shore-based destinations provides a de facto reef system. Marine epifauna and other sessile organisms attach themselves to these structures and fish are subsequently attracted to these locations. Sometimes, the placement of additional reef materials may enhance shore-based opportunities. Design and placement considerations become important management concerns as supplemental structures can accumulate terminal fishing gear, such as lost lures and line (Buckley and Walton 1981, Buckley 1982).

As polluted urban waters become cleaner from legislative and regulatory actions, such as pending amendments to the Clean Water Acts and existing land-based environmental planning regulatory activities with the U.S. Environmental Protection Agency and Office of Coastal Resource Management's Nonpoint Source Pollution Programs (commonly referred to as the '6217 Program' - United States Environmental Protection Agency 1993), a greater opportunity exists to plan artificial reef programs within the urban setting (Leedy et al. 1981). The placement of artificial reefs near designated fishing and abandoned waterfront piers can enhance the fishing environment. Buckley and Walton (1981) noted that placement

of materials can occur such that only a portion of the reef fish population can be reached by pier anglers. In this type of application a nearby complex would be situated out of range of the pier anglers, allowing migrant fish to move between the pier and reef complex, allowing these fish to be targeted as opposed to attracting all fish to within the catch-range of pier anglers.

Buckley and Walton (1981) commented on the importance of having effective pier fishery management practices in place. They observed that general fishery regulations on bag limits, size limits and gear restrictions are typically based on the fish population dynamics and biological trends of larger areas and may not be modified to the limited area represented by the urban pier or access point. Buckley and Walton (1981) stated that "for many species these generalized regulations are too liberal to sustain a harvest from a fishing pier." Bag limits and size limits can help to alleviate marine recreational by-catch impacts (the harvest, subsequent mortality, and disposal of undesired species), as well as impacts to the juveniles of desired recreational fishes. In some situations they advised the closure of a significant area adjacent to all other fishing, in this case from marine recreational boaters, so that a sustained harvest for pier anglers is maintained.

The ongoing restoration of our marine coastal waters creates an additional consideration for state artificial reef planners to evaluate. The quality of marine waters may cause urban fishing and artificial reef planners to evaluate the safety of those fish consumed by the subsistence angler. There may be existing restrictions on the recommended numbers of fish that should be consumed when caught in contaminated waters. The deployment of artificial reef habitat into polluted waters is not recommended as individuals may be consuming contaminated fish. The U. S. Environmental Protection Agency maintains an on-line computer access system which identifies areas with fish consumption bans (U. S. Environmental Protection Agency 1992). This system is generally accessible to the public and should be subscribed to. Although this may not interrupt artificial reef development planning within the urban waterfront setting, it may establish a temporal element of when an artificial reef should be constructed.

A final consideration addresses the need to re-evaluate onshore access infrastructure. As noted in the state application of comprehensive reef planning, there is an growing conflict occurring in the Northeast with shore-based recreational anglers parking in areas that were originally intended to accommodate vehicles with boat trailers. Facility operators must determine whether infrastructure can be improved with larger capacities or whether restrictions must take place. The use of restrictions may be difficult as state coastal zone management programs are usually disadvantaged by the amount of available access to coastal waters. Restrictions may further reduce access.

Long and short-term funding support (from saltwater license fees or federal sources) to improve parking infrastructure may be necessary. Long-term responses may be used to provide a comprehensive evaluation of marine recreational access infrastructure. Although State Comprehensive Outdoor Recreation Plans inventory these resources, state parks and recreation agencies may not interact effectively with access programs that operate from state divisions of marine fisheries or coastal management authorities. Appropriate linkages should be established to resolve the need for coastal access and related parking.

Recommended State Plan Policy Guidance Should Include:

- An inventory process which evaluates shore-based access infrastructure (fishing piers, jetties, waterfront locations or other shore-based access locations) should be undertaken to identify respective quantity, distribution, condition and related safety considerations. Support infrastructure for parking should also be assessed in this process.

- Functional plans for the enhancement of fishing piers, jetties, waterfront locations or other shore-based access locations by effectively utilizing artificial reefs. Plans should also address support infrastructure needs.

- An assessment of the number of existing sport divers, shore-based and offshore recreational anglers should be undertaken (as noted in Section VII: research requirements) to assess present demand as well as to identify the growth potential and subsequent needs within these various user groups. (Commercial needs are addressed below).

- An assessment of sport and professional tournament activity should be undertaken to identify potential conflicts with existing recreational and commercial fishing activity. As noted, an effective use of artificial reefs can distribute fishing activity over a wide area, allowing formal or informal zoning or allocation of existing and planned reef resources. The development of sportfishing tournaments may be a means of enhancing local and state tourism economies.

F. Commercial Utilization of Reefs

For purposes of this guide, commercial use of an artificial reef is defined as either fishing, or providing fishing opportunities to clients, for direct economic gain. Commercial users are broken down into three respective client groups: (1) finfishermen, (2) lobstermen, and (3) charter and party boat operators.

Although Sections 202 and 203 of the NEFA stated that efforts should be made to facilitate the use of artificial reefs by commercial fishermen, U.S. artificial reef planning has traditionally placed a minimal emphasis on commercial utilization of artificial reefs. This is a direct contrast to other coastal nations such as Japan (Nakamura 1985, Grove et al. 1989, Yamane 1989), in which artificial reefs development is directed almost exclusively towards the commercial sector.

To comply with NEFA provisions, state planners should identify the applications and extent to which artificial reefs can be used by commercial fishermen. Once commercial applications have been identified, planners should develop or modify their plans accordingly. This will require state artificial reef managers to coordinate efforts with respective state and federal agencies. In states where recreational fisheries are not as abundant, artificial reefs development should be directed to enhance commercial fisheries.

1. Finfish

Commercial finfish fisheries represent a potential source of conflict with artificial reef development activities. Commercial trawlers, draggers, shrimpers, etc., attempt to avoid bottom obstructions that may damage or destroy their nets and gear. While noting this danger, it is not uncommon for commercial finfish fishermen to work as close as possible to wreck sites or other bottom habitat to reap the benefits of reef productivity.

The issue of access to an artificial reef is not as much of a concern to other forms of commercial fishing. For example, commercial handline and longline boats can work adjacent to, and over, artificial reef sites. Commercial use of a reef site may pose a conflict of use with private recreational anglers and divers, as well as with party and charter boat operations. The deployment and management of artificial reefs intended for multiple users should be addressed early in the artificial reef planning process.

Murray (1989) identified that a majority of Gulf and Atlantic coast states target their artificial reef planning activities exclusively to recreational interests (including party and charter boat operations). In those situations where overfishing occurs, artificial reefs may be designated for exclusive use by recreational users. The use of special management zones (SMZs) are recommended where restrictions may be made by gear type, as well as the number and size of allowable fish to be caught

(Reeff et al. 1990). The use of SMZs as a management tool is presented later in this guide (see section VI(d)).

2. Lobster

In some regions of the United States, the development of artificial reefs is directed towards those geological areas that pose a threat to trawlers and draggers. In the Gulf of Mexico, artificial reefs are recommended for those areas that have natural snags, hangs and ledges. Placement of artificial reefs according to this practice will maintain as much bottomlands as possible for trawling operations.

In the Atlantic northeast, the placement of reef material in close proximity to bottom features may result in a conflict with the lobster fishery. This is problematic because the lobster fishery makes up a significant economic component of northeast commercial fisheries. Homarus Americanus, the Maine lobster, seeks those areas which provide protection and cover from marine predators. Thus, lobstermen often seek out natural ledges and hangs as preferred locations to set their lobster pots or traps. Placing artificial reef materials too close to these natural disruptions of the bottom may interfere with lobster fisheries by creating a situation where recreational anglers will either be (1) competing for surface area to fish from, (2) tangling their fishing lines with pot or buoy lines, or (3) tangling their propellers in buoy lines.

Concrete rubble (clean of materials such as asbestos) from old buildings, highway roadways or the road deck of obsolete bridges may be ideal material for establishing benthic lobster habitat. The careful layering of slabs or the deployment of large pieces of rubble will, in most situations, establish prime lobster habitat (Sheehy 1977). Although some Atlantic states (such as Maine) may not have an economic justification for developing an artificial reef program devoted to the needs of an underdeveloped recreational fishery, the use of obsolete materials for carefully planned lobster habitat will provide additional benefits to the lobster industry.

An additional habitat consideration might involve the use of artificial reefs for urchin fisheries. Materials targeted within the euphotic zone where light has its optimal effects may provide important habitat for Maine urchins, which have recently become a significant and highly overfished resource.

Recommended State Plan Policy Guidance Should Include:

- An identification of potential applications to use artificial reef development to enhance commercial fishing opportunities in state waters. This planning effort should identify likely stocks to be enhanced, including preferred and underutilized species. A coordinated effort is recommended for planning artificial reef

deployment in federal jurisdictions. This may be accomplished by consulting with federal officials at the NMFS and regional fishery management councils. This consultation will also facilitate any planning for economic relocation of commercial fishermen to other sectors of the commercial fishery.

- An outline of artificial reef design considerations which note particular type(s) of desired habitat to be enhanced.

3. Party and charter boat operations

The commercial fishing applications described above represent a direct harvest of fish for intended profit. Party and charter boats differ because they provide a marine transportation service to recreational anglers so that they may harvest fish. According to Ditton et al. (1992) "party boats provide anglers with a relatively low-cost means of accessing nearshore and offshore fishing locations." Because owning a personal craft capable of travelling safely offshore represents a significant financial expenditure, chartering services are an important economic option for non-boat owners. In fact, this is often the only opportunity for these individuals to fish offshore locations.

Although the capture of fish may be incidental to a paying charter on a given day, the economic success of a charter boat operation is ultimately dependent upon the boat's reputation for successful catches. This raises the question of when the threshold for overfishing by a charter boat fleet will occur. This is a serious concern, not only to commercial party and charter boat operations, but also to those marine recreational anglers who own craft. Unrestricted fishing may result in the decline of a fishery, therefore establishing the need for resource allocation or regulation. Ditton et al. (1992) noted that "total allowable catch ultimately impacts party boat operations in terms of minimum size regulation, bag limits and closures when recreational allocations are met." They also concluded that reduced bag limits may result in a loss of existing clientele.

The literature is representative of comprehensive efforts to understand the catch and non-catch motivations of charter boat anglers (Ditton et al. 1978), as well as the market for charter and headboat services (Ditton et al. 1991). Ditton et al. (1992) stated that: "By understanding the assemblage of fish currently targeted by party boat operators in each state, it is possible to predict the likelihood that other species will become more heavily targeted in response to increased regulation of the primary target species and better assess potential economic impacts." These authors also observed that because most party boat operators lack a capability to adequately market their service, they are often forced with alternatives to leave their business, oppose new management regulations, or target new species when restrictive

regulations are implemented. This poses an interesting dilemma in the Gulf of Mexico as "nearly all offshore species are currently regulated (Ditton et al. 1992)."

When the magnitude of charter and party boat operations is understood, the need to establish reliable baseline data to monitor the success, stress, decline and failure of recreationally targeted fisheries becomes quite clear. Ditton et al. (1992) estimated that during a twelve month period in 1986 and 1987, the 97 party boats located in Texas, Louisiana, Mississippi, Alabama and Florida provided services to 329,116 anglers who fished offshore. Holland et al. (1992) noted that 142,000 trips were conducted offshore in the same study area by charter boats with an estimated 568,000 angling clients. The development of optional artificial reef destinations will provide additional economic opportunities for this marine recreational fishing industry and ensure the vitality of targeted stocks.

a. economic relocation tool

One of the current economic problems facing Commission member states, especially in the Northeast, is the decline of the groundfish stocks. Future regulatory responses to stock depletion may force many current commercial fishermen out of their economic involvement with the fishery. For states that have marginal development of their charter and party boat industry, there may be an opportunity for some commercial fishermen to relocate within this recreational industry. Ditton et al. (1991) noted that there have been enough studies conducted so that there is little need to further describe the motivations and satisfaction of charter and headboat anglers. The need does exist however to identify the role that artificial reef planning and development may have in supporting developing charter and party boat industries to accommodate economic relocation.

According to Holland et al. (1992), charter (and party) boats make important contributions to state and local tourism economies. Although there is extensive regulation in some regions of the country and the respective number of operators differs over time, Ditton et al. (1992) argued the need for the party boat industry to survive from a social equity perspective. They also concluded that without these services, many anglers would be precluded from offshore fishing. Ditton et al. (1992) placed a responsibility upon the NMFS to see that a role continues to exist for this industry. The identification of industry capacity, market demand, promotional requirements, economic tourism benefits and growth potential should be determined by NMFS or the regional fishery management councils, with cooperation from state plan managers, to assess the capacity and capabilities for artificial reef development to provide additional habitat opportunity. However, managers must ensure that additional opportunities don't translate into a more effective means of stressing other fisheries.

Recommended State Plan Policy Guidance Should Include:

- An effort to examine the demand for artificial reef deployment by charter and party boat operators. It is this industry that is usually most vocal in its support of reef development programs.

- The determination of the effective range of operators in offshore waters. Managers should note where charter operators observe a decline in the number of private recreational craft. This area of decline may offer an appropriate point to begin seaward deployment of reef materials for the party and charter boat industry.

- Research to determine the capacity for relocating economically impacted commercial fishermen into the party and charter boat industry.

G. Artificial Reefs as Refuge

The use of artificial reefs managed exclusively as habitat or refuge is ill-defined in the literature. Although various studies have been done which examine recruitment between natural and artificial structures (Alevizon and Gorham 1989, Grove et al. 1989), there has been little research that suggests that reefs as refuge are a viable deployment option that should be pursued. This guide proposes that artificial reefs should be developed, when materials and funding are available, merely for enhancing the marine environment. Recognizing that artificial reefs deployed in a refuge program would in fact recruit fish from other locations, the intended goal would be for the reef to serve as a producer, providing a supply of fish that could migrate or be attracted to other natural or artificial settings.

All recreational and commercial fishing would be prohibited in this application as this type of use would be self-defeating to the intentions involved. If all natural and artificial reefs are fished to capacity, then the quality and quantity of fishing WILL decline. Artificial reef habitat as refuge would provide a means for this resource system to recharge or regenerate itself. Strict enforcement would be necessary, but realistically would be difficult as it appears that the lack of consistent enforcement is one of the principal reasons why many fish stocks have gone into decline (illegal fishing or overfishing of available stocks).

Recommended State Plan Policy Guidance Should Include:

- A policy to promote the use of artificial reefs as refuge where commercial or recreational fishing would be prohibited. Managers may want to investigate dedicating reef sites as SMZs.

- A means of providing strict enforcement or compliance through reporting of violations by offshore participants. Proper reporting of violations is essential to ensure the success of a refuge program. This may be facilitated by (1) dedicating a portion of any collected fines to those who report the violations, and (2) attaching accountability protection guidelines to enforcement components of the state plans.

H. Protected Area Management

Protected area management refers to the nomination and designation of specific marine areas for conservation or protection purposes. Restricted fishing, usually rod and reel, or spearfishing, is allowed within the confines of some protected areas. A management program usually outlines the approved techniques for fishing and the allowed size or creel limits for participants within the protected area (United States Department of Commerce 1991).

1. Uses in marine sanctuaries

Applications for artificial reefs within federal marine sanctuaries have not been explored within the traditional sanctuary planning process (United States Department of Commerce; 1992, 1991, 1980). There is a potential for use as (1) a buffer for damage to the marine ecology of natural habitats, (2) a means of distributing fishing and other use pressures, and (3) a refuge to generate fish for recruitment to non-sanctuary areas. The federal Office of Ocean and Coastal Resource Management (OCRM) should examine ways to incorporate artificial reef technology as a management tool within its marine sanctuary program.

Recommended State Plan Policy Guidance Should Include:

- Conducting meetings with state artificial reef program managers and federal marine sanctuary authorities (for those sanctuaries situated

directly off a state's coastline), to determine if there are any applications or benefits to derived from placing artificial reefs within sanctuary boundaries.

V. JURISDICTIONAL CONSIDERATIONS

This section briefly examines the role of federal, state and local jurisdictions in the artificial reef planning process. Regulatory authorities and legal procedures are also addressed.

A. Jurisdictions for Offshore Planning Zones

U.S. coastal states play a unique role in planning offshore artificial reefs in what has traditionally been considered federal jurisdiction (typically beyond three n.mi. from shore, nine n.mi. for Texas and the west coast of Florida). Gordon (1994) commented that this is an ineffective arrangement as states can `plan' and deploy reef materials in federal waters, but do not have the authority to manage the fishery resources or anglers that frequent the artificial habitat. The NMFS, the U.S. Coast Guard and other federally authorized agents (such as deputized state fishery personnel) police offshore waters for illegal fishing activities. Unless regulated under federal and state authorities, there is a potential to overfish artificial reefs and related stocks by marine recreational anglers, charter and party boat operations, sport divers and commercial fishermen. A solution can be achieved by effectively coordinating state artificial reef planning activities with NMFS and the regional fishery management councils and commissions, as well as other federal agencies that have a mandated interest in state artificial reef planning.

B. Federal Agency Jurisdictions

The following discussion involves a breakdown of federal agency jurisdictions and responsibilities for artificial reef development in state and federal waters. Legal mandates are reviewed, as need occurs.

1. The National Marine Fisheries Service

The National Marine Fisheries Service (NMFS) is responsible for fisheries management seaward of state jurisdiction. Under provisions of the Magnuson Fishery Conservation and Management Act of 1974, as amended, (16 U.S.C.A. 1801-1882), NMFS has the responsibility to develop Fishery Management Plans (FMPs). Various species of reef fish, coastal migratory pelagics, spiny lobster and stone crab

are already managed under FMPs in the Gulf of Mexico and the South Atlantic regions (Gulf of Mexico and South Atlantic Fishery Management Councils 1990). NMFS, at its discretion, can serve in an advisory capacity for artificial reef activities taking place in state waters. NMFS actively reviews proposed state reef sites that are located on the federal OCS.

2. The United States Army Corps of Engineers

The U.S. Army Corps of Engineers (USACE) is responsible for permitting artificial reef development within state and federal waters. This permitting authority is granted to USACE through the Rivers and Harbors Act of 1899 (33 U.S.C.A. 403 et seq.), Section 404 Permitting Program. This authority is also granted under Section 205 of the NEFA. The USACE focuses on potential conflicts to navigation, as well as the financial ability to assume liability for future damages. (NEFA, Gulf of Mexico and South Atlantic Fishery Management Councils 1990).

3. The United States Coast Guard

The Coast Guard may be involved in artificial reef development through two legislative vehicles. The Ports and Waterways Safety Act of 1978, as amended, (33 U.S.C.A. 1221 to 1227) gives the Coast Guard the right to ensure navigational safety with allowable clearances and marker requirements over artificial reefs. Under provisions of the MFCMA, the Coast Guard is mandated with marine environmental and fisheries protection (16 U.S.C.A. 1801-1882). The Coast Guard is also one of the enforcement agents for NMFS FMPs and OCRM marine sanctuaries.

4. Environmental Protection Agency

The Environmental Protection Agency (EPA) is the federal agency given responsibility for regulating air and water pollution in the U.S. Under provisions of the Clean Water Act's (33 U.S.C.A. 1251 et seq.) National Pollutant Discharge Elimination System (NPDES), the EPA is often consulted with to inspect candidate reef materials for any leakage or pollution potential.

5. The United States Department of Commerce, Office of Coastal Resource Management, Marine and Estuarine Management Division, Marine Sanctuaries Program

The National Marine Sanctuaries Program is managed and implemented by the Office of Coastal Resource Management (OCRM), pursuant to Title III of the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C.A. 1401 to 1445) On-site management and enforcement is maintained by Marine Sanctuaries staff or through special arrangement with adjacent coastal states. The U.S. Coast Guard is also responsible for on-site enforcement within the Marine Sanctuary system.

C. Regional Jurisdictions

There are two types of regional entities that have jurisdiction over U.S. artificial reef development: Interstate Marine Fisheries Commissions and Regional Fishery Management Councils. The Councils are the regional binding authority which develop fishery management plans for federal waters (EEZ). The Secretary of Commerce provides final approval of council developed plans, with NMFS serving as implementing agency. Enforcement of federal plans is shared with NMFS and the U.S. Coast Guard. The Commissions develop interstate fishery management plans for implementation in state waters by the respective states.

1. Interstate Marine Fisheries Commissions

The Atlantic States Marine Fisheries Commission (ASMFC) is one of three Interstate Marine Fisheries Commissions which represent the states interest in marine fisheries issues on the three U.S. coasts. The ASMFC was established by an interstate compact agreed to by the U.S. Congress during the early 1940s. The Atlantic , Gulf, and Pacific States Marine Fisheries Commissions represent state fishery management needs for commercial and recreational fisheries of their respective states. The Commissions interact between state and federal authorities to coordinate management activities for marine fisheries which migrate among the various jurisdictions.

2. Regional Fishery Management Councils

Regional Fisheries Management Councils established by the Magnuson Fishery Conservation and Management Act, prepare fishery management regulations for resources within U.S. federal waters (3 to 200 n. mi. offshore), or within the federal portion of the EEZ. Council involvement with artificial reefs to date has been minimal. However, some regulatory authority as been established through designation of Special Management Zones (SMZ) around artificial reefs in the South Atlantic. SMZs are used to regulate the fishing activities on particular state-permitted reef sites. The South Atlantic Fishery Management Council pioneered SMZ language for the Atlantic coast within their Snapper/Grouper Fishery Management Plan. Such language established a mechanism through which the holder of a permit for an artificial reef in federal waters may petition the Council for SMZ status to protect the interest and intent for which the reef was built. According to Reeff et al. (1990), the management responsibility for Fishery Management Councils to regulate artificial reef use is important as over half (56%) of all Atlantic reef sites are situated in federal waters.

D. State Agency Jurisdictions

State jurisdiction over artificial reef development is usually found within state departments or divisions of marine fisheries. These agencies are responsible for fishery management issues within the state territorial waters, usually within three n. mi. of shore. Although advocated within this document in the next section, state coastal zone management authorities generally have little interest or authority in state fishery management.

1. Legislative

The initiative to establish state artificial reef plans is often accomplished through the enactment of state artificial reef legislation. State legislation is an effective means to establish an artificial reef planning and management mandate within a state resource agency. Murray (1989) in a study of Gulf and Atlantic coast states found four states had artificial reef program elements mandated by state legislative efforts, they included North Carolina, Florida, Louisiana and Texas. Many of the elements within the state laws are modelled after NFEA. These elements involve permitting, design standards, state plan requirements, liability and funding elements (Texas Parks and Wildlife Code 1989)

2. Rulemaking

Agency rulemaking is another means of describing the government function of establishing regulations. The rulemaking powers of government establish standards that have similar legal authority as legislative efforts. Therefore, the mandate for a state artificial reef program could be undertaken within the regulatory framework of a state agency, without any intervention by a state legislature.

E. County Jurisdictions

Among the ASMFC's member states, Florida is the only one in which counties within the states sponsor extensive development of artificial reefs. Eleven of thirteen Atlantic coast counties in Florida have county sponsored reef programs (McGurrin et al. 1988). Responsibility for program development and operation is given to county departments such as parks and recreation, resource management, waste management, port authorities or environmental services (McGurrin et al. 1988). Planning efforts are directed to the tourism attractiveness of the county, by placing artificial reef structures off county shorelines to enhance the economic and fisheries benefits for the county.

Florida allows the development of artificial reefs by individuals, fishing clubs, municipalities and county governments. The state reviews projects in state waters, but does not involve itself in deployments on the federal OCS. Only a federal 404

permit is required for offshore deployment. The majority of reef deployment activity is administered on a county level (McGurrin et al 1988). This policy is generally not recommended in its present form. A central clearinghouse (ie., the state artificial reef manager), is required to make comprehensive and systematic artificial reef planning a reality. If each county is establishing its own plans (with de facto approval by the state), the question must be asked whether a states entire assemblage of artificial reefs is optimal in terms of human and natural resource benefits. The argument could be made that this type of effort represents an incremental and reactive response to the availability of reef materials as opposed to a proactive assignment of materials to appropriate sites, based upon the availability of pre-approved candidate materials.

Historically in Florida, much of the artificial reef development activities in the United States have been undertaken by local sport fishing groups and private interests. The respective needs of groups such as these, as well as county-wide interests, should be funneled through the state artificial reef program manager. Issues such as conflict resolution, overcrowding and coordinated program development can be dealt with most effectively by a central decision-making authority. In the traditional county setting, noted above, one county could be ignorant as to the extent of artificial reef planning activities an adjacent county was undertaking. Ineffective deployments can result; therefore promoting an ocean dumping approach to artificial reef management.

F. Municipal Jurisdictions

As in the case of county reef planning activities, it is not recommended that artificial reef planning be carried out at the local level independently of state review. Virginia Vail, in McGurrin et al. (1988) stated that:

> "In general, artificial reef development in Florida is not guided by any policies other than those defining permitting criteria. Responsibility for and authority over reef related issues (e.g. placement, construction, fisheries management, maintenance, enforcement, monitoring, etc.) is assigned to separate federal, state and local government bodies which function independently from the state reef program."

Many questions arise regarding an incremental approach to reef development. There may be no clear single vision of the level of infrastructure placed offshore and how this might be managed, should the need occur. What are the implications to the public trust doctrine where the state is supposed to hold and manage state lands, in this case bottom lands, for the benefit of the people?

H. Environmental Planning of Onshore Activities and Offshore Impacts

Two essential elements of artificial reef management, which have been totally disregarded in state plans, are the needs to conduct environmental planning for onshore infrastructure or support activities, and offshore environmental impacts resulting from artificial reef development activities. Although these considerations may be subject to other environmental regulatory authorities (State Environmental Policy Acts), state plans should reflect their influence and role in potential environmental degradation and note any means to rectify these situations. On and offshore garbage is a serious concern as many states have suffered budget reductions in recent years and have been forced to utilize a carry out policy to trash pick-up; i.e., you bring it - you take it out. Unfortunately, not everyone subscribes to this notion. Public awareness programs need to bring these issues to a higher level of public consciousness. Enforcement needs to maintain a consistent level of service and presence in this regard.

VI. FEDERAL CONSISTENCY AND PROGRAM CONSIDERATIONS

A. The Dilemma of Federal Consistency with State Artificial Reef Plans

Federal consistency is a concept that gained national recognition when the Coastal Zone Management Act of 1972 (CZMA) was enacted (16 U.S.C.A. 1451 to 1464). This relationship requires federal agencies to consider state interests when undertaking activities within a state's coastal management area (16 U.S.C.A. 1456 (c)(1)(A), (c)(1)(C), (c)(2), (c)(3)(A-B).

Federal consistency is somewhat unique to the CZMA. There were no similar provisions drafted within the text of the NEFA for establishing consistency reviews between state and federal jurisdictions in state plans or programs. Although future consistency challenges may occur between federal and state interests in the EEZ, where state planning efforts could possibly interfere with federal responsibilities and jurisdiction, the major challenge to date has occurred in state waters.

The topical issue where federal consistency is most likely to be challenged will occur with the mitigation or reduction of anticipated coastal habitat impacts. Simply put, federal agencies presently have jurisdiction to undertake mitigation activities within a state. These activities may involve creating artificial reef habitat. Examples of this already have occurred in Delaware and are pending in Massachusetts. The Delaware case involved creating reef habitat in Delaware Bay in response to dredging impacts of a coastal wetland (McGurrin et al. 1988). This mitigative effort was out-of-kind and off-site from where the initial impacts occurred (McGurrin et

al. 1988). The pending example in Massachusetts involves the Boston Harbor Tunnel Project whereby the U.S. Army Corps of Engineers will require the Massachusetts Department of Transportation to provide mitigation for destroying the bottom habitat where tubular sections of the tunnel system are being submerged within the substrate of Boston Harbor.

The basis of a state objection to federal intervention in the siting of reefs as mitigation by federal agencies is unclear under present legal and regulatory frameworks. None of the existing Atlantic coast state plans have addressed what would be the possible guidelines by which federal agencies can require and implement mitigative actions in state coastal waters. The National Plan did not provide any substantive administrative or management responses to this issue (Department of Commerce 1985) and federal, regional and state fishery management plans typically do not address the resolution of conflict in a consistency challenge.

Although states vary in the administration of existing artificial reef programs, most are managed by state departments of natural resources (DNR) or environmental management (DEM). The state DNR or DEM usually maintains a division of marine fisheries which manages state marine fishery issues. These Guidelines recommend another arrangement.

B. Federal Consistency under the Coastal Zone Management Act

The concept of federal consistency is not without precedence in fishery management. As noted above, FMPs typically do not address this issue. However, according to the Gulf of Mexico and South Atlantic Fishery Management Councils' (1982) fishery management plan for coral and coral reefs of the Gulf of Mexico and South Atlantic:

> "many activities beyond the defined coastal zone may also be influenced by approved coastal programs through operations of CZMA's federal consistency requirements, under which direct federal activities significantly affecting the coastal zone, including the approval of a FMP, must be conducted in a manner consistent to the maximum extent practicable with approved state programs. Activities requiring a federal license or permit, such as plans for OCS exploration, development, and production activities can effectively be vetoed by a coastal state determined not to be consistent with their approved program." (Gulf of Mexico and South Atlantic Fishery Management Councils 1982, page 7-6).

The coral reef management plan sought and received consistency reviews from

states within the geographical area of authority of the two fishery management councils (Gulf of Mexico and South Atlantic Fishery Management Councils 1982, page 15-2). No objections to the plan were noted, yet the coral plan is not an amendment to the state CZM process, but merely reviewed to identify potential consistency conflict. A review does not have the same value or impact as would a program amendment.

Under provisions of the CZMA, the state CZM Program can establish 'unified policies, criteria, and standards' to manage marine uses in the states' territorial waters. One of these marine uses can, and should be, artificial reef planning and management. Simply put, state plans should be amended into respective state CZM programs. This does not preempt state agency responsibilities and jurisdictions. A state DNR or DEM, which may have current (or future) responsibility for developing and implementing the state plan, will not forfeit its mandate by allowing the state CZM Program to 'adopt' the artificial reef program. Typically state DEMs or DNRs do not have an effective working relationship with state CZM authorities or agencies. A Memorandum of Understanding (MOU) between the two agencies or interests can establish the basis of a working relationship, thereby providing the state artificial reef program a means of protecting its interests from federal intervention.

1. Variations in CZM approaches

State coastal zone management programs differ greatly from state-to-state in terms of how they are devised, implemented and managed. Some CZM agencies have rule-making authority, while others do not. The level of autonomy also differs to the extent that management issues are either embraced or dismissed by the CZM process. A weak state CZM program may be inadequate to coordinate an artificial reef program with a state DNR or DEM.

C. Other Federal Linkages to State Artificial Reef Programs.

State artificial reef programs are linked to numerous federal programs. One of the most essential federal/state relationships is accommodated through the Wallop-Breaux amendments of the Sportfish Restoration Act. Many coastal states currently operate their marine recreational fishery programs through federal funding made available through the ten percent excise tax that is imposed on the recreational fishing industry. Although states vary in the amount of monies committed to operating their artificial reef programs and supporting the actual deployment of reef materials, most states have developed a dependent relationship to this program. Without these funds much of the current artificial reef activity would not be possible.

1. NEPA requirements

Another linkage, although not realized, was the potential relationship of the National Environmental Policy Act of 1969 (42 U.S.C.A. 4321-4370b) to the artificial reef development process found nationwide. An interesting oversight involved the lack of an Environmental Impact Statement (EIS) being prepared to assess the programmatic scope of the National Plan. According to McGurrin et al. (1988), there has been a significant amount of artificial reef materials deployed in state and federal waters along the Atlantic coast. One of the threshold considerations in invoking NEPA is that a project or program is of a major and significant nature, and represents a federal action. Although the deployment of these materials was piecemeal, a hypothetical action to remove all of this material would not involve a hypothetical cost.

Under provisions of the National Environmental Policy Act of 1969 (42 U.S.C.A. 4321-4370b), Section 102 (C) requires the completion of an EIS, which in this case would have involved an examination of the cost involved in removing all reef materials. For various political reasons, an EIS was never executed (Gordon 1994). NMFS would have been the logical lead agency in undertaking an EIS but never provided as much as a Regulatory Impact Review (RIR) or a Programmatic Environmental Assessment (PEA). As noted by Gordon (1994), "the issue of a Programmatic Environmental Assessment (PEA) or EIS addressing removal issues is not without precedence, as the U. S. Department of Interior's Minerals Management Service (MMS) conducted such an assessment regarding the removal (by explosives) of obsolete petroleum platforms in the Central Gulf of Mexico" (Iudicello 1989, MMS 1987).

Although there has been some concern about the need for an EIS of state artificial reef development activities, it is argued that an EIS would not be required because of the preparation of a comprehensive state plan. The completion of a state plan in the format prescribed in this guide would, in effect, provide as much analysis as would be executed in a Fisheries Management Plan (FMP) as undertaken by Regional Fishery Management Councils or by NMFS. Typically, FMPs also meet EIS standards, where one document meets two statutory requirements.

D. Special Management Concerns

There are some coastal and marine resource management issues which are involved directly, or indirectly, with artificial reef planning and development activities. Minimal guidance exists, if any, that addresses the application or treatment of these management concerns within the context of artificial reef

planning. The section does not include all possible topics of major concern, but addresses those issues that are believed to be of immediate importance to the artificial reef planning and development process. These topics include: (1) mitigation banking and artificial reef habitat, (2) coral reef management, (3) special management zones (SMZs), and (4) habitat restoration (concentrating on micro-estuaries). Each of these issues represents a recommended functional plan topic within the state plan.

1. Mitigation banking and artificial reef habitat

States have varied in how they perceive the value or potential use for mitigation banking in their respective state plans. One of the reasons for this posture is the recommendation within the National Plan that only on-site compensation be made for the same on-site impacts. It is believed that this process has more potential for application than what was so easily dismissed by the National Plan (U.S. Department of Commerce 1985). A similar attitude prevails in the state plans (Noble 1988, South Carolina Wildlife and Marine Resources Department 1991, New York Department of Environmental Conservation 1993). Their discussions typically define the concept, note where mitigation has been used, and then provide minimal guidance to the positive and negative aspects of designing a mitigation program. None of the state plans reviewed provide any guidance in developing a mitigation planning component.

Mitigation banking is a concept which, under ideal circumstances, promotes environmental compensation. Typically, if a terrestrial or aquatic project results in a loss of some type or quantity of habitat, a mitigative response will attempt to offset this loss by creating a similar (in-kind) or dissimilar (out-of-kind) form of artificial habitat. There are several significant questions that arise during this process:

(1) Is there any state 'program' guidance or protocol for mitigating natural or human impacts to specific marine habitat?

(2) Are mitigative efforts to be in-kind or can they involve an attempt to create or augment another local habitat which is in decline?

(3) Are mitigative efforts limited spatially? Must a mitigative effort take place in immediate proximity to the original loss of habitat, or can mitigative efforts take place nearby or anywhere within a particular region, especially when considering water quality issues such as pollution, dissolved oxygen content, turbidity, euphotics, nutrient loadings, etc?

(4) Can federal agencies undertake mitigative actions in state waters while neglecting or minimizing input from state agencies?

The use of artificial reefs as a mitigation tool should only be considered when adjacent coastal or aquatic habitat will be impacted by properly permitted activities. There is a serious concern (Heins 1993) that coastal developers may view this as an

opportunity to impact or destroy coastal habitat, while paying little in terms of economic or biological compensation. In an application with hypothetical artificial reefs, destruction of coastal habitat could occur with developers promising compensation by creating artificial reefs, without justification or concern for optimal habitat compensation.

According to Steimle and Figley (1990), artificial reefs have been considered as a potential substitute habitat for decreasing areas of sea grasses or mangroves. In various court cases around the United States, the courts have fined companies for impacts to natural resources and have required mitigation activities be undertaken at the expense of the violator. For example, seagrasses and mangroves provide critical spawning or nursery areas to most estuarine or coastal fisheries. Steimle and Figley (1990) observed, appropriately, that little is known about the effectiveness of artificial reefs being used as a substitute for non-reef habitat. They continued by stating that artificial reefs used as mitigation, without appropriate supporting data, could result in a loss of habitat or fishery resources.

If in-kind substitution of habitat (wetlands for wetlands) is not available, then the use of artificial reefs as a mitigative tool should be considered. However, caution must be used. To date there have been few studies which examine the role of artificial reefs as a mitigation tool (Hueckel et al. 1989). Research efforts must be initiated to clearly resolve the possible limits of utilizing artificial reefs as a mitigative tool (Seaman, Buckley and Polovina 1989). Research topics would include: (1) what habitats or biological communities could be substituted by artificial reefs, (2) what is the equivalency of replacement units of habitat, and (3) what is the long-term benefits of this process?

2. Habitat restoration

The development of artificial reef may be viewed as a means of restoring critical coastal habitat. There has been little if any discussion as to the pragmatics involved with such a proposed use.

a. micro-estuaries

Micro-estuaries are one area where future mitigation activities are likely to occur. Micro-estuaries are those smaller embayments, coves or indentations that extend inland from larger estuaries. Along the Atlantic coast it is common to observe tips of estuaries that have essentially been cut off from the larger estuary by man-made structures. Berms are the most common example of these structures.

Similar to a levee, berms were constructed to support railroad or vehicular traffic. It was typical during the 1800s to direct railroad rights of way across coastal wetlands to avoid costly land acquisition. As the rail or roadway was constructed

through marshlands, minimal considerations were made to accommodate boat access or tidal flows by designing trestles or bridges. The principal concern was to ensure that tidal waters moving in and out of the constricted embayment would not cause unnecessary scouring or erosion to undercut piling supports or the embankments of the berm. As a result, many of these micro-estuaries have experienced accelerated sedimentation and infilling because of a lack of tidal flushing.

Micro-estuaries are usually polluted from point and nonpoint source pollution from the adjacent upland. Loadings of nitrates from organic compounds, fecal coliform bacteria from inefficient septic systems and runoff from agriculture and fertilizers used in the urban environment all impact these estuarine environments. In some situations, toxic compounds are introduced and remain within the substrate. Historically, there was no recognition of the importance of micro-estuaries as nurseries to the fish that reside in offshore waters.

As the groundfish stocks of the offshore banks have declined, there has been minimal effort dedicated to reclaiming, restoring, and enhancing coastal juvenile habitat from the threats of coastal pollution or development that occurs in these wetland environments. Restoration efforts for offshore fisheries have primarily been implemented to restrict fishing pressure and competition between recreational and commercial fishing activities, near and offshore. This guide sets forth the proposition that restoration of these micro-estuaries be supported to the greatest extent practicable, to re-establish the viability of these nursery areas as a producer and enhancer of the offshore environment.

There are two basic approaches to restoring groundfish stocks which include: (1) a moratorium on commercial fishing pressure and an elimination of the mortality of groundfish stocks as generated by inflated numbers of predators such skate and dogfish, or (2) enhancing the productivity of juveniles in estuarine environments. The latter is an issue which is presently being debated in Maine with the re-licensing of a hydroelectric dam situated in the lower reaches of the Kennebec River.

Reeff et al. (1990) noted that artificial reefs have not been used effectively to enhance nursery or estuarine habitat and that too much emphasis has been placed on improving habitat used by fish during adulthood." Murray (1989) stated that research should be conducted to determine how reefs produce or attract organisms and what effects reefs have on fish stocks. In a 1990 Commission report, Steimle and Figley noted that research on estuarine applications of artificial reefs should be given the highest priority for future research efforts.

b. coastal lagoons and salt ponds

Similar to micro-estuaries, coastal lagoons (which are situated landward of

barrier islands or spits), and coastal salt ponds (which have sporadic or interrupted flow with the marine environment) serve as nursery for spawning and juvenile fishes. These coastal resources should be evaluated for restoration.

Recommended State Plan Policy Guidance Should Include:

- Identification of uses for small scale reef structures to be deployed in the shallow water areas of estuarine resources. Reef structures may be pre-fabricated structures or made from materials that have a high ratio of interstitial space, to provide maximum cover for juvenile fishes.

3. Coral reef management

Recently, attention has been devoted to the management of natural coral reefs here in the United States. A meeting at the United States Department of State in Washington, D.C. in January, 1994 was devoted to (1) research issues, (2) international partnerships and (3) domestic management of coral resources. Although the greatest threats to coral reefs come from the sedimentation and pollution of coastal waters with nutrient and toxic wastes, there is a significant threat generated by people using the reef for recreational angling and sport diving. The anchoring of personal and commercial craft results in physical damage to the natural reef structure.

Damage to coral reefs is a problem typical to southeastern states, and has been addressed by the Gulf of Mexico and South Atlantic Fishery Management Council's Fishery Management Plan: Final Environmental Impact Statement for Coral and Coral Reefs (Gulf of Mexico and South Atlantic Councils 1982). Under Amendment 1 Gulf of Mexico and South Atlantic Councils 1990) to the Coral Management Plan the joint Councils identified various research needs relative to the management of coral reefs. Of the several recommendations, some were directed to "Identify mitigative methods for preserving and/or establishing reef" and "Determine methods for restoring reef habitat and/or improving existing environmental conditions that adversely affect reefs (Gulf of Mexico and South Atlantic Councils 1990, 16)." This document raised several related issues in its recommendation on habitat. The Amendment stated the importance of coral habitat for recreational and commercial fishing opportunities and highlighted a policy of the Councils to "protect, restore and improve habitat upon which commercial and recreational fisheries depend, to increase their extent and to improve their productive capacity."

The third of three objectives noted the need to "create and develop productive habitats where increase fishery productivity will benefit society" (Gulf of Mexico and South Atlantic Councils 1990, 18). Artificial reefs can enhance recruitment capabilities to coral reefs systems as well as provide a mitigative tool to reduce boating and fishing impacts to coral structures.

4. Special management zones (SMZs)

Special Management Zones (SMZs) are a spatial tool used to regulate and restrict conflicting reef fishing uses. SMZs can also be used to distribute fishing pressure within specific fishery resources and to delimit reef management boundaries (Gordon and Ditton 1986, Phillips 1988, Reeff et al. 1990). SMZs are established at specific artificial reef sites (Gordon and Ditton 1986), and use creel or size limits in coordination with gear restrictions. Although SMZs are an effective tool in reef fish management, Gordon (1994) cautioned that 'this process, to date, is incremental in nature and does not reflect any systematic approach to the fishery management of artificial aquatic habitat.' The use of SMZs, when intended, must be integrated as an operating element of respective state plans to fully utilize the potential of this tool. state plans should identify impacted stocks or those stocks having a potential for impact, and work proactively to establish management procedures with councils prior to a stocks decline, not after fishing pressure has taken a toll.

REFERENCES

Alevizon, W. S., and J. C. Gorham. 1989. Effects of artificial reef deployment on nearby resident fishes. Bull. Mar. Sci. 44(2):646-661.

Baxter, M., and G. O. Ewing. 1981. Models of recreational trip distribution. Regional Studies 15:327-343.

Bell, M. 1986. Needs of marine artificial reef programs in the United States: a state manager's viewpoint. Pages 552-555 in Proceedings: Ocean 86 Conference; September 23-25; Washington, DC.

Bockstael, N., A. Graefe, I. Strand and L. Caldwell. 1986. Economic analysis of artificial reefs: a pilot study of selected valuation methodologies. Artificial Reef Development Center, Tech. Rep. Ser., Rep. No. 6. Washington, DC: Sport Fishing Institute. 90 pp.

Bohnsack, J. A. and D. L. Sutherland. 1985. Artificial reef research: a review with recommendations for future priorities. Bull. Mar. Sci. 37(1): 11-39.

Bowditch, N. 1966. American Practical Navigator. U.S. Navy Hydrographic Office, H. O. Publication No. 9. U.S. Government Printing Office, Washington, D.C.

Bowen, R. E., F. W. Hoole and S. H. Anderson. 1980. Evaluating the impact of coastal zone activities: an illustration of the evaluation research approach. Coastal Zone Mgmt. J. 7(1): 25-46.

Branch, M. C. 1983. Comprehensive Planning: General Theory and Principles. Pacific Palisades, CA: Palisades Publishers. 203 pp.

Buchanan, C. C. 1973. Effects of an artificial habitat on the marine sportfishery and economy of Murrells Inlet, South Carolina. Mar. Fish. Rev. 35(9): 15-22.

Buckley, R. M., D. G. Itano, and T. W. Buckley. 1989. Fish aggregating device (FAD) enhancement of offshore fisheries in American Samoa. Bull. Mar. Sci. 44(2): 942-949.

Buckley, R. M. 1982. Marine habitat enhancement and urban recreational fishing in Washington. Mar. Fish. Rev. 44(6-7): 28-37.

Buckley, R. M., and J. M. Walton. 1981. Fishing piers: Their design, operation, and use. Division of Marine Resources, Tech. Rep. WSG-81-1, Seattle, WA: Washington Sea Grant College Program. 29 pp.

Burroughs, R. H. and V. Lee. 1988. Narragansett Bay pollution control: an evaluation of program outcome. Coastal Mgmt. 16: 363-377.

Carlisle, J. G., Jr., C. H. Turner, and E. E. Ebert. 1964. Artificial habitat in the marine environment. The Resources Agency of California, Department of Fish and Game. Fish Bulletin no. 124. Sacramento, California. 93 pp.

Catanese, A. J. and J. C. Snyder. 1979. Introduction to Urban Planning. New York: McGraw-Hill Book Company. 354 pp.

Chapin, F. S., Jr. and E. J. Kaiser. 1979. Urban Land Use Planning. Urbana, IL: University of Illinois Press. 656 pp.

Chapman, D. G. 1979. Fisheries education as viewed from the inside. Fisheries 4(2): 18-21.

Christian, R. T. 1984. Permitting procedures for artificial reefs. Artificial Reef Development Center, Tech. Rep. Ser. Rep. No. 1. Washington, DC: Sport Fishing Institute. 45 pp.

Christian, R.T. and D.L. Trim 1985. An inventory of a Texas saltwater fishing tournaments: spatial, temporal and participation patterns in 1983. Texas Parks and Wildlife Department, Coastal Fisheries Branch, Management Data Series Number 97, 1986. 29pp.

Clark, Jr., R. D., and B. Huang. 1985. Conflict between sportfishing, commercial fishing, and rehabilitation of lake trout in Lake Michigan. N. Amer. J. Fish. Mgmt. 5:261-276.

Coastal Zone Management Act of 1972. (16 U.S.C.A. 1451 to 1464).

Council on Environmental Quality. 1986. Regulations for implementing the procedural provisions of the National Environmental Policy Act. 40 CFR 1500-1508.

Daniel, D. L. 1976. Empirical and theoretical observations on the potential economic benefits and costs associated with the Mississippi-Alabama Liberty Ship reef programs. Bureau of Business Research. MASGP-77-002. University of Southern Mississippi, Hattiesburg. 22 pp.

Dawson, C. P. and B. T. Wilkins. 1980. Social considerations associated with marine recreational fishing under FCMA. Mar. Fish. Rev. 42(12): 12-17.

Ditton, R. B., S. M. Holland, and D. A. Gill. 1992. The U.S. Gulf of Mexico party boat industry: Activity centers, species targeted, and fisheries management opinions. Mar. Fish. Rev. 54(2): 15-20.

Ditton, R. B., D. A. Gill, and C. L. MacGregor. 1991. Understanding the market for charter and headboat fishing services. Mar. Fish. Rev. 53(1): 19-26.

Ditton, R. B. and L. B. Burke. 1985. Artificial reef development for recreational fishing: a planning guide. Washington DC: Sport Fishing Institute. 68 pp.

Ditton, R. B., and J. Auyong. 1984. Fishing offshore platforms Central Gulf of Mexico - An analysis of recreational and commercial fishing use at 164 major offshore petroleum structures. Minerals Manage. Serv., Gulf Mex. Reg. Off. OCS Monogr. MMS 84-0006, 158 p.

Ditton, R. B., and A. J. Fedler. 1983. A statewide survey of boat owners in Texas and their saltwater fishing activity. Texas A&M University. Sea Grant College Program. Sea Grant Rep. no. TAMU-SG-82-205, 65 p.

Ditton, R. B. 1981. Social and economic considerations for artificial reef deployment and management. Pages 23-32 in D. Y. Aska. ed. Artificial Reefs: Conference Proceedings. Florida Sea Grant Rep. No. 41, University of Florida, Gainesville.

Ditton, R. B., A. R. Graefe, and A. J. Fedler. 1980. Predicting marine recreational patterns from boat characteristics and equipment. Trans. Amer. Fish. Soc. 109:644-648.

Ditton, R. B., T. J. Mertens, and M. P. Schwartz. 1978. Characteristics, participation, and motivations of Texas charter boat fishermen. Mar. Fish. Rev. 40(8): 8-13.

Ditton, R. B., and A. R. Graefe. 1978. Recreational fishing use of artificial reefs on the Texas coast. Texas Coastal Marine Council., Austin, Contr. Rep. (77-79) 0805, 155 p.

Dugas, R., V. Guillory, and M. Fischer. 1979. Oil rigs and offshore sport fishing in Louisiana. Fisheries 4(6):2-10.

Dutton, B. 1942. Navigation and Nautical Astronomy. United States Naval Institute. Annapolis, Maryland.

Englander, E., J. Feldmann and M. Hershman. Coastal zone problems: a basis for evaluation. Coastal Zone Mgmt. J. 3(3): 217-236.

Erickson, Paul A. 1979. Environmental Impact Assessment: Principles and Applications. New York: Academic Press. 395 pp.

Evander, J. L. 1985. Application and evaluation of an artificial reef siting model in the Galveston, Texas region. Artificial Reef Development Center, Tech. Rep. Ser., Rep. No. 7. Washington, DC: Sport Fishing Institute. 43 pp.

Ewing, G. O. 1980. Progress and problems in the development of recreation trip generation and trip distribution models. Leisure Sciences 3:1-24.

Falk, J. M., A. R. Graefe, C. Alkire, and D. Swartz. 1983. 1982 Head/charter-boat fishing in Delaware: An analysis of customers and their economic impact. University of Delaware Sea Grant College Program, Newark. Sea Grant Rep. Del-SG-03-83, 54 p.

Federal Water Pollution Control Act (33 U.S.C.A. 1251 to 1387).

Fedler, A. J., and R. B. Ditton. 1986. A framework for understanding the consumptive orientation of recreational fishermen. Environmental Management. 10(2):221-227.

Fedler, A. J. 1984. Elements of motivation and satisfaction in the marine recreational fishing experience. Mar. Rec. Fish. 9:75-83.

Fernald, E. A., K. Walby, S. J. Miller and J. P. Jones, III. 1979. Marine-related recreation businesses and public facilities in Bay County, Florida. Tech. Paper No. 15. Gainesville, FL: Florida Sea Grant College Program. 82 pp.

Foster, J. W. S., C. Fowler, and the ASMFC Artificial Reef Committee. 1992. Reef material criteria handbook. Special Rep. Washington DC: Atlantic States Marine Fisheries Commission. 72 pp.

Fotheringham, A. S. 1981. Spatial structure and distance-decay parameters. Annals of the Association of American Geographers 71:425-436.

Fotheringham, A. S. 1983. A new set of spatial-interaction models: The theory of competing destinations. Environment and Planning A 15:15-36.

Gallaway, B., and G. S. Lewbel. 1982. The ecology of petroleum platforms in the northwestern Gulf of Mexico: A community profile. U.S. Dep. Inter., Bur. Land Manage., Gulf Mex. OCS Reg. Off. Open File Rep. 82-03, 91 p.

Gordon, W. R. 1994. A role for comprehensive planning, geographical information system (GIS) technologies, and program evaluation in aquatic habitat development. Bull. Mar. Sci. (forthcoming).

Gordon, W. R. 1993a. Travel characteristics of marine anglers using oil and gas platforms in the central Gulf of Mexico. Mar. Fish. Rev. 55(1):25-31.

Gordon, W. R. 1993b. Park planning in the marine recreational environment: The need for comprehensiveness and consistency. 30(2): 8-12.

Gordon, W. R., Jr. 1987. Predicting recreational fishing use of offshore petroleum platforms in the central Gulf of Mexico. Ph.D. Dissertation, Department of Urban and Regional Planning, Texas A&M University. 177 pp.

Gordon, W. R., Jr. and R. B. Ditton. 1986. A user-resource planning framework for offshore recreational artificial reefs. Coastal Zone Mgmt. J. 13(3/4): 369-395.

Graefe, A. R. 1981. Social and economic data needs for reef program assessment. Pages 152-166 in D. Y. Aska. ed. Artificial Reefs: Conference Proceedings. Florida Sea Grant Rep. No. 41, University of Florida, Gainesville.

Great Barrier Reef Marine Park Authority. 1992. Reflections. No. 27/ June. p. 11.

Green, L. M., H. R. Osburn, G. C. Matlock, and R. B. Ditton. 1991. Development of a social and economic questionnaire for on-site interviews of marine recreational anglers in Texas. American Fisheries Society Symposium. 12: 406-412.

Griffith, D. A., and K. G. Jones. 1980. Explorations into the relationship between spatial structure and spatial interaction. Environment and Planning A 12:187-201.

Grove, R. S., C. J. Sonu and M. Nakamura. 1989. Recent Japanese trends in fishing reef design and planning. Bull. Mar. Sci. 44(2): 984-996.

Gulf of Mexico and South Atlantic Fishery Management Councils. 1990. Amendment 1 to the fishery management plan for coral and coral reefs. South Atlantic Fishery Management Council. Charleston, S.C. 18 p.

Gulf of Mexico and South Atlantic Fishery Management Councils. 1982. Final environmental impact statement for the fishery management plan for coral and coral reefs of the Gulf of Mexico and South Atlantic. South Atlantic Fishery Management Council. Charleston, S.C. no pagin.

Gunn, C. A. 1983. Tourism Planning. New York: Crane Russak. 371 pp.

Hahn, J. 1991. Angler specialization: Measurement of a key sociological concept and implications for fisheries management decisions. American Fisheries Society Symposium. 12: 380-389.

Hanni, E. and H. H. Mathews. 1977. Benefit-cost study of Pinellas County artificial reefs. Tech. Paper No. 1. Gainesville, FL: Florida Sea Grant College Program. 44 pp.

Heins, S. W. 1993. Personal Communication. Marine Resources Specialist and New York State Artificial Reef Coordinator, New York Department of Environmental Conservation, Bureau of Finfish and Crustaceans, Division of Marine Resources, SUNY, Stony Brook, NY. December 6.

Holland, S. M., R. B. Ditton, and D. A. Gill. 1992. The U.S. Gulf of Mexico charter boat industry: Activity centers, species targeted, and fisheries management opinions. Mar. Fish. Rev. 54(2): 21-26.

Holland, S.M., and R. B. Ditton. 1992. Fishing Trip Satisfaction: A typolgy of anglers. N. Am. J. Fish. Manage. 12:28-33.

Holland, S. M. 1991. Demographic indicators of the relative need for artificial reefs in Florida. Coastal Mgmt. 19(2): 219-238.

Holland, S. M., and J. W. Milon. 1989. The structure and economics of the charter and party boat fishery fleet of the Gulf Coast of Florida. U.S. Department of Commerce, NOAA, National Marine Fisheries Service, Final Rep. Contract NA-87WC-H-06141, 278 p.

Hoole, F. W. and R. L. Friedheim. 1978. Evaluation research and marine and coastal policies. Mar. Tech. Soc. J. 12(4): 13-17.

Houston Helicopters, Inc. 1985. Louisiana gulf coast flight map. Pearland, Tex.

Hueckel, G. J., R. M. Buckley, and B. L. Benson. 1989. Mitigating rocky habitat loss using artificial reefs. Bull. Mar. Sci. 44(2): 913-922.

Iudicello, S. 1989. Relationship of rigs-to-reefs to U.S. environmental conservation law. Bull. Mar. Sci. 44(2): 789-798.

Johnson, L. 1974. Artificial reefs for Texas. Texas A&M Industrial Economics Division, TAMU-SG-73-214. College Station, TX: Texas A&M University Sea Grant College Program. 38 pp.

Johnston, R. J. 1975. Map pattern and friction of distance parameters: A comment. Regional Studies (9):281-283.

Jones, J. I. (ed). 1986. A plan for siting artificial reefs in the northern Gulf of Mexico. Mississippi-Alabama Sea Grant Consortium MASGP-86-021. 840 pp.

Kenchington, R. A. 1990. Managing Marine Environments. New York: Taylor and Francis. 248 pp.

Klima, E. F., and D. A. Wickham. 1971. Attraction of coastal pelagic fishes with artificial structures. Trans. Am. Fish. Soc. 100:86-99.

Lamb, J. C. 1985. Water Quality and Its Control. New York: John Wiley and Sons. 384 pp.

Leedy, D. L., T. M. Franklin and R. M. Maestro. 1981. Planning for urban fishing and waterfront recreation. Fish and Wildlife Service. FWS/OBS-80/35. Washington, DC: U. S. Department of the Interior. 108 pp.

Liao, D. S. and D. M. Cupka. 1979. Economic impacts and fishing success of offshore sport fishing over artificial reefs and natural habitats in South Carolina. South Carolina Marine Resources Center Tech. Rep. 38, South Carolina Wildlife and Marine Fisheries Department, 27 p.

Loomis, D. K., and R. B. Ditton. 1987. Analysis of motive and participation differences between saltwater sport and tournament fishermen. N. Am. J. Fish. Manage. 7:482-487.

Lukens, R. R., J. D. Cirino, J. A. Ballard, and G. Geddes. 1989. Two methods of monitoring and assessment of artificial reef materials. Special Rep. No. 2-WB. Ocean Springs, MS: Gulf States Marine Fisheries Commission. 58 pp.

Magnuson Fishery Conservation and Management Act of 1974, as amended, 16 U.S.C.A. 1801-1882.

Market Facts, Inc. 1983. National marine fisheries service site description-pressure report. Rep. prep. by Market Facts, Inc., Chicago, for U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., unpagin.

Marine Protection, Research, and Sanctuaries Act of 1972 (16 U.S.C.A. 1431 et seq.).

Mathews, H. H. 1981. Artificial reef site: Selection and evaluation. Pages 50-54. in D. Y. Aska. ed. Artificial Reefs: Conference Proceedings. Florida Sea Grant Rep. No. 41, University of Florida, Gainesville.

Mathews, H. H. 1979. Artificial reef site selection and evaluation. MAFS-20. Gainesville, FL: Florida Sea Grant Marine Advisory Program. 3 pp.

Matlock, G. C., H. R. Osburn, R. K. Riechers, and R. B. Ditton. 1991. Comparison of response scales for measuring angler satisfaction. American Fisheries Society Symposium. 12: 413-422.

McGurrin, J. M., R. B. Stone and R. J. Sousa. 1989a. Profiling United States artificial reef development. Bull. Mar. Sci. 44(2): 1004-1013.

McGurrin, J. M. and the ASMFC Artificial Reef Committee. 1989b. An assessment of Atlantic artificial reef development. Fisheries 14(4): 19-25.

McGurrin, J. M. and the ASMFC Artificial Reef Committee. 1988. A profile of Atlantic artificial reef development. Special Rep. No. 14. Washington DC: Atlantic States Marine Fisheries Commission. 153 pp.

McGurrin, J. M. and M. J. Reeff. 1986. Resource planning as applied to rigs to reef siting. Proceedings: Sixth Annual Gulf of Mexico Information Transfer Meeting, OCS Study MMS 86-0073. U. S. Department of the Interior, Minerals Management Service, New Orleans, Louisiana. pp. 109-112.

McHarg, I. L. 1969. Design with Nature. Garden City, N.Y.: Doubleday/Natural History Press. 197 pp.

Miller, Jr., G. T. 1992. Living in the Environment, 7th edition. Wadsworth Publishing Company, Belmont, California. 705 p.

Miller, M. L. and R. B. Ditton. 1986. Travel, tourism and marine affairs. Coastal Zone Mgmt J. 14(1/2): 1-20.

Milon, J. W. 1991. Socioeconomic evaluation of artificial aquatic habitat. Pages 237-270 in W. Seaman, Jr. and L. M. Sprague. eds. Artificial Habitats for Marine and Freshwater Fisheries. Academic Press, San Diego, California.

Milon, J. W. 1989a. Economic-evaluation of artificial habitat for fisheries: Progress and challenges. Bull. Mar. Sci. 44(2): 831-843.

Milon. J. W. 1989b. Artificial marine habitat characteristics and participation behavior by sport anglers and divers. Bull. Mar. Sci. 44(2): 853-862.

Milon, J. W. 1988. The economic benefits of artificial reefs: an analysis of Dade County, Florida reef system. SGR-90. Gainesville, FL: Florida Sea Grant College Program. 85 p.

Minerals Management Service. 1987. Programmatic Environmental Assessment, Structure Removal Activities, Central and Western Gulf of Mexico Planning Areas. GOM OCS Regional Office. OCS EIS/EA MMS 87-000. April 1987. 45 - pp.

Moeller, G. H., and J. H. Engelken. 1972. What fishermen look for in an angling experience. J. of Wildlife Mgmt. 36:1253-1257.

Murdock, S. H., K. Backman, R. B. Ditton, M. N. Hoque, and D. Ellis. 1992. Implications of future demographic change for participation in fishing in Texas. N. Amer. J. Fish. Mgmt. 12:548-558.

Murray, J. D. 1989. A policy and management assessment of southeast and mid-Atlantic artificial reef programs. UNC-SG-WP-89-3. Raleigh, NC: University of N. C. Sea Grant College Program. 87 pp.

Myatt, D. O. and R. B. Ditton. 1986. Exclusion mapping for artificial reef site selection to maximize recreational fishing benefits in the Gulf of Mexico. Artificial Reef Development Center. Washington, DC: Sport Fishing Institute. 157 pp.

Myatt, D. O. 1981. Planning considerations for reef construction. Pages 41-49 in D. Y. Aska. ed. Artificial Reefs: Conference Proceedings. Florida Sea Grant Rep. No. 41, University of Florida, Gainesville.

Nakamura, M. 1985. Evolution of artificial reef concepts in Japan. Bull. Mar. Sci. 37(1): 271-278.

National Environmental Policy Act of 1969. (42 U.S.C.A. 4321 to 4370b).

National Fishing Enhancement Act of 1984. (33 U.S.C.A. 2103, et seq.).

National Research Council. 1985. Disposal of offshore platforms. Commission on Engineering and Technical Systems, Committee on Disposition of Offshore Platforms. Washington, D.C.

Niagara County, New York. 1984. Salmonid fisheries development plan. Niagra County Department of Economic Development and Planning, Lockport, New York.

Noble, E. B. 1988. North Carolina artificial reef master plan. Division of Marine Fisheries Special Scientific Rep. No 47. Morehead City, NC: N. C. Department of Natural Resources and Community Development. 57 pp.

Noden, D., and T. Brown. 1975. The New York commercial marina and boatyard industry, 1972. N.Y. Sea Grant Inst., Rep. NYSSGP-RS-75-020, 92 p.

Outer Continental Shelf Lands Act of 1953, as amended in 1978, (43 U.S.C.A. 1331 et seq.).

Parker, R. O., Jr., R. B. Stone, C. C. Buchanan and F. W. Steimle, Jr. 1974. How to build marine artificial reefs. National Marine Fisheries Service, Fishery Facts 10. Washington DC: National Oceanic and Atmospheric Administration. 47 pp.

Phillips, S. H. 1988. Artificial reefs and fishery conflicts: Problems and opportunities for the sport fishing industry. Artificial Reef Development Center. Washington, DC: Sport Fishing Institute. 64 pp.

PNR and Associates. 1985. Marketing strategies for the Northeast party boat, charter boat and rental fishing boat industry. U.S. Department of Commerce, NOAA, National Marine Fisheries Service, Final Rep. NMFS Contract NA-84-FA-D-00002, 65 p.

Poffenberger, J. R. 1985. Operational and financial characteristics of reef-fish vessels in the South Atlantic and Gulf of Mexico areas. N. Amer. J. Fish. Mgmt. 5:379-388.

Pope, D. L. and T. F. Moslow. 1989. Geological and geotechnical aspects of artificial reef site selection, offshore Louisiana. Bull. Mar. Sci. 44(2): 1068-9.

Ports and Waterways Safety Act of 1978, as amended, (33 U.S.C.A. 1221 to 1227).

Ranasinghe, J. A. 1981. Biological aspects of artificial reefs. Pages 14-16 in D. Y. Aska. ed. Artificial Reefs: Conference Proceedings. Florida Sea Grant Rep. No. 41, University of Florida, Gainesville.

Reeff, M. J., J. D. Murray, J. M. McGurrin and the ASMFC Artificial Reef Committee. 1990. Atlantic States Marine Fisheries Commission recommendations for Atlantic state artificial reef management. Recreational Fisheries Rep. No. 6. Washington DC: Atlantic States Marine Fisheries Commission. 11 pp.

Reeff, M. J. 1986. Reef profiles: technology evaluation for resource development. Proc. of Oceans 86. 2: 538-541.

Reggio, Jr., V. C., and R. Kasprzak. 1991. Rigs to reefs: Fuel for fisheries enhancement through cooperation. American Fisheries Society Symposium 11:9-17.

Rivers and Harbors Act of 1899 (33 U.S.C.A. 403 et seq.)

Rossi, P. H. and H. E. Freeman. 1982. Evaluation: A Systematic Approach. Beverly Hills, CA: Sage Publications. 350 pp.

Roberts, K. J., and M. E. Thompson. 1983. Petroleum production structures: Economic resources for Louisiana sport divers. La. Sea Grant Coll. Program, Sea Grant Publ. LSU-TL-83-002, 39 p.

Roberts, K. J., M. E. Thompson, and P. W. Pawlyk. 1985. Contingent valuation of recreational diving at petroleum rigs, Gulf of Mexico. Trans. Am. Fish. Soc. 114:214-219.

Samples, K. C. 1989. Assessing recreational and commercial conflicts over artificial fishery habitat use: Theory and practice. Bull. Mar. Sci. 44(2): 844-852.

Samples, K. C., and J. R. Hollyer. 1989. Economic considerations in configuring fish aggregation device networks. Bull. Mar. Sci. 44(2): 863-872.

Schwartz, J. D. 1980. A public program analysis of operations and impacts of the Texas Liberty Ship reef program. Master's thesis. Department of Recreation and Parks, Texas A&M Univ. College Station. 157 pp.

Seaman, W. R., Jr., R. M. Buckley and J. J. Polovina. 1989. Advances in knowledge and priorities for research, technology and management related to artificial aquatic habitats. Bull. Mar. Sci. 44(2): 527-532.

Seaman, W., Jr., W. J. Lindberg, C. R. Gilbert, and T. K. Frazer. 1989. Fish habitat provided by obsolete petroleum platforms off southern Florida. Bull. Mar. Sci. 44:1014-1022.

Simpson, R. A. 1977. The biology of two offshore oil platforms. Institute of Marine Resources, University of California, IMR 76-13.

Sonnier, F., J. Teerling, and H. D. Hoese. 1976. Observations on the offshore reef and platform fish fauna of Louisiana. Copeia 1:105-111

Spencer, P. D. 1993. Factors influencing satisfaction of anglers on Lake Miltona, Minnesota. N. Amer. J. Fish. Mgmt. 13:201-209.

Spencer, P. D., and G. R. Spangler. 1992. Effect that providing fishing information has on angler expectations and satisfaction. N. Amer. J. Fish. Mgmt. 12:379-385.

Stanley, D. R., and C. A. Wilson. 1989. Utilization of offshore platforms by recreational fishermen and scuba divers off the Louisiana coast. Bull. Mar. Sci. 44:767-775.

Steimle, F., W. Figley and the ASMFC Reef Committee. 1990. A review of artificial reef research needs. Atlantic States Marine Fisheries Commission, Artificial Reef Advisory Committee, Recreational Fisheries Rep. No. 7. 27 pp.

Stephan, C. D., B. G. Dansby, H. R. Osburn, G. C. Matlock, R. K. Riechers and R. Rayburn. 1990. Texas artificial reef fishery management plan. Fishery Management Plan Series, No. 3, Source Document. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin. 95 pp.

Stoll, J. R., R. B. Ditton, and D. A. Gill. 1989. Recreational angler participation in the Gulf of Mexico king mackeral fishery: Understanding the value of the resource and socioeconomic impacts of management options. Rep. to National Marine Fisheries Service, Southeast Regional Office, St. Petersburg, FL, Contrib. no. NA86-WE-H-MF132 (RF-86-1015) 213 p.

Stone, R. B. 1985. History of artificial reef use in the U. S. Pages 3-9 in Frank M. D'Itri. ed. Artificial reefs: Marine and Freshwater applications. Lewis Publishers, Inc., Chelsea, Michigan.

Stouffer, S. A. 1940. Intervening opportunities: a theory relating mobility and distance. American Sociological Review 5:845-867.

Stouffer, S. A. 1960. Intervening opportunities and competing migrants. Journal of Regional Science 2:1-26.

Stowe, K. S. 1983. Ocean Science, 2nd edition. John Wiley and Sons. New York. 673 p.

Submerged Lands Act of 1953, 43 U.S.C.A. 1301 et seq.

Texas Parks and Wildlife Code. 1989. Artificial Reefs. Subtitle H., Chapter 89, Sections 89.001 - 89.061.

Turner, C. H., E. E. Ebert, and R. R. Given. 1969. Man-made reef ecology. The Resources Agency of California, Department of Fish and Game. Fish Bulletin no. 146. Sacremento, California. 221 pp.

United States Department of Commerce, 1992. Final environmental impact statement and management plan for the proposed Monterey Bay National Marine Sanctuary. Washington DC: Sanctuaries andReserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. n.p.

United States Department of Commerce, 1991. Final environmental impact statement and management plan for the proposed Flower Garden Banks National Marine Sanctuary. Washington DC: Sanctuaries and Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. n.p.

United States Department of Commerce. 1985. National artificial reef plan. NOAA Tech. Mem. NMFS OF-6, compiled by R. B. Stone, National Marine Fisheries Service. Washington, DC: National Oceanic and Atmospheric Administration. 39 pp.

United States Department of Commerce. 1980. Final environmental impact statement on the proposed Channel Islands Marine Sanctuary. Washington DC: Office of Coastal Zone Management, National Oceanic and Atmospheric Administration. n.p.

United States Department of the Interior. 1987. Programmatic environmental assessment, structure removal activities, Central and Western Gulf of Mexico planning areas. GOM OCS Regional Office. OCS EIS/EA MMS 87-0002. 45 pp.

United States Environmental Protection Agency. 1993. Guidance specifying management measures for sources of nonpoint pollution in coastal waters. Washington DC: Office of Water (WH-553). EPA 840-B-92-002. n.p.

United States Environmental Protection Agency. 1992. U.S. EPA nonpoint source information exchange computer bulletin board system (BBS): User's manual. Washington DC: Office of Water (WH-553). EPA 503/8-92/002. 64 pp.

Voiland, M. P. and M. W. Duttweiler. 1984. Where's the humanity? A challenge and opportunity for the fisheries community. Fisheries 9(4): 10-12.

Wilson, C. A., V. R. Van Sickle and D. L. Pope. 1987. Louisiana artificial reef plan. Louisiana Department of Wildlife and Fisheries Tech. Bull. No. 41. Baton Rouge. 130 pp.

Wilson, K. C., R. D. Lewis and H. A. Togstad. 1990. Artificial reef plan for sport fish enhancement. Admin. Rep. No. 90-15. Long Beach, CA: Marine Resources Division, California Department of Fish and Game. 76 pp.

Witzig, J. F. 1986. Rig fishing in the Gulf of Mexico - 1984 marine recreational fishing survey results. In Proceedings, Sixth Annual Gulf of Mexico Information Transfer Meeting. New Orleans, La. October 22-24, 1985, p. 103-105. Min. Manage. Serv., Gulf Mex. OCS Reg. Off., Metairie, La. OCS Study MMS 86-0073.

Yamane, T. 1989. Status and future plans of artificial reef projects in Japan. Bull. Mar. Sci. 44(2): 1038-1040.

Zapata, A., and R. B. Ditton. 1979. The status of boating information systems. Coastal Zone Mgmt. J. 6:99-107.

APPENDIX I -

NATIONAL FISHING ENHANCEMENT ACT OF 1984

1. NATIONAL FISHING ENHANCEMENT ACT OF 1984: TITLE II – ARTIFICIAL REEFS.

SECTION 201. SHORT TITLE.

This title may be cited as the "National Fishing Enhancement Act of 1984."

SECTION 202. FINDINGS AND CONCLUSIONS.

(a) FINDINGS -- The Congress finds that --

(1) although fishery products provide an important source of protein and industrial products for United States consumption, Unites States fishery production annually falls far short of satisfying United States demand;

(2) overfishing and the degradation of vital fishery resource habitats have caused a reduction in the abundance and diversity of United States fishery resources;

(3) escalated energy costs have had a negative effect on the economics of United States commercial and recreational fisheries;

(4) commercial and recreational fisheries are a prominent factor in United States coastal economies and the direct and indirect returns to the United States economy from commercial and recreational fishing expenditures are threefold; and

(5) properly designed, constructed, and located artificial reefs in waters covered under this title can enhance the habitat and diversity of fishery resources; enhance United States recreational and commercial fishing opportunities; increase the production of fishery products in the United States; increase the energy efficiency of recreational and commercial fisheries; and contribute to the United States and coastal economies.

(b) PURPOSE -- The purpose of this title is to promote and facilitate responsible and effective efforts to establish artificial reefs in waters covered under this title.

SECTION 203. ESTABLISHMENT OF STANDARDS.

Based on the best scientific information available, artificial reefs in waters covered under this title shall be sited and constructed, and subsequently monitored and managed, in a manner which will --

(1) enhance fishery resources to the maximum extent practicable;

(2) facilitate access and utilization by United States recreational and commercial fishermen;

(3) minimize conflicts among competing uses of waters covered under this title and the resources in such waters;

(4) minimize environmental risks and risks to personal health and property; and

(5) be consistent with generally accepted principles of international law and shall not create any unreasonable obstruction to navigation.

SECTION 204. NATIONAL ARTIFICIAL REEF PLAN.

Not later than one year after the date of enactment of this title, the Secretary of Commerce, in consultation with the Secretary of the Interior, the Secretary of Defense, the Administrator of the Environmental Protection Agency, the Secretary of the Department in which the Coast Guard is operating, the Regional Fishery Management Councils, interested States, Interstate Fishery Commissions, and representatives of the private sector, shall develop and publish a long-term plan which will meet the purpose of this title and be consistent with the standards established under section 203.

The plan must include --

(1) geographic, hydrographic, geologic, biological, ecological, social, economic, and other criteria for siting artificial reefs;

(2) design, material, and other criteria for constructing artificial reefs;

(3) mechanisms and methodologies for monitoring the compliance of artificial reefs with the requirements of permits issued under section 205;

(4) mechanisms and methodologies for managing the use of artificial reefs;

(5) a synopsis of existing information on artificial reefs and needs for further research on artificial reef technology and management strategies; and

(6) an evaluation of alternatives for facilitating the transfer of artificial reef construction materials to persons holding permits issued pursuant to section 205, including, but not limited to, credits for environmental mitigation and modified tax obligations.

SECTION 205. PERMITS FOR THE CONSTRUCTION AND MANAGEMENT OF ARTIFICIAL REEFS.

(a) SECRETARIAL ACTION ON PERMITS -- In issuing a permit for artificial reefs under section 10 of the Rivers and Harbors Act of 1899, section 404 of the Federal Water Pollution Control Act, or section 4(e) of the Outer Continental Shelf Lands Act, the Secretary of the Army (hereinafter in this section referred to as the "Secretary") shall --

(1) consult with and consider the views of appropriate Federal agencies, States, local governments, and other interested parties;

(2) ensure that the provisions for siting, constructing, monitoring, and managing the artificial reef are consistent with the criteria and standards established

under this title;

(3) ensure that the title to the artificial reef construction material is unambiguous, and that responsibility for maintenance and the financial ability to assume liability for future damages are clearly established; and

(4) consider the plan developed under section 204 and notify the Secretary of Commerce of any need to deviate from the plan.

(b) TERMS AND CONDITIONS OF PERMITS -- (1) Each permit issued by the Secretary subject to this section shall specify the design and location for construction of the artificial reef and the types and quantities of materials that may be used in constructing such artificial reef. In addition, each such permit shall specify such terms and conditions for construction, operation, maintenance, monitoring, and managing the use of the artificial reef as are necessary for compliance with all applicable provisions of law and as are necessary to ensure the protection of the environment and human safety and property.

(2) Before issuing a permit under section 402 of the Federal Water Pollution Control Act for any activity relating to the siting, design, construction, operation, maintenance, monitoring, or managing of an artificial reef, the Administrator of the Environmental Protection Agency shall consult with the Secretary to ensure that such permit is consistent with any permit issued by the Secretary subject to this section.

(c) LIABILITY OF PERMITTEE -- (1) A person to whom a permit is issued in accordance with subsection (a) and any insurer of that person shall not be liable for damages caused by activities required to be undertaken under any terms and conditions of the permit, if the permittee is in compliance with such terms and conditions.

(2) A person to whom a permit is issued in accordance with subsection (a) and any insurer of that person shall be liable, to the extent determined under applicable law, for damages to which paragraph (1) does not apply.

(3) The Secretary may not issue a permit subject to this section to a person unless that person demonstrates to the Secretary the financial ability to assume liability for all damages that may arise with respect to an artificial reef and for which such permittee may be liable.

(4) Any person who has transferred title to artificial reef construction materials to a person to whom a permit is issued in accordance with subsection (a) shall not be liable for damages arising from the use of such materials in an artificial reef, if such materials meet applicable requirements of the plan published under Section 204 and are not otherwise defective at the time title is

transferred.

(d) LIABILITY OF THE UNITED STATES -- Nothing in this title creates any liability on the part of the United States.

(e) CIVIL PENALTY -- Any person who, after notice and an opportunity for a hearing, is found to have violated any provision of a permit issued in accordance with subsection (a) shall be liable to the United States for a civil penalty, not to exceed $10,000 for each violation. The amount of the civil penalty shall be assessed by the Secretary by written notice. In determining the amount of such penalty, the Secretary shall take into account the nature, circumstances, extent, and gravity of the violation. The Secretary may compromise, modify, or remit with or without conditions, any civil penalty which is subject to imposition or which has been imposed under this section. If any person fails to pay (an) assessment of a civil penalty after it has become final, the Secretary may refer the matter to the Attorney General for collection.

SECTION 206. DEFINITIONS.

For purposes of this title --

(1) The term "artificial reef" means a structure which is constructed or placed in waters covered under this title for the purpose of enhancing fishery resources and commercial and recreational fishing opportunities.

(2) The term "State" means a State of the United States, the District of Columbia, Puerto Rico, the United States Virgin Islands, American Samoa, Guam, Johnston Island, Midway Island, and Wake Island.

(3) The term "waters covered under this title" means the navigable waters of the United States and the waters superjacent to the Outer Continental Shelf as defined in section 2 of the Outer Continental Shelf Lands Act (43 U.S.C. section 1331) to the extent such waters exist in or are adjacent to any State.

SECTION 207. USE OF CERTAIN VESSELS AS ARTIFICIAL REEFS.

The Act entitled "An Act to authorize appropriations for the fiscal year 1973 for certain maritime programs of the Department of Commerce and for other purposes," approved August 22, 1972 (16 U.S.C. 1220-1220c), is amended --

(1) by striking out "Liberty" each place it appears in sections 3, 4, 5, and 6 and inserting in lieu thereof "obsolete";

(2) by striking out "Commerce" in section 3 and inserting in

lieu thereof "Transportation";

(3) by striking out "shall" in the matter preceding paragraph (1) in section 4 and inserting in lieu thereof "may"; and

(4) by adding at the end thereof the following new section:

"**SECTION 7.** For purposes of sections 3, 4, 5, and 6, the term "obsolete ship" means any vessel owned by the Department of Transportation that has been determined to be of insufficient value for commercial or national defense purposes to warrant its maintenance and preservation in the national defense reserve fleet and has been designated as an artificial reef candidate."

SECTION 208. SAVINGS CLAUSES.

(a) TENNESSEE VALLEY AUTHORITY JURISDICTION -- Nothing in this title shall be construed as replacing or superseding section 26a of the Tennessee Valley Authority Act of 1933, as amended (16 U.S.C. 831y-1).

(b) STATE JURISDICTION -- Nothing in this title shall be construed as extending or diminishing the jurisdiction or authority of any State over the siting, construction, monitoring, or managing of artificial reefs within its boundaries.

2. U.S. ARMY CORPS OF ENGINEERS -- SPECIAL POLICY ON ARTIFICIAL REEFS

SECTION 322.5 -- SPECIAL POLICIES.

The Secretary of the Army has delegated to the Chief of Engineers the authority to issue or deny section 10 permits. The following additional special policies and procedures shall also be applicable to the evaluation of permit applications under this regulation.

(A) General. DA permits are required for structures or work in or affecting navigable waters of the United States. However, certain structures or work specified in 33 CFR Part 330 are permitted by that regulation. If a structure or work is not permitted by that regulation, an individual or regional section 10 permit will be required.

(B) Artificial Reefs. -- (1) When considering an application for an artificial reef, as defined in 33 CFR 322.2(g), the district engineer will review the applicant's provisions for siting, constructing, monitoring, operating, maintaining and managing the proposed artificial reef and shall determine if those provisions are

consistent with the following standards:

(i) The enhancement of fishery resources to the maximum extent practicable;

(ii) The facilitation of access and utilization by United States recreational and commercial fishermen;

(iii) The minimization of conflicts among competing uses of the navigable waters or waters overlying the Outer Continental Shelf and of the resources in such waters;

(iv) The minimization of environmental risks and risks to personal health and property;

(v) Generally accepted principles of international law; and

(vi) The prevention of any unreasonable obstructions tonavigation. If the district engineer decides that the applicant's provisions are not consistent with these standards, he shall deny the permit. If the district engineer decides that the provisions are consistent with these standards, and if he decides to issue the permit after the public interest review, he shall make the provisions part of the permit.

(2) In addition, the district engineer will consider the National Artificial Reef Plan developed pursuant to section 204 of the National Fishing Enhancement Act of 1984, and if he decides to issue the permit, will notify the Secretary of Commerce of any need to deviate from that plan.

(3) The district engineer will comply with all coordination provisions required by a written agreement between the DOD and the Federal agencies relative to artificial reefs. In addition, if the district engineer decides that further consultation beyond the normal public commenting process is required to evaluate fully the proposed artificial reef, he may initiate such consultation with any Federal agency, state or local government or other interested party.

(4) The district engineer will issue a permit for the proposed artificial reef only if the applicant demonstrates, to the district engineer's satisfaction, that the title to the artificial reef construction material is unambiguous, that responsibility for maintenance of the reef is clearly established, and that he has the financial ability to assume liability for all damages that may arise with respect to the proposed artificial reef. A demonstration of financial responsibility might include evidence of insurance, sponsorship, or available assets.

(i) A person to whom a permit is issued in accordance with these regulations and any insurer of that person shall not be liable for damages caused by activities required to be undertaker. under any terms and conditions of the permit, if the permittee is in compliance with such terms and conditions.

(ii) A person to whom a permit is issued in accordance with these regulations

and any insurer of that person shall be liable, the extent determined under applicable law, for damages to which paragraph (i) does not apply.

(iii) Any person who has transferred title to artificial reef construction materials to a person to whom a permit is issued in accordance with these regulations shall not be liable for damages arising from the use of such materials in an artificial reef, if such materials meet applicable requirements of the plan published under section 204 of the National Artificial Reef Plan, and are not otherwise defective at the time title is transferred.

APPENDIX II -

RESOLUTIONS OF THE ATLANTIC STATES MARINE FISHERIES COMMISSION RELATIVE TO ARTIFICIAL REEFDEVELOPMENT

Joint Resolution on Collection of Critical Social and Economic Data for Marine Recreational Fisheries of The Atlantic Coast

Prepared by
The ASMFC Artificial Reef and Marine Recreational Fisheries Committees

WHEREAS, marine recreational fishing provides significant social and economic benefits to local, state, and regional communities, and the nation as a whole; and

WHEREAS, estimates of participation and associated social and economic benefits in marine recreational fishing vary greatly in national data collection efforts; and

WHEREAS, timely social and economic data are critical in the development of fishery management plans, the consideration of such is mandated by the Magnuson Fishery Conservation and Management Act of 1976, as amended, for fisheries management plans developed by the regional fishery management councils; and such data are critical to support the development and management of state and federal fisheries programs, in particular during the current austere budgetary climate; and

WHEREAS, the National Environmental Policy Act of 1969 as amended, also requires that an Environmental Impact Statement developed for <u>any</u> significant federal action must consider social and economic information in describing the environmental consequences of the proposed action and alternatives to the human environment, despite that there is no federal source of such data; and

WHEREAS, structure-dependent fish communities constitute a significant portion of the marine recreational catch and the availability of these resources is limited by requisite habitat. And, states have invested significant federal, state, and private resources to enhance marine fisheries habitat and fishing opportunities through establishment of artificial reefs. And, artificial reefs provide a critical reference point for collection of pertinent data for management of vital marine recreational fisheries; and

WHEREAS, there is a scarcity of current information on the social and economic benefits of artificial reefs. And, random data collection programs have been conducted by several states and the federal government (with add-ons to the MRFSS) to meet state specific and national needs; and

WHEREAS, there have been no recent comprehensive studies to assess the full extent of such benefits, and the potential is high for development of disparate data collections programs among state and federal agencies yielding incompatible data among programs;

THEREFORE, be it resolved that the Atlantic States Marine Fisheries Commission finds that the collection, analysis, and utilization of pertinent social and economic data to be a high priority. And, that the states are herewith encouraged to initiate such data programs in coordination with, and consistent with, existing state and federal marine recreational fishery statistics programs. Such efforts should be encouraged and coordinated through the relevant committee(s) established by the Commission and regional fishery management councils in the implementation of statistically compatible interstate and joint state/federal fishery management plans.

Atlantic States Marine Fisheries Commission

Resolution In Opposition to the Use of Combustion/ Incineration Ash for Artificial Reef Construction

WHEREAS, the Atlantic States Marine Fisheries Commission is concerned with the promotion of sound and effective use of artificial reefs in fishery development and management; and

WHEREAS, the National Artificial Reef Plan, developed pursuant to the National Fishing Enhancement Act of 1984 (P.L. 98-623, Title II) states that "artificial reef materials ... should minimize environmental risks," and that "Whenever a material is proposed, the standards for function, durability, stability, availability, compatibility, and safety must be assessed and satisfied"; and

WHEREAS, there is a lack of clear federal or state guidelines and standards for the testing and classification of cement-stabilized combustion/incineration ash; and

WHEREAS, the ASMFC is concerned that in addressing the growing problem of solid waste disposal, precipitous decisions will be made to use the ocean environment as a disposal outlet for unproven, potentially toxic waste products; and

WHEREAS, substantial uncertainty exists as to the long-term stability of cement-stabilized combustion/incineration ash, and the eventual fate of the potentially toxic constituents of this material;

NOW THEREFORE BE IT RESOLVED that the Atlantic States Marine Fisheries Commission request that the Environmental Protection Agency and the United States Army Corps of Engineers develop and adopt standards for the use of stabilized combustion/incineration ash products in the marine environment, particularly as artificial reef substrate;

AND BE IT FURTHER RESOLVED that the Atlantic States Marine Fisheries Commission opposes the use of said stabilized combustion/incineration ash

products as artificial reef substrate and requests that permits not be issued, other than for experimental applications, until such time as these guidelines and standards are adopted; or until the time member states adopt such standards that ensure the protection of the marine environment.

NOAA COASTAL SERVICES CENTER LIBRARY
3 6668 14103 4902