A PLAN FOR SITING ARTIFICIAL REEFS IN THE NORTHERN GULF OF MEXICO

JAMES I. JONES
EDITOR

S. CHANG
UNIVERSITY OF SOUTH ALABAMA

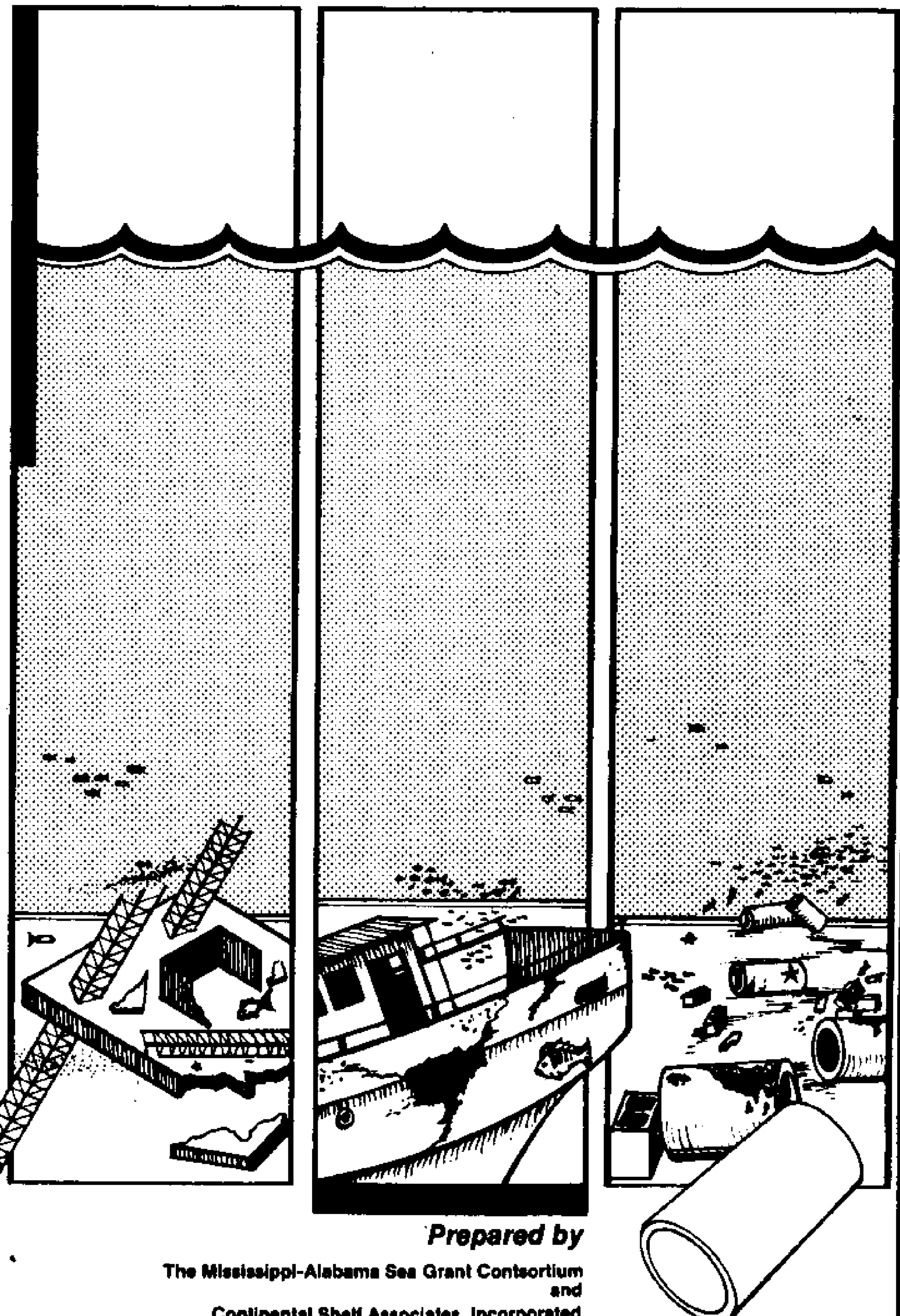
A. COSBY
MISSISSIPPI STATE UNIVERSITY

M. FLANDORFER
MISSISSIPPI-ALABAMA SEA GRANT

K. FUCIK
CONTINENTAL SHELF ASSOCIATES, INC.

A. SAGE
UNIVERSITY OF MISSISSIPPI

R. SHAUL
CONTINENTAL SHELF ASSOCIATES, INC.



Prepared by

The Mississippi-Alabama Sea Grant Consortium
and
Continental Shelf Associates, Incorporated
for
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE

MASGP - 86-021

COVER DESIGN: ERIC FLANDORFER

This work is a result of research sponsored in part by NOAA Office of National Marine Fisheries Service, Department of Commerce as a Saltonstall-Kennedy project under Grant #NA84-WC-H-06150, the Mississippi-Alabama Sea Grant Consortium, Continental Shelf Associates, Inc., the University of South Alabama, the University of Mississippi and Mississippi State University.

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IN THE GULF OF MEXICO

J. I. Jones	Director, Mississippi-Alabama Sea Grant Consortium Editor and Overall Program Manager
S. Chang	University of South Alabama
A. Cosby	Mississippi State University
M. Flandorfer	Mississippi-Alabama Sea Grant Consortium
K. Fucik	Continental Shelf Associates, Inc.
A. Sage	University of Mississippi
R. Shaul	Continental Shelf Associates, Inc.

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ABSTRACT

Artificial reefs have proven useful for the purpose of enhancing commercial and recreational fisheries. While many artificial reefs have been developed off the coast of the United States, for the most part this has been accomplished in a random manner with little or no preplanning and evaluation. Recognizing this, a National Artificial Reef Plan was recently promulgated. This plan recommends that site specific artificial reef plans be developed for areas likely to undergo artificial reef development.

The objective of this project was the development of a generic plan for the siting of artificial reefs, and then to apply it to specific geographic areas in the northern Gulf of Mexico. Fiscal considerations allowed application of the plan in only three areas. These were Gulfport-Biloxi, Mississippi, Mobile-Dauphin Island, Alabama, and Pensacola, Florida. Specific site recommendations were developed after evaluation of the operational, biological, sociological, and economic characteristics of and statutory requirements applicable to the coastal waters, adjacent mainland communities, and population centers in each area. An additional constraint was that only existing and available data would be used. This prohibition against collection of new data imposed a severe limitation on the sociological portion of the site specific plan preparation.

This project was carried out by a multidisiplinary team from the academic and industrial communities using state of the art methodology. At various points in the plan development the team received advice from a regional Advisory Committee established expressly for this project. The Advisory Committee was constituted with twenty-three members encompassing public and private sector groups with interest in artificial reef development. As the plan neared completion, public meetings were held at Biloxi, Mississippi; Mobile, Alabama; and Pensacola, Florida to present the draft recommendations for specific artificial reef sites developed from the conceptual framework of the generic plan. These meetings afforded the opportunity for local interests to comment on the plans. Many of the comments were quite substantive and were factored into the final drafts.

The primary value of this effort has been the development of a logical and rational methodology for defining and evaluating many of the criteria essential for achieving objective decisions dealing with the siting and development of artificial reefs. This has been accomplished through analysis of specific and holistic evaluative criteria, providing numerous dependent and independent standards by which the utility and desirability of an artificial reef development project may be evaluated. The resulting site specific artificial reef siting recommendations and the methodology by which they were derived serve to illustrate both the mechanism and the procedures which have been developed.

This study was conducted by the Mississippi-Alabama Sea Grant Consortium and Continental Shelf Associates, Incorporated. It was sponsored by the National Marine Fisheries Service - Southeast Regional Office with a Saltonstall-Kennedy funded grant.

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A PLAN FOR SITING ARTIFICIAL REEFS IN THE NORTHERN GULF OF MEXICO: MISSISSIPPI, ALABAMA, FLORIDA

I. INTRODUCTION

A. Purpose

The efficacy of artificial reefs for the purpose of enhancing commercial and recreational fisheries has been well established. In past years a number of artificial reefs were installed adjacent to the northern Gulf of Mexico states, using a variety of materials, although no comprehensive plan had been developed for the systematic siting of these reefs. The purpose of this study was to develop a workable plan for the siting of artificial reefs in the northern Gulf of Mexico to benefit recreational and commercial fisheries. This plan considered the biological, operational, sociological, economic, and legal aspects of siting artificial reefs on a state by state basis, for coastal Mississippi, Alabama, and panhandle Florida.

Recently the Federal Government adopted a National Artificial Reef Plan. Development of this plan was undertaken when it was recognized that increasing demands on stocks of fish by commercial and recreational fishermen, coupled with the losses of desirable habitat through development and pollution, have had substantial negative impacts on some species of reef fish. When properly constructed and sited, artificial reefs can enhance the benthic habitat and provide quality fishing grounds close to major demand centers. This is expected to benefit the economies of adjacent shore communities by increasing total fish biomass within a given area without detracting from total biomass potential for that area. On the other hand, poorly planned and improperly placed artificial reefs can become hazards to navigation and obstructions to fisheries. The National Artificial Reef Plan discusses the problems of siting and building artificial reefs in general terms. It does not address the specifics of siting these reefs by region or state. It does recommend that specific studies and evaluations be completed to achieve optimum siting and construction potentials for maximum benefit to the reef fish population.

The artificial reef siting plan presented here was in response to the need identified in the National Artifical Reef Plan. As suggested in that plan, it focuses on the suitability of particular areas for reef construction, evaluating these areas on the basis of social, economic, legal, biological, and operational criteria. While this study is highly specific in that it evaluates and recommends specific reef sites in the areas of coastal Alabama, Mississippi, and panhandle Florida, the techniques and procedures utilized in identifying the recommended sites are of general utility and may be used with little or no revision anywhere specific reef siting studies may be needed.

The original proposed plan was submitted in response to a request for proposals by the National Marine Fisheries Service (NMFS). The proposal was cooperatively developed by the Mississippi-Alabama Sea Grant Consortium (MASGC) and Continental Shelf Associates, Inc. (CSA) of Jupiter, Florida. Although a large number of artificial reefs have been established adjacent to the Gulf states, no comprehensive plan is in use for the systematic siting of these reefs. The product envisioned in this project was the preparation of a detailed set of artificial reef siting plans for the three selected areas in the northeastern Gulf of Mexico. The work was carried out by a multidisciplinary team from academia and industry. Due to fiscal constraints, a decision was made to develop plans for only three specific sites: Gulfport-Biloxi, Mississippi; Mobile-Dauphin Island, Alabama; and Pensacola, Florida. Additionally, the decision was made to utilize only information currently available, with no additional data collection effort. This proved to be a significant constraint on the development of some aspects of the plan. In particular, the sociological component was severely hampered by the restriction that no new data be collected. This restriction, levied by the sponsoring agency, was based on the erroneous assumption that sufficient data were already available. It has resulted in less definitive evaluations and recommendations than were possible in the other programmatic areas.

As noted previously, the purpose of this investigation was to develop detailed and workable plans for siting artificial reefs at three specific sites in the northern Gulf of Mexico for the benefit of recreational and commercial fisheries. Site-specific recommendations were developed utilizing available information derived from evaluation of the operational, biological, sociological, and economic characteristics of and statutory requirements applicable to each site and the adjacent mainland areas and population centers. The plans have been developed using state of the art methodology. Many of the existing data were acquired from the archives of Continental Shelf Associates, from state and county socioeconomic and legal information, and from the Sport Fishing Institute (SFI), Washington, D.C.

One of the major objectives of this effort was to establish a regional Advisory Committee composed of representatives of interested organizations and groups from each of the affected Gulf Coast states and the co-developers of this program. This was accomplished and will be discussed below.

A great deal of importance was attached to the availability and participation of local interests at each of the selected sites. Consequently, public meetings were scheduled and held at each of the primary population centers adjacent to the reef sites under consideration. These meetings provided a mechanism whereby highly specific, local input into all aspects of the reef-siting operation could be realized. These meetings were held prior to preparation of the final draft of the reef-siting document, allowing the authors to evaluate and incorporate information obtained from the meetings into the plan. A high level of local interest was generated by these meetings, and the information and opinions thus obtained were extremely important to developing the final siting recommendations.

B. Participants

The National Marine Fisheries Service Southeast Regional Office (NMFS-SERO) supplied the oversight function and fiscal authority for the project. This was accomplished through Dr. Ronald Schmied, the NMFS Program Monitor.

The early development of this study indicated the advantages of utilizing a number of disciplines, involving both academic and industrial researchers. The industrial expertise supplied by CSA was responsible for the operational and biological sections of the plan. Academic expertise was derived from three member institutions of the MASGC with the MASGC Director providing overall management for the project. Table 1 lists the personnel who were involved in the project and their respective areas of responsibility. Figure 1 depicts the interrelationships of the participants.

In addition to the personnel shown in Table 1, William Hosking and the staff of the Alabama Sea Grant Advisory Service were involved in the planning and implementation of the project and in organizing and conducting the public meeting in Mobile. David Veal and the staff of the Mississippi Sea Grant Advisory Service organized and conducted the public meeting in Biloxi. Don Pybas of the Marine Advisory Service of the Florida Sea Grant College Program organized and conducted the public meeting in Pensacola.

As explained earlier, it was decided that an Advisory Committee composed of members of interested groups from the public and private sectors was essential to the successful conduct of the project. Membership in the Advisory Committee and affiliations are shown in Table 2.

TABLE 1

Personnel Associated With Project and Area of Responsibility

NAME	RESPONSIBILITY
R. Schmied	National Marine Fisheries Service Program Monitor
J. I. Jones	Director, Mississippi-Alabama Sea Grant Consortium and Overall Program Manager
M. Flandorfer	Mississippi-Alabama Sea Grant Consortium Co-Project Manager
A. Cosby	Mississippi State University Sociological Component
S. Chang	University of South Alabama Economic Component
A. Sage	University of Mississippi Legal Component
E. Kennedy (R. Oja)	Continental Shelf Associates, Inc. Co-Program Manager
K. Fucik	Continental Shelf Associates, Inc. Operational Component
R. Shaul	Continental Shelf Associates, Inc. Biological Component

C. Methodology

No comprehensive plan has yet been developed to systematically site artificial reefs in the Gulf of Mexico, although many reefs have been established utilizing a variety of materials. The development of such a comprehensive plan for specific areas off the coasts of Mississippi, Alabama and

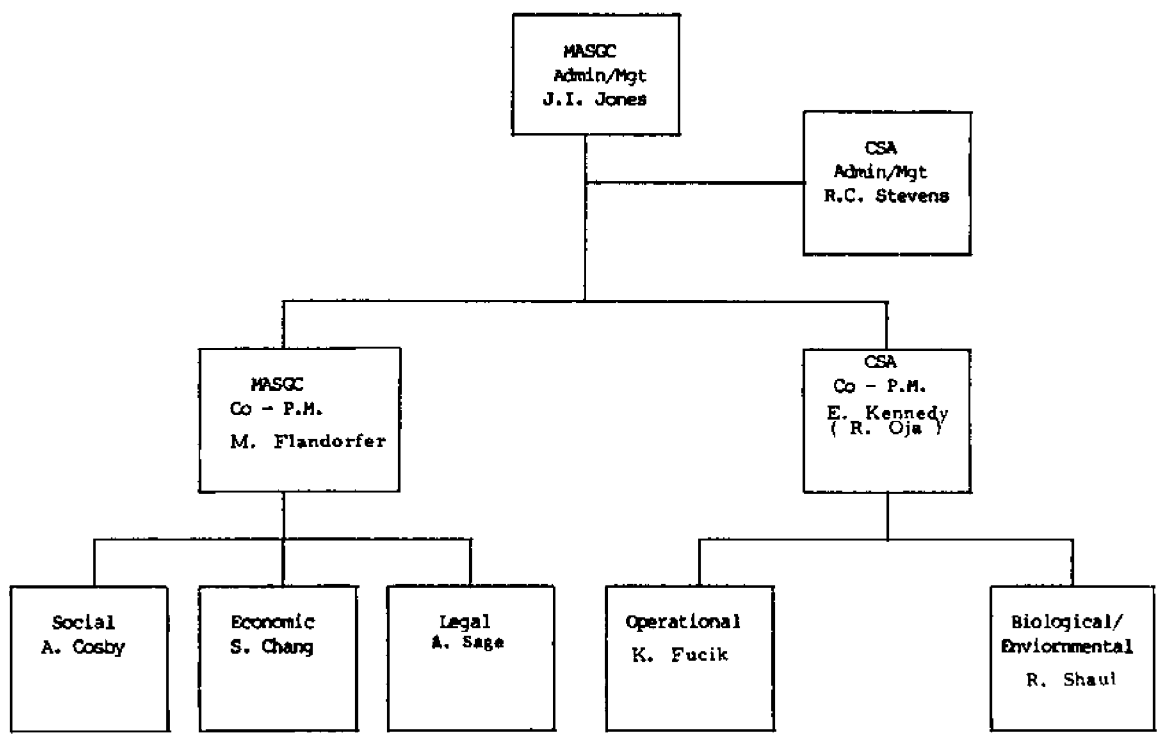

FIGURE 1 ORGANIZATION CHART.

panhandle Florida was the purpose of this study. As the development process of the plan was being formulated, it was determined that the plan had to consider potential impacts on and enhancement of the biota, appropriate reef materials and their orientation, sociological demand and support, fiscal requirements and potential economic benefits, and associated legal matters relating to the siting of artificial reefs. Additionally, it was evident that none of the factors could be evaluated alone as each had a significant effect upon the others.

Accordingly, this study treats the legal, sociologic, biologic, economic, operational subject areas holistically, emphasizing their interdependance. The members of the interdisciplinary team which developed this document are recognized experts in their respective fields. The results of this study do not represent "new" methodology. Rather, they have been accomplished through judiciously utilizing recognized methods and mechanisms to best evaluate the many variables extant within the study.

It is necessary at this point to identify a significant problem in this study and to clearly elucidate the limitations which it has imposed. As originally proposed, it was thought that a significant collection of new data, primarily sociologic and economic were necessary for proper execution of the project. These data would then have been used in the development of the individual reef-siting plans. A significant limitation was placed on the funds available for this work, which precluded any new data collection effort. This forced a decision that only existing data would be used in the development of the reef siting plans. The assumption was made, by the granting agency, that existing data would be readily available from the ongoing and completed studies by the Sport Fishing Institute, plus published information relating to state and local conditions and population characteristics, and that these would be sufficient for the completion of this study. This was not the case. The limitations imposed by this short-sighted approach resulted in a study that is incomplete to some extent, most critically in the sociologic component of the effort. This is not an apology for any aspect of this investigation but merely the objective assessment that limitations were placed upon it at the outset which resulted in a less precise evaluation of the sociologic component than exists in other parts of the study.

The develoment of this project required that each component first be addressed separately and then considered holistically within the context of the total study, as related to the other disciplines and categories which were evaluated. The following discussion identifies the aspects of each component which were deemed necessary to provide sufficient information for the development of the siting plans.

1. Legal Component

In order to develop comprehensive artificial reef siting plans a myriad of State, Federal, and local laws must be considered. These fall into four major categories:

(a) Permitting by Federal and State agencies under the many applicable statutes and regulations which are explained and analyzed in depth in a later section;

(b) Federal and State law applicable to potential legal liability for injuries or damage to third parties throughout the artificial reef development process and once the reef is established;

(c) Appropriate international, Federal, State, and local laws governing obstruction to navigation as related to the establishment of artificial reefs; and

(d) Federal tax incentives for entities willing to yield ownership of artificial reef materials.

While much of the work outlined in this section has been addressed by the Sport Fishing Institute through its 1983 Saltonstall-Kennedy (S-K) grant, considerable interpretation and refinement of that product was needed to produce site plans for the specific geographic areas targeted by this study. Details and nuances of State and local laws had to be analyzed and legal expertise was also required on the site planning Advisory Committee.

2. Sociological Component

The sociological component of the study proposed to evaluate, interpret, and refine available data emanating from the Sport Fishing Institute through its 1983 Saltonstall-Kennedy grant inasmuch as possible. These data regard sociological factors affecting the development of artificial reef site plans for the three target coast areas. In particular, sociological data include recreational boat registration data, demographic information, recreational fishing characterization information, recreation access and facility information, and other pertinent data necessary to develop site plans that are responsive to the needs of various user groups. The sociologists also participated directly on the advisory committee to provide effective consideration of user needs in the selection of specific artificial reef sites.

3. Economic Component

Economic analysis is concerned primarily with estimation and comparison of the benefits and costs of establishing artificial reefs at various locations within each target coastal segment. Benefits and costs are evaluated with special reference to how the siting plans will affect local fishery groups, local communities, and the regional economy. To develop effective site plans the following factors were evaluated:

(a) Number, location, and ownership of existing artificial reefs in each target area;

(b) Annual maintenance costs of artificial reefs;

(c) Liability insurance premiums for artificial reef materials if left unchanged;

(d) Dismantling costs of artificial reef materials;

(e) Transportation costs of dismantling;

(f) Salvage value of artificial reef materials;

(g) Potential sites for artificial reefs;

(h) Transportation costs of artificial reef materials to reef sites;

(i) Installation costs of artificial reefs;

(j) Annual maintenance costs of artificial reefs;

(k) Liability insurance premiums for artificial reefs;

(l) Value of commercial fishing from artificial reefs;

(m) Value of recreational fishing from artificial reefs;

(n) Sources of funds for converting artificial reef materials to artificial reefs;

(o) Itemized list of sunk costs.

In conducting economic analyses in this project, special attention was given to economic research completed by the Sport Fishing Institute. Particular attention was given to its efforts to develop economic evaluation methodologies that enable researchers to estimate the value of artificials reefs, and to facilitate charitable donations of reef construction materials.

An economist served on the Advisory Committee to facilitate effective interpretation and application of economic variables and data, and to provide guidance on the effects of reef design and location factors on the economic soundness of reef siting alternatives.

4. Biologic Component

A number of diverse biological factors were evaluated in the development of the artificial reef siting plans. These data have been collected from numerous data sources, including that collected by SFI, and those data available from the files of CSA.

The biological component addresses:

(a) Existing substrate and oceanographic conditions;

(b) Existing productivity and water quality;

(c) Biology of target species;

(d) Proximity to other productive fishing areas (live bottom areas, established trawling areas, etc.); and

(e) Reef utility as harvest areas/sanctuaries.

5. Operational Component

The operations component assesses and evaluates practical issues relevant to the establishment of articial reef sites.

Factors evaluated include:

(a) Existing reefs/trawl "hangs";

(b) Available deployment techniques;

(c) Methods to transport artificial reef material to the

desired locations;

(d) Reef size and configuration optimization;

(e) Navigation clearance and marking requirements recommendations;

(f) Orientation of reef material on the substrate and within the water column; and

(g) Reef materials available and their suitability for use.

Again, it was assumed that pertinent basic operational data were available from the SFI.

6. Advisory Committee Role

At the two meetings of the Advisory Committee the investigators presented their proposed methodologies to the committee for their consideration and critique. Recommendations of the Advisory Committee were incorporated within the working plan of each investigator.

7. Regional Public Meetings

A significant aspect of this study was to develop and utilize local knowledge and preferences in the artificial reef site selection process. This was accomplished by conducting regional public meetings at each of the population centers adjacent to a selected siting area. These meetings were widely advertised in the local media and were generally well attended. In each case individuals attended who were specifically concerned with reef siting and other aspects of artificial reef development. These groups represented local sport and commercial fishermen, local officials and city and county agency employees, boat owners, charter boat captains, and other concerned citizens. Each attendee has been identified in the Appendix by name. Additionally, each attendee was asked to complete two questionnaires, the data from which were later analyzed and factored into certain of the individual studies. The raw data questionnaires are included in the Appendix. At each meeting the individual investigators presented the scope and preliminary results of their work. A question and answer period was held following each presentation. The investigators utilized the results of the meeting in completing their portions of the study. The public meeting format proved to be a very successful vehicle for obtaining local information and as a mechanism for discussing the preliminary aspects and results of the study. It also has assured that local interests were addressed in the development and completion of the study.

II. ADVISORY COMMITTEE

The Advisory Committee was established to provide a mechanism for receiving information from a broad spectrum of organizations and individuals. These groups and individuals were selected to represent a broad cross-section of Federal, State and local agencies and interests. Two meetings of this group were held, one early in the study to provide information to guide in the development of the effort, the other nearer the end of the study to evaluate and critique the nearly-completed efforts of the individual investigators. This procedure proved to be highly successful in achieving its desired goals. An additional benefit was realized by involving this group in the study, that of stimulating interest and providing an understanding of the varied needs and requirements for artificial reef development and siting in the northern Gulf of Mexico. Table 2 is a list of the membership of the Advisory Committee. A listing of the attendees at each of the Advisory Committee meetings is included in the Appendix.

The project investigators (Oja, Kennedy, Flandorfer, Shaul, Fucik, Cosby, Sage and Chang) were ex officio members of the committee. Meetings of the Advisory Committee were held on January 31 and September 17, 1985 in Mobile, Alabama. These meetings were well attended with almost all of the designated organizations participating. At each meeting an overview of the project and current activities were discussed by the Chairman. Each investigator then summarized his work to date and identified specific activities and problems for discussion with the committee. Each investigator also provided a written synopsis of his work for review by the committee. These were later returned with comments and recommendations of the committee members. This activity provided a great deal of information within a short period of time and allowed a continuing evaluation of the work as it was being accomplished.

III. SITE DEVELOPMENT PLANS

The specific artificial reef siting plans were developed using the mechanisms and procedures described above. It need be emphasized that each element of the plans evolved using a two-step approach. First, the general aspects of each component were evaluated and described. Then a second, site-specific level of evaluation was applied. This results in two levels of information, with the first somewhat general and applicable to all sites. This level may be applied wherever evaluations of artificial reef siting may be required in that it is neither site nor region specific, and has broad utility. This level of development is deemed appropriate for use throughout the Gulf of Mexico, or wherever artificial reef siting evaluations may be required.

The second level of evaluation is specific to each of the selected sites adjacent to Biloxi, Mississippi; Mobile, Alabama; and Pensacola, Florida. The methodology which was applied to the specific site evaluations may be used effectively for any area. The results of those evaluations, however, are applicable only to the specific sites here considered. In other words, while this process is generally applicable, the results reported here are not.

TABLE 2. Advisory Committee Membership

Elton J. Gissendanner, Executive Director, Florida Department of Natural Resources

Hugh Swingle, Director, Division of Marine Resources, Alabama Department of Conservation and Natural Resources

Charles Blalock, Executive Director, Mississippi Department of Natural Resources

Larry Simpson, Director, Gulf States Marine Fisheries Commission

Robert Jones, Executive Director, Southeast Fisheries Association

Lynn Bonner Burke, Research Specialist, Sport Fishing Institute

Lawrence Green, Chief of Planning Division, Environmental Quality Section, U.S. Corps of Engineers Mobile District

William Seaman, Associate Director, Florida Sea Grant College Program

Feenan D. Jennings, Director, Sea Grant College Program, Texas A&M University

Jack Van Lopik, Director, Coastal Fisheries Institute, Sea Grant College Program, Center for Wetland Resources, Louisiana State University

William DuBose, Environmental and Safety Coordinator, National Ocean Industries Association

Villere Reggio, Jr., Recreation Planner, U.S. Department of the Interior, Minerals Management Service

Richard Ingrahm, Executive Director, Gulf Coast Conservation Association

B. J. Putnam, c/o Halfhitch Tackle Shop, Panama City, Florida

Edwin J. Keppner, Area Supervisor, National Marine Fisheries Service, Southeast Fisheries Center

John Burgbacher, Offshore Operators Committee, Offshore West Division, Shell Offshore Incorporated

Paul Johnson, Office of the Governor of Florida

Roger A. Brunell, Commander, 8th Coast Guard District

Lon Strong, Executive Director, Mississippi Department of Wildlife Conservation

Ronald Schmied (Program Monitor), National Marine Fisheries Service

James I. Jones, Director, Mississippi-Alabama Sea Grant Consortium and Chairman of the Advisory Committee

Max Flandorfer (Co-Project Manager), Mississippi-Alabama Sea Grant Consortium

Robert Oja (Co-Project Manager) Continental Shelf Associates, Inc.

E. A. Kennedy (Co-Project Manager) Continental Shelf Associates, Inc.

A. Legal Considerations

Legal considerations for the siting plan development study include permitting, liability, development incentives, and international law.

1. Permitting

The permitting procedure is highly structured, but is still relatively uncomplicated because of the use of regional permits in the two U.S. Army Corps of Engineers districts, within which the true reef siting target areas lie. In the Jacksonville District the permit is a joint permit between the applicable State agencies and the Corps. The required permits are a Section 10 (Rivers and Harbors Act) Corps permit, and within three miles of the coastline, a Corps 404 (Clean Water Act) permit. In Florida, between three and nine miles, the State program still applies, although it is regulated through the same application since the Corps Section 10 permit is required. Because the Corps permit is a regional permit, all other Federal agencies with a consultation role have had prior input regarding permit conditions. These agencies receive copies of applications and have an opportunity to comment on them. Since this is a regional permit, the normal public interest review process is bypassed, and the time for processing a permit is reduced from sixty (60) days to about two weeks. No other permits appear to be required, although there are State certifications for water quality and coastal zone program consistency approvals that must be obtained. In Florida, these are obtained as part of the joint Federal/State permit process.

2. Liability

Liability is a primary concern to many of the parties to reef development, particularly if obsolete oil platforms are used as reef materials. Many of the potential areas of liability i.e., injuries to workers of the towing and towed vessels, and collisions with other vessels or structures, are present in the required removal of an obsolete platform. Negligence in siting and maintaining the reef are significant liabilities, particularly in light of the National Fishing Enhancement Act (NFEA). Donors of reef materials are presently held to a strict liability standard regarding the condition of the reef materials when title is transferred, and it is possible that the standard need be changed to impose liability only if the donor knew or should have known that the materials were defective at the time title was transferred. The permit need be as explicit and detailed as possible to protect the permittee since the NFEA states that the permittee will not be liable for actions required to be taken by the permit. This may also cause a problem because it might be interpreted to mean that if those actions are dangerous under certain circumstances, the permittee would not be liable if they are undertaken with knowledge of the risk.

3. International Law

This study concludes that there are some questions about the legality of reefs under international law, but that this is not an overriding concern.

4. Development Incentives

A variety of development incentives are cited, including tax credits and deductions. It is suggested that other forms of incentives exist, and should be considered particularly in light of the difficulty in calculating values for tax purposes.

A LEGAL ANALYSIS OF ARTIFICIAL REEFS DEVELOPMENT

A.L. Sage, III

THE UNIVERSITY OF MISSISSIPPI

MISSISSIPPI LAW RESEARCH INSTITUTE

MISSISSIPPI-ALABAMA SEA GRANT CONSORTIUM

JUNE, 1986

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A Legal Analysis of Artificial Reef Development

I. Introduction

Artificial reefs have recently become a topic of interest to the marine community, although the subject has had ardent students for some time. One impetus to the increased interest in artificial reefs has been the problem of disposition of obsolete oil production platforms. The supporters of the reefs concept view the oil companies' problems as their opportunity. While many types of materials are available for reef construction, oil platforms may be among the best. Three artificial reefs constructed from platform components have been very successful in enhancing fishing and creating new opportunities for recreational divers.[1] While this paper discusses the questions involved in "rigs to reefs" development, the primary focus is on legal issues in the development of artificial reefs in general, from the permitting stage to permanent maintenance.

The study is divided into four primary parts: permitting, liability, international navigation law and development incentives. Naturally, there are instances of overlapping; for example, a big incentive for oil company donation of obsolete platforms is termination of liability at the time title is transferred.[2] Violation of permitting requirements can lead to liability in various circumstances, especially under the new artificial reef law, the National Fishing Enhancement Act of 1984.[3]

There are various studies that have examined the issues of permitting and liability, but most have done so in a brief or general manner. It is hoped that the reader will find that this study provides a guide for both the layman and the expert.

Finally, a comment should be made regarding the geographic scope of this paper. The ultimate purpose of the overall study of which this paper is a part is to determine site selection criteria and even sites for an area encompassing the Florida Panhandle, Alabama and Mississippi Gulf Coast offshore waters. This theme will be quite evident throughout the study, especially during the permitting section, but the author has endeavored to produce a paper that can be useful throughout the country. Variations in permitting for activities in other areas of the country will necessitate further research, but the information herein should still be useful for work in those areas.

II. Permitting

There are two categories of regulatory authority governing the disposal or placement of materials in offshore waters. There are those that give agencies permitting authority or the power to veto the granting of permits. Others give federal and state agencies a role in the formulation of guidelines governing the permitting process or a consulting role in the actual process. The federal agency with the primary authority to permit an artificial reef is the U.S. Army Corps of Engineers (Corps), therefore the initial discussion will focus on the Corps and its permit authority.

Other agencies with possible permitting, permit veto authority or policy and consultation authority are the Environmental Protection Agency, the Fish and Wildlife Service of the Department of Interior, the Minerals Management Service of the Department of Interior, the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration of the Department of Commerce, the U.S. Coast Guard of the Department of Transportation, the Defense Department and similar states agencies and local governments.

Following a discussion of the federal role in permitting artificial reefs will be a section on each of the three states being specifically studied. Although there are joint regional federal/state applications for artificial reefs, the criteria for concurrence and certification under various state programs are important to the overall process. Also, Florida has a general permit for artificial reefs.

a. U.S. Army Corps of Engineers

1. Rivers and Harbors Act of 1899

Corps Permit Jurisdiction Under Rivers and Harbors Act

Section 10 of the Rivers and Harbors Act of 1899 (RHA)[4] is the basic source of the Corps' permitting authority. It states that

> "it shall be unlawful to excavate or fill, or in any manner to alter or modify the course, location, condition, or capacity of, any port, roadstead, haven, harbor, canal, lake, harbor of refuge, or inclosure within the limits of any breakwater, or of the channel of any navigable water of the United States, unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of the Army prior to beginning the same."[5]

The Secretary of the Army has delegated his authority under the RHA to the Chief of Engineers,[6] who in turn has delegated his authority, with some exceptions, to the Corps District Engineer.[7]

The Outer Continental Shelf Lands Act (OCSLA)[8] extends the jurisdiction of the Corps under Section 10 to the Outer Continental Shelf (OCS).[9] The RHA and the regulations thereunder speak specifically in terms of the navigable waters of the United State, defined as "those waters of the United States that are subject to the ebb and flow of the tide shoreward to the mean high water mark, and/or are presently used, or have been used in the past, or may be susceptible to use to transport interstate or foreign commerce."[10] The territorial limits of the United States are the same as those of the states[11] and thus "waters of the United States" does not include the OCS. Without the extension of the Corps' RHA authority under the OCSLA, Section 10 permits would not be required for artificial reefs outside the territorial waters of the states.

Section 10 activities

The language of Section 10 as quoted above does not naturally lead one to the conclusion that a permit is required under the Rivers and Harbors Act for an artificial reef. The Gulf of Mexico logically would not be classified as a "port", "breakwater", "channel", or any of the other listed items. The facial meaning of the language in Section 10 has been expanded over the years by judicial interpretations to inject into the Corps' permit process considerations other than navigation. The first major expansion came in 1940 in U.S. v. Appalachian Electric Power Co.,[12] which held that federal power over navigable waters was as broad as the needs of commerce and included water power development, flood protection and watershed development.[13] The public interest review provided for in the present regulations has roots in the 1958 amendments to the Fish and Wildlife Coordination Act (FWCA)[14] and was formalized in the 1967 Memorandum of Understanding between the Fish and Wildlife Service (FWS) and the Corps.[15] The FWCA requires that the Corps consult with the FWS before granting permits for activities which would modify streams and other waterbodies, and that the Corps give full consideration to recommendations of the FWS for mitigation of damage to fish and wildlife.[16] The Memorandum of Understanding gave the Secretary of the Army (i.e. the District Engineer) the right to deny permits or to place in the permit such conditions as he deemed in the public interest.[17] The public interest review process was upheld in Zabel v. Tabb,[18] in which the Court upheld the Corps' denial of a permit for dredging and filling on the ground that the resulting damage to fish and wildlife would not be in the public interest.[19]

This expanded interpretation is found in the Section 10 regulations which state that a permit is "required under Section 10 for structures and/or work in or affecting navigable waters of the United States."[20] "Work" is defined to "include, without limitation, any dredging or disposal of dredged material, excavation, filling, or other modification of a navigable water of the United States."[21] Although there is no explicit definition of "filling" or "modification" in the Section 10 regulations, the Corps' regulations for the Clean Water Act (CWA) give some guidance.[22]

In the CWA regulations "fill material" is defined to include "any material used of the primary purpose . . . of changing the bottom elevation of an [sic] waterbody."[23] The next subsection specifically includes artificial reefs in the definition of "discharge of fill material."[24]

General Regulations for Section 10 Permits

An application for a Section 10 permit is subject to review under various guidelines; the discussion here will focus on those in the Corps' Section 10 regulations. General regulatory guidelines for Section 10 permits are found in 33 C.F.R. Part 320; special policies are covered in §322.5. Only one special policy appears to apply to artificial reef development and that is §322.5(e) dealing with aids to navigation. As long as aids to navigation are approved by and installed in accordance with Coast Guard requirements, they fall under the nationwide permit found in 33 C.F.R. Part 330, and thus would not require an individual Section 10 permit. Specific Coast Guard requirements are discussed in detail below.

The public interest review process is outlined in the Corps' general regulatory guidelines and is applicable to other Corps permit programs as well as to Section 10. The Corps' "decision . . . will be based on an evaluation of the probable impacts, including cumulative impacts, of the proposed activity and its intended use on the public interest."[25] The regulations describe this evaluation as a "general balancing" of benefits and foreseeable detriments that should reflect concern for "important resources."[26] It lists a number of factors and values to be considered in this process, concluding with a catchall - "the needs and welfare of the people."[27]

It should be noted that recent amendments to the Corps' regulatory policies have added as a concern "considerations of property ownership."[28] This section has also been amended to change the language of what some commentators to the rule change called the burden of proof. It previously read that "[n]o permit will be granted unless its issuance is found to be in the public interest."[29] The amendment changes the language to read "a permit will be granted unless the district engineer determines that it would be contrary to the public interest."[30] Critics of this change believe it changes the standard from an affirmative one to a negative one, and therefore will result in the issuance of some permits that might not have met the affirmative burden of proof.

> The following general criteria:
> (i) The relative extent of the public and private need for the proposed structure or work;
> (ii) Where there are unresolved conflicts as to resource use, the practicability of using reasonable alternative locations and methods to accomplish the objective of the proposed structure or work; and
> (iii) The extent and permanence of the beneficial and/or detrimental effects which the proposed structure or work may have on the public and private uses to which the area is suited.[31]

The Corps, pursuant to the Fish and Wildlife Conservation Act, consults with the FWS and the National Marine Fisheries Service (NMFS). The regulations also require Corps' consultation with the head of the state agency responsible for fish and wildlife.[32] The purpose of such consultation is to prevent the direct or indirect loss of such resources.[33]

Recent amendments to this subsection require the Corps to give "full consideration to the views of those agencies . . . in deciding on the issuance, denial, or conditioning of individual or general permits."[34] Prior language required the Corps to give "great weight" to the views of those agencies.[35] Some of the commentators to the amendment felt that this change lowered the standard of consideration of those agencies views while others felt it gave those agencies a veto power, especially in the 404 program of the Clean Water Act.[36] The Corps defended the change by saying that it conformed the regulatory language to the statutory language of the Fish and Wildlife Coordination Act.[37] The Corps also felt the new language was consistent with the National Environmental Policy Act (NEPA) and "other legal authority."[38]

Section 10 regulations require state certification of water quality under section 401 of the Clean Water Act (CWA).[39] This certification is essentially a veto power which would apply to all artificial reefs within the territorial limits of the United States, that is, within state territorial boundaries. This certification is considered conclusive unless the Regional Administrator of the Environmental Protection Agency (EPA) "advises of other water quality aspects to be taken into consideration."[40] Thus any permit application for an artificial reef in state territorial waters should be accompanied by a water quality certification from the applicable state agency or should state that such certification is being sought.

The regulations provide for evaluation of applications for permits which involve areas of "historic, cultural, scenic, conservation, recreational or similar values."[41] The public interest review process requires full evaluation of the effects that permitted activities will have on such areas or values. The regulation states that "[a]ction on permit applications should, insofar as possible, be consistent with and avoid significant adverse effects on the values or purposes for which those classifications, controls, or policies were established."[42] The regulation lists numerous examples of such areas, e.g., National Parks, and several of the types of areas listed could affect artificial reef permitting if present. Examples are estuarine and marine sanctuaries and archeological resources such as old shipwrecks.[43]

One last provision of this section should be mentioned. A subsection on considerations of property ownership states: "[a]uthorization of work or structures by the Department of the Army does not convey a property right, nor authorize any injury to property or invasion of other rights."[44]

2. The Clean Water Act

Jurisdiction of Corps

The Corps has jurisdiction of the Clean Water Act's dredge and fill program, commonly called the 404 program after the section number in the Act.[45] The general regulatory policies outlined above are also applicable to the Corps 404 program under the CWA.[46] Under the 404 regulations, "discharge of fill material" is defined to expressly include artificial reefs.[47] It should be noted before beginning a substantive discussion that the 404 program does not apply beyond the territorial sea, i.e. outside the navigable waters of the United States.[48] This geographical restriction does not apply to other provisions of the CWA, such as the National Pollution Discharge Elimination System (NPDES).[49] The NPDES permit regulates discharges not covered by the 404 program.[50] Thus, the NPDES program will not apply to an artificial reef project within the territorial waters of the United States.

Substantive provisions of 404 Program

As with the Section 10 program, the Secretary of the Army has delegated his permitting authority under §404 of the CWA to the Chief of Engineers[51] and the Chief Engineer in turn has delegated his authority to the District Engineers.[52]

The 404 program was assigned to the Corps because disposal of dredged and fill material is very similar to the Section 10 program.[53] Like the Section 10 program, the 404 program applies to "the navigable waters," but unlike the Section 10 program, §404 has not been extended to the Outer Continental Shelf (OCS). "Navigable waters" is defined to mean "the waters of the United States, including the territorial seas."[54] "Territorial seas" essentially is defined as three miles from the coastal baseline.[55] However, under the Submerged Lands Act, the state of Florida benefits from a nine nautical mile territorial sea on its western or Gulf boundary.[56] The Corps does not extend its 404 authority out the full nine miles,[57] so in Florida there is an area between the three and nine mile lines subject to exclusive state regulation for water quality. (Section 10 still applies, of course, within this six mile belt.)

As previously mentioned, the Corps must follow guidelines promulgated by the EPA pursuant to criteria set out in §403(c).[58] When those guidelines alone would "prohibit the specification of a site" the Corps must also consider the "economic impact of the site on navigation and anchorage,"[59] or as the regulations more clearly state, "the economic impact on navigation and anchorage of the failure to authorize the use of the proposed disposal site . . . ."[60]

The guidelines of §403(c) can be summarized as follows: the effect of disposal of pollutants on human health or welfare (a broad term, including plankton), marine life, ecosystems and species, and esthetic, recreation and economic values; the persistence and permanence of effects of disposal of pollutants; effects of varying rates of disposal; possible alternative locations and methods of disposal; and the effect on alternative uses of the ocean.[61]

EPA regulations promulgated pursuant to §404(b) are found in 40 C.F.R. Part 230, and are a product of EPA's consultation with the Corps. These regulation are extensive and cover many areas not directly applicable to artificial reefs. They are also similar to the Corps' own regulations under the 404 program, and allow general permits for certain activities just as the Corps' regulations do.[62] When there is a general Corps permit for a specific activity, the EPA has been consulted and its concerns taken into consideration before the general permit is issued. Because of the similarity of the EPA and Corps regulations, and the fact that there are general permits for artificial reefs in the applicable Corps districts, a discussion of the EPA's 404 substantive regulations will be omitted.

As previously mentioned, the EPA Administrator has a veto power under §404(c) over the Corps' issuance of 404 permits for disposal sites, when he determines that disposal will have an adverse impact on fisheries, wildlife or recreation areas.[63] (In fact, the Regional Administrator is the acting party and "Administrator" should be read to include Regional Administrator.) The regulations governing the procedure in such situations are found at 40 C.F.R. Part 231. The Administrator will take into account compliance with the guidelines set out in 40 C.F.R. Part 230 and will consult with the Chief of Engineers.[64] If the Administrator determines that a site designation will likely result in an unacceptable adverse effect, he will notify the District Engineer who must then satisfy the Administrator that the effect will be avoided or that corrective action will be taken.[65] If he is not satisfied, he holds a public hearing (in some cases), takes comments and submissions of data[66] and, within a specified period, issues a decision.[67] If the Regional Administrator proposes to deny a site, he forwards his proposed determination to the Administrator. If the Administrator decides to review the decision, the administrative record is requested for his examination prior to the final decision.[68] The Administrator's final decision constitutes final agency action for purposes of judicial review.[69]

Other aspects of §404 which apply to artificial reefs will be discussed below, but one other provision should be mentioned again. There is a provision in the 404 program which allows a state to assume responsibility for administering the program,[70] but under this same provision does not apply to coastal waters.[71]

Special regulations for 404 Program

Until recently 404 regulations stated that the District Engineer could condition permits or require modifications in an applicant's proposal for three reasons: (1) conditions or modifications necessary to meet a legal requirement; (2) to serve the public interest; or (3) to avoid or mitigate adverse impacts on fish and wildlife resources.[72] This language has been amended,[73] to require special "conditions" in the first two of the three circumstances. Although the third reason has been eliminated, fish and wildlife resources are considered in the Corps' public interest review. Permit conditions or modifications can be required to meet these objectives when there is no local, state or federal program or policy to achieve the desired result or an agreement between the applicant and the concerned parties would not be legally enforceable.[74] Two new provisions were added: (1) to allow mitigation to be accomplished off-site as well as on-site and (2) to allow the District Engineer to add special conditions at the applicant's request or to clarify the application.[75] The district engineer can also require that the applicant post a bond if he feels that the applicant may not be able to complete work necessary to protect the public interest.[76]

Regional Permits

The Clean Water Act authorizes the Secretary of the Army to promulgate general permits, either on a regional or nationwide basis.[77] In the geographic area that is the specific subject of this study, there are two Corps districts - Jacksonville, Florida and Mobile, Alabama. Both of these districts have promulgated regional permits for artificial reefs in state waters. The regional permit application form is also a joint federal/state form, i.e., it is used to obtain any state permit or certification needed for the proposed project. The permits for the two districts differ somewhat, but more in form than substance. (Copies of the permits are found in the Appendices.)

An application is not required for this type of permit, but "the issuing authority may condition the regional permit to require a case-by-case reporting and acknowledgement system."[78] The reporting and acknowledgement process required in both the Jacksonville and Mobile districts' issuing process virtually amounts to the submission of a permit application.[79] However, the important aspect of the regional permit as applied to artificial reefs is that the public notice, hearing and comment period for Section 10 and Section 404 permits is waived.[80] This means that the federal permit process is shortened (theoretically at least) from approximately sixty days to two weeks.[81] (This does not mean, of course, that any state permitting or certification process is similarly shortened.[82])

It should be pointed out that a regional permit specifically states that it does not authorize an activity that requires other permits or approvals.[83] Examples of such permits, certifications or approvals are state permits, the §401 (CWA) state water quality certification (territorial waters), state coastal program consistency determinations, possible EPA veto or conditioning under §404(c), Coast Guard approval of navigation aids, Endangered Species Act consultations with the Fish and Wildlife Service or the National Marine Fisheries Service, Minerals Management Service consultation on the presence of pipelines or other facilities and Department of Defense consultation on the presence of restricted military area. Many of these are covered by consultations among the Corps and the applicable agencies prior to the issuance of the regional permit.[84] In areas where there is no regional permit, all these agencies and others are notified of the permit application and have an opportunity to comment on it.[85] Even in areas with regional permits, there is generally a reporting and acknowledgement process.[86] This gives concerned agencies the opportunity to review activities that affect their regulatory areas, to comment on the impacts of the proposed activity, and, if necessary, to exercise any veto or conditioning power they may possess.

Although the duration of individual permits is normally dependent on the type of project permitted, i.e. permanent projects are permitted for an indefinite duration,[87] both the Jacksonville and Mobile regional permits state that they are good for a duration of five years. However, it is not clear that the statutory limitation of five years[88] is meant to apply to individual projects permitted under a regional permit, or whether the intent is to allow a five year period in which those activities can begin under the regional permit and remain permitted even if the regional permit expires and is not renewed. One Corps official stated that his opinion is that the latter interpretation is the correct one, but also said that it is a question that has not been specifically addressed.[89]

3. Corps of Engineers Permit Procedures

Permit Applications

Part 325 of 33 C.F.R. describes the application process for all types of Corps permits.[90] This is a very detailed set of procedures, and it would serve little purpose to explain them in detail because such an attempt would amount to little more than quoting the regulations verbatim. Therefore, they are summarized as succinctly as possible.

An applicant can request a pre-application consultation for major applications (a term that is not defined).[91] Although most artificial reef projects would not be considered major activities, the ones that involve the use of oil platform components may benefit by use of this procedure. Even though there are regional permits for artificial reefs in the Jacksonville and Mobile districts, an applicant must submit what is practically equivalent to an original application.[92] The more ambitious reef projects may save time by utilizing this procedure.

Section §325.1 of the regulations covers the application form, contents, signatures, additional information that might be required and fees. One of the most important requirements (which also applies to regional permits) is that the applicant detail all approvals or permits obtained or being sought.[93] If the activity involves disposal of fill material, which by definition includes artificial reefs,[94] the application must include certain information regarding the type and source of the material, the method of transportation and disposal and the proposed location.[95] Fees are not due until the application is approved; the commercial use fee is $100 and the non-commercial fee is $10.[96]

Section 325.2 provides details on the processing of applications, e.g., time limits for such things as requesting additional information and publishing the public notice, receiving comments from interested parties, following the National Environmental Policy Act, holding public meetings, making findings and notifying applicants of final decisions. This section also specifies the various certifications that must be obtained before the application is approved, such as state water quality certifications and coastal program consistency determinations.

If property on or eligible for the National Register of Historic Places is involved, the District Engineer must follow the regulations promulgated by the Corps under the National Historical Preservation Act.[97] If an endangered species or its habitat is jeopardized, the District Engineer is required to consult with the Fish and Wildlife Service or the National Marine Fisheries Service.[98]

Subsection 325.2(d) sets out the various time constraints involved in the permitting process, such as issuance of the public notice, comment time period and so on. Also discussed are alternative procedures such as regional permits. The regulation states that once "a regional permit has been issued, individual activities falling within those categories that are authorized by such regional permits do not have to be further authorized by the procedures of this regulation,"[99] meaning that an applicant does not apply for an individual permit. Special conditions may be added to the permit for protection of the public interest, and in certain cases an individual permit may be required.[100]

A individual permit application goes through public notice requirements.[101] There are fifteen basic items that must be included in every public notice, and there are an additional seven if section 103 of the Ocean Dumping Act[102] is applicable, i.e., the Marine Protection, Research and Sanctuaries Act. Certain evaluation factors must be included in the public notice, depending on the particular statutory authority involved in the application.[103] The regulation contains several provisions governing the distribution of notices, but there is one provision that stands out. A lack of response to the public notice "will be interpreted as meaning that there is no objection to the proposed project."[104]

Modification, suspension or revocation of permits

A permit can be modified, suspended or revoked at any time necessary by considerations of the public interest.[105] When regional permits are involved, the reevaluation may cover only "individual activities, categories of activities, or geographic areas."[106] Various factors are considered, such as compliance with permit conditions, changes in circumstances, continuing adequacy of permit conditions, new significant objections, statutory or regulatory changes and possible adverse effects on the permittee.[107] In all cases of modification, suspension or revocation, a meeting may be requested and even a public hearing.[108]

Enforcement, Supervision and Inspection

The District Engineer is empowered to issue stop orders and to order protective work.[109] Protective work can be ordered to be performed immediately and can range from "minor" modification to complete restoration.[110] The District Engineer can accept an after-the-fact permit application unless civil or criminal action is necessary or if other state, local or federal certification has been denied or enforcement action is pending.[111]

Criminal action is considered appropriate when punitive action or deterrence is considered "essential to the establishment or maintenance of a viable regulatory program.[112] Civil action is justified when a court order is needed to enforce a stop order or a remedial work order, voluntary compliance for modifications cannot be achieved, or when a civil penalty under the Clean Water Act is warranted.[113]

Appropriate inspections are authorized during "performance" (construction) of an activity, with notices and instructions to be issued to insure that permittees do not depart from approved plans.[114] In cases of non-compliance, voluntary cooperation is first sought, and if this fails the District Engineer issues an immediate suspension and considers legal action.[115] Any inspection expenses of an unusual nature or amount will be assessed to the permittee, and he may even be required to deposit in a depository bank an amount sufficient to cover future inspections.[116]

If the unauthorized activity is found not to be in the public interest, the permittee will be ordered to take necessary corrective action. If he fails to do so, the engineer will recommend legal action.[117]

Public hearings

The provisions of 33 CFR, Part 327, governing public hearings are largely procedural in nature, and it will do little good to regurgitate them here. Generally a public hearing will be held unless the District Engineer determines that the issues are "insubstantial or there is otherwise no valid interest to be served by a hearing."[118] A person may be represented by counsel or other representatives.[119] Hearings are to be conducted in a manner to allow all interested persons an opportunity to be heard, but cross examination of witnesses is not allowed.[120] Hearings are reported verbatim, and all written statements, charts, and similar data become part of the record.[121]

4. National Fishing Enhancement Act of 1984

Legislative history

The legislative history to the National Fishing Enhancement Act of 1984 (NFEA), or the Artificial Reefs Act, is found in House Report 98-819.[122] After several bills had been introduced in the previous Congress, H.R. 3474 was introduced in the 98th Congress.[123] House Report 98-819 outlines five purposes of the bill: (1) to establish standards, (2) to call for a national plan, (3) to clarify liability, (4) to establish civil penalties for permit violations, and (5) to create tax credits.[124]

Hearings were held on H.R. 3474, and almost all comments were favorable regarding creating national standards for the development of artificial reefs.[125] Some unfavorable comments were received concerning the effect of the tax credit provisions on tax revenues and the possibility that reefs actually made some species more vulnerable to overfishing by concentrating them.[126]

After the testimony was received, the bill was marked up, a substitute offered and later introduced as H.R. 5447.[127] H.R. 5447 differed from H.R. 3474 in that it contained no tax credit provisions, set a one year deadline for formulation of the national reef plan, called for a synopsis of existing information as part of the plan, called for a study on the alternatives for material transfer and amended the Liberty Ship program to make any obsolete vessel available for use as an artificial reef.[128] Apparently H.R. 5447 was introduced as an amendment to H.R. 6342, because it is Title II of that act.[129]

Summary of the Act

The Act states the findings and conclusions of Congress, stating that artificial reefs will enhance United States fishing resources and that the purpose of the act is "to promote and facilitate responsible and effective efforts to establish artificial reefs . . . ."[130] The standards for siting, constructing, monitoring and managing artificial reefs are made the criteria for the issuance of permits pursuant to the Act.[131] The standards are intended to:

(1) enhance fishery resources to the maximum extent practicable;
(2) facilitate access and utilization by United States recreational and commercial fisheries;
(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 . . . not create any unreasonable obstruction to navigation.[132]

The Act sets out in detail the elements which are required to be covered in the national plan and prescribes a one year deadline for developing the plan.[133] There are six basic elements: technical criteria for siting, construction, monitoring and managing reefs, a synopsis of existing information, and alternatives for facilitating the transfer of reef construction materials to permittees, "including, but not limited to, credits for environmental mitigation and modified tax obligations."[134]

The Act recognizes that the Corps will be the primary permitting authority for artificial reefs, but it does mention the NPDES program.[135] As discussed below, there do not seem to be any situations in which the NPDES program will apply to artificial reefs. (page 41) The Corps' permits under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act are also specifically mentioned.[136] The Secretary of the Army is directed to consult with other agencies, federal, state and local, to insure that permit provisions meet the Act's standards and criteria, to insure that title to reef material is unambiguous and "that responsibility for maintenance and the financial ability to assume liability for future damages are clearly established," and to consider the national plan.[137]

A reef permit must "specify the design and location for construction of the artificial reef and the types and quantities of materials" to be used in the reef.[138] Each permit should specify conditions necessary to comply with the law and to protect the environment and human safety and property.[139]

The liability provisions are important enough to set out in full, but these provisions of the Act are discussed in detail in the liability section. In summary, the Act purports to relieve a permittee from liability for damages caused by activities taken pursuant to the permit if the permittee is complying with the terms of his permit.[140] The Act also purports to relieve from liability any donor of reef materials who has transferred title, if the materials meet applicable standards set out in the national plan and "are not otherwise defective at the time title is transferred."[141] It is not clear exactly what standard of liability these provisions create; this issue will be more fully discussed below. Amendments are probably needed to clarify this section.

The Secretary may not issue a permit to a person not financially able to assume liability for all damages for which he may be responsible.[142] The Act states that nothing in the Act creates any liability on the part of the United States,[143] meaning that a waiver of immunity should not be implied.

The remainder of the act includes provisions covering civil penalties, definitions and amendment of the Liberty Ship program to include any obsolete vessel.[144] There is also a provision preserving the existing authority and jurisdiction of the states and the Tennessee Valley Authority over artificial reefs.[145]

Comments concerning NFEA

A few observations about the NFEA are in order at this point. The act itself is a very short reiteration of many of the standards and criteria of other statutes or regulations that deal with permits in navigable or OCS waters and the environmental protection of various resources. It does mandate the creation of a national program, which seems to be envisioned as a type of clearinghouse for technical and other information.[146] Perhaps the most important thing it attempts to do and the thing that may be most important to oil companies as far as "rigs-to-reefs" is concerned, is to eliminate liability of a donor of materials once he transfers title.[147] This goal is not clearly accomplished, and, in fact, the opposite may have resulted. This point is discussed in detail in the liability section.

Corps regulations under the NFEA

The Corps has promulgated proposed regulations under the NFEA.[148] The proposed rules illustrate the lack of real regulatory substance to the act, or, as some of the agencies testifying to the Congressional committees stated, that there exists sufficient statutory and regulatory authority to administer an artificial reef program.[149] The summary in the notice even states that "[m]any of these procedures are verbatim from the statute."[150]

The definitions of artificial reef and outer continental shelf are promulgated as additions to existing regulations.[151] Another amendment requires the applicant to meet the standards set out in the Act.[152] If the District Engineer decides to issue the permit, those standards will be conditions of the permit.[153] The regulations require the engineer to consider the national plan and, if he decides to issue the permit, to notify the Secretary of Commerce of "any need to deviate from the plan."[154]

The District Engineer must comply with the coordination procedures required by an agreement "between the DOD (Department of Defense) and the Federal agencies relative to artificial reefs."[155] The regulation authorizes him to initiate with any other agency or party "further consultation beyond the normal public commenting process [if] required to evaluate fully the proposed artificial reef."[156] (The written agreement referred to in the prior sentence is the proposed memorandum of agreement among various federal agencies concerning placement of artificial reefs, particularly the nonremoval of obsolete oil platforms. To the knowledge of this writer, this agreement had not been signed as of May 29, 1986.[157])

The District Engineer can issue a permit only if the applicant demonstrates that he has title to the materials and is financially responsible.[158] It reiterates the statutory exemption from liability for the permittee if he is acting in compliance with the terms and conditions of the permit.[159]

A copy of the proposed regulations is included in the Appendices. A copy of the National Artificial Reef Plan can be obtained by writing or calling the National Marine Fisheries Service in Washington (202-634-7449).

b. Other Federal Agencies

1. United States Coast Guard

Aids to navigation

The Coast Guard has authority to regulate aids to navigation on obstructions in navigable waters.[160] Generally speaking, the Coast Guard is authorized to maintain an aid to navigation and charge the owner of the hazard for maintenance of the aid until the hazard is removed or legally abandoned.[161]

The national artificial reef plan contains a fairly good summary of the Coast Guard's role in reef development. The primary role of the Coast Guard is to review reef plans to determine if the project poses a hazard to navigation and, if a project meets its approval, to describe any aids to navigation that may be required.[162] The regulations are found in 33 C.F.R. Part 66; Subpart 66.01 covers private aids to navigation and Subpart 66.05 covers state aids to navigation. The latter provision does not necessarily mean state-owned aids to navigation, but those regulated by the state in waters designated by the Commandant of the Coast Guard.[163] According to the regulations the only such waters in the three states in this study are those in Alabama "not marked with Coast Guard aids to navigation on March 26, 1971."[164] Therefore, almost all navigation devices for artificial reefs would be classed as private aids.

Most of the area involved in this study is in the New Orleans Coast Guard district, but some of the Florida Panhandle is in the Miami district.[165] Any questions about aids to navigation should be directed to the appropriate office.

Private aids to navigation

To obtain permission to operate a private aid to navigation, an applicant must complete all parts of application form CG-2554. (A copy of such a form is found on the following page.) The regulations list the information that is required,[166] but the form requires more specific information than is actually spelled out in the regulations, e.g., candlepower of a light. The basic requirements are location by two or more horizontal angles, or bearing and distance for charted landmarks, name and address of both the financially responsible party and the person in direct charge of maintenance, the necessity for the aid and a detailed description of the aid.[167] The regulations require that all aids conform to the standard U.S. system, except that only tungsten-incandescent lights are approved for electric lights.[168]

When the application is approved, the District Commander will return a signed copy of the application to the applicant.[169] Transfer of ownership of the aid must also be approved by the District Commander, and the parties must submit an application form to receive such approval.[170]

A good summary of the Coast Guard's duties and regulations is found in Proceedings of an International Conference on

Artificial Reefs (1974), in a paper by the then Eighth District Legal Officer.[171] (See Appendices.) Some of the specific requirements he outlines have only recently been changed due to revisions in the requirements of the International Association of Lighthouse Authorities.[172] (See Appendices for current summary.) For example, a quick flashing white light is still required for hazards to navigation that have less than eighty-five (85) feet clearance.[173] It can be either red or green, red to be "left" on the starboard side and green to be "left "on the port side.[174] This is when coming in from sea, so the system reverses when going out.[175] ("Left" means to pass with the buoy on that side, not pass on that side of the buoy.)

If a hazard has between eighty-five (85) feet and two hundred (200) feet of clearance, the Coast Guard generally requires one unlighted buoy with orange and white horizontal bands.[176] This will gradually change until 1989 when all such buoys will be solid yellow.[177]

According to the New Orleans Coast Guard (Eighth District) Office, a minimum of one mile distance is preferred between a safety fairway (shipping lane) and an underwater structure if the clearance is less than eighty-five (85) feet.[178] More than eighty-five (85) feet is not considered hazardous unless the structure is close to a fishing area, then the clearance must be greater than two hundred (200) feet.[179]

Again according to the New Orleans office, the Coast Guard waits until the Corps has issued a permit before it approves aids to navigation.[180] This does not exactly coincide with either the Jacksonville or Mobile regional permit application process since both permits require that Coast Guard approval of private aids be attached to the initial application. The Coast Guard regulations state that the Corps has to permit the aid before the Coast Guard will approve it.[181] Since the Corps has issued a nationwide permit for aids to navigation, this should allow the Coast Guard to approve the aid to navigation without further action on the part of the Corps. The time for getting a Coast Guard approval can be very short, as little as one day.[182]

Although buoys may have to be maintained indefinitely in some areas, some buoys can be removed if sufficient clearance (as little as forty-five (45) feet) is present, they have been charted and the Coast Guard (and probably the Corps) gives its approval.[183]

The aids to navigation program depends to some extent on local conditions, and exact requirements can be determined best, if not only, by contracting the appropriate district office of the Coast Guard. In the geographic area of this study, both the New Orleans office and the Miami offices have jurisdiction. New Orleans has the area from Apalachicola, Florida, to Brownsville, Texas, while the Miami office has the remainder of Florida's Gulf coastline.[184]

2. Fish and Wildlife Consultation

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act is found in 16 U.S.C. §§661 et seq. When a stream or body of water is going to be modified for some reason, including navigation and drainage, by any agency, public or private, that agency must first consult with the Fish and Wildlife Service and the head of the appropriate fish and wildlife agency of the state in which the waterbody is located.[185] The purpose of such consultation is "the conservation of wildlife resources by preventing loss of and damage to such resources as well as providing for the development and improvement thereof in connection with such water-resource development."[186] (Compliance with the requirements of preparation of an environmental impact statement also fulfills the Act.[187])

Reorganization Plan No. 4 of 1970, which created the National Oceanic and Atmospheric Administration (NOAA) in the Department of Commerce, transferred certain functions of the Secretary of Interior to Commerce.[188] One of those functions was the study of "migratory marine species of game fish."[189] Thus, the National Marine Fisheries Service of NOAA is part of the consultation process when a water project, such as an artificial reefs, affects navigation, to protect against loss of and damage to marine game fish.

Memorandum of Agreement

There is a Memorandum of Agreement between the Secretaries of the Army and the Interior providing for a consultation process on projects affecting fish and wildlife resources.[190] This agreement creates a process for input by FWS and NMFS, found in the Corps' regulations. Case law appears to hold that the Corps or other agencies do not have to follow any recommendations of FWS or NMFS, but only that such recommendations be given serious consideration.[191]

Endangered Species Act

It would suffice to discuss the Endangered Species Act[192] (ESA) by saying: "Tellico Dam, $100 million and snail darter." A small fish kept a $100 million dam from being completed. This is the power of the ESA, for the Supreme Court in Tennessee Valley Authority v. Hill[193] stated that the Congressional intent of the ESA is "to halt and reverse the trend towards species extinction, whatever the cost", and that endangered species have priority over the missions of federal agencies.[194]

The operative language of the ESA insofar as artificial reefs are concerned is:

> " [e]ach Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency . . . is not likely to jeopardize the continued existence

> of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which . . . is determined to be critical, unless such agency has been granted an exemption . . .."[195]

Another provision in the same section requires consultation on any agency action that might jeopardize a potentially endangered species or its habitat.[196]

"Secretary", as used in the act, means either the Secretary of Interior or the Secretary of Commerce, according to their respective responsibilities as vested pursuant to Reorganization Plan No. 4 of 1970, mentioned above.[197] Thus, the Secretary of Commerce has consulting duties in regard to endangered species of marine migratory fish, and the Secretary of Interior has jurisdiction of the rest.[198]

The exemption mentioned in the above language essentially involves a showing that the proposed agency action is more important than the preservation of the species, and that adequate mitigation and enhancement measures are taken.[199] It is difficult to imagine any artificial reef project being of such importance.

Marine Mammal Protection Act

The Marine Mammal Protection Act of 1972 concerns "certain species and population stocks of marine mammals [which] are, or may be, in danger of extinction or depletion as a result of man's activities."[200] The Secretaries of Commerce and Interior again have divided jurisdiction - Commerce having the order *Cetacea* and members, other than walruses, of the order *Pinnipedia*, and Interior having all the rest.[201] The purpose of the act is "to obtain an optimum sustainable population keeping in mind the optimum carrying capacity of the habitat."[202] The act prohibits the taking of any marine mammal without a permit, taking meaning "to harass, hunt, capture, or kill, or attempt" any such act.[203]

One interesting note is that the geographic coverage of the Marine Mammal Protection Act is the Fisheries Conservation Zone or 200 miles from the coastal baseline.[204] There appear to be no specified geographic limits for the Endangered Species Act.

Marine Sanctuary Act

Under Title III of the Marine Protection, Research and Sanctuaries Act of 1972,[205] the Secretary of Commerce is authorized to "designate any discrete area of the marine environment as a national marine sanctuary and promulgate regulations implementing the designation . . .."[206] Standards for the designation of a sanctuary are set out in the same section, as is a consultation process for Congressional committees, other federal agencies, affected states and their coastal management agencies, and the appropriate Regional Fishery Management Council.[207]

Simply stated, activities in a marine sanctuary would be severly restricted. There are no known marine sanctuaries in the specific geographic region covered by this study, but there are several areas in Citrus County, Florida, which have been designated as manatee sanctuaries.[208] The regulations governing activities in these areas prohibit all waterborne activities during the period November 15 through March 31 of each year.[209] An exception is made for boat access by residents and their guests, but boats must be operated at idle speed/no wake.[210]

Any reef planned for a sanctuary area may be subject to such restrictions, if it is permitted at all. The Corps' general policies for permits states that no permit will be issued "until the applicant provides a certification from the Secretary of Commerce that the proposed activity is consistent with" the Act and the regulations promulgated by the Department of Commerce.[211]

Summary of Fish and Wildlife Consultation

It is apparent from the discussion that fish and wildlife considerations are important even though the FWS and the NMFS do not have an independent permitting role in the artificial reef permitting process. It not enough to plan a reef to enhance fishing or even fish populations, one must be sure that the reef does not harm other fish or fish habitat. Moreover, it is important that an applicant concern himself with all types of marine life and habitat, not just those that are endangered or potentially endangered. The role of the FWS and the NMFS is to protect fish and wildlife generally, and it would probably be wise in most situations to seek some advice from these agencies in the reef planning stage.

3. Department of Defense

Military Stipulation areas

There are certain areas in the Gulf, as well as other offshore waters, that are restricted for use due to military activities. It is safe to state that no artificial reef would be permitted in such an area.[212] The Sport Fishing Institute is planning to publish a planning guide that will contain descriptions of these areas in the Gulf.[213] There are several other places from which such information can be obtained, such as the Corps or Coast Guard, and the Minerals Management Service has identified such areas in its 1983 Gulf of Mexico Regional Environmental Impact Statement.[214]

National Security Concerns

When the Minerals Management Service (MMS) published its notice concerning possible alternatives to dismantling of obsolete oil production platforms,[215] it got a strong answer from the Defense Department (DOD). DOD objects to leaving existing platforms where they are on the grounds of navigation safety, stating that the required safety zone around oil rigs severly restricts submarine movements.[216] It also objects to the "as is" approach because of considerations of international law, which DOD states requires removal of platforms under the 1958 Geneva Convention on the Continental Shelf.[217] DOD is afraid that an "as is" policy on the part of the United States would lead other nations to adopt varying interpretations of the limits of international standards of navigation.[218]

A question comes to one's mind while reading the DOD's objections concerning its policy toward artificial reefs in general, not just a "leave 'em where they are" policy on obsolete oil platforms. DOD says they are worried that the problem will worsen as the oil industry develops capability for deeper waters.[219] These waters are too far out to be of much benefit for artificial reefs. Many of the platforms that would be suitable reefs if left in place are close to shore, as would be new artificial reefs. These thoughts make one wonder if the DOD would have objections to new reefs if development became widespread. There have been negotiations on a Memorandum of Understanding on artificial reefs among the Departments of Defense, Interior, Transportation, Commerce and the EPA, but the agreement has not yet been signed.[220]

In 1985, the Department of Interior appeared to have given up the battle to develop regulations to leave oil platforms in the Gulf after production was completed. However, it has revived the issue with a notice of proposed rulemaking published in the Federal Register on March 5, 1986.[221] This is a controversy that will greatly affect the availability of obsolete platforms for artificial reefs in other areas. The ultimate outcome is impossible to predict.

4. Environmental Protection Agency

Liberty Ship Program

This program is no longer accurately described as the Liberty Ship program, but the name may be too familiar to change. The actual name of the act is Reefs for Marine Life Conservation,[222] but it involved the transfer by the Secretary of Commerce to an applicant state of a Liberty Ship which would otherwise be scrapped, if the state agreed to use it for an offshore artificial reef.[223] The statute was amended by the National Fishing Enhancement Act to cover any obsolete ship and to transfer jurisdiction of the transfer provisions to the Secretary of Transportation.[224]

One provision of the act is regulated by the EPA. The application for a ship must include "a certificate from the [EPA] that the proposed use of the particular vessel or vessels requested by the State will be compatible with water quality standards and other appropriate environmental protection requirements."[225] Although not specifically covering the use of obsolete ships for reefs, there is a regulation governing the dumping of vessels for disposal.[226] These guidelines grant a general permit for disposal of vessels, subject to certain conditions. In all except emergency situations, the person disposing of the vessel must empty all fuel lines and tanks to the lowest point practicable, flush the lines and tanks with water and again empty the lines and tanks to the lowest point practicable. The vessel hull must be stripped of pollutants and other readily detachable material.[227] One should expect the same requirements for use of obsolete vessels as artificial reefs.

Clean Water Act

The Clean Water Act's 404 program is administered by the Corps and the Corps has promulgated regulations governing the program, but the CWA provides that the Corps must apply guidelines developed by the Administrator of the Environmental Protection Agency.[228] The statute requires these guidelines to be based on criteria similar to those provided for ocean discharges in Section 403(c).[229] Satisfaction of the Section 403(c) criteria is sufficient for the issuance of a NPDES permit under Section 402.[230] Therefore, the 404 program is based on the criteria similar to one type of NPDES permit. While the EPA develops the guidelines for both sections, it is the Corps which interprets the EPA's guidelines.

The EPA does in fact have a "veto" power over the Corps' issuance of a 404 permit if the EPA Administrator determines, after a public hearing, that the discharge would have an adverse effect on "shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreational areas."[231] It is understandable that the veto power will not be exercised in every dispute between the EPA and the Corps; the political realities of administrative relations discourage it. In view of the standard governing the exercise of the veto, it is not foreseeable that many artificial reef permits would be vetoed.

There has been some argument that the Section 402's NPDES program could apply to artificial reefs outside the territorial sea, since the 404 program does not apply outside this limit. This argument has been based on the following language of Section 403(a) of the CWA: "[n]o permit under section 1342 [Section 402] of this title for a discharge into the territorial sea, the waters of the contiguous zone, or the oceans shall be issued, after promulgation of guidelines established under subsection (c) of this section, except in compliance with such guidelines."[232]

However, one must look to the definition section of the CWA to determine the scope of this provision. Section 502[233] of the CWA defines "discharge" to include a discharge of a pollutant or pollutants. "Pollutant" is defined as ". . . solid waste . . . wrecked or discarded equipment, rock . . . ."[234] Thus an obsolete oil rig or almost any previously used material would seem to capable of being classified as a pollutant. (There is, of course, some room for quarrel on this question, and the argument is even weaker when one considers the question of material specifically manufactured for a reef.) However, the definition of "discharge of a pollutant" seems to remove any question of the applicability of NPDES: "(B) any addition of any pollutant to the waters of the contiguous zone or the ocean from any point source other than a vessel or other floating craft."[235] (Emphasis added.) It is difficult to see how any artificial reef could be built without a "discharge" from a vessel or other floating craft.

One authority has made the argument that the NPDES program could apply to reefs outside territorial waters by virtue of authority vested in the EPA Administrator to permit discharges of pollutants for an approved aquaculture project under Section 318 of the CWA.[236] This argument fails under the above analysis because a discharge of pollutants into "navigable waters" from any point source would be covered by the 404 program and thus excluded from the NPDES program. A discharge of pollutants outside territorial waters would not be covered by NPDES unless it came from some source other than a vessel or other floating craft.

After some additional research on the question of aquaculture projects, the author has concluded that past interpretations of this provision are based on a misreading of the legislative history of the Federal Water Pollution Control Act, the predecessor of the Clean Water Act. As has been argued by an EPA official at the time the aquaculture regulations were proposed,[237] the legislative history says that artificial reefs built with "inert bulk solids" are an example of projects contemplated by this section.[238] However, at the time this official made this argument and these regulations were proposed Section 318 did not read as it does today. In 1977 an amendment was added to tie the aquaculture permit to the NPDES permit under Section 402 of the CWA.[239] As previously mentioned, the NPDES regulations specifically exempt any activities covered by §404. Therefore, the aquaculture permit would not apply to 404 projects.

While this may still leave some question for "approved aquaculture projects" outside the three mile zone covered by Section 404, the legislative history[240] and the present regulations (adopted in 1979) indicated that the projects contemplated by the section are not the ordinary artificial reef. The regulation states that it authorizes, "on a selective basis, discharges which would otherwise be unlawful under the Act in order to determine the feasibility of using pollutants to grow aquatic organisms which can be harvested and used beneficially."[241] This does not seem to describe a practice consistent with ordinary artificial reefs. Although there is some indication that reefs can qualify as an "approved aquaculture project,"[242] ordinary projects are not going to "otherwise be unlawful."

Although the NPDES program seemingly would not apply in almost all circumstances, Congress apparently thought that there may be some situations in which a permit would be necessary. In the National Fishing Enhancement Act the EPA Administrator is required to consult with the Secretary of the Army "[b]efore issuing a permit under section 402 of the Federal Water Pollution Control Act [CWA] for any activity relating to the siting, design, construction, operation, maintenance, monitoring, or managing of an artificial reef

. . . .."[243] Legislative history is unclear as to the meaning or impact of this provision.

Marine Protection, Research and Sanctuaries

It is difficult to interpret the above provision as intending to provide a permit process for reefs outside territorial waters other than the Corps' Section 10 permit. While a reef might be defined as a pollutant under the NPDES definition, the NPDES program does not cover pollutants discharged from a "vessel or other floating craft".[244] (See discussion above.) Since NPDES is inapplicable one must look to the law that regulates discharges from vessels. That law is the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA),[245] also known as the Ocean Dumping Act, and it also contains an exemption for projects such as artificial reefs. Section 3(f)[246] defines dumping to exclude "the deposit of oyster shells, or other materials when such deposit is made for the purpose of developing, maintaining, or harvesting fisheries resources and is otherwise regulated by Federal or State law or occurs pursuant to an authorized Federal or State program."[247] "Materials" is defined in almost exactly the same manner as pollutants under the NPDES program, i.e., "wrecked or discarded equipment".[248] Another provision would exclude "devices" placed on the ocean floor for purposes other than disposal when regulated by federal or state law or occurring pursuant to a federal or state program.[249] This provision should cover reefs made of new materials.

The regulations[250] under the MPRSA contain the same definition of pollutants as quoted above for the NPDES program, but one section further provides that the federal or state program must be "certified" to the EPA, and that the National Oceanic and Atmospheric Administration (NOAA), the U.S. Coast Guard (USCG) and the Corps must concur in the placement or deposit "as it may affect their responsibilities and such concurrence [must be] evidenced by letters of concurrence from these agencies."[251]

It appears that neither the NPDES program or the MPRSA permit program would apply to any artificial reef development.

c. State Permits and Certifications

1. Generally

Clean Water Act

Under the Clean Water Act (CWA), states can establish their own Section 404 programs, but these programs do not cover waters seaward of the coastal baseline from the ordinary high water mark.[252] Thus, the siting of a reef would require a state certification under Section 401 rather than a permit under the state program. However, a state may create its own dredge and fill program (including offshore waters) or other type of water quality permit program. In establishing a coastal zone management program, a state may create a permit system which would require compliance with state water quality standards.[253] In the three states that are covered by this study, there are joint federal/state permit/certification processes that cover artificial reefs. In Florida, this is regulated by the Department of Environmental Regulation;[254] in Alabama by the Department of Environmental Management;[255] in Mississippi by the Department of Wildlife Conservation.[256]

The geographic limits of direct state control of water quality in offshore waters is the territorial boundaries of the state.[257] In all three states, the territorial limits of Section 401 certification would be three miles.[258] In Florida, the territorial sea boundary is nine nautical miles, therefore there is a six mile zone in which the Corps' 404 program does not apply. The state's own water quality permitting program applies rather than the 401 certification process.[259] Outside territorial limits, all three states exert indirect control through the Coastal Zone Management Act.

Coastal Zone Management Act

Under the Coastal Zone Management Act (CZMA),[260] any federal activity within the coastal zone is required to be consistent with an approved state CZM program, to the maximum extent practicable.[261] Any applicant for a federal permit for an activity "affecting land or water uses in the coastal zone" must certify to the federal agency that the activity is consistent with the state CZM program.[262] The state is furnished a copy of the certification and has six months in which to concur or object to the certification; after six months concurrence is conclusively presumed.[263] The federal permit will not be issued until concurrence is given or the six months expire.[264] An appeal from a denial of concurrence is to the Secretary of Commerce.[265]

The coastal zone is defined in the Act to include offshore waters to the outer boundary of the territorial sea.[266] Therefore, on the Florida Gulf Coast (and in Texas) the coastal zone extends out for nine nautical miles from the coastal baseline. In all coastal states besides the Great Lakes states, it extends out for three nautical miles.[267] In the Great Lake states, the coastal zone extends to the boundary between the United States and Canada.[268]

Outside state waters, consistency is still required to the maximum extent practicable for federal activities directly affecting the coastal zone.[269] This provision has been the center of a federal-state controversy over the federal oil and gas leasing program on the Outer Continental Shelf. While the primary focus of the argument in the lower courts was whether or not the OCS leasing program "directly affected" the coastal zone, the Supreme Court in California v. Watt[270] held that Congress did not intend that the leasing program be covered by the CZMA consistency determination procedure. The Court reasoned that since Congress had created specific consistency requirements for the exploration and development stages of the OCS program, it therefore must have intended to exclude the leasing stage from consistency requirements.[271]

There is no real guidance on the meaning of "directly affecting." Fortunately for reef applicants in the three states covered by this study, this is no cause for concern. A reading of each state's coastal management program reveals that all three approve of artificial reef development in the coastal zone and believe that it should be encouraged. Reef projects should not have a problem with CZM concurrence as long as the material poses no threat to the environment.

Preservation laws

In addition to possible marine sanctuaries designated by the Secretary of Commerce under Title III of the Marine Protection, Research and Sanctuaries Act, there may be some state programs of a similar nature. Florida has such a program, and some of the preserves are in the Panhandle area. (See, Florida permit discussion, following page.) Such a program also could be less formal in nature and regulated under a state's CZM program.

Another possible consideration in siting a reef is whether or not it is in or near an area that is protected under historic preservation laws. There are state programs created under federal law and some states have their own programs as discussed below. While the likelihood of such a historic area being located in offshore waters is small, there may be some submerged areas protected because of shipwrecks or their proximity to an onshore historic site.

Fishing Regulations

Under the Magnuson Fisheries Conservation and Management Act, a state can not regulate fishing outside its territorial waters unless the vessel is registered in that state.[272] Although Regional Fisheries Management Plans could provide a mechanism whereby states could regulate fishing around artificial reefs, this apparently has not been considered necessary thus far by the Gulf Fisheries Management Council.[273] This is probably because states are not usually reef permittees. If more states become the permit holders, there may be an more interest in the enactment of provisions granting states the power to regulate fishing around the reefs.

2. Florida

The Panhandle section of the state of Florida is within the Jacksonville district of the Corps of Engineers, therefore the joint permit application used in this district is applicable to artificial reef projects in state waters in this area. The state's role in the permitting of an artificial reef can be divided into two parts determined by geographical and regulatory boundaries. If the project is within the territorial waters of the State of Florida, a state permit is required, which permit is equivalent to certification for water quality and Coastal Zone Management consistency concurrence.[274] Responsibility for this role is with the Department of Environmental Regulation (DER).[275] Florida's territorial sea boundary of three marine leagues on the Gulf produces somewhat of a unique situation since the Corps 404 program does not extend beyond three nautical miles. Thus the state's permit, which is still in effect the Clean Water Act 401 certification, is also applicable between three and nine nautical miles.[276] Outside the state's territorial waters, the state's role is one of consistency concurrence, also DER's responsibility.[277]

Under statutory authority[278] DER has promulgated a general permit (not the same as the Corps' general permit) for artificial reefs.[279] Under this process the applicant merely writes a letter to DER summarizing the planned activity. If DER feels that it falls within the conditions described in the general permit, the applicant is notified that he can proceed.[280] The process works the same then as the Corps' general permit procedure outlined above, and only when there is a problem with the activity is there more than minimum paperwork.

Not all types of materials will be approved for artificial reefs, therefore, an applicant should not assume that because there is a general permit that his structure will be approved. The following is the entirety of the general permit regulation; the general conditions section referred to is found in the Appendices:

> 17-4.68 General Permit for the Construction of Artificial Reefs.
>
> (1) A general permit is hereby granted to any person to construct an artificial reef, provided:
>
> (a) The material to be used shall be clean concrete or rock, or clean steel boat hulls; and
>
> (b) The material shall be free of soils, oil and greases, debris, litter, putrescible substances or other pollutants; and
>
> (c) The material shall be firmly anchored to the bottom and shall not be indiscrimately [sic] dumped; and
>
> (d) The material shall be placed so that the top of the reef does not exceed 1/2 the distance from the bottom to the surface of the water unless a greater distance is required for safe navigation. At no time shall the distance between the top of the reef and the

surface of the water be less than 6 feet.

(2) This general permit shall be subject to the general conditions of Section 17-4.54 and the following specific conditions:

(a) The permittee shall conduct a survey of the bottomland on which the reef is to be built and shall submit the survey to the department with notice pursuant to Section 17-4.53 [certified mail, return receipt requested] demonstrating that the bottom does not have grassbeds, or hardbottom or other corals; and

(b) There shall be no reefs constructed in shallow bay or estuarine bottoms; and

(c) There shall be no "white goods", asphalt material, tires or other pollutant materials used in construction of the reef; and

(d) The site shall be marked with buoys to ensure that no material is deposited outside of the site; and

(e) The permittee shall notify the National Ocean Service, National Oceanographic and Atmospheric Association, U.S. Department of Commerce, Rockville, Maryland, of the precise location of the reef.[281]

If there appears to be a problem with the proposed reef, or an objection is made by a reviewing agency, the applicant will be required to submit a formal application.[282] This form is the joint form used for both state and Corps permits, so in reality, DER either will have received a copy of it from the Corps or have taken the original application. (See following page for form; see Appendices for instructions.)

DER has promulgated two types of formal application processes.[283] For fill material applications of an amount greater than 10,000 cubic yards, a standard form application is used; a fill of less than 10,000 cubic yards of material uses the short form application procedure.[284] Unless they are controversial or unusual (perhaps in size), most artificial reefs can take advantage of the short form application because the regulations specifically authorize it.[285] Since the the standard form procedure is a possibility, particularly with projects of magnitude such as a oil platform, the differences will be examined.

First, unless there is a potential controversy, DER waives the requirement of publication of notice of the short form application.[286] If publication of a notice is required, it is usually one time in the local newspaper.[287] Under the standard form application, DER may also require the applicant to publish notice of intent to issue the permit.[288]

Another substantial difference is the amount of information required to be submitted with the application. Under the standard form procedure, the applicant must submit, or DER must perform, a biological survey, an ecological study, and a hydrographic survey, if the latter is deemed necessary by DER.[289] In the short form procedure, a "less extensive" biological survey and ecological study is prepared by DER.[290] DER may still require a hydrographic survey, but this is unlikely.[291] Because of the difference in the amount of work DER has to do in each procedure, the permit fee is much less for a permit granted under the short form procedure.[292] Finally, short form applications are processed through district offices instead of the state DER office in Tallahassee.[293]

Most "run-of-the-mill" applications are permitted within thirty days.[294] The Pensacola district office wants a drawing of the reef structure and profile and a "bottom" report from the divers' survey (usually performed by the applicant).[295] It tries to expedite the approval of the permit.[296] However, if someone asks for a hearing during the procedure, approval can be delayed for up to five months, primarily because administrative hearing officers currently have a three month backlog of hearings to be conducted.[297]

The criteria for the issuance of permits and concurrences or certifications is very similar to that used by the Corps in its public interest review process. Basic criteria enumerated in the regulations are water quality and marine habitat protection.[298] The statutory criteria are that water quality not be degraded and that the project not be contrary to the public interest.[299] The following are specifically enumerated by the Henderson Act[300] to be balanced in public interest decisions:

1. Whether the project will adversely affect the public health, safety, or welfare or the property of others;
2. Whether the project will adversely affect the conservation of fish and wildlife, including endangered or threatened species, or their habitats;
3. Whether the project will adversely affect navigation or the flow of water or cause harmful erosion or shoaling;
4. Whether the project will adversely affect the fishing or recreational values or marine productivity in the vicinity of the project;
5. Whether the project will be of a temporary or permanent nature;
6. Whether the project will adversely affect or will enhance significant historical and archaeological resources under the provisions of s.267.061; and
7. The current condition and relative value of functions being performed by areas affected by the proposed activity.[301]

While DER plays the primary role in the permitting of artificial reefs, there are several other agencies which review both DER and Corps permit applications. The Florida Department of Natural Resources (DNR) is responsible for management of state owned lands, which includes submerged lands in the Gulf of Mexico outward to the limits of the territorial sea.[302] While DNR usually defers to DER and the Corps on environmental matters, such as artificial reef projects, DNR could have a substantial role if a reef would be located near or in an aquatic preserve. Statutory authority does not appear to permit a reef being located within a preserve itself.[303] This is not much of a practical problem with the geographic area encompassed by this study, i.e. the Florida Panhandle. Within this area most preserves are in estaurine areas where reefs would not be suitable.[304] The Fort Pickens Aquatic Preserve in the Perdido Key area does extend into the Gulf about three miles, but most reefs should be beyond that distance.[305]

Another agency with some responsibility for reviewing applications which might have a role is the Division of Archives, History and Records Management of the Florida Department of State. This agency is vested with title to all objects having intrinsic or historical and archaeological value abandoned on state submerged lands.[306] Shipwrecks are the only such "objects" which the author could think of that might present a problem for reef applications. There are apparently only two in the Panhandle area - a Russian freighter and the Massachusetts, both of World War II vintage.[307] Both wrecks actually serve as artificial reefs and are used regularly by divers.[308] While additional reef habitat might enhance the attractiveness of these wrecks for fishing, the historic value would probably limit the proximity of additional material.

The permitting process in Florida is streamlined and approval of a reef application should encounter little "red tape". Personnel have a lot of experience with artificial reefs, and the joint state/federal permit applications reduce paperwork and confusion among the various authorities. State agency cooperation is evidenced by a memorandum of understanding in which responsibilities and procedures are clearly outlined.[309] The program set out above could serve well as a model for other states.

3. Alabama

In Alabama, the state role in permitting an artificial reef is played by the Department of Environmental Management (DEM). Like its Florida counterpart, it is responsible for water quality and coastal program consistency certifications.[310] There is a joint federal/state application form for various activities within state waters. (See following page for form.)

Alabama is in the Mobile Corps district, and there is a regional Corps (not state) permit for certain activities in Alabama state waters. Artificial reefs are one of those activities. (See Appendices for permit.) This is a different approach from the Jacksonville District's regional Corps permit covering only artificial reefs, but there is no real substantive difference. A comparison of the general and special conditions in the two permits show that they are very similar.

When the Mobile District issued the general permit that covers artificial reef projects, the Corps and DEM issued a joint public notice in which DEM stated that it intended to grant water quality certification and consistency concurrence for the various activities in the general permit. (See permit in Appendices.) The joint application form is for this general permit. The review conducted by DEM is primarily to insure that reef projects comply with state water quality standards.[311] The application is circulated to various agencies, including state agencies other than DEM, and, if there are no objections, the Corps issues an authorization for the project to proceed.[312]

Other Alabama agencies which may have an interest in a reef project and will review an application are the Alabama Historical Commission and the Department of Conservation and Natural Resources (DCNR).[313] The Historical Commission would have little interest in a reef project in offshore coastal waters.[314] The primary interest of DCNR is that reefs do not interfere with shrimping in coastal waters.[315]

The Alabama coastal zone management program, also under DEM authority, reflects the two above interests, providing for the protection of "historic, cultural, or archaeological resources of the coastal area"[316] and the nondegradation of fishery habitats.[317]

Alabama has not received many applications for artificial reefs,[318] primarily in part because some potential applicants feel there is too much delay and "red tape" in the process.[319] DEM takes a less active role than its Florida counterpart, and relies to a large extent on other agencies' substantive determinations before approving the issuance of permits or making coastal consistency determinations.[320] The Mobile Field Office of DEM makes coastal program consistency decisions, and it relies on the Water Division of DEM for water quality certifications.[321] DEM has set a general limit for coastal program consistency of two hundred (200) miles.[322]

There are few regulatory standards applicable to an artificial reef project, and the primary requirement is that anything placed in coastal waters "not degrade the coastal area."[323] "Degrade" is defined to mean "to affect the coastal area in such a manner as to produce a continuing reduction or destruction of present levels of coastal resources."[324] Thus, anything that would pollute the water would not be suitable reef material, and an applicant should show that the materials to be used are free of pollutants. Other than this general requirement, a potential reef applicant should be mindful of the conditions set out in the general permit and possible conflicts with shrimp fishermen.

4. Mississippi

A permit is required for artificial reefs in state waters under Mississippi's Coastal Wetlands Protection Law,[325] unless a waiver is given by the Director of the Wetlands Division of the Bureau of Marine Resources (BMR) of the Department of Wildlife Conservation after an on-site inspection.[326] According to the present Director, Mississippi has not permitted any reef projects in state waters, primarily because its coastal waters are too shallow.[327] Mississippi regulatory officials, and most likely the Corps and Coast Guard, would oppose a reef inside the Mississippi Sound because there is not enough water to safely permit a reef.[328] South of the barrier islands, there are places with enough water, but no one has ever applied for a reef in this area.[329] There are two or three permitted reefs in federal waters.[330]

The Wetlands Law permit is part of system designed for the protection of wetlands, and a decision to grant this permit does not mean that a project has the approval of all applicable state agencies.[331] Because the Commission on Wildlife Conservation has to act on a permit application within ninety (90) days,[332] it sometimes issues a permit contingent on the concurrence of other state agencies.[333] Like its sister states of Florida and Alabama, permit applications are circulated to various state agencies for concurrence in issuance. These agencies are the Bureau of Pollution Control of the Department of Natural Resources, the Department of Archives and History, the Bureau of Land and Water Resources of the Department of Natural Resources and the Bureau of Fish and Wildlife of the Department of Wildlife Conservation.[334] Also receiving copies of the application are various local and regional officials, and the application is put into the A-95 review process which circulates it to all interested persons.[335] (See following page for application form.)

State agencies have sixty (60) days to review applications and to concur or object.[336] If an agency objects, the permit will not be issued.[337] If an agency or the Corps asks for more information from the applicant, the sixty (60) day time period is tolled.[338] (Because of the ninety (90) day time limit for acting on permits, BMR might otherwise be put in the position of issuing a permit without any response from other agencies.)

Local agencies and officials include counties, municipalities, county and district attorneys, the director of the Gulf Regional Planning Commission and the chairman of the Mississippi Marine Conservation Commission.[339] At the same time these agencies and officials are reviewing the application, a notice is being published in a newspaper of general circulation in the affected county.[340] This notice is published once a week for three consecutive weeks.[341] Objections, either by a local official or a private individual, must be filed within three weeks of the first publication, i.e., within seven (7) days after the third publication.[342] A hearing will be held if requested, and the proceedings presented to the Commission on Wildlife Conservation at the same time it decides whether or not to issue the permit.[343] The fact that there are no objections does not mean the permit will automatically be issued.[344]

When BMR receives an application, it also sends a copy to the Corps for its review.[345] The Mobile District of the Corps has promulgated a general permit for artificial reefs. (See Appendices for copy of permit.) While Mississippi has promulgated a joint application/regional permit with the Corps for certain projects, it does not include artificial reefs, because the statutory exclusions in the Wetlands Law do not give BMR the authority to issue a general permit for reefs.[346]

BMR then proceeds develop a set of findings based on the requirements of the coastal program.[347] These findings are used to recommend to the Commission whether or not to issue the permit.[348] The following is a condensation of the requirements of the coastal program for these findings:

a. Applicable legislative and judicial statements of public interest.
b. The coastal wetlands use plan . . .; [The use plan is very similar to zoning. While most of the area south of the barrier islands is categorized for general use, there are some areas designated for special use, such as navigation. The applicable coastal use map should be consulted.]
c. The guidelines . . . [for fisheries regulations, not yet promulgated];
d. Precedent setting effects and existing or potential cumulative impacts of similar or other development in the project area;
e. The extent to which the proposed activity would directly and indirectly affect the biological integrity and productivity of coastal wetlands communities and ecosystems;
f. The full extent of the project, including impacts induced by the project, both intended and unintended but reasonably anticipated;
g. The extent of any adverse impact that can be avoided through project modifications, safeguards, or other conditions . . .;
h. The extent of alternative sites available to reduce unavoidable project impacts;
i. The extent to which a proposed activity requires a waterfront location;
j. The preservation of natural scenic qualities . . .;
k. The national interest . . .;
l. Comments received . . .;
m. The provisions of SMA [special management area] plans [pertaining to industrial and port areas, shorefront access areas and urban waterfronts] . . . .[349]

If the Commission approves the permit, the Wetlands Division of BMR prepares it and delivers it to the Coastal Program Division of BMR. The Coastal Division sends a letter to the Corps, forwarding the permit and stating that it is consistent with the coastal program.[350]

The Bureau of Pollution Control (BPC) is the state agency responsible for water quality certification.[351] This certification applies, of course, to any Corps 404 Clean Water Act permit, but BPC also must concur in the issuance of a wetlands permit.[352] The state water quality statutes prohibit the pollution of state waters and declare it to be a public nuisance.[353] "Pollution" is defined to mean "contamination, or other alteration . . . of any waters of the state . . . unless in compliance with a valid permit . . . ."[354] In many cases, if BPC lacks knowledge of the water quality of a specific area, it must send personnel from Jackson to test the water before it will concur in the issuance of a wetlands permit.[355] In such a case BMR's ninety (90) day time limit is in danger of expiration, and it will recommend to the Commission on Wildlife Conservation that a wetlands permit be issued contingent on BPC's water quality certification.[356]

For reef projects outside state waters, the Corps will require state concurrence in the applicant's consistency certification.[357] Coastal program consistency concurrences are based on BMR's review and comments received from other coastal program agencies, i.e., the Bureau of Pollution Control, the Department of Archives and History and the Bureau of Land and Water Resources.[358] Applicants for federal permits are required to use the A-95 review process to notify interested parties of consistency certifications.[359] If there are no objections, BMR issues a coastal program consistency concurrence.[360]

Mississippi's permitting system applicable to artificial reefs is not conducive to reef projects, particularly small ones. It appears that the maximum ninety (90) day period for permit approval will be used in most instances, particularly since there is no active reef development program or state general permit for reefs in Mississippi waters. In federal waters, the same appears to be true, and the time period may be longer since coast program consistency certifications can be made up to six months from the date of notice.[361] Mississippi would do well to follow the lead of Florida and promulgate a general permit for artificial reefs. Adequate protections are found in Florida's program, and its experience has shown that the program works well.

III. Liability

a. The Importance of Facts

The script and the characters are the important elements of any play. Legal liability is ultimately controlled by the facts because they determine the legal rules that apply to a particular situation. The important facts in any situation are the characteristics of the actors and the things that they do. The journalist's Five W's - who, what where, when and why - are applicable to the lawyer. These five questions, when answered concerning a party, will determine the party's legal status, that is, the duties and responsibilities owed to them by others and to others by them . In some cases, such as when a state is sued, the legal status of a party is dispositive of a lawsuit (sovereign immunity). In every case, the legal status of the parties involved will dictate the legal rules that govern the case.

In considering the legal liability involved in an artificial reef project, one should consider the steps in the process from beginning to end. Who the developer or permittee is will determine if certain protections are available. If a permittee was a state, or perhaps even a political subdivision of a state, it might be entitled to immunity from a lawsuit by a person injured using the reef. What the party is or does is critical. If the party is a donor of materials for a reef, it may have a responsibility to take certain actions before supplying the materials or it may be responsible for defects in the materials that later cause injury to someone. What the party does before donating the materials may affect his liability if a question later arises about pollution from the reef. Where the reef is located will determine which rule of law applies where the rules are in conflict. The location itself may be the cause of the problem. When something happens or is done could affect the legal adequacy of a party's actions. A particular course of action may not be maintained long enough to create or sustain an adequate degree of safety. Why someone did something could create a legal cause of action or a valid defense. Actions in good faith by public officials in their official capacity are normally covered by an individual immunity, even though the government for which they work may be liable. These examples only scratch the surface of the possible combinations.

A possible scenario might involve the use of an obsolete oil platform as the material for the reef. The platform (hereinafter called the "rig"), was located somewhere off the coast of Louisiana, but we are not quite sure if it was state or federal waters. The rig was cut off approximately sixteen feet (five meters) below the mudline as required by international law[362] and the Gulf of Mexico Minerals Management Service.[363] It was then floated into a horizontal position by the use of flotation tanks and towed to a location off the coast of Alabama, where the flotation tanks were disengaged by explosive devices and the rig sunk to the bottom. Because the reef has less than eighty-five (85) feet of clearance above it, buoys have been attached to it for navigation safety.

The permittee in this case is the state of Alabama, but the legal rules governing liability are very similar for the three states in this study. There are only a few important distinctions, and these will be discussed when appropriate. Because the reef is located in Alabama state waters, the Corps of Engineers issued both a Section 10 and a Clean Water Act 404 permit for the reef. The Coast Guard approved the state's plan for buoy placement. The oil company, as is its normal procedure, contracted the removal of the rig and the towing of the rig to the reef site. (Of course, it would normally contract to tow the reef to the dry dock for salvage.) The service company removing and towing the rig assumed responsibility in the contract for accidents during the tow and release.

The rig was towed to the reef site and released to sink to the bottom where it was anchored. The buoys were placed on the rig as required by the Coast Guard.

b. Areas of Liability

There are several phases in the project described above in which various types of problems could arise. In the first stage, the oil company must abandon the rig. In order to meet water quality standards under both Alabama and federal law and the standards set out in the National Fishing Enhancement Act (NFEA),[364] the oil company must remove any pollutants from the rig. This could mean various chemicals, oil, grease, loose paint, and similar materials. Any loose equipment would have to be secured or removed.

The next phase is the removal and towing phase. The removal work normally is performed by a service company, and the oil company is usually but not necessarily relieved from liability if the service company causes someone any personal or property damage. The towing company is an independent contractor, meaning that the oil company has no control over the actual conduct of its operations. Therefore the service company normally will be solely responsible for any injuries it may cause. It is highly likely that the contract between the oil company and the service company will state that the service company will reimburse (indemnify) the oil company if a judgment is rendered against the oil company for an accident during the tow. However, the contract may contain a provision stating that this will not apply if the accident was somehow caused by the oil company's negligence before the service company assumed control of the rig.[365]

During the removal and towing stage the service company is faced with several possibly types of liability. One of its employees could get hurt during either phase of this stage, as well as the release phase. The towing vessel or the tow could collide with another vessel or a fixed structure or could run aground.

During the release stage, the rig could be damaged or improperly anchored so that it would be unsafe for recreational divers or be moved from the permit location. It might also be sunk in the wrong location and thus not appear on the charts accurately. Both the towing company and the permittee might bear responsibility for improperly locating or anchoring the rig.

After being released, any aids to navigation must be maintained until such time as the Coast Guard releases the permittee from responsibility. The rig must be examined and maintained to insure that any needed upkeep is performed and that the rig or parts of the rig are not coming loose and being carried to other areas where they might cause damage.

Also during the maintenance stage, any pollutants that were overlooked and begin to escape may have to be cleaned up since they would constitute a nuisance to the public.

There are two types of damage that could occur during any of the above stages, personal injury (including death) or property damage. Personal injuries are compensable under various statutes and the common law, but the elements of compensation sometimes vary with the applicable law. The law to be applied is normally determined by the location of the accident and the status of the injured individual.[366] Different state and federal laws treat personal injury differently. Recovery for both economic and non-economic damages may be allowed. Economic damages are out-of-pocket expenses, such as medical expenses, lost wages or other determinable expenses; non-economic damages are those that not capable of exact mathematical calculation, like pain and suffering and punitive damages.

The status of the individual is important because it may determine the statute or law under which he can recover. In the stages described above, there are many different actors involved in the process: rig workers, divers and other maritime employees, seamen, reef maintenance personnel, recreational and commercial fishermen, recreational divers, net fishermen, property owners, the general public and the permittee. There are different laws that apply to the recovery of damages by these types of people.

As far as property damage is concerned, there are several potential areas of liability. Types of property that may be involved are other vessels, underwater structures, piers, docks or boat slips, beaches and nets. Damages can occur from collision, pollution or the breaking up of the reef.

The example uses an oil rig as the reef construction material, but reefs are made of many different types of materials. The following discussion probably can be applied to any of these materials, except where obviously inapplicable. The discussion begins at the point where the service company begins to remove the rig from the ocean floor. Since the oil company is required by the Outer Continental Shelf Lands Act (OCSLA)[367] and the regulations[368] thereunder to remove the rig once it becomes obsolete, the oil company's liability to that point should not be a consideration in the use of the rig as a reef at another site. The issue of the rig meeting the criteria under the various laws and regulations for a reef will be discussed below.

This may be the appropriate point to mention that the discussion assumes that the oil platform will be moved from its production location. There is one important point that has not yet been clarified regarding the use of existing platforms as reefs by leaving them in place, and that is, will platforms have to be removed from that location at some point after they have begun to be used as reefs. One oil company commentator to the 1984 MMS notice concerning alternative uses for obsolete platforms stated that leaving platforms in place might be the most expensive alternative in the long run, since they would have to be removed anyway.[369] This brings up the question of whether platforms placed in another location would have to be removed eventually because they were deteriorating. This writer cannot answer that question, but it has definite liability implications.

c. Removal and Towing Stage

1. Possible types of liability

In the removal and towing stage of a project, the most common form of liability that might result is a personal injury to one of the employees of the service or towing company. A worker could get hurt in cleaning the rig prior to removal or during the removal process itself. There is, of course, always the possibility that the towing vessel or the tow (rig) itself could collide with another vessel or some structure or sink into a channel. All of these types of injury involve principles of maritime and admiralty law and necessitate a short discussion of the special nature of such cases and when their principles apply.

2. Admiralty

Jurisdiction

While there is a distinction to some extent between admiralty and maritime law, the distinction has been blurred in modern times.[370] General maritime law has developed over the centuries and has been accepted by seafaring nations throughout the world. There are differences in American law and the general maritime law, but the focus here is on American law.[371]

The judicial power of the United States over admiralty and maritime cases was given to the federal government by the United States Constitution.[372] Common law remedies are preserved in the first Judiciary Act, "saving to suitors, in all cases, the right of a common law remedy where the common law is competent to give it . . . ."[373] This basically means that a maritime case can be brought in state court as well as federal court.[374] For some time, it was thought that this also meant that a case brought in state court would be tried solely on state law and not federal law.[375] The Supreme Court has resolved this question by holding that the Constitution gave the federal government power to grant maritime jurisdiction to certain courts and also "to prescribe the substantive law governing the disposition of such cases."[376]

Although the Constitution clearly gives the power to prescribe maritime laws to Congress, there are many areas of the field in which Congress has not enacted legislation. These areas are filled by the courts, which have fashioned a federal admiralty common law.[377] Since maritime jurisdiction covers the navigable waters of the United States, and not just the high seas as in England,[378] the federal courts have often heard cases in which a particular state or states have a high interest. In such cases, the courts have frequently applied the law of the state with the most significant contacts, a "conflicts" or "choice" of laws rule. Such cases are deemed "maritime but local" and substantive state law is applied.[379]

Federal district courts have jurisdiction of maritime cases.[380] Until 1966, there was a wholly separate procedure for admiralty cases, and a case was said to be on the admiralty "side" of the court. Because there are still some unique attributes of an admiralty case, such as no jury trial, a case is sometimes still referred to as being on the admiralty side of the court.[381] However, a case can also be brought in federal court under diversity of citizenship or federal question jurisdiction, and such independent grounds of jurisdiction mean that normal "law side" procedures, such as jury trial, apply.[382]

A determination of whether a case is an admiralty case "involves the application of both geographical and conceptual factors."[383] The geographical factors "vessel" and "navigable waters" are of declining significance, "but continue to play major roles in including or excluding some matters from the maritime jurisdiction."[384] The conceptual factor has been called "maritime flavor" and has to do with "whether the matter has an impact upon maritime shipping and commerce sufficient to invoke the attention of and the expenditure of resources by the federal sovereign."[385] Both approaches have advantages over the other, the former more certain but often less logical results and the latter more logic, but less certainty.[386]

Certain maritime cases, particularly the common law remedies, can be brought in rem in admiralty as well as in personam.[387] In rem actions are those brought against a thing, such as a vessel, while in personam actions are brought against a person. Thus, a vessel may stand good for a debt, such as maintenance and cure, when the claimant cannot obtain in personam jurisdiction over the defendant personally.

Status of employee

This is the primary stage where employee status would be a contested question. There is a basic distinction between a seaman and a maritime employee which has a great deal of effect on the remedy involved. Simply put, a seaman is a "'member of the crew of a vessel.'"[388] Judicial interpretations of this phrase have been anything but simple. (The Fifth Circuit Court of Appeals (Mississippi, Louisiana and Texas), formerly encompassed the area in which the Eleventh Circuit Court (Alabama, Georgia and Florida) now sits, and has decided the bulk of admiralty and maritime cases.)

For a time the determination of status turned on the location or type of work the person was performing at the time the injury occurred.[389] In Longmire v. Sea Drilling Corp.,[390] the Fifth Circuit held that the test should be whether the work performed by a person aboard the vessel, when compared to all his job tasks, amounted to performance of "a significant part of his work aboard the ship with . . . some degree of regularity and continuity."[391] Ordinarily, everybody else who performs tasks aboard vessels is a maritime worker. Compensation of maritime workers injured on the job is covered by a different set of laws.[392]

Seamen are compensated for work injuries under a variety of rules, both statutory and common law. First, the seaman has a remedy for maintenance and cure for sickness or injury which occurs while he is in the service of his ship.[393] The compensation under this common law rule was wages until the end of the voyage, medical expenses until maximum medical cure was reached and a living expense allowance.[394] In addition to maintenance and cure, the owner of a vessel owes the crewmen a duty to furnish a safe place to work and live while on the vessel; this duty eventually reached the status of a warranty, called the warranty of seaworthiness.[395]

However, a crew member still could not sue the owner of the ship for injuries which were caused by the negligence of a fellow crew member.[396] This rule was similar to the "fellow servant" rule in worker's compensation law governing cases in other types of employment. However, it had its roots in general maritime law, and an attempt by Congress to abolish generally defenses based on the fellow servant rule was deemed ineffective by the Supreme Court in 1918.[397] Finally, in 1920 in the Jones Act, Congress extended the Federal Employers Liability Act (FELA) to cover seamen.[398] The Jones Act also abolished the defense of assumption of the risk and provided that contributory negligence would lower recovery but not bar it.[399] The Jones Act is distinguished from maintenance and cure and the warranty of seaworthiness remedies because it is based on the negligence of the employer, while the other two are not fault-based remedies. Those two remedies are still available whether or not the employer was at fault[400]

The maritime employee has some remedies that are similar to those of the seaman, but it was some time before a worker's compensation type remedy was assured. Several attempts by Congress to make state law applicable were struck down by the Supreme Court as unconstitutional.[401] In 1926, the Supreme Court extended the Jones Act to maritime employees who were aboard a vessel and engaged in work normally done by a seaman.[402] The next year Congress adopted the Longshoremen's and Harbor Worker"s Compensation Act (LHWCA) for maritime employees who did not fall within the definition of seamen.[403] In 1972, Congress extended the LHWCA to included workers who primarily performed their jobs on wharfs, terminals, and similar location associated with maritime operations on navigable waters.[404]

Under the LHWCA, the employer may not assert the defenses of the fellow servant doctrine, assumption of the risk or contributory negligence.[405] The employer must procure insurance or qualify as a self-insurer; if he does not, he can be sued in tort and can raise none of the aforementioned defenses.[406]

A worker on a fixed oil platform is not a maritime worker.[407] The OCSLA provides that the Longshoremen and Harbor Workers Compensation Act covers oil platform workers on the OCS, but in state waters the platform worker would be covered by state workers' compensation laws.[408] The latter are usually much less generous than the LHWCA.

Wrongful death

A wrongful death action is just what the term implies - an action for damages for someone's death caused by negligent or intentional conduct for which someone can be held at fault. (For a discussion of negligence, see the property damage section below.) Under the common law there was no action for wrongful death, the theory being that the tort (the wrong) died with the victim.[409] The rule was applied to admiralty cases in the United States by the Supreme Court in 1886.[410]

This naturally led to many unfair situations in which the victim's family was left destitute, and was finally remedied by the passage, in England, of the Fatal Accidents Act, also known as Lord Campbell's Act.[411] The common law rule had been adopted in the United States, and thus each state legislature had to enact a similar law to provide a remedy. The majority of states adopted laws which created a new cause of action called a wrongful death action in the deceased's personal representative, while a minority of states adopted survival statutes which vests in the decedent a cause of action for his injuries which passes on to his estate.[412] In the latter case, there is some authority that instantaneous death will preclude the vesting of the cause of action in the decedent.[413]

The Jones Act provides for both wrongful death actions and survival actions, but wrongful death damages were limited to "pecuniary" losses by the Supreme Court in Michigan Central Railroad Co, v. Vreeland.[414] That case, decided in 1913 under the FELA, before the passage of the Jones Act, was extended to claims under the latter.[415] However, in the same year that Congress passed the Jones Act (1920), it adopted the Death on the High Seas Act (DOHSA).[416] This law creates a wrongful death action in admiralty that is limited to pecuniary loss.[417] The act applies to wrongful deaths on the high seas beyond one marine league.[418] These legislative actions left gaps in recovery of damages that some tried to fill by "borrowing" state law, and the cases that resulted do not answer all the questions. Then, in 1970, in Moragne v. States Marine Lines, Inc.,[419] the Supreme Court abolished the common law rule that there could be no wrongful death action in admiralty. While this solved some problems, it raised other questions. A complete discussion of these issues is truly complex and beyond the scope of this study. The following summary is found in Professor Frank Maraist's Admiralty[420] and should suffice for those who want some detail:

> A summary of recovery of wrongful death and survival damages in maritime law after Moragne, Gaudet and Higginbotham reads like this:
>
> 1. If a seaman is killed by employer negligence occurring either within or beyond three miles, his beneficiaries may recover under the Jones Act. Both wrongful death and survival remedies are available, but wrongful death recovery is limited to pecuniary damages. (However, the seaman's representative may join Jones Act and unseaworthiness claims and recover nonpecuniary damages if unseaworthiness was a cause of a seaman's death.)

2. In all other wrongful death claims arising out of injury beyond three miles (including injury to a seaman caused by an unseaworthy condition), beneficiaries may recover under DOHSA for wrongful death, but recovery is limited to pecuniary losses. [This rule may have changed, at least in the Fifth Circuit, in the case of Tallentire v. Offshore Logistics, Inc.,[421] in which the Court held that state law could supplement the DOHSA.] Survival damages perhaps are recoverable either under admiralty common law, or if such recovery is not encompassed within the Moragne doctrine, perhaps by a "borrowing" of state law, unless the non-abatement provision of DOHSA (section 765) represents "Congress' considered judgment" under Higginbotham and precludes all recovery of survival damages in non-Jones Act cases arising beyond three miles.

3. In all non-Jones Act death actions in which the fatal injury occurs within three miles, wrongful death damages, including non-pecuniary losses, are recoverable under Moragne. Survival damages probably are recoverable under maritime common law.[422]

The foregoing discussion and summary is intended to be descriptive only; the author knows that those parties concerned about such liability have access to people who truly know what they are talking about. For those who are curious and cannot find an expert, the author recommends Professor Maraist's book, which is part of a series of books complementing law courses and therefore is not terribly lengthy. This does not mean that the subject is thereby simplified.

Collisions

Liability for collisions is similar to collision law for automobiles and the basis for liability is fault, primarily negligence.[423] Ordinary negligence can be defined as breach of a duty of reasonable care owed to some person, which breach is the proximate cause of injury to that other person. The party suing, the plaintiff, must show or prove negligence by the other party.

Many times the key question is not whether a party was negligent, but whether that negligence was the proximate cause of the accident. A party could have been negligent, but if his negligence was not the proximate cause of the accident, he will prevail. Proximate is a term that has a clear meaning, but has so many gray areas in application that the subrules become confusing. One is called the "last clear chance" doctrine, and it is applied in admiralty law.[424] Last clear chance means that the defendant may be held not liable even though he was negligent, if the plaintiff had the "last clear chance" to avoid the accident. Thus, the plaintiff's negligence was the "last" negligence. Also inherent in the concept of proximate cause is the element of foreseeability. If the damage was not a foreseeable result of the conduct, then that conduct will not result in liability.[425] This principle precludes liability for damages suffered by a charterer of the vessel for loss of use[426] or by shippers who cannot get out of a harbor because of a blocked channel.[427]

Two other doctrines which affect liability for negligence have been mentioned above but not explained: contributory negligence and assumption of the risk. In many jurisdictions, both are complete bars to an action. In other words, the plaintiff is barred from bringing an action if he was also guilty of negligence, in the smallest degree, that proximately contributed to the accident. He is also barred if he assumed the risk, that is, if he knew there was a danger in his conduct and went ahead anyway. Assumption of the risk is generally applied sparingly, and one reason is the requirement that the plaintiff must have had actual knowledge of the risk and the danger associated with it. It is not enough that he should have known of the danger. It has similar limited application in admiralty law.[428]

In several states, the contributory negligence rule has been modified so that it is more accurately described as comparative negligence. This means that the plaintiff is not barred because of his negligence, but his award is reduced by the percentage which his negligence bears to the whole negligence. Some states will not allow the plaintiff to recover if his negligence is greater than fifty per cent (50%), while others have the "pure" comparative negligence rule and will allow recovery even if the plaintiff is ninety-nine per cent (99%) negligence.

Admiralty now recognizes a similar rule in collision cases, and the court will allocate damages among the offending vessels according to each's fault.[429] This resembles the typical negligence case involving automobiles, when both the plaintiff and defendant are suing each other and both are at fault.

Professor Maraist provides a good summary of admiralty negligence actions.[430] He states that the same rules apply in cases where one ship runs into something, including running aground, as when two ships collide.[431] A vessel is liable in rem for its collision torts, and the owner is liable under the doctrine of respondeat superior for the torts of the master or the crew causing the collision.[432] (The doctrine of respondeat superior requires the superior, the owner/employer, to respond or pay for the damages caused by his servant or employee, even though the owner/employer is not personally at fault.) Respondeat superior does not require the owner to respond for the torts of "compulsory pilots whose employment is forced upon the owner."[433] However, "[t]he vessel is liable in rem for the torts of a compulsory pilot, . . . and since the the compulsory pilot rarely has sufficient assets to cover collision damages, the vessel owner must pay the damages caused by the negligence of the compulsory pilot or lose his equity in his vessel."[434]

A major exception to the respondeat superior theory is commonly referred to as the remedy of limitation of liability.[435] This Act was first passed in 1851[436] and the remainder by 1893[437], during times when maritime commerce operated on a simpler level than today. It is very difficult to summarize the rules that have evolved in application of the principles of this law to present day business entities and relationships.[438] It should suffice to say that the vessel owner's individual liability can be limited to the worth of a vessel and cargo involved in a collision.[439] Since, obviously, a vessel lost in a collision is worth little, this rule has been severly criticized in modern times, but, since it is statutory, the courts are not free to change it.[440] The primary exception to the rule is debts or claims incurred with the "privity or knowledge" of the owner, that is, what he has personally participated in or incurred.[441] The rule applies to coverage of any liability insurance policy that the vessel owner may have, so situations can occur in which the vessel owner receives more than claimants, because the owner's property insurance can not be claimed by anyone but him.[442]

Besides the requirement that the duty of reasonable care be breached, negligence can be predicated on a violation of a statute or regulation. This is called negligence per se, and proof of the violation of a statute shifts the burden to the defendant to show that his negligence could not have been the proximate cause of the accident or that the damage caused was not foreseeable or that the plaintiff was also negligent.[443] It is beyond the scope of this study to discuss the many the violation of which could be the cause of a collision. Professor Maraist gives a rundown of the various Rules of the Road for vessel course of conduct, and the reader is referred to his work[444] and to the statutes[445] for further reference.

Blocking navigation areas

The Wreck Act[446] requires the owner of a vessel wrecked and sunk in a navigable channel to mark the wreck and remove it as expediously as possible. If the owner does not undertake these duties, the United States will do it for him and charge him for it.[447] If the vessel was not at fault, the owner must mark it, but he can abandon the vessel to the United States for removal. The government must remove the vessel and attempt to recover its costs from the negligent party.[448] If the vessel was negligent, the owner may not abandon it and if he does not remove it, he is liable to the government for costs of removal.[449] If the non-negligent owner does not mark his vessel, he may be liable to another vessel which collides with it.[450] The authorities are divided on whether or not the negligent vessel will be liable for collision when the non-negligent owner fails to mark his vessel.[451]

Law of towage

The law of towage involves a contract in which an owner of a tug contracts to tow the barge or tow of another. There are other contracts which are similar but governed by different rules. Towage involves the towing of the barge or "tow" of another; affreightment involves the carrying of the goods of another by one who owns both tug and tow; and charter is a contract whereby the tug owner obtains a tow from another for use with his tug.[452]

In the reef development scenarios that are likely, all three types of contracts could occur. Towing a rig would involve a towage contract, while towing a barge that has reef materials on it would involve an affreightment contract (and a charter contract if the tow were not owned by the tug owner). In the latter case, the tug owner and his vessel could be liable for damages that occur in the towing stage.

The towage contract, however, is more pertinent to this discussion since it involves some responsibilities or duties on the part of the tow and therefore the owner of the tow. Maraist describes the relationship as follows:

> In the absence of express contractual provisions, the tower warrants that it will furnish a seaworthy vessel and crew and that it possesses sufficient skill and knowledge to perform the contract safely. The owner of the tow must furnish a seaworthy vessel, with proper equipment and lighting; where the tow is manned, the crew of the tow must be competent and sufficient in number.[453]

<u>A liability consideration</u>

If the tow is an obsolete rig, the owner of the rig could be responsible for a breach of duty. It is therefore important in the planning of a reef involving the towing of a rig to consider whether the permittee or the oil company will be the party contracting for the tow. It is logical to assume that the oil company will bear this responsibility since it has a statutory duty to remove the rig from the seabottom, and most reef permittees will not have the financial wherewithal to finance a tow.

Tug owners have tried to contract away their liability for negligent performance, but have always been met by the decisions of the Supreme Court holding such contractual provisions void as against public policy.[454] At least one case has held that this public policy is not as strong when the tow is government owned.[455] There are also ways around liability. The Fifth Circuit has upheld a contract clause requiring the owner of the tow to insure and to get its insurer to waive its rights to pay the loss and sue the tug owner (subrogation rights).[456] Therefore, whoever owns the tow should examine the towing contract carefully to determine its potential liability and the need to buy insurance.

d. Release and Placement Stage

This stage is short, but of great importance because the reef must be located in the proper place to comply with the permit and to avoid a hazard to navigation.

The standard for determining if a permittee is liable for injury caused by the mislocation of a reef will probably be negligence, meaning that the permittee did not use reasonable care to insure that the reef was placed in the proper location. Although the towing company may also be responsible for locating the position and dropping the rig or other material on the location, the permittee will be responsible because location is a condition of the permit.[457] In such a situation, both the towing company and the permittee would be liable. It might improve the permittee's legal position if the permittee could show that the towing company also reached the same decision about site location, even if the towing company had not contracted to specifically locate the site. A permittee might also contract for indemnity from the towing company if the permittee relies on it for location of the reef.

If the reef is mislocated, the permittee could be liable for damages due to a collision with the reef or a fisherman's dragging his nets across the reef. Under the National Fishing Enhancement Act (the Artificial Reef Act), a permittee must be in compliance with the permit to avail itself of the immunity from liability provided by the Act for actions required to be taken by the permit.[458] If the reef is mislocated, the permittee will probably be held responsible for any damage or injury resulting from such mislocation.

At this point, any liability an oil company had for negligence of the tow would end. The remaining potential liability it would have involves the suitability of the rig for a reef, which is discussed in the next section.

e. Reef Operation and Maintenance

1. Permit conditions

Permit conditions involve several different areas of concern. First, the reef must be properly buoyed, if buoys are a Coast Guard requirement. Secondly, the permittee must be sure that the materials are suitable for a reef, primarily that the materials are free of pollutants. It should not need to be said that the materials must be durable enough to work as a reef and also not to end up in fishermen's nets miles away. The donor of reef materials must also be concerned about the suitability of reef materials, in some sense more so than the permittee, because the donor is in a better position to determine if materials are free from pollution and are undamaged.

The requirement of suitability can be found in several of the statutes discussed earlier, particularly those pertaining to the environment. Most important, perhaps, is the requirement of the National Fishing Enhancement Act (NFEA) that a reef must meet permit conditions if the permittee is to remain free of liability.[459] A reef that is polluting fishing areas is a nuisance and at the least is subject to a court order enjoining the continued pollution. In other words, the materials would have to be removed, and, in the case of an obsolete oil rig, this would be expensive. The oil company as donor would be in violation of the NFEA because the materials would have been defective at the time title was transferred.[460]

The NFEA states that a permittee is not liable "for damages caused by activities <u>required to be undertaken under any terms and conditions of the permit</u>, if the permittee is in compliance with such terms and conditions."[461] (Emphasis added.) The permit should be carefully examined to determine if there are areas that perhaps should be covered in the permit that are not, so that the permittee can plead compliance and thus non-liability under the statute. For example, the Jacksonville Corps district regional permit states that "the permittee shall maintain the structure or work authorized herein in good condition . . . ."[462] The permit does not state that inspections are to be made at certain times nor does it require other specific conditions. Oil rigs will not last forever, and some oil companies apparently are of the opinion that those left "in place" would have to be removed eventually. The question that comes to mind is whether one used for an artificial reef in some other location is any different. If it is not maintained in "good condition", that in itself may be a breach of the permit, even though efforts are made to keep the reef in good condition. A reef permittee might be advised to request specific conditions (particularly if they are intended anyway), then compliance with permit conditions can be pleaded and immunity under NFEA asserted.

The oil company donating materials must look closely at the NFEA if it is concerned about terminating its liability at the time title to the rig is transferred. The applicable provision states that a donor of reef materials "shall not be liable for damages arising from the use of such materials in an artificial reef, if such materials [meet the national plan standards and] are not otherwise defective at the time title is transferred."[463] This smacks of a strict products liability standard. This legal theory states that if an injury is caused by a defect in a product that is used for the purpose for which it is intended and is not substantially altered after it leaves the manufacturer, the manufacturer is liable for that injury even though the plaintiff cannot prove negligence in the manufacture of the product.[464]

The oil company would prefer the application of an ordinary negligence standard which would impose liability if the oil company knew or should have known that there was a defect in the rig when title changed hands. While some might feel that such a standard is too lenient, they might consider the position of the oil company who hires a towing company which negligently damages the rig enroute to the reef site. Title does not change hands until the rig is in place, so the rig is therefore defective at that time and the oil company would be liable if any injury occurred. One could say that the oil company has insurance or that it can sue the towing company for indemnity, but this begs the question. The oil companies interested in donating rigs for reefs do not want lawsuits or lingering liability, and the towing company may be out of business or insolvent.

2. Sovereign Immunity

Overview of the Doctrine

If the permittee of a reef is a state or one of its political subdivisions, it may be able to assert the defense of sovereign immunity to a lawsuit for damages due to negligence. The doctrine of sovereign immunity is a rule of law that prevents the maintenance of a suit against a state without its permission unless there has been a previous waiver of immunity. It does not *per se* preclude bringing the suit, because the state could consent to the suit or not raise the defense. (This does not usually happen except by mistake because the officers who defend the state have a duty to raise the defense.) Thus, it is more proper to say that the suit cannot be maintained, because the defense must be raised in an affirmative manner. The court will then dismiss the suit. A state's immunity originated from two sources, the Eleventh Amendment to the United States Constitution and state judicial decisions. A state's Eleventh Amendment immunity may or may not be applicable where the state has entered into areas which are regulated by the federal government, such as artificial reefs.[465]

The judicial doctrine of sovereign immunity has been abrogated in almost all of the fifty states, by judicial decree or by statutory provision. Although the statutory schemes vary from state to state, many have reestablished a system of immunity very similar to the judicial doctrine. Mississippi falls clearly into this category, reestablishing the judicial doctrine for the present time. Alabama has a bifurcated system, with the state having total immunity, and counties and municipalities having limited immunity. In Florida, the state and its political subdivisions have immunity only for "planning" level decisions, but not "operational" level decisions. (See the individual discussion below for more detail.)

The judicial doctrine was fairly broad insofar as the state was concerned and protected the state against almost all types of tort actions. The protection was enjoyed by counties and municipalities, but, because the immunity was derived from the state, it was not as strong a principle and did not protect governmental subdivisions from torts in all areas of operation. The primary distinction was between acts that are governmental, which are protected, and acts that are proprietary, which are not protected. (See Mississippi discussion below.) Even ministerial acts, performed in governmental functions, can subject governmental subdivisions to liability.

The importance of sovereign immunity in this discussion is that it may protect the state, and perhaps a county or municipality, against a negligence suit under state law, and, perhaps, against a suit under federal law.

Mississippi

In Mississippi, sovereign immunity was abolished by court decision in 1982.[466] The legislature has passed a comprehensive tort claims law in response to the judicial abolition of sovereign immunity, but has postponed the effective date of the act twice.[467] At the present time, the law states that the doctrine is in effect as it existed as of the date of the judicial decision.[468] The state would almost certainly be protected from a suit for negligence under present law.[469]

The rule would be different when counties or municipalities are involved. As briefly mentioned, the immunity of these political subdivisions is derivative from the state and it is therefore not absolute. Municipalities more so than counties are involved in activities which are regarded as proprietary rather than governmental in nature and for which liability for negligent acts of employees will be imposed under the doctrine of respondeat superior just as for private employers. For example, in Mississippi, the following functions have been held by the courts to be proprietary in nature: maintenance of streets and sidewalks, garbage dumps, sewer systems, electric and gas utilities, sports arenas, airports, trash clean-up, zoos, storm water drainage and recreation facilities. The following list contains examples of activities found to be governmental in nature: fire protection, police protection, flood protection, construction of public buildings and the operation of jails, schools, hospitals and poorhouses.

In accordance with the maxim "there are exceptions to every rule, even this one," it should be noted that there are exceptions to the above classifications. Also, a municipality will be immune for policy decisions made in the performance of proprietary functions, e.g., the decision to build a reef or where to site it would be protected, while maintenance would ordinarily not be covered by immunity. A very good example is the case of the Mississippi town sued because of negligent maintenance of a stop light.[470] The Court said that the maintenance of a traffic signal was a ministerial act that did not involve the exercise of governmental discretion and was therefore not covered by immunity.[471] Later, the Court had before it a case in which a town was sued because it did not replace a traffic signal at a particular intersection after it was blown down by a storm. The Mississippi Supreme Court held that the decision not to replace the sign was a governmental function and was protected by immunity.[472]

Alabama

In Alabama, sovereign immunity for the state is created by state constitutional provision,[473] thus there is little likelihood of it changing suddenly. The provision has been interpreted to mean that the legislature cannot waive the protection.[474] The protection does not extend to suits for an injunction, such as a suit to abate a nuisance.[475] This latter provision is the general rule.

Alabama has had for some time a statute concerning municipal liability, providing that a municipality was liable only for neglect, carelessness or unskillfulness of its agents.[476] This statute was interpreted to apply to functions which can best be described as proprietary in nature, similar to those listed for Mississippi.[477] In 1975, the Alabama Supreme Court abolished governmental immunity for counties and municipalities.[478] In 1977, the legislature enacted a statutory scheme which limits the amount of recovery in suits against cities and counties.[479] There are still certain judicially engrafted exceptions, the most important being decisions on governmental activities "essential to the well-being of the governed."[480] However, this exception appears to be narrowly construed,[481] and it is unlikely that it would be extended to cover the operation and maintenance of an artificial reef.

Florida

Florida has a statute waiving the sovereign immunity of the state and its political subdivisions in circumstances in which a private person would be liable.[482] The statute places monetary limits on the damages that are recoverable in an action against the state or its political subdivisions.[483] As have other states with similar legislation, the courts in Florida have created an exception to the liability rule for decisions on a "planning" level as opposed to an "operational level".[484] It is safe to say that a decision by the state or its political subdivisions to build a reef and the choice of a place to site it would be covered by immunity as a planning level decision. However, this exception to liability is probably not broad enough to cover negligence in reef maintenance.

3. Contributory Negligence

Comparative Negligence

In the discussion of negligence in the collision liability section above, the defense of contributory negligence is briefly discussed. Simply put, contributory negligence is a term used to identify and describe negligence committed by a plaintiff which is at least partially the cause of his injuries. In fact, there are cases in which the negligence of the plaintiff may be greater than that of the defendant.[485] As noted above, some states will bar recovery by the plaintiff is his negligence exceeds fifty per cent (50%). Other states will bar recovery by the plaintiff for even the slightest degree of negligence on his part. These latter states are often referred to as "contributory negligence" states; while states which do not bar recovery because of contributory negligence are called "comparative negligence" states.

In actuality, any negligence by the plaintiff which contributes to his injury is contributory negligence. The term comparative negligence should be stated as comparative contributory negligence, and it means that the plaintiff recovers in comparison to which the negligence of the defendant bears to the whole of the negligent conduct.

There are two types of comparative negligence rules, that which bars a plaintiff's recovery if his negligence exceeds fifty per cent (50%) and that which allows recovery even though the plaintiff's negligence may by ninety-nine per cent (99%) contributory. Both Florida[486] and Mississippi[487] recognize the latter rule. Alabama applies the contributory negligence rule, i.e., any contributory negligence on the part of the plaintiff bars his recovery.[488]

Assumption of the risk

This defense to a negligence suit is self-descriptive, but there are some nuances that make the rule more complicated than perhaps it should be. The basic theory is that a plaintiff should not recover if he is aware of a danger and proceeds to knowingly remain in or place himself in a position where he is injured, thus "assuming the risk" of the injury. This sounds very much like contributory negligence, but it is almost uniformly a complete bar to a plaintiff's recovery. Because it is a complete bar, use of the defense has been restricted by the courts to situations in which application is completely justified. A good example is the plaintiff who is injured while riding in an automobile with a driver who is drunk, but whom he knew was drunk. The law will hold that the plaintiff assumed the risk of injury by getting in a car with someone he knew was incapable of safely driving.[489]

Mississippi still recognizes the defense of assumption of the risk, in fact, the situation described above is from a Mississippi case.[490] Florida[491] and Alabama[492] also follow the rule. Alabama seems to soften the "knowingly" requirement to a carelessness standard, which could make the defense more available.[493]

An Ounce of Prevention

There are probably two situations in which liability would be a major concern of a potential reef permittee. One involves divers who could be injured by a defect in the reef material, e.g., who are hurt by some part of the reef falling on them. The other is damage to property, such as fishing nets, caused by material which has come loose from the reef and been carried away from the reef site. There are other potential liability concerns, but these are the primary ones.

Permits will include a requirement that reefs be maintained in good condition.[493] "Good condition" is a relative term - a reef which has been in place a few months is going to be in better shape than one which has been in place for ten years. The primary guard against liability is to establish a program of inspection and warnings. Immunity is probably not going to be available to a reef permittee (except the states of Alabama and Mississippi), nor is a defense of contributory negligence going to be fully protective. The best cure is prevention, and, since accidents are not completely preventable, the next best cure is to warn of any dangers present. A clear warning can make available the defense of assumption of the risk, while absence of the warning will preclude its availability and perhaps even the availability of contributory negligence. Even inspections, if properly performed, can serve to establish that the permittee was not negligent because it exercised reasonable care in an attempt to find problems and warn users.

The National Fishing Enhancement Act is not a panacea, and creates an "immunity" only for actions required to be taken by a permit.[494] It does not state that this immunity does not apply if someone or something is injured because of an action that is not required to be taken by the permit.[495] For example, if a permittee anchors a reef, although not required to do so by the permit, and a diver is injured by the cable or other anchoring device, a permittee could not respond to a suit by the diver by stating that the permit required the anchoring. Thus, there is unavailable a complete defense that could be used to have the lawsuit dismissed without a trial. Although the use of an anchoring device may be the reasonable thing to have done, the permittee will be forced to go to trial to defend its use and the manner in which it was installed.

The immunity provision does not cover negligent performance of actions required by a permit, because negligent performance of a required action is not in compliance with the terms and conditions of the permit.[496]

IV. INTERNATIONAL NAVIGATION LAW

a. 1958 Geneva Convention on the Outer Continental Shelf

The 1958 Geneva Convention on the Outer Continental Shelf contains provisions dealing with the exploitation of the OCS for natural resources and possible interference with navigation caused by the placement on the OCS of devices or artificial islands for such exploitation.[496] Coastal states, i.e. nations, are given the right to exploit natural resources on the OCS so long as it does not "result in any unjustifiable interference with navigation, fishing or the conservation of the living resources of the sea . . . ."[497]

The Convention defines natural resources as "the mineral and other non-living resources of the seabed and subsoil together with living organisms belonging to the _sedentary species_, that is to say, organisms which, at the harvestable stage, _either are immobile on or under the seabed or are unable to move except in constant physical contact with the seabed or the subsoil_."[498] (Emphasis added.) This obviously does not include the type of fish that artificial reefs are intended to benefit.

The following provision is the basis for the Department of Defense's position that the present oil platforms, when not longer in use for production, must be completely removed: "Due notice must be given of the construction of any such installations [for the exploitation of natural resources], and permanent means for giving warning of their presence must be maintained. Any installations which are abandoned or disused must be entirely removed."[499]

b. The Law of the Sea Treaty

Under the Exclusive Economic Zone provisions of the Law of the Sea Treaty (LOS), the impact of the above language may be lessened. Article 56 gives a coastal state "sovereign rights for the purpose of . . . exploiting, conserving and managing the natural resources, whether living or non-living, of the waters superjacent to the sea-bed and of the sea-bed and its subsoil . . . ."[500] The Treaty states that "the coastal State shall have the exclusive right to construct and to authorize and regulate the construction, operation and use of: . . . (b) installations and structures for the purposes provided for in article 56 and other economic purposes . . . ."[501] This would seem to encompass the permitting and regulation of artificial reefs without too much room for argument to the contrary.

The problem with this argument is that the United States has not yet ratified the Law of the Sea Treaty. It has issued a proclamation on the Exclusive Economic Zone, but this is a unilateral proclamation and also is not identical to the EEZ provisions of the LOS. The pertinent part reads almost identically to the Article 60 provision quoted above, but is preceded by the proviso: "to the extent permitted by international law . . . ."[502] The 1958 Geneva Convention would still be international law since the LOS Treaty has not yet been ratified by the requisite number of states. However, a question remains concerning whether what has progressed to the point of being a "custom" under international law so that it is considered international law equal in effect to treaty international law. Although the United States presently refuses to sign the LOS Treaty, it apparently maintains that some of the provisions of the treaty have become international law. Perhaps more to the point is the question of whether artificial reefs have become accepted international custom.

The important question is whether or not a reef would interfere with navigation from an international law standpoint. It is probably not enough to say that a reef would not be permitted at all if it interferes with navigation. If this question can be answered in the negative, there should be no international law implications.

V. DEVELOPMENT INCENTIVES

a. Tax Incentives

There are two basic types of tax incentives that could be used to encourage the donation of materials for artificial reefs. While the principal subject of conversation in this area has been obsolete oil platforms, other materials might be suitable for consideration as well.

The principle reason for deductions from income for tax purposes is the recognition that there are legitimate expenses involved in operating a business which must be incurred for the endeavor to succeed. Deductions are allowed for depreciation because equipment and plant will deteriorate and must be replaced. A deduction is a reduction of income allowed so that true profit will be taxed.

A tax credit is a reduction in the amount of tax owed after taxable income has been calculated. A tax credit is usually a dollar-for-dollar reduction, although the amount allowed may only be a fraction of the amount expended for the item for which the credit is allowed. Common examples of tax credits are the residential energy, child care and investment (certain equipment) credits.

Tax credits generally are created as a stimulus for certain activities or certain sectors of business or industry. Sometimes it is created as an adjustment for changes in society or business that cannot be accurately reflected in a deduction. The equipment investment credit is an example, and was created to encourage industry to retool its plants and to offer an incentive in addition to normal depreciation deductions.

In order to determine if either of these tax incentives is proper for encouragement of the donation of materials to reef developments, one must first examine the economics involved. Although many types of materials are involved, the oil platform can serve as an example. The cost of removing a platform should not be a consideration because this is required by law. (However, it may be possible to re-permit a platform as an artificial reef, at least it is a possibility being explored by the Minerals Management Service.) If a platform could be re-permitted in place as a reef, the cost of conversion would be allowed as a deduction from business income..

Apparently, once a platform is onshore, it is worth something as scrap (assuming that it or some part of it cannot be reused). It is this value that should be considered the donation. Some oil company officials have stated that it is worth little more than the cost of cutting it up for scrap. In that situation, a donation of a platform for a reef would relieve the oil companies of a burden. The author has had one estimate of $40,000 in salvage value for a platform.[503] Obviously, the value would depend on the condition of the platform, the distance from shore, and numerous other factors of an individual nature.

Assuming that the platform has some value, the ultimate question is how much of a deduction or a credit does the oil company get for donating the rig. If a small platform worth $40,000 after scrapping is donated by a company which pays forty per cent (40%) in taxes on taxable income, the donation has cost it $24,000 in after tax income. However, if given a deduction for donating the material, the deduction "protects" another $40,000 in income on which the company would have to pay $16,000 in taxes, therefore the donation has cost the company $8,000. If the company is allowed a credit, it still will not have the income of $40,000, again costing it $24,000, and the credit will reduce this cost further. If the credit is ten per cent (10%) of the value of the donation, it will be $4,000, and the net cost to the company is $20,000. However, credits are allowed only against actual tax liability. If a company lost money in the tax year it made a donation, it could not take advantage of the credit unless there was a carryover provision in the law.

The problem in this analysis is that the figures and certain assumptions are arbitrary. Primarily, it is arbitrary to expect an easy calculation of the value of what is donated. Secondly, it is somewhat erroneous to say that the donation in the illustration above only costs the company $8,000, because the company may still have money in the rig from the original construction costs. That figure would further increase the actual cost of the donation. It is hoped that figures from the economic study would give a guide for the decision on this aspect of reef development. The author discussed the question of incentive with one oil company official, who suggested that perhaps the value of the reef as an economic asset to the community could be used to figure a tax incentive.[504] Such a value would be more difficult to calculate, but probably more fair to the oil company. The same official mentioned barge crane costs of $55,000 per day,[505] which makes a $40,000 tax deduction seem unrealistic as an incentive to donate a reef.

b. Habitat mitigation credits

There is some interest in a system of mitigation credit banking for habitat enhancement.[506] Mitigation credits are a familiar part of the environmental balancing process, but they are usually found within one project or within a single ecosystem. Banking would involve the use of credits from different areas, theoretically all across the country, to offset environmental damage in another area.[507] Those commentators to the MMS notice on alternative disposition of rigs who mentioned this objected to any use of credits for offshore reefs for mitigation of onshore projects.[508]

FOOTNOTES

[1] Two of the platforms are off the Florida coast and the remaining one is off the Alabama coast.

[2]On November 13, 1984, the Minerals Management Service published an Advance Notice of Proposed Rulemaking on the disposition of obsolete oil production platforms, and solicited comments. Many, if not all, of the comments received were furnished to the author by Villere Reggio of the Minerals Management Office in Metairie, Louisiana. An example of the concerns about liability is the letter from V.C. Eissler, Vice-President, North American Production, Conoco, Inc., dated December 12, 1984, which states in part: "Conoco NAP firmly contends that . . . all liability . . . must transfer immediately to the new user . . . ."

[3]Pub.L. 98-623, 98 Stat. 3394 (1984); 33 USCA §§2101-2106 (1986).

[4]33 U.S.C.A. §403 (1970).

[5]*Id*.

[6]Permits for Structures or Work in or Affecting Navigable Waters of the United States, 33 C.F.R. §322.5 (1985). (Part 322 will hereinafter be cited by title and C.F.R. section only.)

[7]Processing of Department of the Army Permits, 33 C.F.R. §325.1 (1985). (Hereinafter cited to title and section only).

[8]43 U.S.C.A. §§1331 *et seq*. (1986).

[9]43 U.S.C.A. § 1333(e).

[10]33 C.F.R. §322.2(a).

[11]43 U.S.C.A. § 1312 (1986).

[12]311 U.S. 377 (1940).

[13]Shutler, "A Review of the Army Corps of Engineers Regulations in U.S. Waters and an Assessment of Recent Regulatory Changes," *The Coastal Society Bulletin*, vol. 8, no. 3, p. 13 (1985).

[14]16 U.S.C.A. §§661 *et seq*. (1985).

[15]Shutler, *supra* note 13 at 14.

[16]16 U.S.C.A. §662(a).

[17] Shutler, *supra* note 13 at 14.

[18] 430 F.2d 199 (5th Cir. 1970), cert. den. 401 U.S. 910 (1972).

[19] Shutler, *supra* note 13 at 14.

[20] 33 C.F.R. §322.3(a).

[21] 33 C.F.R. §322.2(c).

[22] Permits for Discharges of Dredged or Fill Material into Waters of the United States, 33 C.F.R., Part 323 (1985). (Hereinafter cited to title and section only).

[23] 33 C.F.R. §323.2(k).

[24] 33 C.F.R. §322.2(l).

[25] General Regulatory Policies, 33 C.F.R. §320.4(a)(1) (1985). (Hereinafter cited to title and section only.)

[26] *Id*.

[27] *Id*.

[28] 33 C.F.R. §320.4(g).

[29] *See*, comments to proposed rule change in 48 *Federal Register* 21466 (May 12, 1983).

[30] 33 C.F.R. §320.4(a)(1).

[31] 33 C.F.R. §320.4(a)(2).

[32] 33 C.F.R. §320.4(c).

[33] *Id*.

[34] *Id*.

[35] Shutler, *supra* note 13 at 16.

[36] *Id*. at 15.

[37] *Id*. at 16; 48 *Federal Register* 21466 (May 12, 1983).

[38] 48 *Federal Register* 21466 (May 12, 1983).

[39] 33 C.F.R. §320.4(d).

[40] *Id*.

[41] 33 C.F.R. §320.4(e).

[42] _Id_.

[43] _Id_.

[44] 33 C.F.R. §320.4(g).

[45] Pub.L. 92-500, 86 Stat. 883 (1972); 33 U.S.C.A. §§ 1311-1376 (1986). The 404 program is found in 33 U.S.C.A. §1344.

[46] 33 C.F.R., Part 320.

[47] 33 C.F.R. §323.2(1).

[48] 33 C.F.R. §323.2(a)(6); _see also_, 33 U.S.C.A. §1362(7).

[49] 33 U.S.C.A. §1343(a).

[50] EPA Administered Permit Programs: The National Pollutant Discharge Elimination System, 40 C.F.R. §122.3(b) (1985). (Hereinafter cited only to title and section).

[51] 33 C.F.R. §322.5.

[52] 33 C.F.R. §325.1.

[53] Shutler, _supra_ note 13 at 14.

[54] 43 U.S.C.A. §1362(7).

[55] 43 U.S.C.A. §1362(8).

[56] _U.S. v. Florida_, 425 U.S. 791 (1976).

[57] Telephone conversation with Frank Arendale, Field Monitoring Branch, Regulatory Division, Corps of Engineers, Jacksonville, Florida, District, of July 24, 1985. This conversation will hereinafter be referred to as Jacksonville Corps, _supra_ note 57.

[58] 33 U.S.C.A. §1343(c)

[59] 33 U.S.C.A. §1344(b).

[60] 33 C.F.R. §323.6(a).

[61] 33 U.S.C.A. §1343(c).

[62] Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material, 40 C.F.R. §230.7 (1985). (Hereinafter 40 C.F.R., Part 230 will be referred to by title and section only.)

[63] 33 U.S.C.A. §1344(c); _see also_, Section 404(c) Procedures, 40 C.F.R. §231.1(a) (1985).

[64] 40 C.F.R. §231.1.

[65] 40 C.F.R. §231.3(a).

[66] 40 C.F.R. §231.4.

[67] 40 C.F.R. §231.5.

[68] 40 C.F.R. §231.5(b)(2).

[69] _Id_.

[70] 33 U.S.C.A. §1344(g)(1).

[71] _Id_.

[72] 33 C.F.R. §325.4(a) (1984); _see_, 49 _Federal Register_ 39483 (October 5, 1984). Legal requirements may mean §404(b)(1) guidelines, EPA ocean dumping criteria, the Endangered Species Act, and state 401 certification requirements.

[73] 33 C.F.R. §325.4(a) (1985); 49 _Federal Register_ 39483 (October 5, 1984).

[74] 33 C.F.R. §325.4(a)(2).

[75] 33 C.F.R. §325.4(a)(3) & (b).

[76] 33 C.F.R. §325.4(d).

[77] 33 U.S.C.A. §1344(e).

[78] 33 C.F.R. §325.5(c).

[79] Jacksonville Corps, _supra_ note 57; telephone conversation with Dr. Davis Findley, Mobile District Corps of Engineers, on August 1, 1985. This conversation will hereinafter be referred to Mobile Corps, _supra_ note 79.

[80] 33 C.F.R. § 325.2(e)(2).

[81] Jacksonville Corps, _supra_ note 57; Mobile Corps, _supra_ note 79.

[82] At a public meeting of the MASGC study team, an Alabama citizen had a much different opinion about the length of time it takes to permit an artificial reef in Alabama. Of course, Dr. Findley was speaking about Corps permits and not state permits and certifications.

[83] See, Mobile Corps permit, Special Condition b; Jacksonville Corps permit, Special Condition 6.

[84]Jacksonville Corps, _supra_ note 57; Mobile Corps, _supra_ note 79. Telephone conversation with Bob Green of the EPA Regional Office in Atlanta, Georgia, on July 25, 1985.

[85]See, e.g., those agencies listed in 33 C.F.R. §325.2 (i).

[86]Telephone conversation with Reginald Rogers, Ocean Dumping Coordinator, EPA Regional Office, Atlanta, Georgia, on July 25, 1985.

[87]33 C.F.R. §325.6(a).

[88]33 U.S.C.A. §1344(e)(2).

[89]Telephone conversation with Bernie Goode, Corps of Engineers, Washington, D.C., on July 24, 1985.

[90]This is a set of general procedures; special procedures pertinent to this paper are found in 33 C.F.R., Parts 320-324 and 330 (1985).

[91]33 C.F.R. §325.1(b).

[92]Jacksonville Corps, _supra_ note 57; Mobile Corps, _supra_ note 79.

[93]33 C.F.R. §325.1(d)(1).

[94]33 C.F.R. §323.2(l).

[95]33 C.F.R. §325.1(d)(4).

[96]33 C.F.R. §325.1(f).

[97]33 C.F.R. §325.2(b)(3).

[98]33 C.F.R. §325.2(b)(5).

[99]33 C.F.R. §325.2(e)(2).

[100]_Id_.

[101]_See generally_, 33 C.F.R. §325.3.

[102]33 C.F.R. §325.3(a)(16).

[103]33 C.F.R. §325.3(c).

[104]33 C.F.R. §325.3(d)(3).

[105]33 C.F.R. §325.7(a).

[106]Id.

[107]Id.

[108]33 C.F.R. §325.7(b)-(d).

[109] Enforcement, Supervision and Inspection, 33 C.F.R. §326.2(a) (1985).

[110]33 C.F.R. §326.3(b).

[111]33 C.F.R. §326.3(c).

[112]33 C.F.R. §326.4(a)(1).

[113]33 C.F.R. §326.4(a)(2).

[114]33 C.F.R. §326.5(a).

[115]33 C.F.R. §326.5(b).

[116]33 C.F.R. §326.5(d).

[117]33 C.F.R. §326.5(e) & (f).

[118]Public Hearings, 33 C.F.R. §327.4 (1985).

[119]33 C.F.R. §327.7.

[120]33 C.F.R. §327.8 & §327.8(e).

[121]33 C.F.R. §327.8(e) & (f).

[122]H.R. Rep. No. 819, 98th Cong., 2nd Sess. (1984).

[123]Id. at 3.

[124]Id.

[125]Id. at 3-4.

[126]Id. at 4.

[127]Id.

[128]Id.

[129]Pub.L. 98-623, 98 Stat. 3394 (1984); 33 USCA §§2101-2106 (1986).

[130]33 U.S.C.A. §2101(b).

[131]33 U.S.C.A. §2104(a)(2).

[132] 33 U.S.C.A. §2102.

[133] 33 U.S.C.A. §2103.

[134] *Id*.

[135] 33 U.S.C.A. §2104(b)(2).

[136] 33 U.S.C.A. §2104(a).

[137] *Id*.

[138] 33 U.S.C.A. §2104(b)(1).

[139] *Id*.

[140] 33 U.S.C.A. §2104(c)(1).

[141] 33 U.S.C.A. §2104(c)(4).

[142] 33 U.S.C.A. §2104(c)(3).

[143] 33 U.S.C.A. §2104(d).

[144] 33 U.S.C.A. §§2104(e) & 2105; 16 U.S.C.A. §§1220, 1220a and 1220d (1985).

[145] 33 U.S.C.A. §2106.

[146] 33 U.S.C.A. §2103(5) &(6).

[147] 33 U.S.C.A. §2104(c)(4).

[148] 50 *Federal Register* 30479 (July 26, 1985). As of the date of this writing, May 28, 1986, it does not appear that the regulations have become final.

[149] House Report 98-819 at 4, *supra* at 122.

[150] 50 *Federal Register*, *supra* note 148 at 30479.

[151] *Id*.

[152] 33 C.F.R. §322.5(b)(1) (proposed).

[153] *Id*.

[154] 33 C.F.R. §322.5(b)(2) (proposed).

[155] 33 C.F.R. §322.5(b)(3) (proposed).

[156] *Id*.

[157]Telephone conversation with Richard Stone, National Marine Fisheries Service, Washington, D.C., on May 29, 1986.

[158]33 C.F.R. §322.5(b)(4).

[159]Id.

[160]14 U.S.C.A. §§81-93 (1986). While the Coast Guard is given authority under 43 U.S.C. §1333 to regulate aids to navigation for "artificial islands and fixed structures" on the Outer Continental Shelf, the terms are used in such a context to indicate that this authority is intended to encompass only structures used in oil and gas development. See also, Aids to Navigation on Artificial Islands and Fixed Structures, 33 C.F.R., Part 67 (1985).

[161]14 U.S.C.A. §86.

[162]Stone (ed.), National Artificial Reef Plan, NOAA Technical Memorandum NMFS OF-6, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (1985), 49-51. This document will be hereinafter cited as the Reef Plan, supra at 162. Single copies of the Reef Plan are free; write NMFS, NOAA, Washington, D.C. 20235.

[163]State Aids to Navigation, 33 C.F.R. §66.05-1 (1985). (Hereinafter reference to Part 66.05 will be by title and section only.)

[164]33 C.F.R. §66.05-100(a).

[165]Telephone conversation with C.P.O. Vanderlinden, New Orleans Coast Guard Office, on August 2, 1985. This conversation will hereinafter be referred to as Coast Guard, supra note 165. The Miami District's jurisdiction begins at Apalachicola Bay. Id.

[166]Private Aids to Navigation, 33 C.F.R. §66.01-5 (1985). (Hereinafter reference to Part 66.01 will be by title and section only.)

[167]Id.

[168]33 C.F.R. §66.01-10. The requirements of the standard U.S. system are found in 33 C.F.R., Subpart 62.25 (1985).

[169]33 C.F.R. §66.01-15.

[170]33 C.F.R. §66.01-55.

[171]Burgess, "Role of the Coast Guard in Artificial Reefs," Proceedings of an International Conference on Artificial Reefs

(Houston, 1974) 125, 126-127. The Eighth Coast Guard District is the New Orleans District.

[172]Coast Guard, supra at 165.

[173]Id.

[174]Id.

[175]Id.

[176]Id.

[177]Id. See, Quick Reference Navigation Rules (Seaport Marine, 3rd ed. 1983).

[178]Coast Guard, supra at 165.

[179]Id.

[180]Id.

[181]33 C.F.R. §66.01-30.

[182]Coast Guard, supra at 165.

[183]Id. See, 33 C.F.R. §66.01-25.

[184]Coast Guard, supra at 165. See also, Reef Plan, supra at 162, Appendix B.

[185]16 U.S.C.A. §662(a).

[186]Id.

[187]Sun Enterprises, Ltd. v. Train, 532 F.2d 280 (2nd Cir. 1976).

[188]5 U.S.C.A., Appendix I (Supp. 1985), p. 85-88.

[189]Reorganization Plan No. 4 of 1970, §1(b), id., p. 85.

[190]The Memorandum of Agreement used to be included in an Appendix B to the Corps' permit regulations, 33 C.F.R., Part 325, but is not included in the recent volumes. As stated in the text, the MOA is recognized by Corps' regulatory procedures. The text of the MOA is included in the Appendices; it was copied from microfiche records of C.F.R.

[191]See, Houck, "Judicial Review under the Fish and Wildlife Coordination Act: A Plaintiff's Guide to Litigation," 11 Envtl. L. Rep. 50043 (July, 1981). Houck notes that despite the mandatory language of the Coordination Act, the Act has not

been accorded the clout by the courts that other laws have. Id. at 50044, 50048.

[192] Pub.L. 93-205, 87 Stat. 884 (1973); 16 U.S.C.A. §§1531-1543 (1985).

[193] 437 U.S. 153 (1978).

[194] Id. at 140-141.

[195] 16 U.S.C.A. §1536(a)(2).

[196] 16 U.S.C.A. §1536(a)(3).

[197] 16 U.S.C.A. §1532(15).

[198] Id.

[199] 16 U.S.C.A. §1536(h).

[200] 16 U.S.C.A. §1361(1) (1985). The Act is found in 16 U.S.C.A. §§1361-1407.

[201] 16 U.S.C.A. §1362(11).

[202] 16 U.S.C.A. §1361(6).

[203] 16 U.S.C.A. §§1372(a)(1) & 1362(12).

[204] 16 U.S.C.A. §1362(14).

[205] Pub.L. 92-532, 86 Stat. 1061 (1972); 16 U.S.C.A. §§1431-1439 (1985).

[206] 16 U.S.C.A. §1433(a).

[207] 16 U.S.C.A. §1433(b)(1) & (2).

[208] Endangered and Threatened Wildlife and Plants, 50 C.F.R. §17.108(a)(1)-(3) (1985). Subpart J of Part 17 covers manatee protection area. (This Subpart will hereinafter be referred to by title and section only.)

[209] 50 C.F.R. §17.108(a)

[210] 50 C.F.R. §17.108(b).

[211] 33 C.F.R. §320.4(i).

[212] Goode, "Regulating Artificial Reefs," in D'Itri (ed.), Artificial Reefs, Marine and Freshwater Applications (1985) 525, 526. Goode does note that "if the area is unique and no other area will satisfy . . . [an applicant could] ask the district engineer if the danger zone or restricted area can be

changed to accommodate the reef. It is not an impossible situation." Id.

[213]For information on this and other matters pertaining to artificial reefs, one can contact the Sport Fishing Institute's Artificial Reef Development Center, 1010 Massachusetts Avenue, N.W., Suite 100, Washington, D.C. 20001; 202-898-0770.

[214]Contact the Minerals Management Service, P.O. Box 7944, Metairie, Louisiana 70010.

[215]49 Federal Register 44924, November 13, 1984.

[216]Letter dated January 11, 1985, from Hugh O'Neill, Representative for Ocean Policy Affairs, Office of the Secretary of Defense/ The Joint Chiefs of Staff, to David A. Schuenke, Minerals Management Service.

[217]Id.

[218]Id.

[219]Id.

[220]Telephone conversation with Richard Stone, National Marine Fisheries Service, Washington, D.C., on May 29, 1986.

[221]51 Federal Register 7584 (March 5, 1986).

[222]Pub.L. 92-402, 86 Stat. 618 (1972); 16 U.S.C.A. §§1220-1220d (1985).

[223]16 U.S.C.A. §1220a.

[224]Pub.L. 98-623, 98 Stat. 3397 (1984), §207(1) & (2).

[225]16 U.S.C.A. §1220(b).

[226]Ocean Dumping - General Permits, 33 C.F.R., Part 229, §229.3 (1985).

[227]Id.

[228]33 U.S.C.A. §1344(b).

[229]33 U.S.C.A. §1343(c).

[230]33 U.S.C.A. §1342.

[231]33 U.S.C.A. §1344(c).

[232]33 U.S.C.A. §1343(a).

[233]33 U.S.C.A. §1362(16).

[234] 33 U.S.C.A. §1362(6).

[235] 33 U.S.C.A. §1362(12).

[236] Christian, Permitting Procedures for Artificial Reefs (Sports Fishing Institute, 1984) 8-11. Section 318 of the Clean Water Act is codified at 33 U.S.C.A. §1328.

[237] Amson, "The Regulatory Policies of the United States Environmental Protection Agency Concerning the Construction of Artificial Reefs," Proceedings of an International Conference on Artificial Reefs (Houston, 1974) 113, 113-117. At the time of his speech, Mr. Amson was Chief, Biology Section, Hazardous Materials and Toxic Substances Branch, EPA, Washington, D.C. This paper will hereinafter be cited as Amson, supra at 236.

[238] Id. at 115.

[239] Pub.L. 95-217, 91 Stat. 1599 (1977), §63.

[240] 1972 U.S. Code Cong. and Adm. News 3668; 1977 U.S. Code Cong. and Adm. News 4326.

[241] Criteria for Issuance of Permits to Aquaculture Projects, 40 C.F.R., Part 125, Subpart B, §125.10(b). (This Subpart will hereinafter be referred to by title and section only.)

[242] 40 C.F.R. §125.11(e).

[243] 33 U.S.C.A. §2104 (b)(2).

[244] 33 U.S.C.A. §1362(12). The NPDES program covers discharges of pollutants into the contiguous zone or ocean from point sources other that a vessel or other floating craft. In navigable waters, it covers discharges from any point source. Id. See, Pacific Legal Foundation v. Quarles, 440 F.Supp. 316 (D.C.Cal. 1977), aff'd 614 F.2d 225, cert. den. 449 U.S. 825.

[245] Pub.L. 92-532, 86 Stat. 1052 (1972); 33 U.S.C.A. §§1401-1445 (1986).

[246] 33 U.S.C.A. §1402(f).

[247] Id.

[248] 33 U.S.C.A. §1402(c).

[249] 33 U.S.C.A. §402(f).

[250] Ocean Dumping, 40 C.F.R., Subchapter H, Parts 220-229 (1985).

[251] General, 40 C.F.R. §220.1(c)(2) (1985).

[252]33 U.S.C.A. §1344(g)(1).

[253]All three states involved in this study have approved coastal zone management programs, and all three programs contain certain water quality standards. Detailed discussion is found in the individual state permit sections.

[254]Fla. Stat. §403.031 (1986) (water quality); Id. §403.911 (1986) (wetlands permit).

[255]Ala. Code 1975 §22-22A-4 (1984).

[256]Miss. Code 1972 §§49-27-1 et seq. (Supp. 1985); Id., §57-15-3.

[257]33 U.S.C.A. §1341(a)(1) provides that the applicant provide a certification for discharges into the "navigable waters", defined in §1362(7) as the territorial sea.

[258]33 U.S.C.A. §1362(8).

[259]Fla. Stat. §403.91 (1986).

[260]Pub.L. 92-583, 86 Stat. 1280 (1972); 16 U.S.C.A. §§1451-1464 (1985).

[261]16 U.S.C.A. §1456(c)(1).

[262]16 U.S.C.A. §1456(c)(3)(A).

[263]Id.

[264]Id.

[265]Id.

[266]16 U.S.C.A. §1453(1).

[267]Id.

[268]Id.

[269]16 U.S.C.A. §1456(c)(1).

[270]464 U.S. 312 (1984).

[271]Id.

[272]Pub.L. 94-265, 90 Stat. 331 (1976); codified at 16 U.S.C.A. §§1801-1882 (1985).

[273]See, Environmental Impact Statement and Fishery Management Plan for the Reef Fish Resources of the Gulf of Mexico (Florida Sea Grant College, 1981). See also, Gordon,

"Artificial Reefs and the FCMA," Artificial Reefs: Conference Proceedings (Florida Sea Grant College, 1981) 75.

[274]Fla. Stat. §403.918 (1986); Id. §380.23(1) (Supp. 1986). There is a general permit for artificial reefs, Fla. Admin. Code §17-4.68. In the normal fill material application process, there seem to be two permits that are required, but each is applied for and granted as part of the same process. One is the water quality and wetlands permit under Fla. Stat., Chapter 403, and the other is the permit to use state lands (i.e., the submerged lands under the territorial sea) under Fla. Stat., Chapter 253. DER has jurisdiction of both permits, but the Department of Natural Resources must give its consent or DER will not issue the permits.

[275]Id. §403.911(1).

[276]Id.

[277]Id. §380.22 (Supp. 1986).

[278]Id. 403.814(1) (1986).

[279]Fla. Admin. Code §17-4.68.

[280]Id. §17-4.53. Telephone conversation with Dick Fancher, Pensacola District Office, Department of Environmental Regulation, on May 16, 1986. Hereinafter this conversation will be referred to as DER, supra at 280.

[281]Fla. Admin. Code §17-4.68.

[282]DER, supra at 280.

[283]Id. See, Fla. Stat. §403.813(1)(a) (1986).

[284]DER, supra at 280. See, Fla. Admin. Code §17-4.28(4)(a).

[285]Fla. Admin. Code §17-4.28(4)(j).

[286]DER, supra at 280.

[287]Id.

[288]Id.

[289]Fla. Admin. Code §17-4.29(5).

[290]Id.

[291]DER, supra at 280.

[292]The current fee schedule is $1,000 for a standard form application and $100 for a short form application. Fla. Admin. Code §17-4.05(4)(c). The regulations (§17-4.05(4)) and the joint permit application form state that these fees are nonrefundable. State of Florida Joint Application for Permit, p. 30. Hereinafter as Florida Joint Application.

[293]DER, supra at 280.

[294]Id.

[295]Id.

[296]Id.

[297]Id.

[298]Fla. Admin. Code §17-4.54.

[299]Fla. Stat. §403.918(1) & (2).

[300]Id. §§403.91-403.929 (1986). The full title is the Warren S. Henderson Wetlands Protection Act of 1984.

[301]Fla. Stat. §403.918(2)(a).

[302]Id. §§253.03 & 253.77 (Supp. 1986). The ownership of such lands is vested in the Board of Trustees of the Internal Improvement Trust Fund, but management of state submerged lands is the responsibility of DNR. 1975 Fla. Laws, Chap. 75-22, §§10, 15 and 22.

[303]Fla. Stat. §258.42(3) (Supp. 1986). The Florida Joint Application instructions, Appendix A, Use of State Lands, p. 15, states that an application should contain "[a] statement demonstrating in detail that the proposed project will be in the public interest for applications within an Aquatic Preserve . . . ." The statute has one provision allowing "[s]uch other alteration of physical conditions as may . . . enhance the quality or utility of the preserve . . . ." This language may allow a reef to be placed within an aquatic preserve by the DNR.

[304]Telephone conversation with Susan Radford, Pensacola District Office, Department of Natural Resources, on May 16, 1986. This conversation is hereinafter referred to as DNR, supra at 304. Ms. Radford confirmed that a reef would be allowed within a preserve, but that the Board of Trustees of the Internal Improvement Trust Fund might have to give their consent.

[305]Id.

[306]Fla. Stat. §267.061(1)(b) (Supp. 1986).

[307]DNR, supra at 304. For more specific information of a broader scope, see, Musselman and West, "Historic Shipwrecks: A Coastal Zone Management Issue," The Coastal Society Bulletin, vol. 8, no. 4 (1985) 10.

[308]DNR, supra at 304.

[309]Memorandum of Understanding Between DNR, Florida Department of Veteran and Community Affairs, and DER Relative to the Coastal Management Program, dated July 29, 1981. This MOU recognizes the authority of each of these agencies in specific areas.

[310]Ala. Code 1975 §22-22A-4 (1983).

[311]Telephone conversations with the following officials of DEM: Dick Shell - Montgomery, John Carlton and Brad Gane - both of Mobile Field Office, on May 19, 1986. This conversation is hereinafter referred to as DEM, supra at 311, with the particular individual or individuals identified by name.

[312]Id. - Carlton and Gane.

[313]Telephone conversation with Hugh Swingle, Marine Resources Division of the Alabama Department of Conservation and Natural Resources, on May 19, 1986.

[314]Id.

[315]Id.

[316]ADEM Rules and Regulations, Coastal Program, §8-1-.17 (1984). Hereinafter cited as Alabama Coastal Program. See also, Ala. Code 1975 §§9-7-16, 22-22A-5, 22-22A-6 and 22-22A-8 (1984).

[317]Alabama Coastal Program, §8-1-.18. See also, Ala. Code 1975 §§9-7-16, 22-22A-5, 22-22A-6, and 22-22A-8 (1984).

[318]DEM-Carlton, supra at 311.

[319]At a public meeting in Mobile at which the artificial reef study team presented summaries of their reports, a fisherman told the author that it might take a year or more to permit a reef and that there was little official interest in reef projects.

[320]DEM-Carlton, supra at 311.

[321]Id.

[322]DEM-Gane, supra at 311. Mr. Gane was not sure why this particular limit was set, but after some discussion, he and the

author reached an assumption that it was set to coincide with the limit of the Exclusive Economic Zone.

[323]Alabama Coastal Program, §8-1-.06(5).

[324]Id., §8-1-.02(m).

[325]Miss. Code 1972 §§49-27-1 - 49-27-69 (Supp. 1985), specifically §49-27-9.

[326]Id. at § 49-27-7(s). The term "director" as used in the statute would actually mean the director of the Department of Wildlife Conservation (DWC), since the defunct Marine Resources Council was replaced by the Commission on Wildlife Conservation under §57-15-3. Section 49-27-7(3) says "delegate" also, and since the field work is done by BMR and its divisions, the on-site inspection is done by the Division chiefs, and not the Director of DWC.

[327]Telephone conversation with Joe Gill, Chief of the Wetlands Division, Bureau of Marine Resources, DWC, on May 23, 1986. This conversation is hereinafter cited as BMR, supra at 327. Although the Mobile Corps' general permit covers artificial reefs and there is a joint BMR/Corps application process, Mississippi does not have a general permit for artificial reefs because of the statutory restrictions of §49-27-7. Id.

[328]Id.

[329]Id.

[330]Telephone conversation with Jerry Mitchell, Chief of the Coastal Program Division, BMR, DWC, on May 23, 1986.

[331]Miss. Code 1972 §57-15-6 (Supp. 1985).

[332]BMR, supra at 327.

[333]Id.

[334]Id.

[335]Miss. Code 1972 §49-27-13; Mississippi Coastal Program, Chapter 8, Section 2, Part I.D.1.

[336]BMR, supra at 327.

[337]Id.

[338]Id.

[339]Miss. Code 1972 §49-27-13.

[340]Mississippi Coastal Program, Chapter 8, Section 2, Part I.D.2.b.

[341]*Id.*

[342]BMR, *supra* at 327.

[343]*Id.*

[344]*Id.*

[345]*Id.*

[346]Miss. Code 1972 §49-27-7.

[347]BMR, *supra* at 327.

[348]*Id.*

[349]Mississippi Coastal Program, Chapter 8, Section 2, Part I.E.2.

[350]BMR, *supra* at 327.

[351]Miss. Code 1972 §49-17-7.

[352]BMR, *supra* at 327.

[353]Miss. Code 1972 §49-17-29.

[354]*Id.* at §49-17-5(1)(a).

[355]BMR, *supra* at 327.

[356]*Id.*

[357]16 U.S.C.A. §1456(c)(1).

[358]BMR, *supra* at 327.

[359]Mississippi Coastal Program, Chapter 8, Section 4, Part III.C.2.a.

[360]BMR, *supra* at 327.

[361]16 U.S.C.A. §1456(c)(3).

[362]Convention of the Continental Shelf (Geneva, 1958), Department of State *Bulletin*, p. 1121, June 30, 1958.

[363]Gulf of Mexico Minerals Management Service OCS Order No. 3.

[364]*See generally*, discussion above at pp. 11, 25, 40 and 59.

[365]It is beyond the scope of this paper to discuss in detail the various arrangements that are made between oil companies and service companies. The one described is fairly common.

[366]*Herb's Welding v. Gray*, 470 U.S. ___, 84 L. Ed. 2d 406 (1985).

[367]Act of August 7, 1953, 67 Stat. 462; 43 U.S.C.A. §§1331-1356 (1985).

[368]Oil and Gas and Sulphur Operations in the Outer Continental Shelf, 30 C.F.R., Part 250 (1985).

[369]Letter from J.J. Wasicek, Manager Regulatory Compliance, Union Oil Company of California, dated December 10, 1984, to David A. Schuenke, Minerals Management Service.

[370]Maraist, *Admiralty* (St.Paul, 1983), 8. The author has relied heavily on this work for a discussion of admiralty and maritime law. He makes no apology; this is a difficult subject of which he has no formal training. When one must trust another for interpretation of a difficult area of the law, Professor Maraist would not be a bad choice. Of this, the author has firsthand knowledge. (This source will be cited as Maraist.)

[371]American admiralty law differs from the law of England because it applies to all navigable waters and not just the high seas. *Id.*, 7.

[372]Art. III, §2, cl. 3.

[373]Maraist, 4.

[374]*Id.*

[375]*Id.*

[376]*Id.*

[377]*Id.*, 6-7.

[378]*Id.*, 7.

[379]*Id.*

[380]*Id.*, 11.

[381]*Id.*, 12.

[382]*Id.*, 12-14.

[383]*Id.*, 14-15.

[384]Id., 14.

[385]Id., 14.

[386]Id., 15.

[387]Id., 27.

[388]Id., 175.

[389]Id., 176-179.

[390]610 F.2d 1342 (5th Cir. 1980).

[391]Id. at 1347.

[392]See discussion of Longshoremen's and Harbor Workers' Compensation Act, below, p. 77.

[393]Maraist, 181.

[394]Id.

[395]Id., 194.

[396]Id., 197.

[397]Chelentis v. Luckenbach Steamship Co., Inc., 247 U.S. 205 (1918); see, Maraist, 174-175.

[398]Maraist, 204-205; the Jones Act is codified as 46 U.S.C.A. §688, the FELA as 45 U.S.C.A. §§51 et seq.

[399]Maraist, 211-212.

[400]Because fault-based theories of liability depend on factual determinations, a seaman stands a better chance in a close case of getting his case to the jury under a Jones Act claim than under the warranty of seaworthiness theory. Id., 215.

[401]Id., 222.

[402]International Stevedoring Co. v. Haverty, 272 U.S. 50 (1926), cited in Maraist, 222.

[403]Maraist, 223. The LHWCA is codified as 33 U.S.C.A. §901 et seq.

[404]Maraist, 225-226.

[405]Id., 239.

[406]Id.

[407] Herb's Welding v. Gray, 470 U.S. ___, 85 L. Ed. 2d 406 (1985).

[408] Id. See, 43 U.S.C.A. §1333(b).

[409] Prosser, The Law of Torts (St.Paul, 1971), 901. (Hereinafter cited as Prosser, supra at 409).

[410] The Harrisburg v. Rickards, 119 U.S. 199 (1886).

[411] Prosser, supra at 409 902.

[412] Id. A "wrongful death" action is a new action in favor of the deceased's personal representatives, while a "survival action is one for the deceased's damages accrued before his death that "survives" to his heirs and is expanded into one that includes the damages resulting from his death. Id.

[413] Id.

[414] 227 U.S. 59 (1913); Maraist, 276.

[415] Maraist, 276.

[416] Id. The DOHSA is codified as 46 U.S.C.A. §§761 et seq.

[417] Maraist, 277. In other words, the action allows recovery for medical expenses, lost wages and similar out-of-pocket damages.

[418] 46 U.S.C.A. §761 (1975).

[419] 398 U.S. 375 (1970).

[420] Again, this summary is within the scope of this study, while a complete discussion is not. The overview of admiralty law itself is already much too long.

[421] 754 F.2d 1274 (5th Cir. 1985), cert. granted, ___ U.S. ____, 106 S. Ct. 60 (1986).

[422] Maraist, 285-286.

[423] Id., 150.

[424] Id., 163; albeit sparingly, id.

[425] Prosser, supra at 409, 250.

[426] Robbins Dry Dock v. Flint, 275 U.S. 303 (1927).

[427] Id.

[428] Maraist, 211-212.

[429] *Id.*, 163-164.

[430] *Id.*, 150-152.

[431] *Id.*, 152.

[432] *Id.*

[433] *Id.*

[434] *Id.*

[435] 46 U.S.C.A. §§181-195.

[436] Act of March 3, 1851, 9 Stat. 635.

[437] Act of February 13, 1893, 27 Stat. 446.

[438] *See*, Maraist, 315-320, for a good summary.

[439] *Id.*, 309-310.

[440] *Id.*, 311.

[441] *Id.*, 315.

[442] *Id.*, 310-311.

[443] *Id.*, 153-163.

[444] *Id.*, 154-161.

[445] 33 U.S.C.A. §§1601-1608 (1986); the rules are found following §1602.

[446] 33 U.S.C.A. §409.

[447] Maraist, 166.

[448] *Id.*

[449] *Id.*, 166-167.

[450] *Id.*, 167.

[451] *Id.*

[452] *Id.*, 117.

[453] *Id.*, 117-118.

[454] *Id.*, 118-119.

[455]In re Gulf & Midlands Barge Line, Inc., 509 F.2d 713 (5th Cir. 1975).

[456]BASF Wyandotte Corp. v. Tug Leander, Jr., 590 F.2d 96 (5th Cir. 1979).

[457]33 U.S.C.A. §2104(b)(1), of the NFEA, requires that location be specified in the permit.

[458]33 U.S.C.A. §2104(c)(1).

[459]Id.

[460]33 U.S.C.A. §2104(c)(4).

[461]33 U.S.C.A. §2104(c)(1). Section 2104(c)(2) states that "[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." This language is obviously an attempt to insure that a reef permittee is not given a complete immunity from suits for negligence in conduct not required by the permit, but it might also have the effect, coupled with the language of (c)(1), of making the permittee liable for doing something that is intended to make the reef safer, but is not required by the permit.

[462]General Permit for SAJ-50 for Artificial Fishing Reefs and Fishing Attractors, General Condition g. See Appendix.

[463]33 U.S.C.A. §2104(c)(4).

[464]Prosser, supra at 409, 656-658.

[465]See, e.g., Parden v. Terminal Railroad of Alabama State Docks Dept., 311 F.2d 727, rev'd on other grounds, 377 U.S. 184 (1963) (state operating railroad did not waive 11th Amendment immunity); Edelman v. Jordan, 415 U.S. 651 (1974) (state participation in aid program did not waive immunity); Adams v. Harris County, Texas, 316 F.Supp. 938 (D.C.Tex. 1970), rev'd on other grounds, 452 F.2d 994, cert. den. 406 U.S. 968 (county by building bridge across navigable waters waived 11th Amendment immunity). The rule appears to be that Congress must expressly provide that a state will waive its immunity before participation in a federally regulated program will be considered a waiver. See, Intracoastal Transportation, Inc. v. Decatur County, Georgia, 482 F.2d 361 (5th Cir. 1973).

[466]Pruitt v. City of Rosedale, 421 So.2d 1046 (Miss. 1982).

[467]See, Chapter 495, Laws of 1984; Chapter 474, Laws of 1985.

[468]Miss. Code 1972 §11-46-3 (Supp. 1985).

[469]See, State Highway Comm'n v. Gulley, 145 So. 351 (Miss. 1933).

[470]Tucker v. City of Okalona, 227 So.2d 475 (Miss. 1969).

[471]Id., 476.

[472]Nathaniel v. City of Moss Point, 385 So.2d 599 (Miss. 1980).

[473]Alabama Constitution, Art. I §14.

[474]Druid City Hospital Bd. v. Epperson, 398 So.2d 696 (Ala. 1979).

[475]Jefferson County Pharmaceutical Ass'n v. Abbott Laboratories, 656 F.2d 92 (5th Cir. 1981) (federal law); Gunther v. Beasley, 414 So.2d 41 (Ala. 1982).

[476]Ala. Code 1975 §11-47-190 (1983).

[477]See, Ott v. Everett, 420 So.2d 258 (Ala. 1982); Rich v. City of Mobile, 410 So.2d 385 (Ala. 1982).

[478]Jackson v. City of Florence, 320 So.2d 68 (Ala. 1975).

[479]Ala. Code 1975 §11-93-2 (1983).

[480]See, Rich, supra at 477.

[481]Tutwiler Drug Co. v. City of Birmingham, 418 So.2d 102 (Ala. 1982).

[482]Fla. Stat. §768.28 (Supp. 1985).

[483]Id. §768.28(5).

[484]See, Trianon Park Condominium Ass'n, Inc. v. City of Hialeah, 468 So.2d 912 (Fla. 1985); Avallone v. Board of County Com'rs of Citrus County, 467 So.2d 826 (Fla. App. 1985).

[485]See, Southwestern Insurance Co. v. Stanton, 390 So.2d 417 (Fla. App. 1980).

[486]Id.

[487]Buford v. Horne, 300 So.2d 913 (Miss. 1974).

[488]Godfrey v. Vinson, 110 So. 13 (Ala. 1926).

[489]Saxton v. Rose, 29 So.2d 646 (Miss. 1947).

[490]Id.

[491] *Kaplan v. Wolff*, 198 So.2d 103 (Fla. App. 1967).

[492] *Baptist Medical Center v. Byars*, 271 So.2d 847 (Ala. 1972); *Foster & Creighton Co. v. St. Paul Mercury Indem. Co.*, 88 So.2d 825 (Ala. 1956).

[493] *See*, Jacksonville Corps General Permit, General Condition g; Mobile Corps General Permit, General Condition d; see Appendix for copies of permits.

[494] 33 U.S.C.A. §2104(c)(1).

[495] *Id.* §2104(c)(2).

[496] *Id.* §2104(c)(1).

[497] Geneva Convention on the Outer Continental Shelf (1958), Art. 5, ¶1, Department of State *Bulletin*, June 30, 1958, 1122.

[498] *Id.*, Art. 2, ¶4, 1121-1122.

[499] *Id.*, Art. 5, ¶5, 1122.

[500] United Nations Convention on the Law of the Sea, opened for signature December 10, 1982, U.N. Doc A/Conf. 62/122, Part V, Exclusive Economic Zone, Art. 56, ¶1(a).

[501] *Id.*, Art. 60, ¶¶1 & 2.

[502] Presidential Proclamation 5030, "Exclusive Economic Zone of the United States of America," 48 *Federal Register* 10,605, 3 C.F.R. § 5030 (1983).

[503] Telephone conversation with Rob Abbott, Supervisor of Environmental Safety and Training, Conoco, Inc., New Orleans, on May 27, 1986.

[504] *Id.*

[505] *Id.*

[506] Telephone conversation with Ron Schmeid, Special Assistant for Recreational Fisheries, NMFS, NOAA, St. Petersburg, Florida, late August or early September, 1985; exact date unknown.

[507] *Id.*

[508] Letter from Larry B. Simpson, Executive Director, Gulf State Marine Fisheries Commission, dated November 26, 1984.

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APPENDICES

JACKSONVILLE CORPS DISTRICT

GENERAL PERMIT

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232

APR 11 1984

General Permit For SAJ-50 for
Artificial Fishing Reefs and Fish Attractors

Upon recommendation of the Chief of Engineers, pursuant to Section 10 of the Rivers and Harbors Act of March 3, 1899, (33 U.S.C. 403) and Section 404 of the Clean Water Act of 1977 (86 Stat. 816 FL 92-500), general authority is hereby given to construct and maintain artificial reefs and freshwater fish attractors in the waters of the State of Florida, the Commonwealth of Puerto Rico, and the U.S. Territory of the Virgin Islands subject to the following conditions:

SPECIAL CONDITIONS:

1. Suitable plans and drawings (8 1/2 inches by 11 inches) shall be provided to the Corps of Engineers which specify with particularity the following:

- Site location expressed in both latitude/longitude and Loran C coordinates. Site plans with vicinity maps are acceptable for freshwater fish attractors.
- Water depth measured in feet from mean sea level (msl) or ordinary high waterline (ohwl) as appropriate.
- Proximity to shipping lanes and general navigation channels.
- Types, quantities and onsite orientation of materials to be used for reefs or attractor construction.
- Description of site conditions as evidenced by marine survey or inspection performed by qualified party.
- Anchoring methods for surface and/or midwater fish attracting devices.

2. All material to be placed on the reef(s) or fish attractor(s) is to be selected to avoid/minimize movement of reef materials caused by sea conditions or currents and is to be clean and free of asphalt, creosote, petroleum, other hydrocarbons, toxic residues, loose, free floating material, or other deleterious substances. Such materials may be inspected by the Corps or their designee prior to placement.

3. The permittee shall maintain a minimum vertical clearance above the reef that is no less than that shown in the drawings attached to, and made a part of, the authorization granted.

4. No artificial reefs or fish attractors shall be authorized by this permit which would, in the opinion of the Corps of Engineers, constitute a hazard to/from shipping interests, general navigation, and/or military restricted zones.

5. No authorization is granted by this permit for the construction of artificial reefs or fish attractors in established shrimp, fish and shellfish trawling areas, unless, in the opinion of the Corps of Engineers such construction would not constitute a hazard to those trawling activities.

6. No authorization shall be given unless and until all necessary local, State, or other Federal agency authorizations are granted.

7. Marking of the reef or fish attractor, when applicable, shall be in accordance with U.S. Coast Guard requirements as evidenced by a letter from the U.S. Coast Guard which shall be attached to the application.

8. No authorization is granted by this permit for the construction of artificial reefs within one nautical mile of the Fort Jefferson National Monument, Looe Key National Marine Sanctuary, Key Largo Coral Reef National Marine Sanctuary, Biscayne National Park, Pennekamp State Park, Buck Island Reef, the Florida Middle Grounds [that area bounded by a line beginning at Point A (latitude 28°42.5' N., longitude 84°24.8' W.), proceeding due east for approximately 7.4 nautical miles to Point B (latitude 28°42.5' N., longitude 84°16.3' W.); then proceeding in a southeasterly direction for approximately 34.6 nautical miles to Point C (latitude 28°11' N., longitude 84°00' W.); then proceeding due west for approximately 7 nautical miles to Point D (latitude 28°11' N., longitude 84°07' W.); then proceeding in a northwesterly direction for approximately 22.3 nautical miles to Point E (latitude 28°26.6' N., longitude 84°24.8' W.); then proceeding due north for 15.8 nautical miles to origin at Point A], the Oculina Bank [that area on the East Coast of Florida bounded by latitude 27°30' N. to latitude 27°53' N. and longitude 79°56' W. to longitude 80°00' W.], national historic sites, or other Federal or State parks, preserves, marine sanctuarys, and wildlife management areas.

9. No authorization is granted by this permit for the construction of artificial reefs/fish attractors on significant submerged beds of sea grasses, freshwater grasses, or macroalgae, coral reefs, live bottom (areas supporting dense growth of sponges, sea fans, soft corals, and other sessile microinvertebrates generally associated with rock outcrops), oyster reefs, scallop beds or clam beds.

10. Following expiration of the initial construction authorization, additional material may be placed on the site for an indefinite period for rehabilitative or reef enlargement purposes subject to the approval of necessary plans and materials by the Corps of Engineers.

11. No work shall be performed until after notification of the owner or operator of any marked utilities in the area of the structures.

12. If the issuance of authorization under this permit is found or suspected of affecting the continued existence of an endangered species, the activity will not be authorized by this general permit, and an individual permit will be required.

13. The District Engineer reserves the right to require that any request for authorization under this general permit be processed as an individual permit.

14. Copies of authorized plans shall be furnished by the Corps of Engineers to:

- the Director, Defense Mapping Agency;
- appropriate Environmental Protection Agency and U.S. Fish and and Wildlife Service offices;
- the Director, National Ocean Survey (NOAA);
- the Director, National Marine Fisheries Service, Washington, D.C., and Southeast Region;
- the U.S. Coast Guard;
- affected State agencies of the State of Florida, Commonwealth of Puerto Rico, and the U.S. Territory of the Virgin Islands;
- appropriate fisheries management councils (South Atlantic, Gulf, and Caribbean, etc.); and
- other concerned fishing interests.

15. The General Conditions attached hereto are made a part of this permit (Inclosure 1).

BY AUTHORITY OF THE SECRETARY OF THE ARMY:

ALFRED B. DEVEREAUX, JR.
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232

SAJRD
GENERAL PERMIT

GENERAL CONDITIONS

a. That all activities identified and authorized herein shall be consistent with the terms and conditions of this permit; and that any activities not specifically identified and authorized herein shall constitute a violation of the terms and conditions of this permit which may result in the modification, suspension or revocation of this permit, in whole or in part, as set forth more specifically in General Condition j hereto, and in the institution of such legal proceedings as the United States Government may consider appropriate, whether or not this permit has been previously modified, suspended, or revoked in whole or in part.

b. That all activities authorized herein shall, if they involve a discharge or deposit into navigable waters or ocean waters, be at all times consistent with applicable water quality standards, effluent limitations and standards of performance, prohibitions, and pretreatment standards established pursuant to Sections 301, 302, 306, and 307 of the Federal Water Pollution Control Act of 1972 (P.L. 92-500; 86 Stat. 816), or pursuant to applicable State and local law.

c. That when the activity authorized herein involves a discharge or deposit of dredged or fill material into navigable waters, the authorized activity shall, if applicable water quality standards are revised or modified during the term of this permit, be modified if necessary, to conform with such revised or modified water quality standards within 6 months of the effective date of any revision or modification of water quality standards, or as directed by an implementation plan contained in such revised or modified standards, or within such longer period of time as the District Engineer, in consultation with the Regional Administrator of the Environmental Protection Agency, may determine to be reasonable under the circumstances.

d. That the permittee agrees to make every reasonable effort to prosecute the construction or work authorized herein in a manner so as to minimize any adverse impact of the construction or work on fish, wildlife, and natural environmental values.

e. That the permittee(s) agree to prosecute the construction or work authorized herein in a manner so as to minimize any degradation of water quality.

f. That the permittee shall permit the District Engineer or his authorized representative(s) or designee(s) to make periodic inspections at any time deemed necessary in order to assure that the activity being performed under authority of this permit is in accordance with the terms and conditions prescribed herein.

Incl 1

g. That the permittee shall maintain the structure or work authorized herein in good condition and in accordance with the plans and drawings that are approved.

h. That this permit does not convey any property rights, either in real estate or material, or any exclusive privileges; and that it does not authorize any injury to property or invasion of rights or any infringement of Federal, State, or local laws or regulations, nor does it obviate the requirement to obtain State or local assent required by law for the activity authorized herein.

i. That this permit does not authorize the interference with any existing or proposed Federal project and that the permittee shall not be entitled to compensation for damage or injury to the structures or work authorized herein which may be caused by or result from existing or future operations undertaken by the United States in the public interest.

j. That this permit may be either modified, suspended, or revoked in whole or in part if the Secretary of the Army or his authorized representative determines that there has been a violation of any of the terms or conditions of this permit or that such action would otherwise be in the public interest.

k. That in issuing approval to perform work under this permit the Government has relied on the information and data which the permittee has provided in connection with his application. If, subsequent to the issuance of approval, such information and data prove to be false, incomplete, or inaccurate, this permit may be modified, suspended, or revoked, in whole or in part and/or the Government may, in addition, institute appropriate legal proceedings.

l. That any modification, suspension, or revocation of this permit shall not be the basis for any claim for damages against the United States.

m. That no attempt shall be made by the permittee to prevent the full and free use by the public of all navigable waters at or adjacent to the activity authorized by this permit.

n. That if the display of lights and signals on any structure or work authorized herein is not otherwise provided for by law, such lights and signals as may be prescribed by the United States Coast Guard shall be installed and maintained by and at the expense of the permittee.

o. That this permit does not authorize or approve the construction of particular structures, the authorization or approval of which may require authorization by the Congress or other agencies of the Federal Government.

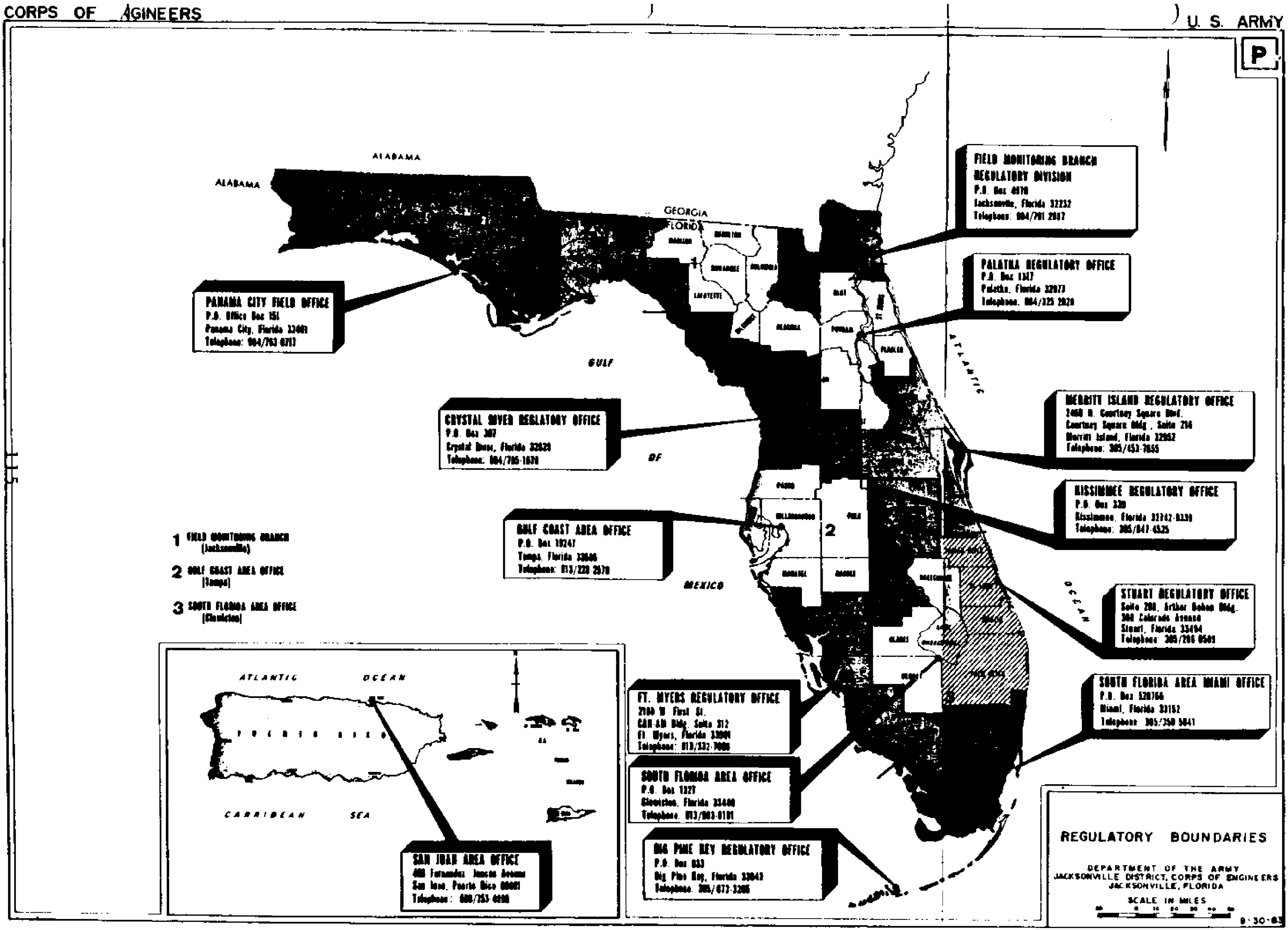
p. That if and when the permittee desires to abandon the activity authorized herein, unless such abandonment is part of a transfer procedure by which the permittee is transferring his interests herein to a third party pursuant to General Condition s hereof, he must restore the area to a condition satisfactory to the District Engineer.

q. That if the recording of this permit is possible under applicable State or local law, the permittee shall take such action as may be necessary to record this permit with the Registrar of Deeds or other appropriate official charged with the responsibility for maintaining records of title to and interests in real property.

r. That there shall be no unreasonable interference with navigation by the existence or use of the activity authorized herein.

s. That authorization under this permit may not be transferred to a third party without prior written notice to the District Engineer by the transferee's written agreement to comply with all terms and conditions of this permit. In addition, if the permittee transfers the interests authorized herein by conveyance of realty, the deed shall reference this permit and the terms and conditions specified herein and this permit shall be recorded along with the deed with the Registrar of Deeds or other appropriate official if law permits.

t. The term "permittee" means the party or parties authorized by the District Engineer to accomplish work under this general permit.


CORPS OF ENGINEERS
U. S. ARMY
P
ALABAMA
ALABAMA
GEORGIA
FLORIDA
GULF
OF
MEXICO
ATLANTIC
OCEAN
FIELD MONITORING BRANCH
REGULATORY DIVISION
PALATKA REGULATORY OFFICE
PANAMA CITY FIELD OFFICE
CRYSTAL RIVER REGULATORY OFFICE
MERRITT ISLAND REGULATORY OFFICE
KISSIMMEE REGULATORY OFFICE
GULF COAST AREA OFFICE
STUART REGULATORY OFFICE
SOUTH FLORIDA AREA MIAMI OFFICE
FT. MYERS REGULATORY OFFICE
SOUTH FLORIDA AREA OFFICE
BIG PINE KEY REGULATORY OFFICE
SAN JUAN AREA OFFICE
1 FIELD MONITORING BRANCH (Jacksonville)
2 GULF COAST AREA OFFICE (Tampa)
3 SOUTH FLORIDA AREA OFFICE (Clewiston)
ATLANTIC OCEAN
CARRIBEAN SEA
REGULATORY BOUNDARIES
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
SCALE IN MILES
9-30-83

MOBILE CORPS DISTRICT

GENERAL PERMIT FOR ALABAMA

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2288
MOBILE, ALABAMA 36628

REPLY TO
ATTENTION OF:

SAMOP-S
PUBLIC NOTICE NOS. ALG02 - ALG19

16 May 1983

JOINT PUBLIC NOTICE
US ARMY CORPS OF ENGINEERS
AND
STATE OF ALABAMA
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

The Mobile District Corps of Engineers has requested water quality certification and coastal management consistency from the ADEM for a period of five years for the activities as described in this public notice. As a result of the ADEM's requirement under law, the ADEM hereby informs the public of its intent to grant the requested certification and consistency determination for those activities as described in this notice of authorization. Following the 30-day advertisement period provided by this notice, the certification and consistency determination as described below can be presumed to be valid, provided there is no significant comment relating to the certification or consistency determination as a result of the notice.

Action pertinent to water quality certification and coastal management consistency is required by Section 401(a)(1) of the Clean Water Act, 33 U.S.C. §1251, et seq., and the Alabama Coastal Area Management Program. We hereby issue official certification that the proposed activities will comply with appropriate postions of Sections 301, 302, 306, and 307 of the Clean Water Act and that the project has been found to be consistent with the Alabama Coastal Management Program conditioned upon continued compliance with the management program.

You are requested to communicate the information contained in this notice to any other parties whom you deem likely to have interest in the matter.

DEPARTMENT OF THE ARMY
REGIONAL PERMITS FOR
MINOR STRUCTURES AND ACTIVITIES WITHIN THE STATE OF ALABAMA

Upon completion of this 30-day notice and upon recommendation of the Chief of Engineers, pursuant to Section 10 of the River and Harbor Act of 1899 (33 USC 403), and Section 404 of the Clean Water Act of 1977 (33 USC 1344), authorizations may be issued by the Mobile District US Army Corps of Engineers for the herein-identified minor structures and activities in waters of the United States within the State of Alabama under the following Regional Permits:

ALG02 - Construction of boatslips. This must involve dredging less than 300 cubic yards of material from below the mean high tide or the ordinary high water mark. The depth of the boatslip must be no greater than the depth of the water leading to the slip and must not extend more than fifty feet landward of the preconstruction mean high tide or the ordinary high water mark. Dredged material shall not be placed in adjacent waters or wetlands. The dredged material must be deposited in an upland area and properly confined in such a manner that the sediment will not reenter the waterway or interfere with natural drainage.

ALG03 - Maintenance dredging of existing boatslips. This must involve the maintenance dredging of less than 500 cubic yards of material. The depth shall be no greater than the design depths and the depth of the waters leading to the area to be maintained. The dredged material must not be placed in adjacent waters or wetlands. The dredged material shall be deposited in an upland area and properly confined in such a manner that the sediment will not reenter the waterway or interfere with natural drainage.

ALG04 - Maintenance dredging of existing canals. This must involve the dredging of less than 500 cubic yards of material. The depth shall be no greater than the design depths and the depth of the waters leading to the area to be maintained. The dredged material shall not be placed in adjacent waters or wetlands. The dredged material shall be deposited in an upland area and and properly confined in such a manner that the sediment will not reenter the waterway or interfere with natural drainage. All work must be performed within that portion of the waterway (canal) fronting the applicant's property.

ALG05 - Maintenance dredging of existing docking or berthing areas. This must involve the dredging of less than 500 cubic yards of material. The depth shall be no greater than the design depths and the depth of the waters leading to the area to be maintained. The dredged material shall not be placed in adjacent waters or wetlands. The dredged material shall be deposited in an upland area and properly confined in such a manner that the sediment will not reenter the waterway or interfere with natural drainage. The activity must be a single and complete project. "Piecemeal Dredging" activities are specifically excluded from this authorization.

ALG06 - Maintenance dredging of existing navigation channels. This must involve the dredging of less than 500 cubic yards of material. The depth shall be no greater than the design depths and the depth of the waters leading to the area to be maintained. The dredged material shall not be placed in adjacent waters or wetlands. The dredged material shall be deposited in an upland area and properly confined in such a manner that the sediment will not reenter the waterway or interfere with natural drainage. The activity must be a single and complete project. "Piecemeal Dredging" activities are specifically excluded from this authorization.

ALG07 - Construction and/or maintenance of piers, wharfs, and their normal appurtenances such as stairways and walkways. Fueling facilities and toilets over navigable waters of the United States are specifically excluded from this authorization.

ALG08 - Construction and/or maintenance of boat shelters, gazebos, hoists, and shelters. Fueling facilities, toilets, and permanent living quarters over navigable waters of the United States are specifically excluded from this authorization.

ALG09 - Construction and maintenance of boat ramps. This must involve the excavation and/or discharge of less than 100 cubic yards of material below the mean high tide or the ordinary high water mark. Dredged material must be deposited on a nonwetland (upland) site and properly confined.

ALG10 - Construction and maintenance of marineways. This must involve the excavation and/or discharge of less than 100 cubic yards of material below mean high tide or the mean high water. Dredged material must be deposited on a nonwetland (upland) site and properly confined.

ALG11 - Mooring pilings and dolphins. The permanent mooring of houseboats are specifically excluded from this authorization.

ALG12 - Permanent mooring anchors.

ALG13 - Fish havens and similar fish attractor and mariculture (aquaculture) activities. The application must include provisions of marking according to current Coast Guard regulations.

ALG14 - Installation of oyster reefs. Oyster reefs must be installed in accordance with US Coast Guard regulations.

ALG15 - Submerged cables. Cables must be buried below the natural ground elevation. Excavated trenches shall be backfilled after installation. Disturbed soil surfaces must be restored to pre-existing contours. Disturbed wetland areas shall be revegetated with naturally occurring species if the areas have not revegetated within one year after completion of the project. Any excess material, beyond that needed to restore the bottom contours to their preconstruction status, must be removed to an upland area and properly confined. Such cables must meet established navigation safety requirements of the US Army Corps of Engineers and the US Coast Guard.

ALG16 - Submerged pipelines. Pipelines must be buried below the natural ground elevation. Excavated trenches shall be backfilled after installation. Disturbed soil surfaces must be restored to pre-existing contours. Disturbed wetland areas will be revegetated with naturally occurring species if the areas have not revegetated within one year after completion of the project. Any excess materials beyond that needed to restore the bottom contours to their pre-construction status must be removed to an upland area and properly confined. Requests for hydrocarbon transmission pipelines will be coordinated with the Alabama Department of Environmental Management by the Mobile District for consistency with the Alabama Coastal Zone Management Program and/or compliance with State water quality standards. Such coordination will provide for a maximum 15-day review period which will begin upon receipt of a request by the ADEM. Upon close of the 15-day period, concurrence will be presumed unless comment and/or objection is received from the ADEM which could possibly necessitate subjection to an individual permit procedure and a full public interest review. Such pipelines must meet established navigation safety requirements of the US Army Corps of Engineers and the US Coast Guard.

ALG17 - Aerial transmission lines. Fill placed incidental to the construction of footings for support structure is authorized under this Regional Permit. Navigation clearances, as designated by the Corps of Engineers, and clearances established by the National Electric Safety Code, must be maintained. Disturbed wetland areas shall be revegetated with naturally occurring species if the areas have not revegetated within one year after completion of the project. Any excess materials beyond that needed to restore the bottom contours to their preconstruction status must be removed to an upland area and properly confined.

ALG18 - Discharge structures in navigable waters of the United States. NPDES permits must be submitted with the application.

ALG19 - Intake structures in the navigable waters of the United States. A letter of concurrence from local and/or State water management agency must be submitted with the application.

CONDITIONS

I. SPECIAL CONDITIONS: The above-described structures and activities may be authorized under these Regional Permits subject to the following conditions:

a. Structures and activities that may be hazardous to navigation, or may produce adverse effects on the chemical, physical, or biological integrity of the water bodies such as dredging or filling of wetland areas, cannot be authorized under these Regional Permits. Activities that involve the disturbance of oyster beds and/or fishing reefs cannot be authorized under these Regional Permits. The term "wetland" means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Such areas serve important purposes relating to water quality, fish and wildlife, recreation, and other elements in the general public interest. As environmentally vital areas, they constitute a productive and valuable public resource, the unnecessary alteration or destruction of which are contrary to the public interest.

b. The applicant must submit satisfactory plans and is advised that all State and local permits must be obtained. Concurrence from local, State, and/or Federal water resource management authorities, where applicable, must be submitted with the application.

c. Conformance with description and quantities contained herein does not necessarily guarantee consideration and/or subsequent authorization under these Regional Permits.

d. These Regional Permits will be valid for a five-year period or until suspended or revoked. They may be suspended or revoked, in whole or in part, if it is determined that the cumulative effects of any activities pursuant to them adversely affect water quality, navigation, or other public interest factors. Such suspension shall be effective upon issuance of a public notice, which shall indicate the date and reason for the suspension. Reviews will be conducted periodically to determine if continuation of these permits are in the overall public interest. Within five years from the date of this public notice these permits will be readvertised via public notice as part of the public interest review. Individual authorization issued under these General Permits will be valid for a 3-year period.

e. Authorizations will not be issued under these Regional Permits which will adversely impact threatened or endangered species, or their critical habitat.

f. Authorizations will not be issued under these Regional Permits which will impact, affect, or otherwise degrade cultural resources such as archaeological, scientific, prehistoric, or historic sites or data. If, during construction of an authorized activity such resources are discovered, all work will be halted immediately and the District Office notified.

g. Authorizations will not be issued under these Regional Permits for activities located in State or National Wild and Scenic streams, rivers, or components thereof.

h. Authorizations will be suspended if State water quality standards are not met.

i. If the proposed activity is located on one of the following Corps of Engineers Lakes, the plans must be reviewed and approved, and may be issued by the Resource Manager in lieu of the Mobile District Office. The Resource Manager will furnish a monthly listing of all such authorizations to the Regulatory Branch, Mobile District Office.

Claiborne Lake, William "Bill" Dannelly Reservoir, and R. B. "Bob" Woodruff Lake:
Alabama River Lakes
US Army Corps of Engineers
Resource Manager
Route 1, Box 43-H
Camden, AL 36726

Aliceville Lock and Dam:
US Army Corps of Engineers
Route 2, Box 332B
Carrollton, AL 35447

Coffeeville Lake, Warrior Lake, Demopolis Lake, and Holt Lake:
Black Warrior and Tombigbee Lakes
US Army Corps of Engineers
Resource Manager's Office
P.O. Box 520
Demopolis, AL 36732

Lake Seminole:
US Army Corps of Engineers
Resource Manager's Office
P.O. Box 96
Chattahoochee, FL 32324

Walter F. George Lake and George W. Andrews Lake:
US Army Corps of Engineers
Resource Manager's Office
P.O. Box 281
Fort Gaines, GA 31751

West Point Lake:
US Army Corps of Engineers
Resource Manager's Office
P.O. Box 574
West Point, GA 31833

II. GENERAL CONDITIONS: In addition to Special Conditions "a" through "i" above, the following general conditions will apply:

a. Any dredging or filling activities not specifically identified and authorized under these Regional Permits constitute a violation of the terms and conditions. Such activities may result in the modification, suspension, or revocation of the individual authorizations, and such legal proceedings as the United States Government may consider appropriate.

b. All activities authorized under these permits, involving a discharge or deposit into navigable or ocean waters, or ground waters, will at all times be consistent with applicable State water quality standards, effluent limitations, and standards of performance established in the Clean Water Act of 1977.

c. The permittee shall allow the District Engineer or his authorized representative(s) or designee(s) to make periodic inspections at any time deemed necessary in order to assure that the activities being performed under authority of these permits are in accordance with the terms and conditions prescribed herein.

d. The permittee shall maintain the structure or work authorized herein in good condition and in accordance with the plans and drawings attached to the individual authorization.

e. These permits and subsequent authorizations convey no property rights, either real or personal, or any exclusive privileges, and it does not authorize any injury to property or invasion of rights or any infringement of Federal, State, or local laws or regulations, nor does it obviate the requirement to obtain State or local assent required by law for the activities authorized herein.

f. These permits do not authorize the interference with any existing or proposed Federal project and the permittee is not entitled to compensation for damage or injury to the structures or work authorized herein which may be caused by or result from existing or future operations undertaken by the United States in the public interest.

g. In issuing an authorization under these permits, the Government relies on the information and data which the permittee provides in connection with the permit application. If, subsequent to the issuance of an authorization, such information and data prove to be false, incomplete, or inaccurate, the authorization may be modified, suspended, or revoked, in whole or in part, and/or the Federal Government may institute appropriate legal proceedings.

h. Any modification, suspension, or revocation of these permits or authorizations thereunder shall not be the basis for any claim for damages against the United States.

i. No attempt shall be made by the permittee to prevent the full and free use of the public of all navigable waters at or adjacent to the activity authorized by the permit.

j. These permits do not authorize or approve the construction of particular structures, the authorization or approval of which may require authorization by the Congress or other agencies of the Federal Government.

k. If and when the permittee desires to abandon the activity authorized herein, unless such abandonment is part of a transfer procedure by which the permittee is transferring his interests herein to a third party pursuant to General Condition l hereof, he must restore the areas to a condition satisfactory to the District Engineer.

l. The authorization may not be transferred to a third party without prior written notice to the District Engineer, either by the transferee's written agreement to comply with all terms and conditions of the authorizations or by the transferee subscribing to the authorizations and hereby agreeing to comply with all terms and conditions of the authorization. In addition, if the permittee transfers the interest authorized by conveyance of realty, the deed shall reference this permit and the authorizations, and the terms and conditions specified herein and these shall be recorded along with the deed with the Registrar of Deeds or other appropriate official.

m. That if an authorized activity pursuant to these Regional Permits is not completed within THREE YEARS from the date of issuance of an authorization, unless otherwise specified, the authorization, if not previously revoked or specifically extended, shall automatically expire.

DATE: 16 May 1983

for PATRICK J. KELLY, Colonel, CE
Mobile District
US Army Corps of Engineers

MOBILE CORPS DISTRICT

GENERAL PERMIT FOR MISSISSIPPI

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628

REPLY TO
ATTENTION OF:
SAMOP-S
REGIONAL PERMITS NOS. MSG02 - MSG19

1 December 1982

TO WHOM IT MAY CONCERN:

DEPARTMENT OF THE ARMY
REGIONAL PERMITS FOR
MINOR STRUCTURES AND ACTIVITIES WITHIN THE STATE OF MISSISSIPPI

Upon recommendation of the Chief of Engineers, pursuant to Section 10 of the River and Harbor Act of 1899 (33 USC 403), and Section 404 of the Clean Water Act of 1977 (33 USC 1344), authorizations have been issued by the Mobile District US Army Corps of Engineers for the herein-identified minor structures and activities in waters of the United States within the State of Mississippi under the following Regional Permits:

MSG02 - Construction of indented boatslips. This must involve dredging less than 200 cubic yards of material from below mean high tide or mean high water. The depth of the boatslip shall be no greater than the depth of the water leading to the slip. Dredged material shall not be placed in adjacent waters or wetlands. The dredged material shall be deposited in a confined upland area in such a manner that the sediment will not reenter waterway or interfere with natural drainage. See attached drawing for details of an indented boatslip.

MSG03 - Maintenance dredging of existing boatslips. This must involve the maintenance dredging of less than 200 cubic yards of material. The depth shall be no greater than the design depths and the depth of the waters leading to the area to be maintained. The dredged material shall not be placed in adjacent waters or wetlands. The dredged material shall be deposited in an upland area and properly confined in such a manner that the sediment will not reenter the waterway or interfere with natural drainage.

MSG04 - Maintenance dredging of existing canals. This must involve the dredging of less than 200 cubic yards of material. The depth shall be no greater than the design depths and the depth of the waters leading to the area to be maintained. The dredged material shall not be placed in adjacent waters or wetlands. The dredged material shall be deposited in an upland area and properly confined in such a manner that the sediment will not reenter the waterway or interfere with natural drainage. All work must be performed within that portion of the waterway (canal) fronting the applicant's property.

MSG05 - Maintenance dredging of existing docking or berthing areas. This must involve the dredging of less than 200 cubic yards of material. The depth shall be no greater than the design depths and the depth of the waters leading to the area to be maintained. The dredged material shall not be placed in adjacent waters or wetlands. The dredged material shall be deposited in an upland area and properly confined in such a manner that the sediment will not reenter the waterway or interfere with natural drainage. The activity must be a single and complete project. "Piecemeal Dredging" activities are specifically excluded from this authorization.

MSG06 - Maintenance dredging of existing navigation channels. This must involve the dredging of less than 200 cubic yards of material. The depth shall be no greater than the design depths and the depth of the waters leading to the area to be maintained. The dredged material shall not be placed in adjacent waters or wetlands. The dredged material shall be deposited in an upland area and properly confined in such a manner that the sediment will not reenter the waterway or interfere with natural drainage. The activity must be a single and complete project. "Piecemeal Dredging" activities are specifically excluded from this authorization.

MSG07 - Construction and/or maintenance of piers, wharfs, and their normal appurtenances such as stairways and walkways. Fueling facilities and toilets over navigable waters of the United States are specifically excluded from this authorization.

MSG08 - Construction and/or maintenance of boat shelters, gazebos, hoists, and shelters. Fueling facilities, toilets, and permanent living quarters over navigable waters of the United States are specifically excluded from this authorization.

MSG09 - Construction and maintenance of boat ramps. This must require less than 100 cubic yards of dredged or fill material below mean high tide or ordinary high water. Dredged material must be deposited on a nonwetland (upland) site and properly confined.

MSG10 - Construction and maintenance of marineways. This must require less than 100 cubic yards of dredged or fill material below mean high tide or mean high water. Dredged material must be deposited on a nonwetland (upland) site and properly confined.

MSG11 - Mooring pilings and dolphins. The permanent mooring of houseboats are specifically excluded from this authorization.

MSG12 - Permanent mooring anchors.

MSG13 - Fish havens and similar fish attractor and mariculture (Aquaculture) activities. The application must include provisions of marking according to current Coast Guard regulations.

MSG14 - Oyster reefs.

MSG15 - Submerged cables. Cables may be loosely laid or buried. Excavated trenches shall be backfilled after installation. Any excess material, beyond that needed to restore the bottom contours to their preconstruction status, must be removed to an upland area and properly confined. Such cables must meet established navigation safety requirements of the US Army Corps of Engineers and the US Coast Guard.

MSG16 - Submerged pipelines. Pipelines may be loosely laid or buried. Excavated trenches shall be backfilled after installation. Any excess material, beyond that needed to restore the bottom contours to their preconstruction status, must be removed to an upland area and properly confined. Such pipelines must meet established navigation safety requirements of the US Army Corps of Engineers and the US Coast Guard.

MSG17 - Aerial transmission lines. Fill placed incidental to the construction of footings for support structure, is authorized under this Regional Permit. Navigation clearances, as designated by the Corps of Engineers and clearances established by the National Electric Safety Code, must be maintained.

MSG18 - Discharge structures in navigable waters of the United States. NPDES permits must be submitted with the application.

MSG19 - Intake structures in the navigable waters of the United States. A letter of concurrence from local and/or State water management agency must be submitted with the application.

CONDITIONS

I. SPECIAL CONDITIONS: The above-described structures and activities may be authorized under this Regional Permits subject to the following conditions:

a. Structures and activities that may be hazardous to navigation, or may produce adverse effects on the chemical, physical, or biological integrity of the water bodies such as dredging or filling of wetland areas, cannot be authorized under these Regional Permits. The term "wetland" means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Such areas serve important purposes relating to water quality, fish and wildlife, recreation, and other elements in the general public interest. As environmentally vital areas, they constitute a productive and valuable public resource, the unnecessary alteration or destruction of which are contrary to the public interest.

b. The applicant must submit satisfactory plans and is advised that all State and local permits must be obtained before work can be authorized.

c. Conformance with description and quantities contained herein does not necessarily guarantee consideration and/or subsequent authorization under these Regional Permits.

d. These Regional Permits will be valid for a five-year period or until suspended or revoked. They may be suspended or revoked, in whole or in part, if it is determined that the cumulative effects of any activities pursuant to them adversely affect water quality, navigation, or other public interest factors. Such suspension shall be effective upon issuance of a public notice, which shall indicate the date and reason for the suspension. Reviews will be conducted periodically to determine if continuation of these permits are in the overall public interest. Within five years from the date of this public notice these permits will be readvertised via public notice as part of the public interest review.

e. Authorizations will not be issued under these Regional Permits which will adversely impact threatened or endangered species, or their critical habitat.

f. Authorizations will not be issued under these Regional Permits which will impact, affect, or otherwise degrade cultural resources such as archaeological, scientific, prehistoric, or historic sites or data.

g. Authorizations will not be issued under these Regional Permits for activities located in State or National Wild and Scenic streams, rivers, or components thereof.

h. Authorizations will be suspended if State water quality standards are not met. Among other conditions the Mississippi Bureau of Pollution Control requires that:

(1) Sewage, oil, and/or refuse generated during the course of the project shall not be discharged into the watercourse.

(2) The turbidity outside the limits of a 750-foot mixing zone shall not exceed the ambient turbidity by more than 50 Jackson Turbidity Units.

II. <u>GENERAL CONDITIONS</u>: In addition to Special Conditions "a" through "g" above, the following general conditions will apply:

a. Any dredging or filling activities not specifically identified and authorized under these Regional Permits constitute a violation of the terms and conditions. Such activities may result in the modification, suspension, or revocation of the individual authorizations, and such legal proceedings as the United States Government may consider appropriate.

b. All activities authorized under these permits, involving a discharge or deposit into navigable or ocean waters, or ground waters, will at all times be consistent with applicable State water quality standards, effluent limitations, and standards of performance established in the Clean Water Act of 1977.

c. The permittee shall allow the District Engineer or his authorized representative(s) or designee(s) to make periodic inspections at any time deemed necessary in order to assure that the activities being performed under authority of these permits are in accordance with the terms and conditions prescribed herein.

d. The permittee shall maintain the structure or work authorized herein in good condition and in accordance with the plans and drawings attached to the individual authorization.

e. These permits and subsequent authorizations convey no property rights, either real or personal, or any exclusive privileges, and it does not authorize any injury to property or invasion of rights or any infringement of Federal, State, or local laws or regulations, nor does it obviate the requirement to obtain State or local assent required by law for the activities authorized herein.

f. These permits do not authorize the interference with any existing or proposed Federal project and the permittee is not entitled to compensation for damage or injury to the structures or work authorized herein which may be caused by or result from existing or future operations undertaken by the United States in the public interest.

g. In issuing an authorization under these permits, the Government relies on the information and data which the permittee provides in connection with the permit application. If, subsequent to the issuance of an authorization, such information and data prove to be false, incomplete, or inaccurate, the authorization may be modified, suspended, or revoked, in whole or in part, and/or the Federal Government may institute appropriate legal proceedings.

h. Any modification, suspension, or revocation of these permits or authorizations thereunder shall not be the basis for any claim for damages against the United States.

i. No attempt shall be made by the permittee to prevent the full and free use of the public of all navigable waters at or adjacent to the activity authorized by the permit.

j. These permits do not authorize or approve the construction of particular structures, the authorization or approval of which may require authorization by the Congress or other agencies of the Federal Government.

k. If and when the permittee desires to abandon the activity authorized herein, unless such abandonment is part of a transfer procedure by which the permittee is transferring his interests herein to a third party pursuant to General Condition l hereof, he must restore the areas to a condition satisfactory to the District Engineer.

l. The authorization may not be transferred to a third party without prior written notice to the District Engineer, either by the transferee's written agreement to comply with all terms and conditions of the authorizations or by the transferee subscribing to the authorizations and hereby agreeing to comply with all terms and conditions of the authorization. In addition, if the permittee transfers the interest authorized by conveyance of realty, the deed shall reference this permit and the authorizations, and the terms and conditions specified herein and these shall be recorded along with the deed with the Registrar of Deeds or other appropriate official.

m. That if an authorized activity pursuant to these Regional Permits is not completed within THREE YEARS from the date of issuance of an authorization, unless otherwise specified, the authorization, if not previously revoked or specifically extended, shall automatically expire.

BY AUTHORITY OF THE SECRETARY OF THE ARMY:

4 November 1982

Patrick J. Kelly

PATRICK J. KELLY
Colonel, CE
District Engineer

Enclosure

DEPARTMENT OF THE ARMY

MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628

REPLY TO
ATTENTION OF:

SAMOP-S

10 July 1983

INFORMATIONAL PUBLIC NOTICE

TO WHOM IT MAY CONCERN:

Reference is made to Public Notice MSG02 through MSG19 dated 1 December 1982 wherein certain minor structures and activities are administered under a General Permit Program by the Mobile District, US Army Corps of Engineers within that District's jurisdiction in the State of Mississippi. If a proposed activity is identified in the above mentioned public notice and is located on one of the following Corps of Engineers Lakes, the plans must be reviewed and approved by the Resource Manager, Additionally, the Resource Manager may, on his discretion, issue a permit in lieu of the Mobile District Office. The Resource Manager will furnish a monthly listing of all such authorizations to the Regulatory Branch, Mobile District Office.

a. The Tennessee-Tombigbee Waterway Lakes, within the State of Mississippi, including Aliceville Lake, Columbus Lake, Lock Pools A through E, and Bay Springs Lake:

Area Engineer
Columbus Area Office
Post Office Box 2800
Columbus, Mississippi 39704

b. Okatibbee Lake:

Okatibbee Lake
US Army Corps of Engineers
P.O. Box 98
Collinsville, MS 39325

If you have any questions concerning this public notice, you may contact Mr. John Winn at the Regulatory Branch, telephone number 205/690-2584.

MOBILE DISTRICT
US Army Corps of Engineers

PROPOSED REGULATIONS FOR ARTIFICIAL REEFS

U.S. ARMY CORPS OF ENGINEERS

DEPARTMENT OF DEFENSE

CORPS OF ENGINEERS, DEPARTMENT OF THE ARMY

33 CFR PARTS 322 and 325

PROPOSED RULE FOR REGULATORY PROGRAM OF THE CORPS OF ENGINEERS

AGENCY: Corps of Engineers, Department of the Army, DOD.

ACTION: Proposed rule.

SUMMARY: We are hereby issuing a proposed rule which governs the regulatory program of the Corps of Engineers. The major changes of these regulations are to implement the National Fishing Enhancement Act of 1984 (P.L. 98-623). Many of these procedures are verbatim from the statute. We will review all comments and determine whether any changes are necessary.

The National Fishing Enhancement Act of 1984 also authorized the Secretary of the Army to assess a civil penalty on any person who, after notice and an opportunity for a hearing, is found to have violated any provision of a permit issued for an artificial reef. Procedures for implementing such civil penalties will be proposed at a later date.

DATES: Comments must be submitted on or before (60 days from date of publication).

ADDRESS: Office of the Chief of Engineers, ATTN: DAEN-CWO-N, Washington, D. C. 20314-1000.

FOR FURTHER INFORMATION CONTACT: Dr. Robert Pierce or Mr. Burt Paynter, Regulatory Branch, (202) 272-0199.

<u>Environmental Documentation</u>: We have determined that this action does not

constitute a major Federal action significantly affecting the quality of the human environment. Appropriate environmental documentation is prepared for all permit decisions.

PART 322 - PERMITS FOR STRUCTURES OR WORK IN OR AFFECTING NAVIGABLE WATERS OF THE UNITED STATES.

Section 322.2(g): This section adds the definition of the term "artificial reefs" from the National Fishing Enhancement Act and clarifies what activities or structures the term does not include.

Section 322.2(h): This section adds the definition of the term "outer continental shelf" from Outer Continental Shelf Land Act.

Section 322.5(b): This section is a new section establishing procedures to comply with the National Fishing Enhancement Act of 1984. The specific provisions are taken directly from the statute.

PART 325 - PROCESSING OF DEPARTMENT OF THE ARMY PERMITS

Section 325.1(d)(8): This is a new section requiring an applicant to include provisions for siting, constructing, monitoring and managing of the artificial reef as part of his application for a permit.

Determinations under Executive Order 12291 and the Regulatory Flexibility Act

The Department of the Army has determined that the revisions to its regulations do not contain a major proposal requiring the preparation of a regulatory analysis under Executive Order 12291. The Department of the Army certifies, pursuant to Section 605(b) of the Regulatory Flexibility Act of 1980, that these regulations will not have a significant economic impact on a substantial number of entities.

NOTE 1. The term "he" and its derivatives used in these regulations are generic and should be considered as applying to both male and female.

List of Subjects:

33 CFR Part 322 — Continental Shelf, Navigation

33 CFR Part 325 — Administrative Practices and Procedure, Environmental Protection, Navigation

DATED: ______________________

____

Robert K. Dawson

Acting Assistant Secretary of the Army

(Civil Works)

Accordingly, the Department of the Army is amending 33 CFR Parts 322 and 325 as set forth below:

Authority: 33 U.S.C. 401 et seq.; 33 U.S.C. 1344; 33 U.S.C. 1413; 33 U.S.C. 2101.

PART 322 - PERMITS FOR STRUCTURES OR WORK IN OR AFFECTING NAVIGABLE WATERS OF THE UNITED STATES

1. Section 322.2 is amended by adding new paragraphs (g) and (h) as follows:

Section 322.2 Definitions.

* * * * *

(g) The term "artificial reef" means a structure which is constructed or placed in the navigable waters of the United States or in the waters overlying the outer continental shelf for the purpose of enhancing fishery resources and commercial and recreational fishing opportunities. The term does not include activities or structures such as wing deflectors, bank stabilization, grade stabilization structures, or low flow key ways, all of which may be useful to enhance fisheries resources.

(h) The term "outer continental shelf" means all submerged lands lying seaward and outside of the area of lands beneath the three mile territorial seas, and of which the subsoil and seabed appertain to the United States and are subject to its jurisdiction and control.

2. Section 322.5 is amended by adding a new paragraph (b), previously reserved, as follows:

Section 322.5 Special Policies

* * * * *

(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 to navigation.

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 he holds unambiguous title to the artificial reef construction materials, and that he is financially able to assume responsibility for all damages which may arise with respect to the artificial reef and for which that applicant may be liable. The permittee and his insurer will be liable, to the extent determined under applicable law, for all damages which may arise with respect to the artificial reef unless those damages result from activities required to be undertaken by the terms and conditions of the permit. The permittee must be acting in compliance with those terms and conditions for this exception from liability to apply.

* * * * *

PART 325 - PROCESSING OF DEPARTMENT OF THE ARMY PERMITS

3. Section 325.1 is amended by adding a new paragraph (d)(8) as follows:

Section 325.1 Applications for Permits

* * * * *

(d) * * *

(8) If the activity would involve the construction or placement of an artificial reef, as defined in 33 CFR 322.2(g), in the navigable waters of the United States or in the waters overlying the outer continental shelf, the application must include provisions for siting, constructing, monitoring, and managing the artificial reef.

* * * * *

COAST GUARD RESPONSIBILITIES

1974 INTERNATIONAL CONFERENCE ON ARTIFICIAL REEFS

HOUSTON, TEXAS

Proceedings of an International Conference on Artificial Reefs

Astroworld Hotel   March 20 - 22, 1974   Houston, Texas

Sponsors:

Center for Marine Resources, Texas A&M University

National Marine Fisheries Service

Texas Coastal and Marine Council

TAMU-SG-74-103

Edited by Laura Colunga and Richard Stone

$4.00

Role of the Coast Guard in Artificial Reefs

FREDRICK F. BURGESS JR.

District Legal Officer, Legal Office, Eighth Coast Guard District, Custom House, New Orleans, Louisiana 70130

The Coast Guard's primary role in regard to artificial reefs deals with the proper marking thereof. The marking role of the Coast Guard stems from authority contained in the provisions of Title 14 U.S. Code § (Section) 81 thru 87 and 43 U.S. Code (USC) § 1333. These statutes give the Coast Guard the prime responsibility for the aids to navigation system of the United States. By aids to navigation is meant any device external to a vessel or aircraft intended to assist a navigator to determine his position or safe course or to warn him of dangers or obstructions to navigation.

Under the authority granted in 14 USC § 81, the Coast Guard establishes and maintains aids to navigation for commerce and the armed forces. Under 14 USC § 85, the Coast Guard has authority to prescribe and enforce necessary rules and regulations relative to lights and signals on fixed structures in or over the navigable waters of the United States, that is, within three miles of the coast. Under 14 USC § 86, the owner of any sunken vessel or other obstruction in navigable waters is responsible for appropriate marking thereof.

Title 14 USC § 83, a most important statute, prohibits the establishment, erection or maintenance of any aid to navigation without the Coast Guard's authority. A violator of this statute is subject to a fine of $100 per offense per day. 14 USC § 84 makes it unlawful for any person or public body to remove, change the location of, obstruct or willfully damage, make fast to or interfere with any aid to navigation either established by the Coast Guard or any aid established under authority granted by the Coast Guard in 14 USC § 83. This statute contains a fine of $500 per offense per day.

Within navigable waters of the United States, we thus have two categories of aids to navigation: first, those established and maintained by the Coast Guard and, second, those established and maintained by other parties after having been authorized by the Coast Guard as well as other agencies requiring approval.

Outside the navigable waters of the United States, under the Outer Continental Shelf Lands Act, 43 USC § 1333, the Coast Guard has authority to require marking by lights or other warning devices on islands and fixed structures or on waters adjacent thereto if those islands and structures are erected for the purpose of exploring for, developing, removing and transporting resources therefrom. The present Coast Guard regulations contained in 33 Code of Federal Regulations (CFR) Part 67 prescribe obstruction lights and fog signals to be operated as privately maintained maritime aids under the circumstances specified in the statute. Included in the regulations are the marking of spoil banks as a result of operations connected with the mentioned purposes. Examples of these latter operations would be laying of pipes and dredging of channels in connection with resource removal structures. The marking and warning devices required by the Coast Guard under these regulations are privately established and maintained but only after having been authorized by the Coast Guard.

As to artificial reefs which have as their purpose the enhancement of swimming fish population, there is some question as to whether the structure is included within the purposes which give rise to the exercise of independent Coast Guard authority to prescribe lights and other warning devices. While the Coast Guard's authority to require marking of Outer Continental Shelf artificial islands or structures appears to be circumscribed by the requirement that the purpose be the development, removal, etc. of natural resources from the sea bed or subsoil, as Mr. Clark will describe, the Corps of Engineers authority relative to the prevention of obstruction in navigable waters, which was extended to the Outer Continental Shelf by 43 USC § 1333 (f), is not so limited. Thus, the placement of any artificial island or structure in either the navigable waters of the United States or on seabed of the Outer Continental Shelf can be done only under a permit from the Army Corps of Engineers. In deciding whether to issue the permit, the Corps of Engineers considers, among other factors, the effect of the erection of a structure or artificial island on navigation. The Coast Guard is given an opportunity to comment on the application. If the Corps grants the permit, the permit itself will contain a condition that the applicant install and maintain, at his own expense, such lights and signals as may be prescribed by the Coast Guard. In some cases the Corps has specified that a buoy mark a reef and that the buoy must be lighted in a manner approved by the Coast Guard.

How does a person go about finding out whether he must mark his submerged artificial reef and the manner in which it should be marked?

The applicant must communicate with the Commander of the Coast Guard District in which the reef is located. The description of the limits of the Coast Guard Districts are contained in 33 CFR Part 3. The applicant should provide the information contained in 33 CFR § 66.01-5 to the District Commander. Included are:

- The proposed position of an aid shown on a chart along with a description of the reef
- The name and address of the person who will maintain the aid and who will be paying for that maintenance
- If a buoy is to be used, the shape, color, number or letter, depth of water and height above water
- If a lighted buoy is to be used, the color, characteristic, height above water and description of illuminating apparatus
- If a fog signal is to be used, the type and character.

The district Commander ordinarily will review the information provided by the applicant and forward a CG 2554 Form to be signed and returned by the applicant. Any additional needed information will be requested. If the type of marking is not known by the applicant; or if the proposed marking is not acceptable, the District Commander will give advice as to the appropriate marking.

The number of aids and type of marking will, of course, depend on a number of factors. Included among these are:

- The vertical clearance over the reef
- The physical size of the reef and the bottom area covered
- The proximity to shipping lanes or fairways
- The proximity to other existing reefs
- Conditions at the site.

Because of the variation in conditions, the exact type of marking required cannot be predicted.

Normally, if there is over 85 feet of vertical clearance, the Coast Guard will not require marking of the reef. However, each project must be considered on its own merits to determine the possible need for marking.

Because a large number of artificial reefs are located within the limits of the Eighth Coast Guard District which covers the bulk of the Gulf of Mexico, I will try to assist those of you from this area by giving you some general guidelines for marking reefs within our District. There may be some variations in other Coast Guard Districts. The general guidelines are:

a. If a light is required, it will generally be a quick flashing white light if there is less than 85 feet of clearance. If the clearance is greater than 85 feet over the reef and circumstances are such that a light is required it will normally be a slow flashing light. The light must be at a height of 8 feet above the water surface unless otherwise specified by the District Commander.

b. Buoys must be colored accordingly to the lateral system when returning from sea, if the buoy is to be passed on the starboard hand, it will be red - if to be left on the port hand, it will be black. It can also be red and black banded horizontally meaning it can be left on either side. The topmost color denotes the preferred side on which it should be left. The projected area is to be at least 6 square feet centered at least 5 feet above water.

c. If the buoy is in close proximity to heavily trafficked areas, a radar reflecting buoy or a fog signal may be required.

Once permission is granted to establish a buoy, the position of the buoy is published in the Light List for the use of mariners. It is most important that the buoy be maintained on this position. Should there be a vessel grounding on the artificial reef and the buoy is off station, the owner of the reef may be liable for substantial damages. If the buoy should get off station or be lost, this information must be given to the Coast Guard so that a Notice to Mariners can be issued to advise mariners of the change. Since the reef material is subject to being moved by currents and/or storms, the reef owner should periodically check to insure that the obstruction has not been moved from its charted position.

When a buoy has been established with the approval of the Coast Guard pursuant to a condition imposed by the Corps of Engineers, the Coast Guard will not ordinarily approve discontinuance of that buoy. Any discontinuance will be coordinated with the Corps of Engineers. If the Corps of Engineers has established a specific condition that the artificial reef be marked, the Corps of Engineers must agree to the deletion of that particular condition. Obviously, the Coast Guard will make its views known to the Corps of Engineers.

In summary, while the independent authority of the Coast Guard to require marking structures on the Outer Continental Shelf is limited to seabed or subsoil development and exploitation, by virtue of the standard condition in the Corps permit, the Coast Guard can require the same type of marking on the Outer Continental Shelf as in navigable waters. There is pending legislation in Congress which would remove the resource development condition which limits Coast Guard Authority under the Outer Continental Shelf Lands Act.

When whatever marking required by the Coast Guard is approved, the owner of the artificial reef, at his own expense, must establish and maintain the buoy or other marking in proper condition and on position.

In planning for any artificial reef, I suggest that early contact be made with your Coast Guard District Office so that the marking requirements can be learned and this cost factor considered in deciding whether the reef should be built.

SUMMARY OF CURRENT EIGHTH DISTRICT COAST GUARD
BUOY REQUIREMENTS FOR ARTIFICIAL REEFS

MAY 1983

(reviewed) JAN 1985

GUIDELINES FOR THE MARKING OF SUBMERGED ARTIFICIAL STRUCTURES IN THE GULF OF MEXICO

1. The intent of these guidelines is to define effective, practical and reasonable signals required for the safety of surface navigation and fishing gear and for the protection of artificial submerged structures on or over the seabed and subsoil of the Outer Continental Shelf and in navigable waters of the United States. Mariners should exercise prudence in approaching sites marked by these aids, bearing in mind the cautionary note regarding buoys contained in the pages of the Coast Guard Light List.

2. Whose duty to mark: When an artificial submerged structure is or has been installed which, in the judgment of the District Commander, constitutes a hazard to surface navigation or to fishing nets or gear, it shall be the duty of the owner to mark such structure and to maintain such marking until the artificial structure is (1) removed or (2) surmounted with an above-water structure which displays the signals prescribed in 33 CFR 67.

3. Marking required:

a. CLEARANCE LESS THAN 85 FEET OF WATER:

Underwater completions with 85 feet or less of water over them must be suitably marked for protection of navigation. This will normally be done with lighted lateral system buoys. Such buoys must be red or black or red and black banded. Red or black buoys must have a quick flashing white light. Red and black banded buoys must have an interrupted quick flashing white light. Fog signals are generally required in both cases.

b. CLEARANCE BETWEEN 85 AND 200 FEET OF WATER:

Underwater completions which terminate between 85 and 200 feet beneath the surface of the water must be suitably marked for the protection of property since they present a hazard to fishing nets and other fishing gear. Required marking will normally be an orange and white special purpose buoy of such construction as not to be a hazard to surface navigation in itself. If such buoy is lighted, it must be a slow flashing white light. Special bonnets to prevent fishing gear hang-ups will generally remove the requirement for a buoy.

If the obstruction is within 500 yards of a fairway or channel, the buoy must be red or black and normally show a slow flashing white light.

c. CLEARANCE OVER 200 FEET OF WATER:

Markings are not currently required for submerged structures having more than 200 feet of water over them. However, if marked, the markings must be in accordance with paragraph 3.b. above.

d. ANCHORAGE AREAS: Markings are the same as prescribed in 3.a.

4. Review of existing structures: The marking of all underwater artificial structures presently having a clear depth of less than 200 feet over them is subject to review in the event that traffic patterns change, vessel characteristics, or fishing methods cause such a structure to present a greater hazard to navigation. A reasonable time will be granted owners of these structures to comply with changed marking requirements.

5. Additional marking data: Marking of a submerged artificial structure when accomplished by means of a lighted buoy with or without sound shall have the characteristics shown below. Requirements stated herein are minimums and may be exceeded at the option of the owner.

a. DAYMARKS: The buoy shall exhibit a daymark having a solid continuous projected area of at least 6 square feet and presenting a square or rectangular aspect when viewed from the horizontal plane. The center of the projected area shall be at least 5 feet above the water. The buoy shall be colored in accordance with the lateral system of aids to navigation as described in 33 CFR 62.25 and as specified by the District Commander in his approval of the Form CG-2554 returned to the owner. The color red wherever specified shall mean fluorescent red-orange in lieu of ordinary red buoy paint.

b. RADAR REFLECTOR: The buoy shall have the ability to provide an "s" and "x" band radar reflectance equivalent to, or exceeding two mutually perpendicular metal plates, each 11 inches high by 16 inches wide with a vertical intersection at the mid point of the widest dimension and with a circular metal plate 16 inches in diameter forming the top and bottom of the reflector. The geometric center of the effective project area of the radar reflector shall be at least 5 feet above the water.

c. SOUND SIGNAL: The buoy shall have a sound signal with the characteristic being 2 seconds blast and 18 seconds off. The signal must be such as to meet the frequency and intensity requirements for one-half mile signals as specified in 33 CFR 67.10.

d. LIGHT: Lighted buoys will exhibit a light at a focal plane of at least 8 feet above the surface of the sea unless specified otherwise by the District Commander in his approval of the Form CG-2554. The lights shall be of sufficient candlepower as to be visible at 5 nautical miles 90% of the nights of the year.

e. POSITION: Buoys required to mark submerged artificial structures shall ordinarily be placed on that side of the submerged structure toward the most navigable water at a distance no greater than 200 yards from the nearest part of the structure.

f. COLOR: Buoy color is determined by the side on which the buoy is to be passed by the mariner. This is set forth in 33 CFR 67.25-5. In the Gulf of Mexico, in the absence of a well defined fairway or channel, marine traffic proceeding in a general northerly or westerly direction is considered proceeding from seaward.

6. Responsibility: The burden of placing and maintaining the buoy within the limits of distance from, and on the proper side of, the submerged structure is on the owner who is required to make application for the marking.

7. Applications: It shall be the duty of the owner or maintainer to submit CG Form 2554 in advance to the District Commander for submerged structures having less than 200 feet of clear water over them. In addition to filling out such of the information called for the basic form as is pertinent, the following supplemental information will be attached or included:

(1) General locality or area.
(2) Block number.
(3) Lease number.
(4) Well number.
(5) Latitude and longitude of submerged structure.
(6) An enlarged plot plan showing the proposed location of the buoy relative to the structure, and a profile drawing showing the type of mooring proposed.

A supply of these forms may be obtained from the Private Aids to Navigation Section, Eighth Coast Guard District, Hale Boggs Federal Building, New Orleans, La. 70130.

8. Cautionary note:

The guidelines set forth herein cover only routine situations and have been prepared to assist in the preparation of aids to navigation permits (CG Form 2554) for new submerged structures and for review of existing submerged structures. There are situations requiring special treatment and, accordingly, this office will specify special markings.

UNITED STATES GOVERNMENT

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

M e m o r a n d u m

16518/AFR

DATE:

SUBJECT: Marking of Artificial Fishing Reef Buoys

FROM: Chief, Aids to Navigation Branch

TO: Policy File

1. This memo sets forth current policy for marking fishing reef buoys in the Eighth Coast Guard District. This system will make the naming and identification of fishing reefs and their buoys easier and consistent.

2. With the ever increasing number of artificial fishing reefs in the Eighth District, what we want is a standard system for marking the offshore reefs. The inshore reefs are no problem, in that, they can be named by the landmarks in the vicinity or after the owner, as in the case with oyster reefs in Mississippi and Texas.

3. Therefore, the sign format on an offshore reef buoy should include the following:

a. The Outer Continental Shelf area name.
b. Indication that the buoy marks a fishing reef.
c. Letter to designate the reef.
d. Number to designate the buoy where multiple buoys mark the reef.

Example:

a. A fishing reef off Florida in the Pensacola Area, with 3 buoys and is the second reef in the area would be marked:
PE-FR-B-1, PE-FR-B-2, PE-FR-B-3

b. A fishing reef off Texas in South Padre Island Area with one buoy and is the 10th reef in the area would be marked: SPI-FR-J

c. A buoy being added to a fishing reef in the Galveston Area marked GA-FR-D would be marked: GA-FR-D-1

W. A. WULFF
Acting

M E M O R A N D U M

(oan)
3264/AYR

Policy File

DATE: 10 MAY 1974

FROM: Acting Chief, (oan)

SUBJECT: Marking of Artificial Fishing Reefs

1. This memo sets forth current policy with regard to the marking of artificial reefs established offshore (outside the navigible waters of the U.S.). The legal aspects of our authority to require markings remain shrouded in heavy mists. . . . .but should clarify someday.

2. Generally, we want them marked in the same fashion as underwater completions, i.e. in accordance with current Eighth District "Guidelines for the markings of submerged Artificial Structures in the Gulf of Mexico". This essentially means structures with less than 85 feet of clearance require lighted buoys, which conform to the lateral system, and show a quick flashing white light. Reefs with more than 85 feet require only unlighted special-purpose buoys unless within 500 yards of a fairway.

3. Waivers (from lighted lateral to unlighted special) will normally be given if:

a. The reef structure is not near fairways

b. Clearance is over 50 feet

c. The inidividual reef structure is part of an overall reef plan involving a number of such reefs, and

d. The entire reef complex is adequately marked/charted

4. Examples: These are MINIMUMS.
(Assuming 500′ x 100′ artificial reef)

Case A - More than 85 foot clearance (away from fairways). One unlighted special purpose buoy as near as possible the center of the reef.

Case B - More than 85 foot clearance (within 500 yards from fairway). One lighted laterally painted buoy showing FL W 4s located on the fairway side of the reef.

Case C - Less than 85 foot clearance (doesn′t meet waiver conditions). One lighted laterally painted buoy showing QK FL W as near as possible the center of the reef.

Case D - Less than 85 foot clearance (but meets waiver conditions). Two unlighted special purpose buoys, one at each end of the structure.

I. L. KRAMS

Secretary or his designee may restore the waterway to its former condition, by contract or otherwise, and recover the cost thereof from the permittee.

(e) Structures for Small Boats: That permittee hereby recognizes the possibility that the structure permitted herein may be subject to damage by wave wash from passing vessels. The issuance of this permit does not relieve the permittee from taking all proper steps to insure the integrity of the structure permitted herein and the safety of boats moored thereto from damage by wave wash and the permittee shall not hold the United States liable for any such damage.

Maintenance Dredging

(a) That when the work authorized herein includes periodic maintenance dredging, it may be performed under this permit for —— years from the date of issuance of this permit (ten years unless otherwise indicated);

(b) That the permittee will advise the District Engineer in writing at least two weeks before he intends to undertake any maintenance dredging.

Discharges of Dredged or Fill Material Into Waters of the United States

(a) That the discharge will be carried out in conformity with the goals and objectives of the EPA Guidelines established pursuant to Section 404(b) of the FWPCA and published in 40 CFR 230;

(b) That the discharge will consist of suitable material free from toxic pollutants in other than trace quantities;

(c) That the fill created by the discharge will be properly maintained to prevent erosion and other non-point sources of pollution; and

(d) That the discharge will not occur in a component of the National Wild and Scenic River System or in a component of a State wild and scenic river system.

Dumping of Dredged Material Into Ocean Waters

(a) That the dumping will be carried out in conformity with the goals, objectives, and requirements of the EPA criteria established pursuant to Section 102 of the Marine Protection, Research and Sanctuaries Act of 1972, published in 40 CFR 220-228.

(b) That the permittee shall place a copy of this permit in a conspicuous place in the vessel to be used for the transportation and/or dumping of the dredged material as authorized herein.

This permit shall become effective on the date of the District Engineer's signature.

Permittee hereby accepts and agrees to comply with the terms and conditions of this permit.

____

(Permittee)

____

(Date)

By authority of the Secretary of the Army:

____

(District Engineer)

____

(Date)

Transferee hereby agrees to comply with the terms and conditions of this permit.

____

(Transferee)

____

(Date)

Appendix B—Memorandum of Understanding Between the Secretary of the Interior and the Secretary of the Army

In recognition of the responsibilities of the Secretary of the Army under sections 10 and 13 of the Act of March 3, 1899 (33 U.S.C. 403 and 407), relating to the control of dredging, filling, and excavation in the navigable waters of the United States, and the control of refuse in such waters, and the interrelationship of those responsibilities with the responsibilities of the Secretary of the Interior under the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. 661-666c), and the Fish and Wildlife Act of 1956, as amended (16 U.S.C. 742a et seq.), relating to the control and prevention of water pollution in such waters and the conservation of the Nation's natural resources and related environment, including fish and wildlife and recreational values therein; in recognition of our joint responsibilities under Executive Order No. 11288 to improve water quality through the prevention, control, and abatement of water pollution from Federal and federally licensed activities; and in recognition of other provisions of law and policy, we, the two Secretaries, adopt the following policies and procedures:

POLICIES

1. It is the policy of the two Secretaries that there shall be full coordination and cooperation between their respective Depart-

ments on the above responsibilities at all organizational levels, and it is their view that maximum efforts in the discharge of those responsibilities, including the resolution of differing views, must be undertaken at the earliest practicable time and at the field organizational unit most directly concerned. Accordingly, District Engineers of the U.S. Army Corps of Engineers shall coordinate with the Regional Directors of the Secretary of the Interior on fish and wildlife, recreation, and pollution problems associated with dredging, filling, and excavation operations to be conducted under permits issued under the 1899 Act in the navigable waters of the United States, and they shall avail themselves of the technical advice and assistance which such Directors may provide.

2. The Secretary of the Army will seek the advise and counsel of the Secretary of the Interior on difficult cases. If the Secretary of the Interior advises that proposed operations will unreasonably impair natural resources or the related environment, including the fish and wildlife and recreational values thereof, or will reduce the quality of such waters in violation of applicable water quality standards, the Secretary of the Army in acting on the request for a permit will carefully evaluate the advantages and benefits of the operations in relation to the resultant loss or damage, including all data presented by the Secretary of the Interior, and will either deny the permit or include such conditions in the permit as he determines to be in the public interest, including provisions that will assure compliance with water quality standards established in accordance with law.

PROCEDURES FOR CARRYING OUT THESE POLICIES

1. Upon receipt of an application for a permit for dredging, filling, excavation, or other related work in navigable waters of the United States, the District Engineers shall send notices to all interested parties, including the appropriate Regional Directors of the Federal Water Pollution Control Administration, the United States Fish and Wildlife Service, and the National Park Service of the Department of the Interior, and the appropriate State conservation, resources, and water pollution agencies.

2. Such Regional Directors of the Secretary of the Interior shall immediately make such studies and investigations as they deem necessary or desirable, consult with the appropriate State agencies, and advise the District Engineers whether the work proposed by the permit applicant, including the deposit of any material in or near the navigable waters of the United States, will reduce the quality of such waters in violation of applicable water quality standards or unreasonably impair natural resources or the related environment.

3. The District Engineer will hold public hearings on permit applications whenever response to a public notice indicates that hearings are desirable to afford all interested parties full opportunity to be heard on objections raised.

4. The District Engineer, in deciding whether a permit should be issued, shall weigh all relevant factors in reaching his decision. In any case where Directors of the Secretary of the Interior advise the District Engineers that proposed work will impair the water quality in violation of applicable water quality standards or unreasonably impair the natural resources or the related environment, he shall, within the limits of his responsibility, encourage the applicant to take steps that will resolve the objections to the work. Failing in this respect, the District Engineer shall forward the case for the consideration of the Chief of Engineers and the appropriate Regional Director of the Secretary of the Interior shall submit his views and recommendations to his agency's Washington headquarters.

5. The Chief of Engineers shall refer to the Under Secretary of the Interior all those cases referred to him containing unresolved substantive differences of views and he shall include his analysis thereof, for the purpose of obtaining the Department of Interior's comments prior to final determination of the issues.

6. In those cases where the Chief of Engineers and the Under Secretary are unable to resolve the remaining issues, the cases will be referred to the Secretary of the Army for decision in consultation with the Secretary of the Interior.

7. If in the course of operations within this understanding, either Secretary finds its terms in need of modification, he may notify the other of the nature of the desired changes. In that event the Secretaries shall within 90 days negotiate such amendment as is considered desirable or may agree upon termination of this understanding at the end of the period.

Dated: July 13, 1967.

STEWART L. UDALL,
Secretary of the Interior.

Dated: July 13, 1967.

STANLEY RESOR,
Secretary of the Army.

PART 326—ENFORCEMENT

Sec.

GENERAL CONDITIONS SECTION OF FLORIDA ADMINISTRATIVE CODE GOVERNING ARTIFICIAL REEFS

qualifying for the use of a general permit are not required to but may publish in a newspaper of general circulation in the area affected by the proposed project a notice of intent to use a general permit. The notice, if published, shall follow substantially the format in Fla. Admin. Code Rule 17-1.62 and shall be published within 14 days of the date when the department receives notification pursuant to Rule 17-4.53(1). No person who has published notice shall begin work until after the 21 days for requesting a hearing has passed or a hearing is held and a decision is rendered.
Specific Authority: 403.814(1), F.S. Law Implemented: 253.123, 253.124, 258.165, 403.061, 403.087, 403.088, 403.702-403.73, 403.814, 403.851-403.864, F.S. History: New 7-8-82, Amended 6-16-84.

17-4.54 General Conditions for All General Permits.

(1) The terms, conditions, requirements, limitations, and restrictions set forth in this Part are "general and specific permit conditions" and are binding upon the permittee. The conditions are enforceable under Chapter 403, F.S.

(2) The general permit is valid only for the specific activity indicated. Any deviation from the specified activity and the conditions for undertaking that activity shall constitute a violation of the permit. The permittee is placed on notice that violation of the permit may result in suspension or revocation of the permittee's use of the general permit and may result in institution of legal proceedings as the Department may consider appropriate.

(3) The general permit does not convey any vested rights or any exclusive privileges. It does not authorize any injury to public or private property nor any invasion of personal rights. It does not authorize any infringement of federal, state or local laws or regulations. It does not obviate the necessity for obtaining any other federal, state or local permits that may be required or operate to allow the permittee to violate any more stringent standards established by federal or local law.

(4) The general permit does not relieve the permittee from liability and the penalties therefore when the construction or operation of the permitted activity causes harm or injury to human health or welfare; causes harm or injury to animal, plant or aquatic life; or causes harm or injury to property. It does not allow the permittee to cause pollution in contravention of Florida Statutes and Department rules.

(5) The general permit conveys no title to land or water, nor does it constitute State recognition or acknowledgement of title. It does not constitute authority for reclamation of submerged lands. Only the Board of Trustees of the Internal Improvement Trust Fund may express State opinion as to title.

(6) No general permit shall authorize the use of state owned land without the prior consent of the Board of Trustees of the Internal Improvement Trust Fund pursuant to Section 253.77, F.S.

(7) The general permit may be modified, suspended or revoked in accordance with Chapter 120, Florida Statutes, if the Secretary determines that there has been a violation of any of the terms or conditions of the permit; there has been a violation of state water quality

standards or state air quality standards; or the permittee has submitted false, incomplete or inaccurate data or information.

(8) The general permit shall not be transferred to a third party except pursuant to Fla. Admin. Code Rule 17-4.12.

(9) The general permit authorizes construction and where applicable operation of the permitted facility. However, the permittee shall give notice of continued use of a general permit thirty (30) days before the expiration of this permit.

(10) The permittee agrees in accepting the general permit to make every reasonable effort to conduct the specific activity or construction authorized by the general permit in a manner that will minimize any adverse impact on the adjacent property or public use of the adjacent property, where applicable, and on the environment, including fish, wildlife, natural resources of the area, water quality or air quality.

(11) The permittee agrees in accepting the general permit to allow a duly authorized representative of the Department access to the permitted facility or activity at reasonable times for the purpose of inspection and testing to determine compliance with the permit and the department rules.

(12) The permittee agrees to maintain any permitted facility, or activity in good condition and in accordance with the plans submitted to the department under Rule 17-4.53(1).

(13) A permittee's use of a general permit is limited to five (5) years. However, the permittee may request continued use of the general permit by notifying the department pursuant to Rule 17-4.53(1).

Specific Authority: 403.814(1), F.S. Law Implemented: 253.123, 253.124, 403.061, 403.087, 403.088, 403.702-403.73, 403.814, 403.851-403.864, F.S. History: New 7-8-82.

17-4.55 General Permit to U.S. Forest Service for Minor Works within National Forests in Florida.

(1) A general permit is hereby granted to the U.S. Forest Service to conduct the works described below:

(a) Culvert placement, replacement, and maintenance in streams of less than fifteen (15) cubic feet per second average discharge at the culvert location or draining less than 5,000 acres in the Apalachicola National Forest, 10,000 acres in the Osceola National Forest, and 7,500 acres in the Ocala National Forest, except for culverts associated with low water crossings.

(b) Bridge construction, replacement and maintenance for structures up to 400 feet in length and two lanes or less in width, pursuant to the restrictions listed in Section 403.813(2)(1), F.S.;

(c) Construction and maintenance of low-water crossings (hard surface crossings over which water flows during storm events or immediately thereafter);

(d) Bathing beach restoration at developed recreation sites where maintenance dredging is less than 100 cubic yards per year and less than 100 cubic yards per single occurrence;

(e) Dock construction, replacement and maintenance for docks of up to 1000 square feet of over water surface area, in Outstanding Florida Waters subject to restrictions

INSTRUCTIONS FOR FLORIDA'S JOINT

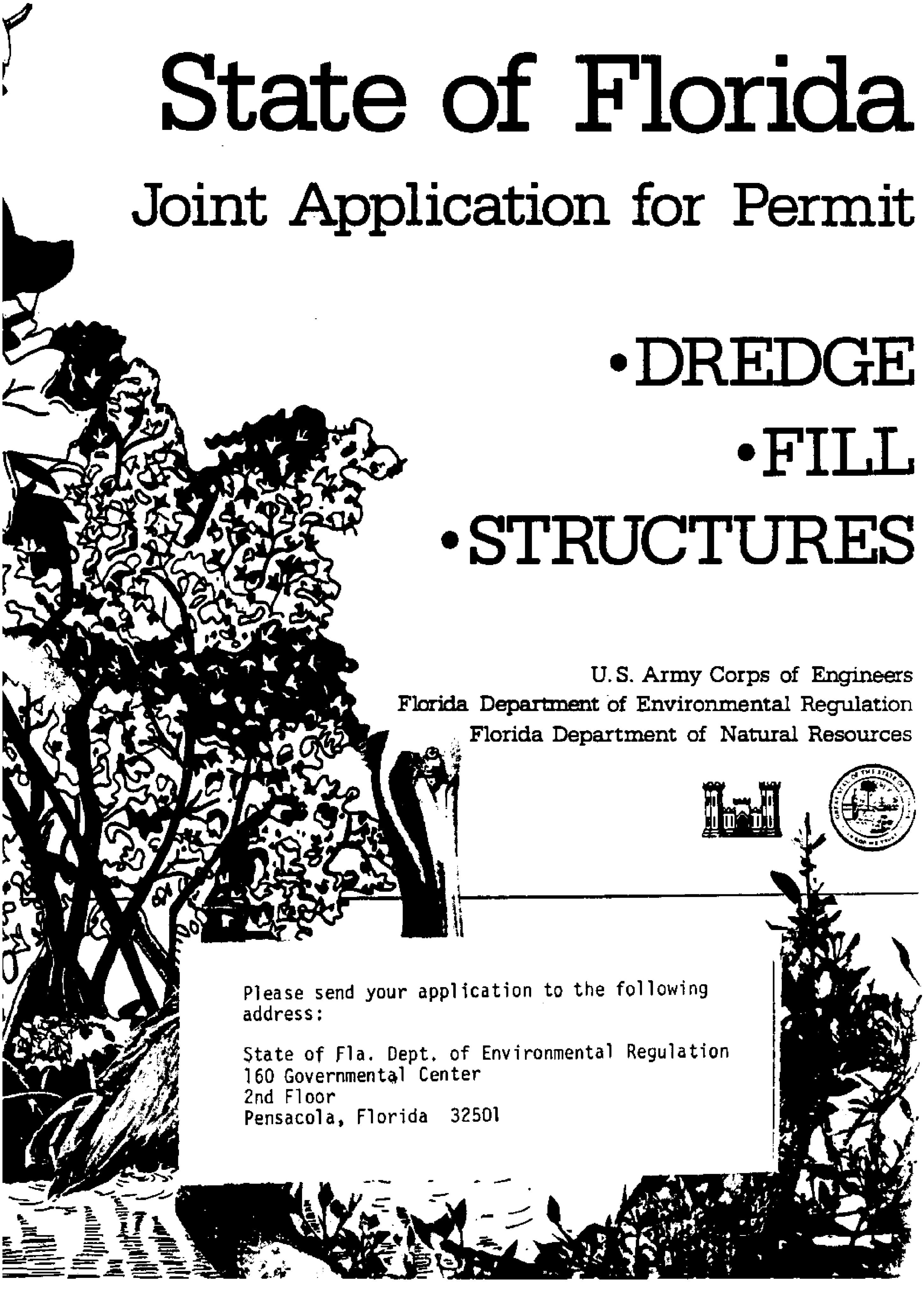
APPLICATION FORM

State of Florida

Joint Application for Permit

•DREDGE
•FILL
•STRUCTURES

U.S. Army Corps of Engineers
Florida Department of Environmental Regulation
Florida Department of Natural Resources



Please send your application to the following address:

State of Fla. Dept. of Environmental Regulation
160 Governmental Center
2nd Floor
Pensacola, Florida 32501

APPLICATION FOR CONSTRUCTION
DREDGING AND FILLING IN THE WATERS OF THE STATE OF FLORIDA

PREFACE

The expanded Federal and State regulatory programs for protecting water resources have from time to time resulted in delayed responses to applicants which might have been avoided with a better coordinated State-Federal program. The duplication of permitting and overlapping notice requirements have all added to these unnecessary delays.

To minimize these problems and others, the State of Florida Department of Environmental Regulation (DER), the State of Florida Department of Natural Resources (DNR), and the U.S. Army Corps of Engineers published this pamphlet and the Joint Application. Our experience has shown that the Joint Application has met with great success.

You must still obtain ALL required local, State, and Federal authorizations/permits BEFORE commencing work, including separate permits or authorizations issued by the Corps, DNR, and DER.

VICTORIA J. TSCHINKEL
Secretary
State of Florida Department
of Environmental Regulation

ALFRED B. DEVEREAUX, JR.
Colonel, Corps of Engineers
District Engineer
Jacksonville District

ELTON GISSENDANNER
Executive Director, Board
of Trustees of the Internal
Improvement Trust Fund

ELTON GISSENDANNER
Executive Director,
State of Florida Department
of Natural Resources

TABLE OF CONTENTS

JOINT APPLICATION
DEPARTMENT OF THE ARMY/FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION
For Activities in the Waters of the State of Florida

CORPS APPLICATION NUMBER (official use only)	DER APPLICATION NUMBER (official use only)

1. APPLICANT'S NAME AND ADDRESS

NAME

STREET

CITY STATE ZIP

TELEPHONE NUMBER (Day) ( ) (Night) ( )

2. Name, address, zip code and title of applicant's authorized agent for permit application coordination

Telephone Number ( )

3. NAME OF WATERWAY AT LOCATION OF THE ACTIVITY.

DER Code ________
W/W Code ________

4. LOCATION WHERE PROPOSED ACTIVITY EXISTS OR WILL OCCUR.

Street, road or other descriptive location

Section Township Range

Incorporated city or town

Latitude Longitude

County

Tax Assessors Description: (if known)

Map No. Subdiv. No. Lot No.

5. NAME AND ADDRESS INCLUDING ZIP CODE OF ADJOINING PROPERTY OWNERS WHOSE PROPERTY ALSO ADJOINS THE WATERWAY.

6. PROPOSED USE
Private Single Dwelling [ ] Private Multi-dwelling [ ] Public [ ]
Commercial [ ] Other [ ] (Explain in remarks)

7. DESCRIPTION OF PROJECT (Use additional sheets, if necessary)

A. Structures: 1. New work [ ] Maintenance of existing structure [ ]

COE Work Code
|_|_|_|_|

2. Piers, docks and use: Commercial [ ] Private [ ] Public [ ]

a. Single pier [ ] length ______ width ______

b. Number of piers [ ] length ______ width ______

c. Number of boat slips [ ] length ______ width ______

d. Number of finger piers [ ] length ______ width ______

e. Other (please describe) ______

3. Seawalls, revetments, bulkheads: length ______

a. Type: Vertical [ ] Riprap [ ] Slope: ______Horizontal:______Vertical

b. Material to be used ______

4. Other type of structure ______

B. Excavation or Dredging: New Work [ ] Maintenance work [ ] Total acreage involved ______

1. Access Channel [ ] or Canal [ ] Length ______ft. Width ______ft. Depth ______ft.

2. Boat Basin [ ] or Boat Slip [ ] Length ______ft. Width ______ft. Depth ______ft.

3. Other ______ Length ______ft. Width ______ft. Depth ______ft.

4. Cubic yards: Total for project ______

a. ______ cyd. waterward/______ cyd. landward of ordinary/mean high water

b. Type of material to be excavated/dredged ______

C. Fill:

1. Amount of material

DER Code
___253
___403

a. Cubic yards placed waterward of ordinary/mean high water ______

b. Cubic yards placed landward of ordinary/mean high water ______

c. Total acreage to be filled ______ Total acreage of wetlands involved ______

2. Containment for fill

a. Dikes [ ] b. Seawall, etc. [ ] c. Other (please explain) ______

______

3. Type of fill material to be used ______

4. Source of fill material to be used ______

8. Date activity is proposed to commence ______________ ; to be completed ____________________.

9. Previous permits for this project have been DER # Corps #

A. Denied (date) ____________ ____________________ ____________________

B. Issued (date) ____________ ____________________ ____________________

C. Other (please explain) ____

Differentiate between existing work and proposed work on the drawings.

10. Remarks (See Instruction Pamphlet for additional information required for all applications and certain activities. Use additional sheets if necessary.)

11. AFFIDAVIT OF OWNERSHIP OR CONTROL of the property on which the proposed project is to be undertaken

I CERTIFY THAT: (please check appropriate space)

[ ] I am the record owner, lessee, or record easement holder of the property described below.

[ ] I am not the record owner, lessee, or record easement holder of the property described below, but I will have before undertaking the proposed work the requisite property interest. (Please explain what the interest will be and how it will be acquired.)

LEGAL DESCRIPTION OF PROPERTY SITUATED IN ________________________ COUNTY, FLORIDA
(Use additional sheets if necessary)

____
Signature

Sworn and subscribed before me at ______________________________________ County,

____________, this ______ day of ______________________, 19__.

____
NOTARY PUBLIC

My commission expires:

DER Form 17-1.203(1) Effective November 30, 1982

12. Application is made for a permit(s) to authorize the activities described herein.

A. I authorize the agent listed in Item #2 to negotiate modifications or revisions, when necessary, and accept or assent to any stipulations on my behalf.

B. I understand I may have to provide any additional information/data that may be necessary to provide reasonable assurance or evidence to show that the proposed project will comply with the applicable State Water Quality Standards or other environmental standards both before construction and after the project is completed.

C. In addition, I agree to provide entry to the project site for inspectors with proper identification or documents as required by law from the environmental agencies for the purpose of making preliminary analyses of the site. Further, I agree to provide entry to the project site for such inspectors to monitor permitted work if a permit is granted.

D. Further, I hereby acknowledge the obligation and responsibility for obtaining <u>all</u> of the required state, federal or local permits <u>before</u> commencement of construction activities I also understand that before commencement of this proposed project I must be granted separate permits or authorizations from the U.S. Corps of Engineers, the U.S. Coast Guard, the Department of Environmental Regulation, and the Department of Natural Resources, as necessary.

I CERTIFY that I am familiar with the information contained in this application, and that to the best of my knowledge and belief such information is true, complete and accurate. I further certify that I possess the authority to undertake the proposed activities.

Signature of Applicant	Date

<u>NOTE</u>: THIS APPLICATION MUST BE SIGNED by the person who desires to undertake the proposed activity or by an authorized agent. If an agent is applying on behalf of the applicant, attach proof of authority for the agent to sign and bind the applicant.

18 U.S.C. Section 1001 provides that: Whoever in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up by any trick, scheme, or device a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than five years, or both.

<u>NOTICE TO PERMIT APPLICANTS</u>

This is a Joint Application; it is <u>NOT</u> a Joint Permit!

You Must Obtain <u>All</u> Required Local, State, and Federal

Authorizations or Permits <u>Before</u> Commencing Work!!

<u>For your information:</u> Section 370.034, Florida Statutes, requires that all dredge and fill equipment owned, used, leased, rented or operated in the state shall be registered with the Department of Natural Resources. Before selecting your contractor or equipment you may wish to determine if this requirement has been met. For further information, contact the Chief of the Bureau of Licenses and Motorboat Registration, Department of Natural Resources, 3900 Commonwealth Boulevard, Tallahassee, Florida 32303. Telephone Number 904/488-1195. THIS IS NOT A REQUIREMENT FOR A PERMIT FROM THE DEPARTMENT OF ENVIRONMENTAL REGULATION.

DRAWING SHEET

PURPOSE:

DATUM:

Adjacent Property Owners:

1.

2.

IN

AT

COUNTY OF STATE

APPLICATION BY:

SHEET OF DATE

DER Form 17-1.203(1) Effective November 30, 1982

APPLICATION INSTRUCTIONS

Section I. APPLICATION FORM

Complete two copies of the application form, together with four copies of detailed plans. The blank application and drawing forms included in this pamphlet may be used as working drafts or removed and submitted. If needed, additional copies of the application form may be obtained from the offices indicated in Appendix D.

The plans shall conform to the requirements in Section III and generally follow the format of the sample drawings included in this pamphlet.

Also, the applicant may be required to furnish such additional information as may be timely requested in order to complete a review of the application. (See s.403.0876, F.S.)

Type or print in ink responses to the numbered items. The application form should be completed as follows:

Item No. 1 - In addition to the applicant's name and address, include the telephone number where the applicant can be reached. If there are no objections to receiving calls after 5 p.m., include a number where the applicant may be reached at night, also.

Item No. 2 - (If no agent is used, mark N/A.) If an agent is acting on behalf of the applicant, then in addition to the name, address and telephone number of the agent, the application form must be accompanied by a letter from the applicant authorizing the designated agent unless the application form is signed by the applicant in Item No. 12. The Corps permit, however, must be executed by the applicant.

Item No. 3 - Give the official name of the water body at the location of the proposed project as indicated on maps. If a water body is called locally by another name, include the secondary name also. If the water body is unnamed, so state.

Item No. 4 - Give the street address of the proposed work. If there is no street address, give directions for finding the location using landmarks, such as color of houses, type of roads, mileage, and commercial establishments. Give the section, township and range designation of the property involved in the project which may be obtained from the property deed. Give the longitude and latitude in degrees, minutes and seconds; include the tax assessor's description of the property, if known. These designations plus city and county names aid the agency in locating the site of the proposed activity.

Item No. 5 - List the names and complete addresses including zip code of adjacent property owners on the water body as they appear on the local tax roles. If property owners on the opposite shoreline may be materially affected, include their names and addresses. If the adjacent property is in multiple ownership such as a condominium, please provide a common address for an association which will reach the multiple owners.

Item No. 6 - Indicate the proposed use in terms of whether it is for use by a single resident (private single dwelling), a governmental unit (public) or for business (commercial). If these categories are not applicable, check "other" and explain.

Item No. 7 -

A. Structures

(1) Check whether the proposed project is maintenance of an existing structure or a new structure.

(2) If the proposed structure is a pier or dock, indicate whether it is commercial (used for business purposes), private (used/owned by one person, or multiple ownership), or public (owned and operated by a government entity). Indicate whether the project is one pier or several and the length and width of the pier(s). If the project is for a number of boat slips or finger piers, indicate the number and the dimensions of the slips/piers. Use additional pages if the dimensions are not the same for each slip, finger pier, or for "T"/"L" shaped docks.

(3) If the proposed structure is a seawall, revetment or bulkhead, please check this category and include the length along the shoreline, the type, the slope (H:V) and the material to be used.

(4) If the proposed structure is not a pier or seawall, please describe the structure in full detail. Use additional sheets as necessary.

B. Excavation or Dredging

If the proposed project includes excavation or dredging, please check whether the work is new work or maintenance dredging and include the total acreage of the proposed excavated/dredged area. Check the type of excavation to be performed (access channel, canal, boat basin, boat slip or other) and include the length, width, and depth of the proposed excavation. Indicate the amount of material in cubic yards taken from submerged lands waterward of the ordinary/mean high water line. Indicate the amount of material in cubic yards removed landward of the ordinary/mean high water line. Indicate the type and composition of material to be dredged. BE SURE YOU PROVIDE DETAILS OF SPOIL DISPOSAL IN THE FILL SECTION.

C. Fill

(1) Indicate the amount of fill in cubic yards to be placed waterward and the amount landward of ordinary/mean high water. Indicate the proposed total acreage of area to be filled and the total acreage of wetlands involved.

(2) Indicate how (dike, seawall or other) you propose to contain the fill so that it will not escape into adjacent waters.

(3) Indicate the type of fill material to be used (clean sand, concrete rubble, dredged spoil, etc.)

(4) Indicate the source of fill material to be used (upland excavation, off-site, dredging, etc.).

Item No. 8 - Indicate the date when the activity is scheduled to commence and the date when completion of the project can be anticipated.

Item No. 9 - If an application has been made for permit for the project, indicate in the appropriate box (denied, issued or other). Also indicate the DER or Corps number of the permit or application for permit. Please indicate the existing work on the drawings.

Item No. 10 - This section is provided for use in explaining or detailing any additional information needed for certain activities. If additional space is needed, use separate sheets and attach to both copies of the application.

All Applications - Explain the need for the proposed work and all alternatives that were considered. Also, give the width of the waterway at the proposed location and state whether or not an overall plan of development has been prepared. Applicants must provide reasonable assurance that the proposed activities will not degrade the waters of the state. This section may be used to describe what precautions will be taken.

Dredging - Describe type and composition of material (if not given in Item No. 7). Include the type of equipment to be used and how it will be brought to the site. Describe the site and methods for disposal of the material, including plans for preventing runoff from contaminating the waters of the state.

Filling - Describe the type and composition of material. Describe the type of structures (if any) to be erected on the fill areas. Also, for the federal permit the applicant must demonstrate that the activity is water dependent or that no alternatives are practical and that the placement of fill will not cause a permanent, unacceptable disruption of the aquatic ecosystem.

Construction - Describe the type and composition of material to be used. If an artificial reef is the proposed construction, itemize the hull, 1500 concrete blocks, etc. If docking facilities are proposed, include a description of plans for sewage pump out facilities, fueling facilities, contingency plans for possible oil spills and any other pertinent information such as type of vessel anticipated to use the facility.

Hazardous Materials - If the activity includes the handling, storage or transportation of petroleum or other hazardous material, the application shall contain a description of a spill contingency plan which shall be developed pursuant to law.

Item No. 11 - Information Needed for Affidavit of Ownership or Control

A. The affidavit of ownership or control should be signed by the owner or owners of the property, the lessee or the easement holder; or must be signer by a person who has the authority to sign for and bind the owner, lessee, or easement holder.

An applicant does not have to be the present owner, lessee, or easement holder for the property, however, prior to commencement of any work under the permit the applicant must have a legal right to conduct the work on the property and to control and maintain the work and project in accord with the permit conditions and State and Federal rules and regulations.

B. If subdivided, the property should be described by lot number, block number (if any), name of subdivision, and plat book number and page where recorded.

C. If unplatted, the property should be described by section, township, range, and subdivision.

D. If the description is based on courses and distances not following the plane coordinates, the point of beginning should be identified.

Please contact the nearest DER office should clarification or further instruction be necessary.

Item No. 12 - The applicant or authorized agent should carefully read the certification before signing and dating the application form. No application can be processed without a signature; therefore, do not forget to complete and sign both copies before mailing. (Note: both signatures must be original, not a photocopy.)

Attach DER check to the front of the application. Be sure the check is completed properly including the correct name of the payee, the appropriate amount and the signature of the payer. Checks should be made payable to the Department of Environmental Regulation.

Attach additional exhibits (Section II) and drawings (Section III) to the back of the application.

If assistance is needed beyond what is provided by this application pamphlet, please contact the nearest state or federal district office.

MAIL APPLICATION TO: The Department of Environmental Regulation at the appropriate address as indicated in Appendix D.

Concurrently, MAIL APPLICATION for groin or jetty construction, beach restoration or other activities permitted pursuant to Chapter 161, Florida Statutes, to: Bureau of Beaches and Shores, Department of Natural Resources, 3900 Commonwealth Boulevard, Tallahassee, Florida 32303. (See Appendix B.)

SECTION II. ADDITIONAL EXHIBITS REQUIRED

A. Attach two copies of vertical aerial photograph of project area, scale 1:24,000 (1" = 2,000 ft.) or greater (more detailed). This may be omitted on artificial reef applications and projects which meet the criteria for short form applications. The project site must be clearly indicated (marked) on the aerial.

B. Submit a copy of a submerged land lease, easement, dedication or other form of consent of use as soon as available from the Board of Trustees, where applicable, pursuant to Section 253.77, F.S. (In most cases, consent of use can only be obtained after the application is filed with DER, therefore, this exhibit may be forwarded at a later time.)

SECTION III. DRAWING REQUIREMENTS AND CHECKLIST

A. General

ALL ACTIVITIES PERMITTED REQUIRE DRAWINGS. The drawings should be to scale and submitted on 8 1/2" X 11" paper (blank sample included). In order to facilitate processing, four legible copies of all drawings are required. If you are unable to reduce your activity to 8 1/2" X 11" sheets, match lined 8 1/2" X 11" sheets are acceptable but each drawing may not include more than 8 sheets of paper. Large scale drawings larger than 8 1/2" X 11" may be submitted for information purposes but they do not replace the drawings required pursuant to these instructions. They must contain a dimensioned cross section, dimensioned plan view of work, and location map of the area. A separate sheet should be used for the location map if greater detail is necessary to accurately identify the location of the proposed project. A one-inch margin should be left at the top edge of each sheet for binding purposes. Since drawings must be reproduced photographically, color shading cannot be used. Drawings may show work as dot shading, hatching, crosshatching or similar graphic symbols. Detailed instructions for the particular activities are included here and sample drawings are included in Appendix E. Florida law requires that drawings, other than those prepared by a person for his own property or by a governmental employee in the course of his assigned duties for a governmental entity, must be certified by a professional engineer or a registered land surveyor (Chapter 471, F.S.). Should you make change in your plans during the processing of the application, be sure that you subm revised drawings to DER.

B. Drawing Checklists

As you prepare your drawings, use the appropriate checklist to assure that your drawings are complete. Drawings which do not contain the listed items will be considered incomplete, and you will be requested to revise your drawings before your application is considered complete for processing. If you have questions concerning those items, please contact DER or the Corps for assistance.

Docking Facility(ies) Drawings

1. Vicinity Map

( ) Clearly label streets leading to project site.

( ) Show location of the activity site including latitude and longitude, if known.

( ) Show name of waterway.

( ) Show name of and distance to local town, community, or identifying location.

( ) Identify map or chart from which vicinity map was taken if applicable.

( ) Show graphic scale.

( ) Show north arrow.

2. Plan View (top view)

( ) Show existing shorelines including applicant's upland property lines with dimensions.

( ) Show direction of ebb and flood in tidal waters and direction of flow in rivers.

( ) Show north arrow.

( ) Show graphic scale.

( ) Show approximate mean high and low waterlines in tidal waters or show approximate ordinary high and low water lines in non-tidal areas.

( ) Show selected water depths taken at approximate mean low or approximate ordinary low water in vicinity of proposed structures.

( ) Show principal dimensions of structure or work and extent of encroachment beyond the approximate high water line.

( ) Show proposed dredging site, if applicable, with dimensions including proposed depth. Show number of cubic yards of material to be removed.

( ) Show proposed spoil site with dimensions including proposed method of retention.

( ) Indicate the square footage of waters of the state to be occupied by the proposed facility, if it is other than a single private noncommercial dock.

( ) Show and identify structures (if any) in waters immediately adjacent to the proposed activity.

( ) Indicate number of boat slips or tie-up spaces.

( ) Show distance between the proposed facility and the nearest edge of the navigation channel.

3. Cross-Sectional and Profile View

( ) Show the approximate mean high and low water line elevation or approximate ordinary high and low water line elevation.

( ) Show existing and proposed depth at waterward face of proposed work or, if dredging is proposed, show dredging grade.

( ) Show proposed structure with dimensions. Identify any structure to be erected thereon.

( ) Show proposed height of spoil site. Include method of retention and dewatering.

( ) Show graphic scale.

4. Notes on Drawings

( ) State purpose of proposed activity.

( ) State datum used in plan and elevation views.

( ) If sewage pump out facilities will be available, so indicate.

( ) If petroleum products or other hazardous material will be stored or handled at the proposed facility, so indicate.

( ) Indicate local zoning classification and whether proposed project is compatible with adjacent construction.

Other Dredging and Filling Project Drawings

1. Vicinity map

( ) Show location of the activity site including latitude and longitude, if known.

( ) Show name of waterway.

( ) Show name of and distance to local town, community, or other identifying location.

( ) Identify map or chart from which vicinity map was taken, if applicable.

( ) Show graphic scale.

( ) Show north arrow.

2. Plan View (top view)

( ) Show existing shoreline(s).

( ) Show ebb and flood in tidal waters and direction of flow in rivers.

( ) Show north arrow.

( ) Show graphic scale.

( ) Show principal dimensions of work or structures.

( ) Show approximate mean high and low waterlines if the proposed activity is in tidal areas on the Atlantic and Gulf Coasts. Show approximate ordinary high and low waterlines if proposed activity is in a lake or stream.

( ) For dredging, excavation or fill, show number of cubic yards, type of material, method of handling, and location of fill or spoil disposal area. If spoil material is to be placed in approved disposal areas, a separate map showing the location shall be attached. The drawing must indicate proposed retention levees, weirs, or other devices for retaining hydraulically placed materials.

( ) Show landward extent of submerged and periodically inundated areas, if applicable.

( ) Show and identify structures (if any) immediately adjacent to the proposed activity, and include permit numbers, if known.

( ) Identify and show location of any structures to be constructed on fill or in waters of the state. If nothing is to be constructed on fill, state the intended use.

Other Dredging and Filling Project Drawings (cont'd.)

3. Cross-sectional and Profile View

( ) Show approximate mean high and low water elevations or approximate ordinary high and low water elevations.

( ) Show depth at waterward face of proposed work or, if dredging is proposed, show existing and proposed depths at mean or ordinary low water and dimensions of proposed site.

( ) If fill is proposed, show dimensions and identify any structures to be erected there on.

( ) Show graphic scale.

4. Notes on Drawings

( ) State datum used in plan and cross-sectional views.

( ) If proposed structure is for the purpose of handling gas, oil, electricity, sewage wastes or hazardous materials, so indicate.

( ) If the proposed work involves filling, give the area to be filled in acres. The acreage should be separated into the area waterward of the line of mean/ordinary high water and the area landward of the line of mean/ordinary high water.

Artificial Reef Drawings

1. Vicinity Map and Plan View

( ) Show location of the activity site including latitude and longitude of the center of the reef. A U.S. Geodetic Survey map may be used.

( ) Show name of waterway.

( ) Show distance from the center line and the name of and distance to local town, community or other identifying location.

( ) Show graphic scale.

( ) Show north arrow.

( ) Show direction of ebb and flood in tidal waters, if applicable.

( ) Show mean high and low water lines and depths of water at mean low water.

( ) Show principal dimensions of structure.

( ) Show a list of the type of material to be used. Indicate the number or quantity of each. See Item 10, "Construction", for further detail.

( ) Show position of buoys marking location during construction.

2. Cross-sectional View

( ) Show depth of top of the reef at mean low water elevation.

( ) Show dimensions on cross section.

3. Notes on Drawings

( ) State purpose of proposed activity.

( ) State datum in plan and cross-sectional views.

SAMPLE APPLICATION

JOINT APPLICATION
DEPARTMENT OF THE ARMY/FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION
For Activities in the Waters of the State of Florida

CORPS APPLICATION NUMBER (official use only)	DER APPLICATION NUMBER (official use only)

1. APPLICANT'S NAME AND ADDRESS

Billy G Wells
NAME

1641 S. Circle Dr.
STREET

Jacksonville FL 32211
CITY STATE ZIP

TELEPHONE NUMBER (Day) (904) 725-8386 (Night) ( )

2. Name, address, zip code and title of applicant's authorized agent for permit application coordination

N/A

Telephone Number ( )

3. NAME OF WATERWAY AT LOCATION OF THE ACTIVITY.

St James River

DER Code ______
W/W Code ______

4. LOCATION WHERE PROPOSED ACTIVITY EXISTS OR WILL OCCUR.

1641 S. Circle Dr.
Street, road or other descriptive location

Jacksonville
Incorporated city or town

Duval
County

31 Section — 27S Township — 41E Range

30.5° Latitude — 81.5° Longitude

Tax Assessors Description: (if known)

Map No. ______ Subdiv. No. ______ Lot No. ______

5. NAME AND ADDRESS INCLUDING ZIP CODE OF ADJOINING PROPERTY OWNERS WHOSE PROPERTY ALSO ADJOINS THE WATERWAY.

① Samuel Evans 1650 S. Circle Dr. Jacksonville 32211
② Robert Hampton 1636 S. Circle Dr. Jacksonville 32211

6. PROPOSED USE
Private Single Dwelling [X] Private Multi-dwelling [ ] Public [ ]
Commercial [ ] Other [ ] (Explain in remarks)

DER Form 17-1.203(1) Effective November 30, 1982 Page 1 of 4

7. DESCRIPTION OF PROJECT (Use additional sheets, if necessary)

A. Structures: 1. New work [X] Maintenance of existing structure [ ]

COE Work Code

2. Piers, docks and use: Commercial [ ] Private [X] Public [ ]

a. Single pier [X] length 65' width 4'

b. Number of piers [ ] length ______ width ______

c. Number of boat slips [ ] length ______ width ______

d. Number of finger piers [ ] length ______ width ______

e. Other (please describe) "L" shaped dock - end is 20'x4'

3. Seawalls, revetments, bulkheads: length 100 ft.

a. Type: Vertical [ ] Riprap [X] Slope: 2 Horizontal: 1 Vertical

b. Material to be used Large Rock

4. Other type of structure ______

B. Excavation or Dredging: New Work [ ] Maintenance work [ ] Total acreage involved ______

1. Access Channel [ ] or Canal [ ] Length ______ ft. Width ______ ft. Depth ______ ft.

2. Boat Basin [ ] or Boat Slip [ ] Length ______ ft. Width ______ ft. Depth ______ ft.

3. Other ______ Length ______ ft. Width ______ ft. Depth ______ ft.

4. Cubic yards: Total for project ______

a. ______ cyd. waterward/ ______ cyd. landward of ordinary/mean high water

b. Type of material to be excavated/dredged ______

C. Fill:

1. Amount of material

DER Code
___253
___403

a. Cubic yards placed waterward of ordinary/mean high water ______

b. Cubic yards placed landward of ordinary/mean high water ______

c. Total acreage to be filled ______ Total acreage of wetlands involved ______

2. Containment for fill

a. Dikes [ ] b. Seawall, etc. [ ] c. Other (please explain) ______

3. Type of fill material to be used ______

4. Source of fill material to be used ______

SAMPLE APPLICATION

8. Date activity is proposed to commence Feb 82 ; to be completed May 82.

9. Previous permits for this project have been DER # Corps #

A. Denied (date) N/A

B. Issued (date) N/A

C. Other (please explain)

Differentiate between existing work and proposed work on the drawings.

10. Remarks (See Instruction Pamphlet for additional information required for all applications and certain activities. Use additional sheets if necessary.)

Private residential pier and bank protection.

11. AFFIDAVIT OF OWNERSHIP OR CONTROL of the property on which the proposed project is to be undertaken

I CERTIFY THAT: (please check appropriate space)

[X] I am the record owner, lessee, or record easement holder of the property described below.

[ ] I am ~~not~~ the record owner, lessee, or record easement holder of the property described below, but I will have before undertaking the proposed work the requisite property interest. (Please explain what the interest will be and how it will be acquired.)

LEGAL DESCRIPTION OF PROPERTY SITUATED IN Duval COUNTY, FLORIDA
(Use additional sheets if necessary)

Lot 27, Block 3L in Floriaville Subdivision as recorded in Official Record Book 13, pg. 21

Billy G Wells
Signature

Sworn and subscribed before me at Jacksonville Duval County, Florida, this 31 day of January, 1982

Larry Jones
NOTARY PUBLIC

My commission expires: December 31, 1983

12\. Application is made for a permit(s) to authorize the activities described herein.

A. I authorize the agent listed in Item #2 to negotiate modifications or revisions, when necessary, and accept or assent to any stipulations on my behalf.

B. I agree to provide any additional information/data that may be necessary to provide reasonable assurance or evidence to show that the proposed project will comply with the applicable State Water Quality Standards or other environmental standards both before construction and after the project is completed.

C. In addition, I agree to provide entry to the project site for inspectors from the environmental agencies for the purpose of making preliminary analyses of the site. Further, I agree to provide entry to the project site for inspectors to monitor permitted work if a permit is granted.

D. Further, I hereby acknowledge the obligation and responsibility for obtaining <u>all</u> of the required state, federal or local permits <u>before</u> commencement of construction activities I also understand that before commencement of this proposed project I must be granted separate permits or authorizations from the U.S. Corps of Engineers, the U.S. Coast Guard, the Department of Environmental Regulation, and the Department of Natural Resources, as necessary.

I CERTIFY that I am familiar with the information contained in this application, and that to the best of my knowledge and belief such information is true, complete and accurate. I further certify that I possess the authority to undertake the proposed activities.

Billy J. Wells — Jan 31, 1982

Signature of Applicant — Date

<u>NOTE</u>: THIS APPLICATION MUST BE SIGNED by the person who desires to undertake the proposed activity or by an authorized agent. If an agent is applying on behalf of the applicant, attach proof of authority for the agent to sign and bind the applicant.

18 U.S.E. Section 1001 provides that: Whoever in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up by any trick, scheme, or device a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than five years, or both.

<u>NOTICE TO PERMIT APPLICANTS</u>

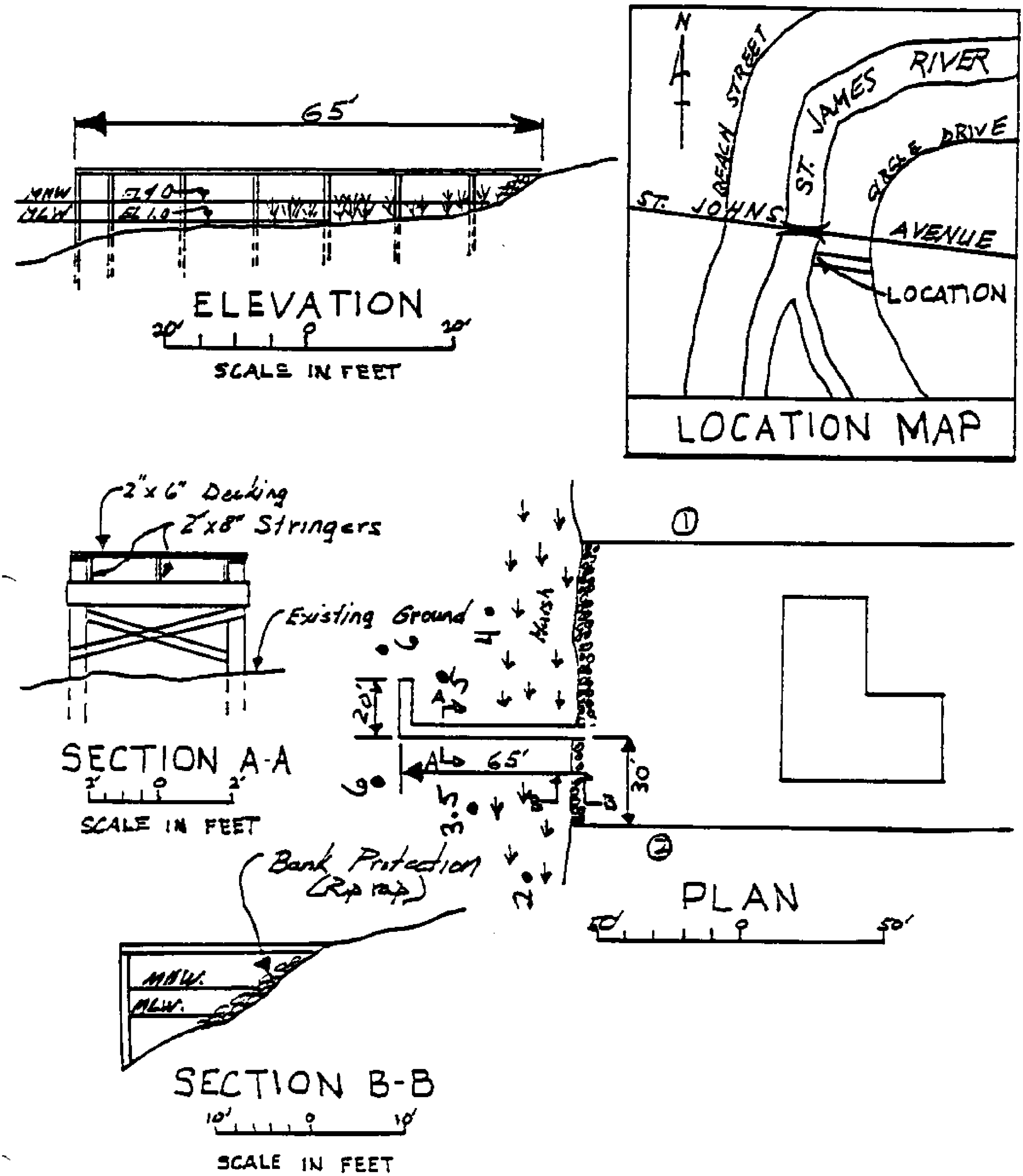
This is a Joint Application; it is <u>NOT</u> a Joint Permit!

You Must Obtain <u>All</u> Required Local, State, and Federal

Authorizations or Permits <u>Before</u> Commencing Work!!

<u>For your information:</u> Section 370.034, Florida Statutes, requires that all dredge and fill equipment owned, used, leased, rented or operated in the state shall be registered with the Department of Natural Resources. Before selecting your contractor or equipment you may wish to determine if this requirement has been met. For further information, contact the Chief of the Bureau of Licenses and Motorboat Registration, Department of Natural Resources, 3900 Commonwealth Boulevard, Tallahassee, Florida 32303. Telephone Number 904/488-1195. THIS IS NOT A REQUIREMENT FOR A PERMIT FROM THE DEPARTMENT OF ENVIRONMENTAL REGULATION.

SAMPLE DRAWING



APPENDIX A

Use of State Lands

PART I. GENERAL INFORMATION

The purpose of this appendix is to list the information that is required by the Board of Trustees of the Internal Improvement Trust Fund to obtain a letter of consent, submerged land lease, easement, or other form of consent sought pursuant to Chapter 253.77, Florida Statutes. Copies of Florida Administrative Code Rules 16Q-21 (Sovereignty Submerged Lands Management Rule), 16Q-20 (Florida Aquatic Preserve Rule), and 16Q-18 (Biscayne Bay Aquatic Preserve Rule) of the Department of Natural Resources, showing the more detailed requirements, and criteria for approval are available upon request. A copy of an application submitted to the Department of Environmental Regulation satisfies many of the information items required by the above rules and will be forwarded to DNR. The Bureau of State Lands Management will review the application for compliance with the administrative rules of the Department of Natural Resources. Additional information will be requested if needed. Exemption from Department of Environmental Regulation permitting requirements does not relieve anyone using state-owned lands from soliciting consent or other authorization from Department of Natural Resources unless specifically exempt under Florida Administrative Code Rule 16Q-21. Questions concerning the status of the application can be obtained by calling the DER/DNR Coordinator at 904/488-9120. All correspondence should be directed to:

Department of Natural Resources
Bureau of State Lands Management
3900 Commonwealth Boulevard
Room 203
Tallahassee, Florida 32303

The following additional information should be provided to assist the Board of Trustees in considering the proposed activity:

1. Two copies of a map 8 1/2" x 11" in size showing the approximate ordinary or mean high water line, locations of existing shoreline vegetation, proposed structures and existing structures, applicant's upland property lines, primary navigation channels, and indicating the direction to the center of the affected water body.

2. If dredging is proposed, an estimate of the number of cubic yards of sovereignty (state-owned) materials to be removed showing how the amount was calculated.

3. Project description which should include the statement of need and proposed use of the parcel sought.

4. Satisfactory evidence of title for the applicant's existing uplands in the form of:

a. current title insurance policy issued by a title insurance company authorized to do business in Florida; or

b. opinion of title prepared by a member of the Florida Bar; and

c. affidavit of ownership attesting to the currency of the current title insurance policy or opinion of title, if required by the Department of Natural Resources.

5. Multiple boat slip facilities may require an affidavit attesting that the facility will not be a revenue generating/income producing

facility.

6. A statement demonstrating in detail that the proposed project will be in the public interest for applications within an Aquatic Preserve as defined in Chapter 258, Florida Statutes. In addition, a statement concerning extreme hardship on the part of the applicant may be required for projects in Biscayne Bay, Boca Ciega Bay, and Lake Jackson Aquatic Preserves.

PART II. SPECIFIC INFORMATION

The following information is not required (by the Bureau of State Lands Management) until a determination has been made that sovereignty (state-owned) lands are involved and that a lease, easement, etc., is required. At that time, the applicant will be notified by DNR of the decision and the following information will be requested:

1. Leases and Easements - These surveys must clearly define the boundaries of the parcel sought and ownership lines of the riparian uplands. Lease surveys must include all structures to be constructed within the area sought for leasing, as well as existing structures.

Please note that the proposed structures should not extend closer than 25 feet from the riparian ownership of the applicant's upland property as extended waterward toward the channel or center of the body of water.

a. A legal or metes and bounds description of the area of state-owned submerged land referencing the section, township, range, name of the affected body of water, county, and point of commencement of the proposed area from a known point on the mean or ordinary high water line. The area must be calculated in acreage for easement and reclamation projects or in square footage for submerged land leases.

b. Prints of survey utilizing an appropriate scale on 8 1/2 x 14" size paper and prepared by a person properly licensed by the Florida State Board of Land Surveyors, or an agent of the Federal Government, acceptable to the Department of Natural Resources, clearly showing the boundaries of the parcel sought.

c. Name and address, as they appear on the latest county tax assessment roll, of each owner of riparian uplands lying within a 1,000 foot radius of the proposed submerged land lease area, verified by the county property appraisers' office, verifying that these name came from the latest tax assessment rolls. Names and addresses shall be clearly typed, preferably on labels suitable for mailing and acceptable to the Department.

d. Written comments from the Department of Environmental Regulation in the form of a permit appraisal or biological assessment, and a letter of intent, if issued.

e. All applications for submerged land leases must have approval or letter of no objection from the appropriate city or county government. Failure to obtain approval will result in automatic deactivation or denial of application.

2. Reclamation of Land Lost by Avulsion or Artificially Induced Erosion - This survey must clearly define the applicant's upland, U.S. Meander Line, the approximate original mean high water line, the existing approximate mean high water line with a land tie to an established reference point, and elevations in

areas exposed at mean high tide. In addition to the survey, the following information will be needed:

a. Two affidavits executed by disinterested parties evidencing the manner, as accurately as possible from personal knowledge, that the loss of land occurred as avulsive action (storms, hurricanes).

b. Accurate aerial photographs showing the date of flight evidencing the location and configuration of the original shoreline. Suggested sources are local office of the Department of Transportation, Tax Assessor's office or the Army Corps of Engineers.

c. Statement of the proposed method of reclaiming the lost lands, if not indicated on the Department of Environmental Regulation permit application form.

PART III. FEES

1. A non-refundable processing fee in the amount of $200.00 for a submerged land lease or an easement for private purposes.

2. Annual fee, computed at $0.045 per square foot or a minimum of $225.00, whichever is greater, payable to the Department of Natural Resources upon approval of a submerged land lease. (The annual fee is subject to change upon adoption of a rule revising this rate.)

3. Florida Department of Revenue registration number. Leases without sales tax exemption certificate shall be subject to Florida State sales tax pursuant to Chapter 212., F.S.

4. Payment for severed material shall be submitted in the following amounts:

(a) $3.25 per cubic yard in Monroe County.

(b) $2.25 per cubic yard in Bay, Brevard, Broward, Charlotte, Collier, Dade, Duval, Escambia, Hillsborough, Lee, Manatee, Palm Beach, Pasco, Pinellas and Sarasota counties.

(c) $1.25 for all other counties.

(d) The minimum payment of $50.

APPENDIX B

Coastal Construction Permits

Section 161.041, Florida Statutes, states: "If any person, firm, corporation, county, municipality, township, special districts, or any public agency shall desire to make any coastal construction or reconstruction or change of existing structures, or any construction or physical activity undertaken specifically for shore protection purposes, or other structures and physical activity including groins, jetties, moles, and breakwaters, seawalls, revetments and artificial nourishment or other deposition or removal of beach material or other structures if of a solid or highly impermeable design, upon sovereignty lands of Florida, below the mean high waterline of any tidal water of the state, a permit must be obtained from the Department of Natural Resources prior to the commencement of such work."

Application is made in accordance with Florida Administrative Code Rule 16B-24.05, as follows:

A. Any person desiring to obtain a coastal construction permit from the Department shall submit an application to the Bureau of Beaches and Shores, Department of Natural Resources, 3900 Commonwealth Boulevard, Tallahassee, Florida 32303, which shall contain the following specific information:

(1) Name, address and phone number of applicant or his duly authorized agent.

(2) Statements describing the proposed erosion control structure, the problem, its causes and the expected effect of the proposed erosion control structure on the problem and on adjacent property.

B. The application shall be accompanied by a location map for use in public notices. This map shall be on either letter size or legal size paper showing the location of each proposed erosion control structure(s) to approximate scale and the shoreline for at least 1,000 feet beyond the proposed erosion control structure(s).

The following information shall be shown on the location map.

(1) Name of applicant.

(2) Section, township, and range in which the subject property is located.

(3) Location by town and county.

(4) Name of water body.

(5) Brief work description or title of project.

(6) General identifying landmarks.

(7) Legend or tables to identify graphic objects.

(8) Date.

(9) Scale and north arrow.

C. The applicant shall provide the Department with evidence of his ownership and legal description of the property seaward or channelward of which the erosion control structure(s) is or is proposed to be located. If the applicant is not the property owner, the applicant shall provide the department with a duly executed statement from the owner of record consenting to the proposed erosion control structure.

D. Except for coastal construction permit applications from duly constituted governmental units, all permit applications shall be accompanied by a $100 fee made payable to the Department of Natural Resources. This application fee is charged to offset the cost of processing of the application for the permit and is non-returnable.

E. Estimate the construction starting date and completion date.

F. Submit a set of construction plans and specifications for the erosion control structure; certified by a professional engineer registered in the State of Florida containing, but not limited to, the following:

(1) Plan view of structure with mean high and mean low water lines extending at least 100 feet high on each side of proposed structure.

(2) Elevation view of structure with mean sea level, mean high water and mean low water indicated.

(3) Profile of beach at proposed structure from dune crest to at least 100 feet beyond the seaward or channelward extremity of the structure. Elevation should be referenced to sea level datum (1929).

(4) Details of construction, including materials to be used.

G. The applicant shall provide to the Department a list of the names and addresses from the latest county tax roll of owners of all riparian property within 1,000 feet of the proposed construction.

H. Separate applications shall be made for unrelated projects involving noncontiguous parcels of upland property. Joint applications may be made in cases of related construction involving contiguous parcels of upland property.

I. The Department may require such additional information as is reasonably necessary for proper evaluation of an application.

J. The Department may waive any of the above requirements if, in the opinion of the Department, such information is not necessary for a proper evaluation of the proposed work.

This application, as described above, must be mailed to:

Bureau of Beaches and Shores
Department of Natural Resources
3900 Commonwealth Building
Tallahassee, Florida 32303

Concurrently, the application described in the section entitled "Application Instructions" must be completed and mailed to the Department of Environmental Regulation for processing by DER and the Corps.

APPENDIX C

Short Form Application and Exemptions

The types of projects described below may be combined in one short-form application. If any portion of the proposed project exceeds the criteria for short-form applications, the application as filed shall be processed as a standard-form application. Successive short-form applications shall not be processed for portions of a project whose total scope exceeds the criteria established.

The following projects are processed as Short-Form Applications pursuant to Florida Administrative Code Rule 17-4.28(4) and 17- 4.29(3), at DER District Office Centers (see map).

(1) Projects not exceeding 10,000 cubic yards of material placed in or removed from the waters of the state. The 10,000 cubic yardage limit shall be separately applied to proposed dredging and/or filling (i.e., a short-form application may be processed for a single project encompassing both 10,000 cubic yards of filling and an additional 10,000 cubic yards of dredging). In addition, the limitations shall include the total yardage of material involved in the creation or elimination of waters of the state. This short-form category is not intended to apply to portions of a project whose total scope exceeds the above maximum cubic yard limitation.

(2) Dockage or marina facilities not exceeding 20,000 square feet of waters of the state to their landward extent, or dockage of marina facilities, regardless of area occupied, designed primarily for the mooring or storage of watercraft used exclusively for sport or pleasure and containing less than one hundred (100) slips which number is the sum of existing and proposed boatslips. The square footage limitation shall include all areas excluded from public use by the facility located in waters of the state.

(3) New rip-rap revetments of any length and new vertical bulkheads, seawalls or similar structures not exceeding 400 linear feet of shoreline, except those exempted under Fla. Admin. Code Rule 17-4.04 (10)(f). This linear footage limitation shall include total shoreline distance existing on the body of water prior to the commencement of work. Applications will not be approved under this section on a cumulative basis.

(4) The installation of buoys, aids to navigation except those described in Fla. Admin. Code Rule 17-4.04(10)(b), the installation of signs, fences, and ski ramps, and the installation of fish attractors by the Florida Game and Fresh Water Fish Commission.

(5) The performance for ten years from the date of issuance of the original permit of the maintenance dredging of permitted navigation channels, port harbors, turning basins, and harbor berths. The phrase "original permit" used in this subsection means the original permit issued by the state pursuant to Chapter 253, Florida Statutes. Maintenance dredging permits of up ten years may also be obtained pursuant to Fla. Admin. Code Rule 17-4.28(11) (e).

(6) The installation of subaqueous transmission and distribution lines entrenched in (not exceeding 10,000 cubic yards of dredging), laid on or embedded [as defined in Fla. Admin. Code Rule 17-4.02(14)] in the bottoms of waters of the state carrying water, wastewater, electricity, communication cables, oil and gas, except those exempted in Fla. Admin. Code Rule 17-4.04(10)(c).

(7) The construction in or on the waters of the state of footbridges and vehicular bridges.

(8) The replacement or widening in or on the waters of the state of footbridges and vehicular bridges supported by pilings or trestles, where the effects of pollutants discharged into open waters can be minimized.

(9) The construction of artificial reefs.

(10) The performance of maintenance dredging [except for those projects described in Fla. Admin. Code Rules 17-4.04 (10)(d) and 17- 4.28(4)(e)] providing there are not more than 10,000 cubic yards of material removed from the waters of the state.

EXEMPTIONS

Projects which are exempt from state permitting requirements pursuant to Chapters 253 or 403, F.S., are documented in Section 403.813, F.S. and Fla. Admin. Code Rule 17-4.04. If the proposed project fits into one of the categories listed, no DER permit or payment of an application fee will be required. Some of the exemptions are only applicable under very particular circumstances; therefore, it is advisable to coordinate with the Department's District offices before commencing construction activities to verify that your proposed project is exempt. Regardless of whether a permit is required, all projects must meet the State Water Quality Standards set forth in Fla. Admin. Code Rules 17-3 and 17-4. Please note that the exemptions pursuant to Chapter 403.813, F.S., only apply to the permitting requirements of Chapters 253, 373, and 403, F.S., administered by DER. They do not exempt the project from compliance with other federal, state or local laws and ordinances. Specifically, exemption from Department of Environmental Regulation permitting requirements does not relieve anyone using state-owned lands from soliciting consent or other authorization from Department of Natural Resources unless specifically exempt under Florida Administrative Code Rule 16Q-21.

APPENDIX D

Addresses and Map of Permitting Offices

DREDGE AND FILL PERMITS

Standard Applications mail to

Department of Environmental Regulation
Twin Towers Building
2600 Blair Stone Road
Tallahassee, Florida 32301
Telephone (904) 488-0130

Short Form Applications see location map for the dredge and fill permitting office serving the area of the proposed project.

For information on U.S. COE permits, see location map for Corps office.

OTHER: DNR, USCG, EPA

Permits for groins, jetties, etc. must also be obtained from (See Appendix B for detailed instructions):

Bureau of Beaches and Shores
Department of Natural Resources
3900 Commonwealth Boulevard
Tallahassee, Florida 32303
Telephone (904) 488 3180

Easements, submerged land leases, etc., must be obtained from (See Appendix A for detailed instructions):

Bureau of State Lands Management
Department of Natural Resources
3900 Commonwealth Boulevard
Tallahassee, Florida 32303
Telephone (904) 488-9120

Where required, approval of a survey for the line of mean high water must be obtained from:

Bureau of Survey and Mapping
Department of Natural Resources
3900 Commonwealth Boulevard
Tallahassee, Florida 32303
Telephone (904) 488-2427

Permits from the U.S. Coast Guard following offices:

For peninsular Florida from Fernandina Beach to the mouth of the Wacissa River:

Commander, Seventh Coast Guard District
51 S.W. First Avenue
Miami, Florida 33130
Telephone (305) 350-5611

For areas west of the mouth of the Wacissa River:

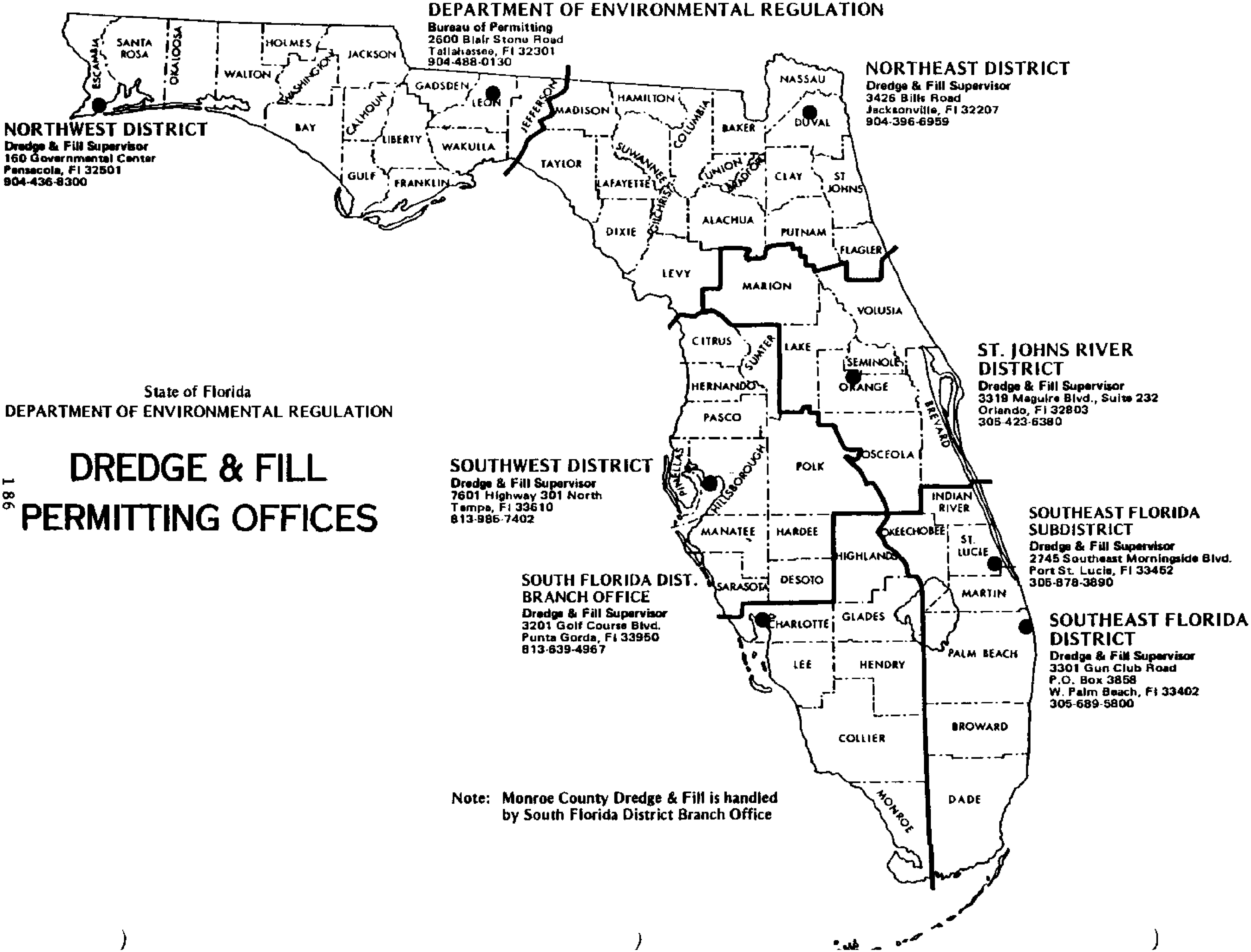
Commander, Eighth Coast Guard District
500 Camp Street
New Orleans, Louisiana 70130
Telephone (504) 589-6298

NPDES permits are obtained from:

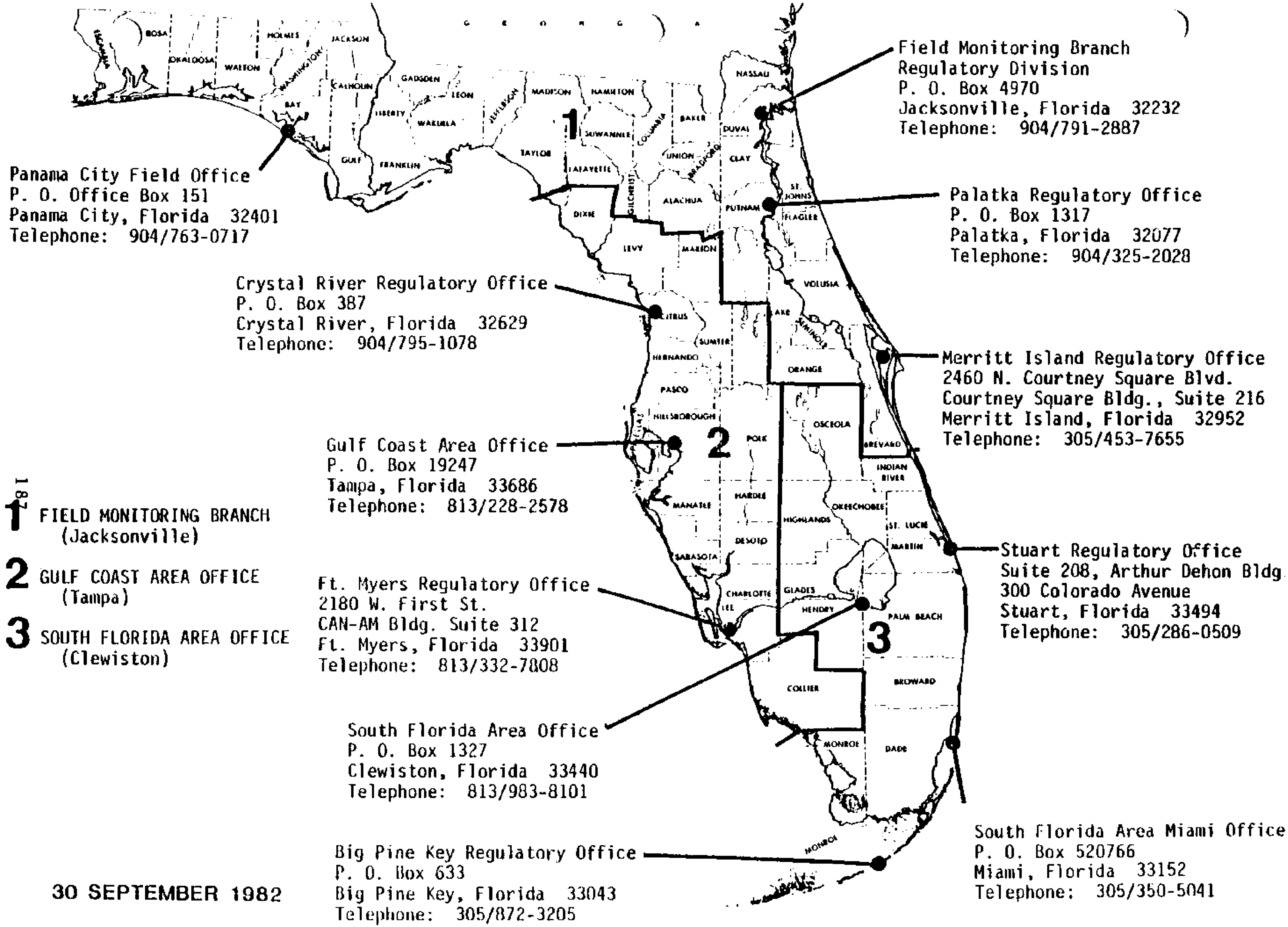
Environmental Protection Agency
345 Courtland Street, N.E.
Atlanta, Georgia 30309
Telephone (404) 881-4201

State of Florida
DEPARTMENT OF ENVIRONMENTAL REGULATION

DREDGE & FILL PERMITTING OFFICES



Note: Monroe County Dredge & Fill is handled by South Florida District Branch Office



CORPS OF ENGINEERS REGULATORY OFFICES AND BOUNDARIES

APPENDIX E

General Information

1. INTRODUCTION

The purpose of this pamphlet is to furnish information on permit programs and instructions for submitting an application to the U.S. Department of Army, Corps of Engineers (Corps), the State of Florida Department of Environmental Regulation (DER), and the State of Florida Department of Natural Resources (DNR) for work in the waters of the state. Federal and state laws prohibit certain activities unless authorized by permit. These laws include the River and Harbor Act of 1899; the Federal Water Pollution Control Act Amendments of 1972, as amended by Clean Water Act of 1977; the Marine Protection, Research and Sanctuaries Act of 1972; and Chapters 161, 253, 258, and 403, Florida Statutes. In addition, other laws are directly related to the procedures for processing permit applications. These include the Fish and Wildlife Coordination Act of 1958, the National Environmental Policy Act of 1969, and Chapter 120, Florida Statutes. Rules and regulations governing the Department of the Army permit programs are listed in Title 33, Section 209.120 of the Code of Federal Regulations. Those governing the Department of Environmental Regulation are listed in Florida Administrative Code Rule 17, while those governing the Department of Natural Resources, Bureau of Beaches and Shores and Bureau of State Lands are listed in Florida Administrative Code Rule 16. A copy of federal regulations may be obtained by writing to the Corps District Office of the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Copies of state regulations may be obtained from the Office of Public Information, Department of Environmental Regulation, 2600 Blair Stone Road, Tallahassee, Florida 32301, or the Bureau of Beaches and Shores and the Bureau of State Lands, Department of Natural Resources, 3900 Commonwealth Boulevard, Tallahassee, Florida 32303.

2. WHAT ACTIVITIES REQUIRE A PERMIT

a. Jurisdiction

(1) Federal: In general, permits are required for work on structures in all tidal areas (channelward of the mean high water lines on the Atlantic and Gulf Coast); in the Ocean and Gulf Waters to the outer limits of the continental shelf; and in all rivers, streams, and lakes to the ordinary high water line; in marshes and shallows which are periodically inundated and normally characterized by aquatic vegetation capable of growth and reproduction; in all artifically created channels and canals used for recreational, navigational or other purposes that are connected to navigable waters; in all tributaries of navigable waters up to their headwaters; in any other waters which the District Engineer determines are necessary for the protection of water quality. (See Figure 1.)

(2) State: Unless specifically exempted, all dredging and filling activities which are to be conducted in or connected directly to waters of the state or which are connected via an excavated water body or series of excavated water bodies to certain waters of the state require permits. These waters of the state are rivers, streams and their tributaries, bayous, sounds, estuaries

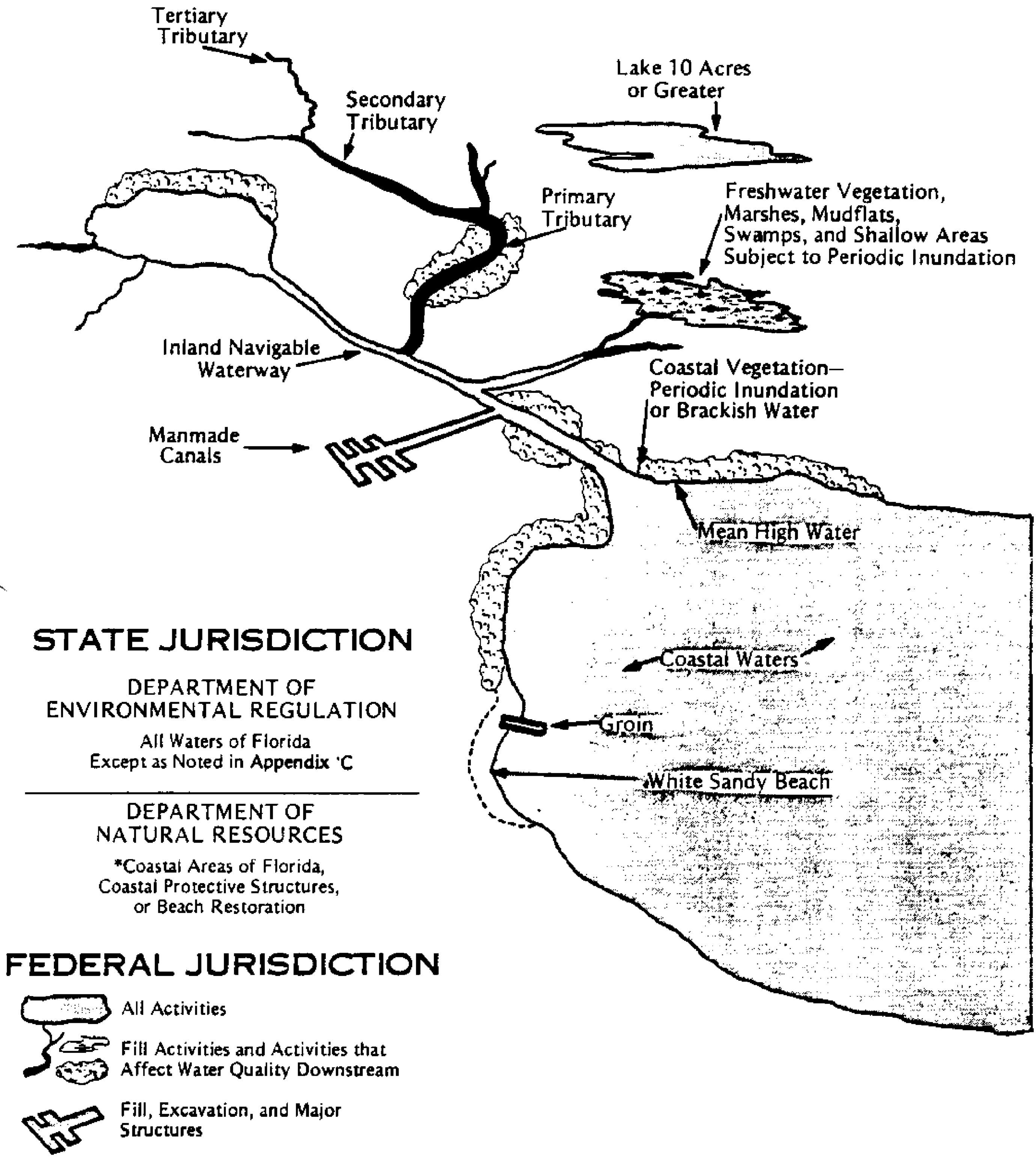

Tertiary Tributary
Secondary Tributary
Lake 10 Acres or Greater
Primary Tributary
Freshwater Vegetation, Marshes, Mudflats, Swamps, and Shallow Areas Subject to Periodic Inundation
Inland Navigable Waterway
Coastal Vegetation— Periodic Inundation or Brackish Water
Manmade Canals
Mean High Water
Coastal Waters
Groin
White Sandy Beach
STATE JURISDICTION
DEPARTMENT OF ENVIRONMENTAL REGULATION
All Waters of Florida Except as Noted in Appendix 'C
DEPARTMENT OF NATURAL RESOURCES
*Coastal Areas of Florida, Coastal Protective Structures, or Beach Restoration
FEDERAL JURISDICTION
All Activities
Fill Activities and Activities that Affect Water Quality Downstream
Fill, Excavation, and Major Structures

FIGURE 1

and bays and their natural tributaries, most natural lakes and the Atlantic Ocean and Gulf of Mexico to the seaward limit of the state's territorial boundaries. Waters owned entirely by one person other than the state are included only with regard to possible discharge on other property or water. If there is a connection, then a permit may be required. The department recognizes that the natural border of certain water bodies may be difficult to establish because of seasonal fluctuations in water levels and other characteristics unique to a given terrain. Vegetation indices for transitional and submerged areas of a water body have been adopted to determine the landward extent of these water bodies.

b. Activities

Activities requiring a permit include, but are not limited to, piers; wharfs; docks; dolphins; mooring pilings; excavation; commercial sand and gravel dredging; filling; disposal of dredged material; riprap and revetments; retaining walls; groins; breakwaters; jetties; beach restoration; levees; wires or cables over the water; pipes, cables and tunnels under the water; fishing reefs; clearing; channel and upland canal construction; intake and outfall pipes or structures; navigational aids; platforms; ramps; signs; fences and the transportation/deposition of dredged material for open water dumping. Permits are required by the U.S. Coast Guard and the Florida Department of Environmental Regulation for bridges, causeways and overhead pipelines. Permits for discharges of other than dredged or fill material must be obtained from the appropriate water pollution control authorities. (See Appendix D for address.)

c. General Permits and Exemptions

(1) Federal: Authority has been given to the Corps to issue General Permits for certain clearly described activities that are substantially similar in nature and that will have only a minimal adverse cumulative effect on the environment. Several general permits have been issued and more are under consideration. You should contact the Corps to determine whether the proposed work meets the reirements of a General Permit.

(2) State: Chapter 403, F.S., exempts certain activities from a DER permit; however, DNR authorization and a federal permit may be required. Applications submitted to DER for these projects will be forwarded by DER directly to the appropriate Corps office for processing.

3. HOW APPLICATIONS ARE PROCESSED

a. Receipt: Upon submittal of an application (see specific instructions for details), DER will forward within 24 hours of receipt one copy of the application along with appropriate drawings to the Corps' District Office and, if state lands are involved, the Bureau of State Lands Management (DNR). Direct mailing to the Corps may delay permit processing. However, applications for groin or jetty construction, beach restoration or other activities permitted pursuant to Chapter 161, F.S., must also be submitted concurrently to the Bureau of Beaches and Shores, Department of Natural Resources, for processing. (See Appendix B for DNR application requirements.)

b. Public Notice

(1) Federal: After the application has been determined to be in proper order, a public notice (usually 30 days) is issued to all known interested individuals, groups and

governmental agencies. Substantive comments received in response to the public notice are furnished to the applicant to afford him an opportunity to comment on or rebut the comments or objections.

(2) State: For all standard-form applications and for some short-form applications, the applicant will be required to publish at his expense one time only a Notice of Intended Agency Action in a newspaper of general circulation in the area of the proposed project. The applicant may also be required to publish a Notice of Application in certain circumstances. DER will provide the applicant with the appropriate wording and instructions for publishing.

c. Public Hearings

(1) Federal: A public hearing may be held by the Corps to afford interested parties full opportunity to express their views and to develop pertinent data to evalute the permit application. If the permit is for an activity involving the discharge of dredged or fill material in the navigable waters or involving the transportation of dredge material for the purpose of dumping it in ocean waters, the laws require the opportunity for public hearings. Thus, a hearing may be held whenever a request stating the substantive reason for holding a hearing is received in accordance with the announced procedures. The other permit authorities of the Corps do not refer to an opportunity for hearing, but as a matter of policy the Corps has always held public hearings whenever the District Engineer considers a hearing warranted by the public interest and likely to produce pertinent information necessary to the proper evaluation of the application.

(2) State: An administrative hearing may be held pursuant to Section 120.57, F.S., if the applicant requests one or if a third party whose substantial interests would be affected by an agency determination requests a hearing. The request must be made in accordance with the procedures outlined in the Fla. Admin. Code Rule 28. If the state intends to deny a permit or does deny a permit, the applicant is afforded an opportunity for an administrative hearing pursuant to Section 120.57, F.S. If a proposed project lies within the boundaries of the Biscayne Bay Aquatic Preserve, DER must hold a hearing pursuant to Section 258.165, F.S., before granting approval of the project.

d. Environmental Impact Statements

If the Corps determines that granting the permit would constitute a major federal action and that the proposed activity would have a significant effect on the human environment, an Environmental Impact Statement will be prepared prior to final action on the permit application as required by Section 102(2)(c) of the National Environmental Policy Act of 1969. The Corps will prepare the EIS, but the applicant will be required to submit data and may be assessed for preparation expenses. Pursuant to Memorandum of Understanding, where the state requires a Development of Regional Impact (DRI) report, the Corps will, where legal constraints allow, use the DRI application for development approval to prepare an environmental assessment to aid in avoiding the delays of an Environmental Impact Statement.

e. Evaluation Factors

(1) Federal: The Corps' decision whether to issue a permit will be based on an evaluation of the

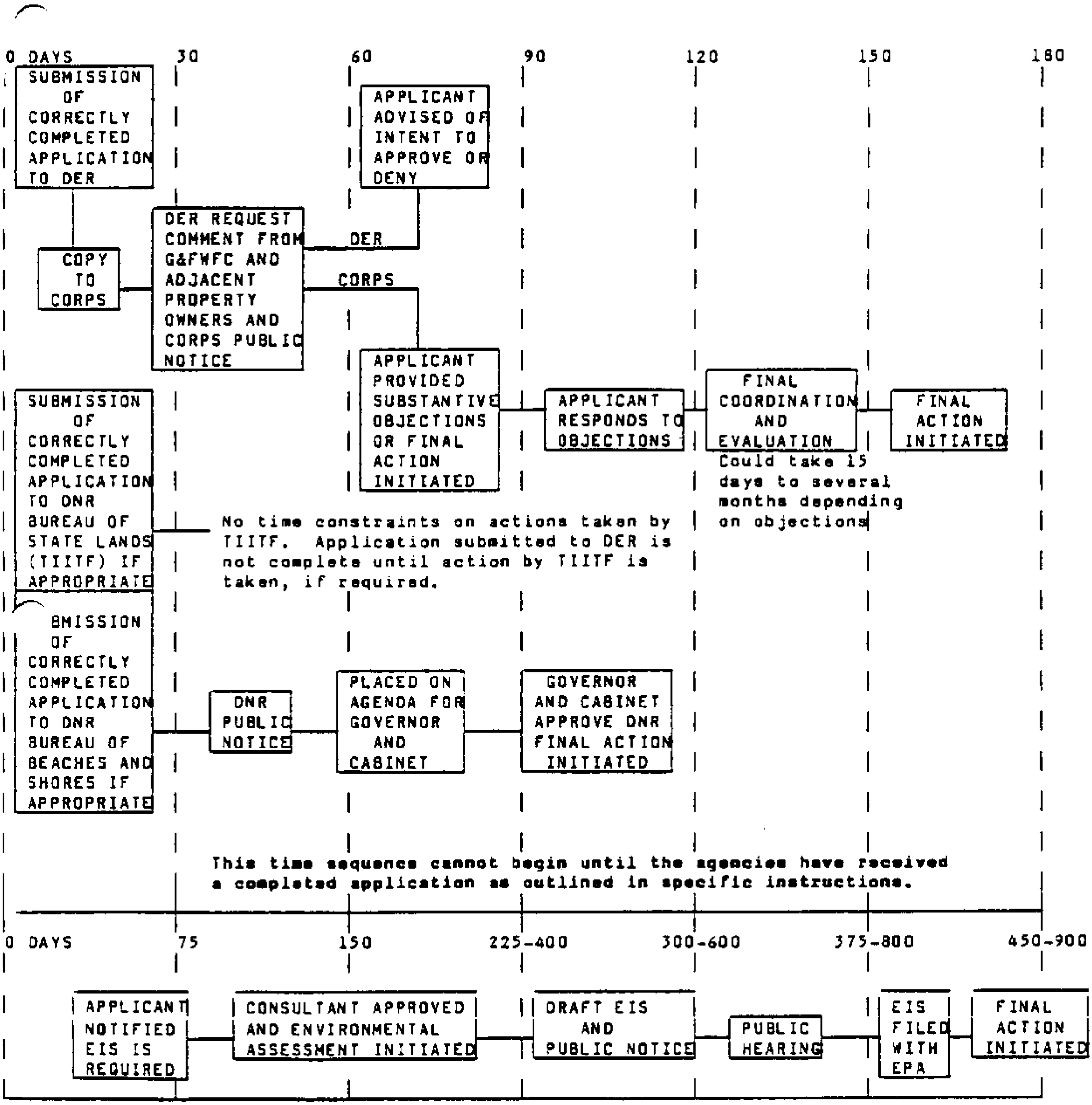
probable impact of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefit which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered. Among those are conservation, economics, aesthetics, general environmental concerns, historic values, fish and wildlife values, flood damage prevention, land use classification, navigation, recreation, water supply, water quality and, in general, the needs and welfare of the people. It is emphasized that, if a proposed activity is to be performed in valuable wetlands, the Corps will evaluate it to determine whether it is a necessary alteration, and the unnecessary alteration or destruction of these wetlands will be discouraged as being contrary to the public interest. In determining whether the alteration is necessary, the Corps will primarily consider whether the proposed activity is dependent on the wetland resource and whether alternatives are practical.

(2) State: DER will evaluate the potential impact of the proposed project on the waters of the state. In assessing this impact DER will determine for the purpose of a permit pursuant to Chapter 253, F.S., if the project will be a harmful obstruction to or alteration of the natural flow of navigable waters; will induce harmful or increased erosion, shoaling of channels or create stagnant areas of water; will interfere with the conservation of fish, marine and wildlife or other natural resources; will induce destruction of oyster beds, clam beds or marine productivity including, but not limited to, destruction of natural marine habitats, grass flats suitable as nursery or feeding grounds for marine life; or for the purpose of a permit pursuant to Chapter 403, F.S., DER will determine if the proposed project will degrade the quality of water by destruction of resources which maintain water quality or will degrade the quality of water by discharging materials harmful to the environment. For authorization by DNR prusuant to Chapter 253, F.S., DNR will evaluate whether the project is water-dependent, sufficiently setback from the applicant's riparian lines, and will assure consistency with other policies, standards, and criteria set forth in Florida Administrative Code Rule 16Q-21.04. For permits pursuant to Chapter 161, F.S., DNR will evaluate the functionality of the proposed construction and its compatibility with the existing coastal processes at the location of construction. An evaluation will be made of the protection afforded against coastal flooding and storm induced erosion and of the physical impact on adjacent properties. Public response to the project will be considered, which may include, but not be limited to, the restriction of public access, the effect of archaeological and historical values, and the impact on turtle nesting sites.

f. Timing

Usually a permit can be issued within 60 to 90 days after the receipt of the completed application, however, in many cases more time is required. For example,if the Corps is required to hold a public hearing, to prepare an Environmental Impact Statement, or if the proposed work is controversial, the processing of a federal application could take up to one year or more.

FIGURE 2
NORMAL PROCESSING
Simplified Flow Chart



Within 30 days after receipt of an application, DER shall review the application, notify the applicant of any apparent errors or omissions, and request any additional information the agency is permitted by law to require. Unless DER has notified the applicant within 30 days, failure to correct errors or omissions or to supply additional information shall not be grounds for denial.

State applications shall be approved or denied within 90 days after receipt of the original application or receipt of the timely requested information or correction of errors or omissions (completed application). However, the 90 days may be extended by a request for a hearing and by the time needed for public notice. In some cases, it may be extended at the request of the applicant. Unless extended, state law provides that a completed application for permit not approved or denied within the 90-day period shall be deemed approved, and the permit shall be issued.

It is important that permit applications be submitted well in advance of the date the work is supposed to commence. (See Figure 2.)

g. State and Local Approvals

It is the applicant's responsibility to determine what local authorizations are required for the proposed activity. While the federal and state governments will process applications simultaneously, the federal permit will not be issued before the state permit where water quality certification by the state pursuant to PL 92-500 is required. Where the proposed activity involves the use of state-owned submerged lands, DER shall not issue a permit before approval or consent of use is obtained from DNR, although DER will continue to process the application to the extent possible. If the applicant is pursuing his rights to state administrative proceedings, reasonable time will be allowed before final action on the federal permit. However, if the state permit is denied, the federal permit usually will be denied.

4. ADDITIONAL PROCEDURES

a. Fees

(1) Federal: Collection of the fee will be deferred until the applicant is notified by the Corps that a public interest review has been completed and that the proposed activity has been determined to be in the public interest. Upon receipt of this notification the applicant will forward a check or money order to the Corps, made payable to the Treasurer of the United States. A fee of $100 will be charged when the plan or ultimate purpose of the activity is commercial in nature, and a $10 fee will be charged for noncommercial activities. The final decision on commercial/noncommercial status shall be solely the responsibility of the Corps. The permit will be issued upon receipt of the fee. Federal, state and local governments are excluded from this fee requirement. No fee will be charged if the applicant withdraws his application at any time prior to issuance of the permit and/or if his application is denied.

(2) State: A processing fee of <u>$100</u> should accompany all DER short-form applications. Standard-form DER applications should be accompanied by a <u>$1,000</u> nonrefundable processing and biological survey fee. Checks should be made payable to the Department of Environmental Regulation. Applications to DNR for a permit pursuant to Chapter 161, F.S., should be accompanied by a check for <u>$100</u>, made

payable to the Department of Natural Resources.

b. Government-Owned Land

(1) Federally-Owned or Controlled Land: If the proposed activity involves the use of federally-owned land or land over which the federal government owns an easement or other real estate interest, the applicant should contact the official in charge of the federal project prior to submitting a permit application to determine if the federal lands or easement areas can be made available for intended use.

(2) State-Owned Land: If the proposed activity involves the use of state-owned land, DER will forward an information copy of the application to the Department of Natural Resources, Bureau of State Lands Management. When notified by the Bureau, the applicant should initiate the process for obtaining the necessary easement, dedication, submerged land lease or other form of consent of use. (See Appendix A.) Such consent of use must be obtained by the applicant before issuance of a DER permit.

c. Revision of Plans

Modifications and revisions to an existing (currently) valid permit may be requested. Major revisions must be accompanied by a completed application form, revised drawings and processing fee. The proposed change in the permit will be reviewed and evaluated, including a site inspection, before approval is granted. For minor revisions, submittal of a revised drawing with the letter of request is sufficient to allow assessment of the public interest and environmental impact. The final decision as to whether the proposed modification is major or minor in nature is solely the responsibility of the grantor of the permit.

d. Extension of Permit

It is very important that the permitted work be completed within the time specified since it may not be a routine matter to grant a time extension. However, if an extension is needed, a written request should be submitted within six (6) months of, but no later than sixty (60) days before, the permit's expiration date. The request for an extension must include a statement of good cause showing why the permit should be extended. No extension can be granted when a permit has already expired. In such cases, the applicant must file a new application, which will be processed in accordance with procedures established for new applications.

e. Transfer of Permit

A permit is issued for a specific activity to a particular person. Therefore, should the affected property be sold or otherwise assigned to other than the permittee, the permit is no longer valid unless legally transferred by the grantor. A transfer of permit may be granted upon request by the new owner or assignee when accompanied by consent from the permit holder. If any changes, additions or modifications to the terms or conditions of the permit are contemplated, a transfer of permit may not be granted; however, an application for a new permit may be filed for processing.

f. Maintenance Work

(1) Federal: With the exception of maintenance dredging, works constructed under a federal permit must be maintained in good condition, and no further authorization is

required for routine maintenance. However, major renovation or a change in size, type or location of structures must be authorized. Federal permits for works requiring periodic maintenance dredging will authorize maintenance dredging for a specified time. The permittee must give advance notice to the Corps each time maintenance dredging is performed. A revalidation (or extension) should be requested at least six (6) months prior to the expiration date set forth in the federal permit.

(2) State: No state permit is required for the maintenance of dikes, irrigation and drainage ditches provided that spoil material is deposited on a self-contained upland spoil site and that no more dredging is performed than is necessary to restore the dike or ditch to its original design specifications. This does not apply to navigable canals. Certain maintenance dredging of existing man-made canals, channels, and intake and discharge structures is also exempt from state permitting; however, before undertaking such a project, the appropriate DER office should be contacted to deter- mine if the proposed project qualifies for exemption. Additional repair or maintenance work is exempted from permit requirements in Chapter 403, F.S., and Fla. Admin. Code Rules 17 and 16. Therefore, the nearest DER office or the Bureau of Beaches and Shores, DNR, should be consulted.

DATA REQUIRED BY THE PRIVACY ACT OF 1974
(5 U.S.C. 552a)

TITLE OF FORM Joint Application, Dept of the Army/Florida Dept of Environmental Regulation for Activities in Waters of the State of Fl

PRESCRIBING DIRECTIVE ER 1145-2-303

1. AUTHORITY

Section 10 River & Harbor Act 1899, Section 103 Marine Protection, Research & Sanctuaries Act of 1972 and Section 404 Federal Water Pollution Control Act

2. PRINCIPAL PURPOSE(S)

Application form for permits authorizing structures and work in or affecting navigable waters of the State of Florida, the discharge of dredged or fill material into navigable waters, and the transportation of dredged material for the purpose of dumping it into ocean waters. To be used by citizens of Florida as one application form for State and Corps dredge, fill and structure permit applications.

3. ROUTINE USES

Describes the proposed activity, its purpose and intended use, including a description of the type of structures, if any, to be erected on fills, or pile or float-supported platforms, and the type, composition and quantity of materials to be discharged or dumped and means of conveyance.

The application is made at the District level and subsequently the content is made a matter of public record through issuance of a public notice.

The content of the application is made available to any requesting agency, dealing with the review of the application. The form itself is not made available; only that information which is pertinent to the evaluation of the permit request.

The form (or copies) could be kept on file at District, Division or OCE level, depending on the details surrounding the case. The information could become a part of any record of a reviewing agency with a need to know; such as U. S. Fish & Wildlife; Environmental Protection Agency; etc.

4. MANDATORY OR VOLUNTARY DISCLOSURE AND EFFECT ON INDIVIDUAL NOT PROVIDING INFORMATION

The disclosure of information is voluntary. Incomplete data precludes proper evaluation of the permit application. Without the necessary data, the permit application cannot be processed.

SAJ FORM 983 - Privacy Act Statement - 26 Sep 75

DA Form 4363—R, 1 May 75 (One-Time)

B. Sociological Considerations

A review of the literature shows that no comprehensive model for the sociological aspects of artificial reef siting has been developed. Accordingly, the more general Social Impact Assessment (SIA) model was chosen and modified to fit the unique nature of a reef siting plan. The major impact categories of the SIA model are: demographic conditions, fiscal conditions, community services conditions, economic conditions, and social/psychological conditions. A modification was made for this study to include biological conditions. The standard SIA model considers the temporal dimensions of: pre-site characterization, site characterization, construction/operations, and post - construction characterizations. Because of the possibility of artificial reef material movement from the designated site caused by some natural event, or a change in an exclusionary zone, or the need to expand the reef to meet an increased user demand, a "removal/addition" phase was added to the temporal dimensions.

It was determined that for other than demographic data, the wide range of sociological information required for a scientifically grounded siting plan was not available within the fiscal and temporal limitations placed on this study. The available data are generally fragmented, regionalized, and largely anecdotal. In view of the foregoing, this study has proceeded using a skeletal SIA model with demographic data, delphi panels, and community meetings.

DECISION FACTOR SUMMARY
SOCIOLOGICAL COMPONENT

for

DEVELOPMENT OF SITING PLANS FOR THE ESTABLISHMENT OF ARTIFICIAL REEFS IN THE GULF OF MEXICO

Grant No. NA84-WC-H-06150

Mississippi - Alabama Sea Grant Consortium
Dr. James I. Jones, Executive Director
Max Flandorfer, Co-Project Manager

Continental Shelf Associates, Inc.
E.A. Kennedy, Co-Project Manager

Mississippi State University
Department of Sociology
Dr. Arthur G. Cosby, Head, Sociology and Anthropology
Bill Howard, Research Associate

Decision Factor Summary
Sociological Component

by

Arthur G. Cosby
William G. Howard
Department of Sociology and Anthropology
Mississippi State University

To a sociologist the formation of an artificial reef siting plan is essentially a socio-economic development activity. That is to say, we are interested in how the siting of an artificial reef will impact upon individuals, groups, and communities. The concern tends to be with on-shore rather than off-shore aspects of the project. Said differently, artificial reefs are intended in some way to enhance the social and economic environment for people. The basic strategy of an artificial reef siting as a development project emphasizes the utilization of and benefits to individuals and communities. While biological, operational (engineering), legal, and economic considerations are extremely important, the critical question is where can artificial reefs be located for the benefit of individuals and communities. The sequence of events, then, is to decide on the most beneficial location from the point of view of usage and, only then, to alter the siting plan by adjusting location to maximize the advantages of these other factors. For example, a location with the most desirable bottom soil type, with a desirable depth and in an area in which conditions are ideal for the creation of a rich biological environment but yet which was in some manner out of range of potential users would constitute poor site selection. Users should be at the center of planning considerations.

I. Enhancing Existing Fisheries or Creating New Fisheries: The Determination of Project Goals

Philosophically socio-economic planners need to clearly distinguish their strategy of development. On one hand, planners may wish to develop a reef siting plan that attempts to establish fisheries in locations where social or economic circumstances conducive to off-shore fishing are either non-existent or relatively sparse. Operationally we are referring to sectors of the Coast that traditionally have been undeveloped in terms of either recreational or industrial enterprises--an area in which there may be a lack of marinas, ramps, and other facilities to support the development of fisheries. The developmental goal is to create new recreational and industrial opportunities. The second approach would be a development strategy that takes advantage of existing social and economic infrastructures where fisheries, industries, and recreational facilities are present. This strategy emphasizes further development and enhancement of fisheries in a given area. The decision of which strategy to utilize is based upon the goals and preferences of the individuals or groups developing the siting plan. In the planning process it is important to explicitly recognize the type of development that is intended.

Assistance in establishing an overall plan of socioeconomic development can be secured from a number of sources:

1) A basic suggested reference:

   Young, Ken M.
   1978 The Basic Steps of Planning Change. Community Collaborators: Charlottesville, Virginia (Write Community Collaborators, P. O. Box 5429, Charlottesville, VA 22903).

2) For a more advanced text:

   Zaltmore, Gerald and Duncan, Robert
   1977 Strategies for Planned Change. Willy - Interscience: New York.

3) State Cooperative Extension Service Community Development specialists and Sea Grant Advisory Service Personnel can also serve as excellent sources of development information. The following contact persons may prove beneficial.

In Mississippi

Dr. Thomas H. Loftin
State Leader, Community Development
P. O. Box 5446
Mississippi State, MS 39762

Dr. C. David Veal
Leader, Sea Grant Advisory Services
4646 West Beach Blvd., Suite 1-E
Biloxi, MS 39531

In Alabama

Dr. R. Warren McCord
State Leader, CRD
Cooperative Extension Service
Auburn University
Auburn, AL 36830

Dr. Bill Hoskin
Program Leader, Alabama Sea Grant Advisory Services
3940 Government Blvd.
Mobile, AL 36609

In Florida

Dr. J. L. App
Assistant Dean
Center for Community and Rural Development
University of Florida
1038 McCarty Hall
Gainesville, FL 32611

Dr. Marion Clarke
Program Leader, Florida Sea Grant Advisory Services
University of Florida
Gainesville, FL 32611

II. Delineation of the Siting Plan Entity: The Determination

Just as it is important to determine the overall developmental goals, it is also critical to define the appropriate group or groups to plan, sponsor and finance the reef siting. Under existing protocol, individuals, private groups, firms, municipalities, county governments, state governments, or combinations thereof can develop plans for the siting of artificial reefs. At the first level it should be apparent that there should be some match between the developmental goals and the appropriate entities developing the siting plan. Obviously, relatively large siting objectives which would impact substantially on the socio-economic development of the municipality would require ideally some organization reflecting the interest of that community. Correspondingly, the development of a small artificial reef which was intended to improve the fisheries for an individual or a small group of individuals would most likely not require as extensive a siting entity.

For large artificial reef projects, an important activity associated with the siting plan may involve marshalling community and political support as a necessary step for accomplishing the development goal. Community organization, identification of key leaders (both formal and informal), and the promotion of the project will constitute important background activities associated with plan development. The support of critical leaders in the area that can potentially benefit from the actual siting is perhaps the most single important achievement to be gained at this step in the process.

III. The Scope of the Artificial Reef Siting Plan: Coordinated versus Discreet Planning Strategies

Just as siting plans can be developed by various size groups, the actual reef plan can vary from a very small artificial reef involving significantly little cost to relatively large enterprises involving substantial expenditures. From the perspective of socio-economic development, this issue is critical if the siting project involves the establishment of a relatively small reef that would benefit only an individual or a few individuals. In this case it seems safe to assume that the overall impact to communities would be minimal, i.e., the benefits would be localized and fixed to a restricted population. In such circumstances a more elaborate analysis of social factors would be of minimal value and, frankly, most likely should not be conducted. On the other hand, siting plans that are generalized in scope and that may impact substantially on the general population in an area will require additional socio-economic data.

It is also important to determine whether a given artifical reef plan is a stand-alone project or is part of a long-range comprehensive plan of reef development. While individuals may find a single reef siting plan a considerable enterprise, there are many reasons that larger planning units, especially municipalities or larger governmental organizations, should develop a long-range comprehensive plan. The following points are suggestive:

1. The need to collect information for a comprehensive plan results in economies of planning. For example, information necessary for a single reef siting may be useful in subsequent siting plans.
2. A comprehensive siting plan has the advantages of meeting the needs of diverse interest groups. Certain types of reefs are better suited for commercial fishermen. Others are more effective for recreational purposes. Some reefs can be used by owners of smaller boats while others can be used only by owners of larger boats.
3. The ability to muster the necessary political and financial support for artificial reef construction may be improved by the diverse offerings of a comprehensive plan. The greater the number and variety of interests that can be met by a siting plan, the more likely it will draw the necessary financial and political support.
4. It is also likely that a comprehensive reef plan can be more easily coordinated with other socio-economic development activities of a community. For example, the location of existing plans to increase the number of ramp locations, develop marinas, and create or enlarge other access facilities could be altered to take into account artificial reef siting.

IV. Long-Term Management: Issues of Responsibility and Liability

Artificial reefs are relatively permanent structures. Some serious consideration must be devoted to the issue of management and responsibility. If the reef requires maintenance (usually in terms of bouy markers), then who has the responsibility and the necessary financial support to maintain this obligation for the specified time. In a similar fashion, who accepts the responsibility for liability associated with injury and other damages that might occur with users of the reef or in transportation of the reef material to the desired location. A detailed discussion of the legal aspects of reef siting is included in the legal component of this report. It is raised here because a major socio-economic aspect of reef siting is the implementation of the management responsibility and liability issue.

V. Identification of Coastal Urban Areas: Determining Impacted Populations, Characteristic, Estimates and Projections

Planners often delineate basic demographic data as the first step in data collection for the planning of a socio-economic development project. The basic question involves determining 1) where the population concentrations reside, 2) the relevant characteristics of this population and 3) the best guesses (projections) concerning future populations, size and characteristics. The most widely available information of this type is contained in the U.S. Census of Population. Local and university libraries normally carry certain information of this type. Some examples of useful information types are

A. Total Population
B. Total Households
C. Average Household Size
D. Median Household Income
E. Median Age of Population
F. Education Levels
G. Employment Status
H. Industries
I. Occupation
J. Household Characteristics
K. Mobility

The majority of current census data is based on the 1980 Census of the Population. Demographers use the term "estimate" to refer to generated figures of population size and characteristics that are developed for periods between the ten-year censuses. Consequently, if a reef siting plan is being developed in 1986, current estimates would be preferable to 1980 census figures. In addition, demographers use the term "projections" to refer to their calculations of future populations, size, and characteristics. Demographic profiles have been developed for most geographic areas of the upper Gulf Coast including counties and municipalities in Alabama, Mississippi, and Florida. These figures include a detailed demographic profile with estimates for 1985 and projections of populations to 1989. Copies of these profiles can be obtained from:

Dr. Arthur G. Cosby
Department of Sociology and Anthropology
P.O. Drawer C
Mississippi State University, Mississippi State, MS 39762

or from

Mr. Max Flandorfer
Mississippi-Alabama Sea Grant Consortium
Ocean Springs, Mississippi 39564.

Relevant geographic areas include:

A. Alabama

Mobile SMSA, AL
Baldwin County, AL
Escambia County, AL
Mobile County, AL
Gulf Shores City, AL
Mobile City, AL
Prichard City, AL
Tillmans Corner City, AL

B. Florida

Ft. Walton Beach SMSA, FL
Bay County, FL
Okaloosa County, FL
Santa Rosa County, FL
Walton County, FL
Destin City, FL
Ft. Walton City, FL
Pensacola City, FL
Wright City, FL

C. Mississippi

Biloxi-Gulfport SMSA, MS
George County, MS
Hancock County, MS
Harrison County, MS
Jackson County, MS
Pearl River County, MS
Stone County, MS
Biloxi County, MS
D'Iberville City, MS
Gulfport City, MS
Orange Grove City, MS
Pascagoula City, MS

VI. Identification of Non-MSA Tourist Destinations: Determining Non-Resident Users

Since many artificial reef projects are developed with the goal of increasing recreational fishing and, consequently, enhancing the overall tourist industry within a community, existing and projected utilization by tourists can become a important factor in planning. Economic interests in reef construction at this level involve many in the local community who are not directly involved in recreational or commercial fishing. Data on "communities-of-origin" of recreational fishermen are generally lacking. Existing studies tend to be highly localized and fixed to a period of time and thus are often irrelevant to a given artificial reef siting plan. It may become necessary to conduct a survey of current tourists and recreational fishermen as the only means of obtaining such data for a specific artificial reef siting plan. Technical assistance have such a endeavor can possibly be provided by specialists of your state cooperative extension service, by local governmental planners, or by survey scientists at universities or colleges. An excellent introductory source to conducting surveys can be found in:

Babbie, Earl R.
1973 Survey Research Methods, Wadsworth Publishing Company, Belmont, CA.

VII. Estimation of Salt Water Boat Fishermen: Determining the Number of Current and Future Potential Users

Another type of information that is important to ascertain is existing demand for reef development. The number and type of salt water boat owners is an indirect measure that can be of value. Again, reports are not readily available that provide the number and types of boat owners along the upper Mississippi coast. However, such data is maintained by state agencies responsible for boat registration. Requests to your state agency can be made as part of a planning strategy. Several considerations are important when requesting this information:

1. From what geographical area do you anticipate that fishermen will come to utilize the artificial reef? At the minimum, it is is recommended that data for adjacent counties be collected in addition to the primary on-shore location.
2. Most state agencies maintain records on boat length and motor horse power. This information is of great value in distinguishing between boat owners who are able to take advantage of artificial reef at varying distance from shore.
3. By combining existing information on boat owners with projections for future population growth, a rough estimate can be derived for future potential reef users.

VIII. Identification of Access Routes, Facilities and Communities: Determining a Planning Strategy

It is important in evaluating a siting plan to take into account access routes to show locations that will be used for departure. Easily accessible roads and bridges may be an important factor in determining the viability of a siting plan. In most instances, along the upper Gulf Coast roads and bridges are generally adequate and consequently, may present a significant problem in artificial resiting. It is wise, however, to evaluate this issue as a safeguard.

An accessment of communities which will be affected by the development, however, constitutes a potentially more complex aspect of the planning process. An initial question involves identification of those communities that will or will not have ready access to the artificial reef site. In one sense a reef site is intended to provide a community with a developmental advantage. For example, charter boat captains may be keenly interested in developing reefs to enhance the fishing experience of their customers. It is doubtful however that they are eager to expend resources and time developing artificial reefs that would be readily available to their competitors in other communities. At a larger scale, communities would not wish to expend the resources for reef development if it does not give them a developmental advantage over competitors. The same argument would also be true for state land planning. From this perspective the location of a reef is a siting decision similar to that made in decisions concerning business locations. By adjusting the locations of a reef site a community group can determine the accessibility of that reef (usually in terms of time and fuel expense) and thus adjust the competitive advantage enjoyed by one-shore locations.

Specific access facilities refer to marinas, ramps, and other similar facilities that will be available to users of artificial reefs. Information is needed in terms of location, availability, size, cost, and type of user. Information about such existing facilities can provide an assessment of the adequacy of current facilities and point to potential needed on-shore developments. It is also important to recognize that existing facilities, for example, available slips may be misleading in terms of potential artificial reefs. Very expensive slip rental fees may not be economically feasible for commercial users. Wales, et al. (1984) provide an excellent outline for characterizing marina facilities. An adapted version of their outline follows:

A. Marina type
B. Berthing capacity
C. Rental fees
D. Boat types
E. Boating activity
F. Dry storage
G. Dock facilities and services
H. Land facilities and services
I. Launch facilities
J. Tide depth

Not only are the characteristics of specific access facilities important. It may also be of use to profile the marina users. Does the particular marina cater to both commercial and private users? Does the cost of marina usage rule out accessibility to a large number of fishermen? Where do marina users reside? To what degree are existing marina users engaged in existing fishing activities. The foregoing information constitutes baseline data for accessing current circumstances and developing projections for future recreational boating and bearthing demand.

XI. Identification and Mapping of Existing Artificial Reef Sites

The identification of existing artifical reef sites may be of great value in the creation of a comprhensive plan. First, existing sites can be used as a starting place for the design of a long-run plan by incorporating them into the overall strategy of development. Second, existing sites can be used to provide an estimate of artificial reef fishery productivity in a given area. Third, existing sites also give some indication of the level of usage and satisfaction of an artificial reef within a given area.

Existing artificial reefs can also serve as excellent candidate locations for the siting of new reefs. The decision to further develop such a site has the advantages of capitalizing on known levels of productivity and usage. It is also probable that problems of competing usage will be minimal since the area has already been established and most likely accepted as an artificial reef site.

X. Identification of Areas where Artificial Reefs May Not be Appropriate

Planners must also recognize that there are many areas in which the siting of an artificial reefs may not be appropriate. The mapping of exclusionary zones thus becomes an essential feature in site planning. Keen attention to such areas can help avoid conflicts with competing users of these areas throughout the site planning process. In addition to reducing conflict during the planning process, strict adherence to avoiding inappropriate areas will reduce liabiality risks once the reef is in place. Examples of zones which may need to be excluded include the following

A. Established and traditional shipping lanes, fairways, anchorage areas, and offshore ports
B. Traditional shrimping grounds and bottom trawling areas
C. Military areas
D. Marine sanctuaries
E. Biologically sensitive areas

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DECISION FACTOR DOCUMENT:
SOCIOLOGICAL COMPONENT

for

DEVELOPMENT OF SITING PLANS
FOR THE ESTABLISHMENT OF
ARTIFICIAL REEFS IN THE
GULF OF MEXICO

Grant No. NA84-WC-H-06150

Mississippi - Alabama Sea Grant Consortium
Dr. James I. Jones, Executive Director
Max Flandorfer, Co-Project Manager

Continental Shelf Associates, Inc.
E. A. Kennedy, Co-Project Manager

Mississippi State University
Department of Sociology
Dr. Arthur G. Cosby, Head, Sociology and Anthropology
Bill Howard, Research Associate

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Introduction

From a sociological perspective the siting of artificial reefs is essentially a social and economic developmental project that has the potential for enhancing a local community, sets of communities, or a geographic region. As much, certain goals and underlying assumptions concerning these development activities must be made explicit as an integral part of the decision making underlying any artificial reef siting plan. That is to say, what is our fundamental development strategy?

Two philosophically distinct approaches must be addressed. One developmental strategy would be to develop a reef siting plan that attempts to enhance fisheries in locations where social and economic circumstances conducive to offshore fishing are not existent or sparse. Such a plan essentially is an effort to produce new industry and recreational opportunities. The second approach would be to take advantage of existing social and economic infrastructure where fisheries industries and recreational facilities are present and attempt to enhance and further develop such an area. This decision factor document is developed to emphasize the latter developmental approach.

This project investigates three major sites or demand centers. They are as follows: Biloxi-Gulfport, MS; Mobile Bay Area (Pascagoula, MS, Dauphin Island, AL, and Gulf Shores, AL); and, Florida Panhandle (Pensacola, Ft. Walton Beach, and Destin). The siting of several reefs in one project complicates the already complex web of biological, economic, legal, operational, and social issues involved. Several sets of hierarchically arranged geographical areas and several possible sites at sea must be investigated for each demand center. The details of the geographic areas concerned in the sociological component will be discussed in the methods section.

It is felt that the most effective implementation plan is one that first takes advantage of existing resources, provides for possible expansion due to future needs, and then sequentially becomes concerned with activity in essentially undeveloped areas. Since there is no extant model or methodology in any discipline that provides a comprehensive data set and impact analysis strategy for artificial reef siting (Parker, et al., 1974:1; Ditton, 1981:27; Bohnsack and Sutherland, 1984:25), the social component of an artificial reef siting plan will be viewed as a special case of social impact assessment (SIA). SIA is a rèsearch approach that attempts to anticipate the social impacts of project development in advance of actual implementation. The major questions are:

*What are the social consequences of reef siting at a particular location or set of locations?
*What are the relative merits of alternative strategies?
*What social data are needed for mitigation and possible litigation?
*What social monitoring should occur as the development activity occurs?

SIA is usually delineated in a temporal fashion. The following phases are the typical chronology: pre-site characterization, site characterization, construction, operational, and post construction/operation. These will be adapted to an artificial reef siting project.

The research strategy proposed to conduct a SIA on the three sites should be based on a multiple triangulation approach. This research technique utilizes multiple perspectives, multiple methods, and multiple sources of data to address the same research question or set of questions. The major methodological assumption is that if the results of several methods, e.g., economic forecasting, primary data analysis, secondary data analysis and Delphi techniques, all converge, the more likely the research will have valid findings. In other words, "the greater the triangulation the greater the confidence in the observed findings" (Denzin, 1970:472).

The essential function of SIA analysis is first to identify all possible impacts across a wide array of data categories and then to assess the scope and extent of impacts that have already occurred and those which may occur. A paradigm for socioeconomic data categories has been established in the literature (Halstead, 1982; Murdock and Leistritz, 1983). The categories utilized here follow closely those of Halstead. They are as follows: population and other demographic conditions, fiscal conditions, community service conditions, economic conditions, and social/psychological conditions. Since no single approach will provide complete data and assessment, SIA is more a matter of substance than technique (Freudenberg, 1978). The state of the art in social science research indicates that some of the critical impacts may be of a more qualitative, e.g., quality of life, cultural, historical, etc., than of a quantitative nature.

Unfortunately the development of all of the details contained in a complete SIA are beyond the scope of this study. For a comprehensive list and discussion of the extremely complex factors most likely to affect impacted areas see Murdock and Leistritz (1979). For an excellent overview of the methods and techniques for standard SIA see Murdock and Leistritz (1983). However, the rudiments of a decision factor document based on SIA principles will be presented along with a data set and analysis primarily of the pre-site variety.

LITERATURE REVIEW

Initial Intent of This Research

The initial intent of this literature review was to develop a comprehensive review of the social science literature on artificial reef siting and data bases relevant to the subject and produce a computerized annotated bibliography. The first step was to review the Directory of On-line Databases (1983) to determine what was available through computer retrieval services. The database we found to be most closely aligned with our needs appeared to be DIALOG which contains over 200 data bases with 90 million records. A computer search of sixteen databases in this file yielded 622 references. All of the files were searched using artificial reefs as the major keyword. Subsetting artificial reefs by keywords such as sociology, sociological aspects, recreation and Exclusive Economic Zone (EEZ) did not prove useful in limiting the literature to a sociological component. We did, however locate an extensive demographic data base, viz. Donnelly Demographers, that will be discussed in the methods section. Our naivete was becoming painfully evident. Consultation with colleagues and professionals in other disciplines concerned with artificial reefs produced responses to the query, "Where can we find literature by social scientists on artificial reef siting?", from "good-luck" to "we sympathize with you."

Not to be deterred, we found a comprehensive review of the "scientific journals" with over 400 references (Bohnsack and Sutherland, 1984). However, after reviewing this work and interacting further with professionals in other disciplines at meetings, we abandoned the idea of a computerized annotated bibliography since the sociological literature appeared to be so sparse. A comparison between the results of our survey and that of Bohnsack and Sutherland can be found in Appendix A.

General State of the Art

The literature on artificial reefs can be characterized in four words: extensive (Ditton and Burke, 1984:3), non-scientific (Bohnsack and Sutherland, 1984:1-2), non-sociological (Bohnsack and Sutherland, 1984:68; ARDC, personal communication), and disorganized (Bohnsack and Sutherland, 1984; Ditton and Burke, 1984). Ditton and Burke indicate that the Florida Sea Grant College Program has documented over 2,000 articles on artificial reefs. However, they note that these are focused generally on a particular aspect of reef development and there is a need for integrating this body of knowledge into a "comprehensive planning framework" (Ditton and Burke, 1984:3-4).

This demonstrated need for communication and coordination among all affected parties has been addressed at the federal level by the creation of the Artificial Reef Development Center (ARDC). The Sport Fishing Institute created the ARDC "...to fill this need for a national institutional focus. As an information repository, exchange and clearinghouse, the ARDC will facilitate artificial reef development by matching potential reef sponsors with donors, providing data to researchers and managers and supplying pertinent data on artificial reefs to a diversity of user groups" (ARDC, n.d.). Unfortunately, the laudable goals of ARDC are still in the planning and developmental stages.

States of the Art in Sociology

Research activity by sociologists in the area of artificial reef siting is mostly of recent origin and notably sparse. As noted above a thorough review of the literature for articles concerning the sociological aspects of reef siting is primarily an exercise in futility. Most of the work done in the area has been by scientists in other disciplines with little effort being directed toward development of a body of knowledge along the lines of traditional sociological theory or in the tradition of Social Impact Assessment (SIA) research techniques. The need for such research is based on requirements of federal granting agencies and the need for a multi-disciplinary approach to such a complex problem. The legal reasons for thinking about more than fish in artificial reef research has been succinctly summarized by Ditton:

> Two additional reasons to think about more than fish are the National Environmental Policy Act (NEPA) and the Fisheries Conservation and Management Act (FCMA). Language in NEPA implores federal officials to be interdisciplinary and to consider alternatives. The FCMA mandates comprehensive fisheries management in that social, political, and economic considerations be taken into account with biological concerns (1981:25).

One writer has suggested that "A conceptual framework for establishing development criteria is not now available in the literature" (Beardsley, 1977:7). Two other researchers reached a similar conclusion seven years later after an exhaustive review of the literature (Bohnsack and Sutherland, 1984). In terms of the sociological and economic research they found that "Comparatively few studies have examined in detail the sociological and economic aspects of artificial reefs, although artificial reefs are usually considered an economic asset to nearby communities" (Parker, et al., 1974:1; Bohnsack and Sutherland, 1984:25).

Although several bibliographies have been published on artificial reefs, as noted above the most comprehensive effort found in our research is that of Bohnsack and Sutherland (1984). In 1983 they reviewed, annotated and computerized 413 references without finding a coherent, scientific approach to the diversity of problems encompassed by artificial reef siting. Bohnsack and Sutherland also reviewed bibliographies on numerous facets of reef siting. They report on bibliographies of translations and summaries of the extensive Japanese literature (1984:4); descriptions of reef programs in the U.S. and other countries (1984:7); and, historical documents and conference proceedings (1984:7). Their comments on the general state of the art and recommendations for the future are succinct. Their considered opinion on the general state of the art and recommendations for the future are as follows:

"Conclusions were often based on little or no scientific data."
...........(p.1)
"Improved professional publication standards and more carefully controlled studies using an experimental approach are suggested."
...........(p.2)
"The economics and social impact of artificial reef also have not been carefully examined, especially the benefits from alternative designs and approaches."
...........(p.2)

In the areas of sociology and economics they found only 15 articles in scientific journals--eight in sociology and seven in economics (1984:68). Most of the other literature in these areas are in the private libraries of individual scientists, private consulting firms, publications that are non-peer review, government documents and proceedings of meetings.

Bohnsack's and Sutherland's comments on the "socio-economic priorities" for the future are worth quoting in some detail as their general focus is similar to the approach taken in this research.

> Examine alternative artificial reef strategies.
> Particular attention should be given to examining the economics of long-term versus short-term strategies and the economics of building prefabricated versus waste material reefs.
> ....
>
> Determine optimum reef size, design, density, and configuration for particular habitats.
> This research should include economic, social and biologic factors. We find it incredible that some programs spend hundreds of thousands of dollars building reefs without spending anything on research or monitoring the status of the reefs over time. Proper research should show how to balance costs and benefits.
> ....
>
> Document direct and indirect economic and social benefits
> Socio-economic analyses must be able to properly evaluate concepts such as user satisfaction. The aesthetic value of fishing could be more important than the actual dollar catch of the fish.
> (1984:36-37).

They did not, however, limit their critical comments to the scientific community. Management politics and priorities were also scrutinized and found to be a critical part of the problem as well (1984:37-39).

Socio-economic Literature

The limited number of socio-economic studies discussed by Bohnsack and Sutherland were mostly on the economics of reef building and generally limited to the cost of a particular reef project. Only two studies were found to compare the cost of alternative strategies of reef building and these were limited to the most cost-effective material. A few other economic type of studies were reported on such things as expenditures by private boat fishermen (1984:25-27).

Mottet (1981) reviewed a considerable number of Japanese articles (some of which are also reviewed in Bohnsack and Sutherland) and found conflicting results concerning the cost/benefits of reefs. The bottom line is that there is simply not enough data, economic or biological, to prove that the Japanese reef projects were cost beneficial. However, due to the huge investments by the Japanese government in reef research and, hopefully, with more and better data on benefits this may turn around in the near future. It must also be remembered that these data seldom assign benefits in dollar amounts to such psychological and physical benefits of fishing reported by fishermen (Ditton, 19??:??).

The major results of this lack of activity are:

*lack of a codified body of knowledge;
*lack of a readily accessible data base;
*lack of a readily accessible bibliography (more accurately, lack of published scientific material by social scientists);
*lack of frequent interaction among social scientists at professional meetings or in personal communications.

The major efforts we found that bear directly on the sociological aspects of reef siting for recreational purposes, viz., in research orientation, data presented, or implications, were those of Beardsley (1977), Ditton (1978), Ditton and Graefe (1978), Ditton (1980), Ditton (1981), Graefe (1981), Ditton (1982), ARDC (1984), and Wales, et al (1984).

Ditton and Graefe, either individually or together, have provided the most useful insights to data needs and actual survey data for developing a profile of saltwater fishermen and their motives and attitudes toward artificial reef use that we encountered in our research. Ditton and Graefe (1978) in a research project focusing on saltwater fishermen in the Houston-Galveston Bay area estimated that utilization of an artificial reef constructed with decommissioned Liberty Ships. They noted, as have others, that the cost of gathering field research is generally prohibitive. Other alternatives such as mail-out questionnaires and telephone interviews, although less expensive, suffer considerably from lack of response bias.

Ditton and Graefe analyzed four socio-economic variables in developing their profile of saltwater fishermen. Those were: age, education, occupation and income. Their findings can be summarized as follows:

*the age groups 35-44 and 45-54 had a higher percentage of large boat owners;

*over 70 percent of small boat owners and over 80 percent of large boat owners had an educational level beyond high school;

*nearly 50 percent of small boat owners and almost 75 percent of large boat owners had white collar occupations, viz., the categories, "professional-technical" and "manager, official or proprietor;"

*more than 25 percent of small boat owners and over 50 percent of large boat owners had yearly incomes of $35,000 or more (1978:61-65).

These data can, of course be useful in triangulation with demographic and delphi data for developing sampling frames, scenario analyses, and "best guesstimates" on a variety of aspects of reef siting.

They also presented data on a variety of other aspects such as motivations for fishing, distance traveled to fish, distance traveled off-shore, and types of equipment used on the boat. Motivations are, of course, social psychological variables of interest to sociologists. Distance traveled to launching sites is important in the delineation of land-based geographic regions of interest for development of siting criteria. Finally, distance traveled to fish is important in development of off-shore regions of interest for development of siting criteria off-shore.

Graefe (1981) developed a set of social and economic data needs for an artificial reef development. Two major factors stood out in terms of data needs:

*social and economic information requirements are implied by law; and,

*any efforts to measure the economic development benefits of artificial reefs will require as a minimum a multi-year project with repeated surveys of reef fishermen and their spending habits (1981: 153).

Among the data needs he listed were: boat length, distance traveled, disposition of catch, attitudinal data, sociodemographic data, benefits of food production, motivations and preferences for fishing, and identification of conflicts among user groups.

Graefe also noted a number of problems of data collection beyond the legal requirements and cost. First, it is difficult to identify what the population of saltwater anglers is and especially which ones fish reefs. At the time of his research no state required issuance of a license for saltwater fishing. Finally, there are problems of recall in any data collected by survey and interview methods.

Wales, et al (1984), produced the most extensive data set including variables needed in reef siting. Although the data were produced primarily for evaluation and needs assessment for marinas, many of the results pertain to one of the sites included in this study, viz., the Gulfport-Biloxi area. Even though their data suffer definitional problems, e.g., there is not a consensus for a definition of marina (1984:2), and a low response rate (30 percent to questionnaires for slip users at marinas (1984:30), the data is useful and the most comprehensive that we could locate on any of the three sites researched in this study. Their data set includes the following:

*Marina characteristics and distribution
1. Marina types;
2. Berthing capacity;
3. Boat types;
4. Boating activity;
5. Dry storage;
6. Dock facilities and services;
7. Land facilities and services;
8. Launch facilities; and,
9. Tide depth

*Public marina user characteristics
1. Marina user profile;
2. Marina use and services; and,
3. Spatial patterns of users.

*Projections for recreational boating and berthing demand.

They also discuss environmental impacts and assessment, planning considerations for marina development, regulatory responsibilities, and recommendations for impact mitigation. Since details of their findings, particularly maps of use patterns, are utilized at length in the methods section, they will be discussed there.

Finally, we found research strategies other than traditional sociology to be useful in developing our approach for the rudiments of a decision factor document from the sociological point of view. In particular, the SIA literature proved most useful and includes the recommendation of Bohnsack and Sutherland (1984) and almost directly comparable to the recommendations of the ARDC technical report (1984). The SIA approach will be discussed in the methods section and the ARDC report will be more thoroughly discussed in the discussion of this report.

Methods

As we noted in the introduction, research on an artificial reef siting plan is a special case of social impact assessment (SIA). This section includes a discussion of the major components of a modified SIA approach. These are: the temporal dimension, the social dimension, and the multiple triangulation analysis technique. This research does not present and analyze data on all dimensions of the SIA as they are not in a readily accessible data base. For example, comparable data on marina location, volume of traffic through marinas by type of activities, location, and scale of ramps, accessibility to ramps and marinas and boat registration for all geographic regions along the coast of the U.S. are currently being developed by the Sport Fishing Institute but they are not currently on-line. However, analysis of a demographic data set including information for 1980, estimates for 1984, and projections for 1989 is presented for all three demand centers. Further, a data set on marina locations, characteristics of users, and preference of fishing location, in the Gulfport-Biloxi demand center of users is presented. Data of similar quality and magnitude could not be found for the other sites at the time of this research. Data for Florida on the location of existing reefs is briefly discussed.

Research Strategy: Modified SIA

1. Temporal Dimensions

Social impact assessment is usually delineated in a temporal fashion. The following phases are the typical chronology: pre-site characterization, site character?zation, construction, operational, and post construction/operational. Since artificial reef siting is a special case of SIA analysis we have added a dimension, viz., additional construction/removal. This is necessary due to the desire to bring attention to the fact that reefs may well need to be enlarged as demand increases and may also be removed for a variety of reasons, e.g., exclusionary zones, especially military zones, may change, storms, and other forces of nature.

The temporal phases are defined as follows:

*Pre-site characterization refers to an assessment of social data and related social infrastructure information that can be used to identify candidate sites for reef placement.

*Site characterization refers to a more intensive investigation of social factors in infrastructure when a subset of sites have been identified.

*Artificial reef construction refers to the social and related factors associated with construction phase of development.

*Operational refers to the social and related factors associated with the reef operation.

*Post construction/operational phase refers to the long run social implications of reef siting.

*Additional construction/removal phase refers to the long run social implications of changes environmental and/or social, which cause an alteration of previous construction, either enlargement or removal.

These temporal dimensions are shown in Figure 1.

2. Major Social Dimensions of SIA

The essential function of SIA analysis is first to identify all possible impacts across a wide array of data categories and then to assess the scope and extent of impacts that have already occurred and those which may occur. A paradigm for socioeconomic data categories has been established in the literature (Halstead, 1982; Murdock and Leistritz, 1983). The categories are as follows: population and other demographic conditions, fiscal conditions, community services conditions, economic conditions, and social service conditions. We have modified these categories for the special case of artificial reefs by adding a biological conditions category.

A. Population and Other Demographic Conditions.

Population data is of the utmost importance in describing prior and current configurations of a target population. Demographic techniques and models are significant SIA tools for predicting future population size and composition as well as providing input data for estimates of other data categories. For example, future economic activity and demands on services are closely linked to demographic change in scale and composition.

A much more extensive data set was included in the appendices of this report to bring the nature and extent of the database to the attention of researchers concerned with reef siting. Not only does the data include numerous variables, estimates and projections, it is unique in the hierarchical depth of units of analysis. Data can be obtained at several levels of aggregation from the U.S. as a whole, to multi-state areas used in marketing analysis, to states and various substate regions such as counties, cities and even zip codes. These data are invaluable in determining sampling frames for field and survey research and "best guesstimates" for comparison with sample survey data.

Although the complete data set includes numerous variables, a subset was chosen for this analysis to correspond as closely as possible to previous research. These variables are: population size, age, education, income, and occupation. These data are discussed for all three demand centers for 1980 and some 1984 estimates and 1989 projections are discussed as well.

Population estimates are population data estimated for an intercensual year. Population projections refer to the determination of future population levels if a certain set of assumptions proves to be valid. There are numerous types of techniques for projection population presented in various publications. Shyrock and Siegel (1975) is the standard text used by many demographers. However, a very comprehensive treatment of the various projection techniques can be found in a technical manual on SIA by Murdock and Leistritz (1983). Of the five techniques discussed, the cohort component technique requires the largest input of data and is generally viewed as superior to non-component techniques (Murdock and Leistritz, 1984; Chapter 3). The component technique was used to develop the population projections used in this report. Refer to Appendix B for variable definitions and explanation of techniques used for estimates and projections. Refer to Appendix C for a complete listing of the data set.

B. Fiscal Conditions.

This refers to the composition and pattern of tax structures and government expenditures within the targeted area. SIA must address the complexities of revenue flows and expenditures associated with the project as they are linked to demographic change, economic activity, and community services. Refer to the economic and legal decision factor documents for more information and data on this issue.

C. Community Services Conditions.

This represents measures of adequacy and quality of services in the areas of education, transportation, utilities, housing, real estate, public safety, health care, and human services, both governmental and non-governmental. SIA requires research that measures the adequacy and quality and assesses changes in both the extent and types of community services related to relevant impacts. In addition, it must relate such impacts on community conditions to other substantive impacts, i.e., demographic, fiscal, economic and social/psychological. These conditions are less likely to be seriously affected by artificial reef construction than in the case of larger projects such as energy projects and nuclear waste disposal projects. This does not mean, however, that this dimension should be excluded from analysis.

D. Economic Conditions.

Economic conditions refer to such information as income, employment, unemployment, distribution of wealth, property value, economic development (such as the ability to attract industry - in this research this could be such things as tourism, marinas, boat building and services, fishing tackle, etc.), as well as non-market, non-cash economic activities. Key questions include: What are the economic impacts? What opportunities are created? What opportunities are foregone? As with other data categories, the economic dimension is also seen as highly interrelated. Refer to the economic decision factor document for more information and data on these issues.

E. **Social/Psychological.**

This data category refers to such important issues as social organization and structure, community cohesiveness and structure, local relationships with the physical environment, trust in institutions, overall life satisfaction, stress levels, local self-sufficiency, mental health, coping skills, values, as well as other local cultural and societal features. These social and psychological dimensions should be analyzed in the context of their interaction with the other data areas.

F. **Biological Conditions.**

Biological conditions refer to a wide range of impacts such as location of the reef vis-a-vis other artificial and/or natural reefs. "Line bottom areas, existing traveling lanes, are as of water and wind turbulence, depth, type of fish, appropriate reef materials and design are among the major area of interest. Figure 2 graphically portrays a crosstabulation of the major temporal dimensions with the major social dimensions.

3. Multiple Triangulation of Data

A major assumption underlying this research is that there is no existing scientific discipline, research methodology or other analytical technique which will provide a comprehensive SIA for artificial reef siting (Beardsley, 1977:7; Murdock and Leistritz, 1983: ; Bohnsack and Sutherland, 1984:25). Since no single approach will provide complete data and assessment, SIA is more a matter of substance than technique (Freudenberg, 1978). The state of the art in social science research indicates that some of the critical impacts may be of a more qualitative nature, e.g., quality of life, cultural, historical, etc., than quantitative.

The research strategy proposed to conduct a SIA on the three sites should be based on a multiple triangulation approach. This research technique utilizes multiple perspectives, multiple methods, and multiple sources of data to address the same research question or set of questions. The major methodological assumption is that if the results of several methods, e.g., economic forecasting, primary data analysis, secondary data analysis and Delphi techniques, all converge, the more likely the research will have valid findings. In other words, "the greater the triangulation the greater the confidence in the observed findings" (Denzin, 1970:472).

There are numerous techniques for forecasting technological developments and the alternative socioeconomic scenarios surrounding changes affecting major elements of a society. One research team has identified nearly one hundred techniques for forecasting technological scenarios (Lien, Anton, and Duncan, 1968:5). The most frequently utilized techniques, however, are some type of "Delphi" and cross-impact analysis (Christaki, Globe and Kawanura, 1977:B-1). The co-inventor of both techniques, Olaf Helmer, has analyzed their strengths and weaknesses as follows:

> "...whether we like it or not, it must be recognized that future analysis, like operations analysis, of which it should be properly considered a part, is

Figure 1
Cumulative Impacts Over the Temporal Dimensions of an Artificial Reef Siting Project

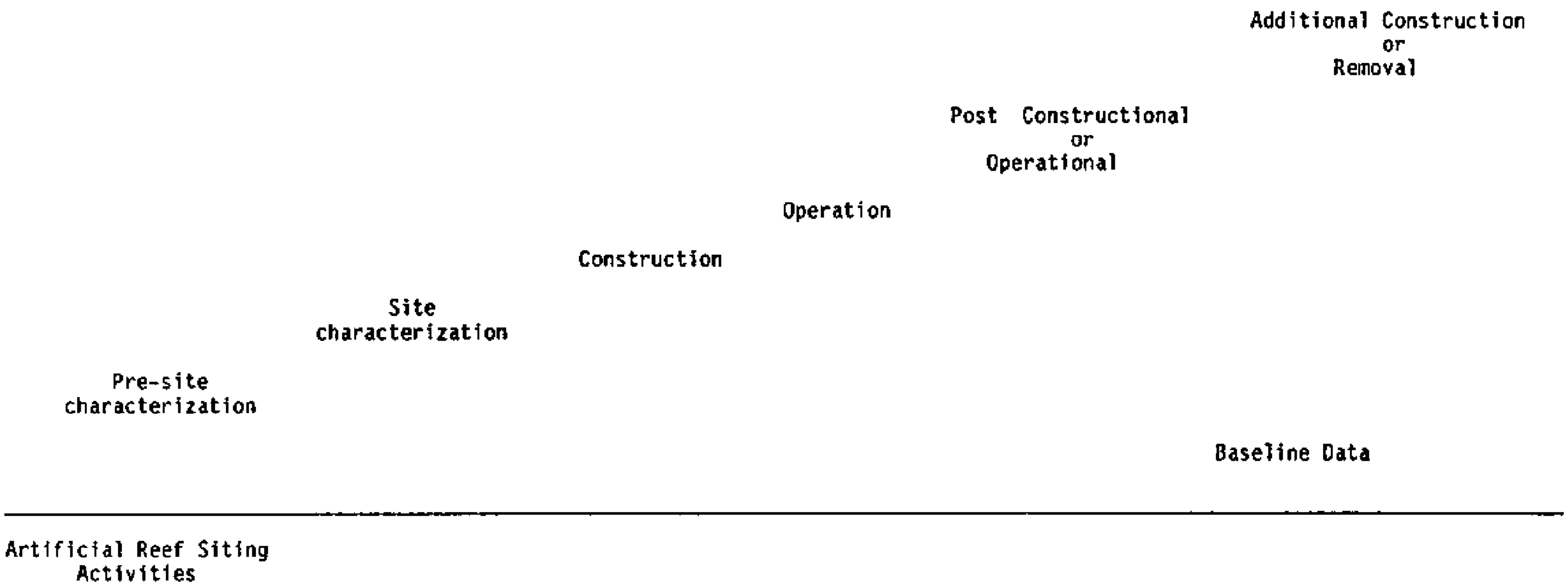


Figure 2
Partial List of SIA Primary Social Dimensions Relative to Temporal Dimensions of an Artificial Reef Siting Project

Project Phase	Pre-site Characterization	Characterization	Construction	Operation	Additional Construction/ Removal
Type of Impact					
Demographic	X	X	X	X	X
Economic					
Employment			X	X	X
Income			X	X	X
Economic Development	X	X	X	X	
Opportunity Costs	X	X	X	X	
Land Values	X	X	X		
Community Services					
Education			X	X	
Transportation			X	X	X
Utilities			X	X	
Public Safety			X	X	X
Health	X	X	X	X	
Housing			X	X	
Other Governmental Services	X	X	X	X	
Fiscal Impacts					
Tax Structure		X	X	X	X
Budget Patterns			X	X	X
Social & Cultural					
Stress Levels	X	X	X	X	
Trust in Institutions	X	X	X	X	
Social Structure			X	X	
Belief in Systems			X	X	
Ways of Life			X	X	
Biological	X	X	X	X	X

Figure 3

Partial Listing of data and Projection Methodologies
Necessary for Multiple Triangulation

Data

Primary Data Sources
- *Delphi studies
- *social surveys
- *field surveys
- *psychological tests
- *content analysis
- *unobtrusive observations

Secondary Data Sources
- *professional journals
- *government documents
- *literature searches
- *data banks/computer networks

Methodologies (Primarily Projection)
- *component/non-component population models
- *Delphi projections
- *ecomometric models
- *time lag models
- *simulation models
- *scenario analysis

> inevitably conducted in a domain of what might be called 'soft data' and 'soft laws'. This means that dependence on instinctive judgement is not just a temporary expedient but in fact a mandatory requirement. In place of firm observational data we have to resort to judgemental inputs; in place of well-confirmed empirical laws we have to have our expectation on intuitively perceived regularities. Reliance on expert opinion is a sine qua non" (Helmer, 1977).

Refer to Figure 3 for a partial list of information and techniques required for the multiple triangulation technique. When all components of this grant are considered (legal, biological, operational, economic, sociological, and operational) several of the methodologies were utilized. Under the heading "primary data source" a delphi panel was utilized, viz., the advisory committee, to represent the interest of various user groups and concerned governmental and private agencies. All of the methodologies listed under "secondary data sources" were utilized in this component of the project. It is likely that several components did this as well. Finally, under the heading of "methodologies (primarily projection)" this component used the component population projection model. The entire project was informed by a delphi panel as mentioned above. Other components of the grant may have also utilized other categories of the methodology/section.

4. Analysis of Data

The complete demographic data set is in Appendix C. A subset of the data representing the Mississippi demand center of Gulfport-Biloxi are presented in Figure 4. This subset was chosen since we have other supporting data for this area and not for the others. Demographic data for the other two demand centers will be discussed but are not presented in the text.

The delphi method or technique will permit the researcher to make forecast the socioeconomic considerations for alternative artificial reef strategies and to render them both plausible and credible through a dialogue among experts over a period of several years.

There are two major problems with analyzing existing aggregated data: 1. the variables of interest to the research issues may not be adequately measured or even addressed at all; and, 2. it is often difficult if not impossible to examine a "direct" relationship between variables investigated (Babbie, 1973:36). The latter issue is generally termed the "ecological fallacy." The ecological correlations or relationships that are observed between variables is highly aggregated data, and such as demographic data, do not necessarily indicate a "causal" relationship between such variables in a sample survey. That is to say, an individual's behavior may not always be anticipated based on personal characteristics, e.g., income, age, occupation, or education, shown to be effective in predicting group behavior based on the same variables (see Robinson, 1950:551-57 for a comprehensive review of the issues involved). With these caveats in mind we will proceed to the analysis of some "existing, highly aggregated demographic data."

Figure 4. Demographic Data for Gulfport-Biloxi Demand Center, 1980, 1984 and 1989.

1980

	Total Population	%	Population 35-54	%	Education 12+ years	%	Occupation White Collar	%	Income $35,000+	%
Mississippi	2,520,638	100.0	492,324	19.5	749,167	54.8	181,216	19.4	58,094	7.0
Biloxi-Gulfport SMSA, MS	191,918	100.0	38,764	20.2	67,862	66.1	14,325	21.7	4,990	7.9
Hancock County, MS	24,537	100.0	5,147	21.0	8,172	58.5	1,834	22.6	667	8.1
Harrison County, MS	151,665	100.0	31,746	20.1	56,659	67.7	11,858	21.8	4,141	8.0
George County, MS	15,297	100.0	3,201	20.9	4,458	54.2	756	14.7	274	5.7
Jackson County, MS	118,015	100.0	26,222	22.2	41,730	67.5	9,405	20.6	3,496	9.3
Pearl River County, MS	33,795	100.0	7,469	21.9	10,834	58.2	2,253	19.7	803	7.2
Stone County, MS	9,716	100.0	1,871	19.2	3,031	58.7	633	19.0	182	6.2
Biloxi City, MS	49,311	100.0	8,336	16.9	17,181	70.5	3,078	22.2	1,104	6.9
D'Iberville City, MS	13,369	100.0	3,050	22.8	4,526	67.0	720	14.8	204	5.1
Gulfport City, MS	39,676	100.0	8,348	21.0	15,709	66.6	3,693	23.8	1,210	8.2
Orange Grove City, MS	13,476	100.0	3,023	22.5	5,061	72.7	1,268	24.3	433	10.8
Pascagoula City, MS	29,318	100.0	6,202	21.2	10,935	69.6	2,703	22.4	1,016	10.2

Figure 4. Continued A.
1984

	Total Population	Population 35-54 #	Population 35-54 %	Income $35,000+ %
Mississippi	2,607,619	526,739	20.2	10.2
Biloxi-Gulfport SMSA, MS	206,318	42,914	20.8	11.5
Hancock County, MS	28,607	6,065	21.2	12.1
Harrison County, MS	167,538	34,680	20.7	11.5
George County, MS	16,551	3,575	21.6	9.2
Jackson County, MS	129,581	29,804	23.0	15.3
Pearl River County, MS	37,161	8,324	22.4	9.6
Stone County, MS	10,173	2,035	20.0	8.3
Biloxi City, MS	49,943	8,440	16.9	8.7
D'Iberville City, MS	15,519	3,818	24.6	12.6
Gulfport City, MS	39,557	8,347	21.1	12.0
Orange Grove City, MS	16,377	3,996	24.4	15.7
Pascagoula City, MS	32,105	6,935	21.6	15.9

Figure 4. Continued B.
1989

	Total Population	Population 35-54 #	%	Income $35,000+ %
Mississippi	2,723,522	593,728	21.8	16.5
Biloxi-Gulfport SMSA, MS	225,511	50,063	22.2	19.5
Hancock County, MS	34,032	7,487	22.0	19.0
Harrison County, MS	180,697	40,476	22.4	19.9
George County, MS	18,222	4,100	22.5	19.4
Jackson County, MS	144,991	35,378	24.4	31.4
Pearl River County, MS	41,647	9,579	23.0	15.0
Stone County, MS	10,782	2,286	21.2	13.1
Biloxi City, MS	51,442	9,774	19.0	14.1
D'Iberville City, MS	18,268	4,731	25.9	22.8
Gulfport City, MS	38,998	8,697	22.3	18.1
Orange Grove City, MS	20,324	5,487	27.0	34.5
Pascagoula City, MS	35,305	8,403	23.8	28.3

The demographic data can be utilized to provide "best guesstimates" about the likelihood of having population concentrations with the "appropriate" demographic characteristics, geographic proximity to the coast and areas to facilities for inclusion in artificial reef siting programs. The characteristics identified in the literature from sample surveys which are associated with the probability of owning a boat large enough and outfitted with the appropriate equipment to permit reef fishing expeditions are: age 35-54, education of 12+ years, white-collar occupation, and an annual income of $35,000 or more. These data are presented for selected Mississippi coastal counties and cities in figure 4. All of the Mississippi coastal counties were included as they were either in the Gulfport-Biloxi demand center or the Mobile Bay demand center as defined in the grant. The cities of Gulfport, Biloxi and Pascagoula were included for the same reason. Other cities and counties were included for illustrative purposes, particularly the CDP's in the coastal counties. ("census designated place--closely settled population centers without corporate limits.") Although a complete data set and analysis on all geographic units in the data set from the state to zip code level would have been desirable, the selected units show the utility for further research along these lines with funding to match needs.

The baseline data for 1980 provided in figure 5 show the demographic ranking for number of persons across all variables for 1980. The data indicate that Harrison and Jackson counties are numbers 1 and 2 respectively on all four variables for 1980, and for 1984 and 1989 on the age variable. Age was the only variable for which estimates and projections were available. For 1980 Gulfport is ranked number 3 which is higher than all other cities and even Hancock county on age, occupation and income. Biloxi is number 3 on education. However, Biloxi moves up to number 3 on the age dimension in 1984 and 1989. Therefore, there appears to be some justification for focusing on the cities of Gulfport, Biloxi, and Pascagoula when absolute number of persons in these demographic categories is a desirable feature of the research. However, when the desire to have community meetings or to focus sample or research surveys on areas where the population is homogeneous in terms of these characteristics, other data should be utilized. For example, the data in figure 6 show the demographic ranking by percentage of the population in the areas arrayed across the same set of variables. A different picture emerges when the data are presented in this manner. The city of Orange Grove (CDP) has the highest percentage of persons on three of the four variables. It is number 2 on the age variable. The city of D'Iberville (CDP) is ranked number 1 on the age variable. It is significant that these two CDP's remain in the top five ranking on the two variables whose percentages are estimated for 1984 and 1989, viz., age and income.

The data on the Gulfport-Biloxi demand center that can provide some guidance for siting an artificial reef in this area is adapted from Wales, et al (1984). The major conclusions the authors reached are:

*Demand for slips is very high.
*Marina users prefer accessible locations for marinas.
*Most marina owners are coastal residents.

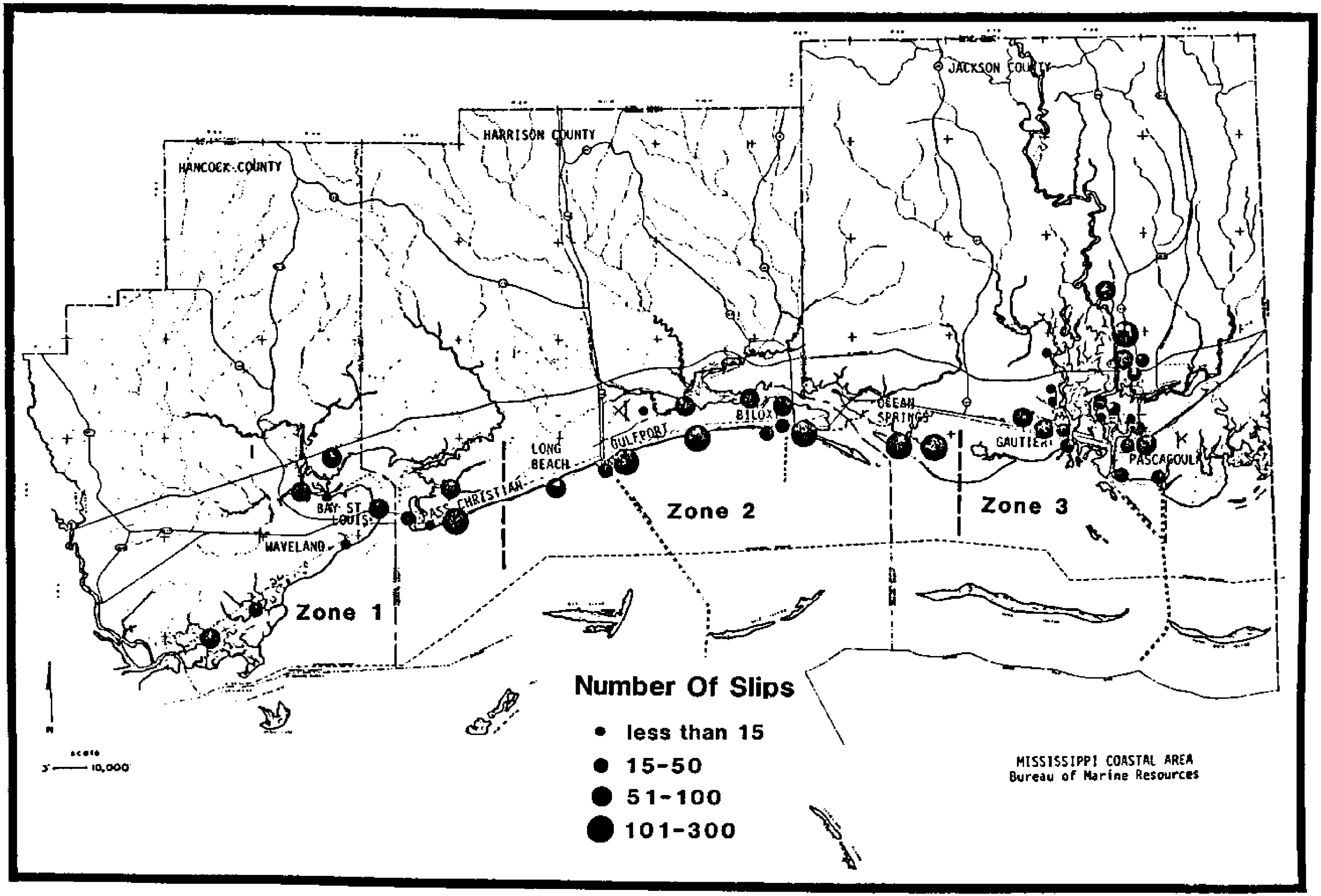
Figure 5
Demographic Ranking (1-5) of Mississippi Coastal Areas by Size of Population in the Categories of Ages 35-54, 12+ years of Education, White-collar Occupations and Yearly Income of $35,000 or over for 1980 and for ages 35-54 in 1984 and 1989

Demographic Ranking	Age 35-54	Education 12+ years	Occupation White Collar	Income $35,000	Age-35-54 1984	Age-35-54 1989
1	Harrison Co.	Harrison Co.	Harrison Co.	Harrison Co.	Harrison Co.	Harrison Co.
2	Jackson Co.	Jackson Co.	Jackson Co.	Jackson Co.	Jackson Co.	Jackson Co.
3	Gulfport Cty.	Biloxi Cty.	Gulfport Cty.	Gulfport Cty.	Biloxi Cty.	Biloxi Cty.
4	Biloxi Cty.	Gulfport Cty.	Biloxi Cty.	Pascagoula Cty.	Gulfport Cty.	Gulfport Cty.
5	Pascagoula Cty.	Pascagoula Cty.	Pascagoula Cty.	Pascagoula Cty.	Pascagoula Cty.	Pascagoula Cty.

Figure 6
Demographic Ranking (1-5) of Mississippi Coastal Areas by Percent of Population in the Categories of Ages 35-54, 12+ Years

Demographic Ranking	Age 35-54	Education 12+ Years	Occupation White Collar	Income $35,000+	Age 35-54		Income $35,000	
					1984	1989	1984	1989
1	D'Iberville Cty.	Orange Grove Cty.	Orange Grove Cty.	Orange Grove Cty.	D'Iberville Cty.	Orange Grove Cty.	Pascagoula Cty.	Orange Grove Cty.
2	Orange Grove Cty.	Biloxi City	Gulfport Cty.	Pascagoula Cty.	Orange Grove Cty.	D'Iberville Cty.	Orange Grove Cty.	Jackson Co.
3	Jackson Co.	Pascagoula Cty.	Harrison Cty.	Jackson Cty.	Jackson Co.	Jackson Co.	Jackson Co.	Pascagoula Cty.
4	Pascagoula Cty.	Harrison Cty.	Hancock Cty.	Gulfport Cty.	Pascagoula Cty.	Pascagoula Cty.	D'Iberville Cty.	D'Iberville Cty.
5	Gulfport Cty.	Jackson Cty.	Pascagoula Cty.	Hancock Cty.	Hancock Cty.	Gulfport Cty.	Hancock Cty.	Harrison Co.

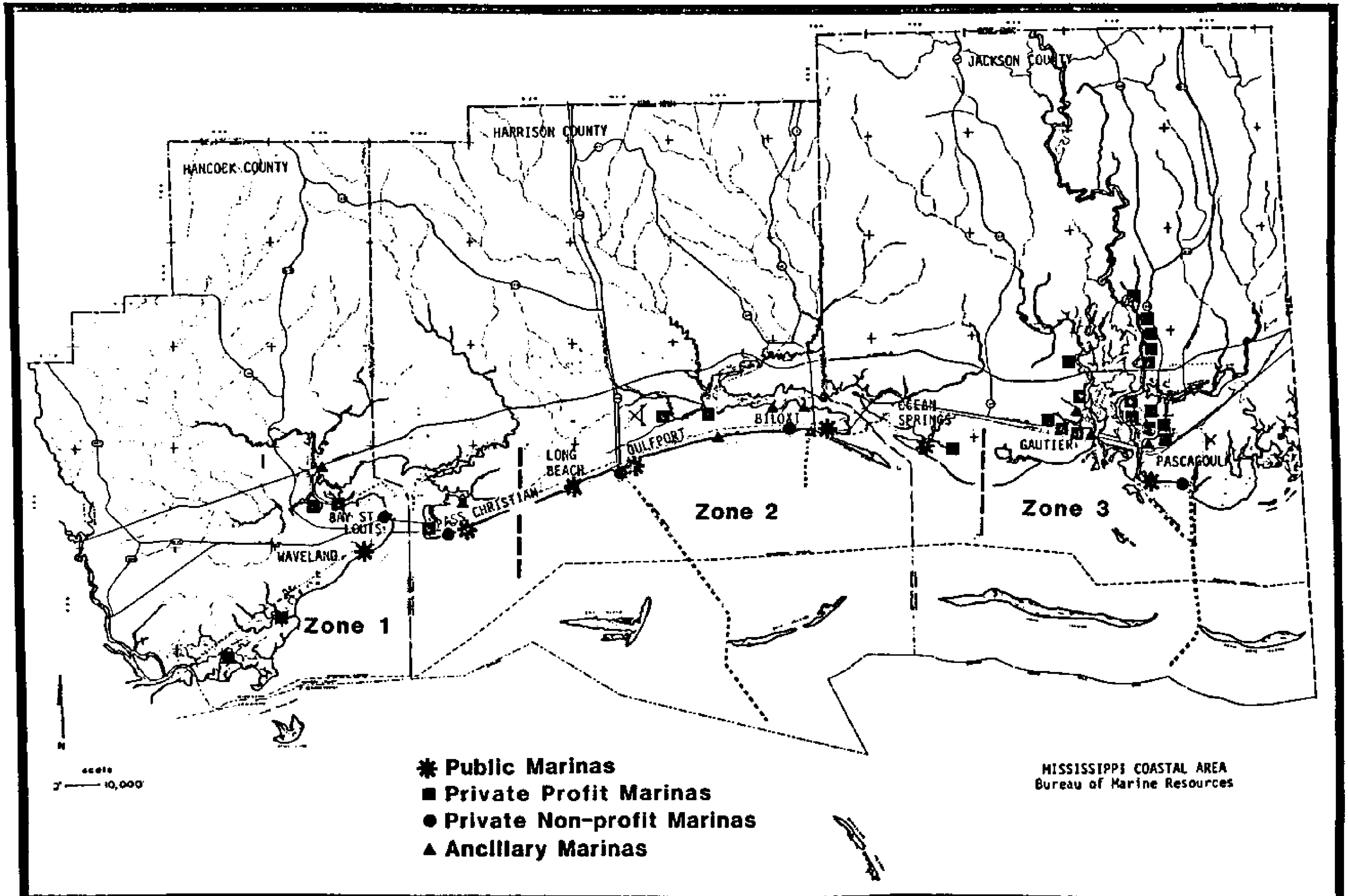
Mississippi Coastal Marinas By Slip Capacity *



*Adapted from Wales, et al, 1984:23

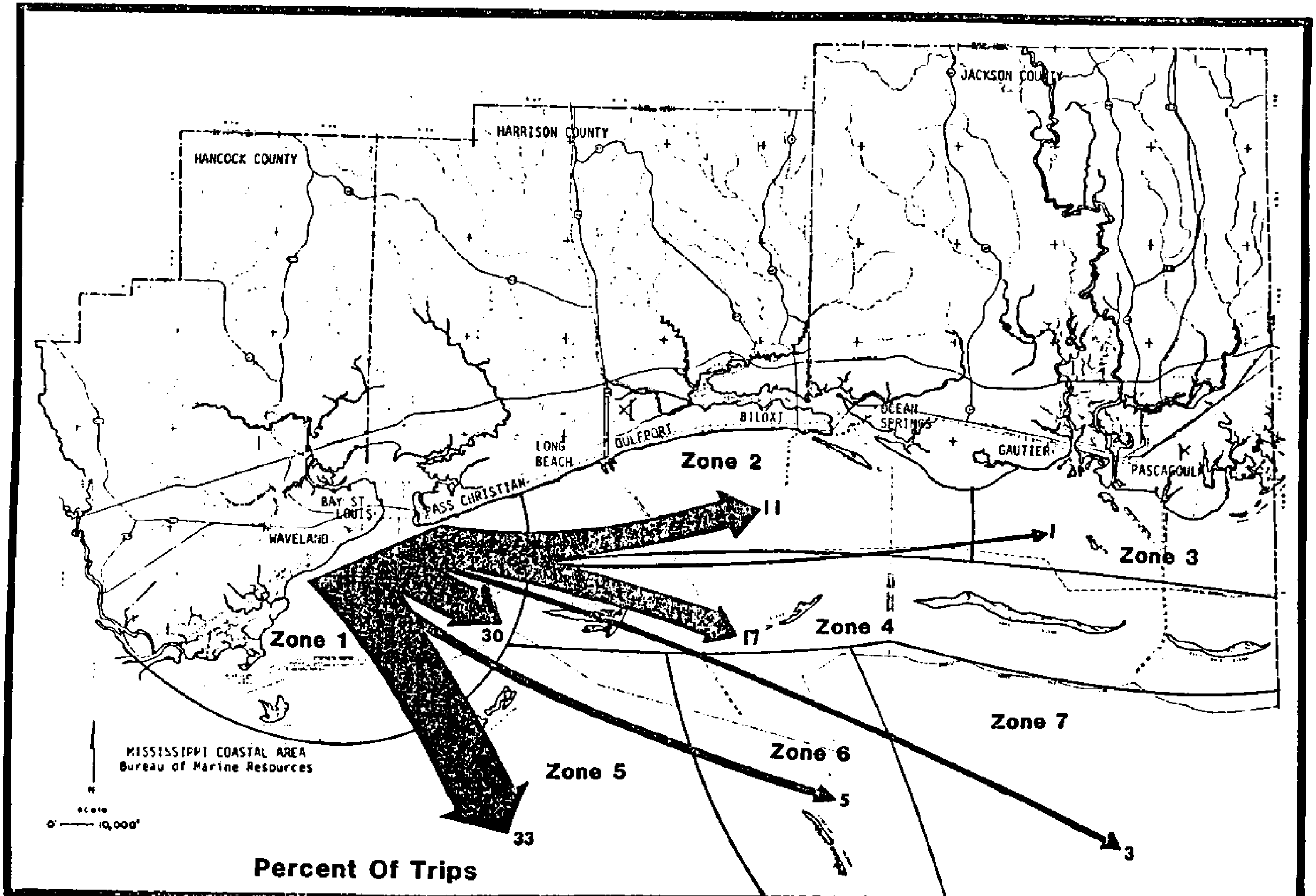
Figure 8

Mississippi Coastal Marinas By Type *



*Adapted from Wales, et al, 1984:24

Boater Destination Zones Originating From Zone 1 *



*Adapted from Wales, et al, 1984:38

Figure 10

Boater Destination Zones Originating From Zone 2 *

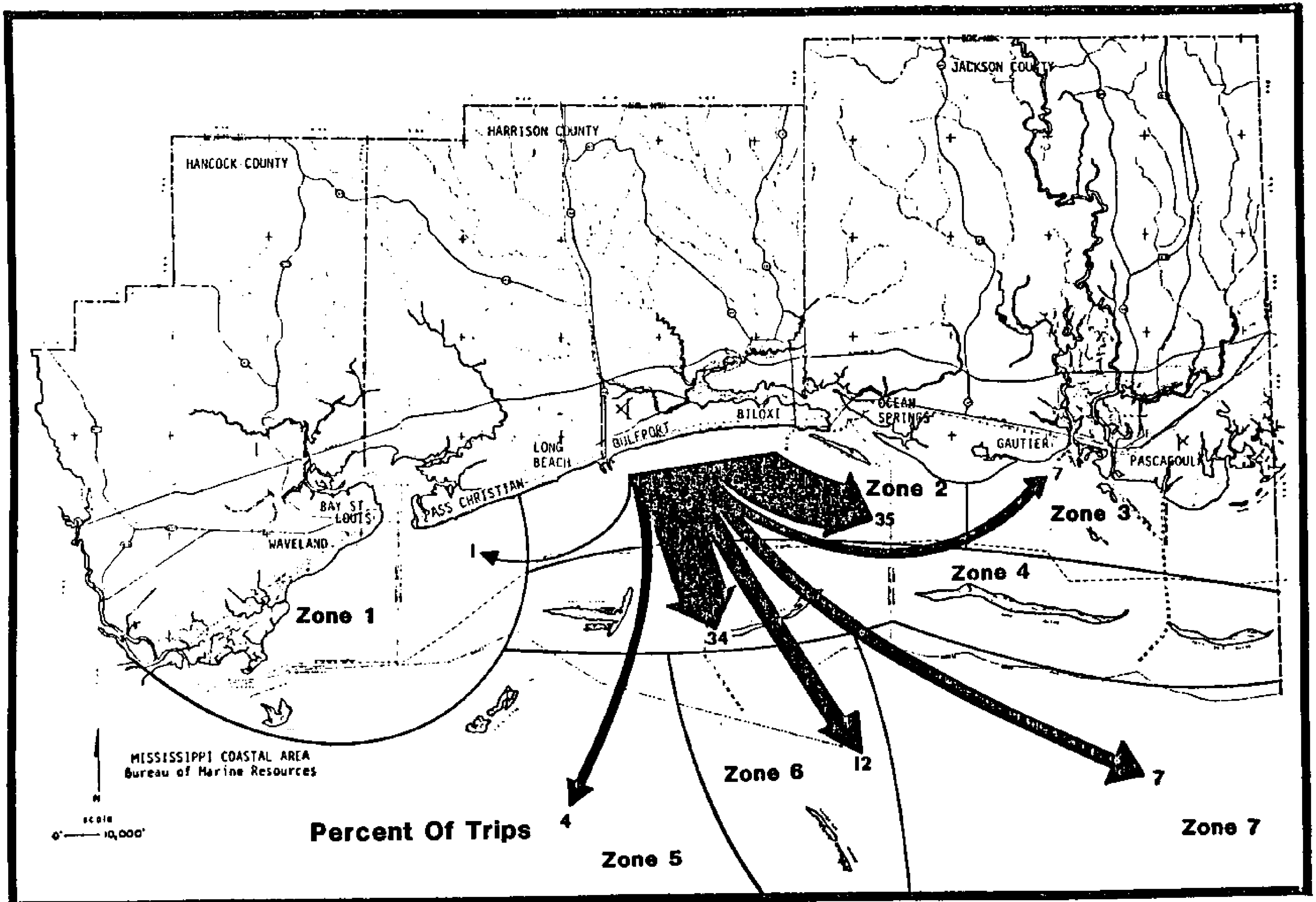
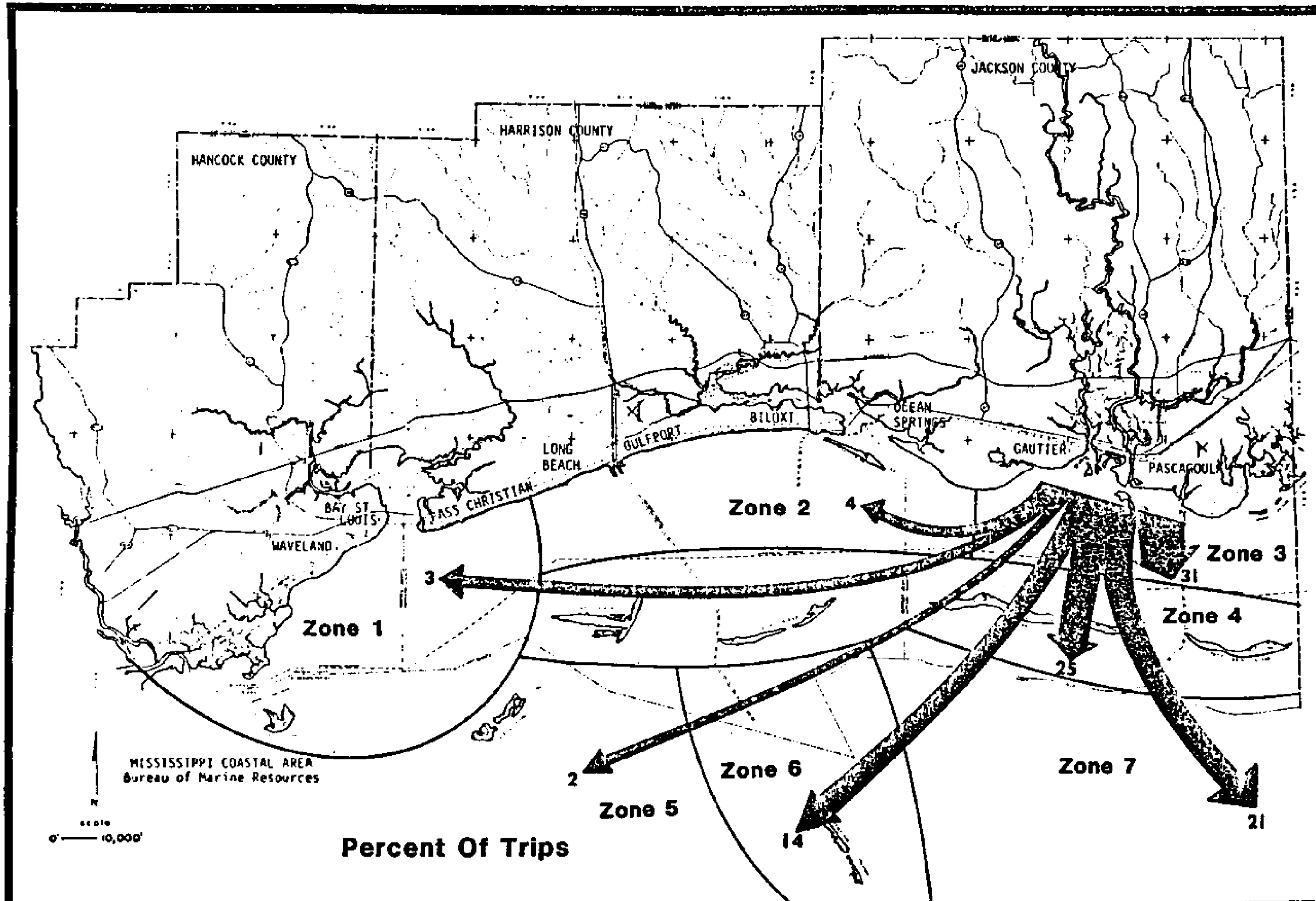


Figure 11

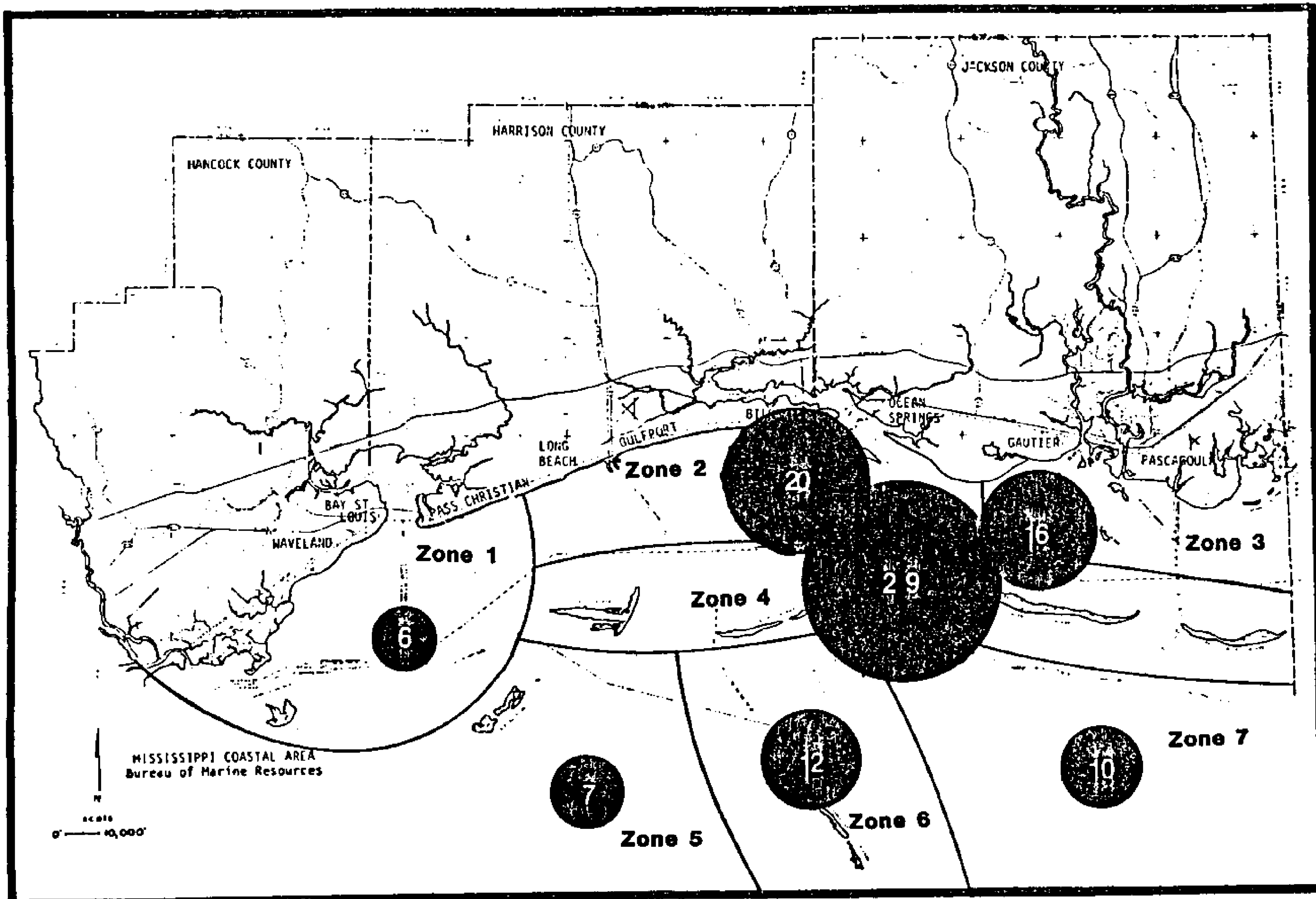
Boater Destination Zones Originating From Zone 3*



*Adapted from Wales, et al, 1984:40

Figure 12

Total Percent Of Trips Made To Each Zone*



*Adapted from Wales, et al 1984:41

*Most users own power boats 16-25 feet in length with a significant number of users owning boats in the 26-39 feet range.
*The average frequency of use is in the 30-40 times per year range.
*Marina users seldom use motel/hotel accommodations.
*Many users are interested in dry-stack storage in a marina.
*Public marina users are willing to rent in private marinas but have moderate concerns about cost and security (1984:32).

Other research we reviewed that covered the same issues essentially agrees with these conclusions. However, the most important information provided by this document for our research is the information provided on Mississippi coastal marinas by type and slip capacity, location of origin and destination for saltwater fishermen and trip frequency. These data were adapated from Wales, et al (1984:23, 24, 38-41) and are presented in figures 5-10.

Figures 5-10 go about here.

The marinas are spread out all along the coast throughout Jackson, Harrison, and Hancock counties. The largest concentrations are in Jackson and Harrison counties with Harrison county having proportionally more public than private for profit marinas (Figures 5 and 6). However, the authors note throughout their report that the number of marinas and fishermen for Hancock county are misleading and are expected to expand at a faster rate than the other two counties and become an increasingly larger percentage of the total for the three counties. These results in combination with the conclusions from the study reported above have obvious social and economic implications for the reef siting process.

The geographic zones of origin and destination for trips by fishermen are presented in Figures 9-11. The total percent of trips made to each zone are presented in Figure 12. These data provide very direct evidence, from the sociological perspective of possible reef locations. Zones 2, 3, and 4 were the most heavily utilized with zone 4 being the most preferred destination. Since this zone is the location of the barrier reefs and probably has a large "live bottom" area, the biological data must be used in conjunction with the sociological data (as well as that from the other components of this grant) to help determine appropriate possible reef sites. These results should then be triangulated with information of the Delphi panel and information provided in public meetings to be help on this issue.

It is interesting to note that less than 21 percent of the fishing trips were to zone 7 which extends toward the Mobile Bay demand center. Since at least part of zone 7 (if not all) and all of the other zones of this study are directly in the Gulfport/Biloxi area it would seem desirable to include the Pascagoula data with the rest Mississippi rather than including it with the Mobile area data. More detailed information is, of course, needed for both demand centers.

Demographic data for the Mobile Bay Demand Center is not discussed in detail since we could not locate any supplementary information of the nature we found on the Gulfport/Biloxi and Florida Panhandle areas. Further, given our reticence about including Pascagoula (and Jackson county) in the Mobile Bay area as mentioned above, other data will be necessary to enhance that analysis.

Analysis of the demographic data for the Florida Panhandle yields some interesting results when supplemented with information on current artificial reef sites and compared with the Mississippi demographic and trip location data. The location data for current reef sites are found in Figures 13 and 14.

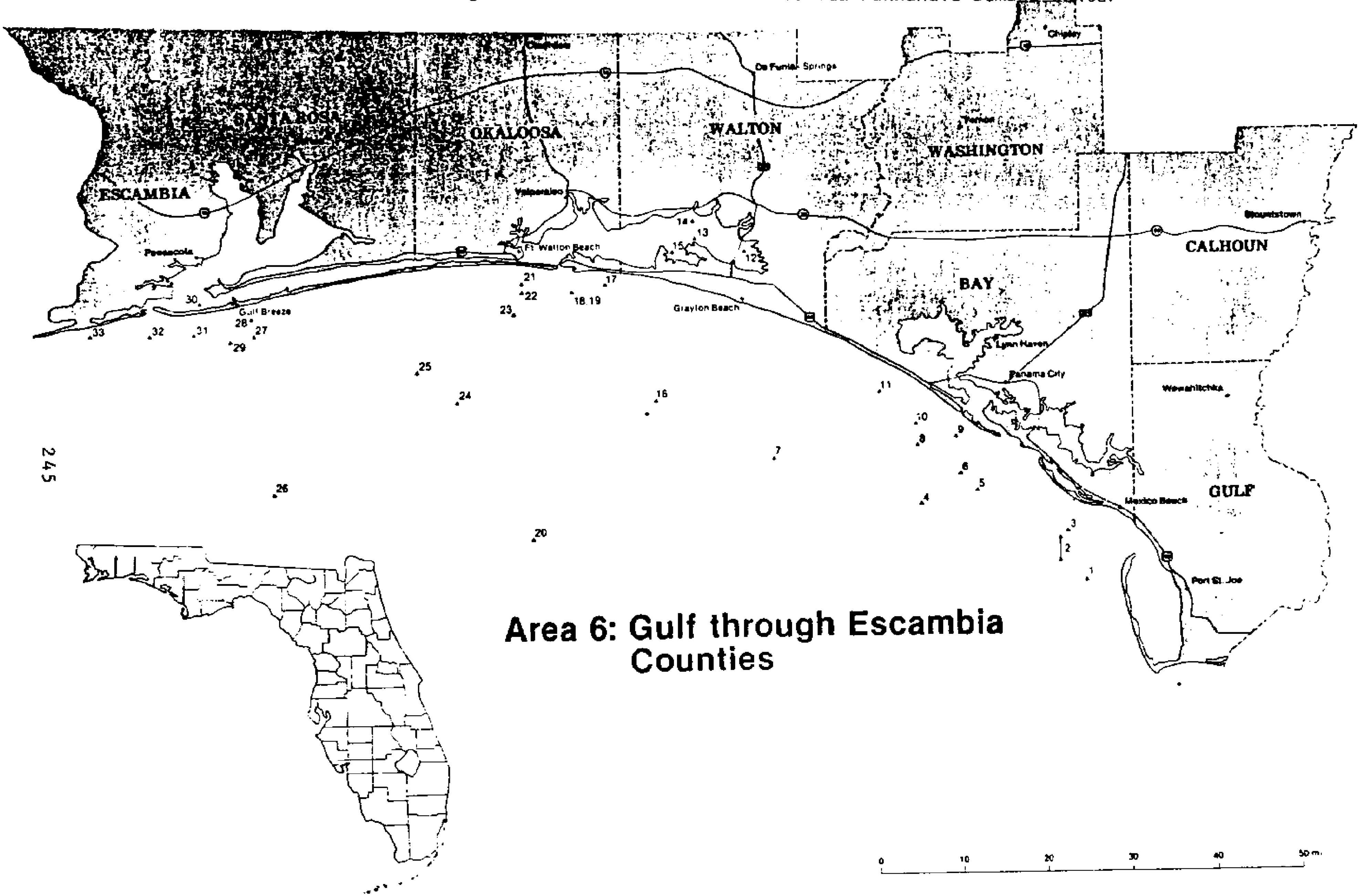
There are numerous reefs already located in this area, and Okaloosa county is the top county of Florida for reef location (Aska and Pykas, 1983:15). The demographic data (See Appendix C) appear to support the survey data dismissed above concerning the variables associated with saltwater fishermen and boat ownership with appropriate equipment for reef fishing. For the three major cities involved, Destin, Ft. Walton, and Pensacola, the data indicate that there are considerably higher concentration of persons with the age, education, occupation and income characteristics likely to support artificial reefs than the cities in Alabama and Mississippi. For example, in terms of age, the Florida cities range from 21.5 - 27.4 percent in the 35-54 year age range for 1980. No city in either Mississippi or Alabama had over 23 percent of its population in this age group. All three cities in Florida had a higher percentage of its population in the education of 12+ year category, white collar occupation and income over $35,000 than all cities in Alabama and Mississippi except Gulf Shores, Alabama, and Orange Grove, Mississippi. The estimates for 1984 and projections for 1989 follow a similar pattern. Therefore, in terms of locational principles, there appear to be some degree of "triangulation" between the survey data and demographic data.

Discussion

This section will provide a discussion of several facets of site selection. These include: the criteria for site selection, which include maximizing benefits and minimizing conflicts and objectives necessary for obtaining desirable characteristics; identification of sites/zones that satisfy the site selection criteria; and, identification of sites/zones that should be excluded from consideration.

The only integrated approach to a set of criteria for site selection known to us is that of Ditton and Burke (1984) which is an appendix (Appendix H) to the ARDC technical manual The Implementation of Artificial Reef Construction and Placement Technology Into Management Strategies for Development of Marine Recreational Opportunities (1984). Further, the only comprehensive guide to exclusionary mapping is that of Ditton (1984) in the same document (Appendix B). As a result these documents were used heavily in this section.

Figure 13
Location of Existing Artificial Reefs for the Florida Panhandle Demand Center*



*Adopted from Aska and Pybar, 1983:12.

Figure 14

Backround and Locational Data for Artificial Reefs for the Florida Panhandle Demand Center*

		Year Built	Name	Latitude	Longitude	Loran C Coordinates				Depth (ft.)	Distance (Naut. mi)	Composition
Gulf	1	1964	unnamed	29°50'24"	85°29'18"	14111.6		46802.0		40	4.4	Concrete rubble, prefab concrete
	2	1971	Cluster of Ten Reefs	29°53'15"	85°32'00"	14105.3	31219.1	46819.9		44-70	6.5-8.5	Autos
				29°55'05"		14088.0	31199.3	46818.1				
Bay County	3	1979	Mexico Beach Site	29°54'06"	85°31'55"	14116.6		46845.5		54	17	Metal junk, tires
	4	1979	Stage I Site	29°58'07"	85°48'49"	14011.3		46925.5		100	10	Concrete rubble
	5	1974	Liberty Ship	29°59'03"	85°42'20"	14065.1		46918.6		74	6.2	Liberty ship
	6	1979	Midway Site	30°02'23"	85°43'18"	14072.6		46949.6		71	5.5	Steel objects, tires, concrete rubble
	7	1978	Grey Ghost	30°02'49"	86°05'32"	13891.1		46991.7		105	21	Steel tug
	8	1978	Warsaw Site	30°04'16"	85°48'53"	14036.8		46977.2		77	5	Concrete rubble
	9	1978	Loss Pontoon	30°05'01"	85°44'02"	14078.5		46973.8		65	3	Tires, steel objects, concrete rubble
	10	1980	PCMI Site	30°07'05"	85°49'29"	14043.8		47000.0		75	5	Barge, steel objects
	11	1979	Fountainbleau Site	30°09'32"	85°53'33"	14019.8		47028.2		72	4	Concrete rubble
Walton	12	1972	unnamed	30°24'38"	86°08'48"	13933.2		47151.7		9	0.9	
	13	1972	unnamed	30°25'56"	86°14'18"	13883.2		47160.9		13	0.4	
	14	1972	unnamed	30°27'58"	86°14'34"	13885.9		47173.8		13	1.2	
	15	1972	unnamed	30°24'36"	86°17'35"	13847.3		47152.6		7	0.7	Tires, concrete rubble
Okaloosa	16		unnamed	30°09'08"	86°19'07"	13786.4		47055.1		102	12.4	Barge
	17	1977	Christmas Tree Reef	30°22'00"	86°25'00"	13768.0		47136.5		43-71	1	Tires, concrete, Christmas trees
	18	1976	Pole Spot	30°21'00"	86°29'05"	13720.4		47131.0		85	1.9	Bridge rubble
	19	1977	Elgin Barge	30°21'04"	86°29'06"	13720.4		47132.8		85	1.5	Barge
	20		unnamed	29°55'01"	86°34'09"	13602.3		46967.1			27.8	Target ship
	21	1976	Pier Rubble	30°22'03"	86°35'04"	13664.9		47138.0		65	1.3	Pier rubble
	22	1977	Brown Barge	30°21'04"	86°35'07"	13660.7		47134.1		68	2.1	Barge
	23	1977	Thomas Hayward	30°18'09"	86°36'02"	13648.2		47115.8		85	5.2	Liberty ship
	24	1979	Diamond Barge	30°09'04"	86°43'06"	13544.2		47062.7		118	14.2	Barge
Santa Rosa	25	1980	Joseph E. Brown Reef	30°12'46"	86°48'20"	13515.2		47083.9		70-80	9.4	Liberty ship
Escambia	26	1982	Tenneco Reef	30°00'00"	87°04'00"	13323.0		47013.0		175	22	Dismantled oil/gas platform
	27	1978	P5M Reef	30°17'02"	87°07'06"	13326.3	30531.6	47105.8	64082.4	85	3.1	Airplane wreck, tires
	28	1973	Casino Fishing Reef	30°18'08"	87°07'30"	13326.3	30533.5	47116.0	64081.5	60	0.4	Concrete rubble
	29	1976	Liberty Ship Fishing Reef	30°16'03"	87°09'07"	13305.2	30505.5	47103.1	64082.4	67	3.0	Liberty ship
	30		unnamed	30°19'56"	87°13'12"	13263.3	30445.4	47073.7		20	0.3	Polypropylene strips
	31	1974	Santa Rosa Barge Reef	30°17'25"	87°13'13"	13271.0	30475.3	47108.3	64081.1	45	1.0	Three barges, concrete rubble
	32	1920	Battleship Reef	30°17'42"	87°18'42"	13215.0	30420.1	47103.6		exposed	3.4	Battleship, concrete rubble
	33		unnamed	30°16'54"	87°25'36"	13145.0	30347.8	47108.9		20	0.9	Polypropylene strips

*Adop from Aska and Pybar, 1983:13.

*Mark Access Facilities on Maps and Charts;
*Draw Arcs and Mean Distances Traveled;
*Identificiation of Areas Where Artificial Reefs May Not be Appropriate;

1. Established and traditional shipping lanes, fairways, anchorage areas and offshore ports.
2. Biologically sensitive areas (live bottom).
3. Marine sanctuaries.
4. Military areas.
5. Traditional shrimping groups and bottom trawling areas.

*Conclusion of Exclusion Mapping; and,
*Mapping Existing Artificial Reef Sites (Ditton, 1984:3-11).

This approach requires a multi-disciplinary research team and a great deal of money. Within the limits of this research projects budget only a few of these suggested procedures could be accomplished.

Ditton and Graefe (1978), for example, have provided a profile of saltwater fishermen from a sample of fishermen in the Houston-Galveston area using four socioeconomic variables. The variables analyzed were: age, education, occupation, and income.

The appropriate identification of sites/zones that satisfy the site selection criteria were identified from the perspective of demographic data for all three demand centers. The appropriate sites for the Mississippi demand center were augmented with other data appropriate for site location. The Florida data were supplemented with data on current artificial reef sites. This information should be acquired for the other demand centers. Further, if the appropriate finances were available the entire matrix of the modified SIA and the ARDC guidelines should be gathered to optimize locational principles.

C. Identification of Sites/Zones that Should be Excluded from Consideration

The principles for exclusionary zones have been identified by Ditton in the ARDC technical manual (1984) discussed above. Demographic data have been provided in this research to inform a part of that research. In the case of Mississippi other information was provided to aid in further delineate exclusionary zones based on fisherman origin and destination. In the case of Florida the existing site data should be used for exclusionary zones unless a case can be made to expand a reef.

Results

Benefits to be Derived if Desirable Sites are Selected

The benefits to be derived from the selection of desirable sites are too numerous to be listed in detail. However, some of the more global and obvious benefits are:

*enhanced food production by fishermen and other reef users who harvest fish;
*minimum conflict among users;
*increase the "live bottom" area near existing population centers and infrastructure;
*provide users with the myriad of social/psychological and physical benefits that have been documented in the literature;
*provide for future expansion when demand increases;
*provide data and information for future siting activities; and,
*provide incentives for funding governmental agencies as well as the general public and organizations concerned with reef development.

Efforts Required to Implement

To appropriate locate and implement an artificial reef the procedures listed above for the modified SIA and those in the ARDC technical manual should be followed. However, a great deal of further effort will be required. Just from the sociological perspective numerous field and survey studies would have to be made in each area along the lines of that by Wales, et al, (1984) and Ditton and Graefe (1978). Numerous other procedures to complete the triangulation process would be necessary. The demographic data base needs to be expanded and analyzed in detail, other delphi panels need to be consulted, numerous community meetings should be held, economic projections should be made in several areas, and there should be at least some scenario analyses conducted, especially as related to possible removal of a reef. The execution of this complex research will obviously take a great deal of financial backing and several years of initial research coupled with on-going evaluation for the "life" of the reef.

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Appendix A: Tabular Results of Bibliographical Searches

Summary of Computer Search of DIALOG*
in
Mitchell Memorial Library
Mississippi State University

Data Bases Searched Citation	Year	Number of References
NITS	64-85	80
Dissertation Abstracts	1861-Jan.85	7
Sociological Abstracts	63-64	0
PTS Defense Markets and Technology	82-84	33
Conference Papers Index	73-Sept. 84	7
Federal Research In Progress	Sept. 84	1
Federal Research In Progress	(unabridged) Sept. 84	2
BIOSIS Previews	81-84	31
BIOSIS Previews	77-80	15
BIOSIS Previews	69-76	17
COMPENDEX	70-Nov. 84	20
Oceanic Abstracts	64-Oct. 84	148
ENVIROLINE	70-Nov. 84	47
Aquatic Science Abstracts	78-Sept. 84	178
Environmental Bibliography	74-Oct. 84	8
Aquaculture	70-Jan. 84	0
Water Resources Abstracts	68-Nov. 84	28
	TOTAL	622

*All files were searched using artificial reef(s) as the major concept. Other concepts such as sociology, sociological aspects, recreation and EEZ were also used. None were useful in limiting the artificial reef papers to a sociological component. EEZ was useful for the PTS Defense Markets and Technology database as no entries were shown using artificial reef.

Table 1. Frequency of Primary Topics in 413 Artificial Reef References

TOPIC	FREQUENCY
GENERAL PAPERS	(143)
Program descriptions	68
General articles	68
History and bibliographies	7
BIOLOGICAL STUDIES	(162)
Ecology	35
Behavior	32
Production	29
Recruitment	26
Comparison of artificial and natural reefs	13
Fishes	10
Invertebrates	6
Algae and seagrasses	6
Faunal lists	4
Communities	1
DESIGN AND CONSTRUCTION	(78)
Construction materials	22
Reef construction	18
Reef design	13
Permit procedures	6
Site selection	6
Buoys	6
Legal aspects	3
Currents and oceanographic factors	2
Pollution and toxicity	2
SOCIOLOGY AND ECONOMICS	(15)
Sociology and user conflicts	8
Economics (costs and benefits)	7
OIL AND GAS PLATFORMS	(15)

*Table adapted from Bohnsack and Sutherland (1984:68).

Table 2. Frequency of source and approach to artificial reef literature.*

SOURCE	No.	APPROACH	No.
Peer review journals	87	Theoretical	9
Other journals	42	Descriptive	151
Theses and dissertations	5	Experimental	79
Books	23	Methods and management	114
Technical reports	188	Popular (non-scientific)	60
Pamphlets	7		
Popular magazines	19	Total	413
Total	413		

*Table adopted from Bohnsack and Sutherland (1984:69).

Appendix B: Data Sources and Variable Definitions

The data contained in this report were adopted from Donnelley Demographic DIALOG File 575. These data were developed by Donnelley Marketing Services, (DMIS) a company of the Dun and Bradstreet Corporation. The data bank, DIALOG, was accessd through the Computer Assisted Information Retrieval Services (CAIRS) at the Mississippi State University Library and written on floppy disks. These disks were manipulated by an IBM PC to add titles and other text. None of the data were changed or altered in any other manner. The authors wish to acknowledge the patient and efficient aid given by Susan Ellsbury and J. B. Hill of CAIRS and Betsy Parker of DMIS in the development of the data base.

Although the base data are from the 1980 U.S. Bureau of the Census, other information was developed by DMIS. The definitions of variables and methodologies utilized in developing the estimates and projections are contained in this Appendix.

Definitions of Marketing Areas

ADI's and DMA's are similar in concept. Both reflect the reach of broadcasting media in an area.

ADI's and DMA's are geographic areas based on measurable television viewing patterns. Each one consists of all the counties, or all the ZIP codes, in which home market stations receive the largest portion of television viewing hours. Every county in the US, with the exception of Alaska and Hawaii, is assigned to an ADI. All of the continental U.S., Hawaii, and parts of Alaska are assigned to a DMA. Neither ADI's nor DMA's overlap, and each is updated annually by Arbitron, Inc. (ADI) or A. C. Nielson (DMA).

ADI's and DMA's are primarily used by advertisers and media consultants. They are useful to others, such as you or me, because they represent aggregates of counties or of ZIP codes. If this type of definition is appropriate, using DIALOG it is easier to request an ADI, i.e. The alternative is to search for individual counties or ZIP codes and then add them together.

A SAMI is another marketing area defined by Selling Areas Marketing, Inc. These consist of counties or ZIP codes in and around major metropolitan areas. SAMI's measure the market for the movement of food related products by using computerized warehouse withdrawal data. There are 48 SAMI areas covering all of the US except Alaska and Hawaii. The SAMI areas are primarily used by packaged goods firms to determine market share, but again they are useful to DIALOG searchers because they represent aggregates of counties or ZIP Codes.

Demographic Methodology for 1984/1989 Estimates and Projections

1984 Population and Household Estimates

Donnelley Marketing maintains and continuously updates the nation's largest residential data base which describes the characteristics of over 73 million households or 88 percent of all United States households. Through the application of Donnelley's Address Coding Guide, these households are geocoded and assigned to their appropriate small area Census geography. While not a complete census in themselves, longitudinal data from the Donnelley household universe provide a valid measure of household growth and decline, and enables the production of tract level household estimates on an individual basis.

In a unique adaptation of the basic housing unit method, the Donnelley estimate method applies the 1980-1984 rates of change in Donnelley household counts to the 1980 Census household counts to produce 1984 household estimates at the Census Tract level. Since the Donnelley data constitute counts of actual households, the method is more direct than traditional housing unit methods which rely on separate estimates of housing units and vacancies to compute total households.

In order to derive the population figure for each tract, an estimate of average household size must be applied to the number of 1984 households. The household size variable is critical to the development of accurate population figures since household sizes can shift dramatically as a result of changes in marriage paterns, divorces, increased longevity of the elderly, and housing availability. Most estimating procedures compute a household size factor by assigning national level rates of change to the latest Census figures. However, the Donnelley method allows for household size variations specific to each place or county.

Household sizes are determined from the relationship of the number of persons to the number of households. Donnelley uses the latest Census Bureau population figures for places and counties, adjusted to the estimate date for the group quarters population, divided by the Donnelley household update.

A household size rte of change is computed from the comparison of this estimated household size with the respective 1980 Census figure. This rate of change is used for all tracts within a specific place or county to produce variations in household sizes due to the demographic composition of a particular locality are accurately measured.

The household size estimates are multiplied by the corresponding household figures to calculate the updated household population for each tract. The group quarters population is added back to its respective geographic entity resulting in an estimate of the total population.

1984 Age/Sex

Starting with the tract level age/sex structure from the 1980 Census, age and sex specific survival rates from the National Center for Health Statistics are used to "age" the 1980 population ahead to 1984. The number of births during the 1980-1984 period is then estimated on the basis of 1980 child-woman ratios, the ratio of children under the age of five to women in their childbearing years, age 15-44.

The resulting age/sex structures--expressed as a percent distribution--are applied to the tract level 1984 poppulation estimates to produce estimates of 1984 population by age and sex. Care is taken in areas with large colleges or military populations to maintain an accurate age structure, since these persons generally do not remain in these areas, but rather are continuously replaced by persons in the same age/sex categories.

1984 Race

Population estimates by race are provided for three categories: White, Black and Other. Consistent with Census definitions, the White, Black and Other categories sum to the total population. A separate estimate of the Spanish population is made since these persons are an ethnic designation rather than a racial group.

1984 Race

Census Bureau projections of Black population are used to estimate state level changes in the Black population between 1980 and 1984. The three year changes are added to the 1980 Black population counts to produce 1984 state estimates of Black population. The non-Black (or "White and Other") population for each year is difference between total population and Black population. The 1980 proportion of the "White and Other" population which was White, and the proportion which was Other, are computed and applied to produce the 1984 state level White and Other figures.

Changes in racial characteristics between the 1970 and 1980 Census are used to trend tract level race to 1984. The 1984 race estimates are then controlled to the state level race distributions.

Since consistently defined counts of the Spanish population are not available for two points in time, the estimates of the 1984 Spanish population are computed using a separate procedure. The proportion of the Spanish to the "White and Other" population in 1980 is applied to the estimated 1984 "White and Other" population to produce the 1984 Spanish population estimate.

1984 Income

Donnelley estimates are based on a money income concept to be consistent with data collected by the Census Bureau. This represents the total gross income received, through deductions for personal income taxes and Social Security, through: wage and salary income; net non-farm self-employed income; net farm self-employed income; Social Security and railroad retirement income; public assistance income; and all other sources of money such as interest, dividends, veteran's payments, pensions, unemployment insurance, and alimony.

1980 Census income distributions at the tract and minor civil division level are used as a basis for 1984 estimates. Estimation of a rate of change in county and sub-county level medians and distributions is the key process through which Donnelley income estimates are derived.

The county rates of change in median income between 1980 and 1984 are estimated by using the latest Bureau of Labor Statistics data describing changes in wages and salaries in conjunction with information regarding inflation trends exhibited by the Consumer Price Index between 1980 and 1984. These county rates of change are then adjusted to reflect sub-county patterns of household and income growth, and applied against the 1980 Census income base to produce 1984 medians and distributions at the sub-county level.

1989 Population and Household Projections

Donnelley population and household projections are produced by a demographic technique entitled Cohort Component Method. This method is preferred because it projects the three components of demographic change separately: births, deaths, and migration.

Using 1984 population by age and sex as a base, age and sex specific five-year survival rates from the National Center for Health Statistics are used to "age" each age/sex cohort ahead to 1989, thus accounting for the mortality component.

Since the number of births in an area is most closely related to the number of women in childbearing ages, births are accounted for through the application of 1980 child-woman ratios. This is the ratio of children under the age of five to the number of women ages 15-44. The advantage of using the child-woman ratio is that projected births reflect any changes in the proportion and number of women in an area. In addition, this technique enables the measurement of fertility at an individual tract level rather than applying state or national fertility rates than can be extremely misleading in smaller units of geography.

Migration is the most important component as well as the most difficult to estimate. Donnelley's unique ability to continuously measure the net movement of households both into and out of specific Census tracts enables the forecasting of accurate migration trends. Other projection methods, however, rely on historical data such as the change form 1970-1980 and, therefore, tend to be less accurate the further from the Census date the projection is made.

The Donnelley method, however, uses the household migration determined for the most recent estimate period and projects this migration to 1989. The number of persons resulting from this household movement is produced by the application of projected 1989 household sizes for each tract.

The survived population, the population under age five (births during the projection period), and the migrant population are summed to compute the 1989 population projections. These 1989 projectsions are then controlled to 1989 county, state and national population projections based on the most current Census Bureau projections available.

A projected household size is applied to the population figures to compute a projected number of households. These projected household sizes are based upon the assumption that household sizes will continue to decline as the result of certain demographic factors: postponement of marriage, rise in divorce, and an increasing elderly population.

1989 Age/Sex

Projections of the 1989 population by age and sex are generated as part of the projection method previously described. In fact, the key to computing total 1989 population is anticipating changes in the age/sex structure at the tract level of geography.

1989 Race

Population projections by race are computed in a manner similar to the race estimates, and the definitions and categories provided are identical.

Census Bureau projections of Black populations are used to project state level changes in the Black population between 1980 and 1989. The eight year changes are added to the 1980 Black population counts to produce 1989 state estimates of the difference between total population and Black population. The 1980 proportion of the "White and Other" population which was White, and the proportion which was Other, are computed and applied to produce 1988 state level White and Other figures.

The 1970 and 1980 Census data are used to project tract level White, Black and Other populations to 1989. The 1989 race projections are then controlled to the state level race distributions and summed to the estimated 1989 tract level projections of total population.

As in the case of the 1984 estimates, projections of the 1989 Spanish population are computed on the basis of their proportion of the White and Other population.

1989 Income

Household income distributions are projected to 1989 by computing five-year rates of change for each tract and minor civil division based upon the changes exhibited by the 1980 Census and 1984 income estimates. These rates of change in income are adjuted by using inflation trends from the Consumer Price Index as well 1989 projected age/sex population distribution patterns.

Appendix C: Demographic Data for Site Characteristics and Sample Selection: 1980 Census Data, 1984 Estimates, 1980-84 Percent Change, and 1989 Projections.

Table 1. UNITED STATES

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	226,545,805	235,687,225	4.0%	246,083,269
Total Households	80,389,673	85,165,923	5.9%	89,538,890
Household Population	220,796,157	229,937,960	4.1%	240,334,004
Average Household Size	2.7	2.7	-1.6%	2.7
Median Household Income	$17,083	$21,058	23.3%	$26,517

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	226,545,805	100.0%	235,687,225	246,083,269
0 - 5	19,510,945	8.6%	8.7%	8.7%
6 - 13	27,996,610	12.4%	11.5%	11.1%
14 - 17	16,247,405	7.2%	6.5%	5.8%
18 - 24	30,022,207	13.3%	12.6%	11.4%
25 - 34	37,081,839	16.4%	16.7%	16.6%
35 - 44	25,634,710	11.3%	13.0%	14.7%
45 - 54	22,799,787	10.1%	9.7%	10.2%
55 - 64	21,702,875	9.6%	9.5%	8.9%
65 +	25,549,427	11.3%	11.9%	12.6
FEMALE POPULATION BY AGE	116,492,644	100.0%	121,211,896	126,499,794
0 - 5	9,530,636	8.2%	8.2%	8.2%
6 - 13	13,692,387	11.8%	10.9%	10.6%
14 - 17	7,949,662	6.8%	6.1%	5.5%
18 - 24	14,968,532	12.8%	12.0%	10.7%
25 - 34	18,699,936	16.1%	16.5%	16.2%
35 - 44	13,064,991	11.2%	12.8%	14.6%
45 - 54	11,790,868	10.1%	9.7%	10.2%
55 - 64	11,551,120	9.9%	9.9%	9.2%
65 +	15,244,512	13.1%	13.9%	14.8%
MALE POPULATION BY AGE	110,053,161	100.0%	114,474,049	119,582,224
0 - 5	9,980,309	9.1%	9.1%	9.1%
6 - 13	14,304,223	13.0%	12.1%	11.7%
14 - 17	8,297,743	7.5%	6.8%	6.1%
18 - 24	15,053,675	13.7%	13.3%	12.0%
25 - 34	18,381,903	16.7%	17.0%	17.0%
35 - 44	12,569,719	11.4%	13.1%	14.9%
45 - 54	11,008,919	10.0%	9.6%	10.2%
55 - 64	10,151,755	9.2%	9.2%	8.6%
65 +	10,304,915	9.4%	9.8%	10.3%
Median Age Total Population	29.9		31.3	32.8
Median Age Adult Population	40.5		40.6	41.[illegible]

TOTAL POPULATION	226,545,805	100.0%	235,687,225	246,083,269
White	188,371,622	83.1%	82.7%	82.1%
Black	26,495,025	11.7%	11.9%	12.1%
Other	11,679,158	5.2%	5.3%	5.7%
Spanish	14,608,673	6.4%	6.9%	7.3%
HOUSEHOLD INCOME				
\$ 0 - \$ 7,499	17,102,465	21.3%	16.3%	11.9%
\$ 7,500 - \$ 9,999	6,333,385	7.9%	6.1%	4.4%
\$10,000 - \$14,999	12,342,073	15.3%	12.3%	9.1%
\$15,000 - \$24,999	21,383,458	26.6%	25.3%	21.4%
\$25,000 - \$34,999	12,659,261	15.7%	19.8%	21.2%
\$35,000 - \$49,999	6,954,720	8.6%	13.0%	19.1%
\$50,000 - \$74,999	2,574,043	3.2%	5.0%	9.0%
\$75,000 +	1,118,022	1.4%	2.2%	3.9%

1980 Census

	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	3,941,767	4.0%
Construction	5,739,598	5.9%
Manufacturing:		
Nondurable	8,435,543	8.6%
Durable	13,479,211	13.8%
Transportation	4,273,961	4.4%
Communications	2,813,494	2.9%
Wholesale Trade	4,217,232	4.3%
Retail Trade	15,716,694	16.1%
Fin/Ins/Real Est	5,898,059	6.0%
Bus/Repair Serv	4,081,677	4.2%
Pers/Ent/Rec Serv	4,082,834	4.2%
Prof/Related Serv:		
Health	7,250,465	7.4%
Educational	8,377,213	8.6%
Other	4,184,141	4.3%
Public Admin	5,147,466	5.3%
Total	97,639,355	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	10,133,551	10.4%
Prof	12,018,097	12.3%
Tech/Admin/Sales:		
Tech	2,981,951	3.1%
Admin/Clerical	16,851,398	17.3%
Sales	9,760,157	10.0%
Service:		
Private Household	589,352	.6%
Protective Serv	1,475,315	1.5%
Other Serv	10,564,758	10.8%
Farm/Forest/Fish	2,811,258	2.9%
Prod/Craft/Repair	12,594,175	12.9%
Oper/Fabr/Labrs:		
Mach Operators	9,084,988	9.3%

Trans/Mat Moving	4,389,412	4.5%
Handlrs/Cleanrs/ Helprs/Labrs	4,384,943	4.5%
Total Employed	97,639,355	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	1,634,851	1.0%
Civ Labor Force:		
Employed	97,639,355	57.0%
Unemployed	6,810,462	4.0%
Not in Labor Force	65,129,590	38.0%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	81,258,496	84.1%
Public Trans	6,175,061	6.4%
Other	9,183,739	9.5%
Total	96,617,296	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	32,590,519	34.5%
15 - 29 Minutes	34,976,915	37.0%
30 - 59 Minutes	21,251,509	22.5%
60 + Minutes	5,668,152	6.0%
Total	94,487,095	100.0%
EDUCATION OF ADULTS OVER 25,		
YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	44,535,197	33.5%
12 Years	45,947,035	34.6%
13 - 15 Years	20,794,975	15.7%
16 + Years	21,558,480	16.2%
Median Years Completed	12.4	
MARITAL STATUS		
Male:		
Single	25,132,125	30.0%
Married	50,354,476	60.1%
Separated	1,654,630	2.0%
Widowed	2,155,696	2.6%
Divorced	4,538,924	5.4%
Total	83,835,851	100.0%
Female:		
Single	21,027,177	23.0%
Married	50,072,130	54.8%
Separated	2,424,923	2.7%
Widowed	11,317,896	12.4%
Divorced	6,577,489	7.2%
Total	91,419,615	100.0%

WORKING MOTHERS:		
With Children under 6	6,220,525	20.3%
With Children 6 - 17	10,726,125	35.0%
Subtotal	16,946,650	55.3%
Non-Working Mothers	13,688,302	44.7%
Total	30,634,952	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	48,371,006	82.1%
Female Householder	8,409,168	14.3%
Male Householder	2,101,979	3.6%
Total	58,882,153	100.0%
HOUSEHOLDS WITH:		
Children Under 18	32,199,614	40.1%
Persons 65 and Over	18,356,796	22.8%
Householder 65 and Over	16,133,989	20.1%
Married Couple With Children	24,779,964	30.8%
Married Couple Without Children	24,210,335	30.1%
Female Householder With Children	4,932,478	6.1%
Female Householder Without Children	3,272,801	4.1%
Male Householder With Children	759,897	.9%
Male Householder Without Children	1,234,658	1.5%
Non-Families	21,277,294	26.4%
PERSONS PER HOUSEHOLD:		
1 Person	18,247,536	22.7%
2 Persons	25,175,607	31.3%
3 Persons	13,972,483	17.4%
4+ Persons	22,994,047	28.6%
Total Households	80,389,673	100.0%
Average Household Income	$20,326	
Per Capita Income	$7,400	
FAMILIES		
Total Families	58,882,153	
Average Family Size	3.3	
Average Family Income	$23,213	
Family Population	194,967,451	
Nonfamily Population	25,828,706	
Group Quarters Population	5,749,648	
HOUSING		
Median Home Value	$47,303	
Average Home Value	$55,843	
Median Monthly Rent	$198	
Average Monthly Rent	$210	

UNITS AT ADDRESS:		
1 Unit	61,666,251	71.1%
2 - 9 Units	11,971,904	13.8%
10+ Units	8,732,098	10.1%
Mobile Home	4,322,570	5.0%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	10,798,236
Last 5 Years	31,679,455
6 - 9 Years Ago	10,166,073
10 - 14 Years Ago	7,409,646
15+ Years Ago	11,545,582
Socioeconomic Status Score	50
Private Sector Employment	70,602,156

Table 2. Alabama

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	3,893,888	4,020,345	3.2%	4,191,274
Total Households	1,341,856	1,413,071	5.3%	1,484,949
Household Population	3,815,578	3,942,035	3.3%	4,112,964
Average Household Size	2.8	2.8	-1.8%	2.8
Median Household Income	$13,809	$17,324	25.5%	$21,443

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	3,893,888	100.0%	4,020,345	4,191,274
0 - 5	355,547	9.1%	9.2%	9.2%
6 - 13	514,376	13.2%	12.3%	11.7%
14 - 17	292,325	7.5%	6.7%	6.2%
18 - 24	515,003	13.2%	12.9%	11.7%
25 - 34	598,752	15.4%	16.1%	16.6%
35 - 44	429,714	11.0%	12.4%	13.8%
45 - 54	388,995	10.0%	9.5%	9.9%
55 - 64	359,161	9.2%	9.2%	8.7%
65 +	440,015	11.3%	11.8%	12.2%
FEMALE POPULATION BY AGE	2,022,354	100.0%	2,086,455	2,171,746
0 - 5	175,052	8.7%	8.7%	8.7%
6 - 13	251,290	12.4%	11.6%	11.1%
14 - 17	143,022	7.1%	6.4%	5.8%
18 - 24	260,695	12.9%	12.3%	11.0%
25 - 34	305,145	15.1%	15.8%	16.2%
35 - 44	222,418	11.0%	12.3%	13.7%
45 - 54	205,215	10.1%	9.6%	10.0%
55 - 64	194,875	9.6%	9.6%	9.0%
65 +	264,642	13.1%	13.8%	14.4%
MALE POPULATION BY AGE	1,871,534	100.0%	1,933,890	2,019,528
0 - 5	180,495	9.6%	9.7%	9.8%
6 - 13	263,086	14.1%	13.0%	12.4%
14 - 17	149,303	8.0%	7.1%	6.5%
18 - 24	254,308	13.6%	13.6%	12.4%
25 - 34	293,607	15.7%	16.3%	17.1%
35 - 44	207,296	11.1%	12.5%	13.9%
45 - 54	183,780	9.8%	9.4%	9.8%
55 - 64	164,286	8.8%	8.8%	8.3%
65 +	175,373	9.4%	9.6%	9.8%
Median Age Total Population	29.2		30.2	31.6
Median Age Adult Population	40.8		40.5	40.8

TOTAL POPULATION	3,893,888	100.0%	4,020,345	4,191,274
White	2,872,621	73.8%	74.0%	74.[illegible]
Black	996,335	25.6%	25.3%	24.[illegible]
Other	24,932	.6%	.7%	.7%
Spanish	33,299	.9%	.9%	.9%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	386,660	28.8%	22.8%	17.2%
$ 7,500 - $ 9,999	118,971	8.9%	7.2%	5.4%
$10,000 - $14,999	217,278	16.2%	13.8%	10.8%
$15,000 - $24,999	334,535	24.9%	27.0%	25.8%
$25,000 - $34,999	170,957	12.7%	16.9%	20.9%
$35,000 - $49,999	78,021	5.8%	8.5%	13.2%
$50,000 - $74,999	24,398	1.8%	2.7%	4.7%
$75,000 +	11,551	.9%	1.2%	2.1%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	56,738	3.8%
Construction	103,369	6.8%
Manufacturing:		
Nondurable	197,204	13.0%
Durable	197,709	13.1%
Transportation	53,316	3.5%
Communications	53,500	3.5%
Wholesale Trade	64,120	4.2%
Retail Trade	226,226	15.0%
Fin/Ins/Real Est	71,988	4.8%
Bus/Repair Serv	48,967	3.2%
Pers/Ent/Rec Serv	59,006	3.9%
Prof/Related Serv:		
Health	108,531	7.2%
Educational	125,034	8.3%
Other	53,142	3.5%
Public Admin	93,078	6.2%
Total	1,511,928	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	130,725	8.6%
Prof	165,909	11.0%
Tech/Admin/Sales:		
Tech	42,652	2.8%
Admin/Clerical	224,130	14.8%
Sales	144,745	9.6%
Service:		
Private Household	15,882	1.1%
Protective Serv	20,646	1.4%
Other Serv	142,255	9.4%
Farm/Forest/Fish	40,395	2.7%
Prod/Craft/Repair	214,243	14.2%
Oper/Fabr/Labrs:		

Mach Operators	191,976	12.7%
Trans/Mat Moving	84,841	5.6%
Handlrs/Cleanrs/ Helprs/Labrs	93,529	6.2%
Total Employed	1,511,928	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	30,609	1.1%
Civ Labor Force:		
Employed	1,511,928	52.5%
Unemployed	122,815	4.3%
Not in Labor Force	1,215,996	42.2%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	1,402,471	93.1%
Public Trans	20,519	1.4%
Other	83,242	5.5%
Total	1,506,232	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	483,086	32.5%
15 - 29 Minutes	574,425	38.7%
30 - 59 Minutes	346,757	23.3%
60 + Minutes	81,243	5.5%
Total	1,485,511	100.0%
EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	964,840	43.5%
12 Years	704,207	31.8%
13 - 15 Years	278,205	12.5%
16 + Years	270,063	12.2%
Median Years Completed	12.2	
MARITAL STATUS		
Male:		
Single	375,515	27.0%
Married	879,413	63.1%
Separated	25,335	1.8%
Widowed	37,370	2.7%
Divorced	75,051	5.4%
Total	1,392,684	100.0%
Female:		
Single	316,411	20.2%
Married	876,229	56.1%
Separated	38,369	2.5%
Widowed	222,482	14.2%
Divorced	109,055	7.0%
Total	1,562,546	100.0%

WORKING MOTHERS:		
With Children under 6	121,144	21.9%
With Children 6 - 17	185,976	33.6%
Subtotal	307,120	55.5%
Non-Working Mothers	246,411	44.5%
Total	553,531	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	845,944	81.4%
Female Householder	160,933	15.5%
Male Householder	32,004	3.1%
Total	1,038,881	100.0%
HOUSEHOLDS WITH:		
Children Under 18	583,965	43.5%
Persons 65 and Over	325,431	24.3%
Householder 65 and Over	288,397	21.5%
Married Couple With Children	440,408	32.8%
Married Couple Without Children	414,638	30.9%
Female Householder With Children	87,656	6.5%
Female Householder Without Children	69,699	5.2%
Male Householder With Children	10,639	.8%
Male Householder Without Children	19,531	1.5%
Non-Families	299,800	22.3%
PERSONS PER HOUSEHOLD:		
1 Person	273,632	20.4%
2 Persons	410,018	30.6%
3 Persons	253,355	18.9%
4+ Persons	404,851	30.2%
Total Households	1,341,856	100.0%
Average Household Income	$16,926	
Per Capita Income	$5,953	
FAMILIES		
Total Families	1,038,881	
Average Family Size	3.3	
Average Family Income	$19,268	
Family Population	3,475,343	
Nonfamily Population	340,235	
Group Quarters Population	78,310	
HOUSING		
Median Home Value	$34,660	
Average Home Value	$39,887	
Median Monthly Rent	$122	
Average Monthly Rent	$130	

UNITS AT ADDRESS:

1 Unit	1,167,749	80.5%
2 - 9 Units	110,578	7.6%
10+ Units	54,005	3.7%
Mobile Home	117,679	8.1%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	166,880
Last 5 Years	496,448
6 - 9 Years Ago	164,686
10 - 14 Years Ago	140,291
15+ Years Ago	180,741
Socioeconomic Status Score	38
Private Sector Employment	1,000,071

Table 2A. Mobile SMSA, AL

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	443,536	467,671	5.4%	499,842
Total Households	150,073	159,958	6.6%	171,987
Household Population	437,005	461,140	5.5%	493,311
Average Household Size	2.9	2.9	-.9%	2.9
Median Household Income	$14,721	$18,992	29.0%	$25,051

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	443,536	100.0%	467,671	499,842
0 - 5	44,428	10.0%	10.0%	10.0%
6 - 13	59,952	13.5%	12.9%	12.6%
14 - 17	34,514	7.8%	6.7%	6.2%
18 - 24	58,263	13.1%	12.8%	11.4%
25 - 34	70,411	15.9%	16.6%	16.8%
35 - 44	48,526	10.9%	12.4%	14.0%
45 - 54	42,236	9.5%	9.1%	9.7
55 - 64	40,187	9.1%	8.9%	8.1
65 +	45,019	10.2%	10.7%	11.2%
FEMALE POPULATION BY AGE	229,911	100.0%	242,033	258,172
0 - 5	21,682	9.4%	9.4%	9.5%
6 - 13	29,370	12.8%	12.2%	11.9%
14 - 17	16,928	7.4%	6.4%	5.9%
18 - 24	30,178	13.1%	12.4%	10.9%
25 - 34	35,754	15.6%	16.4%	16.7%
35 - 44	25,098	10.9%	12.3%	13.9%
45 - 54	22,285	9.7%	9.2%	9.8%
55 - 64	21,727	9.5%	9.3%	8.5%
65 +	26,889	11.7%	12.4%	13.1%
MALE POPULATION BY AGE	213,625	100.0%	225,638	241,670
0 - 5	22,746	10.6%	10.6%	10.6%
6 - 13	30,582	14.3%	13.7%	13.3%
14 - 17	17,586	8.2%	7.0%	6.5%
18 - 24	28,085	13.1%	13.2%	11.9%
25 - 34	34,657	16.2%	16.7%	17.0%
35 - 44	23,428	11.0%	12.5%	14.2%
45 - 54	19,951	9.3%	9.0%	9.6%
55 - 64	18,460	8.6%	8.4%	7.8%
65 +	18,130	8.5%	8.8%	9.1%
Median Age Total Population	28.2		29.3	30.
Median Age Adult Population	39.8		39.7	40.2

TOTAL POPULATION	443,536	100.0%	467,671	499,842
White	312,533	70.5%	71.3%	71.9%
Black	126,835	28.6%	27.8%	27.1%
Other	4,168	.9%	.9%	1.0%
Spanish	4,625	1.0%	1.1%	1.1%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	39,555	26.3%	19.8%	14.0%
$ 7,500 - $ 9,999	12,901	8.6%	6.7%	4.8%
$10,000 - $14,999	24,060	16.0%	13.1%	9.7%
$15,000 - $24,999	39,028	26.0%	25.7%	21.3%
$25,000 - $34,999	20,993	14.0%	19.9%	23.1%
$35,000 - $49,999	9,325	6.2%	10.0%	18.1%
$50,000 - $74,999	3,014	2.0%	3.2%	6.3%
$75,000 +	1,480	1.0%	1.4%	2.6%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	5,133	3.0%
Construction	16,452	9.5%
Manufacturing:		
Nondurable	19,071	11.0%
Durable	15,577	9.0%
Transportation	8,430	4.9%
Communications	5,341	3.1%
Wholesale Trade	8,901	5.2%
Retail Trade	28,903	16.7%
Fin/Ins/Real Est	9,695	5.6%
Bus/Repair Serv	6,446	3.7%
Pers/Ent/Rec Serv	7,571	4.4%
Prof/Related Serv:		
Health	12,886	7.5%
Educational	12,849	7.4%
Other	6,953	4.0%
Public Admin	8,424	4.9%
Total	172,632	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	16,116	9.3%
Prof	18,850	10.9%
Tech/Admin/Sales:		
Tech	5,205	3.0%
Admin/Clerical	26,282	15.2%
Sales	19,381	11.2%
Service:		
Private Household	1,799	1.0%
Protective Serv	2,848	1.6%
Other Serv	16,819	9.7%
Farm/Forest/Fish	4,082	2.4%
Prod/Craft/Repair	27,321	15.8%
Oper/Fabr/Labrs:		

Mach Operators	13,886	8.0%
Trans/Mat Moving	9,666	5.6%
Handlrs/Cleanrs/ Helprs/Labrs	10,377	6.0%
Total Employed	172,632	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	1,715	.5%
Civ Labor Force:		
Employed	172,632	53.5%
Unemployed	13,353	4.1%
Not in Labor Force	134,804	41.8%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	158,297	93.2%
Public Trans	2,879	1.7%
Other	8,674	5.1%
Total	169,850	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	41,563	24.9%
15 - 29 Minutes	70,612	42.3%
30 - 59 Minutes	44,832	26.9%
60 + Minutes	9,886	5.9%
Total	166,893	100.0%
EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	95,171	38.6%
12 Years	85,251	34.6%
13 - 15 Years	35,677	14.5%
16 + Years	30,424	12.3%
Median Years Completed	12.3	
MARITAL STATUS		
Male:		
Single	43,737	28.0%
Married	95,961	61.5%
Separated	3,514	2.3%
Widowed	3,985	2.6%
Divorced	8,961	5.7%
Total	156,158	100.0%
Female:		
Single	37,754	21.6%
Married	95,499	54.6%
Separated	5,715	3.3%
Widowed	22,715	13.0%
Divorced	13,259	7.6%
Total	174,942	100.0%

WORKING MOTHERS:		
With Children under 6	13,581	21.0%
With Children 6 - 17	19,397	30.0%
Subtotal	32,978	51.1%
Non-Working Mothers	31,580	48.9%
Total	64,558	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	92,069	79.4%
Female Householder	20,010	17.3%
Male Householder	3,867	3.3%
Total	115,946	100.0%
HOUSEHOLDS WITH:		
Children Under 18	68,307	45.5%
Persons 65 and Over	33,565	22.4%
Householder 65 and Over	29,336	19.5%
Married Couple With Children	49,911	33.2%
Married Couple Without Children	43,412	28.9%
Female Householder With Children	11,937	7.9%
Female Householder Without Children	7,885	5.2%
Male Householder With Children	1,496	1.0%
Male Householder Without Children	2,068	1.4%
Non-Families	33,647	22.4%
PERSONS PER HOUSEHOLD:		
1 Person	30,504	20.3%
2 Persons	43,544	29.0%
3 Persons	27,958	18.6%
4+ Persons	48,067	32.0%
Total Households	150,073	100.0%
Average Household Income	$17,681	
Per Capita Income	$6,072	
FAMILIES		
Total Families	115,946	
Average Family Size	3.4	
Average Family Income	$19,998	
Family Population	398,322	
Nonfamily Population	38,683	
Group Quarters Population	6,531	
HOUSING		
Median Home Value	$39,011	
Average Home Value	$44,611	
Median Monthly Rent	$134	
Average Monthly Rent	$141	

UNITS AT ADDRESS:		
1 Unit	129,503	80.4%
2 - 9 Units	12,144	7.5%
10+ Units	8,739	5.4%
Mobile Home	10,651	6.6%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	20,618
Last 5 Years	59,117
6 - 9 Years Ago	20,764
10 - 14 Years Ago	14,749
15+ Years Ago	19,018
Socioeconomic Status Score	45
Private Sector Employment	129,914

Table 2B. Baldwin County, AL

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	78,556	85,606	9.0%	95,003
Total Households	26,775	30,006	12.1%	33,635
Household Population	77,807	84,857	9.1%	94,254
Average Household Size	2.9	2.8	-2.5%	2.8
Median Household Income	$14,659	$18,778	28.1%	$24,955

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	78,556	100.0%	85,606	95,003
0 - 5	7,359	9.4%	9.4%	9.5%
6 - 13	10,739	13.7%	12.7%	12.0%
14 - 17	6,100	7.8%	6.7%	6.2%
18 - 24	8,736	11.1%	12.3%	11.4%
25 - 34	11,169	14.2%	14.3%	15.5%
35 - 44	9,024	11.5%	12.4%	13.0%
45 - 54	7,799	9.9%	9.6%	10.2%
55 - 64	7,781	9.9%	9.4%	8.7%
65 +	9,849	12.5%	13.3%	13.7%
FEMALE POPULATION BY AGE	40,197	100.0%	43,947	48,888
0 - 5	3,581	8.9%	8.9%	9.0%
6 - 13	5,263	13.1%	12.0%	11.4%
14 - 17	2,930	7.3%	6.4%	5.8%
18 - 24	4,401	10.9%	11.8%	10.9%
25 - 34	5,689	14.2%	14.2%	15.1%
35 - 44	4,615	11.5%	12.3%	12.9%
45 - 54	4,007	10.0%	9.6%	10.2%
55 - 64	4,177	10.4%	9.9%	8.9%
65 +	5,534	13.8%	14.8%	15.7%
MALE POPULATION BY AGE	38,359	100.0%	41,659	46,115
0 - 5	3,778	9.8%	9.9%	10.0%
6 - 13	5,476	14.3%	13.4%	12.7%
14 - 17	3,170	8.3%	7.0%	6.6%
18 - 24	4,335	11.3%	12.8%	12.0%
25 - 34	5,480	14.3%	14.3%	15.8%
35 - 44	4,409	11.5%	12.5%	13.0%
45 - 54	3,792	9.9%	9.5%	10.1%
55 - 64	3,604	9.4%	9.0%	8.4%
65 +	4,315	11.2%	11.6%	11.5%
Median Age Total Population	30.5		31.1	31.7
Median Age Adult Population	43.0		42.3	42.1

TOTAL POPULATION	78,556	100.0%	85,606	95,003
White	65,840	83.8%	84.1%	85.5%
Black	12,048	15.3%	15.1%	13.7%
Other	668	.9%	.8%	.8%
Spanish	795	1.0%	1.0%	1.0%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	6,675	25.0%	19.2%	13.7%
$ 7,500 - $ 9,999	2,468	9.2%	7.1%	5.1%
$10,000 - $14,999	4,507	16.9%	13.0%	9.2%
$15,000 - $24,999	7,014	26.3%	28.4%	22.1%
$25,000 - $34,999	3,698	13.9%	19.6%	27.8%
$35,000 - $49,999	1,657	6.2%	9.1%	15.9%
$50,000 - $74,999	473	1.8%	2.6%	4.5%
$75,000 +	196	.7%	1.0%	1.7%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	1,829	6.1%
Construction	2,903	9.7%
Manufacturing:		
Nondurable	3,453	11.6%
Durable	2,679	9.0%
Transportation	1,392	4.7%
Communications	979	3.3%
Wholesale Trade	1,441	4.8%
Retail Trade	4,951	16.6%
Fin/Ins/Real Est	1,597	5.4%
Bus/Repair Serv	967	3.2%
Pers/Ent/Rec Serv	1,340	4.5%
Prof/Related Serv:		
Health	1,733	5.8%
Educational	1,983	6.7%
Other	960	3.2%
Public Admin	1,600	5.4%
Total	29,807	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	2,887	9.7%
Prof	2,926	9.8%
Tech/Admin/Sales:		
Tech	731	2.5%
Admin/Clerical	4,032	13.5%
Sales	3,319	11.1%
Service:		
Private Household	214	.7%
Protective Serv	393	1.3%
Other Serv	2,676	9.0%
Farm/Forest/Fish	1,613	5.4%

Prod/Craft/Repair	4,733	15.9%
Oper/Fabr/Labrs:		
Mach Operators	2,919	9.8%
Trans/Mat Moving	1,831	6.1%
Handlrs/Cleanrs/ Helprs/Labrs	1,533	5.1%
Total Employed	29,807	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	110	.2%
Civ Labor Force:		
Employed	29,807	51.7%
Unemployed	2,453	4.3%
Not in Labor Force	25,236	43.8%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	26,866	92.1%
Public Trans	249	.9%
Other	2,065	7.1%
Total	29,180	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	10,077	36.3%
15 - 29 Minutes	8,236	29.7%
30 - 59 Minutes	6,940	25.0%
60 + Minutes	2,514	9.1%
Total	27,767	100.0%
EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	18,125	39.7%
12 Years	15,380	33.7%
13 - 15 Years	6,602	14.5%
16 + Years	5,498	12.1%
Median Years Completed	12.3	
MARITAL STATUS		
Male:		
Single	6,761	23.8%
Married	19,127	67.5%
Separated	370	1.3%
Widowed	681	2.4%
Divorced	1,410	5.0%
Total	28,349	100.0%
Female:		
Single	5,256	17.1%
Married	19,124	62.3%
Separated	533	1.7%
Widowed	3,921	12.8%
Divorced	1,862	6.1%
Total	30,696	100.0%

WORKING MOTHERS:		
With Children under 6	2,229	20.3%
With Children 6 - 17	3,429	31.3%
Subtotal	5,658	51.6%
Non-Working Mothers	5,304	48.4%
Total	10,962	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	18,565	86.1%
Female Householder	2,419	11.2%
Male Householder	576	2.7%
Total	21,560	100.0%
HOUSEHOLDS WITH:		
Children Under 18	11,740	43.8%
Persons 65 and Over	7,036	26.3%
Householder 65 and Over	6,314	23.6%
Married Couple With Children	9,334	35.0%
Married Couple Without Children	9,297	34.8%
Female Householder With Children	1,289	4.8%
Female Householder Without Children	1,116	4.2%
Male Householder With Children	201	.8%
Male Householder Without Children	331	1.2%
Non-Families	5,120	19.2%
PERSONS PER HOUSEHOLD:		
1 Person	4,854	18.1%
2 Persons	8,684	32.4%
3 Persons	4,768	17.8%
4+ Persons	8,469	31.6%
Total Households	26,775	100.0%
Average Household Income	$17,423	
Per Capita Income	$5,996	
FAMILIES		
Total Families	21,560	
Average Family Size	3.3	
Average Family Income	$19,433	
Family Population	72,138	
Nonfamily Population	5,669	
Group Quarters Population	749	
HOUSING		
Median Home Value	$41,396	
Average Home Value	$48,092	
Median Monthly Rent	$144	
Average Monthly Rent	$152	

UNITS AT ADDRESS:		
1 Unit	23,867	80.3%
2 - 9 Units	1,426	4.8%
10+ Units	598	2.0%
Mobile Home	3,845	12.9%

1984 Estimate

NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	3,673
Last 5 Years	11,430
6 - 9 Years Ago	4,056
10 - 14 Years Ago	3,082
15+ Years Ago	2,488
Socioeconomic Status Score	43
Private Sector Employment	14,002

Table 2C. Escambia County, AL

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	38,440	34,859	-9.2%	32,482
Total Households	12,653	11,739	-7.1%	11,021
Household Population	36,855	33,274	-9.6%	30,897
Average Household Size	2.9	2.8	-2.5%	2.8
Median Household Income	$11,740	$15,128	28.9%	$18,585

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	38,440	100.0%	34,859	32,482
0 - 5	3,612	9.4%	9.5%	9.5%
6 - 13	5,261	13.7%	13.0%	12.3%
14 - 17	3,047	7.9%	6.7%	6.4%
18 - 24	4,525	11.8%	13.0%	12.0%
25 - 34	5,821	15.1%	15.3%	16.8%
35 - 44	4,364	11.4%	12.1%	12.6%
45 - 54	3,740	9.7%	9.3%	9.6%
55 - 64	3,410	8.9%	8.7%	8.3%
65 +	4,660	12.1%	12.3%	12.4%
FEMALE POPULATION BY AGE	19,383	100.0%	17,542	16,312
0 - 5	1,771	9.1%	9.2%	9.3%
6 - 13	2,547	13.1%	12.6%	12.0%
14 - 17	1,465	7.6%	6.4%	6.2%
18 - 24	2,165	11.2%	12.0%	10.8%
25 - 34	2,671	13.8%	13.9%	15.2%
35 - 44	2,142	11.1%	11.9%	12.5%
45 - 54	1,959	10.1%	9.6%	9.9%
55 - 64	1,850	9.5%	9.4%	8.9%
65 +	2,813	14.5%	15.0%	15.2%
MALE POPULATION BY AGE	19,057	100.0%	17,317	16,170
0 - 5	1,841	9.7%	9.7%	9.8%
6 - 13	2,714	14.2%	13.4%	12.6%
14 - 17	1,582	8.3%	7.0%	6.6%
18 - 24	2,360	12.4%	14.0%	13.3%
25 - 34	3,150	16.5%	16.7%	18.5%
35 - 44	2,222	11.7%	12.4%	12.7%
45 - 54	1,781	9.3%	9.0%	9.4%
55 - 64	1,560	8.2%	8.1%	7.6%
65 +	1,847	9.7%	9.6%	9.6%
Median Age Total Population	29.6		29.9	30.2
Median Age Adult Population	41.6		40.8	40.5

TOTAL POPULATION	38,440	100.0%	34,859	32,482
White	26,056	67.8%	68.4%	69.4%
Black	11,376	29.6%	29.1%	28.4%
Other	1,008	2.6%	2.5%	2.2%
Spanish	280	.7%	.7%	.7%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	4,335	34.5%	28.3%	21.6%
$ 7,500 - $ 9,999	1,271	10.1%	8.3%	6.3%
$10,000 - $14,999	1,925	15.3%	13.0%	9.9%
$15,000 - $24,999	3,138	25.0%	31.1%	34.0%
$25,000 - $34,999	1,232	9.8%	12.6%	18.4%
$35,000 - $49,999	442	3.5%	4.5%	6.6%
$50,000 - $74,999	133	1.1%	1.4%	2.0%
$75,000 +	77	.6%	.8%	1.2%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	824	6.1%
Construction	1,044	7.8%
Manufacturing:		
Nondurable	2,503	18.7%
Durable	1,332	9.9%
Transportation	383	2.9%
Communications	327	2.4%
Wholesale Trade	531	4.0%
Retail Trade	1,938	14.5%
Fin/Ins/Real Est	419	3.1%
Bus/Repair Serv	349	2.6%
Pers/Ent/Rec Serv	540	4.0%
Prof/Related Serv:		
Health	812	6.1%
Educational	1,050	7.8%
Other	288	2.1%
Public Admin	1,071	8.0%
Total	13,411	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	984	7.3%
Prof	1,391	10.4%
Tech/Admin/Sales:		
Tech	184	1.4%
Admin/Clerical	1,472	11.0%
Sales	1,194	8.9%
Service:		
Private Household	250	1.9%
Protective Serv	246	1.8%
Other Serv	1,152	8.6%
Farm/Forest/Fish	530	4.0%
Prod/Craft/Repair	1,993	14.9%

Oper/Fabr/Labrs:		
Mach Operators	2,201	16.4%
Trans/Mat Moving	920	6.9%
Handlrs/Cleanrs/		
Helprs/Labrs	894	6.7%
Total Employed	13,411	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	41	.1%
Civ Labor Force:		
Employed	13,411	47.6%
Unemployed	1,423	5.1%
Not in Labor Force	13,287	47.2%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	12,010	92.1%
Public Trans	185	1.4%
Other	840	6.4%
Total	13,035	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	5,730	44.2%
15 - 29 Minutes	3,745	28.9%
30 - 59 Minutes	2,158	16.6%
60 + Minutes	1,331	10.3%
Total	12,964	100.0%
EDUCATION OF ADULTS OVER 25,		
YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	10,842	49.2%
12 Years	7,230	32.8%
13 - 15 Years	2,365	10.7%
16 + Years	1,586	7.2%
Median Years Completed	12.0	
MARITAL STATUS		
Male:		
Single	3,985	28.2%
Married	8,484	60.1%
Separated	355	2.5%
Widowed	416	2.9%
Divorced	881	6.2%
Total	14,121	100.0%
Female:		
Single	2,715	18.4%
Married	8,265	56.1%
Separated	395	2.7%
Widowed	2,418	16.4%
Divorced	946	6.4%
Total	14,739	100.0%

WORKING MOTHERS:		
With Children under 6	1,201	22.4%
With Children 6 - 17	1,691	31.6%
Subtotal	2,892	54.0%
Non-Working Mothers	2,462	46.0%
Total	5,354	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	7,960	80.5%
Female Householder	1,612	16.3%
Male Householder	313	3.2%
Total	9,885	100.0%
HOUSEHOLDS WITH:		
Children Under 18	5,782	45.7%
Persons 65 and Over	3,511	27.7%
Householder 65 and Over	3,139	24.8%
Married Couple With Children	4,274	34.0%
Married Couple Without Children	3,753	29.9%
Female Householder With Children	880	7.0%
Female Householder Without Children	705	5.6%
Male Householder With Children	100	.8%
Male Householder Without Children	130	1.0%
Non-Families	2,711	21.6%
PERSONS PER HOUSEHOLD:		
1 Person	2,612	20.6%
2 Persons	3,660	28.9%
3 Persons	2,349	18.6%
4+ Persons	4,032	31.9%
Total Households	12,653	100.0%
Average Household Income	$15,153	
Per Capita Income	$5,202	
FAMILIES		
Total Families	9,885	
Average Family Size	3.4	
Average Family Income	$17,430	
Family Population	33,880	
Nonfamily Population	2,975	
Group Quarters Population	1,585	
HOUSING		
Median Home Value	$25,108	
Average Home Value	$29,889	
Median Monthly Rent	$77	
Average Monthly Rent	$89	

UNITS AT ADDRESS:

1 Unit	11,069	82.3%
2 - 9 Units	704	5.2%
10+ Units	149	1.1%
Mobile Home	1,531	11.4%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	1,666
Last 5 Years	4,198
6 - 9 Years Ago	1,544
10 - 14 Years Ago	600
15+ Years Ago	2,399
Socioeconomic Status Score	30
Private Sector Employment	6,968

Table 2D. Mobile County, AL

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	364,980	382,065	4.7%	404,839
Total Households	123,298	129,952	5.4%	138,352
Household Population	359,198	376,283	4.8%	399,057
Average Household Size	2.9	2.9	-.5%	2.9
Median Household Income	$14,735	$19,048	29.3%	$25,078

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	364,980	100.0%	382,065	404,839
0 - 5	37,069	10.2%	10.1%	10.1%
6 - 13	49,213	13.5%	13.0%	12.7%
14 - 17	28,414	7.8%	6.7%	6.2%
18 - 24	49,527	13.6%	12.9%	11.4%
25 - 34	59,242	16.2%	17.1%	17.1%
35 - 44	39,502	10.8%	12.4%	14.3%
45 - 54	34,437	9.4%	9.0%	9.6%
55 - 64	32,406	8.9%	8.7%	8.0%
65 +	35,170	9.6%	10.1%	10.6%
FEMALE POPULATION BY AGE	189,714	100.0%	198,086	209,284
0 - 5	18,101	9.5%	9.5%	9.6%
6 - 13	24,107	12.7%	12.2%	12.0%
14 - 17	13,998	7.4%	6.4%	5.9%
18 - 24	25,777	13.6%	12.5%	10.9%
25 - 34	30,065	15.8%	16.9%	17.0%
35 - 44	20,483	10.8%	12.3%	14.1%
45 - 54	18,278	9.6%	9.2%	9.7%
55 - 64	17,550	9.3%	9.1%	8.4%
65 +	21,355	11.3%	11.8%	12.4%
MALE POPULATION BY AGE	175,266	100.0%	183,979	195,555
0 - 5	18,968	10.8%	10.8%	10.7%
6 - 13	25,106	14.3%	13.8%	13.4%
14 - 17	14,416	8.2%	7.0%	6.5%
18 - 24	23,750	13.6%	13.3%	11.9%
25 - 34	29,177	16.6%	17.3%	17.2%
35 - 44	19,019	10.9%	12.5%	14.4%
45 - 54	16,159	9.2%	8.9%	9.5%
55 - 64	14,856	8.5%	8.3%	7.6%
65 +	13,815	7.9%	8.2%	8.6%
Median Age Total Population	27.8		29.0	30.5
Median Age Adult Population	39.1		39.1	39.8
TOTAL POPULATION	364,980	100.0%	382,065	404,839
White	246,693	67.6%	68.4%	68.7%
Black	114,787	31.5%	30.6%	30.2%

Other	3,500	1.0%	1.0%	1.0%
Spanish	3,830	1.0%	1.1%	1.
HOUSEHOLD INCOME				
$ 0 - $ 7,499	32,880	26.6%	20.0%	14.1%
$ 7,500 - $ 9,999	10,433	8.4%	6.7%	4.8%
$10,000 - $14,999	19,553	15.8%	13.2%	9.8%
$15,000 - $24,999	32,014	25.9%	25.1%	21.1%
$25,000 - $34,999	17,295	14.0%	20.0%	21.9%
$35,000 - $49,999	7,668	6.2%	10.2%	18.7%
$50,000 - $74,999	2,541	2.1%	3.3%	6.8%
$75,000 +	1,284	1.0%	1.5%	2.8%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	3,304	2.3%
Construction	13,549	9.5%
Manufacturing:		
Nondurable	15,618	10.9%
Durable	12,898	9.0%
Transportation	7,038	4.9%
Communications	4,362	3.1%
Wholesale Trade	7,460	5.2%
Retail Trade	23,952	16.8%
Fin/Ins/Real Est	8,098	5.7%
Bus/Repair Serv	5,479	3.8%
Pers/Ent/Rec Serv	6,231	4.4%
Prof/Related Serv:		
Health	11,153	7.8%
Educational	10,866	7.6%
Other	5,993	4.2%
Public Admin	6,824	4.8%
Total	142,825	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	13,229	9.3%
Prof	15,924	11.1%
Tech/Admin/Sales:		
Tech	4,474	3.1%
Admin/Clerical	22,250	15.6%
Sales	16,062	11.2%
Service:		
Private Household	1,585	1.1%
Protective Serv	2,455	1.7%
Other Serv	14,143	9.9%
Farm/Forest/Fish	2,469	1.7%
Prod/Craft/Repair	22,588	15.8%
Oper/Fabr/Labrs:		
Mach Operators	10,967	7.7%
Trans/Mat Moving	7,835	5.5%

Handlrs/Cleanrs/ Helprs/Labrs	8,844	6.2%
Total Employed	142,825	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	1,605	.6%
Civ Labor Force:		
Employed	142,825	53.9%
Unemployed	10,900	4.1%
Not in Labor Force	109,568	41.4%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	131,431	93.4%
Public Trans	2,630	1.9%
Other	6,609	4.7%
Total	140,670	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	31,486	22.6%
15 - 29 Minutes	62,376	44.8%
30 - 59 Minutes	37,892	27.2%
60 + Minutes	7,372	5.3%
Total	139,126	100.0%
EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	77,046	38.3%
12 Years	69,871	34.8%
13 - 15 Years	29,075	14.5%
16 + Years	24,926	12.4%
Median Years Completed	12.3	
MARITAL STATUS		
Male:		
Single	36,976	28.9%
Married	76,834	60.1%
Separated	3,144	2.5%
Widowed	3,304	2.6%
Divorced	7,551	5.9%
Total	127,809	100.0%
Female:		
Single	32,498	22.5%
Married	76,375	52.9%
Separated	5,182	3.6%
Widowed	18,794	13.0%
Divorced	11,397	7.9%

WORKING MOTHERS:		
With Children under 6	11,352	21.2%
With Children 6 - 17	15,968	29.8%
Subtotal	27,320	51.0%
Non-Working Mothers	26,276	49.0%
Total	53,596	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	73,504	77.9%
Female Householder	17,591	18.6%
Male Householder	3,291	3.5%
Total	94,386	100.0%
HOUSEHOLDS WITH:		
Children Under 18	56,567	45.9%
Persons 65 and Over	26,529	21.5%
Householder 65 and Over	23,022	18.7%
Married Couple With Children	40,577	32.8%
Married Couple Without Children	34,115	27.6%
Female Householder With Children	10,648	8.6%
Female Householder Without Children	6,769	5.5%
Male Householder With Children	1,295	1.0%
Male Householder Without Children	1,737	1.4%
Non-Families	28,527	23.1%
PERSONS PER HOUSEHOLD:		
1 Person	25,650	20.8%
2 Persons	34,860	28.3%
3 Persons	23,190	18.8%
4+ Persons	39,598	32.1%
Total Households	123,298	100.0%
Average Household Income	$17,737	
Per Capita Income	$6,088	
FAMILIES		
Total Families	94,386	
Average Family Size	3.5	
Average Family Income	$20,128	
Family Population	326,184	
Nonfamily Population	33,014	
Group Quarters Population	5,782	
HOUSING		
Median Home Value	$38,580	
Average Home Value	$43,854	
Median Monthly Rent	$133	
Average Monthly Rent	$140	

UNITS AT ADDRESS:

1 Unit	105,636	80.5%
2 - 9 Units	10,718	8.2%
10+ Units	8,141	6.2%
Mobile Home	6,806	5.2%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	16,945
Last 5 Years	47,687
6 - 9 Years Ago	16,708
10 - 14 Years Ago	11,667
15+ Years Ago	16,530
Socioeconomic Status Score	46
Private Sector Employment	115,912

Table 2E. Gulf Shores City, AL

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	1,349	1,464	8.5%	1,583
Total Households	598	573	-4.1%	626
Household Population	1,346	1,464	8.8%	1,583
Average Household Size	2.3	2.6	13.2%	2.5
Median Household Income	$15,202	$18,389	21.0%	$25,218

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	1,349	100.0%	1,464	1,583
0 - 5	72	5.3%	8.0%	8.0%
6 - 13	113	8.4%	11.1%	10.5%
14 - 17	71	5.3%	5.9%	5.6%
18 - 24	103	7.6%	10.8%	10.3%
25 - 34	164	12.2%	13.4%	14.3%
35 - 44	119	8.8%	11.1%	11.9%
45 - 54	149	11.0%	10.0%	9.9%
55 - 64	268	19.9%	12.0%	10.4%
65 +	290	21.5%	17.8%	19.1%
FEMALE POPULATION BY AGE	687	100.0%	749	816
0 - 5	40	5.8%	7.6%	7.6%
6 - 13	42	6.1%	10.4%	9.9%
14 - 17	33	4.8%	5.7%	5.3%
18 - 24	53	7.7%	10.7%	9.9%
25 - 34	76	11.1%	12.6%	14.1%
35 - 44	65	9.5%	11.2%	10.9%
45 - 54	86	12.5%	10.5%	10.4%
55 - 64	145	21.1%	12.3%	10.9%
65 +	147	21.4%	19.0%	21.0%
MALE POPULATION BY AGE	662	100.0%	715	767
0 - 5	32	4.8%	8.4%	8.5%
6 - 13	71	10.7%	11.7%	11.1%
14 - 17	38	5.7%	6.0%	6.0%
18 - 24	50	7.6%	10.9%	10.7%
25 - 34	88	13.3%	14.3%	14.6%
35 - 44	54	8.2%	10.9%	13.0%
45 - 54	63	9.5%	9.5%	9.3%
55 - 64	123	18.6%	11.6%	9.8%
65 +	143	21.6%	16.6%	17.1%
Median Age Total Population	47.1		35.7	36.0
Median Age Adult Population	55.4		47.2	46.3

TOTAL POPULATION	1,349	100.0%	1,464	1,583
White	1,333	98.8%	92.2%	93.4%
Black	8	.6%	7.3%	6.3%
Other	8	.6%	.5%	.4%
Spanish	13	1.0%	1.8%	1.8%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	138	23.8%	18.7%	13.1%
$ 7,500 - $ 9,999	49	8.4%	6.5%	4.5%
$10,000 - $14,999	99	17.1%	14.3%	10.1%
$15,000 - $24,999	148	25.5%	30.9%	21.6%
$25,000 - $34,999	76	13.1%	17.3%	29.2%
$35,000 - $49,999	58	10.0%	9.4%	16.3%
$50,000 - $74,999	12	2.1%	2.6%	4.6%
$75,000 +	0	.0%	.3%	.6%

	1980 Census Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	23	4.9%
Construction	69	14.7%
Manufacturing:		
Nondurable	18	3.8%
Durable	32	6.8%
Transportation	13	2.8%
Communications	14	3.0%
Wholesale Trade	2	.4%
Retail Trade	107	22.8%
Fin/Ins/Real Est	84	17.9%
Bus/Repair Serv	0	.0%
Pers/Ent/Rec Serv	25	5.3%
Prof/Related Serv:		
Health	28	6.0%
Educational	13	2.8%
Other	9	1.9%
Public Admin	33	7.0%
Total	470	100.0%

OCCUPATION:		
Mgr/Prof:		
Mgr	91	19.4%
Prof	45	9.6%
Tech/Admin/Sales:		
Tech	11	2.3%
Admin/Clerical	40	8.5%
Sales	98	20.9%
Service:		
Private Household	0	.0%
Protective Serv	12	2.6%
Other Serv	25	5.3%
Farm/Forest/Fish	23	4.9%
Prod/Craft/Repair	89	18.9%

Oper/Fabr/Labrs:		
Mach Operators	11	2.3%
Trans/Mat Moving	9	1.9%
Handlrs/Cleanrs/ Helprs/Labrs	16	3.4%
Total Employed	470	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	3	.3%
Civ Labor Force:		
Employed	470	41.1%
Unemployed	49	4.3%
Not in Labor Force	622	54.4%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	411	91.5%
Public Trans	4	.9%
Other	34	7.6%
Total	449	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	231	63.3%
15 - 29 Minutes	72	19.7%
30 - 59 Minutes	53	14.5%
60 + Minutes	9	2.5%
Total	365	100.0%
EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	252	25.5%
12 Years	366	37.0%
13 - 15 Years	206	20.8%
16 + Years	166	16.8%
Median Years Completed	12.6	
MARITAL STATUS		
Male:		
Single	90	16.3%
Married	404	73.1%
Separated	2	.4%
Widowed	11	2.0%
Divorced	46	8.3%
Total	553	100.0%
Female:		
Single	68	11.4%
Married	403	67.5%
Separated	3	.5%
Widowed	79	13.2%
Divorced	44	7.4%
Total	597	100.0%

WORKING MOTHERS:		
With Children under 6	25	19.2%
With Children 6 - 17	46	35.4%
Subtotal	71	54.6%
Non-Working Mothers	59	45.4%
Total	130	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	392	89.7%
Female Householder	33	7.6%
Male Householder	12	2.7%
Total	437	100.0%
HOUSEHOLDS WITH:		
Children Under 18	145	24.2%
Persons 65 and Over	204	34.1%
Householder 65 and Over	197	32.9%
Married Couple With Children	110	19.0%
Married Couple Without Children	287	49.5%
Female Householder With Children	10	1.7%
Female Householder Without Children	8	1.4%
Male Householder With Children	2	.3%
Male Householder Without Children	3	.5%
Non-Families	160	27.6%
PERSONS PER HOUSEHOLD:		
1 Person	31	5.0%
2 Persons	11	1.8%
3 Persons	71	11.4%
4+ Persons	511	81.9%
Total Households	624	100.0%
Average Household Income	$17,386	
Per Capita Income	$7,724	
FAMILIES		
Total Families	437	
Average Family Size	2.7	
Average Family Income	$19,676	
Family Population	1,178	
Nonfamily Population	168	
Group Quarters Population	3	
HOUSING		
Median Home Value	$58,333	
Average Home Value	$61,984	
Median Monthly Rent	$172	
Average Monthly Rent	$186	

UNITS AT ADDRESS:		
1 Unit	524	84.7%
2 - 9 Units	26	4.2%
10+ Units	28	4.5%
Mobile Home	41	6.6%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	78
Last 5 Years	237
6 - 9 Years Ago	69
10 - 14 Years Ago	32
15+ Years Ago	26
Socioeconomic Status Score	45
Private Sector Employment	376

Table 2F. Mobile City, AL

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	200,452	203,917	1.7%	207,104
Total Households	71,400	73,216	2.5%	74,740
Household Population	196,475	199,947	1.8%	203,134
Average Household Size	2.8	2.7	-.6%	2.7
Median Household Income	$14,634	$18,762	28.2%	$24,370

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	200,452	100.0%	203,917	207,104
0 - 5	18,369	9.2%	9.2%	9.2%
6 - 13	24,753	12.3%	11.9%	11.6%
14 - 17	14,938	7.5%	6.4%	5.9%
18 - 24	28,509	14.2%	12.9%	11.1%
25 - 34	32,321	16.1%	17.7%	17.8%
35 - 44	20,620	10.3%	12.0%	14.4%
45 - 54	19,416	9.7%	9.1%	9.5%
55 - 64	19,215	9.6%	9.3%	8.5%
65 +	22,311	11.1%	11.5%	12.0%
FEMALE POPULATION BY AGE	105,679	100.0%	107,170	108,386
0 - 5	8,874	8.4%	8.5%	8.5%
6 - 13	12,166	11.5%	11.0%	10.8%
14 - 17	7,367	7.0%	6.0%	5.5%
18 - 24	14,857	14.1%	12.4%	10.5%
25 - 34	16,406	15.5%	17.3%	17.5%
35 - 44	10,933	10.3%	12.0%	14.1%
45 - 54	10,561	10.0%	9.3%	9.7%
55 - 64	10,553	10.0%	9.8%	9.0%
65 +	13,962	13.2%	13.7%	14.3%
MALE POPULATION BY AGE	94,773	100.0%	96,740	98,710
0 - 5	9,495	10.0%	9.9%	9.8%
6 - 13	12,587	13.3%	12.8%	12.6%
14 - 17	7,571	8.0%	6.8%	6.2%
18 - 24	13,652	14.4%	13.4%	11.7%
25 - 34	15,915	16.8%	18.1%	18.2%
35 - 44	9,687	10.2%	12.1%	14.7%
45 - 54	8,855	9.3%	8.8%	9.3%
55 - 64	8,662	9.1%	8.8%	7.9%
65 +	8,349	8.8%	9.2%	9.5%
Median Age Total Population	28.8		30.1	31.8
ledian Age Adult Population	40.0		39.7	40.3

TOTAL POPULATION	200,452	100.0%	203,917	207,104
White	125,786	62.8%	62.6%	61.8%
Black	72,568	36.2%	36.3%	37.0
Other	2,098	1.0%	1.1%	1.2%
Spanish	2,265	1.1%	1.2%	1.2%

HOUSEHOLD INCOME				
$ 0 - $ 7,499	18,898	26.4%	20.0%	14.2%
$ 7,500 - $ 9,999	6,328	8.8%	7.1%	5.2%
$10,000 - $14,999	11,434	16.0%	13.5%	10.2%
$15,000 - $24,999	17,835	24.9%	24.9%	21.7%
$25,000 - $34,999	9,514	13.3%	17.2%	19.7%
$35,000 - $49,999	4,789	6.7%	11.0%	17.1%
$50,000 - $74,999	1,871	2.6%	4.2%	8.3%
$75,000 +	982	1.4%	2.0%	3.6%

	1980 Census Number	1980 Census Percent
INDUSTRY:		
Agr/For/Fish/Min	1,126	1.4%
Construction	6,516	8.0%
Manufacturing:		
Nondurable	7,347	9.0%
Durable	5,638	6.9%
Transportation	4,201	5.1%
Communications	2,394	2.9%
Wholesale Trade	4,473	5.5%
Retail Trade	14,272	17.4%
Fin/Ins/Real Est	5,572	6.8%
Bus/Repair Serv	3,249	4.0%
Pers/Ent/Rec Serv	4,014	4.9%
Prof/Related Serv:		
Health	7,470	9.1%
Educational	7,291	8.9%
Other	4,055	5.0%
Public Admin	4,237	5.2%
Total	81,855	100.0%

OCCUPATION:		
Mgr/Prof:		
Mgr	8,955	10.9%
Prof	11,572	14.1%
Tech/Admin/Sales:		
Tech	2,889	3.5%
Admin/Clerical	13,820	16.9%
Sales	10,263	12.5%
Service:		
Private Household	1,068	1.3%
Protective Serv	1,439	1.8%
Other Serv	8,236	10.1%
Farm/Forest/Fish	895	1.1%
Prod/Craft/Repair	10,238	12.5%

Oper/Fabr/Labrs:		
Mach Operators	4,403	5.4%
Trans/Mat Moving	3,772	4.6%
Handlrs/Cleanrs/		
Helprs/Labrs	4,305	5.3%
Total Employed	81,855	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	780	.5%
Civ Labor Force:		
Employed	81,855	54.6%
Unemployed	6,116	4.1%
Not in Labor Force	61,236	40.8%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	74,616	92.7%
Public Trans	1,979	2.5%
Other	3,897	4.8%
Total	80,492	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	21,432	26.8%
15 - 29 Minutes	38,730	48.4%
30 - 59 Minutes	16,347	20.4%
60 + Minutes	3,470	4.3%
Total	79,979	100.0%
EDUCATION OF ADULTS OVER 25,		
YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	37,496	32.9%
12 Years	37,863	33.2%
13 - 15 Years	19,272	16.9%
16 + Years	19,403	17.0%
Median Years Completed	12.5	
MARITAL STATUS		
Male:		
Single	22,320	31.5%
Married	40,116	56.6%
Separated	1,900	2.7%
Widowed	1,998	2.8%
Divorced	4,599	6.5%
Total	70,933	100.0%
Female:		
Single	20,485	24.7%
Married	39,893	48.1%
Separated	3,185	3.8%
Widowed	11,995	14.5%
Divorced	7,396	8.9%
Total	82,954	100.0%

WORKING MOTHERS:		
With Children under 6	6,173	22.6%
With Children 6 - 17	8,892	32.6%
Subtotal	15,065	55.2%
Non-Working Mothers	12,216	44.8%
Total	27,281	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	38,346	74.6%
Female Householder	11,072	21.5%
Male Householder	1,972	3.8%
Total	51,390	100.0%
HOUSEHOLDS WITH:		
Children Under 18	29,063	40.7%
Persons 65 and Over	16,691	23.4%
Householder 65 and Over	14,606	20.5%
Married Couple With Children	19,429	27.1%
Married Couple Without Children	19,611	27.4%
Female Householder With Children	6,528	9.1%
Female Householder Without Children	4,541	6.3%
Male Householder With Children	743	1.0%
Male Householder Without Children	1,040	1.5%
Non-Families	19,759	27.6%
PERSONS PER HOUSEHOLD:		
1 Person	3,361	4.8%
2 Persons	7,343	10.4%
3 Persons	8,332	11.8%
4+ Persons	51,417	73.0%
Total Households	70,453	100.0%
Average Household Income	$18,335	
Per Capita Income	$6,663	
FAMILIES		
Total Families	51,390	
Average Family Size	3.4	
Average Family Income	$21,354	
Family Population	173,375	
Nonfamily Population	23,100	
Group Quarters Population	3,977	
HOUSING		
Median Home Value	$40,292	
Average Home Value	$47,379	
Median Monthly Rent	$140	
Average Monthly Rent	$147	

UNITS AT ADDRESS:		
1 Unit	60,279	79.8%
2 - 9 Units	7,620	10.1%
10+ Units	6,902	9.1%
Mobile Home	711	.9%

1984 Estimate

NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	10,853
Last 5 Years	28,221
6 - 9 Years Ago	9,500
10 - 14 Years Ago	7,428
15+ Years Ago	11,379
Socioeconomic Status Score	52
Private Sector Employment	83,147

Table 26. Prichard City, AL

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	39,541	38,962	-1.4%	40,094
Total Households	12,038	11,940	-.7%	12,398
Household Population	39,327	38,783	-1.3%	39,915
Average Household Size	3.3	3.2	-.5%	3.2
Median Household Income	$8,457	$11,398	34.8%	$14,633

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	39,541	100.0%	38,962	40,094
0 - 5	5,324	13.5%	13.4%	13.4%
6 - 13	6,187	15.6%	15.6%	16.0%
14 - 17	3,536	8.9%	7.4%	6.9%
18 - 24	5,495	13.9%	14.0%	11.9%
25 - 34	5,696	14.4%	16.0%	17.2%
35 - 44	3,544	9.0%	10.0%	11.7%
45 - 54	3,045	7.7%	7.3%	7.4%
55 - 64	3,067	7.8%	7.2%	6.[illegible]
65 +	3,647	9.2%	9.1%	9.2[illegible]
FEMALE POPULATION BY AGE	21,205	100.0%	20,710	21,171
0 - 5	2,639	12.4%	12.4%	12.4%
6 - 13	3,102	14.6%	14.6%	14.9%
14 - 17	1,780	8.4%	7.0%	6.5%
18 - 24	2,987	14.1%	13.6%	11.4%
25 - 34	3,085	14.5%	16.3%	17.4%
35 - 44	1,980	9.3%	10.5%	12.1%
45 - 54	1,696	8.0%	7.6%	7.8%
55 - 64	1,744	8.2%	7.6%	6.6%
65 +	2,192	10.3%	10.4%	10.8%
MALE POPULATION BY AGE	18,336	100.0%	18,252	18,923
0 - 5	2,685	14.6%	14.6%	14.5%
6 - 13	3,085	16.8%	16.8%	17.1%
14 - 17	1,756	9.6%	7.8%	7.3%
18 - 24	2,508	13.7%	14.4%	12.5%
25 - 34	2,611	14.2%	15.7%	17.0%
35 - 44	1,564	8.5%	9.5%	11.3%
45 - 54	1,349	7.4%	6.9%	7.0%
55 - 64	1,323	7.2%	6.8%	5.8%
65 +	1,455	7.9%	7.5%	7.4%
Median Age Total Population	24.0		24.7	25.9
Median Age Adult Population	37.9		36.8	37.[illegible]

TOTAL POPULATION	39,541	100.0%	38,962	40,094
White	10,208	25.8%	24.6%	21.4%
Black	29,129	73.7%	74.9%	78.1%
Other	204	.5%	.5%	.5%
Spanish	437	1.1%	1.1%	.9%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	5,577	46.2%	37.0%	29.0%
$ 7,500 - $ 9,999	1,180	9.8%	8.4%	6.6%
$10,000 - $14,999	1,852	15.4%	16.5%	15.5%
$15,000 - $24,999	2,287	19.0%	22.9%	27.6%
$25,000 - $34,999	823	6.8%	10.9%	13.8%
$35,000 - $49,999	307	2.5%	3.8%	6.6%
$50,000 - $74,999	23	.2%	.4%	.7%
$75,000 +	10	.1%	.1%	.2%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	223	1.9%
Construction	1,355	11.3%
Manufacturing:		
Nondurable	1,547	12.9%
Durable	1,487	12.4%
Transportation	716	6.0%
Communications	340	2.8%
Wholesale Trade	530	4.4%
Retail Trade	1,606	13.4%
Fin/Ins/Real Est	267	2.2%
Bus/Repair Serv	468	3.9%
Pers/Ent/Rec Serv	875	7.3%
Prof/Related Serv:		
Health	872	7.3%
Educational	819	6.8%
Other	313	2.6%
Public Admin	540	4.5%
Total	11,958	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	440	3.7%
Prof	720	6.0%
Tech/Admin/Sales:		
Tech	159	1.3%
Admin/Clerical	1,142	9.6%
Sales	708	5.9%
Service:		
Private Household	333	2.8%
Protective Serv	182	1.5%
Other Serv	2,033	17.0%
Farm/Forest/Fish	206	1.7%
Prod/Craft/Repair	1,804	15.1%

Oper/Fabr/Labrs:		
Mach Operators	1,589	13.3%
Trans/Mat Moving	1,021	8.5%
Handlrs/Cleanrs/		
Helprs/Labrs	1,621	13.6%
Total Employed	11,958	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	43	.2%
Civ Labor Force:		
Employed	11,958	45.2%
Unemployed	1,777	6.7%
Not in Labor Force	12,669	47.9%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	10,509	91.0%
Public Trans	536	4.6%
Other	499	4.3%
Total	11,544	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	1,585	14.0%
15 - 29 Minutes	5,262	46.4%
30 - 59 Minutes	3,671	32.4%
60 + Minutes	828	7.3%
Total	11,346	100.0%
EDUCATION OF ADULTS OVER 25,		
YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	10,998	57.8%
12 Years	5,355	28.2%
13 - 15 Years	1,899	10.0%
16 + Years	766	4.0%
Median Years Completed	10.3	
MARITAL STATUS		
Male:		
Single	4,203	34.5%
Married	6,244	51.3%
Separated	574	4.7%
Widowed	473	3.9%
Divorced	678	5.6%
Total	12,172	100.0%
Female:		
Single	4,250	28.2%
Married	6,271	41.6%
Separated	1,140	7.6%
Widowed	2,269	15.1%
Divorced	1,138	7.6%
Total	15,068	100.0%

WORKING MOTHERS:		
With Children under 6	1,612	25.5%
With Children 6 - 17	1,614	25.5%
Subtotal	3,226	50.9%
Non-Working Mothers	3,106	49.1%
Total	6,332	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	5,878	62.0%
Female Householder	3,150	33.2%
Male Householder	453	4.8%
Total	9,481	100.0%
HOUSEHOLDS WITH:		
Children Under 18	6,544	54.4%
Persons 65 and Over	2,845	23.6%
Householder 65 and Over	2,491	20.7%
Married Couple With Children	3,554	29.5%
Married Couple Without Children	2,393	19.8%
Female Householder With Children	2,129	17.7%
Female Householder Without Children	963	8.0%
Male Householder With Children	221	1.8%
Male Householder Without Children	277	2.3%
Non-Families	2,522	20.9%
PERSONS PER HOUSEHOLD:		
1 Person	387	3.3%
2 Persons	1,392	11.9%
3 Persons	2,546	21.8%
4+ Persons	7,357	63.0%
Total Households	11,682	100.0%
Average Household Income	$11,151	
Per Capita Income	$3,413	
FAMILIES		
Total Families	9,481	
Average Family Size	3.8	
Average Family Income	$12,487	
Family Population	36,467	
Nonfamily Population	2,860	
Group Quarters Population	214	
HOUSING		
Median Home Value	$21,319	
Average Home Value	$25,619	
Median Monthly Rent	$69	
Average Monthly Rent	$84	

UNITS AT ADDRESS:		
1 Unit	11,324	86.7%
2 - 9 Units	1,361	10.4%
10+ Units	145	1.1%
Mobile Home	231	1.8%

1984 Estimate

NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	1,127
Last 5 Years	3,316
6 - 9 Years Ago	1,372
10 - 14 Years Ago	1,023
15+ Years Ago	1,531
Socioeconomic Status Score	17
Private Sector Employment	5,854

Table 2H. Tillmans Corner City, AL

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	15,941	19,532	22.5%	24,081
Total Households	5,239	6,467	23.4%	8,063
Household Population	15,941	19,529	22.5%	24,078
Average Household Size	3.0	3.0	-.6%	3.0
Median Household Income	$18,608	$25,257	35.7%	$32,715

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	15,941	100.0%	19,532	24,081
0 - 5	1,768	11.1%	10.9%	10.6%
6 - 13	2,309	14.5%	14.1%	13.5%
14 - 17	1,192	7.5%	6.8%	6.6%
18 - 24	1,971	12.4%	12.0%	11.3%
25 - 34	3,040	19.1%	17.4%	15.8%
35 - 44	2,091	13.1%	15.0%	16.2%
45 - 54	1,542	9.7%	9.7%	10.8%
55 - 64	1,128	7.1%	7.8%	7.7%
65 +	900	5.6%	6.3%	7.4%
FEMALE POPULATION BY AGE	8,025	100.0%	9,865	12,209
0 - 5	917	11.4%	10.7%	10.3%
6 - 13	1,125	14.0%	14.1%	13.5%
14 - 17	568	7.1%	6.6%	6.5%
18 - 24	1,027	12.8%	11.8%	11.0%
25 - 34	1,543	19.2%	17.8%	16.1%
35 - 44	1,033	12.9%	14.8%	16.2%
45 - 54	748	9.3%	9.4%	10.6%
55 - 64	585	7.3%	7.9%	7.6%
65 +	479	6.0%	6.9%	8.3%
MALE POPULATION BY AGE	7,916	100.0%	9,667	11,872
0 - 5	851	10.8%	11.0%	11.0%
6 - 13	1,184	15.0%	14.2%	13.6%
14 - 17	624	7.9%	7.0%	6.7%
18 - 24	944	11.9%	12.2%	11.6%
25 - 34	1,497	18.9%	17.0%	15.6%
35 - 44	1,058	13.4%	15.2%	16.2%
45 - 54	794	10.0%	10.0%	11.0%
55 - 64	543	6.9%	7.8%	7.9%
65 +	421	5.3%	5.6%	6.4%
Median Age Total Population	27.4		28.6	30.0
Median Age Adult Population	36.5		38.1	39.6

TOTAL POPULATION	15,941	100.0%	19,532	24,081
White	15,765	98.9%	98.6%	98.7%
Black	50	.3%	.8%	.7
Other	126	.8%	.6%	.6%
Spanish	166	1.0%	1.0%	1.0%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	694	13.2%	9.2%	5.9%
$ 7,500 - $ 9,999	368	7.0%	4.7%	3.0%
$10,000 - $14,999	937	17.8%	12.3%	7.8%
$15,000 - $24,999	1,746	33.2%	23.0%	14.8%
$25,000 - $34,999	997	19.0%	31.9%	23.9%
$35,000 - $49,999	344	6.5%	13.5%	32.0%
$50,000 - $74,999	137	2.6%	4.3%	9.7%
$75,000 +	36	.7%	1.1%	2.9%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	140	2.0%
Construction	942	13.4%
Manufacturing:		
Nondurable	612	8.7%
Durable	775	11.0%
Transportation	374	5.3%
Communications	231	3.3%
Wholesale Trade	360	5.1%
Retail Trade	1,315	18.7%
Fin/Ins/Real Est	388	5.5%
Bus/Repair Serv	372	5.3%
Pers/Ent/Rec Serv	156	2.2%
Prof/Related Serv:		
Health	336	4.8%
Educational	321	4.6%
Other	292	4.2%
Public Admin	404	5.8%
Total	7,018	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	618	8.8%
Prof	562	8.0%
Tech/Admin/Sales:		
Tech	235	3.3%
Admin/Clerical	1,382	19.7%
Sales	783	11.2%
Service:		
Private Household	25	.4%
Protective Serv	173	2.5%
Other Serv	471	6.7%
Farm/Forest/Fish	97	1.4%
Prod/Craft/Repair	1,538	21.9%

Oper/Fabr/Labrs:		
Mach Operators	454	6.5%
Trans/Mat Moving	340	4.8%
Handlrs/Cleanrs/ Helprs/Labrs	340	4.8%
Total Employed	7,018	100.0%

EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	112	1.0%
Civ Labor Force:		
Employed	7,018	62.1%
Unemployed	311	2.8%
Not in Labor Force	3,862	34.2%

MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	6,791	96.9%
Public Trans	8	.1%
Other	207	3.0%
Total	7,006	100.0%

TRAVEL TIME TO WORK:		
0 - 14 Minutes	720	10.7%
15 - 29 Minutes	3,291	49.1%
30 - 59 Minutes	2,360	35.2%
60 + Minutes	329	4.9%
Total	6,700	100.0%

EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	2,943	33.8%
12 Years	3,962	45.5%
13 - 15 Years	1,095	12.6%
16 + Years	701	8.1%
Median Years Completed	12.3	

MARITAL STATUS		
Male:		
Single	1,225	21.4%
Married	4,031	70.4%
Separated	58	1.0%
Widowed	83	1.4%
Divorced	329	5.7%
Total	5,726	100.0%
Female:		
Single	869	14.9%
Married	4,014	68.8%
Separated	86	1.5%
Widowed	423	7.2%
Divorced	446	7.6%
Total	5,838	100.0%

WORKING MOTHERS:		
With Children under 6	561	21.5%
With Children 6 - 17	702	26.9%
Subtotal	1,263	48.5%
Non-Working Mothers	1,343	51.5%
Total	2,606	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	3,914	88.5%
Female Householder	391	8.8%
Male Householder	118	2.7%
Total	4,423	100.0%
HOUSEHOLDS WITH:		
Children Under 18	2,816	53.8%
Persons 65 and Over	695	13.3%
Householder 65 and Over	567	10.8%
Married Couple With Children	2,359	44.9%
Married Couple Without Children	1,598	30.4%
Female Householder With Children	205	3.9%
Female Householder Without Children	144	2.7%
Male Householder With Children	27	.5%
Male Householder Without Children	88	1.7%
Non-Families	838	15.9%
PERSONS PER HOUSEHOLD:		
1 Person	241	5.2%
2 Persons	572	12.3%
3 Persons	541	11.6%
4+ Persons	3,293	70.9%
Total Households	4,647	100.0%
Average Household Income	$20,393	
Per Capita Income	$6,702	
FAMILIES		
Total Families	4,423	
Average Family Size	3.4	
Average Family Income	$21,482	
Family Population	14,994	
Nonfamily Population	947	
Group Quarters Population	0	
HOUSING		
Median Home Value	$41,721	
Average Home Value	$44,545	
Median Monthly Rent	$184	
Average Monthly Rent	$194	

UNITS AT ADDRESS:

1 Unit	4,260	77.0%
2 - 9 Units	197	3.6%
10+ Units	267	4.8%
Mobile Home	808	14.6%

1984 Estimate

NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	813
Last 5 Years	2,685
6 - 9 Years Ago	785
10 - 14 Years Ago	373
15+ Years Ago	323
Socioeconomic Status Score	51
Private Sector Employment	3,348

Table 3. Florida

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	9,746,324	10,997,032	12.8%	12,347,125
Total Households	3,744,254	4,291,318	14.6%	4,844,350
Household Population	9,550,078	10,800,806	13.1%	12,150,899
Average Household Size	2.6	2.5	-1.2%	2.5
Median Household Income	$14,707	$18,614	26.6%	$23,288

	1980 Census		1984	1989
	Number	Percent	Estimate	Projection
TOTAL POPULATION BY AGE	9,746,324	100.0%	10,997,032	12,347,125
0 - 5	684,269	7.0%	7.0%	7.1%
6 - 13	1,048,065	10.8%	9.8%	9.4%
14 - 17	627,302	6.4%	5.7%	5.2%
18 - 24	1,139,905	11.7%	11.2%	10.2%
25 - 34	1,411,411	14.5%	14.9%	15.2%
35 - 44	1,038,778	10.7%	11.9%	13.3%
45 - 54	989,160	10.1%	9.7%	10.2%
55 - 64	1,119,861	11.5%	11.2%	10.5%
65 +	1,687,573	17.3%	18.3%	18.9%
FEMALE POPULATION BY AGE	5,070,698	100.0%	5,735,826	6,450,776
0 - 5	334,515	6.6%	6.6%	6.7%
6 - 13	513,279	10.1%	9.2%	8.8%
14 - 17	306,912	6.1%	5.4%	4.8%
18 - 24	570,678	11.3%	10.6%	9.5%
25 - 34	714,867	14.1%	14.5%	14.7%
35 - 44	534,819	10.5%	11.8%	13.1%
45 - 54	518,994	10.2%	9.8%	10.2%
55 - 64	617,421	12.2%	11.8%	11.0%
65 +	959,213	18.9%	20.3%	21.2%
MALE POPULATION BY AGE	4,675,626	100.0%	5,261,202	5,896,345
0 - 5	349,754	7.5%	7.5%	7.6%
6 - 13	534,786	11.4%	10.5%	10.1%
14 - 17	320,390	6.9%	6.1%	5.5%
18 - 24	569,227	12.2%	11.9%	10.9%
25 - 34	696,544	14.9%	15.4%	15.8%
35 - 44	503,959	10.8%	12.1%	13.5%
45 - 54	470,166	10.1%	9.7%	10.2%
55 - 64	502,440	10.7%	10.5%	9.9%
65 +	728,360	15.6%	16.2%	16.4%
Median Age Total Population	34.7		36.0	37.1
Median Age Adult Population	46.0		45.6	45.4

TOTAL POPULATION	9,746,324	100.0%	10,997,032	12,347,125
White	8,184,513	84.0%	83.9%	83.5%
Black	1,342,688	13.8%	13.8%	14.1%
Other	219,123	2.2%	2.3%	2.4%
Spanish	858,158	8.8%	9.4%	10.6%
HOUSEHOLD INCOME				
\$ 0 - \$ 7,499	889,751	23.7%	18.3%	13.4%
\$ 7,500 - \$ 9,999	359,199	9.6%	7.5%	5.5%
\$10,000 - \$14,999	664,207	17.7%	14.5%	11.0%
\$15,000 - \$24,999	956,507	25.5%	26.8%	24.2%
\$25,000 - \$34,999	478,374	12.8%	17.2%	20.9%
\$35,000 - \$49,999	246,584	6.6%	9.7%	15.2%
\$50,000 - \$74,999	99,210	2.6%	3.9%	6.5%
\$75,000 +	54,710	1.5%	2.1%	3.3%

	1980 Census Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	157,629	3.9%
Construction	334,121	8.3%
Manufacturing:		
Nondurable	207,650	5.2%
Durable	296,910	7.4%
Transportation	188,147	4.7%
Communications	132,890	3.3%
Wholesale Trade	175,690	4.4%
Retail Trade	769,137	19.2%
Fin/Ins/Real Est	305,828	7.6%
Bus/Repair Serv	191,269	4.8%
Pers/Ent/Rec Serv	269,670	6.7%
Prof/Related Serv:		
Health	291,825	7.3%
Educational	292,009	7.3%
Other	169,979	4.2%
Public Admin	219,576	5.5%
Total	4,002,330	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	463,496	11.6%
Prof	449,245	11.2%
Tech/Admin/Sales:		
Tech	119,235	3.0%
Admin/Clerical	687,251	17.2%
Sales	488,329	12.2%
Service:		
Private Household	33,894	.8%
Protective Serv	70,537	1.8%
Other Serv	479,489	12.0%
Farm/Forest/Fish	125,827	3.1%
Prod/Craft/Repair	530,330	13.3%
Oper/Fabr/Labrs:		

Mach Operators	215,166	5.4%
Trans/Mat Moving	162,089	4.0%
Handlrs/Cleanrs/ Helprs/Labrs	177,442	4.4%
Total Employed	4,002,330	100.0%

EMPLOYMENT STATUS:

Labor Force:		
Armed Forces	86,471	1.1%
Civ Labor Force:		
Employed	4,002,330	51.9%
Unemployed	215,335	2.8%
Not in Labor Force	3,409,387	44.2%

MEANS TRANSPORTATION TO WORK:

Drive/Carpool	3,557,675	89.4%
Public Trans	106,546	2.7%
Other	314,186	7.9%
Total	3,978,407	100.0%

TRAVEL TIME TO WORK:

0 - 14 Minutes	1,262,830	32.2%
15 - 29 Minutes	1,595,664	40.6%
30 - 59 Minutes	906,198	23.1%
60 + Minutes	161,702	4.1%
Total	3,926,394	100.0%

EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:

0 - 11 Years	2,082,948	33.3%
12 Years	2,189,572	35.0%
13 - 15 Years	1,047,471	16.8%
16 + Years	930,134	14.9%
Median Years Completed	12.4	

MARITAL STATUS

Male:		
Single	950,049	25.6%
Married	2,331,215	62.7%
Separated	74,110	2.0%
Widowed	116,194	3.1%
Divorced	245,604	6.6%
Total	3,717,172	100.0%
Female:		
Single	773,470	18.6%
Married	2,321,809	55.9%
Separated	101,728	2.4%
Widowed	596,382	14.4%
Divorced	358,989	8.6%
Total	4,152,378	100.0%

WORKING MOTHERS:		
With Children under 6	239,124	20.8%
With Children 6 - 17	438,971	38.2%
Subtotal	678,095	59.0%
Non-Working Mothers	470,349	41.0%
Total	1,148,444	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	2,225,162	82.7%
Female Householder	372,795	13.9%
Male Householder	92,165	3.4%
Total	2,690,122	100.0%
HOUSEHOLDS WITH:		
Children Under 18	1,234,678	33.0%
Persons 65 and Over	1,191,739	31.8%
Householder 65 and Over	1,057,965	28.3%
Married Couple With Children	899,625	24.0%
Married Couple Without Children	1,356,467	36.2%
Female Householder With Children	211,218	5.6%
Female Householder Without Children	152,042	4.1%
Male Householder With Children	34,434	.9%
Male Householder Without Children	52,699	1.4%
Non-Families	1,042,057	27.8%
PERSONS PER HOUSEHOLD:		
1 Person	885,498	23.6%
2 Persons	1,416,930	37.8%
3 Persons	589,349	15.7%
4+ Persons	852,477	22.8%
Total Households	3,744,254	100.0%
Average Household Income	$18,718	
Per Capita Income	$7,339	
FAMILIES		
Total Families	2,690,122	
Average Family Size	3.1	
Average Family Income	$21,458	
Family Population	8,281,296	
Nonfamily Population	1,268,782	
Group Quarters Population	196,246	
HOUSING		
Median Home Value	$45,530	
Average Home Value	$54,071	
Median Monthly Rent	$209	
Average Monthly Rent	$218	

UNITS AT ADDRESS:		
1 Unit	2,797,611	65.5%
2 - 9 Units	429,420	10.1%
10+ Units	631,921	14.8%
Mobile Home	411,439	9.6%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	651,873
Last 5 Years	1,965,300
6 - 9 Years Ago	587,279
10 - 14 Years Ago	369,461
15+ Years Ago	317,093
Socioeconomic Status Score	49
Private Sector Employment	2,707,098

Table 3A. Fort Walton Beach SMSA, FL

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	109,920	123,223	12.1%	137,636
Total Households	37,538	43,193	15.1%	48,812
Household Population	106,700	120,003	12.5%	134,416
Average Household Size	2.8	2.8	-2.1%	2.8
Median Household Income	$15,183	$19,768	30.2%	$26,037

	1980 Census		1984	1989
	Number	Percent	Estimate	Projection
TOTAL POPULATION BY AGE	109,920	100.0%	123,223	137,636
0 - 5	10,066	9.2%	8.9%	8.7%
6 - 13	14,221	12.9%	12.0%	11.3%
14 - 17	8,870	8.1%	6.7%	6.0%
18 - 24	17,445	15.9%	14.6%	12.2%
25 - 34	18,140	16.5%	17.9%	19.1%
35 - 44	14,264	13.0%	13.6%	14.2%
45 - 54	12,058	11.0%	10.5%	11.1%
55 - 64	8,483	7.7%	8.8%	9.2%
65 +	6,373	5.8%	6.8%	8.2%
FEMALE POPULATION BY AGE	54,113	100.0%	60,883	68,230
0 - 5	4,944	9.1%	8.9%	8.6%
6 - 13	6,976	12.9%	11.9%	11.2%
14 - 17	4,334	8.0%	6.5%	5.7%
18 - 24	7,756	14.3%	13.6%	11.3%
25 - 34	8,838	16.3%	17.2%	18.3%
35 - 44	7,322	13.5%	14.1%	14.3%
45 - 54	5,969	11.0%	10.8%	11.7%
55 - 64	4,253	7.9%	9.1%	9.5%
65 +	3,721	6.9%	7.9%	9.5%
MALE POPULATION BY AGE	55,807	100.0%	62,340	69,406
0 - 5	5,122	9.2%	9.0%	8.8%
6 - 13	7,245	13.0%	12.1%	11.4%
14 - 17	4,536	8.1%	6.9%	6.2%
18 - 24	9,689	17.4%	15.6%	13.1%
25 - 34	9,302	16.7%	18.6%	20.0%
35 - 44	6,942	12.4%	13.2%	14.1%
45 - 54	6,089	10.9%	10.3%	10.5%
55 - 64	4,230	7.6%	8.6%	8.9%
65 +	2,652	4.8%	5.8%	7.0%
Median Age Total Population	27.2		28.8	31.0
Median Age Adult Population	36.9		37.6	38.9

TOTAL POPULATION	109,920	100.0%	123,223	137,636
White	97,093	88.3%	87.6%	86.6%
Black	9,483	8.6%	9.3%	10.
Other	3,344	3.0%	3.1%	3.3%
Spanish	2,577	2.3%	2.5%	3.0%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	7,570	20.1%	15.2%	10.5%
$ 7,500 - $ 9,999	3,892	10.3%	7.6%	5.3%
$10,000 - $14,999	7,156	19.0%	14.6%	10.1%
$15,000 - $24,999	10,109	26.9%	26.4%	21.6%
$25,000 - $34,999	5,270	14.0%	21.2%	23.6%
$35,000 - $49,999	2,504	6.7%	10.3%	19.1%
$50,000 - $74,999	808	2.1%	3.5%	7.4%
$75,000 +	299	.8%	1.2%	2.3%

	1980 Census Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	959	2.6%
Construction	2,998	8.0%
Manufacturing:		
Nondurable	989	2.6%
Durable	2,346	6.3%
Transportation	1,041	2.8%
Communications	1,221	3.3%
Wholesale Trade	912	2.4%
Retail Trade	8,173	21.9%
Fin/Ins/Real Est	2,218	5.9%
Bus/Repair Serv	1,540	4.1%
Pers/Ent/Rec Serv	2,817	7.5%
Prof/Related Serv:		
Health	1,888	5.0%
Educational	3,280	8.8%
Other	1,444	3.9%
Public Admin	5,565	14.9%
Total	37,391	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	3,863	10.3%
Prof	4,794	12.8%
Tech/Admin/Sales:		
Tech	1,399	3.7%
Admin/Clerical	5,578	14.9%
Sales	4,515	12.1%
Service:		
Private Household	333	.9%
Protective Serv	614	1.6%
Other Serv	5,637	15.1%
Farm/Forest/Fish	755	2.0%
Prod/Craft/Repair	5,238	14.0%
Oper/Fabr/Labrs:		

Mach Operators	1,600	4.3%
Trans/Mat Moving	1,296	3.5%
Handlrs/Cleanrs/ Helprs/Labrs	1,769	4.7%
Total Employed	37,391	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	11,876	14.5%
Civ Labor Force:		
Employed	37,391	45.8%
Unemployed	3,447	4.2%
Not in Labor Force	28,917	35.4%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	43,361	89.6%
Public Trans	535	1.1%
Other	4,521	9.3%
Total	48,417	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	20,973	44.6%
15 - 29 Minutes	18,024	38.4%
30 - 59 Minutes	6,321	13.5%
60 + Minutes	1,673	3.6%
Total	46,991	100.0%
EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	13,391	22.6%
12 Years	24,546	41.4%
13 - 15 Years	11,550	19.5%
16 + Years	9,836	16.6%
Median Years Completed	12.6	
MARITAL STATUS		
Male:		
Single	12,240	28.8%
Married	26,425	62.2%
Separated	611	1.4%
Widowed	590	1.4%
Divorced	2,598	6.1%
Total	42,464	100.0%
Female:		
Single	7,544	18.3%
Married	26,259	63.7%
Separated	783	1.9%
Widowed	3,328	8.1%
Divorced	3,300	8.0%
Total	41,214	100.0%

WORKING MOTHERS:		
With Children under 6	3,359	19.8%
With Children 6 - 17	5,823	34.3%
Subtotal	9,182	54.1%
Non-Working Mothers	7,778	45.9%
Total	16,960	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	25,255	85.6%
Female Householder	3,463	11.7%
Male Householder	792	2.7%
Total	29,510	100.0%
HOUSEHOLDS WITH:		
Children Under 18	17,856	47.6%
Persons 65 and Over	4,801	12.8%
Householder 65 and Over	3,948	10.5%
Married Couple With Children	14,133	37.6%
Married Couple Without Children	11,371	30.2%
Female Householder With Children	2,400	6.4%
Female Householder Without Children	971	2.6%
Male Householder With Children	468	1.2%
Male Householder Without Children	351	.9%
Non-Families	7,914	21.0%
PERSONS PER HOUSEHOLD:		
1 Person	6,511	17.3%
2 Persons	11,667	31.1%
3 Persons	7,818	20.8%
4+ Persons	11,542	30.7%
Total Households	37,538	100.0%
Average Household Income	$18,369	
Per Capita Income	$6,462	
FAMILIES		
Total Families	29,510	
Average Family Size	3.3	
Average Family Income	$20,188	
Family Population	96,814	
Nonfamily Population	9,886	
Group Quarters Population	3,220	
HOUSING		
Median Home Value	$44,225	
Average Home Value	$49,942	
Median Monthly Rent	$173	
Average Monthly Rent	$181	

UNITS AT ADDRESS:

1 Unit	30,126	70.3%
2 - 9 Units	3,923	9.2%
10+ Units	4,273	10.0%
Mobile Home	4,512	10.5%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	9,816
Last 5 Years	21,420
6 - 9 Years Ago	4,568
10 - 14 Years Ago	2,943
15+ Years Ago	2,455
Socioeconomic Status Score	51
Private Sector Employment	22,203

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Table 3B: Bay County, FL

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	97,740	107,074	9.5%	116,683
Total Households	34,754	38,914	12.0%	42,751
Household Population	95,788	105,124	9.7%	114,733
Average Household Size	2.8	2.7	-1.8%	2.7
Median Household Income	$13,495	$16,816	24.6%	$20,908

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	97,740	100.0%	107,074	116,683
0 - 5	8,633	8.8%	8.7%	8.7%
6 - 13	12,499	12.8%	11.9%	11.2%
14 - 17	7,319	7.5%	6.5%	5.9%
18 - 24	13,276	13.6%	13.2%	11.6%
25 - 34	15,404	15.8%	16.6%	17.6%
35 - 44	11,511	11.8%	12.8%	13.8%
45 - 54	10,505	10.7%	10.1%	10.3%
55 - 64	9,336	9.6%	9.7%	9.3
65 +	9,257	9.5%	10.5%	11.6%
FEMALE POPULATION BY AGE	49,696	100.0%	54,554	59,549
0 - 5	4,160	8.4%	8.3%	8.3%
6 - 13	6,067	12.2%	11.3%	10.6%
14 - 17	3,523	7.1%	6.1%	5.5%
18 - 24	6,546	13.2%	12.4%	10.6%
25 - 34	7,645	15.4%	16.4%	17.5%
35 - 44	6,010	12.1%	13.0%	13.6%
45 - 54	5,426	10.9%	10.3%	10.7%
55 - 64	4,984	10.0%	10.3%	9.7%
65 +	5,335	10.7%	11.9%	13.5%
MALE POPULATION BY AGE	48,044	100.0%	52,520	57,134
0 - 5	4,473	9.3%	9.1%	9.1%
6 - 13	6,432	13.4%	12.6%	11.8%
14 - 17	3,796	7.9%	6.9%	6.3%
18 - 24	6,730	14.0%	14.1%	12.7%
25 - 34	7,759	16.1%	16.8%	17.8%
35 - 44	5,501	11.4%	12.6%	13.9%
45 - 54	5,079	10.6%	9.8%	9.8%
55 - 64	4,352	9.1%	9.2%	8.9%
65 +	3,922	8.2%	8.9%	9.6%
Median Age Total Population	29.3		30.5	31.[illegible]
Median Age Adult Population	40.1		40.1	40.7

TOTAL POPULATION	97,740	100.0%	107,074	116,683
White	83,799	85.7%	85.6%	85.1%
Black	11,681	12.0%	12.1%	12.4%
Other	2,260	2.3%	2.3%	2.5%
Spanish	1,537	1.6%	1.7%	2.0%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	9,245	26.6%	20.9%	15.6%
$ 7,500 - $ 9,999	3,535	10.2%	8.2%	6.1%
$10,000 - $14,999	6,620	19.0%	15.8%	12.3%
$15,000 - $24,999	8,729	25.1%	28.2%	27.2%
$25,000 - $34,999	4,036	11.6%	16.0%	20.8%
$35,000 - $49,999	1,747	5.0%	7.3%	12.2%
$50,000 - $74,999	635	1.8%	2.6%	4.1%
$75,000 +	271	.8%	1.1%	1.7%

	1980 Census Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	801	2.2%
Construction	3,032	8.3%
Manufacturing:		
Nondurable	1,945	5.3%
Durable	2,146	5.9%
Transportation	1,475	4.1%
Communications	1,346	3.7%
Wholesale Trade	1,458	4.0%
Retail Trade	8,078	22.2%
Fin/Ins/Real Est	2,171	6.0%
Bus/Repair Serv	1,295	3.6%
Pers/Ent/Rec Serv	2,607	7.2%
Prof/Related Serv:		
Health	2,339	6.4%
Educational	2,994	8.2%
Other	1,585	4.4%
Public Admin	3,084	8.5%
Total	36,356	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	3,964	10.9%
Prof	4,472	12.3%
Tech/Admin/Sales:		
Tech	1,008	2.8%
Admin/Clerical	5,739	15.8%
Sales	4,437	12.2%
Service:		
Private Household	237	.7%
Protective Serv	726	2.0%
Other Serv	4,759	13.1%
Farm/Forest/Fish	803	2.2%
Prod/Craft/Repair	4,575	12.6%

Oper/Fabr/Labrs:		
Mach Operators	2,066	5.7%
Trans/Mat Moving	1,716	4.7%
Handlrs/Cleanrs/ Helprs/Labrs	1,854	5.1%
Total Employed	36,356	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	4,687	6.4%
Civ Labor Force:		
Employed	36,356	49.9%
Unemployed	2,823	3.9%
Not in Labor Force	29,028	39.8%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	36,673	91.4%
Public Trans	211	.5%
Other	3,247	8.1%
Total	40,131	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	16,931	42.5%
15 - 29 Minutes	16,833	42.2%
30 - 59 Minutes	4,955	12.4%
60 + Minutes	1,162	2.9%
Total	39,881	100.0%
EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	19,152	34.2%
12 Years	20,027	35.7%
13 - 15 Years	9,466	16.9%
16 + Years	7,408	13.2%
Median Years Completed	12.4	
MARITAL STATUS		
Male:		
Single	9,046	24.9%
Married	23,681	65.3%
Separated	530	1.5%
Widowed	754	2.1%
Divorced	2,276	6.3%
Total	36,287	100.0%
Female:		
Single	6,553	16.9%
Married	23,660	61.2%
Separated	871	2.3%
Widowed	4,438	11.5%
Divorced	3,161	8.2%
Total	38,683	100.0%

WORKING MOTHERS:		
With Children under 6	2,861	20.5%
With Children 6 - 17	4,669	33.4%
Subtotal	7,530	53.9%
Non-Working Mothers	6,448	46.1%
Total	13,978	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	22,786	84.3%
Female Householder	3,498	12.9%
Male Householder	740	2.7%
Total	27,024	100.0%
HOUSEHOLDS WITH:		
Children Under 18	15,154	43.6%
Persons 65 and Over	6,853	19.7%
Householder 65 and Over	5,989	17.2%
Married Couple With Children	11,462	32.9%
Married Couple Without Children	11,419	32.8%
Female Householder With Children	2,232	6.4%
Female Householder Without Children	1,251	3.6%
Male Householder With Children	476	1.4%
Male Householder Without Children	420	1.2%
Non-Families	7,558	21.7%
PERSONS PER HOUSEHOLD:		
1 Person	6,736	19.4%
2 Persons	11,377	32.7%
3 Persons	6,841	19.7%
4+ Persons	9,800	28.2%
Total Households	34,754	100.0%

Average Household Income	$16,480
Per Capita Income	$5,979
FAMILIES	
Total Families	27,024
Average Family Size	3.2
Average Family Income	$18,557
Family Population	86,828
Nonfamily Population	8,960
Group Quarters Population	1,952
HOUSING	
Median Home Value	$35,476
Average Home Value	$39,852
Median Monthly Rent	$160
Average Monthly Rent	$163

UNITS AT ADDRESS:		
1 Unit	27,831	68.8%
2 - 9 Units	3,874	9.6%
10+ Units	3,662	9.1%
Mobile Home	5,059	12.5%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	7,179
Last 5 Years	19,270
6 - 9 Years Ago	4,651
10 - 14 Years Ago	3,144
15+ Years Ago	3,807
Socioeconomic Status Score	43
Private Sector Employment	21,713

Table 3C. Okaloosa County, FL

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	109,920	123,223	12.1%	137,636
Total Households	37,538	43,193	15.1%	48,812
Household Population	106,700	120,003	12.5%	134,416
Average Household Size	2.8	2.8	-2.1%	2.8
Median Household Income	$15,183	$19,768	30.2%	$26,037

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	109,920	100.0%	123,223	137,636
0 - 5	10,066	9.2%	8.9%	8.7%
6 - 13	14,221	12.9%	12.0%	11.3%
14 - 17	8,870	8.1%	6.7%	6.0%
18 - 24	17,445	15.9%	14.6%	12.2%
25 - 34	18,140	16.5%	17.9%	19.1%
35 - 44	14,264	13.0%	13.6%	14.2%
45 - 54	12,058	11.0%	10.5%	11.1%
55 - 64	8,483	7.7%	8.8%	9.2%
65 +	6,373	5.8%	6.8%	8.2%
FEMALE POPULATION BY AGE	54,113	100.0%	60,883	68,230
0 - 5	4,944	9.1%	8.9%	8.6%
6 - 13	6,976	12.9%	11.9%	11.2%
14 - 17	4,334	8.0%	6.5%	5.7%
18 - 24	7,756	14.3%	13.6%	11.3%
25 - 34	8,838	16.3%	17.2%	18.3%
35 - 44	7,322	13.5%	14.1%	14.3%
45 - 54	5,969	11.0%	10.8%	11.7%
55 - 64	4,253	7.9%	9.1%	9.5%
65 +	3,721	6.9%	7.9%	9.5%
MALE POPULATION BY AGE	55,807	100.0%	62,340	69,406
0 - 5	5,122	9.2%	9.0%	8.8%
6 - 13	7,245	13.0%	12.1%	11.4%
14 - 17	4,536	8.1%	6.9%	6.2%
18 - 24	9,689	17.4%	15.6%	13.1%
25 - 34	9,302	16.7%	18.6%	20.0%
35 - 44	6,942	12.4%	13.2%	14.1%
45 - 54	6,089	10.9%	10.3%	10.5%
55 - 64	4,230	7.6%	8.6%	8.9%
65 +	2,652	4.8%	5.8%	7.0%
Median Age Total Population	27.2		28.8	31.0
Median Age Adult Population	36.9		37.6	38.9

TOTAL POPULATION	109,920	100.0%	123,223	137,636
White	97,093	88.3%	87.6%	86.6%
Black	9,483	8.6%	9.3%	10.1
Other	3,344	3.0%	3.1%	3.3%
Spanish	2,577	2.3%	2.5%	3.0%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	7,570	20.1%	15.2%	10.5%
$ 7,500 - $ 9,999	3,892	10.3%	7.6%	5.3%
$10,000 - $14,999	7,156	19.0%	14.6%	10.1%
$15,000 - $24,999	10,109	26.9%	26.4%	21.6%
$25,000 - $34,999	5,270	14.0%	21.2%	23.6%
$35,000 - $49,999	2,504	6.7%	10.3%	19.1%
$50,000 - $74,999	808	2.1%	3.5%	7.4%
$75,000 +	299	.8%	1.2%	2.3%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	959	2.6%
Construction	2,998	8.0%
Manufacturing:		
Nondurable	989	2.6%
Durable	2,346	6.3%
Transportation	1,041	2.8%
Communications	1,221	3.3%
Wholesale Trade	912	2.4%
Retail Trade	8,173	21.9%
Fin/Ins/Real Est	2,218	5.9%
Bus/Repair Serv	1,540	4.1%
Pers/Ent/Rec Serv	2,817	7.5%
Prof/Related Serv:		
Health	1,888	5.0%
Educational	3,280	8.8%
Other	1,444	3.9%
Public Admin	5,565	14.9%
Total	37,391	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	3,863	10.3%
Prof	4,794	12.8%
Tech/Admin/Sales:		
Tech	1,399	3.7%
Admin/Clerical	5,578	14.9%
Sales	4,515	12.1%
Service:		
Private Household	333	.9%
Protective Serv	614	1.6%
Other Serv	5,637	15.1%
Farm/Forest/Fish	755	2.0%
Prod/Craft/Repair	5,238	14.0%

Oper/Fabr/Labrs:		
Mach Operators	1,600	4.3%
Trans/Mat Moving	1,296	3.5%
Handlrs/Cleanrs/ Helprs/Labrs	1,769	4.7%
Total Employed	37,391	100.0%

EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	11,876	14.5%
Civ Labor Force:		
Employed	37,391	45.8%
Unemployed	3,447	4.2%
Not in Labor Force	28,917	35.4%

MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	43,361	89.6%
Public Trans	535	1.1%
Other	4,521	9.3%
Total	48,417	100.0%

TRAVEL TIME TO WORK:		
0 - 14 Minutes	20,973	44.6%
15 - 29 Minutes	18,024	38.4%
30 - 59 Minutes	6,321	13.5%
60 + Minutes	1,673	3.6%
Total	46,991	100.0%

EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	13,391	22.6%
12 Years	24,546	41.4%
13 - 15 Years	11,550	19.5%
16 + Years	9,836	16.6%
Median Years Completed	12.6	

MARITAL STATUS		
Male:		
Single	12,240	28.8%
Married	26,425	62.2%
Separated	611	1.4%
Widowed	590	1.4%
Divorced	2,598	6.1%
Total	42,464	100.0%
Female:		
Single	7,544	18.3%
Married	26,259	63.7%
Separated	783	1.9%
Widowed	3,328	8.1%
Divorced	3,300	8.0%
Total	41,214	100.0%

Table 3D. Santa Rosa County, FL

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	55,988	62,134	11.0%	69,662
Total Households	18,595	21,094	13.4%	23,534
Household Population	54,706	60,852	11.2%	67,380
Average Household Size	2.9	2.9	-1.8%	2.9
Median Household Income	$15,101	$19,489	29.1%	$25,457

	1980 Census		1984	1989
	Number	Percent	Estimate	Projection
TOTAL POPULATION BY AGE	55,988	100.0%	62,134	68,662
0 - 5	5,089	9.1%	9.2%	9.0%
6 - 13	7,663	13.7%	12.3%	11.7%
14 - 17	4,648	8.3%	7.0%	6.2%
18 - 24	7,788	13.9%	14.2%	12.8%
25 - 34	9,086	16.2%	16.5%	17.0%
35 - 44	7,297	13.0%	13.8%	14.4%
45 - 54	5,835	10.4%	10.3%	11.2%
55 - 64	4,510	8.1%	8.8%	8.7
65 +	4,072	7.3%	7.9%	9.1%
FEMALE POPULATION BY AGE	27,887	100.0%	31,026	34,398
0 - 5	2,492	8.9%	9.0%	8.8%
6 - 13	3,675	13.2%	11.9%	11.4%
14 - 17	2,204	7.9%	6.7%	5.8%
18 - 24	3,655	13.1%	13.1%	11.6%
25 - 34	4,542	16.3%	16.5%	16.8%
35 - 44	3,755	13.5%	14.2%	14.6%
45 - 54	2,950	10.6%	10.5%	11.6%
55 - 64	2,296	8.2%	9.1%	9.0%
65 +	2,318	8.3%	9.0%	10.4%
MALE POPULATION BY AGE	28,101	100.0%	31,108	34,264
0 - 5	2,597	9.2%	9.4%	9.3%
6 - 13	3,988	14.2%	12.7%	12.0%
14 - 17	2,444	8.7%	7.3%	6.5%
18 - 24	4,133	14.7%	15.3%	14.0%
25 - 34	4,544	16.2%	16.4%	17.2%
35 - 44	3,542	12.6%	13.4%	14.1%
45 - 54	2,885	10.3%	10.0%	10.7%
55 - 64	2,214	7.9%	8.4%	8.4%
65 +	1,754	6.2%	6.9%	7.8%
Median Age Total Population	27.9		29.2	30.8
Median Age Adult Population	38.3		38.6	39.7

TOTAL POPULATION	55,988	100.0%	62,134	68,662
White	52,468	93.7%	93.8%	93.9%
Black	2,501	4.5%	4.4%	4.4%
Other	1,019	1.8%	1.7%	1.7%
Spanish	752	1.3%	1.5%	1.7%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	4,488	23.9%	17.9%	12.6%
$ 7,500 - $ 9,999	1,676	8.9%	6.6%	4.6%
$10,000 - $14,999	3,159	16.8%	12.8%	9.0%
$15,000 - $24,999	5,043	26.9%	28.4%	22.6%
$25,000 - $34,999	2,639	14.1%	20.0%	26.7%
$35,000 - $49,999	1,210	6.5%	9.9%	16.4%
$50,000 - $74,999	401	2.1%	3.4%	6.3%
$75,000 +	134	.7%	1.0%	1.7%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	900	4.4%
Construction	1,988	9.8%
Manufacturing:		
Nondurable	2,470	12.2%
Durable	764	3.8%
Transportation	887	4.4%
Communications	556	2.7%
Wholesale Trade	733	3.6%
Retail Trade	3,256	16.1%
Fin/Ins/Real Est	1,078	5.3%
Bus/Repair Serv	604	3.0%
Pers/Ent/Rec Serv	775	3.8%
Prof/Related Serv:		
Health	1,444	7.1%
Educational	2,062	10.2%
Other	790	3.9%
Public Admin	1,931	9.5%
Total	20,238	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	1,801	8.9%
Prof	2,579	12.7%
Tech/Admin/Sales:		
Tech	955	4.7%
Admin/Clerical	2,910	14.4%
Sales	2,020	10.0%
Service:		
Private Household	73	.4%
Protective Serv	363	1.8%
Other Serv	2,011	9.9%
Farm/Forest/Fish	528	2.6%
Prod/Craft/Repair	3,617	17.9%

Oper/Fabr/Labrs:		
Mach Operators	1,397	6.9%
Trans/Mat Moving	999	4.9%
Handlrs/Cleanrs/ Helprs/Labrs	985	4.9%
Total Employed	20,238	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	2,663	6.5%
Civ Labor Force:		
Employed	20,238	49.4%
Unemployed	1,723	4.2%
Not in Labor Force	16,351	39.9%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	20,169	90.4%
Public Trans	90	.4%
Other	2,047	9.2%
Total	22,306	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	7,769	35.3%
15 - 29 Minutes	7,215	32.8%
30 - 59 Minutes	5,665	25.8%
60 + Minutes	1,345	6.1%
Total	21,994	100.0%
EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	9,397	30.5%
12 Years	12,007	38.9%
13 - 15 Years	4,988	16.2%
16 + Years	4,451	14.4%
Median Years Completed	12.5	
MARITAL STATUS		
Male:		
Single	5,536	26.4%
Married	13,714	65.4%
Separated	232	1.1%
Widowed	361	1.7%
Divorced	1,114	5.3%
Total	20,957	100.0%
Female:		
Single	3,665	17.3%
Married	13,732	64.6%
Separated	400	1.9%
Widowed	1,957	9.2%
Divorced	1,488	7.0%
Total	21,242	100.0%

WORKING MOTHERS:		
With Children under 6	1,519	17.4%
With Children 6 - 17	2,856	32.7%
Subtotal	4,375	50.1%
Non-Working Mothers	4,363	49.9%
Total	8,738	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	13,289	86.1%
Female Householder	1,758	11.4%
Male Householder	379	2.5%
Total	15,426	100.0%
HOUSEHOLDS WITH:		
Children Under 18	9,262	49.8%
Persons 65 and Over	3,051	16.4%
Householder 65 and Over	2,624	14.1%
Married Couple With Children	7,501	40.0%
Married Couple Without Children	6,034	32.2%
Female Householder With Children	1,205	6.4%
Female Householder Without Children	565	3.0%
Male Householder With Children	215	1.1%
Male Householder Without Children	135	.7%
Non-Families	3,095	16.5%
PERSONS PER HOUSEHOLD:		
1 Person	2,760	14.8%
2 Persons	5,677	30.5%
3 Persons	3,904	21.0%
4+ Persons	6,254	33.6%
Total Households	18,595	100.0%
Average Household Income	$17,807	
Per Capita Income	$6,053	
FAMILIES		
Total Families	15,426	
Average Family Size	3.3	
Average Family Income	$19,480	
Family Population	51,020	
Nonfamily Population	3,686	
Group Quarters Population	1,282	
HOUSING		
Median Home Value	$39,269	
Average Home Value	$45,096	
Median Monthly Rent	$159	
Average Monthly Rent	$165	

UNITS AT ADDRESS:		
1 Unit	16,312	80.7%
2 - 9 Units	1,129	5.6%
10+ Units	366	1.8%
Mobile Home	2,401	11.9%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	3,372
Last 5 Years	10,003
6 - 9 Years Ago	2,093
10 - 14 Years Ago	1,518
15+ Years Ago	861
Socioeconomic Status Score	46
Private Sector Employment	4,455

Table 3E. Walton County, FL

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	21,300	24,840	16.6%	28,848
Total Households	8,043	9,649	20.0%	11,348
Household Population	21,196	24,736	16.7%	28,744
Average Household Size	2.6	2.6	-2.6%	2.5
Median Household Income	$10,774	$14,026	30.2%	$18,258

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	21,300	100.0%	24,840	28,848
0 - 5	1,645	7.7%	7.9%	8.1%
6 - 13	2,568	12.1%	10.9%	10.4%
14 - 17	1,499	7.0%	6.2%	5.5%
18 - 24	2,149	10.1%	11.4%	10.7%
25 - 34	2,620	12.3%	12.7%	14.6%
35 - 44	2,250	10.6%	11.4%	11.8%
45 - 54	2,498	11.7%	10.5%	10.1%
55 - 64	2,676	12.6%	12.0%	10.8%
65 +	3,395	15.9%	17.0%	18.0%
FEMALE POPULATION BY AGE	10,959	100.0%	12,837	14,957
0 - 5	804	7.3%	7.5%	7.6%
6 - 13	1,236	11.3%	10.4%	9.9%
14 - 17	722	6.6%	5.7%	5.2%
18 - 24	1,098	10.0%	10.6%	9.8%
25 - 34	1,327	12.1%	12.7%	14.1%
35 - 44	1,149	10.5%	11.2%	11.6%
45 - 54	1,315	12.0%	10.6%	10.0%
55 - 64	1,407	12.8%	12.2%	11.2%
65 +	1,901	17.3%	19.0%	20.4%
MALE POPULATION BY AGE	10,341	100.0%	12,003	13,891
0 - 5	841	8.1%	8.3%	8.6%
6 - 13	1,332	12.9%	11.5%	11.0%
14 - 17	777	7.5%	6.7%	5.8%
18 - 24	1,051	10.2%	12.2%	11.6%
25 - 34	1,293	12.5%	12.8%	15.0%
35 - 44	1,101	10.6%	11.6%	12.0%
45 - 54	1,183	11.4%	10.4%	10.1%
55 - 64	1,269	12.3%	11.7%	10.4%
65 +	1,494	14.4%	14.9%	15.4%
Median Age Total Population	35.7		35.7	35.6
Median Age Adult Population	48.0		46.8	45.9

TOTAL POPULATION	21,300	100.0%	24,840	28,848
White	18,910	88.8%	88.9%	88.8
Black	2,051	9.6%	9.5%	9.5%
Other	339	1.6%	1.6%	1.7%
Spanish	173	.8%	.9%	1.0%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	2,911	35.7%	28.0%	20.9%
$ 7,500 - $ 9,999	950	11.6%	9.1%	6.8%
$10,000 - $14,999	1,413	17.3%	15.9%	11.9%
$15,000 - $24,999	1,832	22.4%	29.0%	31.9%
$25,000 - $34,999	715	8.8%	12.1%	19.3%
$35,000 - $49,999	201	2.5%	3.4%	5.6%
$50,000 - $74,999	78	1.0%	1.3%	1.9%
$75,000 +	62	.8%	1.1%	1.7%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	453	6.5%
Construction	765	10.9%
Manufacturing:		
Nondurable	691	9.9%
Durable	376	5.4%
Transportation	351	5.0%
Communications	261	3.7%
Wholesale Trade	325	4.6%
Retail Trade	1,023	14.6%
Fin/Ins/Real Est	314	4.5%
Bus/Repair Serv	238	3.4%
Pers/Ent/Rec Serv	272	3.9%
Prof/Related Serv:		
Health	270	3.9%
Educational	705	10.1%
Other	230	3.3%
Public Admin	725	10.4%
Total	6,999	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	549	7.8%
Prof	706	10.1%
Tech/Admin/Sales:		
Tech	175	2.5%
Admin/Clerical	900	12.9%
Sales	558	8.0%
Service:		
Private Household	24	.3%
Protective Serv	129	1.8%
Other Serv	748	10.7%
Farm/Forest/Fish	407	5.8%
Prod/Craft/Repair	1,214	17.3%

Oper/Fabr/Labrs:		
Mach Operators	562	8.0%
Trans/Mat Moving	595	8.5%
Handlrs/Cleanrs/ Helprs/Labrs	432	6.2%
Total Employed	6,999	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	195	1.2%
Civ Labor Force:		
Employed	6,999	42.8%
Unemployed	435	2.7%
Not in Labor Force	8,707	53.3%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	6,320	90.3%
Public Trans	43	.6%
Other	638	9.1%
Total	7,001	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	2,807	40.5%
15 - 29 Minutes	1,638	23.7%
30 - 59 Minutes	1,619	23.4%
60 + Minutes	861	12.4%
Total	6,925	100.0%
.DUCATION OF ADULTS OVER 25,		
YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	6,616	49.2%
12 Years	4,089	30.4%
13 - 15 Years	1,447	10.8%
16 + Years	1,290	9.6%
Median Years Completed	12.0	
MARITAL STATUS		
Male:		
Single	1,700	21.3%
Married	5,412	67.7%
Separated	120	1.5%
Widowed	271	3.4%
Divorced	492	6.2%
Total	7,995	100.0%
Female:		
Single	1,206	13.8%
Married	5,447	62.3%
Separated	162	1.9%
Widowed	1,369	15.7%
Divorced	558	6.4%
Total	8,742	100.0%

WORKING MOTHERS:		
With Children under 6	516	18.5%
With Children 6 - 17	863	31.0%
Subtotal	1,379	49.6%
Non-Working Mothers	1,404	50.4%
Total	2,783	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	5,237	84.8%
Female Householder	759	12.3%
Male Householder	180	2.9%
Total	6,176	100.0%
HOUSEHOLDS WITH:		
Children Under 18	2,973	37.0%
Persons 65 and Over	2,513	31.2%
Householder 65 and Over	2,283	28.4%
Married Couple With Children	2,382	29.2%
Married Couple Without Children	3,055	37.4%
Female Householder With Children	377	4.6%
Female Householder Without Children	334	4.1%
Male Householder With Children	55	.7%
Male Householder Without Children	78	1.0%
Non-Families	1,881	23.0%
PERSONS PER HOUSEHOLD:		
1 Person	1,767	22.0%
2 Persons	2,884	35.9%
3 Persons	1,379	17.1%
4+ Persons	2,013	25.0%
Total Households	8,043	100.0%
Average Household Income	$13,903	
Per Capita Income	$5,276	
FAMILIES		
Total Families	6,176	
Average Family Size	3.1	
Average Family Income	$15,672	
Family Population	19,212	
Nonfamily Population	1,984	
Group Quarters Population	104	
HOUSING		
Median Home Value	$25,121	
Average Home Value	$31,577	
Median Monthly Rent	$89	
Average Monthly Rent	$99	

UNITS AT ADDRESS:

1 Unit	7,999	76.8%
2 - 9 Units	755	7.3%
10+ Units	289	2.8%
Mobile Home	1,370	13.2%

1984 Estimate

NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	1,412
Last 5 Years	3,054
6 - 9 Years Ago	567
10 - 14 Years Ago	537
15+ Years Ago	459
Socioeconomic Status Score	30
Private Sector Employment	2,642

Table 3F. Destin City, FL

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	3,672	4,060	10.6%	4,334
Total Households	1,421	1,610	13.3%	1,744
Household Population	3,665	4,050	10.5%	4,324
Average Household Size	2.6	2.5	-2.3%	2.5
Median Household Income	$18,810	$25,260	34.3%	$35,111

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	3,672	100.0%	4,060	4,334
0 - 5	248	6.8%	6.5%	6.3%
6 - 13	416	11.3%	9.7%	8.7%
14 - 17	255	6.9%	5.8%	4.9%
18 - 24	408	11.1%	11.2%	10.1%
25 - 34	569	15.5%	15.3%	15.7%
35 - 44	504	13.7%	14.8%	14.9%
45 - 54	502	13.7%	12.6%	12.8%
55 - 64	473	12.9%	13.4%	12.4%
65 +	297	8.1%	10.7%	14.2%
FEMALE POPULATION BY AGE	1,822	100.0%	2,030	2,186
0 - 5	123	6.8%	6.3%	6.1%
6 - 13	199	10.9%	9.3%	8.4%
14 - 17	121	6.6%	5.6%	4.7%
18 - 24	185	10.2%	10.5%	9.7%
25 - 34	291	16.0%	14.8%	14.4%
35 - 44	258	14.2%	15.4%	15.3%
45 - 54	253	13.9%	12.8%	13.1%
55 - 64	242	13.3%	13.8%	12.7%
65 +	150	8.2%	11.4%	15.6%
MALE POPULATION BY AGE	1,850	100.0%	2,030	2,148
0 - 5	125	6.8%	6.7%	6.6%
6 - 13	217	11.7%	10.1%	9.0%
14 - 17	134	7.2%	5.9%	5.2%
18 - 24	223	12.1%	11.9%	10.4%
25 - 34	278	15.0%	15.7%	17.0%
35 - 44	246	13.3%	14.2%	14.5%
45 - 54	249	13.5%	12.4%	12.4%
55 - 64	231	12.5%	13.0%	12.2%
65 +	147	7.9%	10.1%	12.8%
Median Age Total Population	33.9		36.0	37.8
Median Age Adult Population	42.9		43.4	44.5

TOTAL POPULATION	3,672	100.0%	4,060	4,334
White	3,638	99.1%	99.2%	99.3%
Black	5	.1%	.1%	.1%
Other	29	.8%	.7%	.6%
Spanish	30	.8%	.9%	1.0%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	227	16.4%	12.4%	8.1%
$ 7,500 - $ 9,999	84	6.1%	4.2%	2.8%
$10,000 - $14,999	233	16.8%	12.4%	8.1%
$15,000 - $24,999	391	28.2%	20.4%	13.4%
$25,000 - $34,999	237	17.1%	26.3%	17.3%
$35,000 - $49,999	134	9.7%	15.1%	30.8%
$50,000 - $74,999	76	5.5%	8.8%	18.1%
$75,000 +	6	.4%	.6%	1.3%

	1980 Census Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	101	5.9%
Construction	142	8.3%
Manufacturing:		
Nondurable	29	1.7%
Durable	83	4.9%
Transportation	94	5.5%
Communications	54	3.2%
Wholesale Trade	46	2.7%
Retail Trade	336	19.7%
Fin/Ins/Real Est	222	13.0%
Bus/Repair Serv	72	4.2%
Pers/Ent/Rec Serv	214	12.6%
Prof/Related Serv:		
Health	59	3.5%
Educational	88	5.2%
Other	77	4.5%
Public Admin	86	5.0%
Total	1,703	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	265	15.6%
Prof	164	9.6%
Tech/Admin/Sales:		
Tech	53	3.1%
Admin/Clerical	208	12.2%
Sales	299	17.6%
Service:		
Private Household	3	.2%
Protective Serv	17	1.0%
Other Serv	220	12.9%
Farm/Forest/Fish	83	4.9%
Prod/Craft/Repair	217	12.7%

Oper/Fabr/Labrs:		
Mach Operators	60	3.5%
Trans/Mat Moving	102	6.0%
Handlrs/Cleanrs/		
Helprs/Labrs	12	.7%
Total Employed	1,703	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	64	2.2%
Civ Labor Force:		
Employed	1,703	58.7%
Unemployed	73	2.5%
Not in Labor Force	1,061	36.6%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	1,578	91.1%
Public Trans	0	.0%
Other	155	8.9%
Total	1,733	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	679	43.8%
15 - 29 Minutes	558	36.0%
30 - 59 Minutes	280	18.1%
60 + Minutes	34	2.2%
Total	1,551	100.0%
EDUCATION OF ADULTS OVER 25,		
YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	376	16.2%
12 Years	906	39.2%
13 - 15 Years	603	26.1%
16 + Years	429	18.5%
Median Years Completed	12.8	
MARITAL STATUS		
Male:		
Single	346	23.3%
Married	1,017	68.5%
Separated	18	1.2%
Widowed	19	1.3%
Divorced	84	5.7%
Total	1,484	100.0%
Female:		
Single	191	12.9%
Married	1,016	68.7%
Separated	20	1.4%
Widowed	121	8.2%
Divorced	130	8.8%
Total	1,478	100.0%

WORKING MOTHERS:		
With Children under 6	99	19.3%
With Children 6 - 17	222	43.4%
Subtotal	321	62.7%
Non-Working Mothers	191	37.3%
Total	512	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	980	89.3%
Female Householder	95	8.7%
Male Householder	22	2.0%
Total	1,097	100.0%
HOUSEHOLDS WITH:		
Children Under 18	517	36.4%
Persons 65 and Over	226	15.9%
Householder 65 and Over	199	14.0%
Married Couple With Children	447	32.2%
Married Couple Without Children	520	37.5%
Female Householder With Children	41	3.0%
Female Householder Without Children	45	3.2%
Male Householder With Children	0	.0%
Male Householder Without Children	5	.4%
Non-Families	330	23.8%
PERSONS PER HOUSEHOLD:		
1 Person	154	1.8%
2 Persons	3,265	38.5%
3 Persons	3,978	46.9%
4+ Persons	1,087	12.8%
Total Households	8,484	100.0%
Average Household Income	$20,723	
Per Capita Income	$8,035	
FAMILIES		
Total Families	1,097	
Average Family Size	3.0	
Average Family Income	$22,843	
Family Population	3,296	
Nonfamily Population	369	
Group Quarters Population	7	
HOUSING		
Median Home Value	$59,099	
Average Home Value	$64,706	
Median Monthly Rent	$202	
Average Monthly Rent	$221	

UNITS AT ADDRESS:		
1 Unit	1,310	40.3%
2 - 9 Units	153	4.7%
10+ Units	1,622	49.9%
Mobile Home	166	5.1%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	1,518
Last 5 Years	2,248
6 - 9 Years Ago	293
10 - 14 Years Ago	29
15+ Years Ago	11
Socioeconomic Status Score	64
Private Sector Employment	3,580

Table 36. Ft. Walton City, FL

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	20,829	23,250	11.6%	25,396
Total Households	7,140	8,336	16.8%	9,232
Household Population	20,580	23,001	11.8%	25,147
Average Household Size	2.9	2.8	-4.1%	2.7
Median Household Income	$17,166	$20,973	22.2%	$27,170

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	20,829	100.0%	23,250	25,396
0 - 5	1,477	7.1%	7.4%	7.2%
6 - 13	2,702	13.0%	10.7%	9.8%
14 - 17	2,005	9.6%	6.8%	5.4%
18 - 24	2,733	13.1%	14.6%	11.7%
25 - 34	2,827	13.6%	16.0%	19.3%
35 - 44	2,840	13.6%	13.3%	13.3%
45 - 54	2,838	13.6%	12.2%	12.0%
55 - 64	2,044	9.8%	11.0%	11.4%
65 +	1,363	6.5%	7.9%	10.0%
FEMALE POPULATION BY AGE	10,614	100.0%	11,807	12,936
0 - 5	734	6.9%	7.1%	6.9%
6 - 13	1,321	12.4%	10.4%	9.5%
14 - 17	990	9.3%	6.6%	5.2%
18 - 24	1,291	12.2%	14.0%	11.3%
25 - 34	1,442	13.6%	15.1%	18.0%
35 - 44	1,557	14.7%	14.1%	13.4%
45 - 54	1,459	13.7%	12.6%	12.9%
55 - 64	1,000	9.4%	11.2%	11.7%
65 +	820	7.7%	8.9%	11.1%
MALE POPULATION BY AGE	10,215	100.0%	11,443	12,460
0 - 5	743	7.3%	7.6%	7.5%
6 - 13	1,381	13.5%	11.1%	10.0%
14 - 17	1,015	9.9%	7.0%	5.7%
18 - 24	1,442	14.1%	15.3%	12.0%
25 - 34	1,385	13.6%	16.9%	20.6%
35 - 44	1,283	12.6%	12.5%	13.2%
45 - 54	1,379	13.5%	11.7%	11.0%
55 - 64	1,044	10.2%	10.8%	11.1%
65 +	543	5.3%	6.9%	8.8%
dian Age Total Population	29.9		31.0	33.0
Median Age Adult Population	41.2		40.1	40.8

TOTAL POPULATION	20,829	100.0%	23,250	25,396
White	17,521	84.1%	83.6%	81.5
Black	2,618	12.6%	12.9%	14.7%
Other	690	3.3%	3.5%	3.8%
Spanish	400	1.9%	2.1%	2.5%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	1,285	17.8%	14.8%	10.5%
$ 7,500 - $ 9,999	601	8.3%	6.3%	4.5%
$10,000 - $14,999	1,288	17.9%	14.5%	10.2%
$15,000 - $24,999	1,985	27.5%	24.0%	20.0%
$25,000 - $34,999	1,145	15.9%	21.4%	22.3%
$35,000 - $49,999	640	8.9%	13.2%	20.6%
$50,000 - $74,999	187	2.6%	4.3%	X] 9.2%
$75,000 +	78	1.1%	1.4%	2.8%

	1980 Census Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	106	1.3%
Construction	460	5.6%
Manufacturing:		
Nondurable	106	1.3%
Durable	496	6.0%
Transportation	228	2.8%
Communications	196	2.4%
Wholesale Trade	119	1.4%
Retail Trade	2,008	24.4%
Fin/Ins/Real Est	524	6.4%
Bus/Repair Serv	481	5.8%
Pers/Ent/Rec Serv	871	10.6%
Prof/Related Serv:		
Health	483	5.9%
Educational	598	7.3%
Other	354	4.3%
Public Admin	1,216	14.7%
Total	8,246	100.0%

OCCUPATION:		
Mgr/Prof:		
Mgr	894	10.8%
Prof	1,050	12.7%
Tech/Admin/Sales:		
Tech	316	3.8%
Admin/Clerical	1,175	14.2%
Sales	1,071	13.0%
Service:		
Private Household	119	1.4%
Protective Serv	161	2.0%
Other Serv	1,370	16.6%
Farm/Forest/Fish	111	1.3%
Prod/Craft/Repair	1,091	13.2%

Oper/Fabr/Labrs:		
Mach Operators	348	4.2%
Trans/Mat Moving	201	2.4%
Handlrs/Cleanrs/ Helprs/Labrs	339	4.1%
Total Employed	8,246	100.0%

EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	1,220	7.7%
Civ Labor Force:		
Employed	8,246	52.1%
Unemployed	770	4.9%
Not in Labor Force	5,589	35.3%

MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	8,651	92.7%
Public Trans	59	.6%
Other	627	6.7%
Total	9,337	100.0%

TRAVEL TIME TO WORK:		
0 - 14 Minutes	4,667	50.5%
15 - 29 Minutes	3,313	35.9%
30 - 59 Minutes	1,100	11.9%
60 + Minutes	153	1.7%
Total	9,233	100.0%

EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	2,504	21.0%
12 Years	4,851	40.7%
13 - 15 Years	2,365	19.9%
16 + Years	2,188	18.4%
Median Years Completed	12.7	

MARITAL STATUS		
Male:		
Single	2,327	29.6%
Married	4,862	61.8%
Separated	120	1.5%
Widowed	140	1.8%
Divorced	418	5.3%
Total	7,867	100.0%
Female:		
Single	1,751	21.0%
Married	4,924	59.0%
Separated	181	2.2%
Widowed	763	9.1%
Divorced	724	8.7%
Total	8,343	100.0%

WORKING MOTHERS:		
With Children under 6	634	20.0%
With Children 6 - 17	1,357	42.8%
Subtotal	1,991	62.7%
Non-Working Mothers	1,182	37.3%
Total	3,173	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	4,701	82.9%
Female Householder	800	14.1%
Male Householder	171	3.0%
Total	5,672	100.0%
HOUSEHOLDS WITH:		
Children Under 18	3,287	46.0%
Persons 65 and Over	911	12.8%
Householder 65 and Over	720	10.1%
Married Couple With Children	2,501	34.7%
Married Couple Without Children	2,347	32.6%
Female Householder With Children	621	8.6%
Female Householder Without Children	218	3.0%
Male Householder With Children	64	.9%
Male Householder Without Children	88	1.2%
Non-Families	1,370	19.0%
PERSONS PER HOUSEHOLD:		
1 Person	634	9.5%
2 Persons	607	9.1%
3 Persons	547	8.2%
4+ Persons	4,888	73.2%
Total Households	6,676	100.0%
Average Household Income	$20,635	
Per Capita Income	$7,159	
FAMILIES		
Total Families	5,672	
Average Family Size	3.3	
Average Family Income	$23,020	
Family Population	18,779	
Nonfamily Population	1,801	
Group Quarters Population	249	
HOUSING		
Median Home Value	$44,902	
Average Home Value	$51,263	
Median Monthly Rent	$183	
Average Monthly Rent	$188	

UNITS AT ADDRESS:

1 Unit	6,401	84.9%
2 - 9 Units	547	7.3%
10+ Units	524	7.0%
Mobile Home	65	.9%

1984 Estimate

NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	1,433
Last 5 Years	3,622
6 - 9 Years Ago	1,066
10 - 14 Years Ago	886
15+ Years Ago	771
Socioeconomic Status Score	54
Private Sector Employment	6,912

Table 3H. Pensacola City, FL

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	57,619	58,574	1.7%	57,894
Total Households	21,641	22,696	4.9%	22,567
Household Population	56,903	57,706	1.4%	57,026
Average Household Size	2.6	2.5	-3.1%	2.5
Median Household Income	$14,307	$17,974	25.6%	$23,488

	1980 Census		1984	1989
	Number	Percent	Estimate	Projection
TOTAL POPULATION BY AGE	57,619	100.0%	58,574	57,894
0 - 5	4,495	7.8%	7.8%	7.9%
6 - 13	6,825	11.8%	10.6%	10.3%
14 - 17	4,111	7.1%	5.9%	5.3%
18 - 24	7,059	12.3%	12.0%	10.3%
25 - 34	8,697	15.1%	16.4%	17.0%
35 - 44	6,010	10.4%	12.2%	14.4%
45 - 54	6,380	11.1%	10.0%	9.8%
55 - 64	6,420	11.1%	10.8%	10.0
65 +	7,622	13.2%	14.3%	15.0%
FEMALE POPULATION BY AGE	30,992	100.0%	31,409	30,895
0 - 5	2,205	7.1%	7.1%	7.2%
6 - 13	3,441	11.1%	9.8%	9.4%
14 - 17	2,004	6.5%	5.6%	4.9%
18 - 24	3,639	11.7%	11.3%	9.7%
25 - 34	4,571	14.7%	15.9%	16.5%
35 - 44	3,265	10.5%	12.1%	14.2%
45 - 54	3,512	11.3%	10.2%	10.0%
55 - 64	3,525	11.4%	11.2%	10.5%
65 +	4,830	15.6%	16.8%	17.7%
MALE POPULATION BY AGE	26,627	100.0%	27,165	26,999
0 - 5	2,290	8.6%	8.6%	8.7%
6 - 13	3,384	12.7%	11.6%	11.3%
14 - 17	2,107	7.9%	6.4%	5.7%
18 - 24	3,420	12.8%	12.7%	11.0%
25 - 34	4,126	15.5%	16.9%	17.6%
35 - 44	2,745	10.3%	12.3%	14.7%
45 - 54	2,868	10.8%	9.7%	9.6%
55 - 64	2,895	10.9%	10.3%	9.4%
65 +	2,792	10.5%	11.4%	12.0%
Median Age Total Population	32.1		33.2	34.5
Median Age Adult Population	43.8		42.7	42.6

TOTAL POPULATION	57,619	100.0%	58,574	57,894
White	36,916	64.1%	62.9%	61.6%
Black	19,537	33.9%	34.7%	35.6%
Other	1,166	2.0%	2.4%	2.8%
Spanish	802	1.4%	1.5%	1.7%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	5,925	27.3%	20.5%	14.4%
$ 7,500 - $ 9,999	1,858	8.6%	7.2%	5.0%
$10,000 - $14,999	3,558	16.4%	14.8%	11.4%
$15,000 - $24,999	5,314	24.5%	25.1%	22.6%
$25,000 - $34,999	2,739	12.6%	15.3%	17.3%
$35,000 - $49,999	1,562	7.2%	11.6%	18.0%
$50,000 - $74,999	497	2.3%	3.8%	8.0%
$75,000 +	245	1.1%	1.7%	3.3%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	311	1.4%
Construction	1,186	5.3%
Manufacturing:		
Nondurable	1,465	6.6%
Durable	634	2.8%
Transportation	1,046	4.7%
Communications	870	3.9%
Wholesale Trade	804	3.6%
Retail Trade	4,106	18.4%
Fin/Ins/Real Est	1,378	6.2%
Bus/Repair Serv	792	3.5%
Pers/Ent/Rec Serv	1,614	7.2%
Prof/Related Serv:		
Health	2,230	10.0%
Educational	2,532	11.3%
Other	1,094	4.9%
Public Admin	2,290	10.2%
Total	22,352	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	2,664	11.9%
Prof	3,782	16.9%
Tech/Admin/Sales:		
Tech	820	3.7%
Admin/Clerical	3,458	15.5%
Sales	2,728	12.2%
Service:		
Private Household	565	2.5%
Protective Serv	307	1.4%
Other Serv	3,154	14.1%
Farm/Forest/Fish	231	1.0%
Prod/Craft/Repair	1,879	8.4%

Oper/Fabr/Labrs:		
Mach Operators	830	3.7%
Trans/Mat Moving	814	3.6%
Handlrs/Cleanrs/		
Helprs/Labrs	1,120	5.0%
Total Employed	22,352	100.0%

EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	1,195	2.7%
Civ Labor Force:		
Employed	22,352	50.3%
Unemployed	1,672	3.8%
Not in Labor Force	19,218	43.2%

MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	20,837	91.2%
Public Trans	713	3.1%
Other	1,305	5.7%
Total	22,855	100.0%

TRAVEL TIME TO WORK:		
0 - 14 Minutes	7,919	34.4%
15 - 29 Minutes	10,569	45.9%
30 - 59 Minutes	3,998	17.4%
60 + Minutes	552	2.4%
Total	23,038	100.0%

EDUCATION OF ADULTS OVER 25,		
YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	10,900	31.0%
12 Years	10,788	30.7%
13 - 15 Years	6,256	17.8%
16 + Years	7,198	20.5%
Median Years Completed	12.6	

MARITAL STATUS		
Male:		
Single	6,071	29.6%
Married	11,850	57.9%
Separated	438	2.1%
Widowed	678	3.3%
Divorced	1,445	7.1%
Total	20,482	100.0%
Female:		
Single	5,523	22.2%
Married	11,915	47.9%
Separated	996	4.0%
Widowed	3,977	16.0%
Divorced	2,480	10.0%
Total	24,891	100.0%

WORKING MOTHERS:		
With Children under 6	1,332	18.2%
With Children 6 - 17	2,656	36.2%
Subtotal	3,988	54.4%
Non-Working Mothers	3,346	45.6%
Total	7,334	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	11,379	74.4%
Female Householder	3,441	22.5%
Male Householder	469	3.1%
Total	15,289	100.0%
HOUSEHOLDS WITH:		
Children Under 18	7,858	36.3%
Persons 65 and Over	5,634	26.0%
Householder 65 and Over	4,974	23.0%
Married Couple With Children	5,077	23.4%
Married Couple Without Children	6,405	29.5%
Female Householder With Children	1,915	8.8%
Female Householder Without Children	1,521	7.0%
Male Householder With Children	144	.7%
Male Householder Without Children	318	1.5%
Non-Families	6,318	29.1%
PERSONS PER HOUSEHOLD:		
1 Person	1,704	7.1%
2 Persons	3,163	13.2%
3 Persons	2,803	11.7%
4+ Persons	16,258	67.9%
Total Households	23,928	100.0%
Average Household Income	$18,178	
Per Capita Income	$6,913	
FAMILIES		
Total Families	15,289	
Average Family Size	3.2	
Average Family Income	$21,392	
Family Population	49,342	
Nonfamily Population	7,561	
Group Quarters Population	716	
HOUSING		
Median Home Value	$37,753	
Average Home Value	$43,075	
Median Monthly Rent	$157	
Average Monthly Rent	$161	

UNITS AT ADDRESS:		
1 Unit	19,480	83.6%
2 - 9 Units	1,718	7.4%
10+ Units	2,016	8.7%
Mobile Home	75	.3%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	3,643
Last 5 Years	9,667
6 - 9 Years Ago	2,811
10 - 14 Years Ago	2,208
15+ Years Ago	3,679
Socioeconomic Status Score	49
Private Sector Employment	20,301

Table 3I. Wright City, FL

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	13,011	15,615	20.0%	18,556
Total Households	4,987	5,987	20.1%	7,174
Household Population	12,990	15,599	20.1%	18,540
Average Household Size	2.6	2.6	.0%	2.6
Median Household Income	$13,538	$18,093	33.6%	$25,021

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	13,011	100.0%	15,615	18,556
0 - 5	1,328	10.2%	9.4%	9.0%
6 - 13	1,549	11.9%	12.0%	11.9%
14 - 17	897	6.9%	6.1%	5.6%
18 - 24	2,632	20.2%	14.2%	10.3%
25 - 34	2,371	18.2%	21.1%	22.1%
35 - 44	1,553	11.9%	13.4%	14.9%
45 - 54	1,294	9.9%	10.2%	10.6%
55 - 64	808	6.2%	8.1%	8.8%
65 +	579	4.5%	5.5%	6.9%
FEMALE POPULATION BY AGE	6,492	100.0%	7,836	9,330
0 - 5	661	10.2%	9.2%	8.7%
6 - 13	770	11.9%	11.9%	11.8%
14 - 17	429	6.6%	5.9%	5.5%
18 - 24	1,250	19.3%	13.6%	9.9%
25 - 34	1,159	17.9%	20.3%	21.1%
35 - 44	809	12.5%	13.8%	14.7%
45 - 54	626	9.6%	10.5%	11.2%
55 - 64	438	6.7%	8.4%	9.0%
65 +	350	5.4%	6.4%	8.0%
MALE POPULATION BY AGE	6,519	100.0%	7,779	9,226
0 - 5	667	10.2%	9.5%	9.2%
6 - 13	779	11.9%	12.2%	12.0%
14 - 17	468	7.2%	6.3%	5.7%
18 - 24	1,382	21.2%	14.8%	10.6%
25 - 34	1,212	18.6%	21.9%	23.1%
35 - 44	744	11.4%	13.0%	15.1%
45 - 54	668	10.2%	9.9%	10.0%
55 - 64	370	5.7%	7.8%	8.6%
65 +	229	3.5%	4.6%	5.7%
edian Age Total Population	25.3		28.3	31.2
Median Age Adult Population	33.1		35.7	37.9

TOTAL POPULATION	13,011	100.0%	15,615	18,556
White	11,472	88.2%	85.1%	83.6%
Black	1,146	8.8%	12.1%	13.5%
Other	393	3.0%	2.8%	2.9%
Spanish	280	2.2%	2.3%	2.6%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	1,199	23.9%	17.5%	12.9%
$ 7,500 - $ 9,999	593	11.8%	9.0%	6.6%
$10,000 - $14,999	1,013	20.2%	15.7%	11.6%
$15,000 - $24,999	1,173	23.4%	25.1%	18.8%
$25,000 - $34,999	742	14.8%	21.7%	32.9%
$35,000 - $49,999	215	4.3%	7.1%	11.2%
$50,000 - $74,999	67	1.3%	2.9%	4.5%
$75,000 +	17	.3%	1.0%	1.6%

	1980 Census Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	39	.8%
Construction	393	8.5%
Manufacturing:		
Nondurable	124	2.7%
Durable	349	7.5%
Transportation	134	2.9%
Communications	223	4.8%
Wholesale Trade	91	2.0%
Retail Trade	1,186	25.5%
Fin/Ins/Real Est	187	4.0%
Bus/Repair Serv	283	6.1%
Pers/Ent/Rec Serv	425	9.2%
Prof/Related Serv:		
Health	189	4.1%
Educational	235	5.1%
Other	182	3.9%
Public Admin	604	13.0%
Total	4,644	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	516	11.1%
Prof	595	12.8%
Tech/Admin/Sales:		
Tech	104	2.2%
Admin/Clerical	714	15.4%
Sales	538	11.6%
Service:		
Private Household	27	.6%
Protective Serv	82	1.8%
Other Serv	800	17.2%
Farm/Forest/Fish	49	1.1%
Prod/Craft/Repair	633	13.6%

Oper/Fabr/Labrs:		
Mach Operators	203	4.4%
Trans/Mat Moving	169	3.6%
Handlrs/Cleanrs/ Helprs/Labrs	214	4.6%
Total Employed	4,644	100.0%

EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	1,573	16.2%
Civ Labor Force:		
Employed	4,644	47.7%
Unemployed	413	4.2%
Not in Labor Force	3,098	31.8%

MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	5,556	90.6%
Public Trans	37	.6%
Other	542	8.8%
Total	6,135	100.0%

TRAVEL TIME TO WORK:		
0 - 14 Minutes	2,264	37.2%
15 - 29 Minutes	3,025	49.8%
30 - 59 Minutes	586	9.6%
60 + Minutes	204	3.4%
Total	6,079	100.0%

EDUCATION OF ADULTS OVER 25,		
YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	1,283	19.4%
12 Years	2,735	41.4%
13 - 15 Years	1,348	20.4%
16 + Years	1,237	18.7%
Median Years Completed	12.7	

MARITAL STATUS		
Male:		
Single	1,466	29.4%
Married	2,974	59.6%
Separated	77	1.5%
Widowed	46	.9%
Divorced	425	8.5%
Total	4,988	100.0%
Female:		
Single	902	18.2%
Married	2,994	60.3%
Separated	136	2.7%
Widowed	390	7.9%
Divorced	544	11.0%
Total	4,966	100.0%

WORKING MOTHERS:		
With Children under 6	509	25.3%
With Children 6 - 17	616	30.7%
Subtotal	1,125	56.0%
Non-Working Mothers	884	44.0%
Total	2,009	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	2,881	81.0%
Female Householder	554	15.6%
Male Householder	121	3.4%
Total	3,556	100.0%
HOUSEHOLDS WITH:		
Children Under 18	2,182	43.8%
Persons 65 and Over	477	9.6%
Householder 65 and Over	383	7.7%
Married Couple With Children	1,633	32.5%
Married Couple Without Children	1,353	27.0%
Female Householder With Children	338	6.7%
Female Householder Without Children	105	2.1%
Male Householder With Children	96	1.9%
Male Householder Without Children	67	1.3%
Non-Families	1,427	28.4%
PERSONS PER HOUSEHOLD:		
1 Person	494	8.8%
2 Persons	949	16.8%
3 Persons	378	6.7%
4+ Persons	3,812	67.7%
Total Households	5,633	100.0%
Average Household Income	$16,389	
Per Capita Income	$6,292	
FAMILIES		
Total Families	3,556	
Average Family Size	3.1	
Average Family Income	$18,248	
Family Population	11,124	
Nonfamily Population	1,866	
Group Quarters Population	21	
HOUSING		
Median Home Value	$52,111	
Average Home Value	$51,907	
Median Monthly Rent	$162	
Average Monthly Rent	$170	

NITS AT ADDRESS:		
1 Unit	2,730	50.8%
2 - 9 Units	539	10.0%
10+ Units	309	5.7%
Mobile Home	1,801	33.5%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	1,182
Last 5 Years	2,779
6 - 9 Years Ago	564
10 - 14 Years Ago	318
15+ Years Ago	181
Socioeconomic Status Score	54
Private Sector Employment	3,211

Table 4. MISSISSIPPI

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	2,520,638	2,607,619	3.5%	2,723,522
Total Households	827,169	876,047	5.9%	923,690
Household Population	2,455,073	2,542,061	3.5%	2,657,964
Average Household Size	3.0	2.9	-2.1%	2.9
Median Household Income	$12,335	$15,464	25.4%	$19,467

	1980 Census		1984	1989
	Number	Percent	Estimate	Projection
TOTAL POPULATION BY AGE	2,520,638	100.0%	2,607,619	2,723,522
0 - 5	257,331	10.2%	10.3%	10.4%
6 - 13	356,820	14.2%	13.3%	12.9%
14 - 17	200,046	7.9%	7.2%	6.6%
18 - 24	338,789	13.4%	13.6%	12.4%
25 - 34	369,539	14.7%	15.4%	16.4%
35 - 44	260,505	10.3%	11.5%	12.8%
45 - 54	231,819	9.2%	8.7%	9.0%
55 - 64	216,432	8.6%	8.4%	7.8
65 +	289,357	11.5%	11.6%	11.6%
FEMALE POPULATION BY AGE	1,306,760	100.0%	1,350,977	1,408,299
0 - 5	126,135	9.7%	9.7%	9.9%
6 - 13	175,083	13.4%	12.6%	12.2%
14 - 17	97,960	7.5%	6.8%	6.2%
18 - 24	170,647	13.1%	12.9%	11.7%
25 - 34	189,043	14.5%	15.2%	16.0%
35 - 44	135,239	10.3%	11.5%	12.8%
45 - 54	123,373	9.4%	8.9%	9.2%
55 - 64	117,910	9.0%	8.8%	8.3%
65 +	171,370	13.1%	13.5%	13.8%
MALE POPULATION BY AGE	1,213,878	100.0%	1,256,638	1,315,219
0 - 5	131,196	10.8%	10.9%	11.0%
6 - 13	181,737	15.0%	14.1%	13.6%
14 - 17	102,086	8.4%	7.6%	7.0%
18 - 24	168,142	13.9%	14.3%	13.2%
25 - 34	180,496	14.9%	15.6%	16.8%
35 - 44	125,266	10.3%	11.5%	12.8%
45 - 54	108,446	8.9%	8.5%	8.9%
55 - 64	98,522	8.1%	7.9%	7.4%
65 +	117,987	9.7%	9.6%	9.3%
Median Age Total Population	27.7		28.4	29.[illegible]
Median Age Adult Population	40.5		39.9	39.8

TOTAL POPULATION	2,520,638	100.0%	2,607,619	2,723,522
White	1,615,190	64.1%	64.8%	65.6%
Black	887,206	35.2%	34.5%	33.6%
Other	18,242	.7%	.7%	.8%
Spanish	24,731	1.0%	1.0%	1.0%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	269,583	32.5%	26.0%	20.0%
$ 7,500 - $ 9,999	79,434	9.6%	7.8%	5.9%
$10,000 - $14,999	139,507	16.8%	15.0%	12.0%
$15,000 - $24,999	194,771	23.5%	26.8%	27.1%
$25,000 - $34,999	87,000	10.5%	14.2%	18.5%
$35,000 - $49,999	38,062	4.6%	6.7%	10.7%
$50,000 - $74,999	13,119	1.6%	2.3%	3.9%
$75,000 +	6,913	.8%	1.2%	1.9%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	57,258	6.1%
Construction	67,680	7.2%
Manufacturing:		
Nondurable	100,623	10.7%
Durable	129,485	13.8%
Transportation	35,555	3.8%
Communications	28,937	3.1%
Wholesale Trade	38,285	4.1%
Retail Trade	138,008	14.7%
Fin/Ins/Real Est	40,252	4.3%
Bus/Repair Serv	27,153	2.9%
Pers/Ent/Rec Serv	38,235	4.1%
Prof/Related Serv:		
Health	64,905	6.9%
Educational	90,329	9.6%
Other	33,140	3.5%
Public Admin	47,361	5.1%
Total	937,206	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	79,304	8.5%
Prof	101,912	10.9%
Tech/Admin/Sales:		
Tech	23,534	2.5%
Admin/Clerical	131,117	14.0%
Sales	87,135	9.3%
Service:		
Private Household	10,954	1.2%
Protective Serv	12,059	1.3%
Other Serv	92,413	9.9%
Farm/Forest/Fish	41,465	4.4%
Prod/Craft/Repair	130,413	13.9%

Oper/Fabr/Labrs:		
Mach Operators	120,293	12.8%
Trans/Mat Moving	54,598	5.8%
Handlrs/Cleanrs/ Helprs/Labrs	52,009	5.5%
Total Employed	937,206	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	22,223	1.2%
Civ Labor Force:		
Employed	937,206	51.8%
Unemployed	72,168	4.0%
Not in Labor Force	777,016	43.0%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	855,046	91.5%
Public Trans	11,121	1.2%
Other	68,565	7.3%
Total	934,732	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	356,495	38.6%
15 - 29 Minutes	336,359	36.4%
30 - 59 Minutes	178,173	19.3%
60 + Minutes	53,243	5.8%
Total	924,270	100.0%
EDUCATION OF ADULTS OVER 25,		
YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	618,625	45.2%
12 Years	398,848	29.2%
13 - 15 Years	182,233	13.3%
16 + Years	168,086	12.3%
Median Years Completed	12.1	
MARITAL STATUS		
Male:		
Single	252,992	28.8%
Married	536,124	61.1%
Separated	20,092	2.3%
Widowed	27,004	3.1%
Divorced	40,983	4.7%
Total	877,195	100.0%
Female:		
Single	214,236	21.8%
Married	534,723	54.4%
Separated	30,315	3.1%
Widowed	144,890	14.7%
Divorced	58,676	6.0%
Total	982,840	100.0%

WORKING MOTHERS:		
With Children under 6	92,586	25.9%
With Children 6 - 17	117,569	32.9%
Subtotal	210,155	58.8%
Non-Working Mothers	147,297	41.2%
Total	357,452	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	513,518	79.9%
Female Householder	106,659	16.6%
Male Householder	22,527	3.5%
Total	642,704	100.0%
HOUSEHOLDS WITH:		
Children Under 18	378,727	45.8%
Persons 65 and Over	213,725	25.8%
Householder 65 and Over	190,801	23.1%
Married Couple With Children	278,523	33.6%
Married Couple Without Children	242,626	29.3%
Female Householder With Children	59,855	7.2%
Female Householder Without Children	43,570	5.3%
Male Householder With Children	8,175	1.0%
Male Householder Without Children	12,704	1.5%
Non-Families	182,936	22.1%
PERSONS PER HOUSEHOLD:		
1 Person	168,444	20.4%
2 Persons	240,236	29.0%
3 Persons	149,842	18.1%
4+ Persons	268,647	32.5%
Total Households	827,169	100.0%
Average Household Income	$15,580	
Per Capita Income	$5,249	
FAMILIES		
Total Families	642,704	
Average Family Size	3.5	
Average Family Income	$17,720	
Family Population	2,249,478	
Nonfamily Population	205,595	
Group Quarters Population	65,565	
HOUSING		
Median Home Value	$31,909	
Average Home Value	$37,025	
Median Monthly Rent	$116	
Average Monthly Rent	$129	

UNITS AT ADDRESS:

1 Unit	731,811	80.9%
2 - 9 Units	64,760	7.2%
10+ Units	34,402	3.8%
Mobile Home	73,105	8.1%

1984 Estimate

NEIGHBORHOOD MOBILITY

HOUSEHOLD MOVED IN:

Most Recent Year	96,698
Last 5 Years	297,848
6 - 9 Years Ago	100,142
10 - 14 Years Ago	76,393
15+ Years Ago	94,525

Socioeconomic Status Score	35
Private Sector Employment	579,774

Table 4A. Biloxi-Gulfport SMSA, MS

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	191,918	206,318	7.5%	225,511
Total Households	63,380	69,578	9.8%	76,491
Household Population	181,694	196,094	7.9%	215,287
Average Household Size	2.9	2.8	-1.6%	2.8
Median Household Income	$13,567	$17,292	27.5%	$22,475

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	191,918	100.0%	206,318	225,511
0 - 5	18,694	9.7%	9.8%	9.9%
6 - 13	25,480	13.3%	12.5%	12.3%
14 - 17	14,807	7.7%	7.4%	6.8%
18 - 24	30,149	15.7%	14.9%	13.4%
25 - 34	29,846	15.6%	16.2%	17.1%
35 - 44	20,603	10.7%	11.8%	12.9%
45 - 54	18,161	9.5%	9.0%	9.3%
55 - 64	16,571	8.6%	8.7%	8.1%
65 +	17,607	9.2%	9.7%	10.3%
FEMALE POPULATION BY AGE	95,626	100.0%	102,887	112,491
0 - 5	9,238	9.7%	9.7%	9.7%
6 - 13	12,463	13.0%	12.4%	12.1%
14 - 17	7,183	7.5%	6.7%	6.2%
18 - 24	13,460	14.1%	13.5%	11.9%
25 - 34	14,875	15.6%	16.3%	17.0%
35 - 44	10,434	10.9%	12.0%	13.2%
45 - 54	9,225	9.6%	9.1%	9.6%
55 - 64	8,505	8.9%	9.0%	8.3%
65 +	10,243	10.7%	11.3%	12.1%
MALE POPULATION BY AGE	96,292	100.0%	103,431	113,020
0 - 5	9,456	9.8%	10.0%	10.1%
6 - 13	13,017	13.5%	12.7%	12.4%
14 - 17	7,624	7.9%	8.1%	7.4%
18 - 24	16,689	17.3%	16.2%	14.9%
25 - 34	14,971	15.5%	16.2%	17.2%
35 - 44	10,169	10.6%	11.6%	12.7%
45 - 54	8,936	9.3%	8.8%	9.1%
55 - 64	8,066	8.4%	8.4%	7.8%
65 +	7,364	7.6%	8.0%	8.5%
Median Age Total Population	27.1		28.0	29.1
Median Age Adult Population	38.1		38.3	38.9

TOTAL POPULATION	191,918	100.0%	206,318	225,511
White	153,391	79.9%	79.6%	79.5%
Black	35,036	18.3%	18.4%	18.4%
Other	3,491	1.8%	1.9%	2.1%
Spanish	3,553	1.9%	1.8%	1.8%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	16,933	26.8%	20.7%	15.0%
$ 7,500 - $ 9,999	6,170	9.8%	7.5%	5.4%
$10,000 - $14,999	11,934	18.9%	15.5%	11.2%
$15,000 - $24,999	15,634	24.7%	27.7%	24.6%
$25,000 - $34,999	7,577	12.0%	17.2%	24.3%
$35,000 - $49,999	3,333	5.3%	7.7%	13.0%
$50,000 - $74,999	1,127	1.8%	2.6%	4.5%
$75,000 +	530	.8%	1.2%	2.0%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	1,803	2.7%
Construction	5,737	8.7%
Manufacturing:		
Nondurable	3,651	5.6%
Durable	5,270	8.0%
Transportation	3,044	4.6%
Communications	2,433	3.7%
Wholesale Trade	2,240	3.4%
Retail Trade	12,385	18.8%
Fin/Ins/Real Est	3,286	5.0%
Bus/Repair Serv	2,565	3.9%
Pers/Ent/Rec Serv	3,558	5.4%
Prof/Related Serv:		
Health	5,091	7.7%
Educational	5,402	8.2%
Other	3,079	4.7%
Public Admin	6,233	9.5%
Total	65,777	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	6,341	9.6%
Prof	7,984	12.1%
Tech/Admin/Sales:		
Tech	2,224	3.4%
Admin/Clerical	9,219	14.0%
Sales	7,325	11.1%
Service:		
Private Household	551	.8%
Protective Serv	1,227	1.9%
Other Serv	8,592	13.1%
Farm/Forest/Fish	1,140	1.7%
Prod/Craft/Repair	9,791	14.9%
Oper/Fabr/Labrs:		

Mach Operators	4,232	6.4%
Trans/Mat Moving	3,652	5.6%
Handlrs/Cleanrs/		
Helprs/Labrs	3,499	5.3%
Total Employed	65,777	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	12,793	9.1%
Civ Labor Force:		
Employed	65,777	46.7%
Unemployed	5,504	3.9%
Not in Labor Force	56,746	40.3%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	65,096	84.8%
Public Trans	650	.8%
Other	11,001	14.3%
Total	76,747	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	29,718	39.3%
15 - 29 Minutes	28,050	37.1%
30 - 59 Minutes	13,188	17.4%
60 + Minutes	4,694	6.2%
Total	75,650	100.0%
EDUCATION OF ADULTS OVER 25,		
YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	34,907	34.0%
12 Years	36,582	35.6%
13 - 15 Years	17,531	17.1%
16 + Years	13,749	13.4%
Median Years Completed	12.4	
MARITAL STATUS		
Male:		
Single	22,292	30.9%
Married	41,914	58.1%
Separated	1,356	1.9%
Widowed	1,835	2.5%
Divorced	4,684	6.5%
Total	72,081	100.0%
Female:		
Single	14,453	20.0%
Married	41,298	57.2%
Separated	1,876	2.6%
Widowed	8,748	12.1%
Divorced	5,879	8.1%
Total	72,254	100.0%

WORKING MOTHERS:		
With Children under 6	5,540	20.4%
With Children 6 - 17	8,433	31.0%
Subtotal	13,973	51.4%
Non-Working Mothers	13,221	48.6%
Total	27,194	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	39,404	81.4%
Female Householder	7,350	15.2%
Male Householder	1,627	3.4%
Total	48,381	100.0%
HOUSEHOLDS WITH:		
Children Under 18	28,872	45.6%
Persons 65 and Over	12,990	20.5%
Householder 65 and Over	11,368	17.9%
Married Couple With Children	21,432	33.9%
Married Couple Without Children	18,208	28.8%
Female Householder With Children	4,690	7.4%
Female Householder Without Children	2,340	3.7%
Male Householder With Children	698	1.1%
Male Householder Without Children	997	1.6%
Non-Families	14,873	23.5%
PERSONS PER HOUSEHOLD:		
1 Person	13,334	21.0%
2 Persons	18,645	29.4%
3 Persons	11,752	18.5%
4+ Persons	19,649	31.0%
Total Households	63,380	100.0%
Average Household Income	$16,662	
Per Capita Income	$5,812	
FAMILIES		
Total Families	48,381	
Average Family Size	3.4	
Average Family Income	$18,619	
Family Population	164,564	
Nonfamily Population	17,130	
Group Quarters Population	10,224	
HOUSING		
Median Home Value	$36,210	
Average Home Value	$41,107	
Median Monthly Rent	$157	
Average Monthly Rent	$161	

UNITS AT ADDRESS:

1 Unit	56,194	77.4%
2 - 9 Units	6,049	8.3%
10+ Units	5,524	7.6%
Mobile Home	4,839	6.7%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	10,310
Last 5 Years	26,569
6 - 9 Years Ago	7,764
10 - 14 Years Ago	6,548
15+ Years Ago	6,753
Socioeconomic Status Score	42
Private Sector Employment	41,185

Table 4B. George County, MS

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	15,297	16,551	8.2%	18,222
Total Households	4,828	5,371	11.2%	5,980
Household Population	15,181	16,435	8.3%	18,106
Average Household Size	3.1	3.1	-2.5%	3.0
Median Household Income	$13,613	$17,925	31.7%	$24,778

	1980 Census		1984	1989
	Number	Percent	Estimate	Projection
TOTAL POPULATION BY AGE	15,297	100.0%	16,551	18,222
0 - 5	1,707	11.2%	11.0%	11.1%
6 - 13	2,413	15.8%	14.8%	13.7%
14 - 17	1,275	8.3%	7.4%	7.1%
18 - 24	1,688	11.0%	12.6%	12.3%
25 - 34	2,173	14.2%	13.9%	15.0%
35 - 44	1,819	11.9%	12.6%	12.5%
45 - 54	1,382	9.0%	9.0%	10.0%
55 - 64	1,242	8.1%	8.1%	7.5%
65 +	1,598	10.4%	10.6%	10.7%
FEMALE POPULATION BY AGE	7,701	100.0%	8,360	9,225
0 - 5	822	10.7%	10.5%	10.7%
6 - 13	1,166	15.1%	14.3%	13.1%
14 - 17	619	8.0%	7.1%	6.9%
18 - 24	847	11.0%	12.2%	11.8%
25 - 34	1,109	14.4%	13.9%	14.8%
35 - 44	904	11.7%	12.6%	12.7%
45 - 54	676	8.8%	8.9%	9.9%
55 - 64	680	8.8%	8.5%	7.5%
65 +	878	11.4%	12.0%	12.6%
MALE POPULATION BY AGE	7,596	100.0%	8,191	8,997
0 - 5	885	11.7%	11.4%	11.6%
6 - 13	1,247	16.4%	15.4%	14.4%
14 - 17	656	8.6%	7.7%	7.3%
18 - 24	841	11.1%	13.1%	12.8%
25 - 34	1,064	14.0%	13.9%	15.3%
35 - 44	915	12.0%	12.6%	12.3%
45 - 54	706	9.3%	9.2%	10.1%
55 - 64	562	7.4%	7.7%	7.5%
65 +	720	9.5%	9.1%	8.8%
Median Age Total Population	27.6		27.9	28.4
Median Age Adult Population	40.9		40.4	40.3

TOTAL POPULATION	15,297	100.0%	16,551	18,222
White	13,808	90.3%	91.0%	91.9%
Black	1,457	9.5%	8.8%	7.8%
Other	32	.2%	.2%	.3%
Spanish	98	.6%	.6%	.6%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	1,483	30.6%	22.3%	14.5%
$ 7,500 - $ 9,999	394	8.1%	5.9%	3.9%
$10,000 - $14,999	750	15.5%	11.3%	7.3%
$15,000 - $24,999	1,465	30.3%	35.6%	24.9%
$25,000 - $34,999	473	9.8%	15.6%	30.0%
$35,000 - $49,999	200	4.1%	6.7%	14.0%
$50,000 - $74,999	42	.9%	1.4%	3.1%
$75,000 +	32	.7%	1.1%	2.3%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	367	7.2%
Construction	510	9.9%
Manufacturing:		
Nondurable	426	8.3%
Durable	926	18.1%
Transportation	226	4.4%
Communications	212	4.1%
Wholesale Trade	152	3.0%
Retail Trade	842	16.4%
Fin/Ins/Real Est	139	2.7%
Bus/Repair Serv	145	2.8%
Pers/Ent/Rec Serv	93	1.8%
Prof/Related Serv:		
Health	360	7.0%
Educational	375	7.3%
Other	118	2.3%
Public Admin	236	4.6%
Total	5,127	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	310	6.0%
Prof	446	8.7%
Tech/Admin/Sales:		
Tech	200	3.9%
Admin/Clerical	561	10.9%
Sales	414	8.1%
Service:		
Private Household	5	.1%
Protective Serv	37	.7%
Other Serv	349	6.8%
Farm/Forest/Fish	226	4.4%
Prod/Craft/Repair	992	19.3%

Oper/Fabr/Labrs:		
Mach Operators	778	15.2%
Trans/Mat Moving	463	9.0%
Handlrs/Cleanrs/ Helprs/Labrs	346	6.7%
Total Employed	5,127	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	18	.2%
Civ Labor Force:		
Employed	5,127	48.4%
Unemployed	385	3.6%
Not in Labor Force	5,070	47.8%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	4,642	93.9%
Public Trans	49	1.0%
Other	252	5.1%
Total	4,943	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	1,410	29.0%
15 - 29 Minutes	1,272	26.2%
30 - 59 Minutes	791	16.3%
60 + Minutes	1,381	28.5%
Total	4,854	100.0%
EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	3,775	45.9%
12 Years	3,108	37.8%
13 - 15 Years	816	9.9%
16 + Years	534	6.5%
Median Years Completed	12.1	
MARITAL STATUS		
Male:		
Single	1,231	23.2%
Married	3,687	69.3%
Separated	56	1.1%
Widowed	142	2.7%
Divorced	201	3.8%
Total	5,317	100.0%
Female:		
Single	845	15.2%
Married	3,695	66.4%
Separated	77	1.4%
Widowed	695	12.5%
Divorced	251	4.5%
Total	5,563	100.0%

WORKING MOTHERS:		
With Children under 6	407	16.9%
With Children 6 - 17	610	25.3%
Subtotal	1,017	42.2%
Non-Working Mothers	1,394	57.8%
Total	2,411	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	3,587	88.4%
Female Householder	381	9.4%
Male Householder	88	2.2%
Total	4,056	100.0%
HOUSEHOLDS WITH:		
Children Under 18	2,486	51.5%
Persons 65 and Over	1,157	24.0%
Householder 65 and Over	1,050	21.7%
Married Couple With Children	2,141	44.2%
Married Couple Without Children	1,453	30.0%
Female Householder With Children	208	4.3%
Female Householder Without Children	153	3.2%
Male Householder With Children	18	.4%
Male Householder Without Children	77	1.6%
Non-Families	789	16.3%
PERSONS PER HOUSEHOLD:		
1 Person	749	15.5%
2 Persons	1,333	27.6%
3 Persons	896	18.6%
4+ Persons	1,850	38.3%
Total Households	4,828	100.0%

Average Household Income	$15,404
Per Capita Income	$4,899
FAMILIES	
Total Families	4,056
Average Family Size	3.5
Average Family Income	$16,893
Family Population	14,380
Nonfamily Population	801
Group Quarters Population	116
HOUSING	
Median Home Value	$27,731
Average Home Value	$31,871
Median Monthly Rent	$101
Average Monthly Rent	$99

UNITS AT ADDRESS:		
1 Unit	4,811	84.2%
2 - 9 Units	244	4.3%
10+ Units	5	.1%
Mobile Home	657	11.5%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	346
Last 5 Years	1,582
6 - 9 Years Ago	697
10 - 14 Years Ago	479
15+ Years Ago	461
Socioeconomic Status Score	27
Private Sector Employment	2,046

Table 4C. Hancock County, MS

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	24,537	28,607	16.6%	34,032
Total Households	8,182	9,829	20.1%	11,849
Household Population	24,046	28,116	16.9%	33,541
Average Household Size	2.9	2.9	-2.5%	2.8
Median Household Income	$13,247	$17,318	30.7%	$22,623

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	24,537	100.0%	28,607	34,032
0 - 5	2,223	9.1%	9.4%	9.5%
6 - 13	3,537	14.4%	12.7%	12.0%
14 - 17	2,230	9.1%	7.3%	6.2%
18 - 24	2,595	10.6%	13.1%	12.4%
25 - 34	3,292	13.4%	13.4%	15.4%
35 - 44	2,700	11.0%	11.8%	12.2%
45 - 54	2,447	10.0%	9.4%	9.8%
55 - 64	2,630	10.7%	10.1%	8.8%
65 +	2,883	11.7%	12.7%	13.7%
FEMALE POPULATION BY AGE	12,201	100.0%	14,293	17,086
0 - 5	1,079	8.8%	9.2%	9.2%
6 - 13	1,674	13.7%	12.3%	11.7%
14 - 17	974	8.0%	6.8%	5.9%
18 - 24	1,273	10.4%	11.9%	11.4%
25 - 34	1,665	13.6%	13.6%	14.6%
35 - 44	1,372	11.2%	12.1%	12.4%
45 - 54	1,230	10.1%	9.6%	10.0%
55 - 64	1,362	11.2%	10.4%	9.0%
65 +	1,572	12.9%	14.2%	15.7%
MALE POPULATION BY AGE	12,336	100.0%	14,314	16,946
0 - 5	1,144	9.3%	9.6%	9.8%
6 - 13	1,863	15.1%	13.1%	12.3%
14 - 17	1,256	10.2%	7.9%	6.5%
18 - 24	1,322	10.7%	14.3%	13.4%
25 - 34	1,627	13.2%	13.2%	16.1%
35 - 44	1,328	10.8%	11.6%	12.1%
45 - 54	1,217	9.9%	9.3%	9.6%
55 - 64	1,268	10.3%	9.7%	8.5%
65 +	1,311	10.6%	11.2%	11.8%
Median Age Total Population	30.0		30.4	30.8
Median Age Adult Population	43.8		42.4	41.8
TOTAL POPULATION	24,537	100.0%	28,607	34,032

White	21,892	89.2%	90.3%	91.4%
Black	2,435	9.9%	8.8%	7.6%
Other	210	.9%	.9%	1.0%
Spanish	429	1.7%	1.8%	1.8%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	2,305	28.2%	21.6%	15.5%
$ 7,500 - $ 9,999	796	9.7%	7.5%	5.4%
$10,000 - $14,999	1,518	18.6%	14.2%	10.2%
$15,000 - $24,999	1,949	23.8%	29.0%	24.8%
$25,000 - $34,999	940	11.5%	15.6%	25.1%
$35,000 - $49,999	440	5.4%	7.9%	11.6%
$50,000 - $74,999	126	1.5%	2.3%	4.0%
$75,000 +	101	1.2%	1.9%	3.4%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	295	3.6%
Construction	1,042	12.8%
Manufacturing:		
Nondurable	445	5.5%
Durable	734	9.0%
Transportation	508	6.2%
Communications	334	4.1%
Wholesale Trade	245	3.0%
Retail Trade	1,272	15.6%
Fin/Ins/Real Est	311	3.8%
Bus/Repair Serv	474	5.8%
Pers/Ent/Rec Serv	242	3.0%
Prof/Related Serv:		
Health	421	5.2%
Educational	738	9.1%
Other	371	4.6%
Public Admin	705	8.7%
Total	8,137	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	861	10.6%
Prof	973	12.0%
Tech/Admin/Sales:		
Tech	273	3.4%
Admin/Clerical	1,049	12.9%
Sales	792	9.7%
Service:		
Private Household	43	.5%
Protective Serv	114	1.4%
Other Serv	904	11.1%
Farm/Forest/Fish	170	2.1%
Prod/Craft/Repair	1,478	18.2%
Oper/Fabr/Labrs:		

Mach Operators	577	7.1%
Trans/Mat Moving	497	6.1%
Handlrs/Cleanrs/ Helprs/Labrs	406	5.0%
Total Employed	8,137	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	112	.6%
Civ Labor Force;		
Employed	8,137	46.0%
Unemployed	715	4.0%
Not in Labor Force	8,723	49.3%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	7,309	90.9%
Public Trans	78	1.0%
Other	651	8.1%
Total	8,038	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	2,425	31.2%
15 - 29 Minutes	1,335	17.2%
30 - 59 Minutes	2,659	34.2%
60 + Minutes	1,345	17.3%
Total	7,764	100.0%
EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	5,775	41.4%
12 Years	4,817	34.5%
13 - 15 Years	1,843	13.2%
16 + Years	1,512	10.8%
Median Years Completed	12.2	
MARITAL STATUS		
Male:		
Single	2,512	27.8%
Married	5,671	62.9%
Separated	131	1.5%
Widowed	295	3.3%
Divorced	414	4.6%
Total	9,023	100.0%
Female:		
Single	1,616	17.6%
Married	5,629	61.2%
Separated	177	1.9%
Widowed	1,239	13.5%
Divorced	541	5.9%
Total	9,202	100.0%

WORKING MOTHERS:		
With Children under 6	444	13.3%
With Children 6 - 17	952	28.6%
Subtotal	1,396	41.9%
Non-Working Mothers	1,937	58.1%
Total	3,333	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	5,423	84.6%
Female Householder	755	11.8%
Male Householder	232	3.6%
Total	6,410	100.0%
HOUSEHOLDS WITH:		
Children Under 18	3,598	44.0%
Persons 65 and Over	2,140	26.2%
Householder 65 and Over	1,889	23.1%
Married Couple With Children	2,734	33.4%
Married Couple Without Children	2,685	32.8%
Female Householder With Children	470	5.7%
Female Householder Without Children	287	3.5%
Male Householder With Children	73	.9%
Male Householder Without Children	162	2.0%
Non-Families	1,764	21.6%
PERSONS PER HOUSEHOLD:		
1 Person	1,621	19.8%
2 Persons	2,518	30.8%
3 Persons	1,413	17.3%
4+ Persons	2,630	32.1%
Total Households	8,182	100.0%
Average Household Income	$17,008	
Per Capita Income	$5,787	
FAMILIES		
Total Families	6,410	
Average Family Size	3.4	
Average Family Income	$18,056	
Family Population	22,061	
Nonfamily Population	1,985	
Group Quarters Population	491	
HOUSING		
Median Home Value	$33,609	
Average Home Value	$40,455	
Median Monthly Rent	$148	
Average Monthly Rent	$151	

UNITS AT ADDRESS:		
1 Unit	9,763	84.0%
2 - 9 Units	567	4.9%
10+ Units	512	4.4%
Mobile Home	778	6.7%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	989
Last 5 Years	3,378
6 - 9 Years Ago	1,049
10 - 14 Years Ago	1,013
15+ Years Ago	611
Socioeconomic Status Score	35
Private Sector Employment	2,909

Table 4D. Harrison County, MS

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	157,665	167,538	6.3%	180,697
Total Households	52,202	56,515	8.3%	61,169
Household Population	148,599	158,472	6.6%	171,631
Average Household Size	2.8	2.8	-1.4%	2.8
Median Household Income	$13,614	$17,304	27.1%	$22,515

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	157,665	100.0%	167,538	180,697
0 - 5	15,579	9.9%	10.0%	10.0%
6 - 13	20,621	13.1%	12.5%	12.3%
14 - 17	11,827	7.5%	7.5%	6.9%
18 - 24	25,965	16.5%	15.1%	13.7%
25 - 34	25,228	16.0%	16.8%	17.2%
35 - 44	16,917	10.7%	11.8%	13.1%
45 - 54	14,829	9.4%	8.9%	9.3%
55 - 64	13,028	8.3%	8.4%	7.9%
65 +	13,671	8.7%	9.0%	9.5%
FEMALE POPULATION BY AGE	78,538	100.0%	83,459	89,950
0 - 5	7,712	9.8%	9.8%	9.8%
6 - 13	10,135	12.9%	12.4%	12.2%
14 - 17	5,846	7.4%	6.7%	6.2%
18 - 24	11,443	14.6%	13.6%	12.0%
25 - 34	12,548	16.0%	16.9%	17.3%
35 - 44	8,581	10.9%	12.1%	13.4%
45 - 54	7,535	9.6%	9.1%	9.6%
55 - 64	6,674	8.5%	8.7%	8.2%
65 +	8,064	10.3%	10.7%	11.3%
MALE POPULATION BY AGE	79,127	100.0%	84,079	90,747
0 - 5	7,867	9.9%	10.1%	10.1%
6 - 13	10,486	13.3%	12.6%	12.5%
14 - 17	5,981	7.6%	8.2%	7.7%
18 - 24	14,522	18.4%	16.5%	15.3%
25 - 34	12,680	16.0%	16.7%	17.2%
35 - 44	8,336	10.5%	11.6%	12.8%
45 - 54	7,294	9.2%	8.7%	9.0%
55 - 64	6,354	8.0%	8.1%	7.7%
65 +	5,607	7.1%	7.4%	7.8%
Median Age Total Population	26.7		27.7	28.8
Median Age Adult Population	37.1		37.6	38.4
TOTAL POPULATION	157,665	100.0%	167,538	180,697

White	124,036	78.7%	78.0%	77.3%
Black	30,406	19.3%	19.9%	20.2%
Other	3,223	2.0%	2.2%	2.4%
Spanish	3,037	1.9%	1.9%	1.9%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	13,780	26.4%	20.4%	14.8%
$ 7,500 - $ 9,999	5,129	9.8%	7.6%	5.4%
$10,000 - $14,999	9,877	19.0%	15.7%	11.5%
$15,000 - $24,999	12,909	24.8%	27.3%	24.4%
$25,000 - $34,999	6,266	12.0%	17.4%	24.1%
$35,000 - $49,999	2,750	5.3%	7.7%	13.3%
$50,000 - $74,999	977	1.9%	2.7%	4.7%
$75,000 +	414	.8%	1.1%	1.9%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	1,303	2.4%
Construction	4,475	8.2%
Manufacturing:		
Nondurable	2,830	5.2%
Durable	3,900	7.2%
Transportation	2,392	4.4%
Communications	2,068	3.8%
Wholesale Trade	1,863	3.4%
Retail Trade	10,698	19.7%
Fin/Ins/Real Est	2,928	5.4%
Bus/Repair Serv	2,020	3.7%
Pers/Ent/Rec Serv	3,195	5.9%
Prof/Related Serv:		
Health	4,531	8.3%
Educational	4,197	7.7%
Other	2,606	4.8%
Public Admin	5,303	9.8%
Total	54,309	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	5,290	9.7%
Prof	6,568	12.1%
Tech/Admin/Sales:		
Tech	1,861	3.4%
Admin/Clerical	7,787	14.3%
Sales	6,327	11.7%
Service:		
Private Household	461	.8%
Protective Serv	1,072	2.0%
Other Serv	7,345	13.5%
Farm/Forest/Fish	698	1.3%
Prod/Craft/Repair	7,847	14.4%
Oper/Fabr/Labrs:		

Mach Operators	3,316	6.1%
Trans/Mat Moving	2,818	5.2%
Handlrs/Cleanrs/ Helprs/Labrs	2,919	5.4%
Total Employed	54,309	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	12,681	10.9%
Civ Labor Force:		
Employed	54,309	46.8%
Unemployed	4,426	3.8%
Not in Labor Force	44,567	38.4%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	54,819	83.8%
Public Trans	557	.9%
Other	10,070	15.4%
Total	65,446	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	25,992	40.1%
15 - 29 Minutes	25,923	40.0%
30 - 59 Minutes	9,940	15.4%
60 + Minutes	2,888	4.5%
Total	64,743	100.0%
EDUCATION OF ADULTS OVER 25,		
YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	27,000	32.3%
12 Years	30,031	35.9%
13 - 15 Years	14,980	17.9%
16 + Years	11,648	13.9%
Median Years Completed	12.4	
MARITAL STATUS		
Male:		
Single	18,639	31.4%
Married	34,100	57.4%
Separated	1,165	2.0%
Widowed	1,430	2.4%
Divorced	4,098	6.9%
Total	59,432	100.0%
Female:		
Single	12,034	20.3%
Married	33,534	56.5%
Separated	1,640	2.8%
Widowed	6,977	11.8%
Divorced	5,157	8.7%
Total	59,342	100.0%

WORKING MOTHERS:		
With Children under 6	4,870	21.6%
With Children 6 - 17	7,093	31.5%
Subtotal	11,963	53.1%
Non-Working Mothers	10,547	46.9%
Total	22,510	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	31,927	80.7%
Female Householder	6,317	16.0%
Male Householder	1,320	3.3%
Total	39,564	100.0%
HOUSEHOLDS WITH:		
Children Under 18	23,873	45.7%
Persons 65 and Over	10,095	19.3%
Householder 65 and Over	8,817	16.9%
Married Couple With Children	17,651	33.9%
Married Couple Without Children	14,595	28.0%
Female Householder With Children	4,034	7.7%
Female Householder Without Children	1,907	3.7%
Male Householder With Children	590	1.1%
Male Householder Without Children	793	1.5%
Non-Families	12,532	24.1%
PERSONS PER HOUSEHOLD:		
1 Person	11,159	21.4%
2 Persons	15,263	29.2%
3 Persons	9,767	18.7%
4+ Persons	16,013	30.7%
Total Households	52,202	100.0%
Average Household Income	$16,674	
Per Capita Income	$5,857	
FAMILIES		
Total Families	39,564	
Average Family Size	3.4	
Average Family Income	$18,777	
Family Population	134,095	
Nonfamily Population	14,504	
Group Quarters Population	9,066	
HOUSING		
Median Home Value	$37,141	
Average Home Value	$41,848	
Median Monthly Rent	$159	
Average Monthly Rent	$163	

UNITS AT ADDRESS:		
1 Unit	43,573	75.6%
2 - 9 Units	5,330	9.3%
10+ Units	4,973	8.6%
Mobile Home	3,736	6.5%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	9,102
Last 5 Years	22,320
6 - 9 Years Ago	6,360
10 - 14 Years Ago	5,209
15+ Years Ago	5,825
Socioeconomic Status Score	43
Private Sector Employment	36,086

Table 4E. Jackson County, MS

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	118,015	129,581	9.8%	144,991
Total Households	37,589	42,111	12.0%	47,612
Household Population	116,560	128,128	9.9%	143,538
Average Household Size	3.1	3.0	-1.8%	3.0
Median Household Income	$17,393	$21,971	26.3%	$28,549

	1980 Census		1984	1989
	Number	Percent	Estimate	Projection
TOTAL POPULATION BY AGE	118,015	100.0%	129,581	144,991
0 - 5	12,723	10.8%	10.7%	10.6%
6 - 13	18,070	15.3%	14.1%	13.3%
14 - 17	10,082	8.5%	7.4%	6.7%
18 - 24	15,339	13.0%	13.5%	12.3%
25 - 34	19,428	16.5%	16.3%	16.7%
35 - 44	14,770	12.5%	13.4%	14.0%
45 - 54	11,452	9.7%	9.6%	10.4%
55 - 64	8,704	7.4%	8.0%	7.9%
65 +	7,447	6.3%	7.1%	8.1%
FEMALE POPULATION BY AGE	58,937	100.0%	64,919	72,875
0 - 5	6,213	10.5%	10.5%	10.3%
6 - 13	8,841	15.0%	13.8%	13.0%
14 - 17	4,925	8.4%	7.1%	6.4%
18 - 24	7,539	12.8%	13.0%	11.8%
25 - 34	9,669	16.4%	16.3%	16.6%
35 - 44	7,434	12.6%	13.5%	14.1%
45 - 54	5,601	9.5%	9.5%	10.5%
55 - 64	4,461	7.6%	8.1%	7.9%
65 +	4,254	7.2%	8.1%	9.3%
MALE POPULATION BY AGE	59,078	100.0%	64,658	72,112
0 - 5	6,510	11.0%	11.0%	10.9%
6 - 13	9,229	15.6%	14.4%	13.6%
14 - 17	5,157	8.7%	7.6%	6.9%
18 - 24	7,800	13.2%	13.9%	12.9%
25 - 34	9,759	16.5%	16.4%	16.9%
35 - 44	7,336	12.4%	13.3%	14.0%
45 - 54	5,851	9.9%	9.6%	10.2%
55 - 64	4,243	7.2%	7.8%	7.9%
65 +	3,193	5.4%	6.1%	6.9%
Median Age Total Population	26.3		27.6	29.0
Median Age Adult Population	37.5		38.0	39.0

TOTAL POPULATION	118,015	100.0%	129,581	144,991
White	94,710	80.3%	79.9%	79.2%
Black	22,119	18.7%	19.0%	19.6%
Other	1,186	1.0%	1.1%	1.2%
Spanish	1,487	1.3%	1.3%	1.2%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	7,135	19.0%	14.0%	9.5%
$ 7,500 - $ 9,999	2,619	7.0%	5.1%	3.4%
$10,000 - $14,999	6,262	16.6%	12.0%	8.1%
$15,000 - $24,999	11,679	31.0%	27.1%	18.9%
$25,000 - $34,999	6,433	17.1%	26.4%	28.7%
$35,000 - $49,999	2,552	6.8%	11.2%	23.0%
$50,000 - $74,999	758	2.0%	3.3%	6.6%
$75,000 +	186	.5%	.8%	1.8%

	1980 Census Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	928	2.0%
Construction	3,497	7.7%
Manufacturing:		
Nondurable	3,880	8.5%
Durable	11,565	25.4%
Transportation	1,205	2.6%
Communications	906	2.0%
Wholesale Trade	1,190	2.6%
Retail Trade	7,643	16.8%
Fin/Ins/Real Est	1,751	3.8%
Bus/Repair Serv	1,454	3.2%
Pers/Ent/Rec Serv	1,806	4.0%
Prof/Related Serv:		
Health	2,786	6.1%
Educational	3,147	6.9%
Other	1,427	3.1%
Public Admin	2,416	5.3%
Total	45,601	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	4,125	9.0%
Prof	5,280	11.6%
Tech/Admin/Sales:		
Tech	1,686	3.7%
Admin/Clerical	6,432	14.1%
Sales	4,042	8.9%
Service:		
Private Household	271	.6%
Protective Serv	752	1.6%
Other Serv	4,238	9.3%
Farm/Forest/Fish	689	1.5%
Prod/Craft/Repair	9,530	20.9%

Oper/Fabr/Labrs:		
Mach Operators	4,254	9.3%
Trans/Mat Moving	1,766	3.9%
Handlrs/Cleanrs/ Helprs/Labrs	2,536	5.6%
Total Employed	45,601	100.0%

EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	2,277	2.8%
Civ Labor Force:		
Employed	45,601	55.4%
Unemployed	4,558	5.5%
Not in Labor Force	29,913	36.3%

MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	43,420	93.2%
Public Trans	349	.7%
Other	2,806	6.0%
Total	46,575	100.0%

TRAVEL TIME TO WORK:		
0 - 14 Minutes	14,762	31.7%
15 - 29 Minutes	18,906	40.6%
30 - 59 Minutes	10,785	23.2%
60 + Minutes	2,130	4.6%
Total	46,583	100.0%

EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	20,091	32.5%
12 Years	24,226	39.2%
13 - 15 Years	10,511	17.0%
16 + Years	6,993	11.3%
Median Years Completed	12.4	

MARITAL STATUS		
Male:		
Single	11,298	26.8%
Married	26,925	63.9%
Separated	773	1.8%
Widowed	709	1.7%
Divorced	2,423	5.8%
Total	42,128	100.0%
Female:		
Single	8,170	19.1%
Married	26,644	62.4%
Separated	1,039	2.4%
Widowed	3,858	9.0%
Divorced	2,986	7.0%
Total	42,697	100.0%

WORKING MOTHERS:		
With Children under 6	4,201	22.2%
With Children 6 - 17	6,094	32.2%
Subtotal	10,295	54.4%
Non-Working Mothers	8,642	45.6%
Total	18,937	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	25,748	83.8%
Female Householder	3,940	12.8%
Male Householder	1,023	3.3%
Total	30,711	100.0%
HOUSEHOLDS WITH:		
Children Under 18	19,812	52.7%
Persons 65 and Over	5,592	14.9%
Householder 65 and Over	4,764	12.7%
Married Couple With Children	15,632	41.5%
Married Couple Without Children	10,358	27.5%
Female Householder With Children	2,541	6.8%
Female Householder Without Children	1,235	3.3%
Male Householder With Children	385	1.0%
Male Householder Without Children	605	1.6%
Non-Families	6,868	18.3%
PERSONS PER HOUSEHOLD:		
1 Person	5,947	15.8%
2 Persons	10,259	27.3%
3 Persons	7,496	19.9%
4+ Persons	13,887	36.9%
Total Households	37,589	100.0%
Average Household Income	$18,987	
Per Capita Income	$6,123	
FAMILIES		
Total Families	30,711	
Average Family Size	3.5	
Average Family Income	$20,676	
Family Population	108,485	
Nonfamily Population	8,075	
Group Quarters Population	1,455	
HOUSING		
Median Home Value	$36,341	
Average Home Value	$40,163	
Median Monthly Rent	$161	
Average Monthly Rent	$167	

UNITS AT ADDRESS:		
1 Unit	33,183	79.2%
2 - 9 Units	2,723	6.5%
10+ Units	2,775	6.6%
Mobile Home	3,215	7.7%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	5,741
Last 5 Years	17,061
6 - 9 Years Ago	5,339
10 - 14 Years Ago	3,659
15+ Years Ago	1,007
Socioeconomic Status Score	45
Private Sector Employment	35,670

Table 4F. Pearl River County, MS

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	33,795	37,161	10.0%	41,647
Total Households	11,004	12,454	13.2%	14,115
Household Population	33,217	36,583	10.1%	41,069
Average Household Size	3.0	2.9	-2.5%	2.9
Median Household Income	$12,458	$15,963	28.1%	$20,786

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	33,795	100.0%	37,161	41,647
0 - 5	3,408	10.1%	10.1%	10.1%
6 - 13	4,996	14.8%	13.5%	12.8%
14 - 17	2,735	8.1%	7.2%	6.5%
18 - 24	4,030	11.9%	13.3%	12.1%
25 - 34	4,779	14.1%	14.0%	15.8%
35 - 44	4,005	11.9%	12.6%	12.7%
45 - 54	3,464	10.3%	9.8%	10.3%
55 - 64	3,003	8.9%	9.1%	8.7%
65 +	3,375	10.0%	10.5%	11.2%
FEMALE POPULATION BY AGE	17,264	100.0%	19,014	21,329
0 - 5	1,650	9.6%	9.6%	9.6%
6 - 13	2,440	14.1%	12.8%	12.2%
14 - 17	1,344	7.8%	6.8%	6.1%
18 - 24	2,015	11.7%	12.8%	11.5%
25 - 34	2,470	14.3%	14.1%	15.6%
35 - 44	2,030	11.8%	12.6%	12.8%
45 - 54	1,782	10.3%	9.9%	10.3%
55 - 64	1,575	9.1%	9.4%	8.9%
65 +	1,958	11.3%	12.0%	12.9%
MALE POPULATION BY AGE	16,531	100.0%	18,147	20,318
0 - 5	1,758	10.6%	10.6%	10.6%
6 - 13	2,556	15.5%	14.3%	13.4%
14 - 17	1,391	8.4%	7.6%	6.9%
18 - 24	2,015	12.2%	13.8%	12.7%
25 - 34	2,309	14.0%	13.9%	16.1%
35 - 44	1,975	11.9%	12.5%	12.5%
45 - 54	1,682	10.2%	9.7%	10.2%
55 - 64	1,428	8.6%	8.8%	8.4%
65 +	1,417	8.6%	8.8%	9.3%
Median Age Total Population	28.6		29.1	29.7
Median Age Adult Population	41.2		40.8	40.8

TOTAL POPULATION	33,795	100.0%	37,161	41,647
White	28,622	84.7%	85.9%	87.2%
Black	5,032	14.9%	13.7%	12.3%
Other	141	.4%	.5%	.5%
Spanish	283	.8%	.8%	.9%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	3,521	31.8%	25.5%	19.0%
$ 7,500 - $ 9,999	1,091	9.8%	7.9%	5.8%
$10,000 - $14,999	1,883	17.0%	13.9%	10.3%
$15,000 - $24,999	2,510	22.7%	27.8%	25.8%
$25,000 - $34,999	1,269	11.5%	15.3%	24.1%
$35,000 - $49,999	577	5.2%	6.8%	10.5%
$50,000 - $74,999	134	1.2%	1.7%	2.8%
$75,000 +	92	.8%	1.1%	1.7%

	1980 Census Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	902	7.9%
Construction	1,338	11.6%
Manufacturing:		
Nondurable	917	8.0%
Durable	1,379	12.0%
Transportation	581	5.1%
Communications	251	2.2%
Wholesale Trade	272	2.4%
Retail Trade	1,832	16.0%
Fin/Ins/Real Est	376	3.3%
Bus/Repair Serv	522	4.5%
Pers/Ent/Rec Serv	265	2.3%
Prof/Related Serv:		
Health	602	5.2%
Educational	1,000	8.7%
Other	511	4.4%
Public Admin	737	6.4%
Total	11,485	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	903	7.9%
Prof	1,350	11.8%
Tech/Admin/Sales:		
Tech	398	3.5%
Admin/Clerical	1,421	12.4%
Sales	987	8.6%
Service:		
Private Household	38	.3%
Protective Serv	173	1.5%
Other Serv	911	7.9%
Farm/Forest/Fish	522	4.5%
Prod/Craft/Repair	2,239	19.5%

Oper/Fabr/Labrs:		
Mach Operators	1,031	9.0%
Trans/Mat Moving	886	7.7%
Handlrs/Cleanrs/ Helprs/Labrs	626	5.5%
Total Employed	11,485	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	34	.1%
Civ Labor Force:		
Employed	11,485	47.6%
Unemployed	1,063	4.4%
Not in Labor Force	11,564	47.9%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	10,230	93.4%
Public Trans	54	.5%
Other	671	6.1%
Total	10,955	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	4,046	38.1%
15 - 29 Minutes	2,320	21.9%
30 - 59 Minutes	2,314	21.8%
60 + Minutes	1,931	18.2%
Total	10,611	100.0%
EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	7,783	41.8%
12 Years	6,708	36.0%
13 - 15 Years	2,366	12.7%
16 + Years	1,760	9.5%
Median Years Completed	12.2	
MARITAL STATUS		
Male:		
Single	2,971	25.0%
Married	7,995	67.2%
Separated	179	1.5%
Widowed	297	2.5%
Divorced	447	3.8%
Total	11,889	100.0%
Female:		
Single	2,252	17.5%
Married	8,003	62.1%
Separated	290	2.2%
Widowed	1,726	13.4%
Divorced	618	4.8%
Total	12,889	100.0%

WORKING MOTHERS:		
With Children under 6	878	17.5%
With Children 6 - 17	1,310	26.2%
Subtotal	2,188	43.7%
Non-Working Mothers	2,815	56.3%
Total	5,003	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	7,723	85.8%
Female Householder	1,055	11.7%
Male Householder	221	2.5%
Total	8,999	100.0%
HOUSEHOLDS WITH:		
Children Under 18	5,377	48.9%
Persons 65 and Over	2,549	23.2%
Householder 65 and Over	2,290	20.8%
Married Couple With Children	4,472	40.4%
Married Couple Without Children	3,517	31.8%
Female Householder With Children	498	4.5%
Female Householder Without Children	445	4.0%
Male Householder With Children	68	.6%
Male Householder Without Children	107	1.0%
Non-Families	1,970	17.8%
PERSONS PER HOUSEHOLD:		
1 Person	1,903	17.3%
2 Persons	3,146	28.6%
3 Persons	2,064	18.8%
4+ Persons	3,891	35.4%
Total Households	11,004	100.0%
Average Household Income	$15,739	
Per Capita Income	$5,214	
FAMILIES		
Total Families	8,999	
Average Family Size	3.5	
Average Family Income	$17,641	
Family Population	31,087	
Nonfamily Population	2,130	
Group Quarters Population	578	
HOUSING		
Median Home Value	$34,623	
Average Home Value	$38,528	
Median Monthly Rent	$114	
Average Monthly Rent	$125	

UNITS AT ADDRESS:		
1 Unit	10,420	82.2%
2 - 9 Units	691	5.5%
10+ Units	181	1.4%
Mobile Home	1,384	10.9%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	1,699
Last 5 Years	4,267
6 - 9 Years Ago	1,266
10 - 14 Years Ago	1,279
15+ Years Ago	947
Socioeconomic Status Score	34
Private Sector Employment	5,085

Table 4G. Stone County, MS

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	9,716	10,173	4.7%	10,782
Total Households	2,996	3,234	7.9%	3,473
Household Population	9,049	9,506	5.1%	10,115
Average Household Size	3.0	2.9	-2.5%	2.9
Median Household Income	$13,563	$17,027	25.5%	$21,406

	1980 Census		1984	1989
	Number	Percent	Estimate	Projection
TOTAL POPULATION BY AGE	9,716	100.0%	10,173	10,782
0 - 5	892	9.2%	9.2%	9.5%
6 - 13	1,322	13.6%	12.5%	11.7%
14 - 17	750	7.7%	7.1%	6.1%
18 - 24	1,589	16.4%	15.7%	12.1%
25 - 34	1,326	13.6%	15.1%	19.4%
35 - 44	986	10.1%	11.4%	12.3%
45 - 54	885	9.1%	8.6%	8.9%
55 - 64	913	9.4%	9.0%	8.0%
65 +	1,053	10.8%	11.4%	12.0%
FEMALE POPULATION BY AGE	4,887	100.0%	5,135	5,455
0 - 5	447	9.1%	8.9%	9.1%
6 - 13	654	13.4%	12.5%	11.4%
14 - 17	363	7.4%	6.9%	6.1%
18 - 24	744	15.2%	15.1%	11.7%
25 - 34	662	13.5%	14.4%	18.4%
35 - 44	481	9.8%	11.1%	12.1%
45 - 54	460	9.4%	8.7%	8.7%
55 - 64	469	9.6%	9.4%	8.4%
65 +	607	12.4%	13.1%	14.0%
MALE POPULATION BY AGE	4,829	100.0%	5,038	5,327
0 - 5	445	9.2%	9.4%	9.8%
6 - 13	668	13.8%	12.4%	12.0%
14 - 17	387	8.0%	7.4%	6.0%
18 - 24	845	17.5%	16.4%	12.6%
25 - 34	664	13.8%	15.8%	20.5%
35 - 44	505	10.5%	11.7%	12.4%
45 - 54	425	8.8%	8.5%	9.1%
55 - 64	444	9.2%	8.6%	7.5%
65 +	446	9.2%	9.6%	10.0%
Median Age Total Population	27.2		28.2	29.6
Median Age Adult Population	39.6		39.2	38.9

TOTAL POPULATION	9,716	100.0%	10,173	10,782
White	7,463	76.8%	77.2%	77.9%
Black	2,195	22.6%	22.1%	21.4%
Other	58	.6%	.6%	.7
Spanish	87	.9%	.9%	.9%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	848	28.6%	22.6%	16.6%
$ 7,500 - $ 9,999	245	8.3%	6.6%	4.8%
$10,000 - $14,999	543	18.3%	14.5%	10.6%
$15,000 - $24,999	772	26.1%	31.0%	28.0%
$25,000 - $34,999	371	12.5%	17.0%	26.8%
$35,000 - $49,999	147	5.0%	6.7%	10.6%
$50,000 - $74,999	29	1.0%	1.4%	2.1%
$75,000 +	6	.2%	.2%	.4%

	1980 Census Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	205	6.2%
Construction	220	6.6%
Manufacturing:		
Nondurable	376	11.3%
Durable	636	19.1%
Transportation	144	4.3%
Communications	31	.9%
Wholesale Trade	132	4.0%
Retail Trade	415	12.5%
Fin/Ins/Real Est	47	1.4%
Bus/Repair Serv	71	2.1%
Pers/Ent/Rec Serv	121	3.6%
Prof/Related Serv:		
Health	139	4.2%
Educational	467	14.0%
Other	102	3.1%
Public Admin	225	6.8%
Total	3,331	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	190	5.7%
Prof	443	13.3%
Tech/Admin/Sales:		
Tech	90	2.7%
Admin/Clerical	383	11.5%
Sales	206	6.2%
Service:		
Private Household	47	1.4%
Protective Serv	41	1.2%
Other Serv	343	10.3%
Farm/Forest/Fish	272	8.2%
Prod/Craft/Repair	466	14.0%

Oper/Fabr/Labrs:		
Mach Operators	339	10.2%
Trans/Mat Moving	337	10.1%
Handlrs/Cleanrs/ Helprs/Labrs	174	5.2%
Total Employed	3,331	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	0	.0%
Civ Labor Force:		
Employed	3,331	46.6%
Unemployed	363	5.1%
Not in Labor Force	3,456	48.3%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	2,968	91.0%
Public Trans	15	.5%
Other	280	8.6%
Total	3,263	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	1,301	41.4%
15 - 29 Minutes	792	25.2%
30 - 59 Minutes	589	18.7%
60 + Minutes	461	14.7%
Total	3,143	100.0%
EDUCATION OF ADULTS OVER 25,		
YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	2,132	41.3%
12 Years	1,734	33.6%
13 - 15 Years	708	13.7%
16 + Years	589	11.4%
Median Years Completed	12.2	
MARITAL STATUS		
Male:		
Single	1,141	31.5%
Married	2,143	59.1%
Separated	60	1.7%
Widowed	110	3.0%
Divorced	172	4.7%
Total	3,626	100.0%
Female:		
Single	803	21.6%
Married	2,135	57.5%
Separated	59	1.6%
Widowed	532	14.3%
Divorced	181	4.9%
Total	3,710	100.0%

WORKING MOTHERS:		
With Children under 6	226	16.7%
With Children 6 - 17	388	28.7%
Subtotal	614	45.4%
Non-Working Mothers	737	54.6%
Total	1,351	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	2,054	85.3%
Female Householder	278	11.5%
Male Householder	75	3.1%
Total	2,407	100.0%
HOUSEHOLDS WITH:		
Children Under 18	1,401	46.8%
Persons 65 and Over	755	25.2%
Householder 65 and Over	662	22.1%
Married Couple With Children	1,047	35.4%
Married Couple Without Children	928	31.3%
Female Householder With Children	186	6.3%
Female Householder Without Children	146	4.9%
Male Householder With Children	35	1.2%
Male Householder Without Children	42	1.4%
Non-Families	577	19.5%
PERSONS PER HOUSEHOLD:		
1 Person	554	18.5%
2 Persons	864	28.8%
3 Persons	572	19.1%
4+ Persons	1,006	33.6%
Total Households	2,996	100.0%
Average Household Income	$15,234	
Per Capita Income	$5,044	
FAMILIES		
Total Families	2,407	
Average Family Size	3.5	
Average Family Income	$17,187	
Family Population	8,408	
Nonfamily Population	641	
Group Quarters Population	667	
HOUSING		
Median Home Value	$24,834	
Average Home Value	$29,496	
Median Monthly Rent	$103	
Average Monthly Rent	$110	

UNITS AT ADDRESS:		
1 Unit	2,858	84.7%
2 - 9 Units	152	4.5%
10+ Units	39	1.2%
Mobile Home	325	9.6%

1984 Estimate

NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	219
Last 5 Years	871
6 - 9 Years Ago	355
10 - 14 Years Ago	326
15+ Years Ago	317
Socioeconomic Status Score	34
Private Sector Employment	2,190

Table 4H. Biloxi City, MS

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	49,311	49,943	1.3%	51,442
Total Households	16,096	16,620	3.3%	17,274
Household Population	42,954	43,586	1.5%	45,085
Average Household Size	2.7	2.6	-1.6%	2.6
Median Household Income	$12,515	$15,145	21.0%	$19,585

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	49,311	100.0%	49,943	51,442
0 - 5	4,871	9.9%	9.8%	9.7%
6 - 13	5,347	10.8%	11.1%	11.4%
14 - 17	3,008	6.1%	8.3%	8.2%
18 - 24	11,665	23.7%	18.6%	16.9%
25 - 34	8,023	16.3%	18.7%	18.8%
35 - 44	4,338	8.8%	9.7%	11.8%
45 - 54	3,998	8.1%	7.2%	7.2%
55 - 64	3,835	7.8%	7.5%	6.8%
65 +	4,226	8.6%	9.0%	9.2%
FEMALE POPULATION BY AGE	23,563	100.0%	23,766	24,287
0 - 5	2,389	10.1%	10.1%	10.0%
6 - 13	2,635	11.2%	11.5%	11.9%
14 - 17	1,474	6.3%	6.7%	6.4%
18 - 24	4,524	19.2%	15.4%	13.2%
25 - 34	3,797	16.1%	19.0%	19.5%
35 - 44	2,171	9.2%	10.0%	12.1%
45 - 54	2,022	8.6%	7.7%	7.8%
55 - 64	1,980	8.4%	8.1%	7.1%
65 +	2,571	10.9%	11.5%	11.9%
MALE POPULATION BY AGE	25,748	100.0%	26,177	27,155
0 - 5	2,482	9.6%	9.6%	9.5%
6 - 13	2,712	10.5%	10.8%	11.0%
14 - 17	1,534	6.0%	9.8%	9.8%
18 - 24	7,141	27.7%	21.6%	20.2%
25 - 34	4,226	16.4%	18.4%	18.1%
35 - 44	2,167	8.4%	9.4%	11.5%
45 - 54	1,976	7.7%	6.8%	6.7%
55 - 64	1,855	7.2%	7.0%	6.5%
65 +	1,655	6.4%	6.7%	6.8%
Median Age Total Population	24.8		25.9	26.9
Median Age Adult Population	32.4		33.7	34.8

TOTAL POPULATION	49,311	100.0%	49,943	51,442
White	38,739	78.6%	76.4%	74.0%
Black	8,727	17.7%	19.4%	21.0%
Other	1,845	3.7%	4.2%	5.1%
Spanish	1,419	2.9%	2.9%	2.8%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	4,475	27.9%	21.9%	15.8%
$ 7,500 - $ 9,999	1,818	11.3%	9.0%	6.7%
$10,000 - $14,999	3,442	21.4%	18.7%	14.0%
$15,000 - $24,999	3,688	23.0%	28.9%	29.5%
$25,000 - $34,999	1,524	9.5%	12.8%	20.0%
$35,000 - $49,999	715	4.5%	5.6%	9.3%
$50,000 - $74,999	302	1.9%	2.4%	3.7%
$75,000 +	87	.5%	.7%	1.1%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	305	2.2%
Construction	969	7.0%
Manufacturing:		
Nondurable	545	3.9%
Durable	898	6.5%
Transportation	359	2.6%
Communications	436	3.1%
Wholesale Trade	495	3.6%
Retail Trade	2,955	21.3%
Fin/Ins/Real Est	668	4.8%
Bus/Repair Serv	418	3.0%
Pers/Ent/Rec Serv	1,177	8.5%
Prof/Related Serv:		
Health	1,282	9.2%
Educational	1,131	8.2%
Other	695	5.0%
Public Admin	1,542	11.1%
Total	13,875	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	1,291	9.3%
Prof	1,787	12.9%
Tech/Admin/Sales:		
Tech	519	3.7%
Admin/Clerical	2,008	14.5%
Sales	1,663	12.0%
Service:		
Private Household	100	.7%
Protective Serv	286	2.1%
Other Serv	2,444	17.6%
Farm/Forest/Fish	137	1.0%
Prod/Craft/Repair	1,729	12.5%

Oper/Fabr/Labrs:		
Mach Operators	668	4.8%
Trans/Mat Moving	601	4.3%
Handlrs/Cleanrs/ Helprs/Labrs	642	4.6%
Total Employed	13,875	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	9,590	25.4%
Civ Labor Force:		
Employed	13,875	36.7%
Unemployed	1,393	3.7%
Not in Labor Force	12,910	34.2%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	16,126	70.0%
Public Trans	201	.9%
Other	6,697	29.1%
Total	23,024	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	11,729	51.6%
15 - 29 Minutes	8,303	36.5%
30 - 59 Minutes	2,178	9.6%
60 + Minutes	516	2.3%
Total	22,726	100.0%
EDUCATION OF ADULTS OVER 25,		
YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	7,208	29.6%
12 Years	8,989	36.9%
13 - 15 Years	4,711	19.3%
16 + Years	3,481	14.3%
Median Years Completed	12.5	
MARITAL STATUS		
Male:		
Single	7,628	37.7%
Married	10,309	50.9%
Separated	388	1.9%
Widowed	437	2.2%
Divorced	1,475	7.3%
Total	20,237	100.0%
Female:		
Single	4,039	22.2%
Married	9,860	54.2%
Separated	489	2.7%
Widowed	2,203	12.1%
Divorced	1,617	8.9%
Total	18,208	100.0%

WORKING MOTHERS:		
With Children under 6	1,450	22.8%
With Children 6 - 17	1,704	26.8%
Subtotal	3,154	49.7%
Non-Working Mothers	3,197	50.3%
Total	6,351	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	9,324	80.8%
Female Householder	1,839	15.9%
Male Householder	381	3.3%
Total	11,544	100.0%
HOUSEHOLDS WITH:		
Children Under 18	6,805	42.3%
Persons 65 and Over	3,304	20.5%
Householder 65 and Over	2,967	18.4%
Married Couple With Children	5,127	31.9%
Married Couple Without Children	4,377	27.3%
Female Householder With Children	1,056	6.6%
Female Householder Without Children	578	3.6%
Male Householder With Children	151	.9%
Male Householder Without Children	228	1.4%
Non-Families	4,534	28.2%
PERSONS PER HOUSEHOLD:		
1 Person	704	3.8%
2 Persons	3,068	16.4%
3 Persons	3,129	16.7%
4+ Persons	11,836	63.2%
Total Households	18,737	100.0%
Average Household Income	$15,458	
Per Capita Income	$5,793	
FAMILIES		
Total Families	11,544	
Average Family Size	3.3	
Average Family Income	$17,730	
Family Population	37,705	
Nonfamily Population	5,249	
Group Quarters Population	6,357	
HOUSING		
Median Home Value	$34,589	
Average Home Value	$40,876	
Median Monthly Rent	$167	
Average Monthly Rent	$167	

UNITS AT ADDRESS:		
1 Unit	12,193	68.3%
2 - 9 Units	2,090	11.7%
10+ Units	2,471	13.8%
Mobile Home	1,098	6.2%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	3,249
Last 5 Years	7,150
6 - 9 Years Ago	1,532
10 - 14 Years Ago	1,286
15+ Years Ago	1,798
Socioeconomic Status Score	40
Private Sector Employment	9,757

Table 4I. D'Iberville City, MS

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	13,369	15,519	16.1%	18,268
Total Households	4,084	4,921	20.5%	5,864
Household Population	13,369	15,515	16.1%	18,264
Average Household Size	3.3	3.2	-3.5%	3.1
Median Household Income	$15,196	$21,234	39.7%	$27,254

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	13,369	100.0%	15,519	18,268
0 - 5	1,448	10.8%	10.4%	10.0%
6 - 13	2,076	15.5%	13.7%	13.0%
14 - 17	1,295	9.7%	7.6%	6.4%
18 - 24	1,820	13.6%	14.6%	12.5%
25 - 34	2,261	16.9%	16.3%	17.8%
35 - 44	1,818	13.6%	14.3%	14.2%
45 - 54	1,232	9.2%	10.3%	11.7%
55 - 64	796	6.0%	7.3%	8.0%
65 +	623	4.7%	5.4%	6.4%
FEMALE POPULATION BY AGE	6,729	100.0%	7,824	9,239
0 - 5	692	10.3%	10.1%	9.7%
6 - 13	1,044	15.5%	13.4%	12.5%
14 - 17	633	9.4%	7.4%	6.3%
18 - 24	918	13.6%	14.4%	12.2%
25 - 34	1,135	16.9%	16.5%	17.9%
35 - 44	936	13.9%	14.6%	14.3%
45 - 54	612	9.1%	10.3%	12.0%
55 - 64	404	6.0%	7.2%	7.9%
65 +	355	5.3%	6.0%	7.3%
MALE POPULATION BY AGE	6,640	100.0%	7,695	9,029
0 - 5	756	11.4%	10.8%	10.4%
6 - 13	1,032	15.5%	14.0%	13.4%
14 - 17	662	10.0%	7.8%	6.6%
18 - 24	902	13.6%	14.8%	12.8%
25 - 34	1,126	17.0%	16.2%	17.8%
35 - 44	882	13.3%	14.0%	14.0%
45 - 54	620	9.3%	10.3%	11.4%
55 - 64	392	5.9%	7.4%	8.1%
65 +	268	4.0%	4.7%	5.6%
Median Age Total Population	25.1		27.1	29.0
Median Age Adult Population	36.0		37.2	38.5

TOTAL POPULATION	13,369	100.0%	15,519	18,268
White	12,376	92.6%	94.0%	94.1%
Black	746	5.6%	4.0%	3.9%
Other	247	1.8%	1.9%	2.0%
Spanish	319	2.4%	2.2%	2.2%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	711	17.5%	11.6%	8.2%
$ 7,500 - $ 9,999	393	9.7%	6.3%	4.4%
$10,000 - $14,999	899	22.2%	14.4%	10.0%
$15,000 - $24,999	1,270	31.3%	28.2%	19.5%
$25,000 - $34,999	581	14.3%	26.8%	35.1%
$35,000 - $49,999	157	3.9%	9.5%	17.1%
$50,000 - $74,999	35	.9%	2.5%	4.6%
$75,000 +	12	.3%	.6%	1.1%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	152	3.1%
Construction	329	6.7%
Manufacturing:		
Nondurable	144	2.9%
Durable	552	11.3%
Transportation	134	2.7%
Communications	174	3.6%
Wholesale Trade	199	4.1%
Retail Trade	1,222	25.0%
Fin/Ins/Real Est	186	3.8%
Bus/Repair Serv	224	4.6%
Pers/Ent/Rec Serv	309	6.3%
Prof/Related Serv:		
Health	297	6.1%
Educational	183	3.7%
Other	251	5.1%
Public Admin	529	10.8%
Total	4,885	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	369	7.6%
Prof	351	7.2%
Tech/Admin/Sales:		
Tech	189	3.9%
Admin/Clerical	727	14.9%
Sales	584	12.0%
Service:		
Private Household	15	.3%
Protective Serv	125	2.6%
Other Serv	789	16.2%
Farm/Forest/Fish	73	1.5%
Prod/Craft/Repair	983	20.1%

Oper/Fabr/Labrs:		
Mach Operators	251	5.1%
Trans/Mat Moving	189	3.9%
Handlrs/Cleanrs/ Helprs/Labrs	240	4.9%
Total Employed	4,885	100.0%

EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	594	6.5%
Civ Labor Force:		
Employed	4,885	53.2%
Unemployed	326	3.5%
Not in Labor Force	3,383	36.8%

MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	4,971	94.6%
Public Trans	40	.8%
Other	243	4.6%
Total	5,254	100.0%

TRAVEL TIME TO WORK:		
0 - 14 Minutes	1,282	24.1%
15 - 29 Minutes	2,569	48.3%
30 - 59 Minutes	1,101	20.7%
60 + Minutes	368	6.9%
Total	5,320	100.0%

EDUCATION OF ADULTS OVER 25,		
YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	2,233	33.0%
12 Years	3,029	44.8%
13 - 15 Years	1,113	16.5%
16 + Years	384	5.7%
Median Years Completed	12.3	

MARITAL STATUS		
Male:		
Single	1,205	25.7%
Married	3,158	67.3%
Separated	50	1.1%
Widowed	66	1.4%
Divorced	213	4.5%
Total	4,692	100.0%
Female:		
Single	902	18.6%
Married	3,173	65.4%
Separated	93	1.9%
Widowed	352	7.3%
Divorced	329	6.8%
Total	4,849	100.0%

WORKING MOTHERS:		
With Children under 6	444	18.6%
With Children 6 - 17	798	33.5%
Subtotal	1,242	52.1%
Non-Working Mothers	1,143	47.9%
Total	2,385	100.0%

FAMILY HOUSEHOLDS:		
Married Couple	3,074	86.4%
Female Householder	388	10.9%
Male Householder	95	2.7%
Total	3,557	100.0%

HOUSEHOLDS WITH:		
Children Under 18	2,420	59.3%
Persons 65 and Over	500	12.2%
Householder 65 and Over	409	10.0%
Married Couple With Children	2,063	50.8%
Married Couple Without Children	1,054	26.0%
Female Householder With Children	242	6.0%
Female Householder Without Children	98	2.4%
Male Householder With Children	42	1.0%
Male Householder Without Children	47	1.2%
Non-Families	512	12.6%

PERSONS PER HOUSEHOLD:		
1 Person	335	8.9%
2 Persons	394	10.5%
3 Persons	655	17.4%
4+ Persons	2,377	63.2%
Total Households	3,761	100.0%

Average Household Income	$16,660
Per Capita Income	$5,089

FAMILIES	
Total Families	3,557
Average Family Size	3.6
Average Family Income	$17,597

Family Population	12,760
Nonfamily Population	609
Group Quarters Population	0

HOUSING	
Median Home Value	$35,986
Average Home Value	$36,221
Median Monthly Rent	$173
Average Monthly Rent	$176

UNITS AT ADDRESS:		
1 Unit	3,802	86.8%
2 - 9 Units	164	3.7%
10+ Units	32	.7%
Mobile Home	382	8.7%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	768
Last 5 Years	2,300
6 - 9 Years Ago	927
10 - 14 Years Ago	506
15+ Years Ago	242
Socioeconomic Status Score	48
Private Sector Employment	1,367

Table 4J. Gulfport City, MS

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	39,676	39,557	-.2%	38,998
Total Households	14,711	14,834	.8%	14,700
Household Population	38,177	37,738	-1.0%	37,179
Average Household Size	2.6	2.5	-1.8%	2.5
Median Household Income	$13,059	$16,430	25.8%	$21,163

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	39,676	100.0%	39,557	38,998
0 - 5	3,455	8.7%	8.6%	8.7%
6 - 13	4,596	11.6%	11.0%	11.1%
14 - 17	2,714	6.8%	6.0%	5.6%
18 - 24	5,368	13.5%	13.0%	11.3%
25 - 34	6,112	15.4%	16.8%	17.5%
35 - 44	3,974	10.0%	11.3%	13.0%
45 - 54	4,374	11.0%	9.8%	9.3%
55 - 64	4,344	10.9%	10.9%	9.9%
65 +	4,739	11.9%	12.5%	13.5%
FEMALE POPULATION BY AGE	20,390	100.0%	20,114	19,836
0 - 5	1,758	8.6%	8.4%	8.4%
6 - 13	2,261	11.1%	10.9%	10.9%
14 - 17	1,361	6.7%	5.7%	5.3%
18 - 24	2,722	13.3%	12.3%	10.4%
25 - 34	3,038	14.9%	16.2%	17.0%
35 - 44	2,032	10.0%	11.3%	12.9%
45 - 54	2,256	11.1%	9.8%	9.3%
55 - 64	2,213	10.9%	11.1%	10.2%
65 +	2,749	13.5%	14.3%	15.6%
MALE POPULATION BY AGE	19,286	100.0%	19,443	19,162
0 - 5	1,697	8.8%	8.9%	9.0%
6 - 13	2,335	12.1%	11.2%	11.2%
14 - 17	1,353	7.0%	6.4%	6.0%
18 - 24	2,646	13.7%	13.8%	12.2%
25 - 34	3,074	15.9%	17.4%	18.0%
35 - 44	1,942	10.1%	11.4%	13.2%
45 - 54	2,118	11.0%	9.8%	9.4%
55 - 64	2,131	11.0%	10.6%	9.6%
65 +	1,990	10.3%	10.7%	11.4%
Median Age Total Population	30.6		31.3	32.5
Median Age Adult Population	42.4		41.4	41.5

TOTAL POPULATION	39,676	100.0%	39,557	38,998
White	29,329	73.9%	72.1%	71.2%
Black	9,944	25.1%	26.9%	27.7%
Other	403	1.0%	1.0%	1.1%
Spanish	640	1.6%	1.5%	1.5%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	4,183	28.5%	22.3%	16.4%
$ 7,500 - $ 9,999	1,519	10.3%	7.9%	5.7%
$10,000 - $14,999	2,692	18.3%	16.0%	11.8%
$15,000 - $24,999	3,412	23.2%	26.8%	26.1%
$25,000 - $34,999	1,684	11.5%	15.1%	21.9%
$35,000 - $49,999	719	4.9%	7.0%	10.1%
$50,000 - $74,999	299	2.0%	3.1%	5.0%
$75,000 +	192	1.3%	1.9%	3.0%

	1980 Census	
	Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	284	1.8%
Construction	1,093	7.1%
Manufacturing:		
Nondurable	738	4.8%
Durable	887	5.7%
Transportation	896	5.8%
Communications	669	4.3%
Wholesale Trade	521	3.4%
Retail Trade	3,202	20.7%
Fin/Ins/Real Est	976	6.3%
Bus/Repair Serv	613	4.0%
Pers/Ent/Rec Serv	971	6.3%
Prof/Related Serv:		
Health	1,347	8.7%
Educational	1,093	7.1%
Other	698	4.5%
Public Admin	1,510	9.7%
Total	15,498	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	1,710	11.0%
Prof	1,983	12.8%
Tech/Admin/Sales:		
Tech	436	2.8%
Admin/Clerical	2,304	14.9%
Sales	1,978	12.8%
Service:		
Private Household	105	.7%
Protective Serv	360	2.3%
Other Serv	2,099	13.5%
Farm/Forest/Fish	179	1.2%
Prod/Craft/Repair	2,024	13.1%

Oper/Fabr/Labrs:		
Mach Operators	737	4.8%
Trans/Mat Moving	810	5.2%
Handlrs/Cleanrs/ Helprs/Labrs	773	5.0%
Total Employed	15,498	100.0%

EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	718	2.4%
Civ Labor Force:		
Employed	15,498	51.0%
Unemployed	1,035	3.4%
Not in Labor Force	13,134	43.2%

MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	14,547	91.6%
Public Trans	165	1.0%
Other	1,171	7.4%
Total	15,883	100.0%

TRAVEL TIME TO WORK:		
0 - 14 Minutes	7,010	44.4%
15 - 29 Minutes	6,399	40.5%
30 - 59 Minutes	1,796	11.4%
60 + Minutes	582	3.7%
Total	15,787	100.0%

EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	7,841	33.3%
12 Years	7,686	32.6%
13 - 15 Years	4,176	17.7%
16 + Years	3,847	16.3%
Median Years Completed	12.5	

MARITAL STATUS		
Male:		
Single	4,195	28.1%
Married	8,414	56.3%
Separated	381	2.6%
Widowed	535	3.6%
Divorced	1,415	9.5%
Total	14,940	100.0%
Female:		
Single	3,156	19.6%
Married	8,222	51.2%
Separated	534	3.3%
Widowed	2,407	15.0%
Divorced	1,744	10.9%
Total	16,063	100.0%

WORKING MOTHERS:		
With Children under 6	1,102	21.3%
With Children 6 - 17	1,806	34.9%
Subtotal	2,908	56.1%
Non-Working Mothers	2,272	43.9%
Total	5,180	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	7,830	76.4%
Female Householder	2,011	19.6%
Male Householder	404	3.9%
Total	10,245	100.0%
HOUSEHOLDS WITH:		
Children Under 18	5,519	37.5%
Persons 65 and Over	3,315	22.5%
Householder 65 and Over	2,917	19.8%
Married Couple With Children	3,675	25.0%
Married Couple Without Children	4,273	29.1%
Female Householder With Children	1,263	8.6%
Female Householder Without Children	631	4.3%
Male Householder With Children	133	.9%
Male Householder Without Children	289	2.0%
Non-Families	4,436	30.2%
PERSONS PER HOUSEHOLD:		
1 Person	805	4.8%
2 Persons	2,204	13.0%
3 Persons	2,724	16.1%
4+ Persons	11,179	66.1%
Total Households	16,912	100.0%
Average Household Income	$16,944	
Per Capita Income	$6,529	
FAMILIES		
Total Families	10,245	
Average Family Size	3.2	
Average Family Income	$19,828	
Family Population	33,081	
Nonfamily Population	5,096	
Group Quarters Population	1,499	
HOUSING		
Median Home Value	$35,069	
Average Home Value	$41,196	
Median Monthly Rent	$149	
Average Monthly Rent	$155	

UNITS AT ADDRESS:		
1 Unit	11,917	74.2%
2 - 9 Units	1,788	11.1%
10+ Units	1,701	10.6%
Mobile Home	646	4.0%

1984 Estimate

NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	2,448
Last 5 Years	5,541
6 - 9 Years Ago	1,547
10 - 14 Years Ago	1,356
15+ Years Ago	2,428
Socioeconomic Status Score	44
Private Sector Employment	16,851

Table 4K. Orange Grove City, MS

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	13,476	16,377	21.5%	20,324
Total Households	4,133	5,151	24.6%	6,460
Household Population	13,476	16,331	21.2%	20,278
Average Household Size	3.3	3.2	-2.6%	3.1
Median Household Income	$18,848	$23,186	23.0%	$29,849

	1980 Census Number	1980 Census Percent	1984 Estimate	1989 Projection
TOTAL POPULATION BY AGE	13,476	100.0%	16,377	20,324
0 - 5	1,632	12.1%	12.1%	11.8%
6 - 13	2,347	17.4%	15.8%	14.8%
14 - 17	1,096	8.1%	7.5%	7.2%
18 - 24	1,446	10.7%	12.0%	12.3%
25 - 34	2,747	20.4%	17.1%	14.7%
35 - 44	1,880	14.0%	15.3%	16.4%
45 - 54	1,143	8.5%	9.1%	10.6%
55 - 64	684	5.1%	6.5%	6.6%
65 +	501	3.7%	4.6%	5.5%
FEMALE POPULATION BY AGE	6,792	100.0%	8,244	10,255
0 - 5	796	11.7%	11.8%	11.4%
6 - 13	1,132	16.7%	15.4%	14.4%
14 - 17	538	7.9%	7.2%	7.0%
18 - 24	745	11.0%	11.9%	11.8%
25 - 34	1,477	21.7%	17.7%	14.9%
35 - 44	939	13.8%	15.7%	17.3%
45 - 54	550	8.1%	8.9%	10.6%
55 - 64	334	4.9%	6.4%	6.5%
65 +	281	4.1%	5.0%	6.1%
MALE POPULATION BY AGE	6,684	100.0%	8,133	10,069
0 - 5	836	12.5%	12.4%	12.2%
6 - 13	1,215	18.2%	16.2%	15.2%
14 - 17	558	8.3%	7.8%	7.5%
18 - 24	701	10.5%	12.2%	12.7%
25 - 34	1,270	19.0%	16.4%	14.5%
35 - 44	941	14.1%	14.8%	15.5%
45 - 54	593	8.9%	9.3%	10.7%
55 - 64	350	5.2%	6.5%	6.7%
65 +	220	3.3%	4.2%	5.0%
Median Age Total Population	25.7		26.6	27.5
Median Age Adult Population	35.0		37.0	38.7

TOTAL POPULATION	13,476	100.0%	16,377	20,324
White	12,478	92.6%	93.0%	93.1%
Black	737	5.5%	5.4%	5.3%
Other	261	1.9%	1.6%	1.6%
Spanish	240	1.8%	1.6%	1.7%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	599	14.9%	12.5%	8.1%
$ 7,500 - $ 9,999	276	6.9%	4.8%	3.1%
$10,000 - $14,999	669	16.7%	13.0%	8.5%
$15,000 - $24,999	1,198	29.9%	24.1%	15.7%
$25,000 - $34,999	836	20.8%	29.9%	30.3%
$35,000 - $49,999	283	7.1%	10.8%	23.8%
$50,000 - $74,999	125	3.1%	3.7%	8.1%
$75,000 +	25	.6%	1.2%	2.6%

	1980 Census Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	141	2.7%
Construction	440	8.4%
Manufacturing:		
Nondurable	395	7.6%
Durable	481	9.2%
Transportation	199	3.8%
Communications	204	3.9%
Wholesale Trade	128	2.5%
Retail Trade	1,078	20.6%
Fin/Ins/Real Est	330	6.3%
Bus/Repair Serv	243	4.7%
Pers/Ent/Rec Serv	149	2.9%
Prof/Related Serv:		
Health	375	7.2%
Educational	500	9.6%
Other	164	3.1%
Public Admin	396	7.6%
Total	5,223	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	599	11.5%
Prof	669	12.8%
Tech/Admin/Sales:		
Tech	213	4.1%
Admin/Clerical	743	14.2%
Sales	681	13.0%
Service:		
Private Household	0	.0%
Protective Serv	80	1.5%
Other Serv	494	9.5%
Farm/Forest/Fish	32	.6%
Prod/Craft/Repair	839	16.1%

Oper/Fabr/Labrs:		
Mach Operators	396	7.6%
Trans/Mat Moving	285	5.5%
Handlrs/Cleanrs/ Helprs/Labrs	192	3.7%
Total Employed	5,223	100.0%

EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	398	4.5%
Civ Labor Force:		
Employed	5,223	58.6%
Unemployed	431	4.8%
Not in Labor Force	2,864	32.1%

MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	5,107	94.3%
Public Trans	11	.2%
Other	296	5.5%
Total	5,414	100.0%

TRAVEL TIME TO WORK:		
0 - 14 Minutes	1,315	24.7%
15 - 29 Minutes	2,765	51.9%
30 - 59 Minutes	832	15.6%
60 + Minutes	418	7.8%
Total	5,330	100.0%

EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	1,909	27.4%
12 Years	2,670	38.3%
13 - 15 Years	1,300	18.7%
16 + Years	1,091	15.7%
Median Years Completed	12.5	

MARITAL STATUS		
Male:		
Single	981	21.8%
Married	3,240	72.1%
Separated	41	.9%
Widowed	33	.7%
Divorced	198	4.4%
Total	4,493	100.0%
Female:		
Single	721	15.3%
Married	3,338	70.8%
Separated	64	1.4%
Widowed	260	5.5%
Divorced	329	7.0%
Total	4,712	100.0%

WORKING MOTHERS:		
With Children under 6	652	27.4%
With Children 6 - 17	761	32.0%
Subtotal	1,413	59.3%
Non-Working Mothers	968	40.7%
Total	2,381	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	3,156	86.3%
Female Householder	404	11.0%
Male Householder	97	2.7%
Total	3,657	100.0%
HOUSEHOLDS WITH:		
Children Under 18	2,515	60.9%
Persons 65 and Over	374	9.0%
Householder 65 and Over	290	7.0%
Married Couple With Children	1,966	49.0%
Married Couple Without Children	1,081	27.0%
Female Householder With Children	293	7.3%
Female Householder Without Children	79	2.0%
Male Householder With Children	77	1.9%
Male Householder Without Children	42	1.0%
Non-Families	473	11.8%
PERSONS PER HOUSEHOLD:		
1 Person	797	19.7%
2 Persons	350	8.6%
3 Persons	512	12.6%
4+ Persons	2,393	59.1%
Total Households	4,052	100.0%
Average Household Income	$19,698	
Per Capita Income	$6,041	
FAMILIES		
Total Families	3,657	
Average Family Size	3.5	
Average Family Income	$20,597	
Family Population	12,912	
Nonfamily Population	564	
Group Quarters Population	0	
HOUSING		
Median Home Value	$41,950	
Average Home Value	$44,483	
Median Monthly Rent	$209	
Average Monthly Rent	$206	

UNITS AT ADDRESS:

1 Unit	4,006	90.5%
2 - 9 Units	92	2.1%
10+ Units	60	1.4%
Mobile Home	269	6.1%

1984 Estimate

NEIGHBORHOOD MOBILITY

HOUSEHOLD MOVED IN:

Most Recent Year	667
Last 5 Years	1,835
6 - 9 Years Ago	617
10 - 14 Years Ago	375
15+ Years Ago	191

Socioeconomic Status Score	52
Private Sector Employment	1,462

Table 4L. Pascagoula City, MS

	1980 Census	1984 Estimate	% Change 80 to 84	1989 Projection
Total Population	29,318	32,105	9.5%	35,305
Total Households	10,033	11,131	10.9%	12,379
Household Population	28,158	30,945	9.9%	34,145
Average Household Size	2.8	2.8	-.8%	2.8
Median Household Income	$16,250	$20,381	25.4%	$26,759

	1980 Census		1984	1989
	Number	Percent	Estimate	Projection
TOTAL POPULATION BY AGE	29,318	100.0%	32,105	35,305
0 - 5	2,946	10.0%	10.0%	10.0%
6 - 13	3,805	13.0%	12.7%	12.6%
14 - 17	2,234	7.6%	6.7%	6.2%
18 - 24	4,642	15.8%	13.9%	11.7%
25 - 34	4,959	16.9%	18.7%	18.7%
35 - 44	3,430	11.7%	12.5%	14.2%
45 - 54	2,772	9.5%	9.1%	9.6%
55 - 64	2,373	8.1%	8.3%	7.8%
65 +	2,157	7.4%	8.2%	9.1%
FEMALE POPULATION BY AGE	14,387	100.0%	15,823	17,464
0 - 5	1,447	10.1%	9.9%	9.9%
6 - 13	1,879	13.1%	12.7%	12.5%
14 - 17	1,094	7.6%	6.5%	5.9%
18 - 24	2,137	14.9%	13.0%	10.7%
25 - 34	2,249	15.6%	17.7%	18.4%
35 - 44	1,651	11.5%	12.2%	13.5%
45 - 54	1,403	9.8%	9.3%	9.8%
55 - 64	1,241	8.6%	8.8%	8.2%
65 +	1,286	8.9%	9.9%	11.0%
MALE POPULATION BY AGE	14,931	100.0%	16,282	17,841
0 - 5	1,499	10.0%	10.0%	10.1%
6 - 13	1,926	12.9%	12.7%	12.7%
14 - 17	1,140	7.6%	6.9%	6.4%
18 - 24	2,505	16.8%	14.8%	12.7%
25 - 34	2,710	18.2%	19.6%	19.0%
35 - 44	1,779	11.9%	12.8%	14.8%
45 - 54	1,369	9.2%	8.9%	9.5%
55 - 64	1,132	7.6%	7.9%	7.4%
65 +	871	5.8%	6.5%	7.3%
Median Age Total Population	26.8		28.3	30.1
Median Age Adult Population	36.6		37.2	38.6

TOTAL POPULATION	29,318	100.0%	32,105	35,305
White	24,005	81.9%	80.3%	79.4%
Black	4,920	16.8%	18.3%	19.1%
Other	393	1.3%	1.4%	1.5%
Spanish	403	1.4%	1.3%	1.3%
HOUSEHOLD INCOME				
$ 0 - $ 7,499	2,109	21.1%	16.2%	11.3%
$ 7,500 - $ 9,999	767	7.7%	5.7%	4.0%
$10,000 - $14,999	1,772	17.7%	13.2%	9.1%
$15,000 - $24,999	2,838	28.4%	27.7%	21.0%
$25,000 - $34,999	1,505	15.0%	21.3%	26.3%
$35,000 - $49,999	709	7.1%	11.2%	19.7%
$50,000 - $74,999	247	2.5%	3.8%	6.9%
$75,000 +	60	.6%	.9%	1.7%

	1980 Census Number	Percent
INDUSTRY:		
Agr/For/Fish/Min	217	1.8%
Construction	743	6.2%
Manufacturing:		
Nondurable	1,111	9.2%
Durable	3,080	25.6%
Transportation	258	2.1%
Communications	226	1.9%
Wholesale Trade	349	2.9%
Retail Trade	2,127	17.7%
Fin/Ins/Real Est	534	4.4%
Bus/Repair Serv	354	2.9%
Pers/Ent/Rec Serv	392	3.3%
Prof/Related Serv:		
Health	682	5.7%
Educational	886	7.4%
Other	436	3.6%
Public Admin	646	5.4%
Total	12,041	100.0%
OCCUPATION:		
Mgr/Prof:		
Mgr	1,158	9.6%
Prof	1,545	12.8%
Tech/Admin/Sales:		
Tech	372	3.1%
Admin/Clerical	1,938	16.1%
Sales	1,116	9.3%
Service:		
Private Household	85	.7%
Protective Serv	257	2.1%
Other Serv	986	8.2%
Farm/Forest/Fish	118	1.0%
Prod/Craft/Repair	2,350	19.5%

Oper/Fabr/Labrs:		
Mach Operators	1,134	9.4%
Trans/Mat Moving	320	2.7%
Handlrs/Cleanrs/ Helprs/Labrs	662	5.5%
Total Employed	12,041	100.0%
EMPLOYMENT STATUS:		
Labor Force:		
Armed Forces	995	4.6%
Civ Labor Force:		
Employed	12,041	56.0%
Unemployed	1,080	5.0%
Not in Labor Force	7,369	34.3%
MEANS TRANSPORTATION TO WORK:		
Drive/Carpool	11,377	89.3%
Public Trans	182	1.4%
Other	1,188	9.3%
Total	12,747	100.0%
TRAVEL TIME TO WORK:		
0 - 14 Minutes	6,131	48.5%
15 - 29 Minutes	5,002	39.6%
30 - 59 Minutes	1,122	8.9%
60 + Minutes	385	3.0%
Total	12,640	100.0%
EDUCATION OF ADULTS OVER 25, YEARS OF SCHOOL COMPLETED:		
0 - 11 Years	4,756	30.3%
12 Years	5,857	37.3%
13 - 15 Years	2,987	19.0%
16 + Years	2,091	13.3%
Median Years Completed	12.5	
MARITAL STATUS		
Male:		
Single	3,356	29.9%
Married	6,624	58.9%
Separated	257	2.3%
Widowed	195	1.7%
Divorced	806	7.2%
Total	11,238	100.0%
Female:		
Single	2,144	19.8%
Married	6,254	57.8%
Separated	296	2.7%
Widowed	1,167	10.8%
Divorced	951	8.8%
Total	10,812	100.0%

WORKING MOTHERS:		
With Children under 6	940	22.2%
With Children 6 - 17	1,329	31.4%
Subtotal	2,269	53.6%
Non-Working Mothers	1,966	46.4%
Total	4,235	100.0%
FAMILY HOUSEHOLDS:		
Married Couple	6,009	79.8%
Female Householder	1,218	16.2%
Male Householder	305	4.0%
Total	7,532	100.0%
HOUSEHOLDS WITH:		
Children Under 18	4,543	45.3%
Persons 65 and Over	1,585	15.8%
Householder 65 and Over	1,380	13.8%
Married Couple With Children	3,410	34.1%
Married Couple Without Children	2,735	27.3%
Female Householder With Children	698	7.0%
Female Householder Without Children	399	4.0%
Male Householder With Children	80	.8%
Male Householder Without Children	161	1.6%
Non-Families	2,524	25.2%
PERSONS PER HOUSEHOLD:		
1 Person	317	2.6%
2 Persons	3,361	27.3%
3 Persons	1,567	12.7%
4+ Persons	7,078	57.4%
Total Households	12,323	100.0%
Average Household Income	$18,906	
Per Capita Income	$6,736	
FAMILIES		
Total Families	7,532	
Average Family Size	3.3	
Average Family Income	$21,256	
Family Population	25,204	
Nonfamily Population	2,954	
Group Quarters Population	1,160	
HOUSING		
Median Home Value	$34,782	
Average Home Value	$38,629	
Median Monthly Rent	$159	
Average Monthly Rent	$166	

UNITS AT ADDRESS:		
1 Unit	8,170	71.8%
2 - 9 Units	975	8.6%
10+ Units	1,999	17.6%
Mobile Home	229	2.0%

	1984 Estimate
NEIGHBORHOOD MOBILITY	
HOUSEHOLD MOVED IN:	
Most Recent Year	1,590
Last 5 Years	3,925
6 - 9 Years Ago	1,187
10 - 14 Years Ago	2,222
15+ Years Ago	265
Socioeconomic Status Score	45
Private Sector Employment	17,370

C. Economic Considerations

The economic aspects explored in this artificial reef siting plan development study include recreational fishing benefits, costs of dismantling and transporting platforms, costs of maintaining platforms as artificial reefs, and procedures for estimating the value of an artificial reef (platform or other) to a coastal community. The following items are significant to this study.

Identifying the means of measuring the value of recreational fishing by either the travel cost method or the contingent valuation method.

Artificial reefs can provide additional catch for both commercial and recreational fishermen and recreational value for sportsmen.

Cost components of an artificial reef include a manufacturing or dismantling cost, a transportation and installation cost, a maintenance cost, and a liability insurance cost.

Individual reefs are established if their expected benefits are greater than their cost of installation.

In a simplified manner, the optimum number of reefs can be determined by dividing the dollar value of the maximum possible catch from the unlimited number of artificial reefs by the average cost of establishing artificial reefs and then taking the natural logarithm of the result.

A large amount of data has been published in an industry position paper with respect to the removal costs of obsolete oil and gas platforms in the Gulf of Mexico.

The decision by oil companies on whether to sell obsolete platforms for scrap or to donate them for use as artificial reefs is one of economics.

On the basis of the economic findings in the available information, an economic model has been developed which may be applied to each of the selected reef siting areas. A summary of this economic model follows. The site-specific models will be covered in a later section.

SITING PLANS FOR THE ESTABLISHMENT OF ARTIFICIAL REEFS IN THE GULF OF MEXICO: A COOKBOOK PROCEDURE

by

Semoon Chang, Director
Center for Business and Economic Research
University of South Alabama
Mobile, Alabama 36688

July 1, 1986

SITING PLANS FOR THE ESTABLISHMENT OF ARTIFICIAL REEFS IN THE GULF OF MEXICO: A COOKBOOK PROCEDURE

Introduction

This report summarizes a cookbook procedure of making decisions as to whether a population center should attempt to have an artificial reef established in its waters. All technical arguments and presentations are deleted. Questionnaires were distributed to participants of town meetings that were held in Biloxi (January 21, 1986), Mobile (January 22, 1986), and Pensacola (January 23, 1986). These questionnaires and their responses are summarized and presented in this report. This report may be used together with cookbook procedures developed for each of three study areas; Biloxi, Pensacola, and Mobile.

Summary of Procedures

Step 1: Identify the population center.

A given community that considers establishing an artificial reef is the population center. If fishing waters are shared by another adjacent community, this neighboring community should also be included in the population center. Population centers are selected usually on the basis of social and demographic data.

Step 2: Develop an exclusion map.

An exclusion map should identify areas where artificial reefs may not be placed. These areas include shipping lanes, offshore ports, biologically sensitive areas, marine sanctuaries, military areas, and areas of particular shipping interests. An exclusion map shows areas that are most suitable for eastablishing artificial reefs in waters of the particular population center.

Step 3: Clarify the requirements and procedures of obtaining the permit to establish an artificial reef.

Early in the process, the population center may clarify the requirements and procedures of obtaining the permit to establish an artificial reef. This step is intended to make sure that no problems arise from the permit procedure after the decision is made to establish an artificial reef in the waters of the population center. This step requires personal interviews or telephone conversation with those who issue the permit.

Step 4: Obtain the numbers of commercial and recreational fishermen for the population center.

These numbers are necessary in estimating potential benefits from use of the artificial reef under consideration. The local fishermen's association, the U. S. Coast Guard, or a state office that issues fishing licenses may be able to provide information on these numbers. It is almost impossible to obtain accurate numbers of commercial and recreational fishermen. Since these numbers are the basis for the subsequent calculation, it is important to come up with reasonably accurate numbers. Saltwater divers should be counted as recreational fishermen.

Step 5: Estimate the dollar value of additional fish catch.

The dollar value is the sum of retail prices of different species of fish that both commercial and recreational fishermen are expected to catch off the artificial reef under consideration. Opinions of local fishermen and local marine biologists would be the source of this estimation. Since the fish catch off an artificial reef may vary with the type of the artificial reef, it may be necessary to presuppose the type of artificial reef the population may plan to have established.

Step 6: Obtain the numbers of resident and tourist recreational fishermen in the population center.

These numbers are necessary to estimate total fishing days of recreational fishermen in the population center. Rather than undertaking costly studies, it is suggested that fishing communities use the results of the 5-year interval national survey on fishing, hunting, and wildlife-associated recreation. The 1980 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation was published in 1982 by the U. S. Department of the Interior and the U. S. Department of Commerce. The 1985 survey may be made available in 1987. The survey indicates the ratios of resident recreational fishermen and tourist recreational fishermen relative to an area's residence recreational fishermen. Residence fishermen refer to fishermen who live in the population center. Resident fishermen refer to residence fishermen who fish in waters of the population center. If a residence fishman fishes in areas other than the population center, the residence fisherman is not a resident fisherman. Tourist fishermen refer to out-of-town fishermen who came to the population center for fishing. The ratios presented in the survey are different from one state to another.

Step 7: Estimate the total annual fishing days of the population center's recreational fishermen.

The total annual fishing days of the population center are obtained by adding the total annual fishing days of the resident recreational fishermen and the total annual fishing days of the tourist fishermen. The total annual fishing days of recreational and tourist fishermen for the northwest Florida are available in,"The Economic Impact and Valuation of Saltwater Recreational Fisheries in Florida", a 1982 study by Bell, Sorenson, and Leeworthy. The annual fishing days per resident recreational fisherman are 17.5 days, while the annual fishing days per tourist recreational fisherman are 8.1 days. Since no comparable data are available in the national survey, these findings may also be applied for Alabama and Mississippi as well as northwest Florida. The estimation of the total annual fishing days of the population center's (resident and tourist) recreational fishermen is made as follows:

	[Resident recreational fishermen x 17.5]
Plus	[Tourist recreational fishermen x 8.1]
Equals	[Total fishing days of recreational fishermen] 21.9342Fr

Step 8: Estimate the total dollar value of recreational fishing.

To estimate the dollar value of recreational fishing, the total number of fishing days for recreational fishermen should be multiplied by how much each day is worth to each fisherman. Unless reliable studies are available for particular population centers that estimate the value of recreational fishing, it is suggested that population centers use the guidelines for assigning points for special recreation, developed by the Corps of Engineers. The unit-day value for saltwater recreational fishing in 1986 price is $14.73. Total dollar value of recreational fishing of the population center, therefore, is obtained as

	[Total fishing days of recreational fishermen]
Multiplied by	x $14.73
Equals	[Total dollar value of recreational fishing]

Step 9: Estimate the value of recreational fishing for the artificial reef under consideration.

The value of recreational fishing derived in step 8 is based on the assumption that all fishing days of all recreational fishermen are spent around the artificial reef. The value, therefore, should be multiplied by the percentage of fishing days spent on fishing around the artificial reef relative to total fishing days. The population center must make the best judgment for the percentage. That is,

	[Total dollar value of recreational fishing]
Multiplied by	[Percent of fishing around artificial reef]
Equals	[Dollar value of recreational fishing around artificial reef]

Step 10: Estimate the expenditure impact owing to the artificial reef.

The net economic development impact from expenditures by out-of-town fishermen (and additional local fishermen, if there are any) should be included in estimating the expenditure impact. Additional expenditures by only those fishermen who are attracted to the area due to the artificial reef should be considered. The annual expenditures per fisherman by state of activity are available in the 1980 national survey. These expenditure figures are adjusted to the 1986 price level. To obtain the expenditure impact, out-of-town (commercial and recreational) fishermen and local (commercial and recreational) fishermen who are newly attracted to the area due to the artificial reef under consideration need to be estimated.

Step 11: Estimate the total annual benefit from the artificial reef.

The total annual benefit from the artificial reef under consideration is obtained by adding the following benefit categories:

(A) the dollar value of additional fish catch from the artificial reef [Step 5]

(B) the dollar value of recreational fishing for the artificial reef [Step 9]

(C) the expenditure impact of the artificial reef [Step 10].

Step 12: Convert the total annual benefit from the artificial reef to its present value.

Since total benefit figures are recurring each year, these figures should be converted to their present values so that benefits can be compared with costs for the same price level. To simplify the computational procedure, it is assumed that the discount rate is 10 percent and the life of an artificial reef is 25 years. The present value of the total annual benefit, then, is obtained as follows:

	[Total annual benefit]
Multiplied by	9.077040
Equals	[Present value of benefit]

Step 13: Estimate the total cost of establishing the artificial reef.

The total cost of establishing an artificial reef consists of (a) manufacturing or dismantling cost, (b) transportation cost that may include a liability insurance on shipment of an artificial reef, and the maintenance cost including an annual liability insurance premium. The maintenance cost should be discounted to the present value since it is recurring annually. Cost estimates are made usually after potential donors of artificial reefs are identified. The total cost is obtained by adding the following cost categories:

(A) Manufacturing or dismantling cost, if this cost is assumed by the population center.

(B) Transportation cost, unless this is assumed by the donor of the artificial reef.

(C) Present value of annual maintenance cost, which is Annual maintenance cost x 9.077040.

Step 14: Identify the sources of external funding and apply for funds.

The next step is to identify the sources of external funding and apply for funds needed to establish the artificial reef. Sources include the Wallop-Breaux fund at the federal level, state and local government, and local fishermen's groups. The fact that out-of-town fishermen would be attracted to the area may be presented as a basis for requesting a subsidy from the local government. Subtract the amount that can be acquired from these sources from the remaining cost to obtain the net cost of establishing an artificial reef to the population center. That is,

	Total cost obtained in Step 13
Minus	External funds
Equals	Net cost of establishing an artificial reef

Step 15: Make the decision.

The final decision on whether or not to establish an artificial reef in a given population center is made by comparing the present value of total annual benefit obtained in Step 12 with the net cost of establishing the artificial reef obtained in Step 14. If benefits are greater than costs, the population center may establish the artificial reef. If benefits are smaller than costs, the population center may not establish the artificial reef.

Artificial Reef Questionnaire and Responses

Responses summarized in the below are estimates by fishermen in each of the three towns who participated in the town meetings. Since the range between low estimates and high estimates is substantial in all three towns, caution should be exercised in interpretation of these figures.

1. What is the name of your town? [ ]

   Response:

   There were 23 usable responses in Biloxi, 6 usable responses in Pensacola, and 44 usable responses in Mobile.

2. How many fishermen live in your town?

   a. commercial fishermen [ ]
   b. recreational fishermen [ ]

   Response:

	Commercial Fishermen	Recreational Fishermen
Biloxi	814	4,127
Pesacola	400	12,500
Mobile	1,874	16,680

3. On any given day, how many local fishermen fish in the waters of your town for recreation? [ ]

   Response:

   The average figures are 261 in Biloxi, 925 in Pensacola, and 2,180 in Mobile.

4. On any given day, how many out-of-town fishermen fish in the waters of your town? [ ]

   Response:

   The average figures are 85 in Biloxi, 563 in Pensacola, and 465 in Mobile.

5. Approximately how many days during a year does a typical recreational fisherman of your town fish in the waters of your town?

   [ ] 5 days [ ] 20 days
   [ ] 10 days [ ] 25 days
   [ ] 15 days [ ] 30 days

   Response:

The average days are 26 in Biloxi, 25 in Pensacola, and 26 in Mobile. The average fishing days of a typical recreational fisherman is remarkably consistent across the state line.

6. Approximately how many days during a year does a typical out-of-town recreational fisherman fish in the waters of your town?

[ ]	1 day	[ ]	15 days
[ ]	5 days	[ ]	20 days
[ ]	10 days		

Response:

The average days are 8 in Biloxi, 5 in Pensacola, and 8 in Mobile. These figures are also quite consistent.

7. According to your judgment, will artificial reefs increase fish catch in the waters of your town? [ ] Yes [ ] No

Response:

	Yes	No	No Response
Biloxi	21	1	1
Pensacola	6	0	0
Mobile	41	1	2

8. Would you be interested in having artificial reefs in the waters of your town? [ ] Yes [ ] No

Response:

	Yes	No	No Response
Biloxi	23	0	0
Pensacola	6	0	0
Mobile	42	0	2

Please continue only if your answer to No. 8 is Yes:

9. Check the types of artificial reefs that you prefer to have in the waters of your town:

a. [ ] oil/gas platforms
b. [ ] sunken ships
c. [ ] tires
d. [ ] concrete rubbles
e. [ ] others: specify___________________

Response:

Biloxi:

Yes No

oil/gas platforms	17	6
sunken ships	18	5
tires	8	15
concrete rubbles	19	4
others	7	16

Pensacola:

oil/gas platforms	6	0
sunken ships	5	1
tires	1	5
concrete rubbles	5	1
others	3	3

Mobile:

oil/gas platforms	33	11
sunken ships	38	6
tires	15	29
concrete rubbles	28	16
others	16	28

10. If you have to pay for siting an artificial reef in the waters of your town, how much would you be willing to pay during a year for the right to use the artificial reef?

1 [ ] zero
2 [ ] 1 to 50 dollars
3 [ ] 51 to 100 dollars
4 [ ] 101 to 150 dollars
5 [ ] 151 to 200 dollars
6 [ ] 201 to 250 dollars
7 [ ] 251 to 300 dollars
8 [ ] more than 300 dollars

Response:

	Biloxi	Pensacola	Mobile
zero dollars	3	2	9
1 to 50 dollars	15	2	17
51 to 100 dollars	4	0	7
101 to 150 dollars	0	1	3
151 to 200 dollars	1	0	1
201 to 250 dollars	0	0	1
251 to 300 dollars	0	0	0
300-plus dollars	0	1	4
average	$58.50	$75.00	$91.67

11. Are you a commercial fisherman or a recreational fisherman?

[ ] commercial fisherman
[ ] recreational fisherman

Response:

	Biloxi	Pensacola	Mobile
commercial	20	2	33
recreational	2	2	2
both	1	1	5
other	0	1	4

12. If you have an artificial reef sited in the waters of your town, what percent of your fishing time do you expect to spend around the reef for fishing?

1 [ ] less than 10 percent
2 [ ] 11 to 20 percent
3 [ ] 21 to 30 percent
4 [ ] 31 to 40 percent
5 [ ] 41 to 50 percent
6 [ ] more than 50 percent

Response:

	Biloxi	Pensacola	Mobile
less than 10 %	2	1	2
11 to 20 %	2	1	5
21 to 30 %	6	1	8
31 to 40 %	5	0	4
41 to 50 %	2	0	10
more than 50 %	6	2	9
average	39.1%	36.0%	41.1%

13. Artificial reefs in your town may attract out-of-town fishermen and their dollars. Expenditures by these out-of-town fishermen on local goods and services are expected to be:

1 [ ] substantial
2 [ ] moderate
3 [ ] little, if any.
4 [ ] zero.

Response:

	Biloxi	Pensacola	Mobile
substantial	9	4	19
moderate	9	2	17
little, if any	5	0	4
zero	0	0	0

Additional open-ended questions were asked to participants of the town meetings.

14. If you fish from a boat, how far offshore do you typically travel to fish?

Response:

Biloxi	30.1 miles (16 samples)
Pensacola	16.0 miles (5 samples)
Mobile	19.9 miles (44 samples)

15. What is the farthest distance offshore you are willing to travel to fish?

Response:

Biloxi	46.1 miles (14 samples)
Pensacola	34.0 miles (5 samples)
Mobile	37.3 miles (44 samples)

16. If you SCUBA dive, how far will you travel to SCUBA dive?

Response:

Biloxi	37.5 miles (4 samples)
Pensacola	27.5 miles (2 samples)
Mobile	21.9 miles (14 samples)

17. What is the deepest water depth you feel comfortable with diving?

Response:

Biloxi	110 feet (5 samples)
Pensacola	110 feet (2 samples)
Mobile	98 feet (15 samples)

SITING PLANS FOR THE ESTABLISHMENT OF ARTIFICIAL REEFS IN THE GULF OF MEXICO: AN ECONOMIC ANALYSIS

by

Semoon Chang, Director
Center for Business and Economic Research
University of South Alabama
Mobile, Alabama 36688

July 1, 1986

ABSTRACT

This project deals with the economic component of siting plans for the establishment of artificial reefs in the Gulf of Mexico. The project was funded by the Saltonstall-Kennedy funds of the National Marine Fisheries Service through the Mississippi-Alabama Sea Grant Consortium. The project period is October 1, 1984 to September 30, 1985.

There are approximately 3,350 petroleum platforms in the Gulf of Mexico. As oil and gas exploration activities decline, these platforms should be removed according to the Outer-Continental Shelf Lands Act and the Bureau of Land Management lease agreement. The cost of removing a typical platform in 40 to 75 meters of water is estimated at $1.4 million in the Gulf of Mexico, and $70 million in the North Sea. The project is concerned with how to make the best use of obsolete oil and gas platforms that will benefit commercial and recreational fishermen and minimize costs of removal to the oil industry.

The project evaluates economic aspects of converting oil and gas platforms into artificial reefs, and develops a model which coastal communities may use in making decisions as to whether or not to establish artificial reefs near their waters. Economic aspects explored in the project include valuation of recreational fishing, costs of dismantling and transporting platforms, costs of maintaining platforms as artificial reefs, procedures of estimating the value of an artificial reef to a coastal community. The project has been developed in close consultation with the Artificial Development Center in Washington, D.C. and contains a complete list of references on the subject.

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EXECUTIVE SUMMARY

This study deals with the economic component of developing siting plans for the establishment of artificial reefs in the Gulf of Mexico. Due to the paucity of general economic models of artificial reefs, a considerable effort has been expended in this study to develop such model.

Summary of Findings

1. Studies indicate that artificial reefs enhance reproduction of fish.

2. One problem with the establishment of artificial reefs relates to measuring the value of recreational fishing. Basically, there are two methods by which the value of recreational fishing may be estimated. One is the travel cost method in which per capita use of an artificial reef is hypothesized to depend on the variable cost of travel to the reef and the value of travel time; the other is the contingent valuation method which estimates benefits from an artificial reef by directly asking individual fishermen their willingness to pay for the new artificial reef.

3. If studies have not already been made for a coastal population center that considers the establishment of an artificial reef, the unit day value method used by the Corps of Engineers is suggested. In the unit day value method, points are assigned for specific recreational activities, and these points are converted to a unit day value according to a conversion table.

4. The optimal sustaining yield (OSY) refers to an optimal level of fish population that remains unchanged with fishing activities. If optimal means the maximum physical yield, the OSY becomes the maximum sustaining yield (MSY). The OSY is defined in this study as that level of physical yield which provides the maximum utility to all fishermen. The OSY of an artificial reef, it is proven in this study, may be lower than its MSY due to overfishing so long as the dollar value of enjoyment which recreational fishermen derive from the act of fishing is greater than the dollar value of reduced fish catch below the level of MSY.

5. Benefits from an artificial reef are two-fold: additional fish catch for commercial and recreational fishermen, and additional recreational value for recreational fishermen. Cost components of an artificial reef include a manufacturing or dismantling cost, a transportation and installation cost, a maintenance cost, and a liability insurance cost.

6. Individual artificial reefs are established if their benefits are greater than their costs of installation.

7. The optimal number of artificial reefs for a given community may be obtained by optimizing the net benefit function that is the difference between the total benefit function and total cost function. Under simplified conditions, the

optimal number of artificial reefs can be determined, first, by dividing the dollar value of the maximum possible catch (M) from the unlimited number of artificial reefs by the average cost of establishing artificial reefs (C), and, second, by taking the natural logarithm of the result.

8. Literature on published data relating to the model of artificial reefs is surveyed. Important sources include the National Survey of Fishing and Hunting made at 5-year intervals by the U. S. Department of the Interior and the U. S. Department of Commerce, and a survey of saltwater recreational fishing made by Bell, Sorenson, and Leeworthy.

9. Oil and gas platforms are a special case of artificial reefs. The sheer number (3,350 in the Gulf of Mexico alone) and removal cost (millions of dollars) are staggering. A substantial amount of data has been published in the **Industry Position Paper**.

10. The decision by oil companies on whether to sell platforms for scrap or to donate them for use as artificial reefs is a problem of economics. Public policy may influence decision making by oil companies by enabling fishermen to assume part of the transportation costs of platforms or by allowing oil companies to claim tax deductions for donating platforms for use as artificial reefs. Policies that encourage oil firms to donate platforms for use as artificial reefs become less important as the number of platforms used as artificial reefs increases.

Procedures of Applying the Model

The very first step in developing siting plans for the establishment of artificial reefs is to identify population centers and develop an exclusion map. Population centers in the study area include Gulfport, Biloxi, Ocean Springs, and Pascagoula in Mississippi; Bayou La Batre, Dauphin Island, Mobile, Fairhope, Pleasure Island, and Gulf Shores in Alabama; and Perdido Key, Pensacola, Pensacola Beach, Santa Rosa Island, Navarre Beach, and Fort Walton Beach in Florida. Economic components come into the picture once an exclusion map is developed for a population center that considers establishing an artificial reef. Economic procedures are the following:

1. Obtain the number of commercial fishermen (Fc) and the number of recreational fishermen (Fr) with boats for the population center. The source of data would preferably be the local fishermen's association, the Coast Guard, or the state's office that maintains boat registration or sells licenses.

2. Estimate the dollar value of the additional fish catch by both commercial and recreational fishermen from the artificial reef under consideration. Let Va represent the value of the additional catch.

3. Multiply the area's recreational fishermen (Fr) by the ratios indicated below to obtain the number of resident recreational fishermen and the number of tourist recreational fishermen. These ratios are based on the 1980 survey for Alabama, Florida, and Mississippi which is summarized in Table 5-1 of this study.

	Population Centers in Alabama	Florida	Mississippi
Area's residence recreational fishermen	Fr	Fr	Fr
Multiplied by	x 0.9622	x 0.9535	x 0.9615
Resident fishermen	0.9622Fr	0.9535Fr	0.9615Fr
Multiplied by	x 0.3000	x 0.6795	x 0.3873
Tourist fishermen	0.2887Fr	0.6479Fr	0.3724Fr

4. Compute the total annual fishing days by multiplying the number of fishermen found in Step 3 by the average fishing days per angler in Table 5-3 of this study. When the fishing days are multiplied by the user day value obtained in the last section of Chapter VII of this report, the upper limit of the value of recreational fishing from the artificial reef is obtained.

Alabama

resident	0.9622Fr x 17.5 =	16.8385Fr
tourist	0.2887Fr x 8.1 =	2.3385Fr
total		19.1770Fr
multiplied by		x $14.19
value of recreation		$272.12Fr

Florida

resident	0.9535Fr x 17.5 =	16.6862Fr
tourist	0.6479Fr x 8.1 =	5.2480Fr
total		21.9342Fr
multiplied by		x $14.19
value of recreation		$311.25Fr

Mississippi

resident	0.9615Fr x 17.5 =	16.8263Fr
tourist	0.3724Fr x 8.1 =	3.0164Fr
total		19.8427Fr
multiplied by		x $14.19
value of recreation		$281.57Fr

5. The values of recreational fishing derived in Step 4 are based on the assumption that all fishing days of all recreational fishermen are spent around the artificial reef. These values, therefore, should be multiplied by the percentage of fishing days spent on fishing around the artificial reef. For purposes of illustration, assume that the percent is 25. The actual value of recreational fishing (Vr) is obtained:

Alabama

$$Vr = \$272.12Fr \times 0.25 = \$68.03Fr$$

Florida

$$Vr = \$311.25Fr \times 0.25 = \$77.81Fr$$

Mississippi

$$Vr = \$281.57Fr \times 0.25 = \$70.39Fr$$

6. Estimate the expenditure impact (Ve) of out-of-town fishermen and additional local fishermen on the local economy. The transfer portion of Vi may not be included in estimating total benefit from artificial reefs.

7. Add Va in Step 2, Vr in Step 5, and Ve in Step 6 to obtain the total benefit (TB) from an artificial reef for a given population center:

$$TB = Va + Vr + Ve$$

8. Since total benefit figures are recurring each year, obtain the present value of annual total benefits and let NB stand for the present value. That is,

$$NB = \text{Sum of } [TB_i/(1 + d)^i]$$

where d is discount rate and i represents the life of artificial reefs.

9. Estimate the total cost (TC) of establishing an artificial reef. The cost consists of manufacturing dismantling cost, transportation cost including liability insurance, and maintenance cost including liability. Cost estimates are made usually after potential donors of artificial reefs are identified. Determine the remaining cost (RC) by subtracting from total cost the portion that the donor is willing to assume.

10. Identify the sources of funding and apply for funds needed to establish the artificial reef. Sources include the Wallop-Breaux fund at the federal level, state and local government, and local fishermen's groups. Subtract the amount that can be acquired from these sources from the remaining cost to obtain the net cost of establishing an artificial reef. Let NC stand for the net cost.

11. Decide whether or not to establish an artificial reef by comparing NB with NC.

SITING PLANS FOR THE ESTABLISHMENT OF ARTIFICIAL REEFS IN THE GULF OF MEXICO: AN ECONOMIC ANALYSIS

I

INTRODUCTION

Stating the Problem

Artificial reefs refer to structures which are constructed or placed in waters for the purpose of enhancing fishery resources and commercial and recreational fishing opportunities.[1] Artificial reefs differ from dumping in that artificial reefs are deliberately sited with definitive criteria, while dumping is a random disposal or a non-use of surplus products.[2] A random disposal or a surplus product may become an artificial reef if these are accepted as such according to definitive criteria. Artificial reefs have become of great interest to many because there are approximately 4,000 petroleum structures that, with depletion of petroleum drilling, can be used as artificial reefs in state and federal waters in the Gulf of Mexico. Artificial reefs that are known widely include tires, sunken ships, and Liberty ships built during World War II.[3]

The difficulty involved in management of artificial reefs may be illustrated by conflicting views on the use of oil/gas platforms. The Department of Defense is strongly opposed to the "leave it as it stands" option because these platforms interfere with navigation of submarines and may provide a hiding place for enemy submarines. Many commercial shrimpers, on the other hand, are opposed to moving the platforms because moving them inevitably leaves behind a substantial amount of debris, tearing off nets and other fishing equipment.

Section 203 of the National Fishing Enhancement Act of 1984 defines the five objectives of artificial reef programs: (1) to enhance fishery resources to the maximum extent possible; (2) to facilitate access and utilization by United States recreational and commercial fishermen; (3) to minimize conflicts among competing uses of waters covered under this title and the resources in such waters; (4) to minimize environmental risks and risks to personal health and property; and (5) to be consistent with generally accepted principles of international law and not create any unreasonable obstruction to navigation.[4] A similar statement of objectives of artificial reef programs has also been stated by Schmied of the National Marine Fishery Service (NMFS).[5] Artificial reef programs are also consistent with the President's proclamation of an exclusive economic zone (EEZ) on March 10, 1983, which expressed a national interest in resources found within 200 nautical miles from shore.

Stated objectives of artificial reef programs require the establishment of artificial reefs to enhance fishery resources for both commercial and recreational fishermen. Establishing artificial reefs is not a free good, however. An economic analysis is needed for a more efficient allocation of fishery resources.

Objectives of the Study

This study is an attempt to provide answers to the following questions:

(1) What is the economic value of an artificial reef to commercial fishermen? What is the economic value of an artificial reef to recreational fishermen? How is the value measured?

(2) What are the benefits from artificial reefs? How are these benefits measured?

(3) What does it cost to establish an artificial reef?

(4) Who should pay for establishing and maintaining an artificial reef and why?

(5) How can a community determine the optimal number of artificial reefs that provides the maximum benefit to the community?

This study will provide a step-by-step procedure that should be followed when a community makes a decision on whether or not to establish artificial reefs near its waters.

Artificial Reefs and Fish Production

Whether artificial reefs increase the fish population or simply relocate the existing fish population is important to studies of artificial reefs, especially when their establishment depends on the comparison of benefits from these reefs and costs of their establishment. A desirable site of artificial reefs should afford a minimum travel time and fuel consumption, avoid interference with navigation, and avoid strong currents so that the site can be precisely fixed. Artificial reefs that meet these conditions do not necessarily increase the fish population, however.

Fish are attracted to artificial reefs for several reasons. These include orientation, conservation of energy, food, and shelter. There are two hypotheses regarding the fish population around artificial reefs. One is the attraction theory, which states that an artificial reef merely concentrates fish by serving as an orientation point and does not increase the net population of fish. The other is the productivity theory, which suggests that the artificial reef enhances the reproduction of fish because of a greater food supply and protection from predators.[6]

A study exists that strongly favors the productivity theory. Stone et al studied the fish population on an artificial and natural reef. The study area is located northwest of Pacific Reef Light in Biscayne National Monument, 50 km south of Miami, Florida. These researchers built an artificial patch reef on January 21, 1972 with 500 automobile tires to approximate the size of the adjacent natural patch reef. After the artificial reef had been in place 7 months, visual observations indicated about equal numbers of fish and a similar species composition on both the artificial reef and the natural patch reef. Although the artificial reef was less than 25 meters from the natural reef, it did not diminish the resident population of the natural reef but doubled the carrying capacity and fish biomass in the immediate vicinity of the two reefs. For the remaining 2 years of this study, the fish population on both reefs showed similar seasonal fluctuations.[7] Another in-depth study by the Continental Shelf Associates, Inc. supports the hypothesis that oil and gas platforms increase the fish population size, although the increase is limited to those species which actually become residents of the subsurface platform substrate.[8]

Scope of Methodology

This study deals with several different aspects of fishery resource and fishing off artificial reefs. Two of the most important concepts are measuring the value of recreational fishing and defining the optimum sustaining yield. These concepts are discussed in the next two chapters. The discussion is followed by an economic model of artificial reefs in Chapter IV which is developed on the basis of, among others, the value of recreational fishing and the concept of the optimum sustaining yield. The model is intended to provide policy prescriptions relating to the establishment of artificial reefs. A review of literature is presented as concepts are discussed and the model is developed and applied.

The literature survey on data needs of the model is presented in Chapter V, whereas analyses relating to oil and gas platforms are presented in Chapter VI. The procedures of applying the model are summarized in Chapter VII.

Footnotes

1. 98th Congress 2d Session, H.R. 6342 Title II - Artificial Reefs, in **HR 6342 HDS**, 1984, p. 9.

2. Beardsley (1977), p. 19.

3. For more details on the use of Liberty ships as artificial reefs, see Beardsley (1977), pp. 17-18.

4. 98th Congress 2d Session, H.R. 6342 Title II - Artificial Reefs, in **HR 6342 HDS**, 1984, p. 4.

5. Schmied (1974), pp. 128-130. According to Schmied, artificial reefs in the fishery management process have the following six roles; (1) to maintain, restore and enhance fishery habitat; (2) to rebuild fish stocks by increasing fish biomass; (3) to increase food production and recreation opportunities; (4) to promote efficiency by creating fishing opportunities closer to urban population; (5) to reduce user conflicts among different user groups; and (6) to develop underutilized species by helping fishmen selectively target species of interest.

6. Dugas, Guillory, and Fischer (1979), p. 3.

7. Stone, Pratt, Parker and Davis (1979), p. 1.

8. Continental Shelf Associates, Inc. (April 1982), p. 155.

II

ESTIMATING THE VALUE OF RECREATIONAL FISHING

Problem Defined

The value of an artificial reef varies with the value of additional fish to commercial fishermen and the value of additional fishing to recreational fishermen. If the sum of these two types of value from an artificial reef exceeds the cost of establishing the artificial reef, it becomes economically feasible to consider establishing the artificial reef.

Estimating the value of commercial fishing is simple in comparison to estimating the value of recreational fishing. In estimating the value of commercial fishing, Crutchfield assumes that fishery resources such as artificial reefs are well managed and suggests the hypothesis that use of the fishery is to maxi-mize the net yield from leasing or selling the right to fish. The hypothesis leads to the objective function of commercial fishing in that the managerial objective of commercial fishing is to maximize the present value of future net yields in fishing from the artificial reef. The objective makes it necessary to estimate sustainable physical yields from a given artificial reef and long range forecasts of market prices[1]. Physical yields must be sustainable since overfishing may actually decrease the value of artificial reefs. By multiplying annual sustainable physical yields and their prices and by obtaining the net present value of annual catches, one can determine the value of commercial fishing from artificial reefs.

Estimating the value of recreational fishing for an artificial reef is difficult for, at least, the following three reasons. First, the value of recreational fishing may lie more in the act of fishing than in catches of fish. Second, fishing around artificial reefs is currently free once fishermen arrive at the site, making it difficult to measure the exact value of fishing to individual fishermen. Finally, the value of recreational fishing may be different from one fisherman to the next. Any method that estimates the value of recreational fishing should be able to consider interpersonal differences in utility.

From the viewpoint of economic analysis, the problem of estimating the value of recreational fishing boils down to estimating the demand function for recreational fishing, and a consumer's surplus therefrom. This is because the value which a buyer attaches to a good or a service is indicated by the buyer's demand curve for the product. Numerous methods have been suggested for estimation of a demand function for recreational services including recreational fishing.[2] Two of these methods that are comparatively more significant are discussed in the remainder of this section[3].

Travel Cost Method

The basic premise of the travel cost method (TCM) is that per capita use of a recreation site such as an artificial reef will decrease as out-of-pocket and time costs of traveling to the site increase, other variables being constant[4]. In TCM, a demand curve is derived by using the variable costs of travel and the value of time as proxies for price. TCM progresses from estimating the use of an artificial reef to deriving a demand curve[5].

To estimate the use of a proposed recreational project, one may specify a use estimating model that relates use at a proposed site to the distance traveled, socio-economic factors, and characteristics of the site and alternative recreational opportunities. Actual data may be gathered through questionnaires to potential users of the proposed recreational site or by observing the visitation patterns at one or more existing projects with similar resource, operation, and anticipated recreational use characteristics.

The procedure of deriving demand in TCM consists of (a) calculating total use at different incremental distances (prices) and (b) statistically estimating a demand curve for the site being evaluated that relates "prices" to total visits. Distances are converted to dollar values using per mile conversion factors reflecting both time and out-of-pocket travel costs. The area under the demand curve plus any user charges or entrance fees measure the recreational benefits attributable to the site.

Some of the important factors that need to be understood regarding TCM are the following. First, variable or out-of-pocket travel costs are used as proxies for price since these are the costs that potential users would be most aware of when making a decision about whether or not to visit a particular recreation area. These do not include fixed costs since these costs general-ly would not affect the potential user's decision to travel the additional mileage for recreational purposes. Second, two adjustments are required. One is an adjustment for round-trip mileage. (The cost per mile should be doubled.) The other is to distribute the travel costs of the trip among the number of users traveling in each vehicle. Third, the opportunity cost of time is the value of work or leisure activities foregone to travel to and recreate at the site. The value may range between zero for no alternative leisure activity and the wage rate if the alternative leisure activity was valuable enough to forego earnings.

The final computational step in the travel cost approach is to measure the area under the demand curve. This area is equal to the amount users would be willing to pay but do not have to pay for the opportunity to participate in recreation at the resource being evaluated. Any user charges or entrance fees should be added to this consumer surplus value in order to determine the gross value of the recreational project.

The travel cost method may suffer the following methodological problems[6]. First, the treatment of travel time of individual fishermen is far from adequate. Second, the interdependent relationship among fishermen, known as the congestion problem, is not adjusted for an accurate aggregation of benefits accruing to individual fishermen. Third, different areas have different substitutes for recreational fishing. Unless these alternative opportunities are considered properly, the travel cost method will overestimate the value of recreational fishing especially at higher price levels. Finally, the travel cost method tends to ignore those who would be willing to pay for improvements like artificial reefs even if they do not intend to use them. This is because the method implicitly assumes a weak complementarity, which means that the improvement has no value to those who do not participate in this type of recreation.

Contingent Valuation Method

The contingent valuation method (CVM) estimates benefits by directly asking individual fishermen their willingness to pay for changes in recreational opportunities at a given site. Individual values may be aggregated by summing the willingness to pay for all users in the study area. CVM consists of designing and using simulated markets to identify the value of recreation just as actual markets would if they existed[7].

Data are gathered through personal interviews. Iterative bidding techniques are most effective in personal interviews. The interviewer iteratively varies the value posed until the interviewer identifies the highest amount the respondent is willing to pay. This amount is the respondent's bid for the specific increment in recreation. In most cases the right to use for one year is measured as price. The question should be worded to suggest the pragmatic "take it or leave it" atmosphere of the market place.

CVM, like the travel cost method, may also be used to develop a statistical model to estimate the recreational value of a specific proposed project. The model may specify the relationship between the bid and selected characteristics of the site(s) and user population as follows:

$$V = f(E, D, C, A, S, Q, I) \qquad (2 - 1)$$

where V = value to individual fishermen of the specified change in recreation opportunity at a given site

E = social and demographic variables of the fishermen

D = distance from home to the recreation site

C = a measure of the capacity use of the existing stock of recreation facilities similar to those at the given site

A = distance from home to the nearest alternative recreation facility

S = index of the availability of subsitute recreation facilities

Q = variables describing the quality of recreation at the given site

I = increment or decrement of recreation at the given site in the contingent valuation mechanism.

Once the model is estimated and the specific data for individual fishermen of the area are collected, we use the specific data and the fitted model to estimate the value of the proposed recreation opportunity for a typical fisherman in the area. We then multiply this value by the number of fishermen in the area to obtain the aggregate benefit estimate.

The contingent valuation method also suffers methodological problems[8]. First, there exists a strategic bias. If the fisherman feels that he will have to pay if the reef project is undertaken, he tends to underestimate his value of the reef. If he feels that he will not have to pay, he may overestimate the value. Second, there is a hypothetical bias. Since the fisherman reveals his preference for reefs with which he has no or little prior experience in valuation, his answer is purely hypothetical.

To minimize the hypothetical bias, the iterative bidding technique has been suggested. This creates the third bias, known as the starting point bias. The starting bid may affect the ultimate value of the fisherman's willingness to pay.

Unit Day Value Method as Last Resort

Hopefully, studies have been made for the study area, that measure the value of recreational fishing using either the travel cost method or the contingent valuation method. If these studies have not been made for the study area, the unit day value (UDV) method may be used as a last resort to approximate the value of recreational fishing.

Assuming that the willingness to pay per user day is known in advance, the total annual benefit from use of an artificial reef may be computed as follows[9]:

Total Annual Benefits

= Willingness to Pay per User Day

x Number of user days per Fisherman (or Diver)

x Total Number of Fishermen (or Divers)

For example, if the average fisherman were willing to pay $10 per trip to an artificial reef, the average number of trips to the reef were 4 per year, and the number of fishermen using the reef during the year were 100, the total annual benefits for fishermen would be

$10 x 4 x 100 = $4,000

The unit day value (UDV) method for estimating recreation benefits relies on expert judgment to approximate the average willingness to pay of users of Federally assisted rereation resources.[10] In the UDV method, outdoor recreation activities are divided into two categories; general and specialized. General activities are those activities that are attractive to the majority of outdoor users and require the development and maintenance of convenient access and adequate facilities. The general activities are associated with water-oriented projects such as boating and fishing. Specialized activities are those for which opportunities in general are limited and the intensity of use is low. Big game hunting and fishing are included in the specialized category. Fishing around artificial reefs appears more for the specialized than for the general recreational activities.

To use the UDV method, one must select appropriate values from the range of values provided in the two guideline tables for assigning points for general and specialized recreation. For instance, let us look at the middle column of the Guidelines for Assigning Points for Special Recreation. Assuming that fishing and diving around artificial reefs can be characterized by features described by the upper values of the middle column, total points would be

$$16 + 10 + 8 + 10 + 10 = 54$$

These points are then applied to the table titled Conversion of Points to Dollar Values. Reading the figure crossed by 50 in the first row and the Specialized fishing and hunting in the first column, the unit day dollar value of fishing and diving around artificial reefs by one person is $14.99 in 1985 prices.

A note of caution is in order. The selection of a unit day value must account for the transfer of values to avoid double counting of benefits. The net value of the use of one artificial reef is the difference between the selected value of the unit day use and the value of use at another recreational opportunity. If recreational activities are comparable between two different opportunities, savings in travel cost, if there are any, would be the only net benefit associated with the transfer from the alternative recreational activity to fishing around artificial reefs.

Table 2 - 1

Guidelines for Assigning Points For General Recreation

Criteria	Judgment factors				
Recreation experience	Two general activities	Several general activities	Several general activities one high quality value activity	Several general activities more than one high quality high activity	Numerous high quality value activities; some general activities
Total Points: 30 Point Value:	0-4	5-10	11-16	17-23	24-30
Availability of opportunity	Several within 1 hr.travel time;a few within 30 min. travel time	Several within 1 hr.travel time;none within 30 min. travel time	One or two within 1 hr. travel time;none within 45 min. travel time	None within 1 hr. travel time	None within 2 hrs. travel time
Total Points: 18 Point Value:	0-3	4-6	7-10	11-14	15-18
Carrying capacity	Minimum facility development for public health and safety	Basic facilities to conduct activity(ies)	Adequate facilities to conduct without deterioration of the resource or activity experience	Optimum facilities to conduct activity at site potential	Ultimate facilities to achieve intent of selected alternative
Total Points: 14 Point value:	0-2	3-5	6-8	9-11	12-14

Total Points: 18 Point Value:	0-3	4-6	7-10	11-14	15-18
Carrying capacity	Minimum facility development for public health and safety	Basic facilities to conduct activity(ies)	Adequate facilities to conduct without deterioration of the resource or activity experience	Optimum facilities to conduct activity at site potential	Ultimate facilities to achieve intent of selected alternative
Total Points: 14 Point value:	0-2	3-5	6-8	9-11	12-14
Accessibility	Limited access by any means to site or within site	Fair access,poor quality roads to site;limited access within site	Fair access,fair roads to site;fair access, good roads within site	Good access good roads to site;fair access,good roads within site	Good access high standard roads to site; good access within site
Total Points: 18 Point value:	0-3	4-6	7-10	11-14	15-18
Environmental quality	Low esthetic factors exist that significantly lower quality	Average esthetic quality; factors exist that lower quality to minor degree	Above average esthetic quality; any limiting factors can be reasonably rectified	High esthetic quality no factors exist that lower quality	Outstanding esthetic quality;no factors exist that lower quality
Total Points: 20 Point value:	0-2	3-6	7-10	11-15	16-20

Source: U.S. Army, Corps of Engineers, **Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies**, March 10, 1983, p. A-67.

Table 2-2

Guidelines for Assigning Points For Special Recreation

Criteria	Judgment factors				
Recreation experience	Heavy use or frequent crowding or other interference with use	Moderate other users evident and likely to interfere with use	Moderate use, some evidence of other users and occasional interference with use due to crowding	Usually little evidence of other users, rarely if ever crowded	Very low low evidence of other users, never crowded
Total Points: 30 Point value:	0-4	5-10	11-16	17-23	24-30
Availability of opportunity	Several within 1 hr. travel time; a few within 30 min. travel time	Several within 1 hr. travel time; none within 30 min. travel time	One or two within 1 hr. travel time;none within 45 min. travel time	None within 1 hr. travel time	None within 2 hrs. travel time
Total Points: 18 Point value:	0-3	4-6	7-10	11-14	15-18
Carrying capacity	Minimum facility development for public health and safety	Basic facilities to conduct activity (ies)	Adequate facilities to conduct without deterioration of the resource or activity experience	Optimum facilities to conduct activity at site potential	Ultimate facilities to achieve intent of selected alternative
Total Points: 14 Point value:	0-2	3-5	6-8	9-11	12-14

Points: 18					
Point value:	0-3	4-6	7-10	11-14	15-18
Carrying capacity	Minimum facility development for public health and safety	Basic facilities to conduct activity (ies)	Adequate facilities to conduct without deterioration of the resource or activity experience	Optimum facilities to conduct activity at site potential	Ultimate facilities to achieve intent of selected alternative
Total Points: 14					
Point value:	0-2	3-5	6-8	9-11	12-14
Accessibility	Limited access by any means to site or within site	Fair access,poor quality roads to site;limited access within site	Fair access fair road to site;fair access,good roads within site	Good access,good roads to site;fair access, good roads	Good access high standard road to site; good access with-
Total Points: 18					
Point value:	0-3	4-6	7-10	11-14	15-18
Environmental	Low esthetic factors that significantly lower quality	Average esthetic quality; factors exist that lower quality to a minor degree	Above average esthetic quality; any limiting factors can be reasonably rectified	High esthetic quality no factors exist that lower quality	Outstanding esthetic quality;no factors exist that lower quality
Total Points: 20					
Point value:	0-2	3-6	7-10	11-15	16-20

Source: U.S. Army, Corps of Engineers, **Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies**, March 10, 1983, p. A-67 and A-68.

Table 2-3

Conversion of Points to Dollar Values

Activity Category	Point values 0	10	20	30	40	50	60	70	80	90	100
General recreation	$1.78	2.11	2.33	2.66	3.33	3.77	4.11	4.33	4.77	5.11	5.33
General fishing and hunting	$2.55	2.89	3.11	3.44	3.77	4.11	4.55	4.77	5.11	5.22	5.33
Specialized fishing and hunting	$12.43	12.77	12.99	13.32	13.65	14.99	16.32	17.32	18.65	19.98	21.09
Specialized recreation other than fishing and hunting	$7.22	7.66	8.21	8.88	9.44	10.66	11.77	14.21	16.54	18.87	21.09

Note: Dollar values are adjusted to the 1985 price level for this study. This table is adapted from U. S. Army, Corps of Engineers, **Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies**, March 10, 1983, p. A-66

Footnotes

1. Crutchfield (1962), pp. 145-146.

2. See for these methods Huppert (1983), pp. 9-15; Milon and Schmied (1984), pp. 1-10; and Bell (1978), pp. 243-265.

3. For a thorough and critical review of these methods, see Graefe, Strand, and Bockstael (1984), Section II titled Review of Major Approaches to Economic Valuation of Nonmarket Goods, pp. 20-44

4. The travel cost method is also known as the gross expenditures method. Gross expenditures consist of (1) transfer or travel costs, also known as variable costs, which include transportation, food, lodging and other costs incurred while traveling, and (2) durable expenditures such as tackle, boats, and unique clothing. For details, see Bell (1978), p. 246. The variable cost may be measured by the occasional survey by the U. S. Department of Transportation on average costs of operating automobiles by type.

5. The analysis of the travel cost method is based on Corps of Engineers (2983), pp. A-57 to A-61.

6. For detailed discussion on problems of the travel cost method, see Graefe, Strand, and Bockstael (1984), Section II, pp. 26-32

7. For a more detailed explanation, see Corps of Engineers (1983), pp. A-61 to A-65.

8. For more details on problems of the contingent valuation method, see Graefe, Strand, and Bockstael (1984), Section II, pp. 26-32.

9. For more discussion on this computation, see J. Walter Milon and Ronald L. Schmied, "Survey Techniques for Identifying the Economic Benefits of Artificial Reef Habitat," unpublished paper, p. 3.

10. For detailed presentation of the user day value method, see U. S. Army Corps of Engineers, **Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies**, March 10, 1983, Section titled Unit Day Value Method, pp. A-65 to A-69.

11. The three tables in this section are quoted from U. S. Army Corps of Engineers, **Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies**, pp. A-66, A-67, and A-68.

III

OPTIMUM SUSTAINING YIELD

OSY Defined

Fishing in open waters is a common, as opposed to private, property, creating a special problem of overfishing. In the absence of effective limits on fishing, it is possible that commercial and recreational fishing around artificial reefs may actually decrease the fish stock, since individual fishermen will compare only their own benefits and costs.

Unless entry is somehow restricted, entry may continue until the economic rent from the fish stock is all dissipated. This excess entry will result in economic inefficiency in the allocation of fishery resources because "the value of the resulting extra output will be less than the social opportunity cost of entry"[1]). Stated in simple terms, the inefficiency comes from two sources. One is due to the fact that since the cost of fishing without restrictions on entry is less than the true cost of fishing, and therefore more fishing activities, boats, and fishing efforts will be expended than what the true cost would have led them to be. The other is due to the fact that the excessive allocation of resources would be even more inefficient if the fish stock is depleted. An economic model of artificial reefs, therefore, should consider an optimum sustaining yield from these reefs.

One of the better definitions of the sustaining yield has been suggested by Gulland. "If during any year, man removes an amount equal to the natural annual increase, then the population abundance will remain unaltered. This removal could, therefore, be repeated each year indefinitely, and may be termed the ′sustaining yield′, or ′equilibrium catch′.[2])" The problem lies in defining what the "optimal" sustaining yield (OSY) is.

If optimal means the maximum physical yield, the OSY becomes the maximum sustaining yield (MSY). If optimal means the value of catch minus the cost of catch, the OSY becomes the maximum net economic yield. Artificial reef programs encompass both commercial and recreational fishing. In recreational fishing, fishermen do not necessarily maximize the catch of fish. They most likely are maximizing their enjoyment or utility from fishing. The catch of fish would certainly be a determinant of the recreational fisherman′s utility function, but not the only determinant as is the case with the commercial fisherman.

Risking the problem of measurability, the optimal sustaining yield of an artificial reef may be defined in this study as that level of physical yield which provides the maximum utility to all commercial and recreational fishermen combined and can be sustained each year. If both commercial and recreational fishermen try to maximize the physical catch of fish, the OSY and the MSY are identical. If the objective of recreational fishermen lies in the act of fishing as well as in the physical catch of fish, however, the level of catch indicated as OSY may be greater or smaller than the level indicated as MSY. It all depends on the utility function of recreational fishermen. It is important to note that the OSY is essentially a concept that can be used as a management tool in order to preserve the maximum productivity of fishery resources for the future by preventing overfishing.

OSY Model

Perhaps the most widely accepted definition of OSY is one suggested by Schaefer in 1954. The Schaefer's definition, graphed in Figure (3 - 1), shows catch on the vertical line and fishing effort on the horizontal line. As fishing effort increases, catch will also increase. With fishing effort at point W, catch is maximized at point V. If fishing effort increases beyond point W, overfishing occurs and catch falls. Fishing effort (E) is defined[3] as:

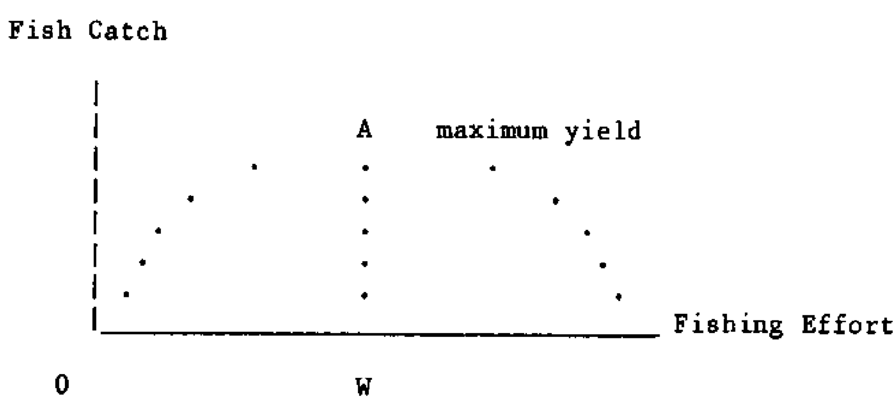
$$E = \text{sum of } HT \qquad (3 - 1)$$

where H refers to horse power or tonnage of individual vessels in a fleet and T refers to time in days of individual vessels spent on fishing. In order to use Schaefer's definition as a managerial concept, it needs to be adapted for OSY as defined in this study and be spelled out more in detail.

Let us make the following assumptions: (1) For a given site of an artificial reef, it is possible to find out the type of fish and their reproduction rate; (2) fishing vessels for the area are homogeneous so that fishing efforts for the artificial reef can be measured by the number of vessels and the days of fishing by these vessels; and (3) the unit of measurement of fishing effort is one day's fishing by one fishing vessel.

Figure 3 - 1

Schaefer's Definition of OSY



Let

F = total catch during a year

E = fishing effort

AC = cost of operation per unit fishing effort.

The catch (F) then is expressed as a function of fishing effort (E) in such way that

$$F = -aE^2 + bE \qquad (3 - 2)$$

Taking the first derivative of F with respect to E, setting the result equal to zero, and solving for E,

$$dF/dE = -2aE + b = 0 \qquad (3 - 3)$$

$$E = b/2a \qquad (3 - 4)$$

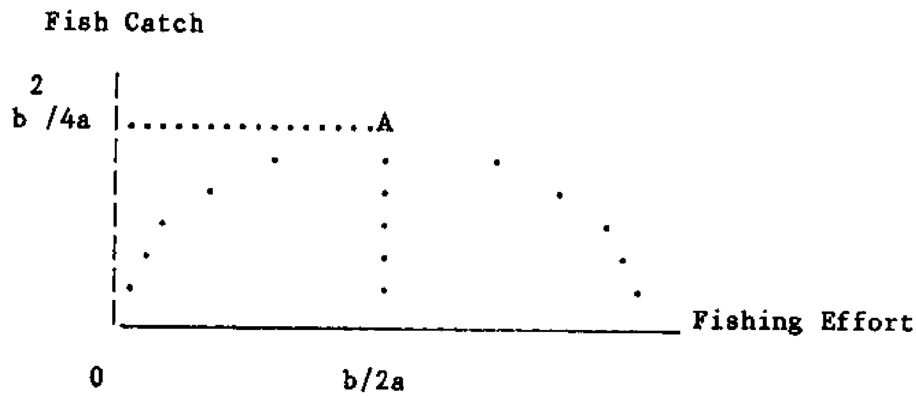
The second derivative of F is taken with respect to E to make sure that the optimal value of F at E = b/2a is a maximum;

$$d^2F/dE^2 = -2a < 0 \qquad (3 - 5)$$

This means that the catch increases at a decreasing rate as more fishing effort is expended, and finally reaches the maximum ($b^2/4a$) when $E = b/2a$. This is graphed in Figure (3 - 2). The maximum catch is obtained by substituting b/2a for E in the F function:

Figure 3 - 2

Catch and Fishing Effort



$$F = -a(b/2a)^2 + b(b/2a) \qquad (3 - 6)$$

$$= -b^2/4a + b^2/2a$$

$$= (-b^2 + 2b^2)/4a$$

$$F = b^2/4a \qquad (3 - 7)$$

Also, notice that the F function has no intercept term because F is zero when there is no fishing effort. Point A in Figure (3 - 2) indicates a maximum yield as was indicated by point A in

Figure (3 - 1).

Assuming that recreational fishermen try to maximize their catch like commercial fishermen rather than try to maximize their enjoyment from fishing, point A in Figure (3 - 2) is OSY as well as MSY. When recreational fishermen try to maximize utility as it is widely believed, the F function needs an adjustment and new solutions are needed.

Note that OSY is defined as the level of catch that maximizes total utility of both commercial and recreational fishermen. For recreational fishermen,

$$U_1 = f(F_1, S) \qquad (3 - 8)$$

where U_1 = utility of recreational fishermen

F_1 = catch by recreational fishermen

S = enjoyment from the act of fishing indicating a surplus beyond catch.

For commercial fishermen,

$$U_2 = f(F_2); \quad dU_2/dF_2 > 0 \qquad (3 - 9)$$

where U_2 = utility of commercial fishermen

F_2 = catch by commercial fishermen.

Total utility (U) and total fish catch (F) are defined as

$$U = U_1 + U_2 \qquad (3 - 10)$$

$$F = F_1 + F_2 \qquad (3 - 11)$$

For simplicity, assume that S increases in direct proportion to fishing effort so that

$$S = sE \qquad (3 - 12)$$

With recreational fishing, the F function changes from

$$F = -aE^2 + bE \qquad (3 - 2)$$

to

$$U = -aE^2 + bE + sE \qquad (3 - 13)$$

Taking the first derivative of U with respect to E to find the maximum,

$$dU/dE = -2aE + b + s = 0 \qquad (3 - 14)$$

and solving for E,

$$E = (b + s)/2a \qquad (3 - 15)$$

To prove that the solution represents a maximum, not a minimum, the second derivative of U is taken with respect to E,

$$d^2U/dE^2 = -2a < 0 \qquad (3 - 16)$$

The level of catch at which the value of s is positive is obtained by substituting (b + s)/2a for E in the F function, not the U function, since the actual catch for a given level of fishing effort is indicated by the F function. That is,

$$F = -aE^2 + bE \qquad (3 - 17)$$

$$= -a(b + s)^2/4a^2 + b(b + s)/2a$$

$$= [2b(b + s) - (b + s)^2]/4a$$

$$= [2b^2 + 2bs - b^2 - 2bs - s^2]/4a$$

2 2

$$F = (b^2 - s^2)/4a \qquad (3 - 18)$$

To summarize, the OSY level of the fish catch when the enjoyment value s of recreational fishing is zero is indicated in

equation (3 - 7) as

$$F = b^2/4a \qquad (3 - 7)$$

The OSY level of the fish catch when the enjoyment value(s) of recreational fishermen is positive is indicated in equation

(3 - 18) as

$$F = (b^2 - s^2)/4a \qquad (3 - 18)$$

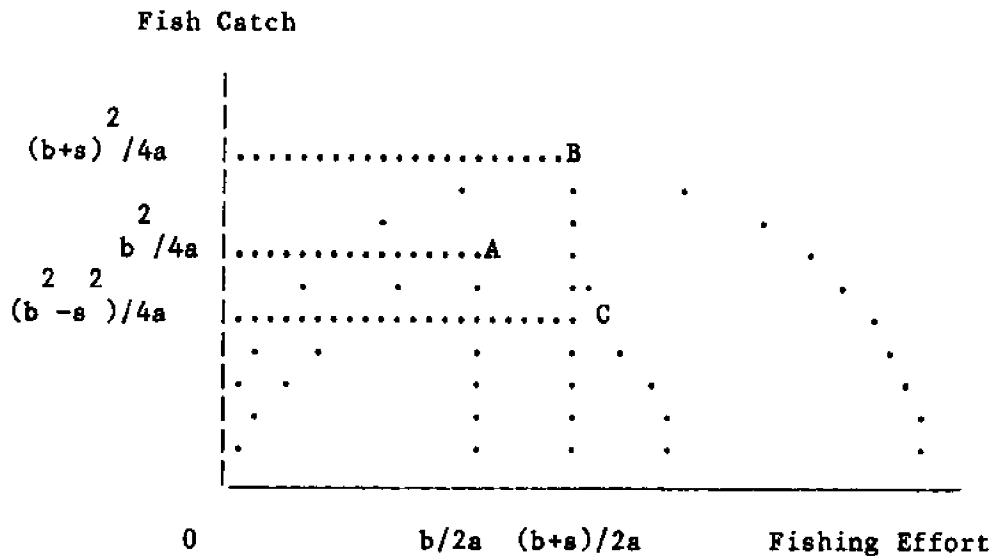
The algebraic difference between equations (3 - 7) and (3 - 10) is that the level of F indicated in (3 - 18) is smaller than the level of F indicated in (3 - 7). This difference means that, when recreational fishing is significant at a given site of artificial reefs, the site's OSY may be lower than its MSY due to overfishing so long as the dollar value of enjoyment which recreational fishermen derive from the act of fishing is greater than the dollar value of the reduced fish catch below the level of MSY.

The possible dichotomy between OSY and MSY in the presence of recreational fishing is illustrated in Figure (3-3). The level of fish catch that represents MSY is indicated as b(2)/4a at point

A. The level of fish catch that represents OSY with a significant level of recreational fishing is indicated as (b(2) - s(2)/4a at point C. The OSY is lower than the MSY by s(2)/4a. Given the value of s, the value of s(2)/4a can be obtained, first, by drawing equation (3 - 13); second, by locating its maximum point B in Figure (3 - 3); and finally by drawing a line from point B that is perpendicular to the horizontal line. Point C is crossed by the perpendicular line and the curve that represents equation (3 - 2).

Figure 3 - 3

Optimal Sustaining Yield



Footnotes

1. For more discussion, see the Corps of Engineers (1983), p. A-72.

2. Gulland, (1974), p. 70

3. See Gulland, (1974), p.76.

IV

AN ECONOMIC MODEL OF ARTIFICIAL REEFS

Objectives of the Model

Economic questions that need to be answered as to the establishment of artificial reefs are two-fold. Should artificial reefs be established, and if so, how many of them should be established for a given area?

It is easier to pose these questions than to answer them. To answer the questions, for instance, it is necessary to know installation and manufacturing cost, transportation cost, maintenance cost, and liability insurance cost of artificial reefs, dismantling and salvage values of reefs if existing oil/gas platforms are used as artificial reefs, the value of commercial and recreational fishing from artificial reefs, and other economic and environmental facts relating to siting of artificial reefs. An economic model of artificial reefs should consider all these facts and be able to provide guidelines for public policy. A useful model should be able to explain the behavioral aspect of artificial reefs and be used for predictive purposes.

Establishing an artificial reef may ultimately be an economic problem. If benefits are greater than costs for establishing an artificial reef, the reef should be established. If costs are greater than benefits, the reef should not be established. As the number of reefs established in an area increases, the benefits from an additional reef are expected to decrease, leading to an optimal number of reefs in which benefits from use of the last reef equal costs of establishing the last reef. The process of developing a workable model is not simple. Assumptions will have to be made and testable hypotheses will have to be suggested.

Let us start the process, first, by studying the benefit side of artificial reefs. The study of benefit side of artificial reefs is followed by the study of cost side of artificial reefs. The study of benefits and the study of costs, then, will be combined to develop a model that determines an optimal number of artificial reefs that needs to be established in a given area.

Benefits of Artificial Reefs: The Case of No Congestion

Imagine a fishing village in the Gulf of Mexico in which recreational fishermen and commercial fishermen live in perfect harmony. The village had no artificial reefs of any kind. One day, an artificial reef was donated to the village and was installed in the open water near the village. What benefits would there be?

There are two types of benefits both of which are based on the enhanced the enhanced fishery resource from the artificial reef[1]. The two benefits are additional fish catch for commercial and recreational fishermen and additional recreational value for recreational fishermen. One may note that the additional recreational value for recreational fishermen arises also from the greater fishing success since several studies have shown that the size and number of fish caught are important to the fishing[2].

Enjoyment of recreational fishermen.

Increased fishing success may lead to a greater fishing effort through participation of additional fishermen or through increased participation of existing fishermen. The greater fishing effort, if left alone, may lead to overfishing beyond what is known as the optimal sustaining yield (OSY). Since unrestricted access to the artificial reef may cause an overfishing which may wipe out all benefits from the reef, it is in the interest of all fishermen in the village and those who come to the village to maintain the OSY for the artificial reef. The OSY in this study is defined as the level of the fish catch that maximizes total utility (or net benefit) of both recreational and commercial fishermen.

For recreational fishermen, the benefit from fishing depends on the actual catch of fish (F) and the enjoyment or surplus (S) through the act of fishing. For commercial fishermen, the benefit from fishing is limited to the actual catch of fish (F). The actual catch of fish varies with fishing effort (E). Let us assume as we did in the preceding section that

$$F = -aE^2 + bE \qquad (3 - 2)$$

and

$$S = sE. \qquad (3 - 12)$$

Total benefit (TB) for both recreational and commercial fishermen is the sum of the fish catch variable (F) and the enjoyment variable (S):[3]
enjoyment variable (S):

$$TB = F + S \qquad (4 - 1)$$

$$TB = -aE^2 + bE + sE \qquad (4 - 2)$$

To find out the level of fishing effort that maximizes total benefit, the first derivative of TB with respect to E is taken;

$$dTB/dE = -2aE + b + s \qquad (4 - 3)$$

Setting the first derivative equal to zero, and solving for E,

$$-2aE + b + s = 0$$

$$E = (b + s)/2a \qquad (4 - 4)$$

The second order condition for a maximum is met since the second derivative of TB with respect to E is negative,

$$d^2TB/dE^2 = -2a < 0 \qquad (4 - 5)$$

To determine the actual level of the fish catch that maximizes total benefit, the solution (4 - 4) of E is substituted for E in

the F function (3 - 2);

$$F = -aE^2 + bE \qquad (3 - 2)$$

$$= -a(b + s)^2/4a^2 + b(b + s)/2a$$

$$F = (b^2 - s^2)/4a \qquad (3 - 18)$$

Please note that[4] the level of F without the variable S in the total benefit function is:

$$F = b^2/4a \qquad (3 - 7)$$

which was derived in the preceding chapter.

A comparison of equations (3 - 18) and (3 - 7) indicates that the optimal level of the recreational fish catch may be lower than the maximum level of the catch so long as the dollar value from overfishing for recreation is greater than or equal to the dollar value of the loss in catch from overfishing. It is also clear that even in the case of one artificial reef, the governing body may wish to impose a size restriction or an access restriction through license requirements in order to maintain the OSY level of the catch.

Benefits of Artificial Reefs: Aggregation and Congestion

Fishermen in the village enjoy the lone artificial reef so much that they are willing to accept more artificial reefs, provided that there is no cost to the village fishermen. So long as additional artificial reefs do not affect the fish reproduction rate of existing artificial reefs, the model developed in the preceding section would still be applicable. As more artificial reefs are obtained, however, there is a problem of congestion.

When there was only one artificial reef, the maximum benefit from the reef was indicated by the solution

$$F = (b^2 - s^2)/4a \qquad (3 - 18)$$

When there are two artificial reefs that are established far away from each other, the total benefit (TB) from both artificial reefs is obtained by

$$TB = 2F \qquad (4 - 6)$$

$$TB = 2(b^2 - s^2)/4a \qquad (4 - 7)$$

Likewise, for n artificial reefs which are located far from one another and have no effect on one another, the total benefit is obtained by

$$TB = nF \qquad (4 - 8)$$

$$TB = n(b^2 - s^2)/4a \qquad (4 - 9)$$

As the number of artificial reefs increases, however, new additions will start affecting the reproduction rate and the fish population of existing artificial reefs. This is the problem of congestion. Adding benefits of individual artificial reefs as if no congestion exists, therefore, will cause an aggregation bias by overestimating the actual total benefit. In terms of the model, the congestion of artificial reefs will change the values of a and b of the F function of existing artificial reefs[5].

The problem of congestion is solved in this study by considering the total benefit itself from all artificial reefs combined. It is assumed here that, as more artificial reefs are added to the existing stock of artificial reefs (Q), the total benefit from cumulative artificial reefs will increase at a decreasing rate and, if continued, will reach a saturation point which indicates the maximum benefit (M) that is possible biologically. This is illustrated in Figure (4 - 1). The total benefit curve appears similar to a learning curve, and may be expressed as

$$TB = M\ (1 - e^{-kQ}); \quad dTB/dQ > 0 \text{ and } d^2TB/dQ^2 < 0 \qquad (4 - 10)$$

where e is the natural number, and the value of k may vary from one area to the next and determines the actual shape of the TB curve.

When the program of artificial reefs is confined to a particular area, the area may also experience a benefit known as the economic impact benefit (I) through additional income and employment that are generated by expenditures of out-of-town fishermen who are attracted to the area because of artificial reefs. In this case, the TB function changes to

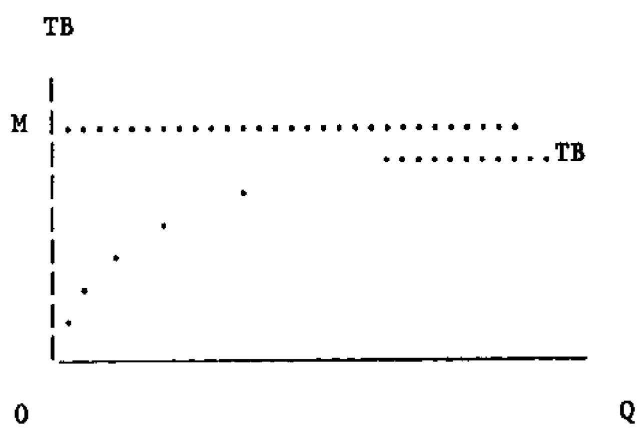
$$TB = M(1 - e^{-kQ}) + I \; ; \quad I = f(Q) \qquad (4 - 11)$$

Costs of Artificial Reefs

Artificial reefs do not come free. Assuming that artificial reefs are all of the same size and the same quality, the total cost of establishing artificial reefs (TC) is the product of the average cost (C) of establishing one artificial reef and the number of artificial reefs (Q);

Figure 1

Total Benefit from Artificial Reefs



$$TC = CQ \qquad (4 - 12)$$

The average cost or cost per unit of artificial reef contains several different cost components. These components are explained below.

One cost component is a dismantling or manufacturing cost (C_d). If an existing facility such as oil/gas platforms were to be dismantled, there would be a dismantling cost. If an artificial reef were to be newly made, there would be a manufacturing cost. For such artificial reefs as old cars, tires, or concrete rubbles, the dismantling cost is zero. Related to dismantling costs, there may be a salvage cost (C_s) if donating an artificial reef involves the sacrifice of its salvage value.

Another major cost component relates to transportation and installation cost (C_t). For many artificial reefs that are donated, the transportation cost is the largest cost component in establishing an artificial reef. Once an artificial reef is firmly in place, it incurs maintenance costs (C_m) such as a decision has to be made on the basis of current dollars, the annual maintenance costs should be capitalized to the present value;

$$PC_m = \text{Sum of } [C_m / (1 + r)^n] \qquad (4 - 13)$$

where PC_m is the present value of the annual maintenance cost (C_m), r is the discount rate, and n is the life year of the artificial reef. If n is permanent,

$$PC_m = C_m / r \qquad (4 - 14)$$

Finally, there is a liability insurance cost. The insurance cost has two parts; one relating to transportation of artificial reefs (C_{it}) and the other relating to their maintenance (C_{im}). The maintenance part of insurance costs should also be discounted for decision making purposes:

$$PC_{im} = \text{Sum of } [C_{im} / (1 + r)^n] \qquad (4 - 15)$$

To summarize, the total cost (TC) of establishing artificial reefs is

$$TC = CQ \qquad (4 - 12)$$

$$= [C_d + C_s + C_t + C_{it} + PC_m + PC_{im}]Q$$

$$= [C_d + C_s + C_t + C_{it} + \text{Sum of } (C_m / (1 + r)^n)$$

$$+ \text{Sum of } (C_{im} / (1 + r)^n)]Q \qquad (4 - 16)$$

Optimal Number of Artificial Reefs

An economic model of artificial reefs is useful only if it can predict the optimal number of artificial reefs for a given community and present policy prescriptions for proper care of the artificial reefs. To find the optimal number of artificial reefs, it is necessary to make a behavioral assumption as to why fishermen in a particular community would want artificial reefs. It is thus hypothesized that fishermen want artificial reefs because of benefits they derive from these reefs and fishermen make decisions in such way to maximize net benefits (NB), i.e., the difference between total benefit (TB) and total cost (TC). That is,

$$NB = TB - TC \qquad (4 - 17)$$

Substituting equations (4 - 11) and (4 - 12) into (4 - 17),

$$NB = M(1 - e^{-kQ}) + I - CQ \qquad (4 - 18)$$

$$NB = M - Me^{-kQ} + I - CQ \qquad (4 - 19)$$

The first order condition for maximum net benefit is derived by taking the first derivative of NB function with respect to Q;

$$dNB\ /\ dQ = kMe^{-kQ} + dI/dQ - C \qquad (4 - 20)$$

Equating the derivative to zero and solving for Q,

$$kMe^{-kQ} = -dI/dQ + C \qquad (4 - 21)$$

Dividing both sides by kM,

$$e^{-kQ} = (-dI/dQ + C)/kM \qquad (4 - 22)$$

$$1/e^{kQ} = (-dI/dQ + C)/kM \qquad (4 - 23)$$

$$e^{kQ} = kM/(-dI/dQ + C) \qquad (4 - 24)$$

Taking the natural log,

$$kQ = \ln (kM/(-dI/dQ + C)) \qquad (4 - 25)$$

Finally, dividing both sides by k,

$$Q = \ln (kM/(-dI/dQ + C))/k \qquad (4 - 26)$$

The second order condition for maximum net benefit is tested by taking the second derivative of NB function with respect to Q:

$$d^2 NB/dQ^2 = -k^2 Me^{-kQ} + d^2 I/dQ^2 \qquad (4 - 27)$$

which is negative.

The solution for Q

$$Q = \ln (kM/(-dI/dQ + C))/k \qquad (4 - 26)$$

is, therefore, an optimal solution.

Under simplified conditions, the solution for Q is transformed into a highly convenient mode for prediction. Assume, first, that a public agency that represents the community is not interested in transfer benefits so that I = 0 and, second, that the TB curve in reality can be approximated by the TB function with k = 1. The solution for Q, then, becomes

$$Q = \ln (M/C) \qquad (4 - 28)$$

This means that the optimal number of artificial reefs of a fishing community can be determined, first, by dividing the dollar value of the maximum possible benefit (M) by the average cost of establishing artificial reefs (C) and, second, by taking the natural logarithm of the result.

Interpretation of the Model

The model and its solution are illustrated in Figure (4 - 2) which is obtained by superimposing the TC curve on Figure (4 -1). The objective of fishermen is to find the Q at which the difference (X - Y) between TB and TC is maximized. The solution is indicated on the horizontal line in Figure 4-2. Under conditions of standardized artificial reefs, estimating the average cost of establishing artificial reefs is not a serious problem. Estimating the maximum possible benefit (M) is more difficult to economists, however, because it involves marine biology as well as economics[6].

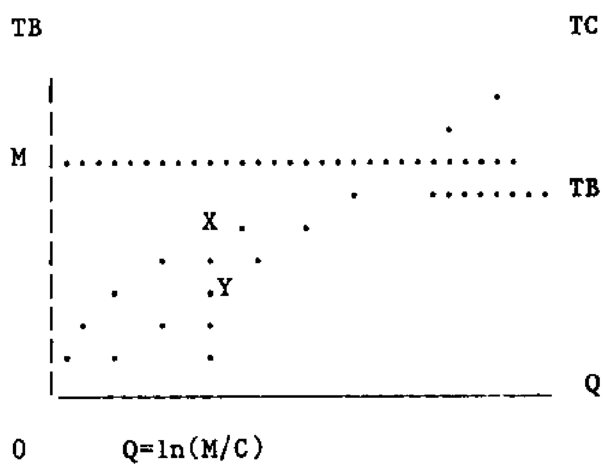
Earlier in this chapter, the actual level of the fish catch that maximizes total benefit at individual artificial reefs without congestion was obtained as

$$F = (b^2 - s^2)/4a \qquad (3 - 18)$$

With congestion, the solution for the fish catch that maximizes total benefit at individual artificial reefs is still the same, but the estimated values of a and b are expected to change to indicate a lower level of catch.

Figure 4 - 2

Maximum Net Benefit



Assuming that the price (P) per pound of fish remains constant, the maximum benefit (M) for all artificial reefs in a given fishing community is obtained as

$$M = [(b^2 - s^2)/4a]P\bar{Q} \qquad (4 - 29)$$

where $\bar{Q}$ is the minimum number of artificial reefs that closely approximates the maximum benefit level of artificial reefs. The algebraic solution for the optimal number of artificial reefs at k = 1 is from (4 - 28)

$$Q = \ln (M/C) \qquad (4 - 28)$$

By substitution,

$$Q = \ln [[P\bar{Q}((b^2 - s^2)/4a)]/C] \qquad (4 - 30)$$

Footnotes

1. Studies have found that artificial reefs improve the fish habitat and thus increase the fish population. See Dugas, Guillory, and Fisher, (1979), p. 3; and Stone, Parker, and Davis, (1979), p. 1.

2. For a summary review of these studies, see Graefe, Strand, and Bockstael, (1984), pp. 4-15.

3. The concept of utility (U) is used in place of benefit (TB) in the preceding chapter.

4. This is obtained as follows:

$$TB = F = -aE^2 + bE$$

$$dTB/dE = -2aE + b = 0$$

$$E = b/2a$$

$$F = -a(b/2a)^2 + b(b/2a)$$

$$= b^2/4a$$

5. For the problem of congestion in estimating the recreational value, see Smith (1981).

6. An interview with marine biologists at the Continental Shell Associates, Inc. of Galveston, Texas, which specializes in marine research in the Gulf of Mexico, reveals that it is possible, although difficult and conjectural, to determine the value of M for a given fishing village.

V

LITERATURE SURVEY ON DATA NEEDS OF THE MODEL

Introduction

When a model is applied to real problems, there is a problem that did not exist in developing the model. The problem is the lack of availability of relevant data. In the subsections that follow, therefore, all published and unpublished data that are needed to apply the model are summarized for the three study states. These observations are then pulled together in Chapter VII in order to develop the procedure of applying the model to the study area.

National Survey of Fishing for the Study Area

Surveys have been made at 5-year intervals since 1955 by the U. S. Fish and Wildlife Service. The following table is a summary of the 1980 survey pertaining to Alabama, Florida, and Mississippi[1].

Table 5-1

Fishery Data for the Tri-State Area

	Alabama	Florida	Mississippi
fishermen by residence (p. 93)			
total	925,000	2,127,000	572,000
saltwater only	34,000	775,000	20,000
freshwater only	763,000	638,000	467,000
saltwater/freshwater	128,000	714,000	84,000
fishermen by residence (adapted from p. 93)			
total	925,000	2,127,000	572,000
saltwater	40,000	1,167,000	24,000
freshwater	885,000	960,000	548,000
fishing days per fisherman by residence (pp. 93-95)			
total	21.6	28.8	24.8
saltwater	23.9	23.9	53.5
freshwater	21.5	34.6	23.4
fishing days by (p. 100)			
resident fishermen	87%	86%	86%
nonresident fishermen	13%	14%	14%
fishermen by state of activity (p. 100)			
total	1,156,000	3,406,000	762,000
resident	890,000	2,028,000	550,000
nonresident	267,000	1,378,000	213,000
annual expenditures per person by state of activity (pp.100-102)			
total	$131.08	$173.93	$120.52
resident	130.57	190.48	133.73
nonresident	132.27	149.58	85.86

Another table of our interest from the 1980 Survey relates to expenditures for saltwater fishing by detailed category, quoted from page 66 of the Survey.

Table 5-2

Expenditures for Saltwater Fishing: 1980

(U.S. Population 16 years old and older)

Expenditure item	Average per fisherman (dollars)
Total	$199.88
Food and lodging:	
Food	61.28
Lodging	15.26
Transportation:	
Public	5.85
Private	44.60
Privilege and other fees:	
Guide	2.87
Pack trip	4.54
Public land use	0.78
Private land use	0.45
Boat launching	3.04
Equipment rental	10.43
Fishing equipment used primarily in saltwater:	
Saltwater rods	8.80
Saltwater reels	7.86
Lures, lines, hoods, etc.	7.78
Depth finders and fish finders	2.08
Tackle boxes	0.96
Minnow seines and traps	0.12
Minnow buckets and other bait holders	0.28
Scales	0.07
Knives	1.33
Prepared bait	5.34
Rod holders	0.39
Spear fishing equipment	0.82
Creels, stringers, and fish bags	0.12
Landing nets	0.35
Seines and other nets	0.72

Other	5.05
Licenses, tags, and permits:	
Licenses	1.14
Stamps, tags, and permits	0.16
Auxiliary equipment used primarily for saltwater fishing	
Camping equipment	0.76
Binoculars, field glasses, etc.	0.29
Snow shoes and skis	....
Special fishing clothes	1.20
Rubber boots and waders	0.35
Maintenance and repair	4.23
Processing and taxidermy costs	....
Other	*0.36

* Estimate based on a small sample size.
.... Sample size too small to report data reliably

Value of Recreational Fishing (Great Lakes, Michigan)

In 1979 the all-or-none value of angling for Great Lakes was $166 million total, or $21 per angler day. In the case of artificial reefs, however, the choice is not all-or-nothing but how much the aggregate willingness to pay would increase as a result of the reef[2]. A one percent increase in the non-salmonid catch per angler day in a given county of southern Lake Michigan would increase the angling value by $15,000, or $11 per new angler day in 1979 price. In the Michigan waters of Lake Erie, a one percent change in the perch and panfish catch rates would increase the angling value by about $18,000, or $7.50 per angler day.

Value of Recreational Fishing
(Florida and Mississippi)

A study by Green covers charter boats and private boats for Florida and Mississippi[3]. User values generated through telephone for Florida anglers are applied to Mississippi anglers. The study concludes that $56.52 of economic user value accrues to a typical charter-private boat angler per day. The angler is willing to pay $56.52 above and beyond his actual fishing expenditures which are $99. All figures are in 1980 prices. The user value is assumed identical to both Florida and Mississippi anglers. Annual permit fees may be obtained by multiplying the daily user value to the number of fishing days.

The study by Green establishes the dollar benefits that accrue to resident Mississippi and Florida marine sport fishermen who use privately owned and charter boats. Sport fishing output is the act of fishing, not fish caught, making it difficult to quantify. Green estimates a demand function in which the quantity is fishing days and the proxy for the price variable is daily variable fishing costs. These costs include such items as bait, charter fees, food, fuel, and travel cost. Note that the unit of sport fishing is days fished, not fish caught. The idea is to estimate the consumer's surplus above the average cost level as an approximation of the dollar value of sport fishing. Data for Florida anglers (385 observations) were obtained for 1980 through a telephone survey. Estimated demand and cost functions for Florida are the following. Those for Mississippi are not estimated.

$$\text{Demand: } \ln D = 5.7752 - \underset{(2.2920)}{1.4127} \ln C + \underset{(0.5235)}{0.0015}\, W + \underset{(1.9211)}{0.1571}\, I + \underset{(3.2034)}{1.2059}\, E$$

$$\text{Cost: } \ln C = 2.8382 + \underset{(0.3956)}{0.0831} \ln D + \underset{(2.2409)}{0.0035}\, W + \underset{(4.8740)}{0.1221}\, I + \underset{(2.2881)}{0.4831}\, Z$$

where D = days fished saltwater
C = Daily fishing cost
W = preference weighted by opportunity cost; opportunity cost is assumed as 35% of income.
I = income
E = fishing experience per age in years
Z = zone; 0 for coastal and 1 to interior

The model is estimated by the two stage least squares method and figures in parentheses are t-values.

The -1.4127 in the demand function is the price elasticity of demand. Green computes the difference between the average price paid ($99) and the maximum price an angler is willing to pay ($141). The difference (claimed to be $56.52) is termed an economic user value that accures to a typical angler per day and is the value of his recreational experience. Aggregate annual fishery valuation is obtained by multiplying user value per day to annual resident fishing days. The same user value is assumed for Mississippi. In Florida, the annual fishing days is 21,168,193. Multiplying by 56.52, the annual value of recreational fishing is obtained as $1,196,444,656 in 1980 dollars. In Mississippi, the annual days are 405,384. Multiplying by 56.52, the annual value of sport fishing is obtained as $22,912,304 in 1980 dollars.

Saltwater Recreational Fishing in Florida

A comprehensive study on various aspects of saltwater recreational fishing in Florida has been made by Bell and others[4]. The study used 1,002 households of 1981-82 data and found the following: 29 percent of the sample households had an adult angler in the house.

For resident saltwater fishermen

a. the average angler had 19.36 fishing days;

b. the average angler spent $508.97 annually. This amounted to $26.29 per fishing day;

c. the user value or satisfaction value per fishing day, received from use of the saltwater fishery resource, was $38.38; and

d. over 67 percent of anglers were willing to pay at least $6.75 for a saltwater fishing license. It is interesting to note that this figure is much smaller than the user value of recreational fishing.

For tourist saltwater fishermen

a. the average angler had 5.39 fishing days;

b. the average angler spent $250.24 annually. This amounted to $46.41 per day;

c. the user value per fishing day was $28.64; and

d. over 52 percent of anglers were willing to pay at least $10.50 for the annual fishing license.

For resident and tourist fishermen combined

a. the average angler had 11.21 fishing days;

b. the average angler spent $358.06 annually. This amounted to $31.93 per day; and

c. the user value per fishing day was $35.65.

The study also presents the following findings for Northwest Florida. The summary is based on pages 29, 36, 71, and 87 of the study.

Table 5-3

Recreational Fishing in Northwest Florida

	Resident	Tourist	Total/Average
number of anglers	202,481	481,477	683,958
expenditures per day	$ 19.04	$ 43.46	$ 31.81
annual expenditure per angler	$ 333.43	$ 350.74	$ 345.61
fishing days per angler	17.5	8.1	10.9
willingness to pay per day	$ 22.91	$ 26.74	$ 24.91
willingness to pay per year	$ 401.14	$ 215.82	$ 270.68
will buy license at	$ 6.75	$ 10.50	$6.75/10.50

Expenditure Impact of Charter Boat Fishing (Mississippi)

According to the 1977 study by Etzold et al, charter fishing related expenditures per fisherman on the Mississippi Gulf Coast are as follows[5]:

Table 5-4

Impact of Charter Boat Fishing in Mississippi

Item	Spending
lodging	$26.40
food and drink	32.40
transportation	15.60
charter fee	30.00
miscellaneous	15.60
Total	$120.00

Expenditure Impact of Nonresident Anglers (Murrells Inlet, South Carolina)

Buchanan made a brief study of the economic impact of Paradise Artificial Reef off Murrells Inlet, S.C. on the local economy[6]. In 1972, the study requested information from non-resident anglers who participated in fishing activities in the Murrells Inlet-Myrtle Beach area. The 102 completed questionnaires were separated into three groups:

Group I: anglers who would not return to the Murrells Inlet - Myrtle Beach area if Paradise Artificial Reef did not exist.

Group II: anglers who fished over the reef but would return even if the reef did not exist, and

Group III: anglers who did not fish over the reef.

Of the anglers who responded, only 14 percent (Group III) had not fished over the reef. Of those who fished over the reef, 82 percent said they would not return if the reef were absent (Group II), and 18 percent said they would not return

(Group I). Anglers in Group I represented the net increase in the number of anglers due to Paradise Artificial Reef.

Group I anglers came to the area primarily for fishing, lived farther from the area, and stayed mostly in public lodgings. Group I anglers also spent nearly twice as much money per manday as those in Group II and about a third more than Group III anglers. During the summer of 1972, these nonresident anglers spent about $36,000; $3,132 (8.7%) by Group I anglers, $28,800 (80%) by Group II anglers, and $4,068 (11.3%) by Group III anglers. This money was spent mostly for gas, oil, bait, tackle, food, launching fees, and lodging. Taxes and maintenance costs are not included.

Characteristics of nonresident anglers fishing out of Murrells Inlet in privately owned and operated boats are the following[7].

Table 5-5

Nonresident Anglers in Murrells Inlet

	Groups I	Groups II	Groups III
No. of parties interviewed	16	72	14
Average number in party	5.7	5.4	5.6
Ave. distance traveled	121	105	93
Ave. trips per year	5.6	13.8	11.8
Ave. days per trip	2.5	5.2	2.5
Private lodging	7	48	8
Rental lodging	8	24	1
Average cost per trip	$53.60	$44.05	$36.85
Average cost per day	$21.44	$ 8.55	$14.74

Expenditure Impact of Fish Aggregating Devices (Hawaii)

Fish aggregating devices (FAD) are artificial buoys designed to attract fish. At a cost of over $400,000, Hawaii installed FADs in 1981 around the eight main islands. The study by Samples and Shug is based on a mail survey of 73 charter boat owners in 1983 for 1982 operations[8]. 1982, 119 charter boats produced 73,780 passenger trips, grossing $8.1 million. The actual cost of developing FADs was $454,207 through the end of 1982. Only about 30.3 percent of all charter fishing excursions involved at least some fishing within one-half mile of FADs. The reason for the low rate of use of FADs by charter boats is that FADs and artificial reefs tend to produce smaller, or otherwise less desirable fish compared with other fishing locations. Congestion may also be a factor.

Cost savings reported by charter boat owners as a result of FAD utilization are summarized in Table (5 - 6)[9].

Table 5 - 6

Cost Savings by Charter Boat Owners in Hawaii

Cost item	Percent of respondents reporting a reduction n = 59	Average percentage cost reduction reported (a)
fuel and oil	58.6%	22.7% (34)
labor	5.1	10.0 (1)
repairs	20.3	15.0 (9)
gear	13.6	23.3 (6)
ice	3.4	25.0 (1)
bait	16.9	41.3 (7)

(a) Numbers in parentheses are the number of observations used to calculate averages.

Savings in fuel and oil are the result of a higher ratio of trolling time to running and scouting time. Given that the average 1982 fuel and oil outlay for a charter boat in Hawaii was approximately $8,400, a 23% cost reduction represents a savings of about $1,900.

In all these savings claims, the benefits are more perceived than actual. A comparison was made, for example, of the average reported fuel and oil costs per full day trip between those who indicated savings from FADs and those who did not. Boats that reported fuel/oil savings paid $65.90 on average, while boats that did not report fuel/oil savings paid $65.50 on average.

Value of Sport Diving (Louisiana)

Roberts and Thompson estimated in 1982 the value of sport diving on the basis of 667 returned questionnaires from sport divers in Louisiana[16]. The questionnaire followed the contingent valuation approach. Among divers who actually took the diving trip, the average number of trips in 1981 was 6. About 50 percent of divers depend on offshore petroleum structures for over 60 percent of their diving activity.

There are two sources of lists of divers: Louisiana divers certified by the National Association of Underwater Instructors (NAUI), and Louisiana subscribers to the Skin Diver magazine (SD). Out of 667 questionnaires, 623 came from NAUI and 44 from SD. The summary of the study is the following.

1. pretax income

NAUI divers	$26,575
SD divers	27,830

2. equipment investment

NAUI divers	$1,709.44
SD divers	$1,844.33

3. daily trip expenditures

NAUI divers	$117
SD divers	109

4. number of trips in 1981

NAUI divers	5.8
SD divers	6.1

5. willingness to pay for one-year permit to use platforms

NAUI divers	$159.39
SD divers	165.87

Costs of Reef Materials

In November 1984, a Venezuelan freighter named Mercedes I was beached onto Mrs. Mollie Wilmot's backyard in Fort Lauderdale, Florida. The 34 year old, German-built, 190-foot ship was purchased by Broward County at $29,950 for use as an artificial reef. The state of Florida paid the Donjon Marine Co. of New Jersey $233,000 to get the freighter off the beach. The ship was sunk in March 1985 after having been blown up with eight 45-pound charges of TNT.

Transportation Costs of Reef Materials

Transportation costs of reef materials depend on the type and amount of materials to be deployed[11]. These materials may be classified into three categories: (1) materials requiring only a tugboat; (2) materials requiring a seagoing barge and tugboat; and (3) materials requiring special transportation needs.

When reef materials require only a tugboat, the average price for tugboats used on recent projects is close to $200 to $250 per hour in 1984 prices. When cost estimates are quoted as an overall towing cost for a specific project, the tugboat cost is approximately $7,000 to $8,000 per project in 1984 prices. In Mississippi where a 173-barge was towed for 23 miles offshore, the cost was $8,000. The same price was quoted for North Carolina where a 240-foot hopper barge was towed 10 to 30 miles offshore to be sunk as an artificial reef[12].

For materials requiring a tugboat and barge, the transportation cost varies with the amount of material and the size of the individual pieces to be hauled. In general, 1200 to 2400 tons of material per barge load can be hauled at a cost of $25.00 to $30.00 per ton.

Most important among other materials that need special attention are offshore oil platforms. Three specific cases may be cited to illustrate the costs of transporting oil plat- forms. First, Exxon donated an experimental Submereged Production System template to the state of Florida in 1980. The structure, weighing 2200 tons, was dismantled and towed 300 miles to Appalachicola. Total cost of the project was $5,500,000. Second, Tenneco donated a 500-ton platform to Florida in 1982. The platform was cut into two parts and towed 275 miles from Morgan City, Louisiana, to Pensacola, Florida. The project cost Tenneco $1,034,000. Finally in 1983, Marathon Oil moved an obsolete platform 220 miles to a reef site 50 miles off the Alabama coast. The project cost $1.5 million to Marathon Oil of which the actual cost of transportation was estimated at $325,000[14].

Liability Insurance

The North Carolina Department of Natural Resources owns two barges for reef operations and carries a $500,000 damage liability policy to cover their operations at a cost of $12,000 to $14,000 per year. The Pinellas County in Florida is self-insured for a liability of $5,000,000 at a cost of $16,000 per year.[15]

Maintenance Costs

The upkeep of buoys of other reef markers is an item of maintenance costs. Inspection, repair, and replacement may cost up to $10,000 per buoy annually.[16]

Footnotes

1. U. S. Department of the Interior and U. S. Department of Commerce, **1980 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation**, Washington, D.C.: U. S. Government Printing Office, 1982.

2. Talheim, "The Economic Impact of Artificial Reefs on Great Lakes Sport Fisheries," pp. 539-540.

3. Green (October 1983).

4. Bell, Sorenson, and Leeworthy (August 1982).

5. Etzold, et al., (1977), p. 12.

6, Buchanan, (1973), pp. 20-21.

7. Buchanan, (1973), p. 20 Table 5.

8. Samples and Schug, **The Economic Impact of Fish Aggregating Devices on Hawaii's Charter Fishing Industry**, 1984.

9. Ibid., p. 9

10. Roberts and Thompson (August, 1983).

11. Unless stated otherwise, this section is based on Richard T. Christian, **Transportation Costs of Artificial Reef Materials**, Washington, D.C.: Artificial Reef Development Center, Technical Report Series No. 4, September 1984.

12. Ibid., p. 4.

13. Ibid. ,p. 6.

14. Ibid., pp. 8-10.

15. Christian, (September 1984), p. 12.

16. DeWitt O. Myatt, **Artificial Reef Maintenance**, Washington, D.C.: Artificial Reef Development Center, Technical Report Series No.2, October 1984, p. 1.

OIL AND GAS PLATFORMS: A SPECIAL CASE

Use of Platforms as Artificial Reefs

Oil platforms are structures used in producing oil. These platforms are supported by a prewelded framework of steel pipe. A framework of hollow tubing is lowered to the sea bottom and then made stationary by solid H-beams driven like pilings into the sea bottom. The long legs or stanchions may extend hundreds of feet from the bottom of the sea to the surface of the structure. The superstructure of some of the larger platforms may include oil storage tanks, living quarters, compressors, and production equipment.

The Gulf of Mexico's offshore petroleum industry got its start in the 1940's. In 1945, a converted land rig was mounted on a wooden structure in about 20 feet of water and drilled the first offshore well. In November, 1947, a World War II LST was used as a tender to drill twelve miles offshore from Louisiana. The well produced 3,400 barrels of oil that year and marked the [1] beginning of the offshore oil industry.

Currently there are approximately 3,350 petroleum platforms in the Gulf of Mexico. Of these, 3,000 are in state and federal waters off Louisiana. The remainder are off Texas. Therefore, fishermen in Louisiana and Texas currently enjoy the fishery benefits produced by petroleum platforms while those in other Gulf states do not. This can change, however, since the Outer Continental Shelf Lands Act and the Bureau of Land Management lease agreement require that platforms be removed when production ceases. Fishermen in Texas and Louisiana may lose their favorite fishing platforms to the scrapyard or their platforms may be used elsewhere for oil production purposes.[2]

A brief history of the use of oil/gas platforms as artificial reefs in the study area is as follows.

In Alabama, an obsolete oil well platform was donated to the state Marine Resources Division by Marathon Oil Company for an offshore fishing reef. The platform was towed from off Louisiana and was sunk at a location approximately 50 miles south-southeast of Mobile Bay on June 27, 1983.

In Florida, the Exxon Corporation donated an oil/gas platform for use as an artificial fishing reef. In 1980, this platform was sunk 35 miles offshore of Carrabelle. Due to the success of this reef, a gas platform donated by Tenneco was sunk 22 miles south of Pensacola in September, 1982. Furthermore, on August 7, 1979, Florida implemented the Artificial Reef Construction Program. By June 1983, 51 projects had been funded under the program.

No use of platforms as artificial reefs is noted in Mississippi. Over the years, the state Marine Fisheries Division created commercial oyster reefs, seed oyster reefs, and recreational fishing reefs along the coast at the Whitehouse Reef, the Biloxi Lighthouse Pier, Biloxi Smallcraft Harbor, Gulfport's Moses Pier, Westside Community Pier, and the Long Beach Harbor jetties.[3]

Fishing Patterns around Platforms

Working oil platforms are effective artificial reefs for at least three reasons. First, they have a high profile extending from the surface of the water to the bottom. This is important in the Gulf of Mexico where currents stir the muddy bottom creating a thick murky layer extending 20 to 30 feet above the seabed. This layer reduces the light necessary for establishing basic marine ecosystems. Low profiles are not efficient in establishing the ecosystems. Second, platforms do not significantly impede water flow. When currents are not impeded, nutrients are evenly distributed to the attached marine life ranging from the near surface areas to those depths where marine life can survive.[4] Third, platforms can be found easily by fishermen. platforms can be found easily by fishermen.

On one day 32 moderately sized boats, 12 yachts, 2 shrimp trawlers, and 3 party boats were observed at Buccaneer Field located approximately 30 miles south of Galveston.[5].

An "access point" type creel survey was run from December 1, 1977 to November 30, 1978, to document the commercial charter boat sport fishery associated with offshore platforms in the Grand Isle, Louisiana vicinity. Although some fishing by these charter boats may take place on ship wrecks, a conservative estimate of the time spent adjacent to oil rigs at the minimum probably approaches 99 percent. Although rig fishing is affected by seasonal, and geographic parameters, the survey indicates that, overall, an average of 6.8 fish and 4.37 kilograms per hour was harvested. The most common fish observed in catches were, in order, Atlantic croaker, silver seatrout, red snapper, bluefish, king mackerel, gafftopsail catfish, and red drum. No survey is available on the total harvest form oil platforms in Louisiana.[6] Survey findings near the Houston-Galveston area indicate that petroleum platforms were used for sport fishing by 87 percent of all offshore sport fishing boats registered in the adjacent area. Further, one-half of the total 66,924 offshore fishing trips taken by the population of resident boat owners in the adjacent 8-county study area were to oil platforms. In addition, charter and party boat operators in the Freeport-Galveston area indicated that of the 2,400 trips they took offshore, 545 (23%) were to platforms.[7]

A 1978 study by Ditton and Graefe on the Texas coast identified the sizes of fishing constituencies at various distances from shore and found that the distance traveled offshore varied markedly by boat length. The table below is quoted from a study by Graefe, and indicates that the 11 to 20 miles normal distance range was the only range to attract a cross section of all boat lengths.[8] The table shows the distance travelled offshore by fishermen in the Houston-Galveston region of the Texas coast by boat length categories.

Table 6 - 1

Percent of Boats Travelling Different MAXIMUM Offshore Distances by Boat Length Categories

	Boat Length (feet)					
Distance (miles)	14-18 n=24	19-25 n=28	26-29 n=116	30-34 n=110	35-39 n=53	40+ n=27
1-10	50	4	3	3	6	4
11-20	33	11	22	9	17	4
21-30	8	29	22	21	25	7
31-40	8	43	22	27	26	22
41-50		11	19	16	11	7
51-60		4	5	10	2	11
61-70			2	3	6	7
71-80			2	5	0	4
81-90			0	1	0	4
>90			3	6	8	30

Table 6-2

Percent of Boats Travelling Different NORMAL Offshore Distances by Boat Length Categories

	Boat Length (feet)					
Distances (miles)	14-28 n=22	19-25 n=28	26-29 n=115	30-34 n=110	35-39 n=52	40+ n=27
1-10	64	7	16	6	8	7
11-20	27	36	36	32	35	19
21-30	5	43	30	29	31	30
31-40	5	14	15	24	14	33
41-50			3	6	12	4
51-60			0	1	0	4
61-70			0	1	2	0
71-80			1	0	0	4
81-90			0	0	0	0
>90			1	2	0	0

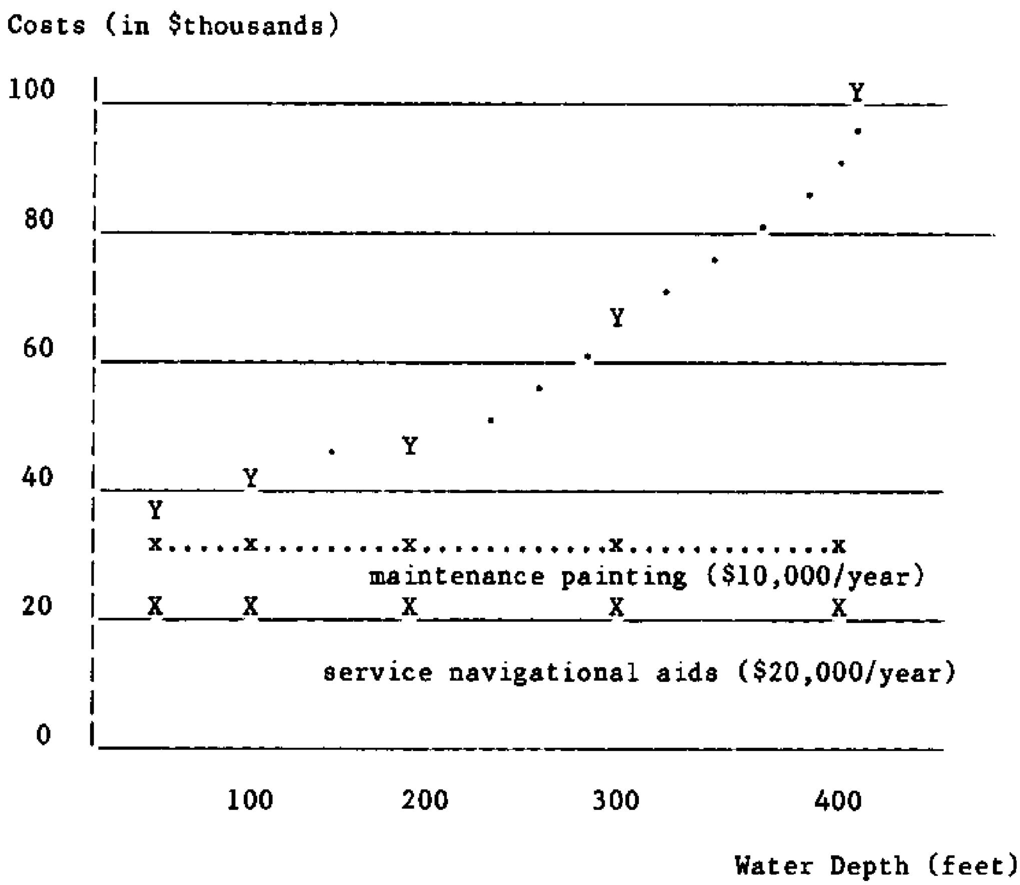
*Percentages may not sum to 100 due to rounding.

Maintenance Costs of Platforms

An indication of annual maintenance costs of an oil platform is indicated in a January 10, 1985 response by Shell Oil Company to the announcement in the Federal Register dated November 13, 1984. Costs indicated in the following graph are cumulative vertically.

Figure 6 - 1

Annual Maintenance Cost versus Water Depth



Removal Costs of Oil and Gas Platforms

In 1973, EXXON U.S.A. computed the cost of removing and salvaging a typical production platform containing 18 wells in 150 feet of water. For this type of structure, they could salvage approximately 1,800 tons of steel at a cost of $900,000 or about $500 per ton actual salvage cost. The incentive of oil companies to remove platforms depends on scrap steel prices. These prices fluctuated between $40 and $120 per ton between 1973 and 1976. fluctuated between $40 and $120 per ton between 1973 and 1976. The process of salvaging platforms was not profitable to oil companies.[9]

According to a letter dated June 7, 1973, from Mr. Dana W. Larson of EXXON Company U.S.A. in Houston to Mr. Joe C. Mosely, III of the Texas Council on Marine-Related Affairs in Austin, a typical production platform containing 18 wells in 150 feet of water contains the following amounts of steel:[10]

	Tons
Jacket	940
Deck	800
Piling	900
Fender	85
Conductor pipe	400-500
total	3,125-3,225

When a platform is removed, it is cut at or near 14 feet beneath the mud line, thus leaving most of the piling and conductor pipe in place.

As a rough rule of thumb, 30% of platform cost is associated with installation. Without considering the effects of inflation, it is reasonable to expect at least the same cost for removal. In most cases, it should be more since the jacket is often installed via air flotation techniques which are not always workable during removal.

If a platform costs $3 million to install, 30% of that leaves about $900,000 for installation costs. If a company leaves the piling and conductor pipe in the ground, it can salvage about 1,800 tons. This equates to about $500/ton compared with current prices of around $50 for #1 heavy melting scrap steel. Regardless of the rounding errors, the petroleum company would be better off leaving the platform in place if at all possible.

An in-depth industry opinion on the removal costs of platforms is available through the **Industry Position Paper**. The cost of removing a platform in 40 to 75 meters of water varies with the region as indicated below.[11]

- Gulf of Mexico	$ 1.4 million
- Middle East Gulf	$ 0.7 million
- California	$ 8.0 million
- North Sea	$70.0 million

The large difference between the cost of removal of a North Sea platform over those in less turbulent regions was typical of those for other platform types. This is partly due to the North Sea structures being more massive than their mild weather counterparts, and partly due to the high cost involved in providing logistic support for any prolonged activity in severe weather areas.

The total cost of removal of the 15 largest platforms reported on was estimated to be $2,784 million, averaging $186 million per platform.

The cost savings resulting from the adoption of partial removal would increase with the depth of water involved, both absolutely and as a percentage of total removal cost. Studies revealed few savings available from the adoption of partial removal in shallow waters, savings of around 27% in 40-75 meters as compared with 87% in 250+ meters of water. The only approach which appeared likely to more than halve removal costs was toppling in situ.

Additional tables of our interest that relate to costs of removing platforms are presented below. These tables are quoted from Oil Industry International Exploration & Production Forum, **The De-Commissioning of Offshore Installations - A World-wide Survey of Timing, Technology and Antiipated** costs, December 1984.

Table 6 - 3

Anticipated Platform Removal Dates - Location

Anticipated Date / Location	Number To Be Removed in Specific Period Before 1985	86-90	91-95	96-2000	2001-10	2011+	Total
North Sea			2	13	59	9	83
Gulf of Mexico	28	157	230	175	81	219	890
Middle East						445	445
Africa			1	18	18	12	49
Far East		2					2
Other location not specified		3	21	9	11	6	50
Total	28	162	254	215	169	691	1519

Source: Page 2 of cited reference.

Table 6 - 4

Estimated Mean Costs for Complete Removal of Individual Steel and Concrete Platforms ($ millions)

Water depth / Location	40	40-75 m	75-150 m	150-250 m	250 m
1. Steel					
North Sea	7.6 (19)	68.7 (22)	183 (12)	196 (3)	
Gulf of Mexico	2.22(34)	1.41 (230)	2.54(70)		75(1)
California		8 (2)			
Middle East Gulf	0.9 (92)	0.7 (44)			
Nigeria	4.2 (37)				
Alaska	12 (1)				
2. Concrete					
North Sea		183 (1)	176 (9)	169 (4)	

Source: Page 5 of cited reference.

Table 6 - 5

Estimated Costs for Partial Removal of Steel Platforms ($ millions)

Water Depth / Location	40	40-75 m	75-150m	150-250 m
North Sea		31 (14)	170 (2)	54 (1)
Gulf of Mexico		1.23 (18)	0.88 (10)	

Source: Page 5 of cited reference.

Table 6 - 6

Partial Removal Costs as % of Total Removal
for Particular Steel Platforms

Water Depth / Location	40	40-75 m	75-150 m	150-250 m	>250 m
North Sea			62 (6)		
Gulf of Mexico	100	73 (18)	48 (10)		13 (1)

Source: Page 6 of cited reference.

Table 6 - 7

Demolition - In-Situ - Toppling Costs as % of Total
for Particular Steel Platforms

Water Depth / Location	40 m	40-75 m	75-150 m	150-250 m
North Sea		45 (14)		20 (1)

( ) = number of platforms involved in given mean estimate.
Source: Page 6 of cited reference.

Additional information is available in Annex 3 of the Industry Position Paper. One such table reveals detailed cost estimates for total removal of steel platforms in water depth greater than 100 meters.

Table 6 - 8

Cost of Removing Steel Platforms in Deep Water

(Money amounts are measured in thousands of British pounds)

Project Team	1,700
Abandon Wells	10,800
Clean and Make Safe	3,800
Topsides Removal	50,100
Disconnect Pipeline and Risers	300
Pile Cutting	930
Jacket Leg Cutting	46,500
Clean Seabed + Survey	1,500
Sub Total (A)	115,630
Ancillary Costs (6% of ST(A) + 250,000 L)	7,188
Sub Total (B)	122,818
Contigency @ 30% of ST(B)	36,845
Total	159,663

The 160 million pounds were approximately 240 million dollars.
Source: Page 4 of Annex 3 of cited reference.

Another table presents detailed cost estimates for toppling deepwater steel platform in water depths greater than 100 meters.

Table 6 - 9

Cost of Toppling Steel Platforms in Deep Water

(Money amounts are measured in thousands of British pounds.)

Project Team	500
Abandon Wells	10,800
Clean and Make Safe	5,930
Remove Floatables	1,980
Disconnect Pipeline and Risers	300
Jacket Demolition	2,253
Survey	700
Sub Total (A)	22,463
Ancillaries (6% of ST(A) + 250,000 pounds)	1,598
Sub Total (B)	24,061
Contingency @ 30% of ST(B)	7,218
Total	31,279

The 31.3 million pounds were approximately 47 million dollars.
Source: Page 5 of Annex 3 of cited reference.

Additional data relate to relative costs of abandonment methods for a steel structure in deep water with water depths greater than 100 meters. Figures are in millions of British pounds.

Table 6 - 10

Cost of Abandoning Steel Structure in Deep Water

Total Removal -5 meters below seabed	160
Partial Removal to -50 meters	120
Toppling complete platform to give 50 meters clearance to surface	32
Toppling is 27% cost of partial removal and only ...20% of cost of total removal	

Source: Page 6 of Annex 3 of cited reference.

Removal Costs of Platforms: An analysis by Shell Oil

Shell Oil made the following analysis in response to notice in Federal Register dated November 13, 1984[12]. According to Shell Oil, the operator of the platform may elect one of the following five alternatives for the disposition of the platform when production from offshore oil and gas ceases.

a. Remove from existing location and scrap onshore;

b. Remove from existing location and tow or haul to another location for disposal, either in deep water or as part of designated fishing reef;

c. Remove and reuse elsewhere either in whole or in part;

d. Leave standing as a high profile fishing reef; and

e. Topple in place, either wholly or partially, creating a low profile reef.

Opportunities for reuse of shore platforms are very limited because (1) the platforms are usually old; (2) they may not meet current design criteria; and (3) there are few opportunities for reuse of a particular platform due to water depth restraints, functional differences, etc.

The cost for each of the five opportunities varies with water depth, size of structure, and disposal method. These are explained in the table below.

Table 6 - 11

Cost of Disposition of Platforms

(dollars in millions)

	Water Depth (ft.)				
Alternative	0-50	50-100	100-200	200-400	400-1000
a.	$25-200	100-1000	1000-2000	2000-8000	7000-75000
	Assumes that the jacket is severed below the mudline, placed on a barge with deck section and taken to shore. No allowance is made for dismantling as the salvage value of the scrap is assumed to offset this cost.				
b.	$25-200	100-400	500-1000	1000-3000	4000-10000
	Assumes that the jacket is severed below the mudline, lifted off bottom with derrick barge and moved to deeper water in a vertical position for disposal. Also, the deck is taken to shore for scrap. If taken to a shallow water reef site, add $1,000M for buoyancy to tow the jacket in horizontal position.				
c.	$100-1500	1000-4000	2000-6000	4000-12000	10,000-125,000
	Assumes that the platform is relocated immediately at a site of comparable depth and that no refurbishing is required. Costs attributable to new piles and extra care necessary to avoid structural damage are included.				
d-1.	$25-250	200-400	400-500	500-600	600+
	Assumes that the deck section is removed and taken to shore for scrap leaving $\pm$15 feet of the jacket protruding above the water line. All unnecessary grating and miscellaneous fixtures will be removed and navigation aids, powered by solar cells, installed on a vertical member. Deduct $100M if the deck is set on bottom adjacent to the jacket.				

d-2.	$36	36-38	38-46	46-100	100±

Unlike the other alternatives, this alternative will require periodic replacement of the cathodic protection system, selective painting of that portion of the jacket above water, and monthly maintenance of the navigational aids. Included in the latter is $15,000/year for boat transportation.

e.	-	-	-	500-2000	100-10000

Jackets in 200 to 600 feet of water would be severed at the mud line, selectively ballasted and sunk horizontally on bottom. In waters deeper than 600 feet, only the top 100-200 feet would be removed and placed on bottom. Unless the deck is returned to shore for reuse, it too would be placed on bottom. costs for water depths of less than 200 feet have not been provided because of anticipated problems in providing adequate clearance.

Platforms and the Model of Artificial Reefs

Obsolete oil and gas platforms are potentially the most important source of artificial reefs. Platforms relate to the cost side of the model of artificial reefs. The very existance of platforms means that there would not be any manufacturing costs. Dismantling and transportation costs would be substantial, however. In this section, the availability of platforms for use as artificial reefs is discussed within the framework of the profit-maximizing or loss-minimizing behavior of oil companies.

Facts are that there are approximately 3,350 oil and gas platforms in the Gulf of Mexico alone, and that these platforms must be removed according to the Outer Continental Shelf Lands Act and the Bureau of Land Management lease agreement. The main objective of oil companies in removing platforms is to find a way that is least costly to oil companies. Suppose that the only way to remove platforms is to dismantle them, transport them to the shore and sell them as scrap metals. The net cost (C^s) to oil companies would be

$$C^s = C^s_d + C^s_t - R^s \qquad (6-1)$$

where C^s_d = cost of dismantling platforms

C^s_t = cost of transporting platforms to the shore

R^s = revenue from sale of platforms as scrap.

One viable alternative to selling platforms as scrap is to donate platforms for use as artificial reefs. Donating platforms involves a dismantling cost and a transportation cost. The net cost (C^r) to oil companies of donating platforms for use as artificial reefs is

$$C^r = C^r_d + C^r_t \qquad (6-2)$$

where C^r_d = cost of dismantling platforms

C^r_t = cost of transporting platforms to the artificial reef site

The decision by oil companies as to whether platforms should be sold for scrap or donated for use as artificial reefs is a problem of economics. Oil companies should sell platforms for scrap if C^s is smaller than C^r, whereas oil companies should donate platforms for use as artificial reefs if C^r is smaller than C^s. Since dismantling costs are the same for the two alternative ways of disposing platforms, the decision making depends ultimately on the comparison between $(C^s_t - R^s)$ for sale as scrap and C^r_t for donation as artificial reefs.

Public policy may influence the decision making of oil companies. Since artificial reefs will benefit fishermen who fish around platforms, policy decisions may be made for fishermen to assume part or all of the transportaion costs of platforms. In the absence of externalities, an ideal solution would be that fishermen who use platforms pay the oil companies an amount that is equivalent to the benefit which fishermen derive from fishing around a given platform. This subsidy to oil companies lowers the net cost of donating platforms for use as artificial reefs, thereby increasing the supply of platforms as artificial reefs.

If external benefits exist and those fishermen who do not pay cannot be excluded from using a given platform, the government may step in and encourage donation of platforms for use as artificial reefs by allowing oil companies to deduct certain expenses such as transportation costs in tax returns. An ideal solution would be to set the tax advantage to the dollar value of external benefits. Under this arrangement, equation (6-2) is changed to

$$C^r = C^r_d + C^r_t - R_b - R_e \qquad (6 - 3)$$

where R_b = the dollar value of benefits accruing to fishermen that is paid to oil companies

R_e = deduction allowed to oil companies for the dollar value of external benefits.

Since C^r in (6 - 3) is smaller than C^r in (6-2) public policies that provide a tax deduction on transportation subsidy to oil companies will encourage oil companies to make available a greater number of platforms for use as artificial reefs.

As the number of platforms used as artificial reefs increases, benefits from use of these platforms will decrease at the margin. As marginal benefits decrease, the value of R_b and R_e should also decrease for an efficient allocation of platforms used as artificial reefs.

Footnotes

1. For more on the history on offshore platforms, see Beardsley, (1977), pp. 43-46.

2. Ditton and Falk, (1981), p. 96.

3. For an overview of artificial reef programs in general in coastal states of the Gulf of Mexico, see Futch (1981).

4. Shinn, (1974), pp. 91-96.

5. Beardsley, (1977), p. 47.

6. Dugas, Guillory, and Fischer, (1979), p. 5.

7. Ditton and Falk, (1981), p. 98.

8. Graefe, (1981), p. 155.

9. Beardsley, (1977), p. 49.

10. See Beardsley, (1977), p. 84.

11. **Removal of Offshore Installations: Industry Position Paper**, May 1984, made available through the American Petroleum Institute, p. 4.

12. The response was made available to the author by Mr. John Burgbacher of the Shell Offshore Development Corporation in 1985.

VII

Procedures of Applying the Model

The model of artificial reefs developed in the preceding chapters is only a foundation for developing the complete procedure for establishing artificial reefs. The procedure, summarized below, is site-specific, although it contains all elements of a general theory that may also apply to other areas.

Step One: Exclusion Mapping

As soon as an area has been identified in which the establishment of artificial reefs is considered, it is necessary to develop an exclusion map for the area in order to locate specific sites that are available for establishing artificial reefs. The procedures of exclusion mapping are the following:[1]

1. Identify coastal population centers that are either urban areas or non-urban tourism destination areas. Population centers in the study area are Gulfport, Biloxi, Ocean Springs, and Pascagoula in Mississippi; Bayou La Batre, Dauphin Island, Mobile, Daphne, Fairhope, Pleasure Island, and Gulf Shores in Alabama; and Perdido Key, Pensacola, Pensacola Beach, Santa Rosa Island, Navarre Beach, and Fort Walton Beach in Florida.

2. Determine from state agency records (a) the number of commercial and recreational boats registered by boat length category and (b) the number of commercial and recreational fishermen in the county. This information is useful to reef planners in estimating the number and types of reef users.

3. Identify access routes and communities that maintain sufficient access facilities including food, lodging, and marine supplies. These routes and communities should be marked on the map.

4. Draw arcs of the mean distance traveled in the seaward area from access routes and communites. This information is useful to reef planners in identifying appropriate users of reefs, i.e., charter, party, individual recreation, or commercial.

5. Identify and mark areas not appropriate for artificial reefs such as shipping lanes, biologically sensitive areas, marine sanctuaries, military areas, traditional shrimping grounds and bottom trawling areas, and existing reef sites.

Step Two: Value of Recreational Fishing

The decision of whether or not to establish artificial reefs depends ultimately on the comparison of benefits from the use of reefs and costs of establishing them. The most important component of benefits is recreational fishing, making it necessary to estimate the value of recreational fishing.

The "willingness to pay" has been accepted as a measure of the value of recreational fishing. The "willingness to pay" refers to the amount of money which individual recreational fishermen must pay, or be compensated, such that these fishermen are indifferent between fishing with pay at artificial reefs and abstinence from fishing without pay. The willingness is approximated by the area under a demand curve, known as the consumer's surplus.

In practice, the value of recreational fishing is measured by the travel cost method or by the contingent valuation method. Although both approaches suffer methodological problems, the bottomline is that the value of recreational fishing will have to be measured. Some may attempt to estimate a demand function for recreational fishing and calculate the dollar value of the consumer's surplus.[2] Others may follow the contingent valuation method as suggested below.

1. Obtain a list of recreational fishermen or the list of owners of registered recreational boats in the selected population center that considers the establishment of artificial reefs. Selected economic data are summarized in the Appendix. It should be noted that the distinction between commercial fishermen and recreational fishermen is quite arbitrary since many recreational fishermen purchase commercial fishing licenses. The best way of obtaining the number of commercial and recreational fishermen is to ask the fishermen's group of the population center selected for the possible establishment of artificial reefs.

2. Develop questionnaire asking the amount of the willingness to pay for different numbers and types of artificial reefs under consideration.

3. Mail the questionnaire and a follow-up questionnaire to the entire list of fishermen, and study the results of the survey.

4. Conduct personal interviews with fishermen selected as samples, and make adjustments on the results of the questionnaire survey in order to reduce the strategic bias, the hypothetical bias, and the sampling or a low return bias.

5. Tabulate the results in such way as to show the total value of recreational fishing according to the number and type of artificial reefs. Although the results will vary from one community to another, the estimated value of recreational fishing is expected to reach a saturation point and remain unchanged once the number of artificial reefs exceeds the first few.[3]

A special section is added at the end of this chapter to discuss how to approximate the value of recreational fishing when the value has not been estimated for a given population center.

Step Three: Estimating Costs of Siting One Artificial Reef

Siting artificial reefs is not a free good. The cost of establishing and maintaining an artificial reef will eventually affect the community's decision on whether or not to establish artificial reef(s). For the purpose of cost estimation, it is necessary to classify artificial reefs into certain types.

The simplest classificiation would be (a) reefs with little or no salvage value such as old tires, concrete rubbles and broken small ships, and (b) reefs with substantial salvage value such as large ships and oil/gas platforms. For each category of artificial reefs, it is necessary to go through the following steps for the collection of cost data.[4]

1. Identify possible donors of artificial reefs by type and the location of the artificial reefs as measured in distance from the community that considers their establishment.

2. For each artificial reef, estimate the cost of dismantling (C_d) if dismantling cost is involved.

3. Obtain the salvage value (C_s) if salvage value is involved.

4. Determine the transportation cost (C_t). Transportation cost varies with types of materials; (a) materials requiring only a tugboat, (b) materials requiring a seagoing barge and tugboat, and (c) materials requiring special transportation needs.

5. Determine the liability insurance cost (C_{it}) relating to transportation of materials. If an outside firm is contracted to move materials, the insurance cost will be a part of total transportation cost.

6. Estimate the maintenance cost (C_m) that includes buoy cost, buoy maintenance, and monitoring expenses. Convert the annual maintenance cost to the present value of the maintenance cost.

$$PC_m = \text{Sum of } C_m/(1 + r)^n$$

7. Estimate the insurance cost relating to maintenance (C_{im}) and convert the annual insurance premium to its present value.

$$PC_{im} = \text{Sum of } C_{im}/(1 + r)^n$$

8. Add all costs for an artificial reef. That is,

$$TC = C_d + C_s + C_t + C_{it} + PC_m + PC_{im}$$

Step Four: Identifying the Sources of Fund

The ultimate decision of having artificial reefs established may depend on who pays for them. If a third party such as the government assumes most of costs, the number of artificial reefs the community wants to have will be greater than that when the community itself is responsible for the entire cost.

Economic principles that relate to the funding of artificial reefs may be stated: (a) that those who benefit directly from artificial reefs pay for the direct cost of their establishment; and (b) that the public sector pays for the portion of artificial reefs that generates externalities. These principles may be compromised like other public spending programs.

At the federal level, the Wallop-Breaux fund is available owing to the Dingell-Johnson Sport Fish Restoration Act. The funds are intended for enhancement of fisheries resources, but are available only to state. The funds may be used for research and construction of artificial reefs.

At the state level, revenues from fishing licenses and boat registration may be used for artificial reef programs. At the local level, a general fund may be used for these programs. If the benefit principle is to be applied in its strict sense, one may even consider selling separate licenses for fishing around artificial reefs. This, however, will create an enforcement problem.

Step Five: Estimating Benefit Without Congestion

This step deals with estimating the benefits of one artificial reef at a time. Benefits in this step refer to "expected" benefits from the establishment of one artificial reef, making them difficult to estimate. The estimation is needed, however.

Recall Figure 3-3 in which the maximum sustaining yield and the optimal sustaining yield are illustrated graphically. It is indicated in Figure 3-3 that the level of the fish catch that indicates OSY may be lower than the level of the fish catch that indicates MSY, provided that the fish catch function F is given as

$$F = -aE^2 + bE$$

To simplify the application procedure, total expected benefits from the establishment of one artificial reef are defined as the sum of the value of recreational fishing (S), obtained in Step Two, and the dollar value of the fish catch by commercial fishermen (D). Both S and D are annual totals and should be discounted to the present value for decision making purposes. That is,

1. Determine the annual value of recreational fishing (S) by all recreational fishermen in the area as obtained in Step Two.

2. Discount the annual value of S to the present value, i.e.,

$$PS = \text{Sum of } S/(1 + r)^n$$

3. Determine the value of D at the MSY level, which is a bio-economic concept

$$D = \text{Sum of } P_i F_i$$

where P_i = prices per pound of different types of fish

F_i = types of fish expected to be caught during a given year around the artificial reef

The value of fish catch by commercial fishermen that is expected from an artificial reef can best be estimated -or guessed-by local commercial fishermen.

4. Discount the annual value of D to the present value, i.e.,

$$PD = \text{Sum of } D/(1 + r)^n$$

5. Add the present value of S and the present value of D to obtain total expected benefit (TB):

$$TB = PS + PD$$

When more than one artificial reef is considered, the value of D is not expected to change so long as there is no congestion. The value of S, however, may change due to the law of diminishing marginal utility, especially after several artificial reefs are established to meet the basic needs of all recreational fishermen. If Step Two investigation is carried out properly, the changing values of S with additional artificial reefs can be made available.

To summarize, when artificial reefs are considered one at a time, the decision on whether or not to establish artificial reefs is made by comparing TB, obtained in Step Five, and TC, obtained earlier in Step Three.

Step Six: Determining the Optimal Number of Artificial Reefs

An important question a community may wish to consider is how many artificial reefs would be optimal for the community. Although several assumptions have been made in the process of developing the model in the preceding section of this study, the model of artificial reefs developed in the preceding section may be applied to approximate the optimal number of artificial reefs for a given community. The procedure under the most simplifying conditions is the following.

1. Determine the maximum catch of fish by type (F_i) that is biologically feasible for the community, assuming that the supply of artificial reefs will continue until the maximum catch is ensured.

2. Determine the dollar value (M) of the maximum catch by multiplying the catch of fish by type by their prices (P_i), i.e.,

$$M = \text{Sum of } P_i F_i$$

Obtaining the dollar value of the maximum catch (M) is expected to be quite complicated and controversial.

3. Obtain the total cost (c) of establishing one artificial reef rom Step Three.

4. Divide M by C and take the natural logarithm of the result. The natural log value is the optimal number of artificial reefs for the community. That is,

$$Q = \ln (M/C)$$

Another way of determining the optimal number is to continue the process in Step Five, which is developed for making decisions on one artificial reef at a time. Provided that all assumptions made in this study hold true, the answer obtained from continuing the process of Step Five should be identical to one that is obtained in Step Six.

Approximating the Value of Recreational Fishing

When a coastal population center considers establishing an artificial reef, the value of recreational fishing should somehow be estimated. Estimating the value of recreational fishing is a project that can be quite costly. In the absence of studies that estimate the value of recreational fishing for a given population center in the study area, the value should be approximated on the basis of published sources. Although several studies are reviewed in Chapter V, only two are suggested for use by coastal counties of the study area: One is Table 5-3 in Chapter V which was developed by Bell, Sorenson and Leeworthy, and the other is the unit day value method in Chapter II which was developed by the Corps of Engineers.

The study area encompasses coastal counties of Mississippi, Alabama, and northwest Florida. Due to the paucity of studies for these counties, Table (5 - 3) is suggested for use (until more reliable studies are made available) on data for expenditures per day, annual expenditure per angler, fishing days per angler, willingness to pay per day, and willingness to pay per year. Although dollar figures in Table (5 - 3) are lower than comparable dollar figures cited in the literature survey in Chapter V, the dollar figures of Table 5-3 may still be an overestimation. In this sense, dollar figures cited in Table 5-3 may be regarded as upper limits. Unfortunately, there is no other table that indicates lower limits of these figures. The only exception is the estimation of the willingness to pay per day.

If studies have not been made to measure the value of recreational activities for a study area, the Corps of Engineers recommends the use of unit day value (UDV) method is explained in Chapter II. Let us make our best judgement to measure the UDV for the recreational fishing around an artificial reef in the study area.

Based on descriptions by the Corps of Engineers, recreational fishing around artificial reefs belongs to special recreation rather than to general recreation. We, therefore, take a look at Table (2 - 2). The first item in criteria is recreation experience. Looking at the judgment factors, reef fishing is characterized by "moderate use, some evidence of other users and occasional interference with use due to crowding." We thus assign 13 points (the middle figure between 11 and 16) for item 1. For item 2 titled the availability of opportunity, reef fishing may be characterized by "one or two within 1 hour travel time; none within 45 minutes travel time." Since a reef may be located in an area within 45 minutes travel time, we assign the lower figure 7 points for the characteristic. For item 3 titled carrying capacity, reef fishing may be characterized by "adequate facilities to conduct without deterioration of the resource or activity experience." Let us assign 7 points, the middle figure suggested in Table (2 - 2). For item 4 titled accessibility, reef fishing may be characterized by "good access, good roads to site; fair access, good roads." We assign the lower end of suggest figures which is 11 points. For item 5 titled environmental, reef fishing may be characterized by "Average esthetic quality; factors exist that lower quality to a minor degree." Let us assign the upper end of suggested figures which is 6 points. Adding all five assigned points, we obtain

$$13 + 7 + 7 + 11 + 6 = 44$$

To convert these points to a dollar value, Table (2 - 3) is employed. For the activity category titled specialized fishing and hunting, the dollar values are \$13.65 for 40 points and \$14.99 for 50 points. Interpolating,

$$\$13.65 + \$(14.99 - 13.65) \times (4/10)$$

$$= \$13.65 + \$0.54$$

$$= \$14.19$$

Based on the UDV method, developed by the Corps of Engineers, the value of recreational fishing per fishing day is \$14.19 in 1985 price. The corresponding value suggested by Bell, Sorenson, and Leeworthy is \$24.91 in 1982 price.

Footnotes

1. The procedures of exclusion mapping are adapted from Ditton (1984).

2. See, for instance, Green (1983).

3. Many coastal communities may already have the value of recreational fishing estimated through research projects of regional sea grant consortiums.

4. For analysis of transportation cost, see Christian (1984). For analysis of maintenance cost, see Myatt (1984).

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Appendix 1:

Review of Studies on Fishing Vessels

The economics of commercial fishing vessels in various parts of the country, including the Gulf Coast, has been the subject of a number of studies in recent years. Some of these studies that are relatively significant are reviewed briefly in this section.

A study by Milon, Wilkowske, and Brinkman is concerned with financial aspects of marinas and boatyards in Florida. The study is highlighted by profit ratio analysis and income statements of marinas and boatyards. Profit ratio analysis is rather unique and is compared to profit ratios published in **Annual Statement Studies** by Robert Morris Associates. A study by Griffin, Nichols, and Smith on shrimp vessels in Texas stresses breakeven analysis under varying conditions. Breakeven analysis is a main feature also in a study by Carley on Georgia shrimp vessels. Prochaska and Cato use a small sample and simple revenue and cost tables, but their target group is interesting. Prochaska and Cato's study is concerned with party boats that specialize in red snapper and grouper. A study by Roberts and Sass is concerned with shrimp vessels in Louisiana. Unlike other studies, this study by Roberts and Sass makes a clear distinction between in-shore shrimping and off-shore shrimping. This study also makes a distinction between vessels operated by owners and vessels operated with hired captain. Another study by the same authors explains in detail how hired crew get paid by sharing revenue.

A publication by Jones, Hubbard, and Roberts in the April 1979 issue of **Marine Fisheries Review** is the only study which used regression analysis. By regressing pounds of shrimp on gallons of fuel used, the authors claim that the result measures efforts by shrimpers since fuel can be used as a proxy variable for time of shrimping. Finally, a nationwide study by Noetzel presents well-documented lists of fixed and variable costs, and clear income statements. The study covers five different groups; groundfish of New England and Pacific Coast, Pacific salmon fisheries, tuna fisheries, shrimp in the Gulf of Mexico, and crab in the Northeast Pacific and Bering Sea.

These studies indicate that a good study on costs and returns of fishing vessels should include at least the following features:

(1) Vessels should be classified according to length in feet and, hopefully, according to type of fish;

(2) Income statements should be presented, clearly indicating fixed costs, variable costs, and return on investment to owners;

(3) Opportunity cost of owner-operated vessels should be clearly presented;

(4) Economies of scale must be studied through estimation of cost and production functions. None of these studies, reviewed in the above, deals with the concept of economies of scale; Fishing vessel information normally requires data of the following items on each vessel:

(A) Vessel

length of vessel, gross tonnage, size of crew, age of vessel, main type of catch, total catch per year, and total sales from sale of catch.

(B) Fixed Cost

depreciation, insurance, utilities, licenses, other taxes, interest payment, advertising, office and docking cost, captain's salary, dues, and legal expenses.

(C) Variable Cost

fuel, oil ice, nets and equipment, repair and maintenance, supplies and groceries, heading and packing, hired labor, and crew share of catch.

Table 1 below is adapted from Noetzel (1977, p. 22, Table 17), and represents one of better studies on fishing vessel operation in the Gulf of Mexico. The table is based on 1974-75 data. Table 2, on the other hand, lists major studies done recently on fishing vessels in the Gulf of Mexico.

Table 1

Costs and Earnings of Vessel Operations

Fishery: shrimp
Region: Gulf of Mexico
Gear Type: otter trawl

Number of vessels in sample	55
1. Vessel characteristics:	
gross tonnage (GRT)	108
length (registered in feet)	69
horesepower (hp)	352
age - end of 1974 (years)	5
crew size (total)	3
2. Gross revenue	$98,014
3. Variable costs:	
(a) goods and services	40,782
(b) crew costs and payroll taxes	31,360
(c) opportunity cost of using own capital	612
Total variable costs	$72,754
4. Fixed costs:	
(a) insurance	$ 4,978
(b) miscellaneous	2,086
(c) depreciation	8,667
Total fixed costs	$15,731
5. Total costs (3 + 4)	$88,485
6. Returns to management and capital (2 -5)	9,529
7. Opportunity cost of management	9,801
8. Returns to captial (6- 7)	-272
9. Investment	104,000
10. Rate of return on investment	-0.3%

Table 2

Sample Sizes of Selected Fishery Studies

Area	Type of Study	Population	Sample Size	Percent	Year Published
Florida	shrimp trawlers	527	53	10.0%	1978
Georgia	shrimp vessels	258	50	19.4%	1968
Texas	shrimp vessles		29		1975
Texas	shrimp vessels		115		1975
S. Carol	shrimp vessels	271	45	16.6	1979
Gulf of Mexico	Shrimp vessels		29		1974
Florida	marinas/boat yards	561	71	12.7	1983
U.S. Fisheries					
	ground fish		54		1977
	salmon		124		1977
	tuna		29		1977
	shrimp		61		1977
	crab		29		1977
Florida	party boat	48	7	14.6	1975
Louisiana	shrimp vessels	1,003	129	12.9	1979

Appendix 2: Table 1

Registered Boats and Fishermen by Type and By County

<table>
<tr><th></th><th>Commerical Boats</th><th>Recreational Boats</th><th>Commercial Fishermen</th><th>Recreational Fishermen</th></tr>
<tr><td>ALA</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Mobile</td><td>3,393</td><td>20,286</td><td>441</td><td>28,524</td></tr>
<tr><td>Baldwin</td><td></td><td>8,881</td><td>245</td><td>24,458</td></tr>
<tr><td>MISS</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Hancock</td><td colspan="2">2,710</td><td>0</td><td>4,618</td></tr>
<tr><td>Harrison</td><td colspan="2">10,694</td><td>0</td><td>19,706</td></tr>
<tr><td>Jackson</td><td colspan="2">11,824</td><td>2</td><td>22,442</td></tr>
<tr><td>FLA</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bay</td><td>1,073</td><td>2,400</td><td colspan="2">23,000</td></tr>
<tr><td>Escambia</td><td>655</td><td>13,892</td><td>898</td><td>17,157</td></tr>
<tr><td>Okaloosa</td><td>219</td><td>5,413</td><td>150</td><td>6,050</td></tr>
<tr><td>Santa Rosa</td><td>546</td><td>9,030</td><td>26</td><td>13,010</td></tr>
<tr><td>Walton</td><td>114</td><td>243</td><td>78</td><td>6,930</td></tr>
</table>

Alabama: 1983 figures
Mississippi: 1983 figures, 1984 figures (boats)
Florida: 1984 figures

Sources:

Alabama Department of Conservation and Wildlife Resources, Accounting Section, Curtis F. Parish; Marine Police, Montgomery, Alabama.

Bay County Offices, Panama City, Florida. Escambia County Offices, Pensacola, Florida. Santa Rosa County Offices, Milton, Florida.

Florida Department of Natural Resources, Doris Dobbins, Tallahassee, Florida.

Mississippi Department of Natural Resources, Mary McGee, Jackson, Mississippi.

Okaloosa County Offices, Crestview, Florida. Walton County Offices, Defuniaks Springs, Florida.

Rush, J. William. **Mississippi Statistical Abstract, 1984.** (College of Business and Industry: Mississippi State, Mississippi). p. 67.

Table 2

Population, Labor Force, Education, and Income by County

	Population, 1980	Civilian Labor Force	Years of School Completed, 1980 (25 yrs+)	Per Capita Income, 1983
<u>Alabama</u>				
Mobile	364,980	142,825	200,918	$8,677
Baldwin	81,500	29,807	45,605	8,295
<u>Mississippi</u>				
Hancock	24,537	8,137	13,947	6,077
Harrison	157,665	54,309	83,659	8,205
Jackson	118,015	45,601	61,821	7,758
<u>Florida</u>				
Bay	97,740	36,356	56,053	8,301
Escambia	233,794	86,170	131,303	8,554
Okaloosa	109,920	37,391	59,323	8,636
Santa Rosa	55,988	20,238	30,843	7,958
Walton	21,300	6,999	13,442	5,728

Source:

County and City Data Book 1983, 10th Edition, U. S. Department of Commerce, Bureau of the Census, pp. 18, 24, 25, 74, 80, 88, 94, 95, 298, 304, 305.

Table 3

Population, Civilian Labor Force, Education, and Per Capita Income of Cities of 25,000 or More

	Per Capita Income	Population	Years Education	Civilian Labor Force
Mobile	$6,593	200,452	114,034	88,162
Pensacola	$6,881	57,619	35,142	26,261
Biloxi	$5,183	49,311	24,389	NA
Gulfport	$6,456	39,676	23,550	NA
Pascagoula	$6,754	29,318	15,691	NA

Table 4

Population and Per Capita Income of Places of 2500 or More

	Per Capita Income	Population
Fairhope	$7,478	7,286
Foley	$5,598	4,003
Fort Walton Beach	$7,083	20,829
Gulf Breeze	$8,942	5,478
Mary Ester	$6,311	3,530
Milton	$5,607	7,206
Ocean City	$7,236	5,582
Panama City	$5,937	33,346
Pretty Bayou	$7,700	3,340
Bay St. Louis	$5,428	7,891
Gulf Hills	$7,264	4,512
North Long Beach	$6,076	7,063
Ocean Springs	$6,867	14,504

Source:

County and City Data Book 1983, 10th Edition, U. S. Department of Commerce, bureau of the Census, pp. 650, 654, 655, 690, 693, 695, 740, 743, 745, 812, 826, 827, 828, 829, 863, 864.

D. Biological Considerations

A number of biological parameters were identified as important to the success of an artificial reef. These include the productivity of existing biota at the site, substrate type, oceanographic conditions and water quality, shape and profile of the reef structure, and life histories of the target species.

The reef substrate should be fairly hard to keep the structure from sinking into the bottom. Orientation of the structure must be carefully evaluated based on oceanographic conditions to minimize scour and to permit a flow of nutrients into the area. In this vein, areas of upwelling make good sites for artificial reefs due to the influx of nutrients associated with this phenomenon. Additionally, specific target species recruitment and residence may be affected by water quality and turbidity.

A controversy exists with respect to the proximity of reefs to one another. The Japanese literature supports large reefs and indicates that they are highly productive. Another view supports building reefs close to others. In this case, some species may be recruited from the older reef populations after which both populations might be expected to increase to an equilibrium level whereupon both become very productive. While the Japanese approach is to maximize food production, this may not be the objective of Gulf of Mexico artificial reefs. It may prove more advantageous to build a number of smaller reefs to reduce concentrations of fishermen at individual sites. The National Artificial Reef Plan suggests building new reefs rather than expanding existing reefs. At this time data are not available to determine whether a specific artificial reef may congregate certain species or may support actual productivity. This portion of the overall study cautions that reef placement may not be an enhancement in the vicinity of existing "live bottoms".

An extensive discussion of "Biological Considerations" is included below in the sections dealing with specific site evaluations.

E. Operational Considerations

Operational factors that influence reef siting include environmental conditions at the site, availability and suitability of different reef materials, transportation and logistics requirements, deployment techniques, optimum reef design, and marking requirements.

Numerous types of materials have been used in the past to construct artificial reefs. Based on availability and durability, concrete blocks and rubble, steel ships and barges, obsolete petroleum platforms, and Japanese-designed structures are the most suitable materials for reef construction. Blocks created from fly ash generated by power plants that burn coal may also have applications for artificial reef use. Although tires have been used extensively in the past, their tendency to drift or break apart makes their use questionable.

Environmental conditions that affect the success of artificial reefs include waves and currents, depth, substrate type, and topography. Areas subject to high energy waves and currents should be avoided because these conditions limit the life-span of a reef. Depth is important for maintaining minimal navigational clearance, attracting the target fish species, and minimizing the effects of storms on reefs. Firm sand substrates are preferred to minimize the loss of a reef due to sinking or siltation. Topographies that are favorable for artificial reefs include flat and featureless bottom regions, near the shoreward edges of valleys or depressions, or areas on either side of submarine ridges.

Transportation of recommended reef materials, including obsolete petroleum platforms, to a site is technically feasible. Barges and heavy equipment or flotation equipment for towing to a site will be required. Little information on deployment methods is available in the literature, however. It is important to anchor an offloading vessel to minimize spreading of reef materials and to optimize their placement.

Reef size, complexity, spatial arrangement, location, orientation, and height are important factors to consider for a successful artificial reef. Optimum reef areas range from 200 to 2500 square meters (cross section) or 2500 to 130,000 cubic meters (bulk volume). Reefs should consist of a hierarchial arrangement that includes blocks or units to form a set, sets clustered to form groups, and several groups to form a reef complex. Sets within a group should be spaced approximately 985 to 1640 feet (300 to 500 meters) apart whereas reef complexes should be spaced at least two miles (3 kilometers) apart. Reefs should be oriented perpendicular to currents. Reef height is probably most important for migratory fishes, and horizontal spread is probably most important to demersal fishes. Reef profile is more important than height, and vertical sides seem to be the best attractants. Vertical panels and horizontal and diagonal skeletal members are effective attractants because of niches and shadows created. Large chambers and holes are avoided by fishes as are chambers with only one opening.

The U.S. Coast Guard determines the necessity for marking an artificial reef on the basis of:

1) physical characteristics of the obstruction;

2) depth of water in which the obstruction is located;

3) proximity of the obstruction to historic or designated vessel routes; and

4) type of vessel traffic at the obstruction site.

Marker buoys are generally not required if there is 85 feet (26 meters) of minimum clearance above the reef.

An extensive discussion of "Operational Considerations" is included below in the sections dealing with specific site evaluations.

F. CHECK-OFF LISTS FOR SITE SPECIFIC EVALUATIONS

Check-off lists have been prepared in each of the disciplinary areas for the convenience of those considering the establishment of artificial reefs. These check-off lists contain the typical information that should be considered in evaluating an area to determine if it can support an artificial reef.

The column titled "reference" contains a list of the pages in the report that contain detailed discussions of the items on the list.

LEGAL CHECK-OFF LIST

ITEM	REFERENCE
Identify and review all state statutes and regulations applicable to placement of an artificial reef	39
a.Environmental protection	19-20,39,43,45,47
b.Pollution control	39,43,45,47-48
c.Coastal zone management	39,41,45,47-48
d.Conservation of natural resources	40,42,47
e.Wildlife protection	43,47
f.Development controls	47
g.Land use planning	40,43-44
h.Liability	63-67
i.Permitting	41,44,45
j.Obstructions to navigation	42,45,46
k.Insurance requirements	27
Review federal statutes and regulations applicable to placement of artificial reefs	39
a.Coastal zone management	39
b.OCS lands act	17
c.Submerged lands act	21
d.Ocean dumping act	35,38
e.Endangered species act	32
f.Marine protection, research, and sanctuaries act	33,38
g.Marine mammals /protection act	33
h.Section 404 of the clean water act	20-23,36-38,39

LEGAL CHECK OFF LIST CONTINUED

ITEM	REFERENCE
i. Section 10 of the rivers and harbors act	17-20
j. Liability for damage or injury to third parties	27,49-67
k. Laws governing obstructions to navigation	17,20,30,31,68,69
l. Tax incentives for reef material donors	70,71
m. Insurance requirements	27
Identify appropriate Federal and State agencies responsible for administering each of the identified statutes and regulations	17,19,20,27,28,30, 32-38,41,44,45
Identify appropriate permits required based on the previous regulation review	24,27,28,30,41,44,45
Acquire appropriate permit application forms	24,28-30,41,44,45, 110-200
Prepare permit applications for submission. Many permits require both a written plan and an engineering drawing depicting the reef layout	24-28,30,41,44,45, 110-200

SOCIOLOGICAL CHECK-OFF LIST

ITEM	REFERENCE
Determine population of artificial reef demand center	221,223,233,229,230, 232
Determine number of commercial fishermen operating from the demand center	222,223
Determine number who own commercial boats	220,221,222,223
Determine number who fish for another boat owner	223
Determine number of recreational fishermen who live in the demand center	221-223,229
Determine number of recreational fishermen who commute to the demand center	222,223
Determine the number of recreational fisherman in each of the above two categories who own boats	222,223
Determine the number of recreational fishermen who do not fish from boats	222,223
Determine the number of recreational fishermen who fish from charter z or party boats	222,223
Determine the number of commercial fishing boats berthed at the demand center	222,223
Determine the number of personally owned recreational boats berthed at the demand center (exclude personally owned charter boats)	222,223
Determine number of charter recreational fishing boats berthed at the demand center	222,223

SOCIOLOGICAL CHECK-OFF LIST CONTINUED

ITEM	REFERENCE
Determine the number of personally owned boats trailered to the demand center	222,223
Determine the number of marinas and dry boat starage facilities in the demand center	222,223,229
Determine number of homesite berths	222,223
Determine if existing berths are adequate for the demand	222,223
Determine number of non-marina boat fueling and servicing facilities	222,223
Determine number of boat launching ramps in the demand center	222,223
Determine average waiting time to launch a boat	222,223
Identify potential artificial reef sponsors	215,217,225,227
Identify public and private groups interested in artificial reef development	227-229,233
Identify entity to be responsible for artificial reef maintenance	215,218,219,222,224, 233

ECONOMICS CHECK-OFF LIST

ITEM	REFERENCE
Identify population centers	227,450,518
Develop exclusion map	450,518,614,703,787
Clarify permit requirements and procedures	450,519
Obtain numbers of commercial and recreational fishermen for the population center	227,450,519
Estimate the dollar value of additional fish catch	450
Obtain the numbers of resident and tourist recreational fishermen	227,450,451
Estimate the total annual fishing days of the population center's recreational fishermen	227,231,451,452
Estimate the total dollar value of recreational fishing	237,450
Estimate the value of recreational fishing for the artificial reef under consideration	237,451,452,523
Estimate the expenditure impact owing to the artificial reef	230,452
Estimate the total annual benefit from the artificial reef	452
Convert the total annual benefit from the artificial reef to its present value	452
Identify the sources of external funding and apply for funds	452,520,587,588,667, 668,760,761
Make the decision	452

BIOLOGICAL CHECK-OFF LIST

ITEM	REFERENCE
Target species	568-571,661-664,746-749
a.Life history	572,573,576,580-582,584,585,656,671-673,751,756,758
b.Habitat preferences	572,573,576,580-582,584,585,656,671-673,751,756,758
c.Predator/prey relationships	584
d.Recruitment conditions	570,571,580-582,663,664,671-673,747,750,751
e.Overall ecosystem requirements	
1.Oceanographic conditions	569,572,574,584,662,665,747,750,751
2.Productivity of surrounding waters	569-571,584,662,664,747-749
3.Water quality	569,571,573,584,662,665,747,750,751
4. Turbidity	569,572,574,584,662,665,747,750,751
Fishery management goals	586-588,676-678,759-761
a.Reef population monitoring	586,587,676,677,759,760
b.Reef productivity	571,664,749
Recruitment monitoring	586,587,676,677,759,760

OPERATIONS CHECK-OFF LIST

ITEM	EXPLANATION
Selection of materials	606-610.695-699,779-783
a.Suitability to reef objectives	609,698,782
b.Cost of preparation	606,608,609,695,697,698, 779,781,782
c.Transportation	628,629,713,714,793,794
Reef site selection	610,611,699,701,783,785
a.Depth of water	580,584,585,610,611,661, 675,699-701,756,758, 783-785
b.Substrate conditions	569,578,580,618,602,667 673,675,700,701,703,704 756,758
c.Energy environment	569,610,662,675,699,747, 758,783
d.Proximity to shipping traffic lanes	610,614,615,699,703,705, 783,787,788
e.Proximity to existing natural or artificial reefs	569-571,614,616,618,662, 664,671,675,703,704,707-712,747-749,787,789,791
f.Proximity to active fishing grounds	614,618,693,705,787
Reef size	629,633-636,714,718-721, 794,798-801
Reef configuration	568-571,661-664,746-749
a.Shape, orientation, construction, entrances/exits	570,580,584,585,629,633-634,663,671,675,714,718-721,748,756,758,794,798-801
b.Marking requirements	636,721,801
c.Maintenance requirements	636,721,801
Accessibility (distance from demand center)	618,620,706,707,787

IV. SITE SPECIFIC ARTIFICIAL REEF SITING PLANS

A major objective of this study has been to develop three site-specific artificial reef development plans. The areas selected for the development of these plans are the waters near or adjacent to Biloxi, Mississippi; Mobile, Alabama; and Pensacola, Florida. This has been accomplished and the results are included below.

While the biological, operational, and economic portions are appropriately discussed relative to the individual site location, it has proven inappropriate to discuss the sociological and legal components in this fashion. The lack of site-specific data for many of the sociological aspects of the study have precluded this detail. Consequently, the sociological component has been developed in a general sense.

The site specific legal recommendations are included in Section III - "Site Development Plan."

SITING PLANS FOR THE ESTABLISHMENT OF ARTIFICIAL REEFS IN THE GULF OF MEXICO: A COOKBOOK PROCEDURE

[Mississippi]

by

Semoon Chang, Director
Center for Business and Economic Research
University of South Alabama
Mobile, Alabama 36688

July 1, 1986

Siting Plans for the Establishment of Artificial Reefs in the Gulf of Mexico: A Cookbook Procedure

Introduction

This report summarizes a cookbook procedure of making decisions as to whether a population center should attempt to have an artificial reef established in its waters. All technical arguments and presentations are deleted.

Step 1: Identify the population center.

A given community that considers establishing an artificial reef is the population center. If fishing waters are shared by another adjacent community, this neighboring community should also be included in the population center. Population centers are selected usually on the basis of social and demographic data.

Step 2: Develop an exclusion map.

An exclusion map should identify areas where artificial reefs may not be placed. These areas include shipping lanes, offshore ports, biologically sensitive areas, marine sanctuaries, military areas, and areas of particular shipping interests. An exclusion map shows areas that are most suitable for establishing artificial reefs in waters of the particular population center.

Step 3: Clarify the requirements and procedures of obtaining the permit to establish an artificial reef.

Early in the process, the population center may clarify the requirements and procedures of obtaining the permit to establish an artificial reef. This step is intended to make sure that no problems arise from the permit procedure after the decision is made to establish an artificial reef in the waters of the population center. This step requires personal interviews or telephone conversation with those who issue the permit.

Step 4: Obtain the numbers of commercial and recreational fishermen for the population center.

These numbers are necessary in estimating potential benefits from use of the artificial reef under consideration. The local fishermen's association, the U. S. Coast Guard, or a state office that issues fishing licenses may be able to provide information on these numbers. It is almost impossible to obtain accurate numbers of commercial and recreational fishermen. Since these numbers are the basis for the subsequent calculation, it is important to come up with reasonably accurate numbers. Saltwater divers should be counted as recreational fishermen.

Estimates by fishermen in the Biloxi area indicate that there are approximately 814 commercial fishermen and 4,127 recreational fishermen in the area.

Step 5: Estimate the dollar value of additional fish catch.

The dollar value is the sum of retail prices of different species of fish that both commercial and recreational fishermen are expected to catch off the artificial reef under consideration. Opinions of local fishermen and local marine biologists would be the source of this estimation. Since the fish catch off an artificial reef may vary with the type of the artificial reef, it may be necessary to presuppose the type of artificial reef the population may plan to have established.

Step 6: Obtain the numbers of resident and tourist recreational fishermen in the population center.

These numbers are necessary to estimate total fishing days of recreational fishermen in the population center. Rather than undertaking costly studies, it is suggested that fishing communities use the results of the 5-year interval national survey on fishing, hunting, and wildlife-associated recreation. The 1980 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation was published in 1982 by the U. S. Department of the Interior and the U. S. Department of Commerce. The 1985 survey may be made available in 1987.

The survey indicates the ratios of resident recreational fishermen and tourist recreational fishermen relative to an area's residence recreational fishermen. Residence fishermen refer to fishermen who live in the population center. Resident fishermen refer to residence fishermen who fish in waters of the population center. If a residence fisherman fishes in areas other than the population center, the residence fisherman is not a resident fisherman. Tourist fishermen refer to out-of-town fishermen who came to the population center for fishing. Since the ratios presented in the survey are different from one state to another, the method of obtaining resident and tourist fishermen is presented only for Mississippi. We already know the number of residence recreational fishermen and our assignment is to obtain the number of resident recreational fishermen and the number of tourist recreational fishermen on the basis of the number of residence recreational fishermen.

Population Centers in Mississippi

(A) [PC's residence recreational fishermen]

Multiplied by x 0.9615

Equals [Resident recreational fishermen]

(B) [Resident recreational fishermen]

Multiplied by x 0.3873

Equals [Tourist recretional fishermen]

Note that the number of tourist recreational fishermen may also be obtained by multiplying the PC's residence recreational fishermen by 0.3724 (which equals 0.9615 x 0.3873).

Step 7: Estimate the total annual fishing days of the population center's recreational fishermen.

The total annual fishing days of the population center are obtained by adding the total annual fishing days of the resident recreational fishermen and the total annual fishing days of the tourist fishermen. The total annual fishing days of recreational and tourist fishermen for the northwest Florida are available in, "The Economic Impact and Valuation of Saltwater Recreational Fisheries in Florida", a 1982 study by Bell, Sorenson, and Leeworthy. The annual fishing days per resident recreational fisherman are 17.5 days, while the annual fishing days per tourist recreational fisherman are 8.1 days. Since no comparable data are available in the national survey, these findings are applied for Mississippi as well as northwest Florida. The estimation of the total annual fishing days of the population center's (resident and tourist) recreational fishermen is made as follows:

[Resident recreational fishermen x 17.5]

Plus [Tourist recreational fishermen x 8.1]

Equals [Total fishing days of recreational fishermen]

It is interesting to note that estimates by fishermen who attended the town meetings indicate that the fishing days of a typical recreational fisherman in the Biloxi area are 25 days (based on 20 responses) and the fishing days of a typical out-of-town fisherman is 8.4 days (based on 17 responses) in the Mobile area.

Step 8: Estimate the total dollar value of recreational fishing.

To estimate the dollar value of recreational fishing, the total number of fishing days for recreational fishermen should be multiplied by how much each day is worth to each fisherman. Unless reliable studies are available for particular population centers that estimate the value of recreational fishing, it is suggested that population centers use the guidelines for assigning points for special recreation, developed by the Corps of Engineers. The unit-day value for saltwater recreational fishing in 1986 price is $14.73. Total dollar value of recreational fishing of the population center, therefore, is obtained as

	[Total fishing days of recreational fishermen]
Multiplied by	x $14.73
Equals	[Total dollar value of recreational fishing]

The $14.73 figure is the lowest estimate available in studies that estimated the daily value of recreational fishing. Based on estimates of fishermen who attended town meetings, however, even this figure may be an overestimation. Recreational fishermen in the Biloxi area were willing to pay only $62.00 (based on 21 responses) for use of artificial reefs for the entire year.

Step 9: Estimate the value of recreational fishing for the artificial reef under consideration.

The value of recreational fishing derived in step 8 is based on the assumption that all fishing days of all recreational fishermen are spent around the artificial reef. The value, therefore, should be multiplied by the percentage of fishing days spent on fishing around the artificial reef relative to total fishing days. The population center must make the best judgment for the percentage. That is,

	[Total dollar value of recreational fishing]
Multiplied by	[Percent of fishing around artificial reef]
Equals	[Dollar value of recreational fishing around artificial reef]

The percent of fishing around artificial reef is approximately 35 percent (based on 21 responses) in the Biloxi area, according to the questionnaire survey at town meetings.

Step 10: Estimate the expenditure impact owing to the artificial reef.

The net economic development impact from expenditures by out-of-town fishermen (and additional local fishermen, if there are any) should be included in estimating the expenditure impact.

Additional expenditures by only those fishermen who are attracted to the area due to the artificial reef should be considered. The annual expenditures per fisherman by state of activity are available in the 1980 national survey. These expenditure figures are adjusted to the 1986 price level. To obtain the expenditure impact, out-of-town (commercial and recreational) fishermen and local (commercial and recreational) fishermen who are newly attracted to the area due to the artificial reef under consideration need to be estimated. The procedure is described by state.

Expenditure Impact for Mississippi

(A) Estimate additional out-of-town and local fishermen due to the artificial reef under consideration.

(B) Multiply (A) by $162.47.

Step 11: Estimate the total annual benefit from the artificial reef.

The total annual benefit from the artificial reef under consideration is obtained by adding the following benefit categories:

(A) the dollar value of additional fish catch from the artificial reef [Step 5]

(B) the dollar value of recreational fishing for the artificial reef [Step 9]

(C) the expenditure impact of the artificial reef [Step 10].

Step 12: Convert the total annual benefit from the artificial reef to its present value.

Since total benefit figures are recurring each year, these figures should be converted to their present values so that benefits can be compared with costs for the same price level. To simplify the computational procedure, it is assumed that the discount rate is 10 percent and the life of an artificial reef is 25 years. The present value of the total annual benefit, then, is obtained as follows:

	[Total annual benefit]
Multiplied by	9.077040
Equals	[Present value of benefit]

Step 13: Estimate the total cost of establishing the artificial reef.

The total cost of establishing an artificial reef consists of (a) manufacturing or dismantling cost, (b) transportation cost that may include a liability insurance on shipment of an artificial reef, and the maintenance cost including an annual liability insurance premium. The maintenance cost should be discounted to the present value since it is recurring annually. Cost estimates are made usually after potential donors of artificial reefs are identified. The total cost is obtained by adding the following cost categories:

(A) Manufacturing or dismantling cost, if this cost is assumed by the population center.

(B) Transportation cost, unless this is assumed by the donor of the artificial reef.

(C) Present value of annual maintenance cost, which is Annual maintenance cost x 9.077040.

Step 14: Identify the sources of external funding and apply for funds.

The next step is to identify the sources of external funding and apply for funds needed to establish the artificial reef. Sources include the Wallop-Breaux fund at the federal level, state and local government, and local fishermen's groups. The fact that out-of-town fishermen would be attracted to the area may be presented as a basis for requesting a subsidy from the local government. Subtract the amount that can be acquired from these sources from the remaining cost to obtain the net cost of establishing an artificial reef to the population center. That is,

	Total cost obtained in Step 13
Minus	External funds
Equals	Net cost of establishing an artificial reef

Step 15: Make the decision.

The final decision on whether or not to establish an artificial reef in a given population center is made by comparing the present value of total annual benefit obtained in Step 12 with the net cost of establishing the artificial reef obtained in Step 14. If benefits are greater than costs, the population center may establish the artificial reef. If benefits are smaller than costs, the population center may not establish the artificial reef.

CSA

Continental Shelf Associates, Inc.

BIOLOGICAL FACTORS AFFECTING
ARTIFICIAL REEF SITING OFF MISSISSIPPI

28 FEBRUARY 1986

PREPARED FOR:

National Marine Fisheries Service
Southeast Region
9450 Koger Boulevard, Duval Building
St. Petersburg, Florida 33702

PREPARED BY:

Continental Shelf Associates, Inc.
759 Parkway Street
Jupiter, Florida 33477
Telephone: (305) 746-7946

"Applied Science and Technology"

ABSTRACT

Available information concerning biological parameters that affect the success of an artificial reef was collected and reviewed. Sites off Mississippi were identified as biologically optimal potential artificial reef sites. Shallow water and deepwater sites were selected and the advantages and disadvantages of each potential site were discussed. Biological parameters identified as important in artificial reef siting include substrate, benthic productivity, oceanographic and water quality conditions, reef structure, and the biology of target species. Shallow water sites were identified to be best suited for low-relief structures that would attract primarily demersal coastal species. Deepwater structures were identified to be best suited for high-profile structures that would attract pelagic as well as demersal species. There is a lack of information concerning the biological parameters important to artificial reef siting. Monitoring of all new artificial reefs is strongly recommended as a source of additional information to optimize future artificial reefs. Government policy makers should investigate the possibility of using artificial reefs as a form of mitigation or fine payment.

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EXECUTIVE SUMMARY

Available information concerning the biology of artificial reefs and potential artificial reef habitats off Mississippi was collected and reviewed. Numerous parameters were identified to be biologically important to the success of an artificial reef, including the productivity of the existing biota at a reef site, substrate type, oceanographic and water quality parameters, shape and profile of the structure, and the life history of target species. Although other parameters such as seasonality and reef size, structure, texture, and complexity are biologically important, they are probably less important to the success of an artificial reef than the previously described parameters.

Shallow water and deepwater sites were selected on the continental shelf off Mississippi. The shallow water sites are probably best suited for relatively low-relief structures such as concrete rubble or Liberty Ships. Due to their relative distance from shore, it is expected that the reefs would attract a significant number of estuarine-dependent species such as seatrouts, croakers, and drums. All of the species are commercially and recreationally important.

The deepwater sites are well suited for both high-relief and low-relief structures. High-relief structures offer potential habitat for a significantly larger number of species than low-relief structures. It is likely that many coastal and oceanic pelagic species will be attracted to a high-profile artificial reef that offers some type of mid-water structure. Species such as mackerels, cobia, bluefish, tunas, and billfishes which are recreationally and/or commercially important are likely to be attracted to such a structure. The lower portion of the structure would be similiar to a low-relief type artificial reef and would probably attract demersal fishes. Species such as snappers, groupers, and sea basses which are commercially and recreationally important would likely be attracted to the reef due to its location in deep water and close proximity to the shelf edge.

Researchers are just beginning to investigate the biological factors that are important to consider when siting and constructing an artificial reef. It is recommended that site-specific data for numerous parameters such as substrate type and existing biota be investigated before final placement of an artificial reef. General information concerning the life histories of many commercially and recreationally important species is lacking and would be useful for artificial reef siting. Monitoring of biological and physical parameters should be conducted on any new artificial reef structure whenever possible.

Information concerning the biological parameters that affect artificial reefs is limited. Most of the data collected have been the result of funding from local, State, and Federal governments and from private industries that have economic interests in artificial reefs. Future funding for artificial reef research and monitoring will probably continue to originate primarily from these same groups. Additional potential funding may originate by using artificial reefs in mitigation or by committing the payment of fines to artificial reef endeavors.

1.0 INTRODUCTION

The use of artificial reefs as a habitat enhancement tool to expand recreational and commercial fishing opportunities has gained tremendous popularity during recent years. Many artificial reefs have been implemented by well intentioned and highly motivated persons who, unfortunately, constructed and sited their reefs with little or no scientific data (Bohnsack and Sutherland, 1985). Political persuasions, costs, available materials, and waste disposal have often been the major considerations for constructing and siting artificial reefs. Subsequently, numerous artificial reef efforts have been total failures resulting in a loss of money, labor, and occasionally already existing habitats (Stevens, 1963; Mathews, 1981). While the aforementioned considerations may continue to play a significant role in the construction and siting of artificial reefs, additional data (i.e., biological, operational, social, economical, and legal) and comprehensive plans are clearly necessary to fully profit from the many potential benefits offered by successful artificial reefs.

Biological considerations are of major importance for constructing and siting artificial reefs. Many parameters such as water depth and quality, reef profile and size, reef complexity, and spatial arrangement and orientation are important for optimizing the biological success of artificial reefs. All of these parameters must be considered along with specific habitat and environmental requirements of desired target species. Additionally, artificial reefs should be constructed and sited with fishery management goals and regulations in mind.

The purpose of this report is to review and evaluate the existing literature and data base concerning the biological parameters to be considered when constructing and siting artificial reefs. Using this existing information, biologically optimum locations will be selected for siting artificial reefs off Mississippi.

It should be pointed out that this is one aspect of a multidisciplinary effort to select sites. Therefore, while operational, social, economic, and legal constraints influence successful artificial reef development, no attempt was made (except in a very general way) to incorporate these other issues into the present analysis. Hence, potential sites are recommended primarily on the basis of biological factors. Biological, operational, social,

economic, and legal constraints must be evaluated in concert before final selections are made.

2.0 METHODS

The primary tasks conducted to achieve the objectives of this project involved collection and review of existing literature and data concerning the biological factors involved in constructing and siting artificial reefs. Data collection was accomplished by several different methods including: (1) computerized literature search and review; (2) review of in-house literature; (3) personal communications with researchers and persons involved with artificial reef projects; (4) input from the Advisory Group--a group of artificial reef knowledgeable persons selected to review and advise on the direction and nature of the project and products; (5) acquisition of information and advice compiled by persons at the Sport Fishing Institute's (SFI's) Artificial Reef Development Center; and (6) acquisition of information available from various State and Federal agencies.

A computerized literature search of numerous data bases from the DIALOG Information Retrieval Service was conducted using the key words "artificial reef." The search was conducted at Mississippi State University by Drs. Arthur Cosby and Bill Howard. Table 2.1 presents a list of data bases searched and the number of citations identified in each. A hard copy print-out of the citations was obtained and reviewed for pertinent literature. Copies of all pertinent literature were obtained and reviewed to identify additional information. An attempt was made to collect all pertinent information identified from the computer search and literature review.

Many in-house documents, including a significant amount of gray literature, were reviewed for pertinent information and additional references. Continental Shelf Associates, Inc. has a continuously expanding file concerning artificial reefs which provided a significant amount of information relevant to this study.

A number of persons at various universities, organizations, and private companies having experience with the construction and siting of artificial reefs were contacted for information. This information often assisted in identifying potential problems and solutions associated with implementing an artificial reef.

Numerous members of the Advisory Group provided valuable suggestions concerning literature and information sources to review and

TABLE 2.1. SUMMARY OF THE COMPUTER LITERATURE SEARCH OF VARIOUS DATA BASES FROM THE DIALOG INFORMATION RETRIEVAL SERVICE USING THE KEY WORDS "ARTIFICIAL REEF."

Data Bases Searched	Years	Citations
NTIS	1964-85	80
Dissertation Abstracts	1861 - Jan 1985	7
Sociological Abstracts	1963-84	0
PTS Defense Markets and Technology	1982-84	33
Conference Papers Index	1973 - Sep 1984	7
Federal Research in Progress	Sep 1984	1
Federal Research in Progress	(unabridged) Sep 1984	2
BIOSIS Previews	1981-85	31
BIOSIS Previews	1977-80	15
BIOSIS Previews	1969-76	17
COMPENDEX	1970 - Nov 1984	20
Oceanic Abstracts	1964 - Oct 1984	148
ENVIROLINE	1970 - Nov 1984	47
Aquatic Science Abstracts	1978 - Sep 1984	178
Environmental Bibliography	1974 - Oct 1984	8
Aquaculture	1970 - Jan 1984	0
Water Resources Abstracts	1968 - Nov 1984	28
	Total	622

offered the results of personal investigations. These individuals were also helpful by providing the views of various interest groups with whom they are associated.

The SFI in Washington, D.C. provided numerous publications concerning the design and siting of an artificial reef and exclusion maps for the specific areas of this study. Individuals at the SFI also helped by providing information that was requested for the study.

Individuals at various State and Federal agencies provided literature and/or information upon request. Many individuals associated with previous or ongoing artificial reef projects were most helpful in making recommendations for this project.

All of the compiled information was reviewed and a report synthesized in an attempt to identify the biologically optimum artificial reef sites off Mississippi.

3.0 LITERATURE REVIEW

The existing literature concerning biological parameters involved in siting a successful artificial reef can be classified into two general categories: (1) descriptive studies that provide biological and ecological observations made on artificial reefs; and (2) experimental studies designed to test and identify factors controlling recruitment, succession, fish attracting properties, and productivity of artificial reefs. Very few of these studies were conducted off Mississippi, however, much of the information is useful and can be applied to these specific study areas.

Bohnsack and Sutherland (1985) examined the artificial reef literature available through 1983. The report reviews the biology and ecology of artificial reefs and makes recommendations for future studies based on data gaps identified from the literature. The following discussions concerning the biological factors affecting artificial reef siting include summaries of information presented by Bohnsack and Sutherland (1985) and incorporate pertinent information made available after 1983.

Studies have shown that fishes use artificial reefs for feeding areas, shelter, spawning, orientation, and development (Klima and Wickham, 1971; Parker et al., 1979; Stone et al., 1979; Kakimoto, 1982). The parameters that attract fishes to artificial reefs have been extensively studied, but are not well understood. Studies attempting to determine the relative role of each parameter in attracting fishes to artificial reefs have been inconclusive and sometimes contradictory (Shinn, 1974; Russell, 1975; Prince and Gotshell, 1976; Prince et al., 1979; Hueckel and Slayton, 1982; Bohnsack and Sutherland, 1985). Although further research may prove otherwise, it seems that the parameters that are important in attracting fishes to artificial reefs are species-specific, and for most species, there is a combination of parameters which attract fishes to artificial reefs.

Studies have shown that several factors are biologically important for attracting fishes to artificial reefs and can be controlled to optimize the success of an artificial reef. These factors include substrate, oceanographic conditions, water quality parameters, productivity of surrounding water and substrate, proximity to other reefs/live-bottom areas, and vertical profile and relief. Although each

of these factors should be considered with respect to the desired target species, very few data are available concerning how these factors influence the recruitment of a particular species to an artificial reef.

The substrate on which an artificial reef is planned is critical to the success of a reef. Whenever possible, it is good practice to place a reef on a bottom where there is known to be underlying rock or hard pan. This will prevent the reef material from sinking into the substrate, and current action around the reef may scour the bottom and make additional reef habitat by exposing the rock (Mathews, 1981). Firm sand or sand/shell bottoms are the best substrate types to support a reef (Mathews, 1981). Substrate types that should be avoided are soft sediments, primarily comprised of clay or silt particles.

Oceanographic conditions should be considered when siting an artificial reef. Areas of upwelling, downwelling, ascending currents, and vortex currents have been suggested as good locations for artificial reef sites (Nakamura, 1982). Artificial reefs should be placed along the front line of internal waves and perpendicular to prevailing currents. Areas with strong tidal currents should be avoided (Mathews, 1981).

Water quality parameters such as temperature, turbidity, and anthropogenic pollutants should be considered when siting an artificial reef (Hueckel and Buckley, 1982; Sanders et al., 1985). Tolerances of desired target species to these parameters should be determined before siting an artificial reef. By comparing the water quality of areas with existing desirable fish populations to potential artificial reef sites, one can gain insight into the suitability of a potential site for colonization by desired species. A potential artificial reef site should be free from pollutants that may be biomagnified and potentially cause serious health problems for persons that eat the catch from the area.

Productivity of the water and benthic environments surrounding an artificial reef will affect artificial reef success (Randall, 1963; Russell, 1975; Hirose et al., 1977; Prince et al., 1979; Hueckel and Buckley, 1982; Steimle and Ogren, 1982). Considerable work is needed to fully understand the trophic pathways of artificial reef communities and the importance of productivity to the success of an artificial reef.

The effect of distance of an artificial reef site from a natural live-bottom area on the relative success of the artificial reef has been studied by numerous investigators. The results of these studies are

sometimes contradictory. Fast and Pagan (1974) observed that when an artificial reef was placed near a natural reef, fishes moved from the natural reef to the artificial reef, but not conversely. More recently, Matthews (1985) found that adult and subadult fishes moved from natural to artificial reefs up to a distance of 1.6 km. The author suggested that artificial reefs may increase fishing pressure that may be detrimental to the local fish population. Other investigators (Dewees and Gotshell, 1974; Stone et al., 1979) reported that artificial reefs in the immediate vicinity of live-bottom areas did not affect the fish community on the natural reef. Yoshimuda and Masuzawa (1982) suggested that artificial reefs should be placed at least 600 m (1,970 ft) from natural reefs so that each reef would not influence the other. Generally, it has been concluded that artificial reefs should be sited on barren sand bottoms where no existing live-bottom communities exist (Mathews, 1981; USDC, NMFS, 1985). It is better to add an additional productive habitat where one does not exist, rather than to make small improvements to an already productive live-bottom area.

Vertical profile and amount of relief offered by an artificial reef should be considered with respect to the target species. Study results concerning these factors are conflicting (Miyazaki and Sawada, 1978; Mottet, 1982; Grove and Sonu, 1983). Generally, it has been found that tall artificial reefs forming mid-water structures are best for attracting migratory pelagic species (i.e., mackerels, bluefish, and tunas). Low-relief structures with more horizontal structure on the seafloor are most suited for attracting demersal fishes (i.e., snappers, groupers, and sea basses) (Klima and Wickham, 1971; Matsumoto et al., 1981; Grove and Sonu, 1983). Other studies have shown that the shape of the reef may be more important than the height (Nakamura, 1982; Grove and Sonu, 1983). An artificial reef will best attract fishes if the sides are nearly vertical to increase turbulence and produce stagnation zones and lee waves.

Another biological factor that may affect artificial reef success may be the seasonality of spawning of target species. Many studies concerning the recruitment and succession of fishes on new artificial reefs indicate that juvenile fishes are often the first to inhabit an artificial reef and are often present in large numbers (Randall, 1963; Russell et al., 1974; Stone et al., 1979; Gascon and Miller, 1981; Walsh, 1985). Although there is little information to show that juveniles associated with artificial reefs survive and grow to adults, it seems that an artificial reef provides additional habitat for juvenile fishes

that may not normally survive. Placement of an artificial reef during the peak influx of juveniles of target species may significantly increase the number of juveniles that develop and mature (Carter et al., 1985). Considerably more research is needed to correlate the juveniles of a species settling on an artificial reef with peaks in spawning and larval availability.

The success of artificial reefs relative to natural reefs has been studied by numerous investigators (Randall, 1963; Buchanan, 1973, 1974; Russell, 1975; Molles, 1978; Smith et al., 1979; Gascon and Miller, 1981; Burchmore et al., 1985; Jessee, 1985). Generally, it has been found that the community structure of fishes colonizing an artificial reef is similar to the fish communities occupying nearby natural reefs. Although there are some conflicting reports, it seems that fish abundances on artificial reefs generally exceed those of nearby natural reefs. This is probably due to the greater complexity of artificial reefs compared to natural reefs, however, many factors are not well understood.

Whether artificial reefs actually increase fish productivity or simply aggregate existing individuals is not known (Mottet, 1982; Kuwatani, 1982; Grove and Sonu, 1983). Some investigators concluded that artificial reefs increase fish availability but not net productivity, while others suggest that artificial reefs allow secondary biomass production through increased survival and growth of new individuals due to the shelter and food resources provided by the reef (Manges, 1960; Beguery, 1974; Bohnsack and Sutherland, 1985). Considerable research is necessary before the productivity of fishes on artificial reefs is understood.

A review of existing information concerning artificial reefs has indicated that considerably more research is necessary to better understand the biological parameters that affect artificial reefs. Additionally, very little information is available from studies conducted offshore Mississippi.

4.0 ARTIFICIAL REEF SITE SELECTION

4.1 MISSISSIPPI

4.1.1 Characterization of Potential Artificial Reef Environments

The coastline of Mississippi has approximately 78 mi (126 km) of barrier islands bordered to the south by the Gulf of Mexico and to the north by a large estuarine area, the Mississippi Sound. The Mississippi Sound is an important estuarine system that provides spawning and nursery areas, and food and shelter for many commercially important finfishes and shellfishes. Inlets between the barrier islands provide important physical, chemical, and biological links between the Mississippi Sound and the Gulf of Mexico. Originally, only the waters seaward of the barrier islands were to be considered as potential artificial reef sites. Due to the interest shown by local fishermen in placing artificial reefs inside the barrier islands, in Mississippi Sound, a discussion of this will also be given.

Water temperatures in Mississippi Sound during the summer months average around 30°C and may fall below 13°C during the winter. Some localized and temporary stratification of the water column may result due to freshwater intrusion from bays and estuaries or intrusion of high salinity waters from the shelf. Currents within Mississippi Sound are quite variable, being influenced by the general westward circulation of nearshore shelf water, tidal currents, freshwater discharge and wind patterns. The net current movement is slowly toward the west. A total of 251 estuarine species were collected in Mississippi Sound and surrounding estuarine areas by Christmas and Waller (1973). The bay anchovy, largescale menhaden, Atlantic croaker, butterfish, and sand seatrout comprised 93% of the total fishes collected. Table 4.1 presents a list of fishes that probably use Mississippi Sound and the surrounding estuaries as nursery areas.

The waters seaward of the barrier islands off Mississippi that overlie the continental shelf range in temperature from approximately 54 to 86°F (12 to 30°C) (Franks et al., 1972). Nearshore surface waters are more seasonally variable than waters deeper and farther from shore and reflect fluctuations in air temperature.

The salinity regime of waters overlying the continental shelf is complicated and has been summarized by TerEco Corporation (1979). The

TABLE 4.1. NURSERY AREAS OF CERTAIN FISHES IN COMMERCIAL AND RECREATIONAL IMPORTANCE OF THE NORTH-CENTRAL GULF AREA (ADAPTED FROM: TERECO, 1979).

Species using sounds, estuaries, salt marshes, and/or tidal creeks for nursery areas

Archosargus probatocephalus	Sheepshead
Brevoortia patronus	Gulf menhaden
Caranx hippos	Crevalle jack
Centropristis philadelphica	Rock sea bass
Cynoscion arenarius	Sand seatrout
Cynoscion nebulosus	Spotted seatrout
Elops saurus	Ladyfish
Lagodon rhomboides	Pinfish
Leiostomus xanthurus	Spot
Megalops atlantica	Tarpon
Micropogon undulatus	Atlantic croaker
Morone saxatilis	Striped sea bass
Mugil cephalus	Striped mullet
Mugil curema	White mullet
Opisthonema oglinum	Atlantic thread herring
Paralichthys lethostigma	Summer flounder
Peprilus burti	Gulf butterfish
Peprilus paru	Harvestfish
Pogonias cromis	Black drum
Orthopristis chrysoptera	Pigfish
Paralichthys albigutta	Gulf flounder
Paralichthys lethostigma	Southern flounder
Pomatomus saltatrix	Bluefish
Rachycentron canadum	Cobia
Scomberomorus maculatus	Spanish mackerel

mixing of Mississippi River water with Gulf of Mexico water creates a seasonally variable environment with respect to salinity. Surface salinities near the barrier islands are the most variable and range from approximately 19 to 31 ppt (Allen and Turner, 1977). Salinities of waters farther away from the barrier islands and deeper are less affected by freshwater runoff, less variable, and usually range from 28 to 37 ppt. As a rule, the salinity patterns on the continental shelf off Mississippi can exhibit very steep gradients and are marked by seasonal influxes of low salinity ratios during spring and early summer.

Circulation of water on the continental shelf off Mississippi is complex and more research is necessary before a complete understanding is available. Circulation is influenced by four factors: open Gulf circulation (Loop Current), winds, tides, and freshwater discharges (TerEco Corporation, 1979). Although currents and circulation in the area are difficult to predict, a few generalities have been observed. When prevailing winds are from the north or northeast, surface circulation on the inner shelf will be to the west. When prevailing winds are west or southwest, surface circulation will be to the east. When winds are from the northwest or southeast, surface circulation may be either to the east or west and other factors such as freshwater discharges or tides may determine direction (TerEco Corporation, 1979). When influences of the Loop Current are present on the shelf, circulation may be from any direction depending upon the location of the impingement. Bottom currents are also highly variable and are influenced by similar parameters described for surface currents. In addition, bottom topography also affects bottom circulation. Generally, wind is the major driving force of normal bottom circulation on the inner shelf off Mississippi (TerEco Corporation, 1979).

Sediments on the continental shelf off Mississippi have been described by SUSIO (1977) and TerEco Corporation (1979). Fine silts and clays dominate the sediments, with a high percentage of sands encompassing the Chandeleur Islands and an extensive area southeast of the islands. TerEco Corporation (1979) reported that this sandy area is highly variable and locally patchy, however, it has the general consistency of sand. Figure 4.1 shows the sediment distribution in the north-central Gulf of Mexico.

The benthic communities of the continental shelf off Mississippi have been described by Defenbaugh (1976) and summarized by TerEco Corporation (1979). The benthos has been classified by habitat type.

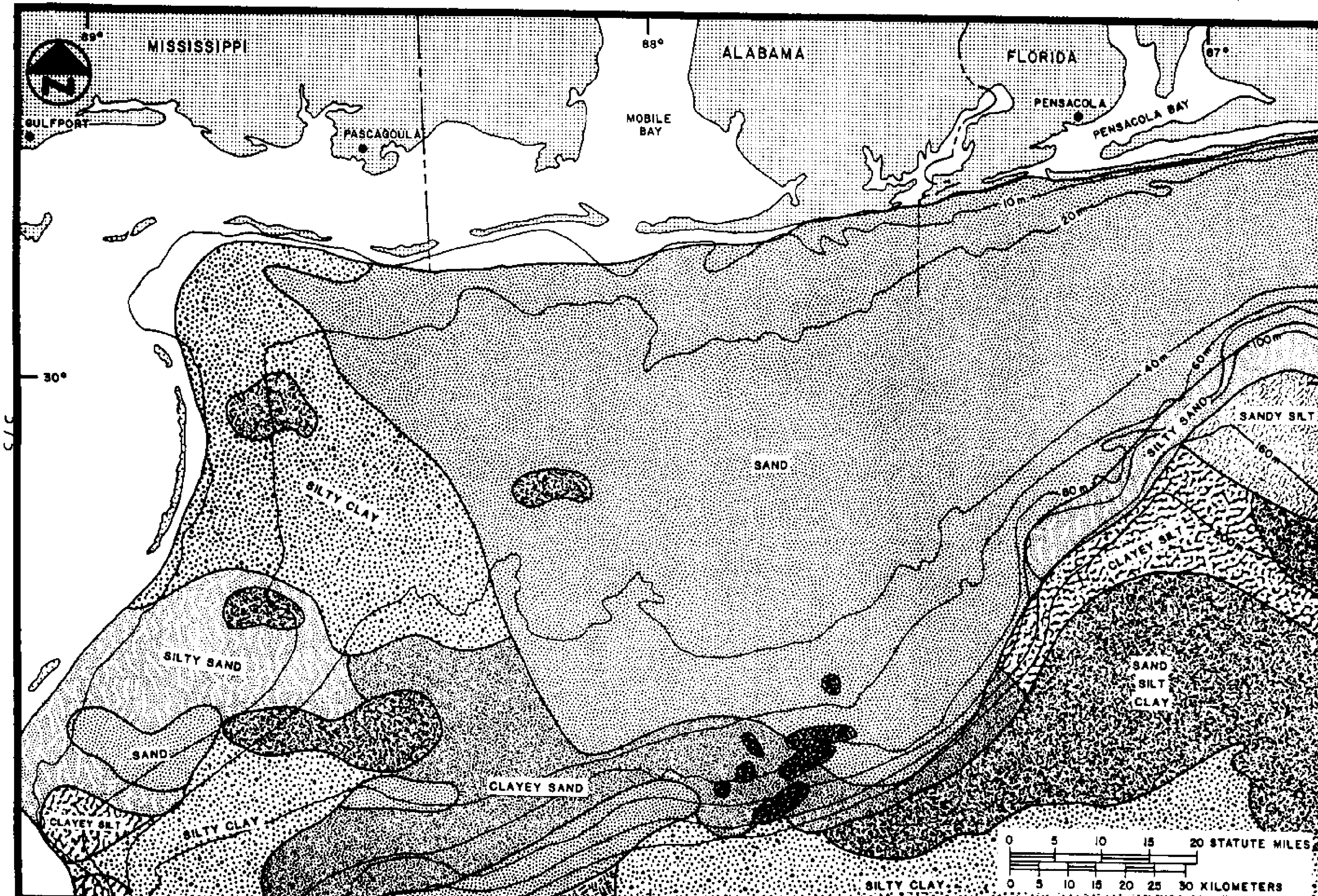

FIGURE 4.1. BATHYMETRIC CONTOURS AND SEDIMENT TYPES OFF MISSISSIPPI, ALABAMA, AND THE FLORIDA PANHANDLE (FROM: BROOKS, 1973).

Species occurring in water depths ranging from 12 to 66 ft (4 to 20 m) were described as the Pro-Delta Fan Assemblage. Table 4.2 presents a list of species characteristic of the Pro-Delta Fan Assemblage. Species occurring in water depths ranging from 72 to 240 ft (22 to 73 m) were considered the Intermediate Shelf Assemblage which is characterized by species listed in Table 4.3. Although these species have been deemed characteristic of particular assemblages, it is not possible to determine which species within a particular assemblage are associated with various bottom types (e.g., sand, silt, etc.). Table 4.4 presents a list of species that occur on natural and artificial hard substrates and that would probably develop on an artificial reef placed in the area. Information concerning the density and diversity of benthic species at a potential artificial reef site may be critical to the success of the reef and should be a factor involved in site selection.

The fishes that occur on the continental shelf off Mississippi have been described by numerous investigators (Walls, 1975; Hoese and Moore, 1977; Dames & Moore, 1979). Fishes off Mississippi are primarily temperate species with occurrences of tropical species generally in deeper waters. Many species generally occur in particular habitats or bottom types. Sciaenids (croakers, seatrouts, drums) and sparids (porgies) are the numerically dominant species occurring in the shallow mud bottom areas off Mississippi. Many of these species are estuarine dependent and euryhaline species that occur in estuarine and relatively shallow offshore waters during some stage of their lives. Offshore in deeper water, the predominant fishes such as serranids (groupers) and lutjanids (snappers) occur in association with natural or man-made irregular bottoms. Often associated with these deeper offshore reef areas are numerous tropical species such as damselfishes and butterflyfishes. In addition to these resident demersal fishes, numerous coastal pelagic and oceanic species occur on the continental shelf seasonally. These species include mackerels, cobia, bluefish, tunas, and billfishes that typically occur in waters overlying the middle and outer shelves and comprise an important part of the recreational and commercial fisheries.

Lukens (1981) reported on the ichthyofaunal colonization of an artificial reef located in approximately 46 ft (14 m) of water due south of Horn Island. A total of 60 species of fishes representing 33 families were observed on the reef over a two-year time period. He reported the presence of numerous commercially and recreationally important species including croakers, dolphin, flounders, groupers, jacks, mackerels,

TABLE 4.2. BENTHIC SPECIES CHARACTERISTIC OF THE PRO-DELTA FAN ASSEMBLAGE (FROM: TERECO CORPORATION, 1979).

Cnidaria	
Renilla mulleri	Sea pansy
Gastropoda	
Cantharus cancellarius	Cancellate cantharus
Nassarius acutus	Sharp-knobbed nassa
Pelecypoda	
Abra lioica	
Macoma tageliformis	Tagelus-like macoma
Nuculana concentrica	Concentric nut clam

TABLE 4.3. BENTHIC SPECIES CHARACTERISTIC OF THE INTERMEDIATE SHELF ASSEMBLAGE (FROM: TERECO CORPORATION, 1979).

Gastropoda	
Busycon contrarium	Lightning whelk
Conus austini	Austin's cone
Distorsio clathrata	Atlantic distorsio
Fasciolaria lilium	Banded tulip
Murex fulvescens	Giant eastern murex
Strombus alatus	Florida fighting conch
Tonna galea	Tun
Pelecypoda	
Amusium papyraceum	Paper scallop
Argopecten gibbus	Calico scallop
Tellina nitens	Tellin
Tellina squamifera	Eastern crenulate tellin
Echinodermata	
Astropecten duplicatus	Starfish
Clypeaster ravenelii	Starfish
Echinaster modestus	Starfish
Luidia alternata	Starfish

TABLE 4.4. BENTHIC SPECIES CHARACTERISTIC OF NATURAL AND ARTIFICIAL HARD SUBSTRATES (FROM: TERECO CORPORATION, 1979).

Porifera	
Leucosolenia sp.	Sponge
Cnidaria	
Clytia fragilis	Hydroid
Obelia hyalina	Hydroid
Aiptasia sp.	Sea anemone
Ectoprocta	
Crisia spp.	Bryozoan
Membranipora spp.	Bryozoan
Crustacea	
Balanus venustus	Acorn barnacle
Balanus calidus	Acorn barnacle
Caprella equilibra	Skeleton shrimp
Ericthonius brasiliensis	Sand hopper
Mithrax sp.	Spider crab
Gastropoda	
Anachis iontha	Dove shell
Thais floridana	Florida rock shell
Pelecypoda	
Anomia simplex	Jingle shell
Argopecten gibbus	Calico scallop

porgies, snappers, and spadefishes. Many tropical species were observed seasonally on the reef. Lukens (1981) reported that temperature fluctuation appeared to be the major factor controlling the fish assemblages present on the reef.

Many fishes also spawn and utilize the continental shelf waters as nursery areas. TerEco Corporation (1979) presented a list of commercially and recreationally important species in the north-central Gulf of Mexico and their respective spawning and nursery areas. Although much of this information is based on research conducted in other areas, the data are probably pertinent to the Mississippi coastal area. Table 4.5 presents a list of important species and their respective spawning areas and seasons.

4.1.2 Identification of Sites Selected for Artificial Reef Placement off Mississippi

Site-specific locations for the placement of artificial reefs in Mississippi Sound have not been selected. Surveys of specific locations to investigate the existing substrate and community will be necessary before placing artificial reefs in Mississippi Sound. During the local meeting with area fishermen in Mississippi, it was suggested that artificial reefs in the Sound be constructed using old oyster shells. This type of low relief material is probably the only substrate feasible due to the shallow waters that occur throughout the Sound. In addition, creating new or expanding existing oyster reefs with old oyster shells serves a dual purpose: (1) it creates relief and substrate to attract fishes; and (2) it serves as additional substrate for oyster recruitment. Artifical reefs within the Sound would also likely serve as nursery areas for numerous fishes (see Table 4.1).

Two separate sites have been selected for the placement of artificial reefs off Mississippi. Figure 4.2 shows the location of the two sites with respect to the Mississippi coastline. A shallow and a deepwater site were selected for artificial reef placement. Each site has definite advantages and disadvantages with respect to the potential target species and reef materials.

The shallow water site is located approximately 14 mi (23 km) south of Horn Island in approximately 60 to 90 ft (18 to 27 m) of water. The coordinates of the reef site are approximately 30°03'N Lat and 88°37'W Long. This site is probably best suited for low-relief, artificial reef materials due to the relatively shallow water depth.

TABLE 4.5. SPAWNING AREAS AND SEASONS OF COMMERCIALLY AND RECREATIONALLY IMPORTANT SPECIES IN THE NORTH-CENTRAL GULF OF MEXICO (ADAPTED FROM: TERECO CORPORATION, 1979).

Species	Season
Species which breed in inlets and nearby waters:	
Centropristis philadelphica, Rock sea bass	spring
Cynoscion nebulosus, Spotted seatrout	spring
Pogonians cromis, Black drum	spring
Sciaenops ocellata, Red drum	summer
Species which breed on the inner continental shelf:	
Archosargus probatacephalus, Sheepshead	spring
Balistes capriscus, Gray triggerfish	summer
Centropristis striata, Black sea bass	spring
Elops saurus, Ladyfish	fall
Epinephelus morio, Red grouper	spring
Haemulon plumieri, White grunt	summer
Lagodon rhombiodes, Pinfish	winter
Leiostomus xanthurus, Spot	winter
Lutjanus campechanus, Red snapper	summer
Lutjanus griseus, Gray snapper	summer/spring
Menticirrhus americanus, Southern kingfish	summer/spring
Menticirrhus littoralis, Gulf kingfish	summer/spring
Menticirrhus saxatilis, Northern kingfish	spring
Micropogon undulatus, Atlantic croaker	winter
Opisthonema oglinum, Atlantic thread herring	summer
Pagrus pagrus, Red porgy	spring
Peprilus burti, Gulf butterfish	winter/spring
Peprilus paru, Harvestfish	summer/spring
Sardinella anchovia, Spanish sardine	summer
Scomberomorus cavalla, King mackerel	summer
Scomberomorus maculatus, Spanish mackerel	summer
Species which breed on the outer continental shelf:	
Auxis thazard, Frigate mackerel	spring
Brevoortia patronus, Gulf menhaden	winter
Caranx crysos, Blue runner	spring
Coryphaena hippurus, Dolphin	spring
Epinephelus morio, Red grouper	spring
Etrumeus teres, Round herring	spring/winter
Euthynnus alletteratus, Little tunny	summer
Istiophorus platypterus, Sailfish	summer
Katswonus pelamis, Skipjack tuna	summer
Leiostomus xanthurus, Spot	fall

TABLE 4.5. (CONTINUED).

Species	Season
Mugil cephalus, Striped mullet	winter
Mugil curema, White mullet	winter
Peprilus burti, Gulf butterfish	winter/spring
Peprilus paru, Harvestfish	summer/spring
Pomatomus saltatrix, Bluefish	summer/spring
Scomber japonicus, Chub mackerel	spring/winter
Scomberomorus cavalla, King mackerel	summer
Rachycentron canadum, Cobia	summer
Trachinotus carolinus, Florida pompano	spring/summer
Trachinotus falcatus, Permit	winter/summer/ spring
Xiphias gladius, Swordfish	spring/summer

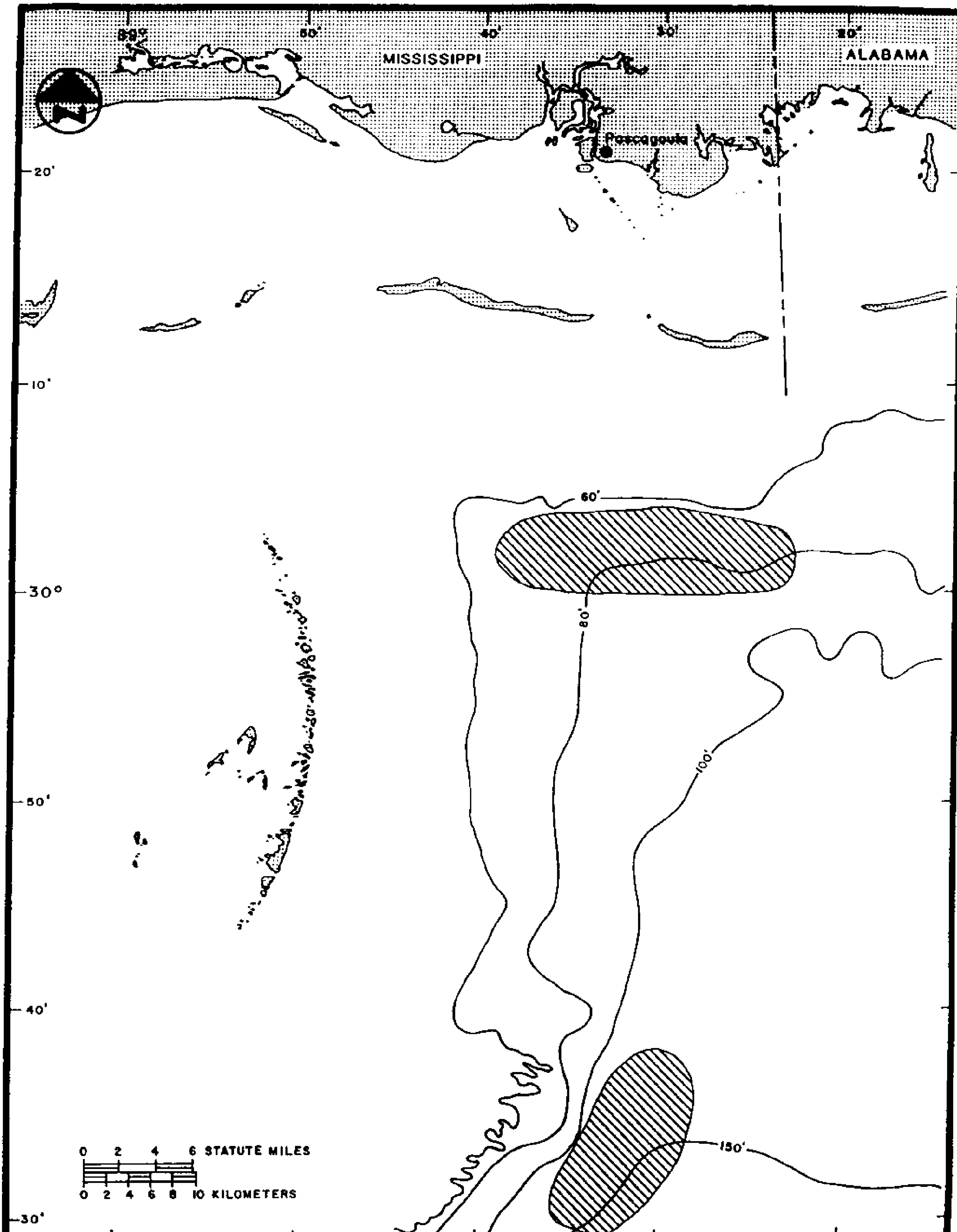

FIGURE 4.2. POTENTIAL ARTIFICIAL REEF SITES OFF MISSISSIPPI.

Substrate in the area is probably relatively fine sand, silt, and clay. The exact nature and depth of sediments in the area should be sampled to be sure that the bottom will support an artificial reef structure. Other artificial reef structures and wrecks occur in the area according to navigational charts and it is likely that locations in the general area could also be found to support additional artificial reefs.

Placing the reef in relatively shallow water overlying fine sand bottom makes the reef potentially attractive to a number of commercially and recreationally important species such as many of the sciaenids and flatfishes that are normally found on the soft bottom. Although these fishes may not be dependent on the artificial reef structure, it is likely that many species will congregate in the immediate vicinity of the reef. For these species, it is important that suitable food sources be available in the surrounding area. Productivity of the bottom surrounding the artificial reef and potential food sources should be sampled prior to siting the reef. Site-specific information was not available for use in the selection of the artificial reef sites.

It is likely that demersal bottom fishes usually associated with irregular bottom will be attracted to the reef and may become permanent residents. Numerous commercially and recreationally important lutjanid and serranid species are likely to be attracted to the reef, especially when the structure becomes biofouled and provides a food source for small herbivorous fishes that are prey items for many of the desired target species. Meetings with local fishermen indicated that these species had a high priority in what they would like to catch when fishing. Turbid, shallow, nearshore waters and the effects of freshwater influx into the area from estuaries may be seasonally limiting factors for some species.

It seems that placement of an artificial reef at the shallow water site would be successful from a biological standpoint. Oceanographic conditions, water quality, currents, estuarine effects, and depth are suitable for numerous commercially and recreationally important species that are already known to occur in the area. Site-specific testing of the substrate type and surrounding benthic productivity is recommended prior to reef placement to optimize the biological success of the reef.

The deepwater location for placing an artificial reef structure off Mississippi is located in approximately 100 to 150 ft (30 to 46 m) of water approximately 35 mi (65 km) south of Horn Island and 20 mi (37 km) southeast of the Chandeleur Islands. The coordinates of the reef are approximately 29°35'N Lat and 88°33'W Long. The substrate in this area has been described as silty sand; however, it has been reported to be extremely patchy, so a site-specific survey is recommended before reef placement. Similar to the shallow water site, acquisition of site-specific information concerning benthic productivity is recommended to optimize the biological success of the reef.

The deep water makes it possible to place a larger reef with more more vertical relief (such as a dismantled petroleum platform) than in shallower water. The placement of such a structure that offers both demersal and mid-water habitats increases the potential number of species that can utilize the reef. While demersal species such as lutjanids, serranids, and some sciaenids can utilize the lower portion of the reef, the upper mid-water portions of the structure will likely serve to attract some of the coastal pelagic and possibly oceanic species such as cobia, king and Spanish mackerels, jacks, and bluefish. Local fishermen already fish in the area for these species and indicated an interest in increasing their catch.

5.0 DISCUSSIONS AND CONCLUSIONS

5.1 FUTURE BIOLOGICAL CONSIDERATIONS

The coastal waters overlying the continental shelf off Mississippi, Alabama, and the Florida Panhandle provide habitat for important commercial and recreational fishery resources. Proper implementation of artificial reef programs could greatly enhance the fishery resources available to all three States.

Biological data were reviewed prior to selecting the potential artificial reef sites. Very little site-specific information was available. It is recommended that further biological and environmental parameters be investigated at each site prior to the final placement of an artificial reef.

Following the review of the literature concerning the biological parameters that affect artificial reefs, it became apparent that there is a general lack of data concerning many of these parameters as related to specific species and geographic areas. Biological monitoring is strongly recommended before and after the placement of any artificial reef structure. Monitoring should include measurements and observations including substrate type, productivity, oceanographic and water quality conditions, species present, their life histories, and their utilization of the reef. Collection of this information will increase the relative cost of an artificial reef program, however, the increase in knowledge can significantly contribute to increasing the successfulness of future artificial reef programs.

Following the regional meetings with local fishermen it became apparent that most recreational fishermen will fish for nearly any species that they think it will be possible to catch. Although a majority prefer to fish for species that are edible, most recreational fishermen set off on a fishing trip planning to catch whatever they can. Few have species that they do not want to catch. Due to the non-specific target species it is probably difficult to build an artificial reef that will not benefit the recreational fishermen in some manner. Commercial fishermen are limited to seeking species that have some marketable quality and are therefore more difficult to please when constructing an artificial reef. These factors must be considered when designing an artifical reef from a biological perspective.

5.2 FUTURE ARTIFICIAL REEF PROGRAMS

Artificial reefs provide an innovative way to increase the potential catch of both recreational and commercial fishermen. Although the placement of artificial reef structures to increase habitat in the marine environment is not a new idea, research concerning the factors that can optimize the beneficial effects of artificial reefs has been limited. Significantly more data are necessary to realize the full potential and effects of artificial reefs.

Commercial and recreational fishermen benefit most from the placement of successful artificial reefs. Unfortunately, fishermen generally do not have significant amounts of capital to invest in artificial reef placement and research. As a result, although numerous artificial reefs have been placed by small localized fishing groups or interests, most of the data that exist concerning the parameters involved in creating a successful artificial reef have been collected by either local, State, or Federal governments or private industry, generally with some commercial interests in the project. It seems that this trend will continue in the future.

The largest sector of private industry with perhaps the most at stake economically is the oil and gas industry because of the problem of removing obsolete offshore petroleum platforms. Legal and economic considerations will probably be foremost in determining the future of artificial reefs, especially artificial reefs from offshore petroleum platforms. The oil and gas industry has been examining these problems and working closely with the Federal Government to determine the most mutually beneficial solutions. The Federal Government is developing a National Artificial Reef Plan to provide reef construction and placement guidelines and is continuing to fund research concerning various aspects of artificial reefs. Many of the existing platforms provide valuable fishery habitats and removal may have detrimental effects on fisheries and fishermen; however, maintenance and liability problems must be solved before any platforms are left in place. Several oil companies have already taken the lead by dismantling, transporting, and placing obsolete petroleum platforms as artificial reefs offshore Alabama and Florida. Very little monitoring has been conducted to determine the successfulness of these artificial reefs to optimize the success of future endeavors. Monitoring should be conducted in the future when additional offshore petroleum platforms are placed as artificial reefs.

One suggested method for promoting artificial reef endeavors is to develop regulatory policies whereby artificial reefs can be used as a form of mitigation or perhaps fine payment. Mitigation is a relatively new concept (e.g., see Soileau et al., 1985; Alevras and Edwards, 1985; Duffy, 1985) that could be used for developing artificial reef projects by industry involved in development of environmentally sensitive areas. Artificial reef programs could serve as mitigation measures to: (1) avoid or minimize impacts on organisms and habitats; or (2) compensate for unavoidable losses of those resources. Perhaps companies that have committed some type of environmental damage could be required to fund artificial reef projects in place of fine payments. These types of programs are potential suggestions that would provide more artificial reefs and data pertinent to artificial reefs, however, legal changes would be necessary to implement such actions. Government policy makers should investigate the feasibility of such policies.

A significant amount of information is still needed to optimize artificial reefs. Artificial reef decisionmakers should adopt comprehensive plans for artificial reef development and data acquisition in the future. With proper planning and data, artificial reefs could provide a useful tool for government, private industry, fishermen, and fishery managers.

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CSA

Continental Shelf Associates, Inc.

OPERATIONAL FACTORS AFFECTING
ARTIFICIAL REEF SITING OFF MISSISSIPPI

28 FEBRUARY 1986

PREPARED FOR:

National Marine Fisheries Service
Southeast Region
9450 Koger Boulevard, Duval Building
St. Petersburg, Florida 33702

PREPARED BY:

Continental Shelf Associates, Inc.
759 Parkway Street
Jupiter, Florida 33477
Telephone: (305) 746-7946

"Applied Science and Technology"

ABSTRACT

Operational factors that influence the siting of artificial reefs include environmental conditions at the site, availability and suitability of different reef materials, transportation and logistics requirements, deployment techniques, optimum reef design, and marking requirements. Concrete blocks and rubble, steel ships and barges, obsolete petroleum platforms, and Japanese-designed structures are the most suitable materials for artificial reefs.

Shallow depths and an extensive network of navigational fairways limit the number of suitable reef sites offshore Mississippi. Low-profile reefs in shallow waters and further development of existing artificial reefs are the most likely options in these waters. New reef sites are suggested along sandy bottoms in the western part of the study area. Two of the proposed sites are within an area for reefs preferred by local fishermen.

In descussions with local fishermen, artificial reefs sited within Mississippi Sound were recommended. Waters inside the Sound are generally shallow (20 ft or less) and bottoms consist of muddy sediments. Because of the shallow water and soft sediments, reefs in the Sound should be low profile. A recommended material consists of a thin veneer of oyster shell seeded with live oysters. In some areas (e.g., around shoals) where depths increase beyond optimum depths for oyster reef development, the oyster shell can be combined with concrete rubble. Other suggested reef sites in the Sound include expansion of existing oyster reefs or known wreck sites.

Technology exists for the transport of reef materials to the selected sites. Barges, heavy equipment, or flotation devices will be needed, depending on the material being used. Reef construction should incorporate a high degree of complexity into the reef structure. Reefs with less than 85 ft (26 m) minimum clearance will probably need a lighted buoy to mark the location.

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EXECUTIVE SUMMARY

This study was initiated as part of a multidisciplinary effort to identify potential artificial reef sites off Mississippi on the basis of legal, social, economic, biological, and operational issues. This report designates sites on the basis of operational constraints.

Operational factors that influence reef siting include environmental conditions at the site, availability and suitability of different reef materials, transportation and logistics requirements, deployment techniques, optimum reef design, and marking requirements. A computerized literature search was undertaken to identify the available literature on these topics.

Numerous types of materials have been used in the past to construct artificial reefs. Based on availability and durability, concrete blocks and rubble, steel ships and barges, obsolete petroleum platforms, and Japanese-designed structures are the most suitable materials for reef construction. Blocks created from fly ash generated by power plants that burn coal may also have applications for artificial reef use. Although tires have been used extensively in the past, their tendency to drift or break apart makes their use questionable.

Environmental conditions that affect the success of artificial reefs include waves and currents, depth, substrate type, and topography. Areas subject to high-energy waves and currents should be avoided because these conditions limit the life-span of a reef. Depth is important for maintaining minimal navigational clearance, attracting the target fish species, and minimizing the effects of storms on reefs. Firm sand substrates are preferred to minimize the loss of a reef due to sinking or siltation. Topographies that are favorable for artificial reefs include flat and featureless bottom regions, near the shoreward edges of valleys or depressions, or areas on either side of ridges.

Factors that affect placement of reefs off Mississippi include a broad, shallow shelf; generally soft sediments except in the eastern portions where sandy sediments exist; an extensive network of navigational channels; and intense utilization by commercial trawlers. Artificial reefs should be sited on available sandy bottoms. A nearshore and intermediate depth zone should be used to expand existing reefs. Low-profile reefs are suggested for the shallow depths. A deepwater zone

is also proposed to attract large pelagic game fishes. Obsolete ships and petroleum platforms are suggested for the deepwater zone.

The shallow waters off Mississippi require fishermen to travel long distances to reach existing artificial reef sites. Local fishermen recommended a program to develop artificial reefs within Mississippi Sound to shorten travel distances. Waters in Mississippi Sound are generally less than 20 ft deep and bottoms are predominantly muddy. This is also an area extensively used by trawl fishermen. Therefore, any reefs in the area must be of a low profile type and of a material that won't immediately sink into the mud. One possible technique for constructing such reefs is to use a thin veneer of oyster shell which is then seeded with live oysters. Such materials could be used to expand existing oyster reefs in the Sound. Other locations for artificial reefs could include expansion of a reef at known wreck sites or around shoals or shallow waters that will be avoided by trawlers.

Transportation of recommended reef materials, including obsolete petroleum platforms, to a site is technically feasible. Barges and heavy equipment or flotation equipment for towing to a site will be required. Little information is available in the literature on deployment methods, however, it is important to anchor an offloading vessel to minimize spreading and to optimize placement of reef materials.

Reef size, complexity, spatial arrangement, location, orientation, and height are important factors to consider for a successful artificial reef. Optimum reef area ranges from 200 to 2,500 m^2 (cross section) or 2,500 to 130,000 m^3 (bulk volume). Reefs should consist of a hierarchical arrangement that includes blocks or units to form a set, sets clustered to form groups, and several groups to form a reef complex. Sets within a group should be spaced approximately 985 to 1,640 ft (300 to 500 m) apart. Reef complexes should be spaced at least 2 mi (3 km) apart. Reefs should be oriented perpendicular to currents. Reef height is probably most important for migratory fishes, and horizontal spread is probably most important for demersal fishes. Reef profile is more important than height, and vertical sides seem to be the best attractants. Vertical panels and horizontal and diagonal skeletal members are effective attractants because of the niches and shadows created. Large chambers and holes are avoided by fishes as are chambers with only one opening.

The U.S. Coast Guard determines the necessity for marking an artificial reef on the basis of:

1) physical characteristics of the obstruction;
2) depth of water in which the obstruction is located;
3) proximity of the obstruction to historic or designated vessel routes; and
4) type of vessel traffic at the obstruction site.

Marker buoys are generally not required if there is a 85-ft (26-m) minimum clearance above the reef.

1.0 INTRODUCTION

The United States has been one of the world's leaders, along with Japan, in using artificial reefs to enhance fishing activities in offshore waters. Many of the efforts in the United States have developed haphazardly as a result of low budget efforts by private groups or minimally-funded State agencies. One thing learned during trial and error endeavors is that knowledge and understanding of operational considerations are imperative to successful reef-building efforts.

Operational factors that need to be considered in planning artificial reef projects include environmental conditions at the site, availability and suitability of different reef materials, transportation and logistics requirements, deployment techniques, optimum reef design, and marking requirements. The objective of this report is to evaluate these factors as they affect reef-building operations and to select areas or sites suitable for the placement of artificial reefs.

It should be pointed out that this is one aspect of a multidisciplinary effort to select sites. Therefore, while legal, social, economic, and biological constraints influence successful artificial reef development, no attempt was made (except in a very general way) to incorporate these other issues into the present analysis. Hence, potential sites are recommended primarily on the basis of operational factors. Operational, legal, social, economic, and biological constraints must be evaluated in concert before final selections are made.

2.0 METHODS

The primary tasks conducted to achieve the objectives of this project involved collection and review of existing literature and data concerning the operational factors involved in constructing and siting artificial reefs. Data collection was accomplished by several different methods including: (1) computerized literature search and review; (2) review of in-house literature; (3) personal communication with researchers and persons involved with artificial reef projects; (4) input from the Advisory Group--a group of artificial reef knowledgeable persons selected to review and advise on the direction and nature of the project and products; (5) acquisition of information and advice compiled by persons at the Sport Fishing Institute's (SFI's) Artificial Reef Development Center; and (6) acquisition of information available from various State and Federal agencies.

A computerized literature search of numerous data bases from the DIALOG Information Retrieval Service was conducted using the key words "artificial reef." The search was conducted at Mississippi State University by Drs. Arthur Cosby and Bill Howard. Table 2.1 presents a list of data bases searched and the number of citations identified in each. A hard copy print-out of the citations was obtained and reviewed for pertinent literature. Copies of all pertinent literature were obtained and reviewed to identify additional information. An attempt was made to collect all pertinent information identified from the computer search and literature review.

Many in-house documents, including a significant amount of gray literature, were reviewed for pertinent information and additional references. Continental Shelf Associates, Inc. has a continuously expanding file concerning artificial reefs which provided a significant amount of information relevant to this study.

A number of persons at various universities, organizations, and private companies having experience with the construction and siting of artificial reefs were contacted for information. This information often assisted in identifying potential problems and solutions associated with implementing an artificial reef.

Numerous members of the Advisory Group provided valuable suggestions concerning literature and information sources to review and

TABLE 2.1. SUMMARY OF THE COMPUTER LITERATURE SEARCH OF VARIOUS DATA BASES FROM THE DIALOG INFORMATION RETRIEVAL SERVICE USING THE KEY WORDS "ARTIFICIAL REEF."

Data Bases Searched	Years	Citations
NTIS	1964-85	80
Dissertation Abstracts	1861 - Jan 1985	7
Sociological Abstracts	1963-84	0
PTS Defense Markets and Technology	1982-84	33
Conference Papers Index	1973 - Sep 1984	7
Federal Research in Progress	Sep 1984	1
Federal Research in Progress	(unabridged) Sep 1984	2
BIOSIS Previews	1981-85	31
BIOSIS Previews	1977-80	15
BIOSIS Previews	1969-76	17
COMPENDEX	1970 - Nov 1984	20
Oceanic Abstracts	1964 - Oct 1984	148
ENVIROLINE	1970 - Nov 1984	47
Aquatic Science Abstracts	1978 - Sep 1984	178
Environmental Bibliography	1974 - Oct 1984	8
Aquaculture	1970 - Jan 1984	0
Water Resources Abstracts	1968 - Nov 1984	28
	Total	622

offered the results of personal investigations. These individuals were also helpful by providing the views of various interest groups with whom they are associated.

The SFI in Washington, D.C. provided numerous publications concerning the design and siting of an artificial reef and exclusion maps for the specific areas of this study. Personnel at the SFI also helped by providing information that was requested for the study.

Literature and/or information was obtained from various State and Federal agencies. Many individuals associated with previous or ongoing artificial reef projects were most helpful in making recommendations for this project.

All of the compiled information was reviewed and a report synthesized in an attempt to identify the operational optimum artificial reef sites off Mississippi.

3.0 LITERATURE REVIEW

Previous attempts at constructing artificial reefs have demonstrated that the type of material used as well as environmental factors affect the success of a reef-building operation. These factors are also important operational issues in selecting potential artificial reef sites. The following section presents a summary of findings from previous reef-building operations as related to these factors.

3.1 TYPES OF REEF MATERIALS

Although many types of materials have been used for artificial reef construction (Table 3.1), not all materials are suitable or recommended for use. Myatt (1981) suggested that persons involved in selection of materials for reef construction should consider the cost of preparing the materials, transportation requirements, suitability of the materials to reef objectives, and abundance of the materials. Hinman (1981) suggested that the reef program objectives (i.e., who will be the user groups) are important considerations in the selection of reef materials as well as the reef size and configuration.

Artificial reef-building efforts in the United States have primarily been directed toward recreational fishermen and have often resulted in large, haphazardly constructed reefs using scrap materials (Bohnsack and Sutherland, in press). Automobile tires and concrete blocks have been the most commonly used materials because of their availability, low cost, and ease of handling. Although tires have been widely used, specialized equipment is required to compress the tires into bales (Tolley, 1981). Ryder (1981) suggested that tire bales not be placed in waters less than 70 ft (21 m) deep because of their tendency to break apart and drift in high energy environments. Mathews (1984) reported that the U.S. Army Corps of Engineers (COE) stopped permitting tire reefs altogether. Other low density materials such as automobile bodies and appliances are not recommended because of their tendency to rust away and/or drift in shallow waters (Ryder, 1981). The use of wooden structures or vessels is also discouraged because of eventual navigational hazards or beach littering following disintegration during storms (Mathews, 1984).

Concrete materials are suitable for artificial reef construction because of their density, durability, low cost, and availability (Ryder,

TABLE 3.1. MATERIALS USED IN THE CONSTRUCTION OF ARTIFICIAL REEFS (FROM: RYDER, 1981).

Metal Material
Light Metal:
Automobiles
Boats
Appliances
Heavy Metal:
Oil platforms
Steel vessels
Rubber
Automobile tires
Truck and heavy equipment tires
Concrete
Culverts
Manholes
Blocks and bricks
Rubble
Rock
Other
Fiberglass
PVC
Wood
Coal waste combustion products
Electrodeposition

1981). Mathews (1983) considered concrete as one of the most effective materials in use in the country. He pointed out that concrete reefs require relatively limited amounts of labor, but do necessitate the use of heavy equipment for loading and unloading. Sheehy (1983) noted that concrete material requires a staging/storage area and that transportation costs from construction sites to staging areas can be considerable.

Ships and barges are the oldest type of artificial reef material (Mathews, 1983). Sunken vessels provide high profile and large surface areas which are advantageous in providing substrate for marine growth and attracting fishes (Bieling, 1981). Steel-hull barges and ships have been among the most successful materials used in Florida's reef-building projects (Dean, 1983). During the 1970s, obsolete Liberty Ships were made available by the Federal government to States interested in artificial reef construction. Mississippi and Alabama deployed five vessels each and Florida deployed six vessels before the supply diminished (Anonymous, 1985). Future sources of this type of material will likely be from private sources.

Recent interest has focused on the use of obsolete offshore oil and gas production platforms as artificial reefs. Six reefs have been created in waters off Alabama and Florida using obsolete structures donated by Exxon Company, U.S.A., Marathon Oil Company, Tenneco Oil Exploration and Production, and the Stage I and II platfoms from the U.S. Navy. All but one of these reefs have been created in Gulf of Mexico waters. The reef outside this area was constructed in the Atlantic off Broward County, Florida.

McIntosh (1981) reported that the reef created from the Exxon structure is one of the most productive in Florida. Over 3,700 structures are located in the Gulf of Mexico and about 40 become obsolete every year (Dean, 1983). The fact that most of these structures are located off Louisiana and Texas results in significant operational and logistic costs for towing these structures to the eastern Gulf. In spite of the costs, it was estimated that Exxon's platform donation as a reef saved 5 million dollars over the costs of dismantling and disposal on shore (Dean, 1983). Costs and/or savings can be expected to vary depending on water depth at the platform site, platform size, and distance to the reef site. Shell Oil Company (1985), for example, estimated that use of a platform as an artificial reef (i.e., one towed to another location) would cost from approximately one half to one seventh of that required for dismantling and disposal on shore. This variation was largely dependent on water depth.

Carleton et al. (1982) and Woodhead et al. (1982) discussed the results of creating artificial reefs from wastes generated by burning coal in power plants. The need to dispose of these wastes and the shortage of sufficient land-fill capacity raised the potential for ocean disposal combined with reef construction. A conversion process that combines a sludge filtercake with fly ash is required to stabilize the wastes and protect the environment. Preliminary results seem to indicate that the waste product is nontoxic to marine life and the reefs attract fishes and invertebrates.

The Japanese government has ceased funding the construction of artificial reefs built from waste materials (Bohnsack and Sutherland, in press). The Japanese artificial reef program is directed toward commercial fishermen and uses special designs and materials including steel-reinforced or prestressed concrete, polyethylene concrete, rubber, and fiberglass-reinforced plastic (FRP). Sheehy (1981) suggested that the manufactured reefs used by the Japanese offer greater design flexibility, extended life spans, and better bottom stability than the materials commonly used in the United States. Sheehy (1983) compared a scrap culvert reef and a Japanese-designed FRP reef and found the latter to be superior in terms of attracting and sustaining desired target species of fishes and forage species in Florida waters. Major costs of FRP reefs are in materials and construction rather than in transportation, handling, and placement as with scrap material reefs (Sheehy, 1983).

The reefs described in the preceding discussion are all designed as bottom structures. Mid-water and surface structures are also available for use in attracting pelagic fish species. These types of fish attractors generally consist of a float, an attractor (e.g., discarded net material, synthetic-covered fiberglass frames and streamers, etc.), and an anchored mooring (McIntosh Marine, 1983). McIlwain and Lukens (1978) reported successful efforts in attracting pelagic species to two artificial reef sites off Mississippi using mid-water attraction devices. McIntosh Marine (1983) also found that it was possible to increase the number of fishes at artificial reef sites by the addition of mid-water attraction devices. Myatt (1978) described the use of mid-water devices to create a "trolling alley" adjacent to natural or artificial reefs and increase the catch rate of pelagic fishes.

Given the existing evidence, it is apparent that concrete materials, steel ships and barges, and obsolete petroleum platforms will most likely be used in constructing artificial reefs in the United States. Japanese-designed structures also present a significant potential for increasing artificial reef productivity in U.S. waters. Other materials are less suitable because of their lack of durability or availability. Therefore, the discussions which follow in selecting reef sites based on operational characteristics will focus only on the proposed use of these four types of materials.

3.2 ENVIRONMENTAL FACTORS

Bohnsack and Sutherland (in press) summarized the state-of-the-art in artificial reef design and placement and found that some investigators concluded that correct site selection was more important than reef design. Many artificial reef projects have been less than successful because reef planners have failed to consider substrate conditions and the energy environment at a site. Site selection should be based on optimum environmental conditions.

Important oceanographic considerations include wave direction and force and magnitude of tidal and ocean currents. Mathews (1985) suggested that areas with strong tidal currents should be avoided because these currents will cause erosion on alternate sides of the reef, causing it to sink. A relatively weak current could be beneficial to a reef situated at right angles to the current. Sheehy (1982) has developed stability calculation equations that use available oceanographic data and estimates of significant and maximum wave heights and periods, current velocities, and substrate data. These equations have been used to predict the stability of various Japanese-designed unit reef configurations under various conditions.

Depth is of prime importance in placing artificial reefs for several reasons. First, regulatory agencies require a certain minimum clearance for navigational purposes. In Florida, the COE prefers a minimum clearance of 50 ft (15 m) although more or less may be required depending on the location and type of reef (J. Winn, 1985, personal communication, COE). The Oil Industry International Exploration and Production Forum (1984) has taken the view that at least 130 ft (40 m) of clearance should exist when petroleum platforms are used as artificial reefs. Figure 3.1 shows bathymetric contours off Mississippi. It is significant to note that the shelf tends to be broad and shallow.

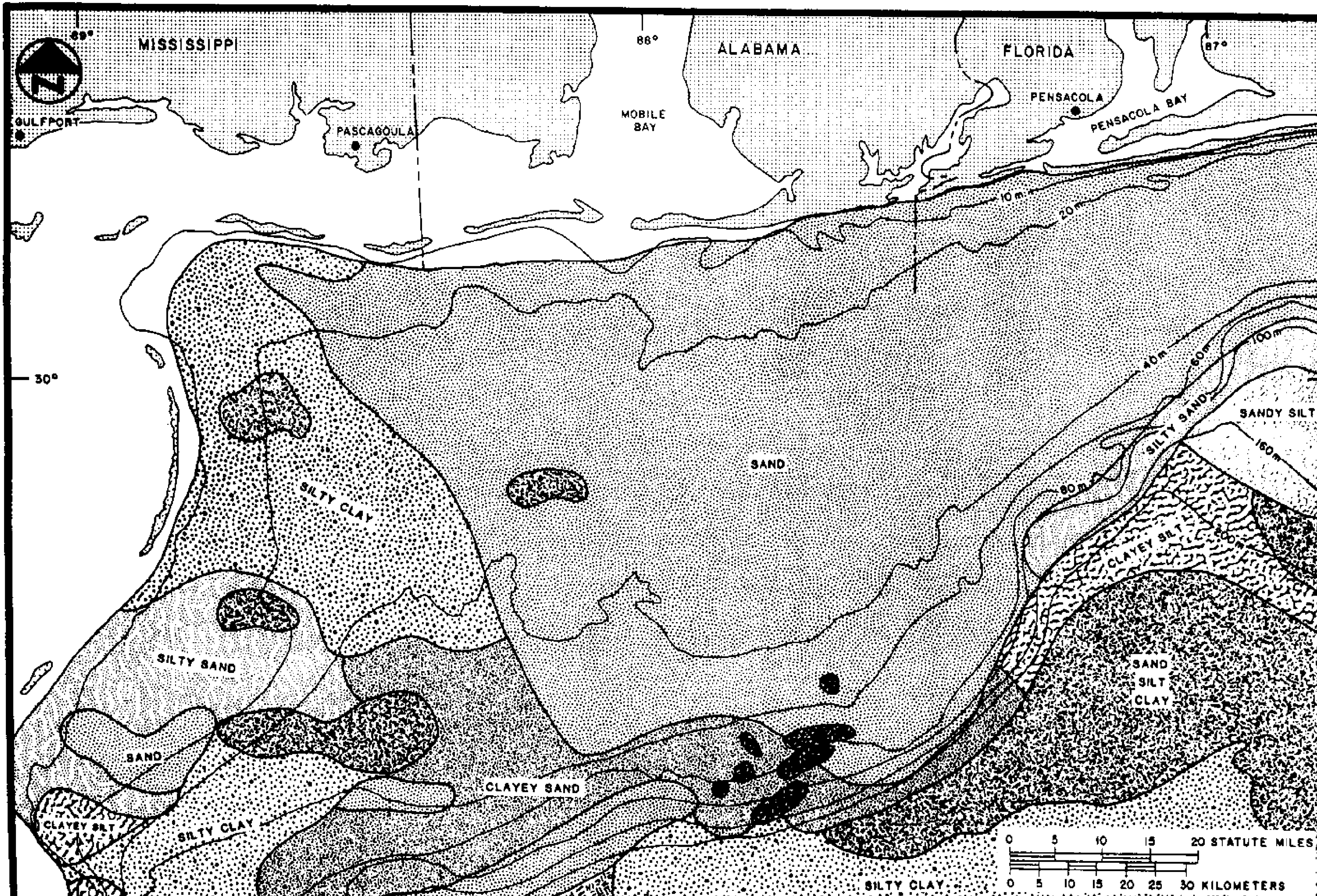

FIGURE 3.1. BATHYMETRIC CONTOURS AND SEDIMENT TYPES OFF MISSISSIPPI, ALABAMA, AND THE FLORIDA PANHANDLE (FROM: BROOKS, 1973).

Secondly, depth is important depending on the target fish species desired. Mathews (1981) suggested that the optimum reef depth is 90 to 120 ft (27 to 37 m). This is due to the fact that shallow reefs in 30 to 45 ft (9 to 14 m) depths do not attract the large benthic species common to reefs in 60 to 120 ft (18 to 37 m) depths. Shallow to intermediate depths may be desired if the reef is to serve a sizeable recreational diver population.

Finally, depth is an important factor when considering the potential impacts of severe storms on a reef. Reef materials in waters too shallow can be moved around or exposed to sedimentation during a storm. Mathews (1981) suggested that sites be chosen in water depths that are below the maximum affected depth during a 10-year storm event. This depth can be determined from the fact that a wave does not affect the bottom when the depth is greater than one half the wave length.

Substrate type is an important biological concern in the siting of artificial reefs. It is also a major operational consideration. Artificial reefs placed in areas of soft clay or silty sediments can sink into the bottom. Sand or sand/shell bottoms are the preferred substrate for siting reefs because of the greater support they provide (Mathews, 1981). Figure 3.1 shows the distribution of sediment types off Mississippi. Most of the bottom consists of a sand substrate, except for the area near Chandeleur Sound where silts and clays predominate (Brooks, 1973).

Grove and Sonu (1985) identified three topographies that are favorable for artificial reef placement (Figure 3.2). These include placement in areas with gentle slopes and a relatively flat profile; in areas not far from the shoreward encroachment of a depression; and in areas on either side of a ridge which divides water masses or bottom topography. Most of the bottoms of concern can be classified under the first type of condition, given the general lack of topographic features and the parallel depth contours in the study area (Figure 3.1).

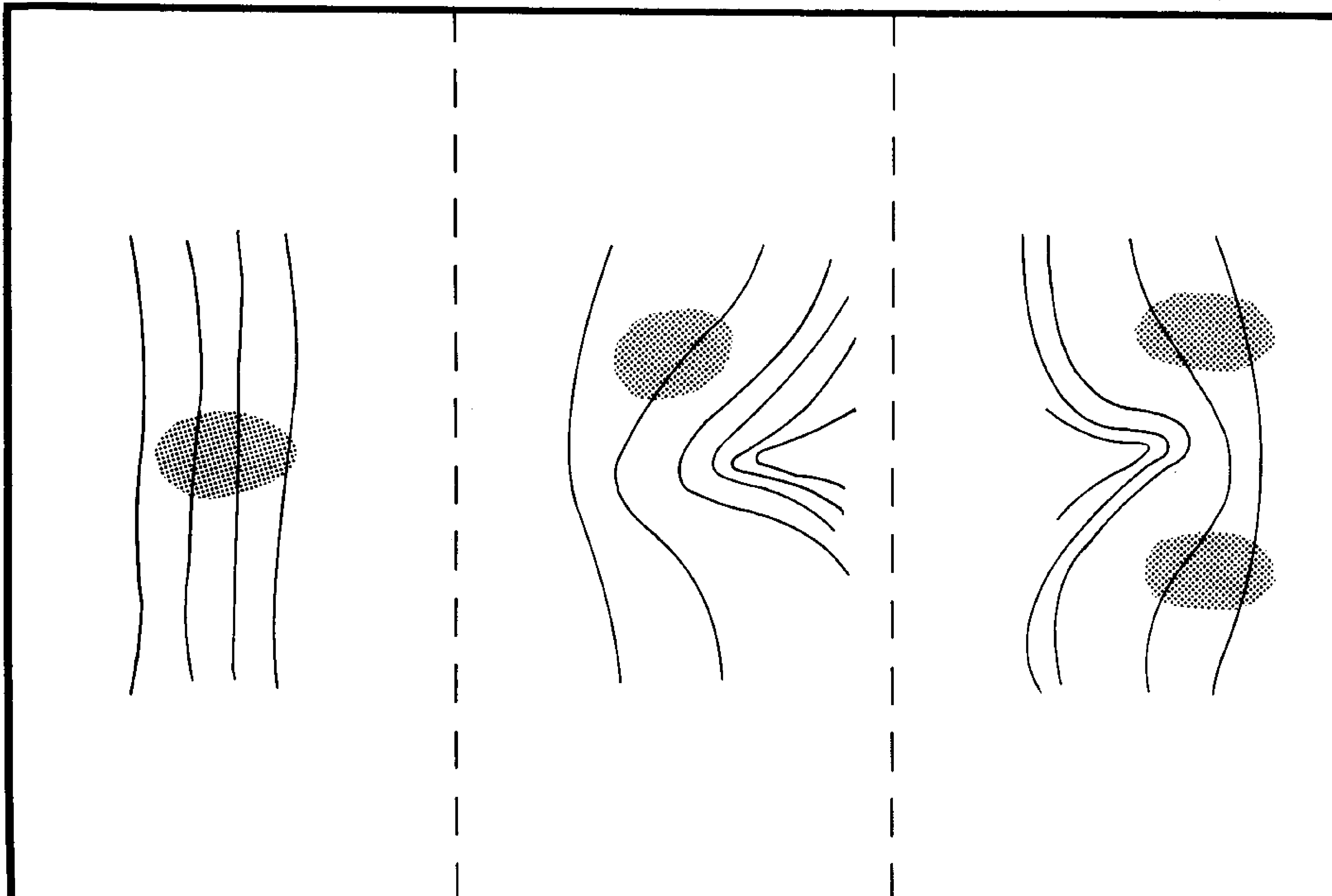

FIGURE 3.2. FAVORABLE TOPOGRAPHIES FOR REEF SITES (ADAPTED FROM: GROVE AND SONU, 1985).

4.0 ARTIFICIAL REEF SITE SELECTION

The previous section discussed the importance of considering the types of reef materials and environmental conditions in siting artificial reefs. Other data which are important in site selection include existing reef locations, navigational fairways, commercial trawl fishing areas, pipeline and communication cable routes, and military exclusion areas. All of these data are considered in the following description concerning the selection of potential reef sites. In the selection process, exclusion mapping techniques were used. With this technique, areas that are unsuitable on the basis of environmental conditions, navigational or military hazards, pipeline or cable routes, or interference with commercial fishing grounds were excluded from consideration. The remaining areas were selected as potential sites.

4.1 MISSISSIPPI - OFFSHORE REEFS

4.1.1 Operational Considerations

Major operational factors that affect potential reef sites off Mississippi are the generally shallow waters and the extensive amount of area dedicated to shipping fairways (Figure 4.1). The shallow waters make much of the area suitable for trawling by commercial fishermen. Bottom sediments tend to be muddy or fine-grained (i.e., silts and clays) over much of the area and grade into predominantly sand in the eastern portion (Figure 4.1). Therefore, the western portion provides less suitable conditions for reef placement than the eastern extremes of the area. However, at an existing artificial reef site in an area of silty clay, only minor sinking of the reef materials (i.e., Liberty Ships) into the sediments has occurred (R. Lukens, 1985, personal communication, Mississippi Sea Grant Advisory Service). Of greater concern for potential reef placement is the fact that a Liberty Ship at one site in approximately 65 ft (20 m) of water was moved about 200 ft (61 m) and broken in two pieces by a recent hurricane. However, other ships at the same site and at a site 8 mi (13 km) away in 45 ft (14 m) of water were not severely affected.

Mississippi currently has three existing artificial reef sites and two additional permitted sites that have not yet been developed (Figure 4.2). Reefs at two of the existing sites were constructed using Liberty Ships, and barges were used at the third site (Table 4.1). The superstructures and much of the bulkheading had been removed from the

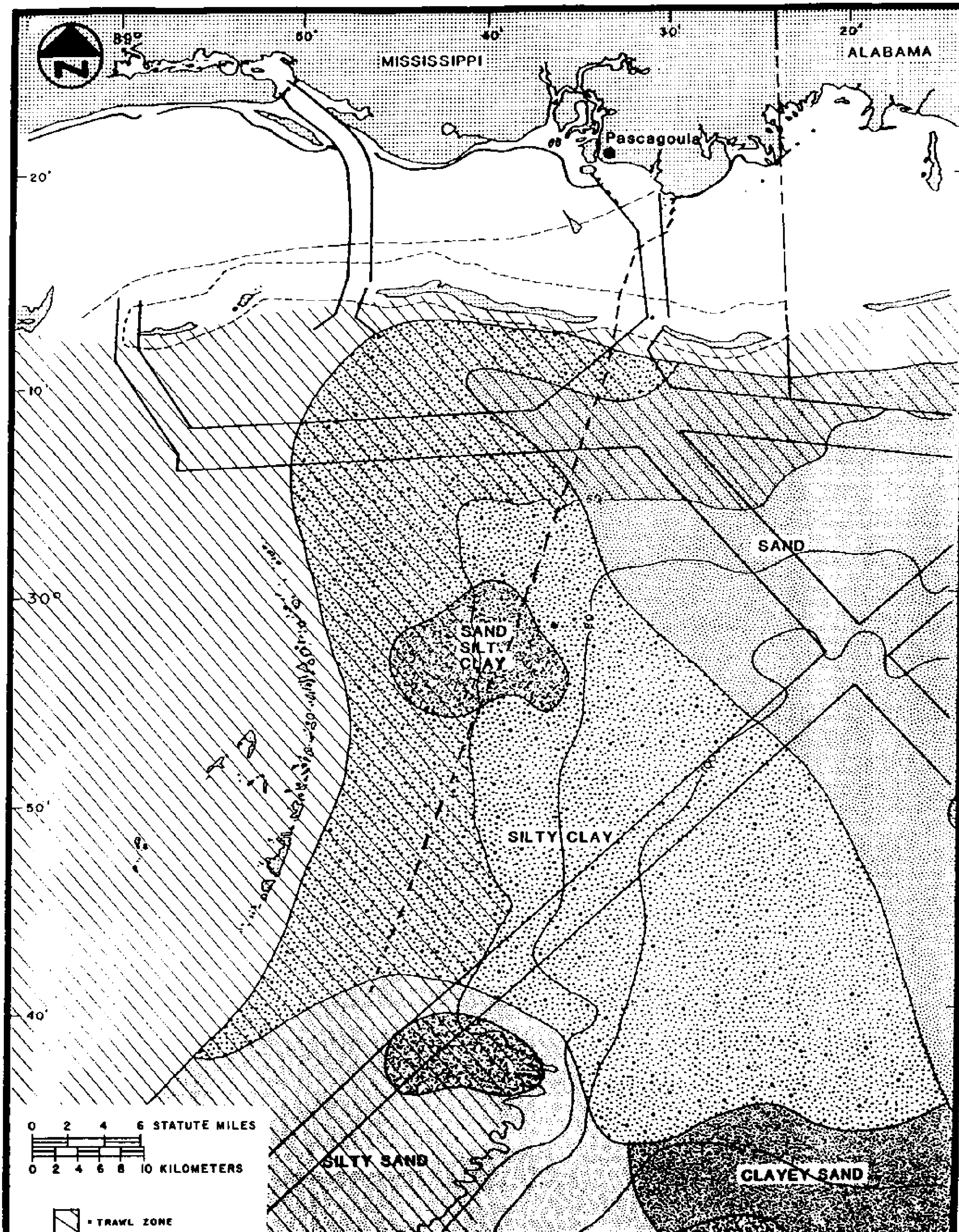

FIGURE 4.1. SEDIMENT TYPES AND LOCATIONS OF SHIPPING FAIRWAYS AND TRAWL ZONES OFF MISSISSIPPI.

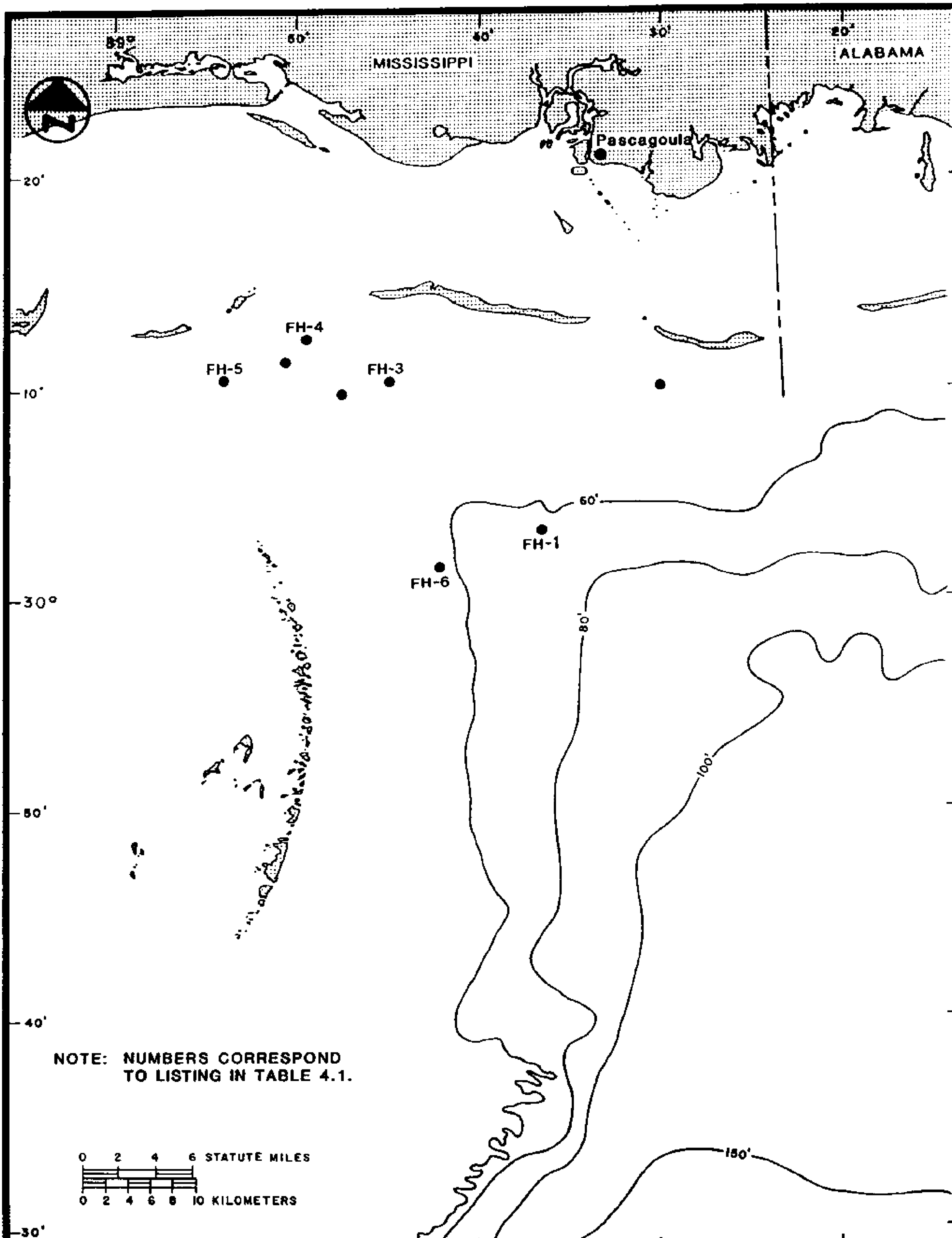

FIGURE 4.2. LOCATION OF EXISTING AND PERMITTED REEF SITES AND UNIDENTIFIED OBSTRUCTIONS/FISH HAVENS OFF MISSISSIPPI.

TABLE 4.1. SUMMARY OF EXISTING AND PERMITTED ARTIFICIAL REEF SITES IN MISSISSIPPI COASTAL WATERS.

Name	Site Designation	Type of Material	Loran-C Coordinates	
Barge Reef	FH-1	2 barges	12406.1	47037.3
Shallow Liberty Ship Reef	FH-3	2 Liberty Ships	12319.6	47061.5
-	FH-4	Permitted	12269.6	47069.1
-	FH-5	Permitted	12226.9	47060.7
Liberty Ship Reef	FH-6	3 Liberty Ships	12355.2	47030.4

Liberty Ships prior to sinking. Three unidentified reef sites are marked on the nautical charts but are not part of Mississippi's current artificial reef program.

4.1.2 Site Selection

Existing conditions off Mississippi limit the available sites for the placement of artificial reefs. The shallow waters suggest that the area is widely used by commercial fishermen. Lukens (1985, personal communication) stated that commercial fishermen have generally opposed any attempts to expand the number of existing artificial reef sites. For this reason, the Mississippi Sea Grant Advisory Service is presently committed to improving existing reef sites. Based on this policy and the existing conditions, four reef site zones are proposed (Figure 4.3). These sites are being proposed on the basis of providing different fishing experiences and satisfying a variety of user needs.

Site A has been designated to take advantage of the plans to improve existing reef sites. The area includes the existing reef at FH-3 and extends eastward to include sand bottom. Although permitted sites are available west of FH-3 at sites FH-4 and FH-5, the silty clay bottom is less suitable for reef placement and stability.

Sites B and C cover intermediate depths between 60 and 80 ft (18 and 24 m). This may be beyond the preferred depth of most trawlers. The primary criterion for selecting Sites B and C was the sand bottom in the region. The inclusion of the existing reef at FH-1 into Site B makes this site a prime candidate for expansion. Site FH-6 is not recommended for further development because of the lack of suitable bottom sediments.

Site D is characterized by water depths greater than 100 ft (31 m) and a sand bottom. This area will be most suitable for reefs designed to attract large pelagic game fish species.

Table 4.2 summarizes the results of responses received from 17 commercial and recreational fishermen at meetings in Biloxi in January, 1986. This table shows the proportion of fishermen and the distances they are currently boating to fish offshore. Also shown are the proportion of fishermen and the distances they are willing to travel to a preferred fishing location. The largest proportion of these fishermen currently fish at distances from 15 to 40 mi (24 to 64 km) from their

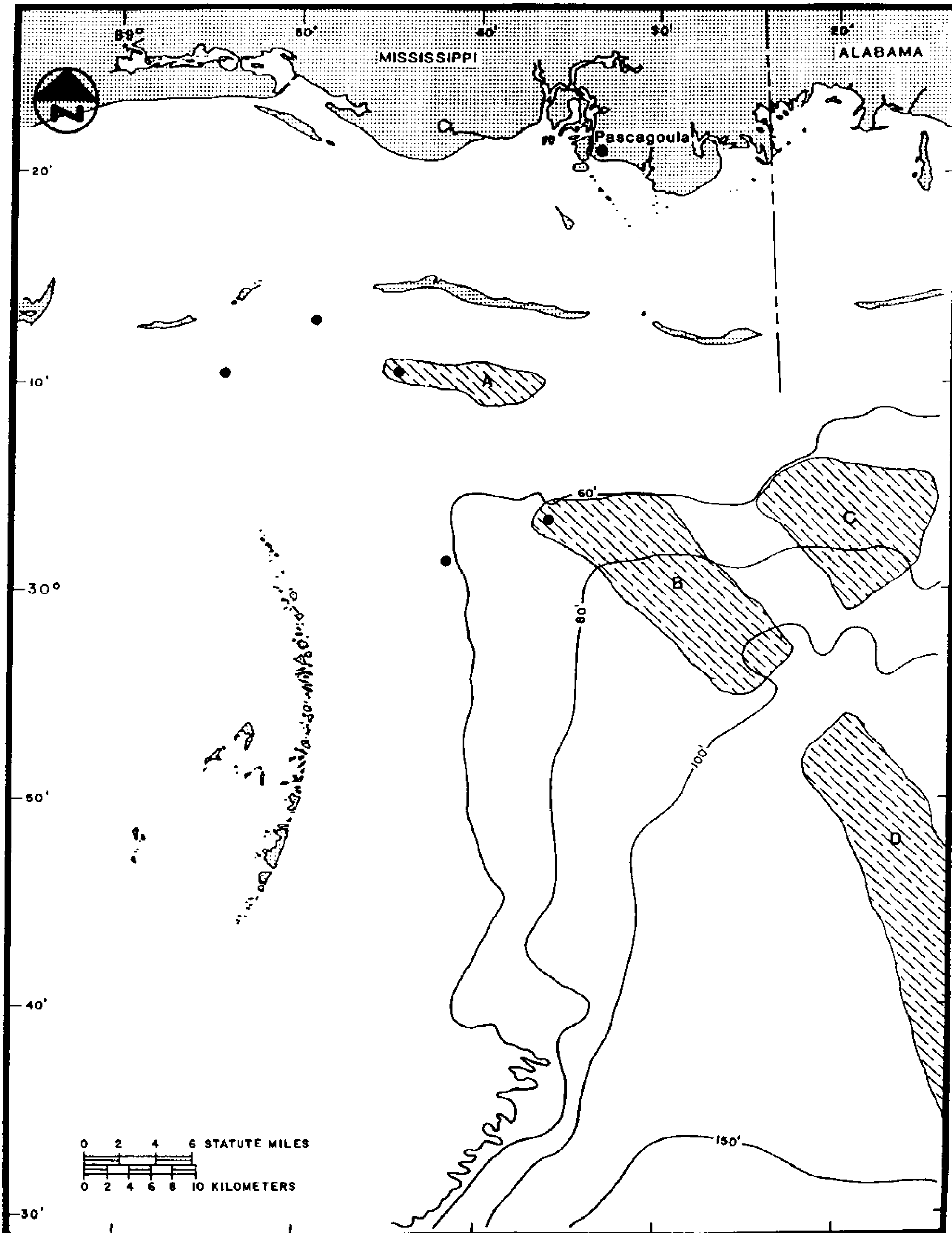

FIGURE 4.3. LOCATIONS OF PROPOSED ARTIFICIAL REEF SITES OFF MISSISSIPPI.

TABLE 4.2. RESULTS OF RESPONSES FROM COMMERCIAL AND RECREATIONAL FISHERMEN CONCERNING THE DISTANCES FROM SHORE CURRENTLY FISHED AND THE DISTANCES WILLING TO TRAVEL TO A PREFERRED SITE. RESULTS ARE EXPRESSED AS THE PROPORTION OF FISHERMEN USING EACH ZONE IN RELATION TO THE TOTAL NUMBER OF RESPONSES (=17). THE TOTAL PROPORTION IS GREATER THAN ONE BECAUSE SOME FISHERMEN REPORTED A MILEAGE RANGE (E.G., 10 TO 20 MILES).

Zone (miles)	Distance to Reach Current Fishing Areas	Distances Willing to Go to Reach a Preferred Spot
≤15	.38	.07
>15 ≤25	.50	.21
>25 ≤40	.56	.29
>40	.25	.50

point of launching. However, half of the fishermen responding said they were willing to go more than 40 mi (64 km) to a preferred site. Distances these fishermen are willing to go ranged from 50 to 100 mi (80 to 160 km).

Figure 4.4 shows the location of the 40-mi (64 km) radius from Biloxi. This distance would encompass the proposed reef sites in Areas A, B, and C. However, this figure also shows the areas preferred by the fishermen for locating artificial reefs. Most of this area corresponds to distances of 15 to 25 mi (24 to 40 km) from the mainland and probably represents fishing at the existing artificial reef sites in these waters. The farthest preferred sites are to the west of the proposed sites and are near the Chandeleur Islands. These islands would offer protection from rough seas in the long runs to any sites in these areas. From an operational standpoint, however, bottom substrates at these sites are not suitable for reefs as described earlier.

In summary, while some consideration should be given to sites in Areas C and D, Areas A and B would appear to satisfy the greatest proportion of user needs as well as operational considerations. This assumes that responses from the general fishing populace would be similar to those received in the meeting in Biloxi.

4.1.3 Suggested Reef Materials

The shallow waters in the nearshore reef zone require that the reefs be low profile. The potential for movement of reef material during a storm is also increased in shallow waters, so the material used should should be of very high density. Large concrete blocks may be best for this situation.

Research has shown that fishes prefer complex reefs with chambers, openings, and interstitial spaces [for a review see Bohnsack and Sutherland (in press)]. Lukens (1985, personal communication) suggested that removal of the superstructure from the Liberty Ships at the existing sites created a flat, hard substrate that minimally attracts fishes. Given the limited amount of reef sites in the nearshore zone, improvements in the reef habitat at the existing FH-3 site should be a priority. Similar criteria as discussed above would apply.

The 60 to 80 ft (18 to 24 m) depths at Sites B and C provide opportunities to construct reefs with high profile to attract pelagic

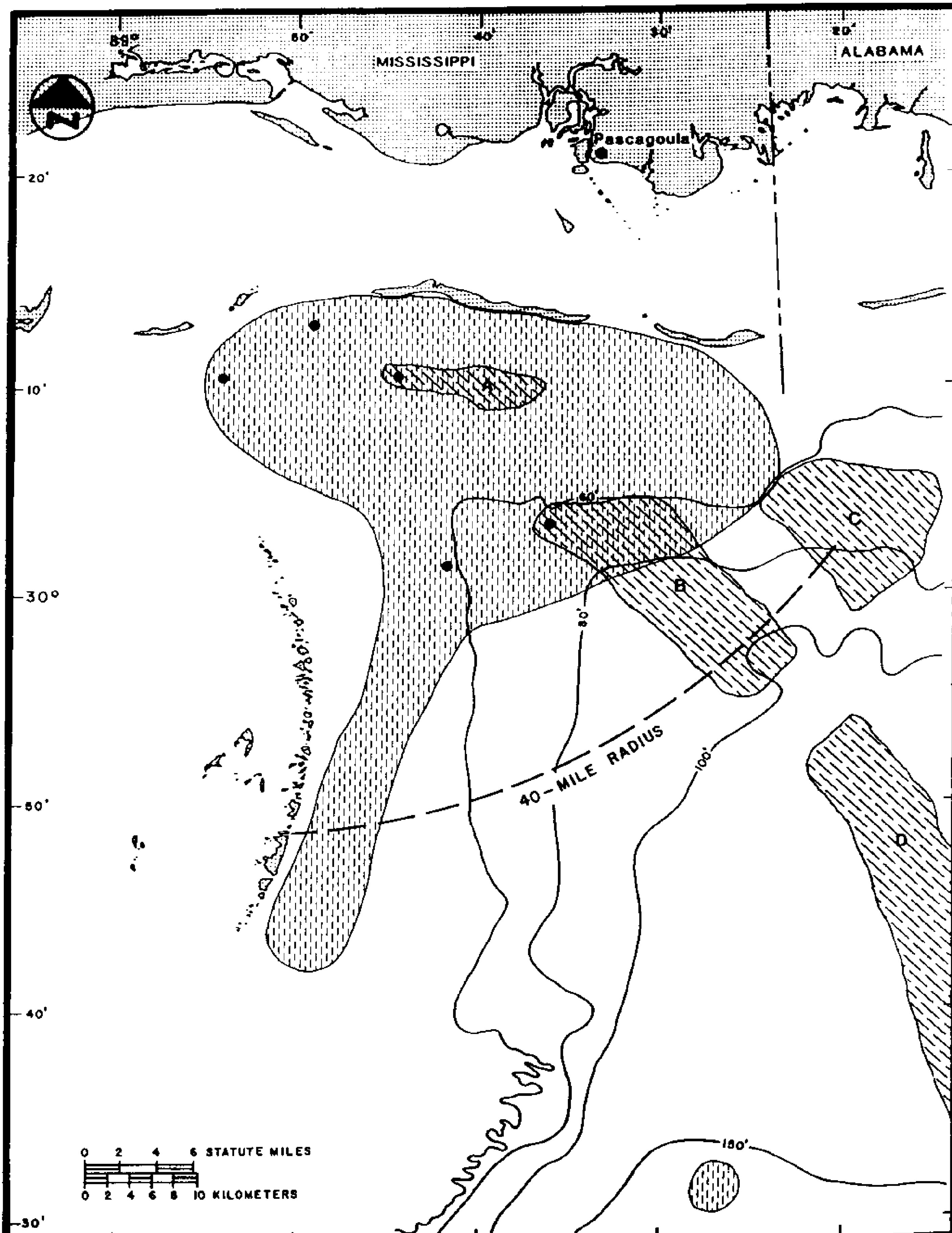

FIGURE 4.4. AREAS IDENTIFIED AS PREFERRED ARTIFICIAL REEF SITES BY MISSISSIPPI FISHERMEN AND THE 40-MILE RADIUS FROM BILOXI.

fishes. However, the depths are not sufficient to place large ships with their superstructure intact. At the same time, depths are deep enough to make dumping of concrete rubble to form high-profile reefs difficult. Reef material candidates for Sites B and C would be some of the prefabricated, Japanese-designed structures that allow construction of a desired reef type.

High-profile material is favorable for reef construction at Site D where water depths are sufficient to provide a required navigational clearance. Intact ships or obsolete petroleum platforms would probably provide the best options for this site.

4.2 MISSISSIPPI - INSHORE REEFS

4.2.1 Operational Considerations

Initially, this project was intended to consider artifical reef siting only in offshore waters. However, in meetings in Biloxi, local fishermen expressed a strong desire for artificial reefs sited within the waters of Mississippi Sound. Reefs in these areas would reduce the distances fishermen must now travel across the Sound to reach the offshore reefs. However, there are a number of factors which influence the development of reefs in this area.

Depths in Mississippi Sound are shallow and generally less than 20 ft (6 m). The general trend is for depths to increase with distance from the mainland to maximum along the north sides of the barrier islands. These generally shallow depths require that any reefs which are installed be of low profile to minimize navigational hazards and impacts from storms.

Navigational fairways traverse the Sound to the open Gulf from the Gulfport, Biloxi, and Pascagoula (Figure 4.5) areas. Smaller dredged channels are also located off Beauvoir and Biloxi. Pipelines cross the Bay from Ship Island Pass and Horn Pass to Pt. aux Chenes, east of Pascagoula. An anchorage area, which should also be avoided, is found south of Biloxi.

The barrier islands which form the southern boundary of Mississippi Sound are part of the Gulf Islands National Seashore. The area around these islands out to a distance of one mile is protected by Federal law. This will be a consideration in any attempts to place artificial reefs near the islands.

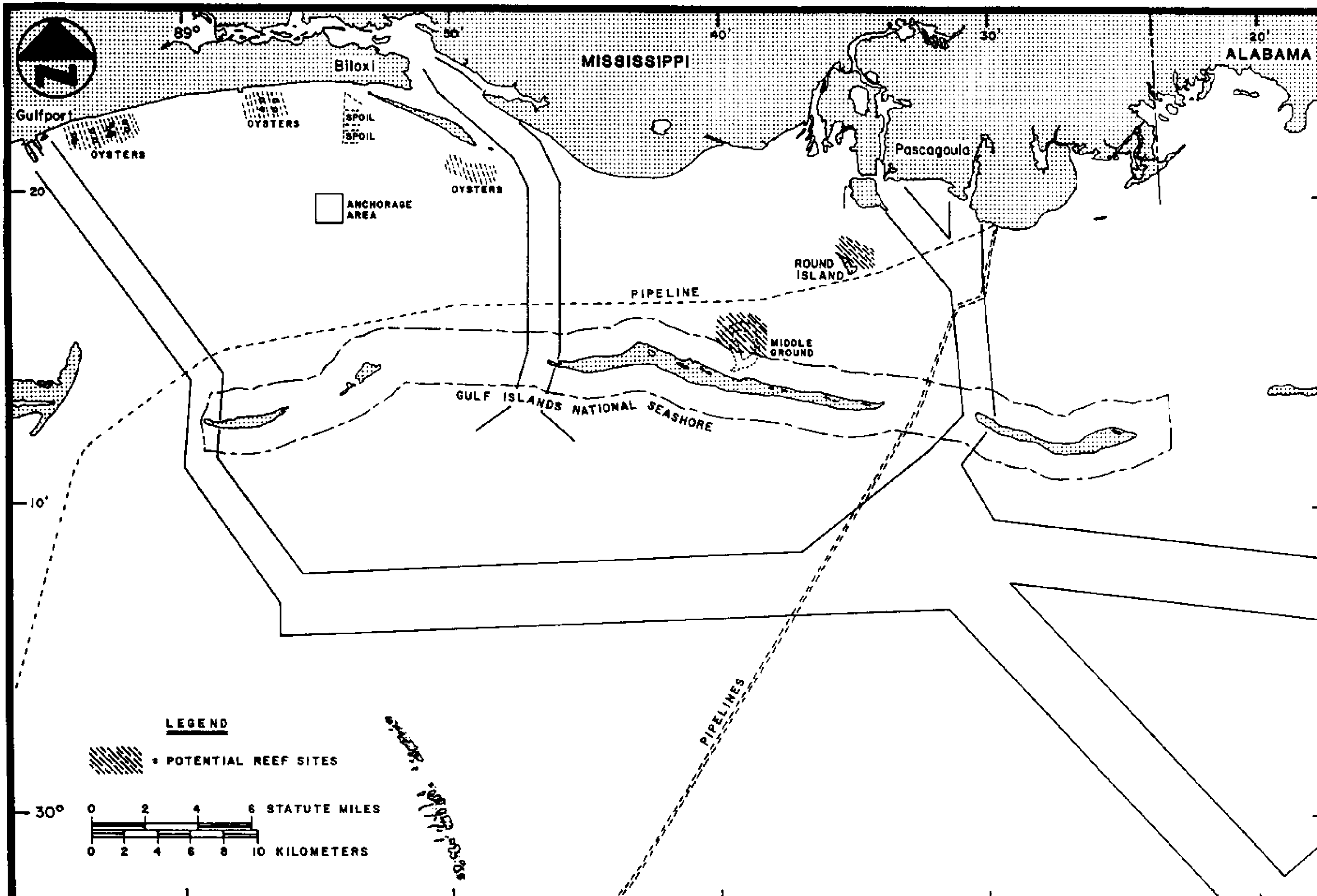

FIGURE 4.6. OPERATIONAL FEATURES AFFECTING ARTIFICIAL REEF PLACEMENT AND SOME POTENTIAL REEF SITES IN THE WATERS OFF MISSISSIPPI SOUND.

Bottom types in the Sound are predominantly muddy, which is generally unsuitable for reef establishment because of problems associated with sinking. However, a number of oyster reefs and obstructions, including shipwrecks are plotted on the navigational charts. These areas may be suitable for expanding a reef. Since they are charted and probably well known to local trawl fishermen, reefs in these areas may not conflict with trawling activities.

4.2.2 Site Selection

Because of the limitations imposed by trawling activities in the Sound, the generally muddy bottoms, and the shallow waters, sites for extensive artificial reef development are limited. Some possible areas however, would include expansion of the existing shoals north of Horn Island near the Middle Ground and north and east from Round Island (Figure 4.5). The islands would provide some protection from storms out of the Gulf and the existing shallows are probably avoided by trawlers.

It was suggested during meetings with local fishermen in Biloxi that expansion of existing oyster reefs along the shore between Biloxi and Gulfport could also provide additional reef habitat. This idea has merit because it would enhance the oyster resources as well as fish populations and the areas are probably avoided by trawlers. Other areas which would be suitable for creating reefs would be around existing piers to provide for the shorebound fishermen and the areas around existing wrecks as mentioned previously.

4.2.3 Suggested Reef Materials

The shallow waters in the Sound require low profile reefs to minimize navigation hazards. Dense materials such as concrete rubble are subject to rapid sinking into soft sediments and would have a short life-span. On the other hand, less dense materials such as tire reefs are demolished during storms and spread over large areas so that they are also not suitable. The Texas Parks and Wildlife Department found that the most effective artificial reef material was a thin veneer of oyster shell spread along the shallow bay bottoms of Texas' coastal estuaries. This thin veneer does not require marking with navigational buoys and allows attachment by species requiring hard substrates (e.g., oysters). Such material could be effective in increasing the size of existing oyster reefs. The thin veneer could be seeded with live oysters to facilitate and speed colonization of the reef. However, such reefs would probably be restricted to shallow waters suitable for oyster growth. An example where oyster shell could be used with concrete rubble to create reefs near the shoals at the Middle Ground or Round Island is shown in Figure 4.6.

In the deeper waters near the barrier islands, obsolete barges or old boats could be sunk if enough clearance were allowed for navigation (it would be necessary to buoy such wrecks until they could be charted). The need for navigational clearance would probably require the removal of any superstructure associated with such wrecks which would reduce the effectiveness of these vessels in attracting fish. Such vessels could also be moved around during storms so that they should be placed leeward of the barrier islands to provide as much protection as possible.

Low profile, Japanese type concrete structures could also be suitable reef materials in the deeper parts of the Sound. Their basic disadvantage would again be associated with their weight and density which could cause sinking into the muddy sediments. The risk of loss of such structures from sinking given the costs associated with their construction may not justify their use.

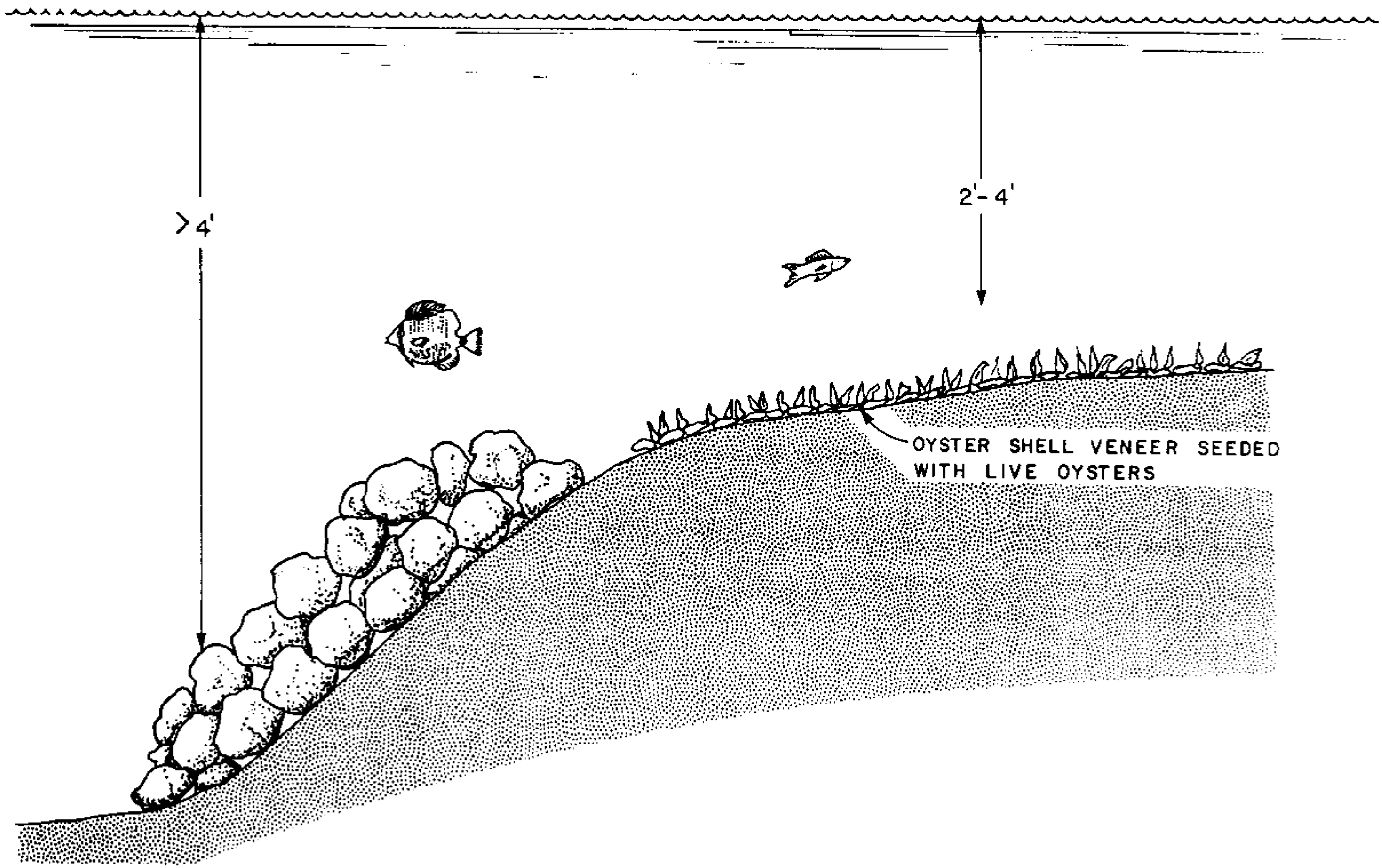

FIGURE 4.6. SUGGESTED DESIGN FOR AN ARTIFICIAL REEF EMPLOYING OYSTER SHELL AND CONCRETE RUBBLE IN SHALLOW WATERS.

5.0 DISCUSSIONS AND CONCLUSIONS

5.1 TRANSPORTATION OF REEF MATERIALS

Transportation of reef materials to the proposed site probably represents the largest single operation in terms of both effort and cost in the artificial reef construction process. Various types of methods are available to transport the materials to a site depending on the materials used.

Barges will generally be the preferred mode of transport for concrete materials because of the weight and volumes involved. Heavy equipment such as trucks or cranes will be required to load the materials onto the vessels. For unloading at the reef site, either "bottom dumping" or crane-equipped barges are necessary. It is significant to note that with barges, placement of materials on the bottom is generally scattered and it is difficult, if not impossible, to form the reef in a particular design. Marking the site with a buoy and anchoring during unloading can minimize the scatter of reef materials.

Sheehy (1983) used air bags to float Japanese-designed FRP reef units to a site off Panama City. These 5-m long by 1.0-m diameter units were towed to the site by small (i.e., 5-ton) boats. However, most Japanese-designed structures weigh on the order of several tons and require crane-equipped barges for transport, unloading, and placement.

To date, two obsolete petroleum platforms (Tenneco and Marathon) and a submerged production system (Exxon) have been moved from their locations off Louisiana and deployed as artificial reefs off Alabama and Florida. The submerged production system was a 2,200-ton structure towed 300 mi (483 km) to a location 35 mi (56 km) offshore Apalachicola, Florida in 110 ft (34 m) of water in 1980 (Sheehy and Vik, 1982). Two other obsolete platforms (Stages I and II) used by the U.S. Navy for scientific observations were sunk in place off Panama City, Florida.

Tenneco donated a platform to the State of Florida in 1982 for an artificial reef in 175 ft (53 m) of water 22 mi (35 km) southeast of Pensacola. The original structure was transported by barge in two sections. The deck section measures 72.5 ft (22 m) by 50 ft (15 m) and is 26 ft tall (8 m). The 130-ft long steel jacket rests on its side and projects upward in the water column about 90 ft (27 m). Holes were cut in the deck section before deployment to permit light penetration and to attract more fishes (Johnke, 1984).

In 1983, Oceaneering International, Inc. engineered a new technique for moving petroleum structures. An obsolete Marathon platform jacket in 208 ft (63 m) of water off Louisiana was fitted with buoyancy tanks, toppled in place, and towed to a reef site 50 mi (80 km) off Alabama. The structure lies on its side in 240 ft (73 m) of water, leaving a clearance of 130 ft (40 m). The deck structure which had been removed from the jacket was also towed to the site on a barge and placed on the bottom near the jacket structure.

A variety of comments were received from oil companies, agencies, and others concerning the technical feasibility of transporting petroleum platforms in response to a Minerals Management Service (MMS) request for information on platform dispositions (Federal Register, 13 November 1984, p. 44925). These comments are summarized in Table 5.1. Overall, it appears that the technology is currently available to remove existing platforms from water depths of 300 ft (91 m) or less and to transport the structures to sites for use as artificial reefs. The weight of the jackets and the available technology may limit the use of platforms in water depths greater than 300 ft (91 m). However, economics, and not technology, will eventually dictate the fate of these structures.

5.2 DEPLOYMENT

Published literature that concerns descriptions of techniques used in deploying reef materials is generally lacking. It is assumed that in most cases, the reef materials are transported to a location above the reef site and allowed to drop from the surface. In shallow waters, a crane can be used to deposit materials and construct a reef to desired specifications. This may be less feasible in deep waters. In deep as well as shallow waters, currents could induce drifting which would result in scattering of the materials. It is important to mark the reef site and to anchor vessels unloading materials to ensure proper placement of the materials. Demoran (1981) reported that anchoring the bow and stern of an obsolete ship before sinking facilitated maintaining the desired position of the hull.

5.3 OPTIMUM REEF SIZE AND CONFIGURATION

The following discussion is summarized from Bohnsack and Sutherland (in press) who reviewed the literature on the optimum design and placement of artificial reefs. While much of the knowledge on this subject has come from U.S.-sponsored research, the vast majority of the

TABLE 5.1. SUMMARY OF RESPONSES TO AN MMS REQUEST FOR INFORMATION ON PLATFORM DISPOSITION AND TECHNICAL FEASIBILITY.

Company/Agency	Comments
Atlantic Richfield Company	a) Buoyancy tanks may be needed for towing a jacket to a disposal site.
Chevron U.S.A. Inc.	a) A major technical problem is providing buoyancy during transport. b) During towing of a refloated platform, operators must ensure control at all times, particularly in congested areas and during periods of adverse weather.
Cities Service	a) Size and bulk of many jackets exceed the capacity of existing equipment to remove in one piece. b) Refloating equipment is not currently available with sufficient capacity to transport large jackets. c) Technology and equipment are being developed to facilitate platform removal by refloating.
Conoco Inc.	a) Capability exists to salvage whole platform jackets in waters to 200 ft. b) In deep waters, platforms have to be dismantled.
Exxon Company, U.S.A.	a) Even in water up to 1,000 ft, it is feasible to cut platforms into pieces and to transport on barges. b) Primary problem in deep waters is to refloat and transport the jacket.
Marathon Oil Company	a) A jacket cannot simply be removed from deep water and placed in a shallow location because the structures are not designed to resist the large overturning moment.

TABLE 5.1. (CONTINUED).

Company/Agency	Comments
Minerals Management Service	a) Only economic and planning limitations restrict the potential utilization of oil and gas structures as artificial reefs. b) Transportation of a jacket by controlled flotation may be safer than transport by a conventional barge. c) Technology is available, but at high cost, to remove platforms from deep water by removing in sections.
National Ocean Industries Association	a) Technology exists for relocating most structures in water depths of 200 ft or less. b) Economics, not technology, is the limiting factor in the use of post production platforms.
Oceaneering International, Inc.	a) Technology exists to remove and dispose of all platforms currently in place. b) Technology has been limited in past by the lifting capacity of derrick barges. c) Oceaneering is investigating options to (1) tow jacket horizontally to a reef site; and (2) tow the entire structure either horizontal or vertically to a reef site.
Pennzoil Company	a) Most of platforms salvaged to date have been small structures in shallow water that could be loaded onto barges. b) Platforms to be salvaged in the future will be too heavy to load onto barges.
Phillips Petroleum Company	a) No technological problems exist in dismantling or transporting platforms. b) Supplemental buoyancy will be a consideration for large or deep platforms.
Shell Oil Company	a) There are no technical problems associated with dismantling and transporting platforms. b) Technological capabilities are limited by lifting capacities of derrick barges.

TABLE 5.1. (CONTINUED).

Company/Agency	Comments
Sohio	a) No technical problems associated with dismantling and transporting platforms in water out to 300-ft depths. b) In water depths from 300 to 600 ft, jacket weight is a serious technical limitation. Lift capacities for present derrick barges are not sufficient for these weights. c) Underwater technology is not currently available for salvage work for platforms in water deeper than 1,000 ft.
Tenneco Oil	a) Transporting an old platform depends on availability of an adequate capacity barge. b) Buoyancy tanks have several limitations.

literature has originated from Japanese scientists. Information is available on how reef size, height, complexity, spatial arrangement and orientation, and location affect reef success in attracting fishes.

The area of the reef (i.e., the amount of material deposited and the area of bottom covered) is one of the most important design considerations. Large reefs seem to be more productive than small reefs, although biological productivity reaches a peak at some optimum size (Grove and Sonu, 1985). In an analysis of Japanese artificial reef studies, Grove and Sonu (1985) found that the advantage of an artificial reef over a natural reef was at a maximum at a reef size of about 1,400 m^2 (cross section) or 50,000 m^3 (bulk volume). Overall, an artificial reef tended to be more attractive than a natural reef at sizes ranging from 200 to 2,500 m^2 (cross section) or 2,500 to 130,000 m^3 (bulk volume) (Figure 5.1). Various investigators have theorized as to what constitutes an optimum size depending on location. Japanese research has indicated that reefs should consist of a hierarchical arrangement; many blocks or units should form a set, sets should be clustered into groups, and several groups should form a reef complex (Figure 5.2). Reef sites within a group should be spaced about 984 to 1,641 ft (300 to 500 m) apart while reef complexes can be spaced at least 2 mi (3 km) apart (Grove and Sonu, 1985).

There seems to be no clear evidence regarding the importance of height or relief for attracting fishes. From the studies conducted, the effect of height depends on the species. Grove and Sonu (1985) concluded that height was more important to migratory fishes, and horizontal spread was more important to demersal fish species.

Of more importance to fish attraction than height is the profile of the reef. Vertical sides seem to be the best attractants (Grove and Sonu, 1985). Sheehy (1981) explained that this is due to the interaction of currents with the reef. Orientation of reefs should be perpendicular to currents to maximize this interaction. Prevailing currents tend to be alongshore in the northeastern Gulf.

Another important factor for artificial reef success is reef complexity. This includes design, spatial arrangement, number of chambers and openings, and the amount of interstitial space. Studies have shown that fishes may avoid chambers with only one opening. Large chambers and holes are also avoided by fishes. Vertical panels and horizontal and diagonal skeletal members may be more effective than

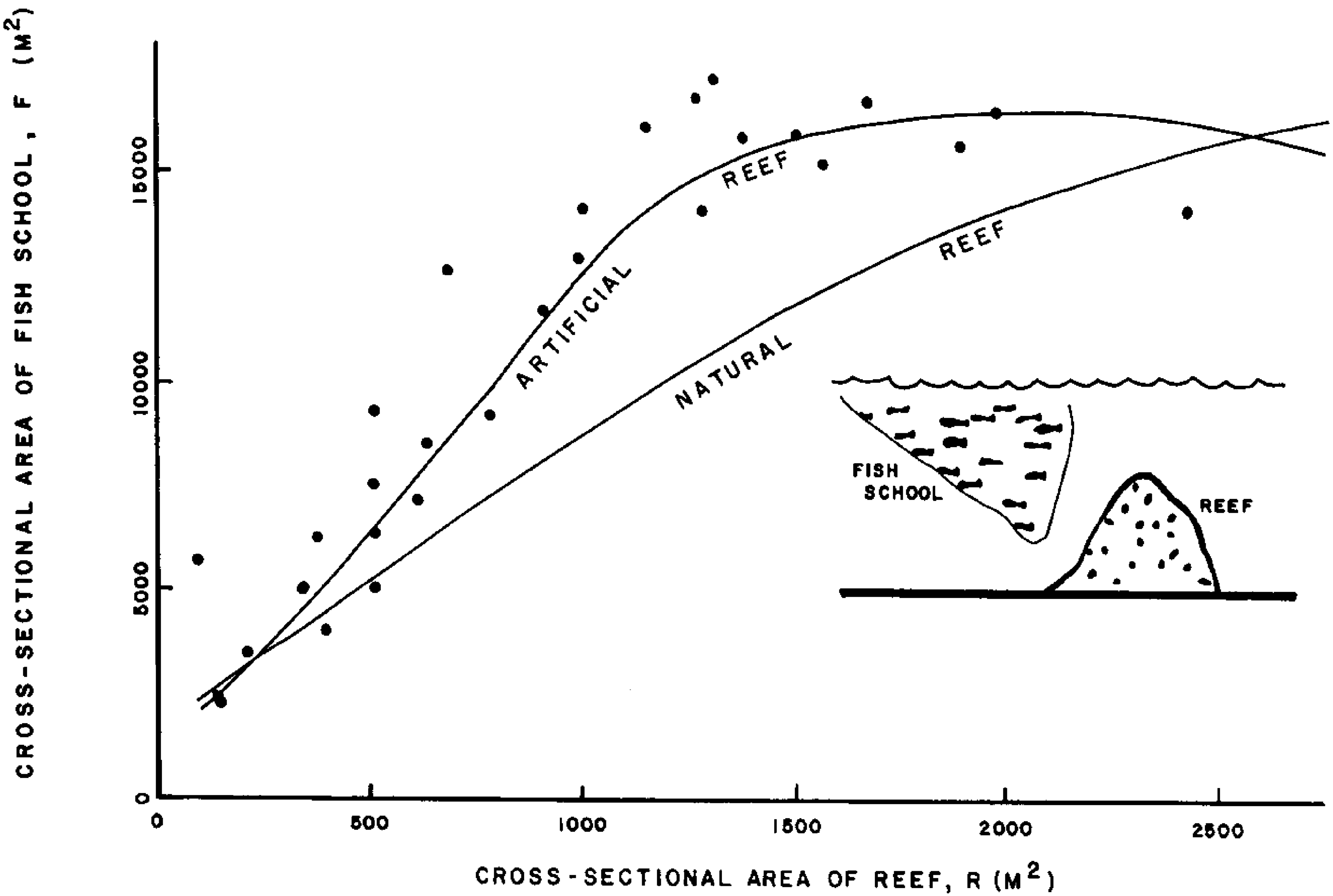

FIGURE 5.1. RELATIONSHIP BETWEEN REEF SIZE AND FISH CONGREGATION (ADAPTED FROM: GROVE AND SONU, 1985).

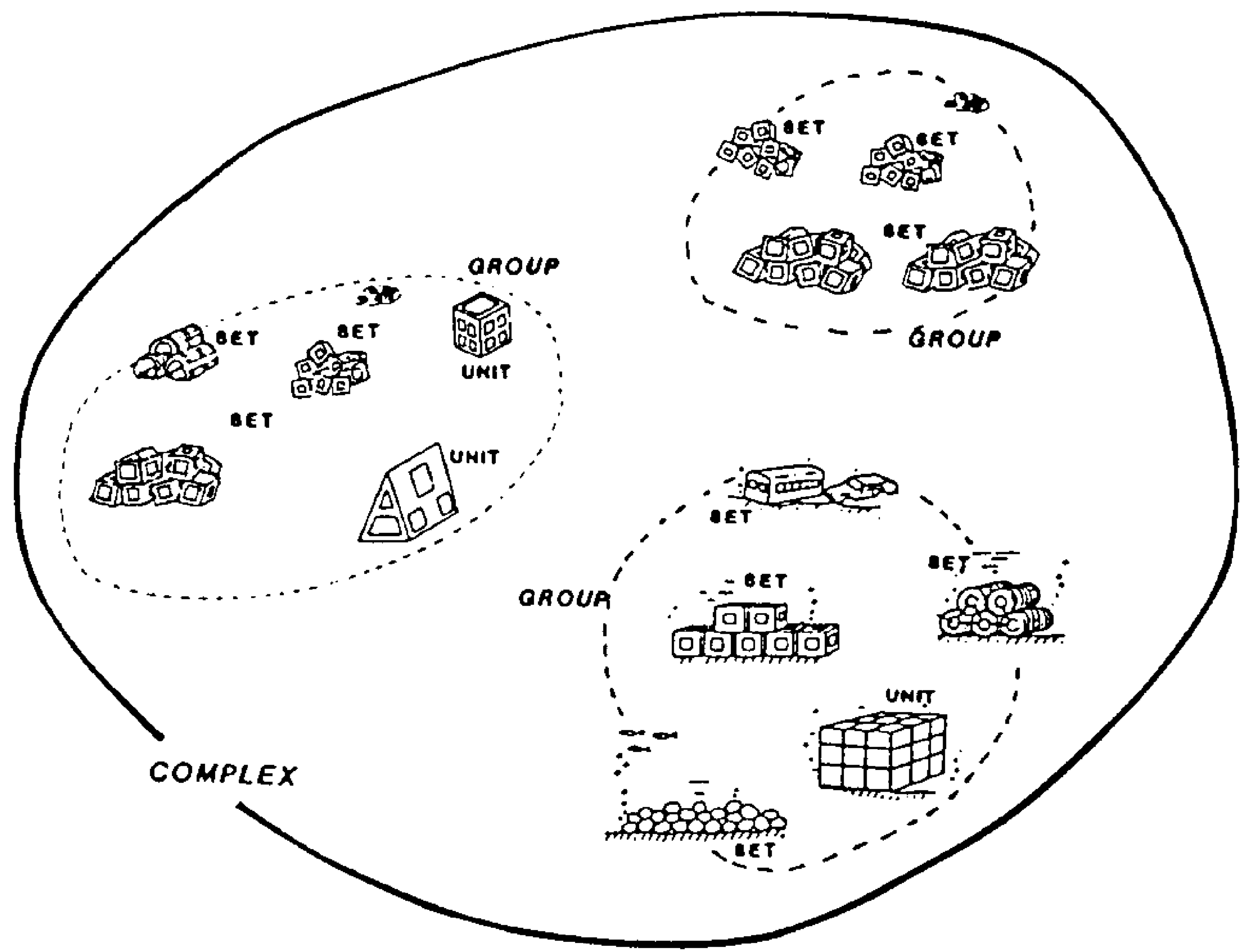

FIGURE 5.2. SCALES OF FISHING REEF (ADAPTED FROM: GROVE AND SONU, 1985).

vertical members because of the shadows created. Investigators have also found that artificial reefs made of different materials are superior to reefs of one material type.

5.4 MARKING REQUIREMENTS

In shallow waters, marking of a reef site is an important consideration for navigational safety reasons. This is of less concern in deep waters, but buoys assist fishermen in locating a reef. Marking also enables commercial trawl fishermen to avoid reefs where nets may become entangled.

The U.S. Coast Guard (USCG) has the legal responsibility to determine if a buoy is required on a reef. This determination is made on the basis of:

1) physical characteristics of the obstruction;
2) depth of water in which the obstruction is located;
3) proximity of the obstruction to historic or designated vessel routes; and
4) type of vessel traffic at the obstruction site.

Burgess (1974) stated that the USCG will not normally require marking of a reef if there is over 85 ft (26 m) of clearance. When marking is required, the owner of the artificial reef must maintain the buoy. At the Marathon platform reef, which has a minimum clearance of 80 ft (24 m), the oil company was required by the States of Florida and Alabama to purchase and place the first USCG-approved permanent buoy (Walters, 1985). Any further responsibility was assumed by the States. Exxon was able to avoid the need for a buoy at the reef created by its production template [minimum clearance of 40 ft (12 m)] by placing the structure near an existing lighted and buoyed U.S. Air Force tower (Ditton and Folk, 1982).

5.5 SUMMARY OF OPERATIONAL REQUIREMENTS

Various zones from shallow to deep waters have been established for potential artificial reef sites. The suitability of these sites can only be established after operational requirements are considered along with the legal, social, economic, and biological concerns associated with creation of reefs in these areas. As part of the analysis, it will be necessary to establish the objectives of the reef program (i.e., the target species desired and the user groups of the reef). These considerations will eventually dictate the final reef design.

In general, four types of materials are suitable for reef construction. These are concrete blocks or rubble, obsolete ships or barges, petroleum platforms, and Japanese-designed structures. High density, concrete material is probably most suitable in shallow areas where low profile structures will be required to comply with minimum clearance requirements. Ships, barges, and Japanese-designed structures are suitable for intermediate depths from 60 to 150 ft (18 to 46 m). Petroleum platforms will be effective in waters more than 150 ft (46 m) deep where the massive structures can attract large pelagic fishes.

Operational considerations should be major concerns in any reef-building effort. Proper siting and deployment of a reef are important not only to the success of the structure in attracting fishes, but also in complying with restrictions related to navigational issues. Finally, the quality of the reef construction is more important than the quantity of reef established. Therefore, reef designers should consider establishing reef complexes that provide diverse habitats. This is accomplished through planned development and careful deployment of materials.

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4. Recommendations for Specific Artificial Reef

Site Locations In

Mississippi

Based on the analyses of available data, there appear to be two potential locations for artificial reefs off Mississippi.

A) A shallow water site located 14 miles south of Horn Island in approximately 60 to 90 feet of water (approximate coordinates are 30° 03'N Latitude and 88° 37'W Longitude). This location is probably best suited for a low profile reef due to the relatively shallow water.

The nature of the bottom in this area was not sampled as a part of this study, but, based on best available information, is probably composed of relatively fine sand, silt, and clay. This makes the location potentially attractive to a number of commercially and recreationally important species such as the sciaenids and flatfishes. Additionally, other species are expected to be recruited as the reef matures.

B) The deep water site is approximately 35 miles south of Horn Island in 100 to 150 feet of water (approximate coordinates are 29°35'N Latitude and 88°33'W Longitude).

This location would permit establishment of a large, high profile reef. Such a structure would offer both bottom and mid-water habitats and increases the potential number of species that can utilize the reef.

Site specific locations in Mississippi Sound have not been selected as part of this study. Surveys of specific locations to investigate existing substrate and communities would be necessary before any such recommendations could be made and were not within the scope of this project.

It was suggested at the regional meeting in Biloxi that oyster shells be used to expand existing reefs or create new oyster reefs in the Sound. This could enhance fishing opportunities as well as providing as substrate suitable for expanded oyster production.

SITING PLANS FOR THE ESTABLISHMENT OF ARTIFICIAL REEFS IN THE GULF OF MEXICO: A COOKBOOK PROCEDURE

[Alabama]

by

Semoon Chang, Director
Center for Business and Economic Research
University of South Alabama
Mobile, Alabama 36688

July 1, 1986

Siting Plans for the Establishment of Artificial Reefs in the Gulf of Mexico: A Cookbook Procedure

Introduction

This report summarizes a cookbook procedure of making decisions as to whether a population center should attempt to have an artificial reef established in its waters. All technical arguments and presentations are deleted.

Step 1: Identify the population center.

A given community that considers establishing an artificial reef is the population center. If fishing waters are shared by another adjacent community, this neighboring community should also be included in the population center. Population centers are selected usually on the basis of social and demographic data.

Step 2: Develop an exclusion map.

An exclusion map should identify areas where artificial reefs may not be placed. These areas include shipping lanes, offshore ports, biologically sensitive areas, marine sanctuaries, military areas, and areas of particular shipping interests. An exclusion map shows areas that are most suitable for establishing artificial reefs in waters of the particular population center.

Step 3: Clarify the requirements and procedures of obtaining the permit to establish an artificial reef.

Early in the process, the population center may clarify the requirements and procedures of obtaining the permit to establish an artificial reef. This step is intended to make sure that no problems arise from the permit procedure after the decision is made to establish an artificial reef in the waters of the population center. This step requires personal interviews or telephone conversation with those who issue the permit.

Step 4: Obtain the numbers of commercial and recreational fishermen for the population center.

These numbers are necessary in estimating potential benefits from use of the artificial reef under consideration. The local fishermen's association, the U.S. Coast Guard, or a state office that issues fishing licenses may be able to provide information on these numbers. It is almost impossible to obtain accurate numbers of commercial and recreational fishermen. Since these numbers are the basis for the subsequent calculation, it is important to come up with reasonably accurate numbers. Saltwater divers should be counted as recreational fishermen.

Estimates by fishermen in the Mobile area indicate that there are approximately 1,874 commercial fishermen and 16,680 recreational fishermen in the area.

Step 5: Estimate the dollar value of additional fish catch.

The dollar value is the sum of retail prices of different species of fish that both commercial and recreational fishermen are expected to catch off the artificial reef under consideration. Opinions of local fishermen and local marine biologists would be the source of this estimation. Since the fish catch off an artificial reef may vary with the type of the artificial reef, it may be necessary to presuppose the type of artificial reef the population may plan to have established.

Step 6: Obtain the numbers of resident and tourist recreational fishermen in the population center.

These numbers are necessary to estimate total fishing days of recreational fishermen in the population center. Rather than undertaking costly studies, it is suggested that fishing communities use the results of the 5-year interval national survey on fishing, hunting, and wildlife-associated recreation.

The 1980 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation was published in 1982 by the U. S. Department of the Interior and the U. S. Department of Commerce. The 1985 survey may be made available in 1987.

The survey indicates the ratios of resident recreational fishermen and tourist recreational fishermen relative to an area's residence recreational fishermen. Residence fishermen refer to fishermen who live in the population center. Resident fishermen refer to residence fishermen who fish in waters of the population center. If a residence fisherman fishes in areas other than the population center, the residence fisherman is not a resident fisherman. Tourist fishermen refer to out-of-town fishermen who came to the population center for fishing. Since the ratios presented in the survey are different from one state to another, the method of obtaining resident and tourist fishermen is presented only for Alabama. We already know the number of residence recreational fishermen and our assignment is to obtain the number of resident recreational fishermen and the number of tourist recreational fishermen on the basis of the number of residence recreational fishermen.

Population Centers in Alabama

[A] [PC's residence recreational fishermen]

Multiplied by x 0.9622

Equals [Resident recreational fishermen]

[B] [Resident recreational fishermen]

Multiplied by x 0.3000

Equals [Tourist recreational fishermen]

Note that the number of tourist recreational fishermen may also be obtained by multiplying the PC's residence recreational fishermen by 0.2887 (which equals 0.9622 x 0.3000).

Step 7: Estimate the total annual fishing days of the population center's recreational fishermen.

The total annual fishing days of the population center are obtained by adding the total annual fishing days of the resident recreational fishermen and the total annual fishing days of the tourist fishermen. The total annual fishing days of recreational and tourist fishermen for the northwest Florida are available in "The Economic Impact and Valuation of Saltwater Recreational Fisheries in Florida", a 1982 study by Bell, Sorenson, and Leeworthy. The annual fishing days per resident recreational fisherman are 17.5 days, while the annual fishing days per tourist recreational fisherman are 8.1 days. Since no comparable data are available in the national survey, these findings are applied for Alabama as well as northwest Florida. The estimation of the total annual fishing days of the population center's (resident and tourist) recreational fishermen is made as follows:

[Resident recreational fishermen x 17.5]

Plus [Tourist recreational fishermen x 8.1)]

Equals [Total fishing days of recreational fishermen]

It is interesting to note that estimates by fishermen who attended the town meetings indicate that the fishing days of a typical recreational fisherman in the Mobile area are 25 days (based on 34 responses) and the fishing days of a typical out-of-town fisherman is 8.5 days (based on 29 responses) in the Mobile area. These figures exclude those for commercial fishermen.

Step 8: Estimate the total dollar value of recreational fishing.

To estimate the dollar value of recreational fishing, the total number of fishing days for recreational fishermen should be multiplied by how much each day is worth to each fisherman. Unless reliable studies are available for particular population centers that estimate the value of recreational fishing, it is suggested that population centers use the guidelines for assigning points for special recreation, developed by the Corps of Engineers. The unit-day value for saltwater recreational fishing in 1986 price is $14.73. Total dollar value of recreational fishing of the population center, therefore, is obtained as

	[Total fishing days of recreational fishermen]
Multiplied by	x $14.73
Equals	[Total dollar value of recreational fishing]

The $14.73 figure is the lowest estimate available in studies that estimated the daily value of recreational fishing. Based on estimates of fishermen who attended town meetings, however, even this figure may be an overestimation. Recreational fishermen in the Mobile area were willing to pay about $92.00 (based on 38 responses) for use of artificial reefs for the entire year.

Step 9: Estimate the value of recreational fishing for the artificial reef under consideration.

The value of recreational fishing derived in step 8 is based on the assumption that all fishing days of all recreational fishermen are spent around the artificial reef. The value, therefore, should be multiplied by the percentage of fishing days spent on fishing around the artificial reef relative to total fishing days. The population center must make the best judgment for the percentage. That is,

	[Total dollar value of recreational fishing]
Multiplied by	[Percent of fishing around artificial reef]
Equals	[Dollar value of recreational fishing around artificial reef]

The percent of fishing around artificial reefs is approximately 36 percent (based on 35 responses) in the Mobile area, according to the questionnaire survey at town meetings.

Step 10: Estimate the expenditure impact owing to the artificial reef.

The net economic development impact from expenditures by out-of-town fishermen (and additional local fishermen, if there are any) should be included in estimating the expenditure impact. Additional expenditures by only those fishermen who are attracted to the area due to the artificial reef should be considered. The annual expenditures per fisherman by state of activity are available in the 1980 national survey. These expenditure figures are adjusted to the 1986 price level. To obtain the expenditure impact, out-of-town (commercial and recreational) fishermen and local (commercial and recreational) fishermen who are newly attracted to the area due to the artificial reef under consideration need to be estimated. The procedure is described by state.

Expenditure Impact for Alabama

(A) Estimate additional out-of-town and local fishermen due to the artificial reef under consideration.

(B) Multiply (A) by $176.71.

Step 11: Estimate the total annual benefit from the artificial reef.

The total annual benefit from the artificial reef under consideration is obtained by adding the following benefit categories:

(A) the dollar value of additional fish catch from the artificial reef [Step 5]

(B) the dollar value of recreational fishing for the artificial reef [Step 9]

(C) the expenditure impact of the artificial reef [Step 10].

Step 12: Convert the total annual benefit from the artificial reef to its present value.

Since total benefit figures are recurring each year, these figures should be converted to their present values so that benefits can be compared with costs for the same price level. To simplify the computational procedure, it is assumed that the discount rate is 10 percent and the life of an artificial reef is 25 years. The present value of the total annual benefit, then, is obtained as follows:

	[Total annual benefit]
Multiplied by	9.077040
Equals	[Present value of benefit]

Step 13: Estimate the total cost of establishing the artificial reef.

The total cost of establishing an artificial reef consists of (a) manufacturing or dismantling cost, (b) transportation cost that may include a liability insurance on shipment of an artificial reef, and the maintenance cost including an annual liability insurance premium. The maintenance cost should be discounted to the present value since it is recurring annually. Cost estimates are made usually after potential donors of artificial reefs are identified. The total cost is obtained by adding the following cost categories:

(A) Manufacturing or dismantling cost, if this cost is assumed by the population center.

(B) Transportation cost, unless this is assumed by the donor of the artificial reef.

(C) Present value of annual maintenance cost, which is Annual maintenance cost x 9.077040.

Step 14: Identify the sources of external funding and apply for funds.

The next step is to identify the sources of external funding and apply for funds needed to establish the artificial reef. Sources include the Wallop-Breaux fund at the federal level, state and local government, and local fishermen's groups. The fact that out-of-town fishermen would be attracted to the area may be presented as a basis for requesting a subsidy from the local government. Subtract the amount that can be acquired from these sources from the remaining cost to obtain the net cost of establishing an artificial reef to the population center. That is,

	Total cost obtained in Step 13
Minus	External funds
Equals	Net cost of establishing an artificial reef

Step 15: Make the decision.

The final decision on whether or not to establish an artificial reef in a given population center is made by comparing the present value of total annual benefit obtained in Step 12 with the net cost of establishing the artificial reef obtained in Step 14. If benefits are greater than costs, the population center may establish the artificial reef. If benefits are smaller than costs, the population center may not establish the artificial reef.

C S A

Continental Shelf Associates, Inc.

BIOLOGICAL FACTORS AFFECTING
ARTIFICIAL REEF SITING OFF ALABAMA

28 FEBRUARY 1986

PREPARED FOR:

National Marine Fisheries Service
Southeast Region
9450 Koger Boulevard, Duval Building
St. Petersburg, Florida 33702

PREPARED BY:

Continental Shelf Associates, Inc.
759 Parkway Street
Jupiter, Florida 33477
Telephone: (305) 746-7946

"Applied Science and Technology"

ABSTRACT

Available information concerning biological parameters that affect the success of an artificial reef was collected and reviewed. Sites off Alabama were identified as biologically optimal potential artificial reef sites. Shallow water and deepwater sites were selected and the advantages and disadvantages of each potential site were discussed. Biological parameters identified as important in artificial reef siting include substrate, benthic productivity, oceanographic and water quality conditions, reef structure, and the biology of target species. Shallow water sites were identified to be best suited for low-relief structures that would attract primarily demersal coastal species. Deepwater structures were identified to be best suited for high-profile structures that would attract pelagic as well as demersal species. There is a lack of information concerning the biological parameters important to artificial reef siting. Monitoring of all new artificial reefs is strongly recommended as a source of additional information to optimize future artificial reefs. Government policy makers should investigate the possibility of using artificial reefs as a form of mitigation or fine payment.

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EXECUTIVE SUMMARY

Available information concerning the biology of artificial reefs and potential artificial reef habitats off Alabama was collected and reviewed. Numerous parameters were identified to be biologically important to the success of an artificial reef, including the productivity of the existing biota at a reef site, substrate type, oceanographic and water quality parameters, shape and profile of the structure, and the life history of target species. Although other parameters such as seasonality and reef size, structure, texture, and complexity are biologically important, they are probably less important to the success of an artificial reef than the previously described parameters.

Shallow water and deepwater sites were selected on the continental shelf off Alabama. The shallow water sites are probably best suited for relatively low-relief structures such as concrete rubble or Liberty Ships. Due to their relative distance from shore, it is expected that the reefs would attract a significant number of estuarine-dependent species such as seatrouts, croakers, and drums. All of the species are commercially and recreationally important. Due to the relative closeness of the shallow water reef site off Florida to the edge of the continental shelf, it is likely that some of the more deepwater species such as snappers and groupers will also occupy the reef.

The deepwater sites are well suited for both high-relief and low-relief structures. High-relief structures offer potential habitat for a significantly larger number of species than low-relief structures. It is likely that many coastal and oceanic pelagic species will be attracted to a high-profile artificial reef that offers some type of mid-water structure. Species such as mackerels, cobia, bluefish, tunas, and billfishes which are recreationally and/or commercially important are likely to be attracted to such a structure. The lower portion of the structure would be similiar to a low-relief type artificial reef and would probably attract demersal fishes. Species such as snappers, groupers, and sea basses which are commercially and recreationally important would likely be attracted to the reef due to its location in deep water and close proximity to the shelf edge.

Researchers are just beginning to investigate the biological factors that are important to consider when siting and constructing an artificial reef. It is recommended that site-specific data for numerous parameters such as substrate type and existing biota be investigated before final placement of an artificial reef. General information concerning the life histories of many commercially and recreationally important species is lacking and would be useful for artificial reef siting. Monitoring of biological and physical parameters should be conducted on any new artificial reef structure whenever possible.

Information concerning the biological parameters that affect artificial reefs is limited. Most of the data collected have been the result of funding from local, State, and Federal governments and from private industries that have economic interests in artificial reefs. Future funding for artificial reef research and monitoring will probably continue to originate primarily from these same groups. Additional potential funding may originate by using artificial reefs in mitigation or by committing the payment of fines to artificial reef endeavors.

1.0 INTRODUCTION

The use of artificial reefs as a habitat enhancement tool to expand recreational and commercial fishing opportunities has gained tremendous popularity during recent years. Many artificial reefs have been implemented by well intentioned and highly motivated persons who, unfortunately, constructed and sited their reefs with little or no scientific data (Bohnsack and Sutherland, 1985). Political persuasions, costs, available materials, and waste disposal have often been the major considerations for constructing and siting artificial reefs. Subsequently, numerous artificial reef efforts have been total failures resulting in a loss of money, labor, and occasionally already existing habitats (Stevens, 1963; Mathews, 1981). While the aforementioned considerations may continue to play a significant role in the construction and siting of artificial reefs, additional data (i.e., biological, operational, social, economical, and legal) and comprehensive plans are clearly necessary to fully profit from the many potential benefits offered by successful artificial reefs.

Biological considerations are of major importance for constructing and siting artificial reefs. Many parameters such as water depth and quality, reef profile and size, reef complexity, and spatial arrangement and orientation are important for optimizing the biological success of artificial reefs. All of these parameters must be considered along with specific habitat and environmental requirements of desired target species. Additionally, artificial reefs should be constructed and sited with fishery management goals and regulations in mind.

The purpose of this report is to review and evaluate the existing literature and data base concerning the biological parameters to be considered when constructing and siting artificial reefs. Using this existing information, biologically optimum locations will be selected for siting artificial reefs off Alabama.

It should be pointed out that this is one aspect of a multidisciplinary effort to select sites. Therefore, while operational, social, economic, and legal constraints influence successful artificial reef development, no attempt was made (except in a very general way) to incorporate these other issues into the present analysis. Hence, potential sites are recommended primarily on the basis of biological factors. Biological, operational, social,

economic, and legal constraints must be evaluated in concert before final selections are made.

2.0 METHODS

The primary tasks conducted to achieve the objectives of this project involved collection and review of existing literature and data concerning the biological factors involved in constructing and siting artificial reefs. Data collection was accomplished by several different methods including: (1) computerized literature search and review; (2) review of in-house literature; (3) personal communications with researchers and persons involved with artificial reef projects; (4) input from the Advisory Group--a group of artificial reef knowledgeable persons selected to review and advise on the direction and nature of the project and products; (5) acquisition of information and advice compiled by persons at the Sport Fishing Institute's (SFI's) Artificial Reef Development Center; and (6) acquisition of information available from various State and Federal agencies.

A computerized literature search of numerous data bases from the DIALOG Information Retrieval Service was conducted using the key words "artificial reef." The search was conducted at Mississippi State University by Drs. Arthur Cosby and Bill Howard. Table 2.1 presents a list of data bases searched and the number of citations identified in each. A hard copy print-out of the citations was obtained and reviewed for pertinent literature. Copies of all pertinent literature were obtained and reviewed to identify additional information. An attempt was made to collect all pertinent information identified from the computer search and literature review.

Many in-house documents, including a significant amount of gray literature, were reviewed for pertinent information and additional references. Continental Shelf Associates, Inc. has a continuously expanding file concerning artificial reefs which provided a significant amount of information relevant to this study.

A number of persons at various universities, organizations, and private companies having experience with the construction and siting of artificial reefs were contacted for information. This information often assisted in identifying potential problems and solutions associated with implementing an artificial reef.

Numerous members of the Advisory Group provided valuable suggestions concerning literature and information sources to review and

TABLE 2.1. SUMMARY OF THE COMPUTER LITERATURE SEARCH OF VARIOUS DATA BASES FROM THE DIALOG INFORMATION RETRIEVAL SERVICE USING THE KEY WORDS "ARTIFICIAL REEF."

Data Bases Searched	Years	Citations
NTIS	1964-85	80
Dissertation Abstracts	1861 - Jan 1985	7
Sociological Abstracts	1963-84	0
PTS Defense Markets and Technology	1982-84	33
Conference Papers Index	1973 - Sep 1984	7
Federal Research in Progress	Sep 1984	1
Federal Research in Progress	(unabridged) Sep 1984	2
BIOSIS Previews	1981-85	31
BIOSIS Previews	1977-80	15
BIOSIS Previews	1969-76	17
COMPENDEX	1970 - Nov 1984	20
Oceanic Abstracts	1964 - Oct 1984	148
ENVIROLINE	1970 - Nov 1984	47
Aquatic Science Abstracts	1978 - Sep 1984	178
Environmental Bibliography	1974 - Oct 1984	8
Aquaculture	1970 - Jan 1984	0
Water Resources Abstracts	1968 - Nov 1984	28
	Total	622

offered the results of personal investigations. These individuals were also helpful by providing the views of various interest groups with whom they are associated.

The SFI in Washington, D.C. provided numerous publications concerning the design and siting of an artificial reef and exclusion maps for the specific areas of this study. Individuals at the SFI also helped by providing information that was requested for the study.

Individuals at various State and Federal agencies provided literature and/or information upon request. Many individuals associated with previous or ongoing artificial reef projects were most helpful in making recommendations for this project.

All of the compiled information was reviewed and a report synthesized in an attempt to identify the biologically optimum artificial reef sites off Alabama.

3.0 LITERATURE REVIEW

The existing literature concerning biological parameters involved in siting a successful artificial reef can be classified into two general categories: (1) descriptive studies that provide biological and ecological observations made on artificial reefs; and (2) experimental studies designed to test and identify factors controlling recruitment, succession, fish attracting properties, and productivity of artificial reefs. Very few of these studies were conducted off Alabama, however, much of the information is useful and can be applied to these specific study areas.

Bohnsack and Sutherland (1985) examined the artificial reef literature available through 1983. The report reviews the biology and ecology of artificial reefs and makes recommendations for future studies based on data gaps identified from the literature. The following discussions concerning the biological factors affecting artificial reef siting include summaries of information presented by Bohnsack and Sutherland (1985) and incorporate pertinent information made available after 1983.

Studies have shown that fishes use artificial reefs for feeding areas, shelter, spawning, orientation, and development (Klima and Wickham, 1971; Parker et al., 1979; Stone et al., 1979; Kakimoto, 1982). The parameters that attract fishes to artificial reefs have been extensively studied, but are not well understood. Studies attempting to determine the relative role of each parameter in attracting fishes to artificial reefs have been inconclusive and sometimes contradictory (Shinn, 1974; Russell, 1975; Prince and Gotshell, 1976; Prince et al., 1979; Hueckel and Slayton, 1982; Bohnsack and Sutherland, 1985). Although further research may prove otherwise, it seems that the parameters that are important in attracting fishes to artificial reefs are species-specific, and for most species, there is a combination of parameters which attract fishes to artificial reefs.

Studies have shown that several factors are biologically important for attracting fishes to artificial reefs and can be controlled to optimize the success of an artificial reef. These factors include substrate, oceanographic conditions, water quality parameters, productivity of surrounding water and substrate, proximity to other reefs/live-bottom areas, and vertical profile and relief. Although each

of these factors should be considered with respect to the desired target species, very few data are available concerning how these factors influence the recruitment of a particular species to an artificial reef.

The substrate on which an artificial reef is planned is critical to the success of a reef. Whenever possible, it is good practice to place a reef on a bottom where there is known to be underlying rock or hard pan. This will prevent the reef material from sinking into the substrate, and current action around the reef may scour the bottom and make additional reef habitat by exposing the rock (Mathews, 1981). Firm sand or sand/shell bottoms are the best substrate types to support a reef (Mathews, 1981). Substrate types that should be avoided are soft sediments, primarily comprised of clay or silt particles.

Oceanographic conditions should be considered when siting an artificial reef. Areas of upwelling, downwelling, ascending currents, and vortex currents have been suggested as good locations for artificial reef sites (Nakamura, 1982). Artificial reefs should be placed along the front line of internal waves and perpendicular to prevailing currents. Areas with strong tidal currents should be avoided (Mathews, 1981).

Water quality parameters such as temperature, turbidity, and anthropogenic pollutants should be considered when siting an artificial reef (Hueckel and Buckley, 1982; Sanders et al., 1985). Tolerances of desired target species to these parameters should be determined before siting an artificial reef. By comparing the water quality of areas with existing desirable fish populations to potential artificial reef sites, one can gain insight into the suitability of a potential site for colonization by desired species. A potential artificial reef site should be free from pollutants that may be biomagnified and potentially cause serious health problems for persons that eat the catch from the area.

Productivity of the water and benthic environments surrounding an artificial reef will affect artificial reef success (Randall, 1963; Russell, 1975; Hirose et al., 1977; Prince et al., 1979; Hueckel and Buckley, 1982; Steimle and Ogren, 1982). Considerable work is needed to fully understand the trophic pathways of artificial reef communities and the importance of productivity to the success of an artificial reef.

The effect of distance of an artificial reef site from a natural live-bottom area on the relative success of the artificial reef has been studied by numerous investigators. The results of these studies are

sometimes contradictory. Fast and Pagan (1974) observed that when an artificial reef was placed near a natural reef, fishes moved from the natural reef to the artificial reef, but not conversely. More recently, Matthews (1985) found that adult and subadult fishes moved from natural to artificial reefs up to a distance of 1.6 km. The author suggested that artificial reefs may increase fishing pressure that may be detrimental to the local fish population. Other investigators (Dewees and Gotshell, 1974; Stone et al., 1979) reported that artificial reefs in the immediate vicinity of live-bottom areas did not affect the fish community on the natural reef. Yoshimuda and Masuzawa (1982) suggested that artificial reefs should be placed at least 600 m (1,970 ft) from natural reefs so that each reef would not influence the other. Generally, it has been concluded that artificial reefs should be sited on barren sand bottoms where no existing live-bottom communities exist (Mathews, 1981; USDC, NMFS, 1985). It is better to add an additional productive habitat where one does not exist, rather than to make small improvements to an already productive live-bottom area.

Vertical profile and amount of relief offered by an artificial reef should be considered with respect to the target species. Study results concerning these factors are conflicting (Miyazaki and Sawada, 1978; Mottet, 1982; Grove and Sonu, 1983). Generally, it has been found that tall artificial reefs forming mid-water structures are best for attracting migratory pelagic species (i.e., mackerels, bluefish, and tunas). Low-relief structures with more horizontal structure on the seafloor are most suited for attracting demersal fishes (i.e., snappers, groupers, and sea basses) (Klima and Wickham, 1971; Matsumoto et al., 1981; Grove and Sonu, 1983). Other studies have shown that the shape of the reef may be more important than the height (Nakamura, 1982; Grove and Sonu, 1983). An artificial reef will best attract fishes if the sides are nearly vertical to increase turbulence and produce stagnation zones and lee waves.

Another biological factor that may affect artificial reef success may be the seasonality of spawning of target species. Many studies concerning the recruitment and succession of fishes on new artificial reefs indicate that juvenile fishes are often the first to inhabit an artificial reef and are often present in large numbers (Randall, 1963; Russell et al., 1974; Stone et al., 1979; Gascon and Miller, 1981; Walsh, 1985). Although there is little information to show that juveniles associated with artificial reefs survive and grow to adults, it seems that an artificial reef provides additional habitat for juvenile fishes

that may not normally survive. Placement of an artificial reef during the peak influx of juveniles of target species may significantly increase the number of juveniles that develop and mature (Carter et al., 1985). Considerably more research is needed to correlate the juveniles of a species settling on an artificial reef with peaks in spawning and larval availability.

The success of artificial reefs relative to natural reefs has been studied by numerous investigators (Randall, 1963; Buchanan, 1973, 1974; Russell, 1975; Molles, 1978; Smith et al., 1979; Gascon and Miller, 1981; Burchmore et al., 1985; Jessee et al., 1985). Generally, it has been found that the community structure of fishes colonizing an artificial reef is similar to the fish communities occupying nearby natural reefs. Although there are some conflicting reports, it seems that fish abundances on artificial reefs generally exceed those of nearby natural reefs. This is probably due to the greater complexity of artificial reefs compared to natural reefs, however, many factors are not well understood.

Whether artificial reefs actually increase fish productivity or simply aggregate existing individuals is not known (Mottet, 1982; Kuwatani, 1982; Grove and Sonu, 1983). Some investigators concluded that artificial reefs increase fish availability but not net productivity, while others suggest that artificial reefs allow secondary biomass production through increased survival and growth of new individuals due to the shelter and food resources provided by the reef (Manges, 1960; Beguery, 1974; Bohnsack and Sutherland, 1985). Considerable research is necessary before the productivity of fishes on artificial reefs is understood.

A review of existing information concerning artificial reefs has indicated that considerably more research is necessary to better understand the biological parameters that affect artificial reefs. Additionally, very little information is available from studies conducted offshore Alabama.

4.0 ARTIFICIAL REEF SITE SELECTION

4.1 ALABAMA

4.1.1 Characterization of Potential Artificial Reef Environments

The coastline of Alabama has approximately 42 mi (63 km) of barrier islands bordered on the north by Mobile Bay, Mississippi Sound, and Perdido Bay, and on the south by the Gulf of Mexico. Similar to coastal Mississippi, the estuaries provide food, shelter, and nursery and spawning areas for many commercially and recreationally important species. Inlets and passes in the barrier islands provide an important link between the estuarine and oceanic habitats. As previously discussed for Mississippi, only the area seaward of the barrier islands will be considered as potential artificial reef sites.

The coastal waters off Alabama are very similar to the coastal waters off Mississippi. Salinity and temperature of the nearshore waters overlying the continental shelf are seasonally variable (TerEco Corporation, 1979). During spring, large quantities of freshwater flow into the coastal waters, reducing the salinity to approximately 20 ppt in nearshore surface waters. During spring, steep salinity gradients often occur nearshore and offshore coastal waters still approximate salinities of 35 ppt. During winter, salinities are less affected by freshwater influx and coastal waters off Alabama generally have a salinity ranging from 30 to 36 ppt (TerEco Corporation, 1979). Bottom salinities are less affected by the seasonal influx of freshwater.

Water temperatures generally range from approximately 54 to 86°F (12 to 30°C) (Franks et al., 1972). Seasonal fluctuations are observed, as expected, with surface water temperatures approximating air temperatures and bottom waters remaining relatively stable. Both salinity and temperature are drastically affected when the Loop Current impinges onto the shelf (TerEco Corporation, 1979).

Water circulation on the continental shelf off Alabama is probably controlled by the same parameters that control the circulation along the entire north-central Gulf coast (TerEco Corporation, 1979). Generally, currents and circulation are controlled by prevailing winds, however, other factors such as the Loop Current, tides, and freshwater discharges can affect circulation on the shelf (see Section 4.1).

Sediments on the continental shelf off Alabama are primarily sand (SUSIO, 1977; TerEco Corporation, 1979), so the entire shelf is probably suitable for an artificial reef site. Figure 4.1 shows the sediments occurring off Alabama. The substrate of the outer edge of the shelf and slope in water depths over 200 ft (61 m) becomes finer, comprised mostly of silt and clay and is probably less suited for an artificial reef site. As a rule, sediments become sandier and coarser the farther to the east, away from the Mississippi River Delta (TerEco Corporation, 1979).

Benthic communities on the continental shelf off Alabama have been characterized and summarized in several studies (Defenbaugh, 1976; SUSIO, 1977; TerEco Corporation, 1979). The benthos in water depths outside the barrier islands to approximately 72 ft (22 m) is characterized as the Inner Shelf Assemblage. This assemblage occurs in both fine and coarse bottom habitats. Table 4.1 presents a list of species characteristic of the Inner Shelf Assemblage. From 72 to 240 ft (22 to 73 m), the benthos is described as the Intermediate Shelf Assemblage and inhabits both fine and coarse bottom sediments. Table 4.2 presents a list of species characteristic of the Intermediate Shelf Assemblage. Benthos characteristic of natural and artificial hard substrates off Alabama are presented in Table 4.3.

The fishes occurring off Alabama are similar to those occurring off coastal Mississippi. Fishes off Alabama are primarily temperate species with occurrences of tropical species generally in deeper waters. Numerous species occur primarily in particular habitats or bottom types. Sciaenids (croakers, seatrouts, and drums) and sparids are the numerically dominant species occurring in shallow mud bottom areas. Many of these species are estuarine dependent euryhaline species that occur in estuarine and relatively shallow offshore waters during some stage of their lives. Offshore in deeper water, serranids (groupers) and lutjanids (snappers) predominate, typically in association with natural or man-made irregular bottoms. Often associated with these deeper offshore reef areas are numerous tropical species such as damselfishes and butterflyfishes. In addition to these resident demersal fishes, numerous coastal pelagic and oceanic species occur on the continental shelf seasonally. These species include mackerels, cobia, bluefish, tunas, and other billfishes that typically occur in waters overlying the middle and outer shelves and comprise an important part of the recreational and commercial fisheries.

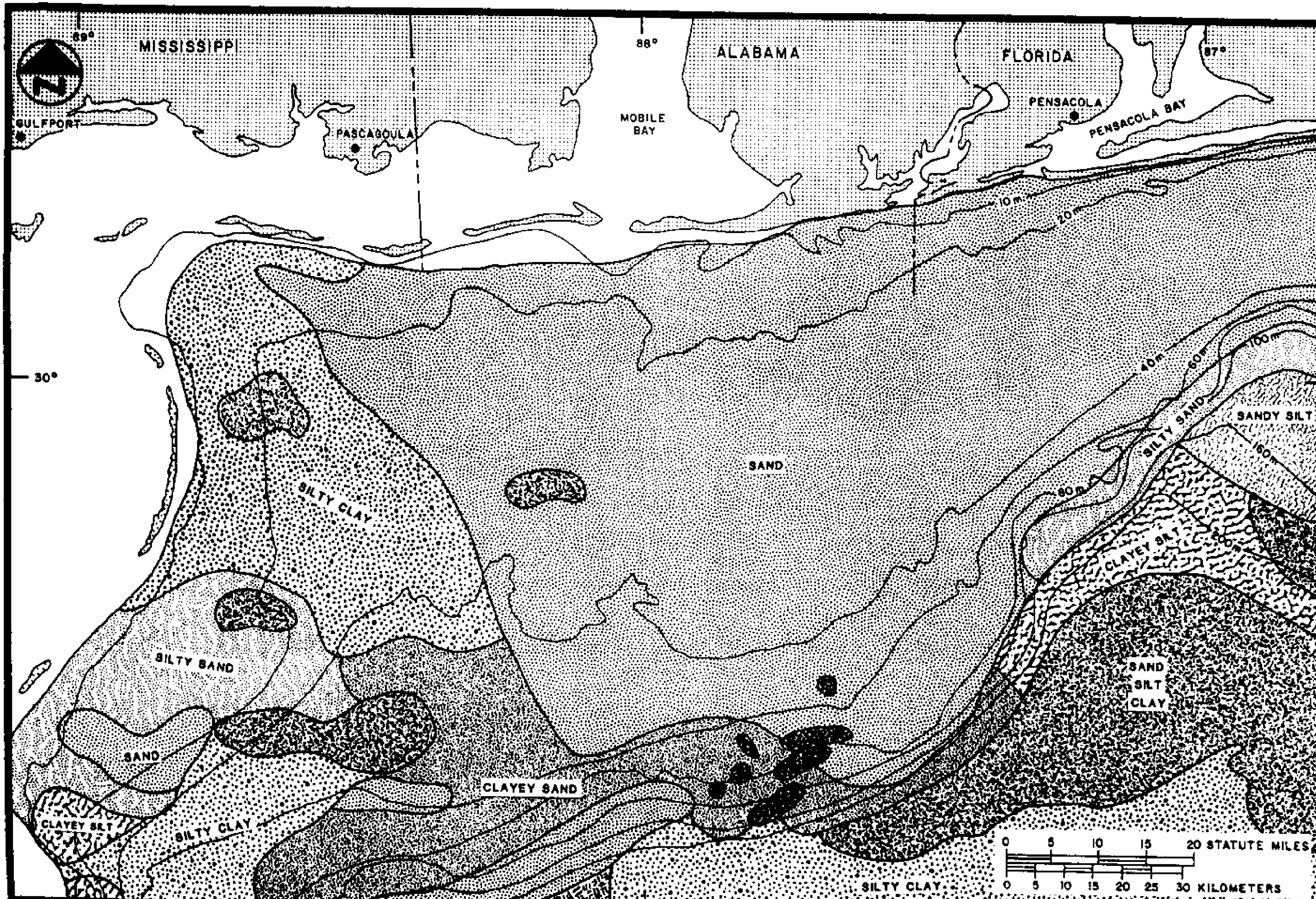

FIGURE 4.1. BATHYMETRIC CONTOURS AND SEDIMENT TYPES OFF MISSISSIPPI, ALABAMA, AND THE FLORIDA PANHANDLE (FROM: BROOKS, 1973).

TABLE 4.1. BENTHIC SPECIES CHARACTERISTIC OF THE INNER SHELF ASSEMBLAGE (FROM: TERECO CORPORATION, 1979).

Gastropoda	
Architectonica nobilis	Common sundial
Busycon spiratum	Pear whelk
Nassarius acutus	Sharp-knobbed nassa
Olivella mutica	Variable dwarf olive
Phalium granulatum	Scotch bonnet
Polinices duplicatus	Sand-collar snail
Terebra dislocata	Common Atlantic auger
Pelecypoda	
Abra aequoris	
Abra lioica	
Anadara brasiliana	
Atrina serrata	Saw-toothed sea pen
Corbula swiftiana	Swift's basket shell
Dinocardim robustum	Great heart cockle
Dosinia discus	Disk shell
Nuculana acuta	Pointed nut clam
Echinodermata	
Luidia clathrata	Starfish
Ophiolepis elegans	Brittle star
Mellita quinquiesperforata	Sea urchin

TABLE 4.2. BENTHIC SPECIES CHARACTERISTIC OF THE INTERMEDIATE SHELF ASSEMBLAGE (FROM: TERECO CORPORATION, 1979).

Gastropoda	
Busycon contrarium	Lightning whelk
Conus austini	Austin's cone
Distorsio clathrata	Atlantic distorsio
Fasciolaria lilium	Banded tulip
Murex fulvescens	Giant eastern murex
Strombus alatus	Florida fighting conch
Tonna galea	Tun
Pelecypoda	
Amusium papyraceum	Paper scallop
Argopecten gibbus	Calico scallop
Tellina nitens	Tellin
Tellina squamifera	Eastern crenulate tellin
Echinodermata	
Astropecten duplicatus	Starfish
Clypeaster ravenelii	Starfish
Echinaster modestus	Starfish
Luidia alternata	Starfish

TABLE 4.3. BENTHIC SPECIES CHARACTERISTIC OF NATURAL AND ARTIFICIAL HARD SUBSTRATES (FROM: TERECO CORPORATION, 1979).

Porifera	
Leucosolenia sp.	Sponge
Cnidaria	
Clytia fragilis	Hydroid
Obelia hyalina	Hydroid
Aiptasia sp.	Sea anemone
Ectoprocta	
Crisia spp.	Bryozoan
Membranipora spp.	Bryozoan
Crustacea	
Balanus venustus	Acorn barnacle
Balanus calidus	Acorn barnacle
Caprella equilibra	Skeleton shrimp
Ericthonius brasiliensis	Sand hopper
Mithrax sp.	Spider crab
Gastropoda	
Anachis iontha	Dove shell
Thais floridana	Florida rock shell
Pelecypoda	
Anomia simplex	Jingle shell
Argopecten gibbus	Calico scallop

Many fishes also spawn and utilize the continental shelf waters as nursery areas. TerEco Corporation (1979) presented a list of commercially and recreationally important species in the north-central Gulf of Mexico and their respective spawning and nursery areas. Much of this information is based on studies conducted in other areas, however, the data are probably pertinent to the Alabama coastal area. Table 4.4 presents a list of important species and their respective spawning areas and seasons.

4.1.2 Identification of Sites Selected for Artificial Reef Placement off Alabama

Two sites have been selected for potential artificial reef placement off Alabama, one in shallow water and one in deep water. Figure 4.2 shows the location of the potential artificial reef sites selected off Alabama. Each site has distinct advantages and disadvantages that were taken into account before the sites were selected.

The shallow water site is in approximately 80 to 100 ft (24 to 30 m) of water southeast of the main fairway into Mobile Bay. The site is 12 mi (19 km) from the nearest barrier island and 20 mi (32 km) from the entrance to Mobile Bay. Coordinates of the center of the site are approximately 29°58'N Lat and 87°40'W Long. The site is near an area where numerous fish havens have been placed by the Alabama Department of Natural Resources. It is recommended that the reef be placed away from any existing reefs [at least 1,969 ft (600 m)]. Probably a low-relief structure is most suited to the site due to the relatively shallow water depths. The substrate present should be sand; however, it is suggested that site-specific substrate sampling be conducted before the final placement of the reef is made. The location should be suitable for numerous estuarine-dependent species (e.g., sciaenids) and also for other commercially and recreationally important species (e.g., lutjanids). Information obtained during meetings with local fishermen in Alabama indicated that those are both commercially and recreationally valued species. The productivity of the surrounding bottom with respect to potential food sources should also be investigated before final placement of the reef. Due to the number of existing and successful artificial reefs in the general vicinity, it is likely that the conditions are acceptable for a successful reef; however, a site-specific survey is recommended before the reef is placed on location.

TABLE 4.4. SPAWNING AREAS AND SEASONS OF COMMERCIALLY AND RECREATIONALLY IMPORTANT SPECIES IN THE NORTH-CENTRAL GULF OF MEXICO (ADAPTED FROM: TERECO CORPORATION, 1979).

Species	Season
Species which breed in inlets and nearby waters:	
Centropristis philadelphica, Rock sea bass	spring
Cynoscion nebulosus, Spotted seatrout	spring
Pogonians cromis, Black drum	spring
Sciaenops ocellata, Red drum	summer
Species which breed on the inner continental shelf:	
Archosargus probatacephalus, Sheepshead	spring
Balistes capriscus, Gray triggerfish	summer
Centropristis striata, Black sea bass	spring
Elops saurus, Ladyfish	fall
Epinephelus morio, Red grouper	spring
Haemulon plumieri, White grunt	summer
Lagodon rhombiodes, Pinfish	winter
Leiostomus xanthurus, Spot	winter
Lutjanus campechanus, Red snapper	summer
Lutjanus griseus, Gray snapper	summer/spring
Menticirrhus americanus, Southern kingfish	summer/spring
Menticirrhus littoralis, Gulf kingfish	summer/spring
Menticirrhus saxatilis, Northern kingfish	spring
Micropogon undulatus, Atlantic croaker	winter
Opisthonema oglinum, Atlantic thread herring	summer
Pagrus pagrus, Red porgy	spring
Peprilus burti, Gulf butterfish	winter/spring
Peprilus paru, Harvestfish	summer/spring
Sardinella anchovia, Spanish sardine	summer
Scomberomorus cavalla, King mackerel	summer
Scomberomorus maculatus, Spanish mackerel	summer
Species which breed on the outer continental shelf:	
Auxis thazard, Frigate mackerel	spring
Brevoortia patronus, Gulf menhaden	winter
Caranx crysos, Blue runner	spring
Coryphaena hippurus, Dolphin	spring
Epinephelus morio, Red grouper	spring
Etrumeus teres, Round herring	spring/winter
Euthynnus alletteratus, Little tunny	summer
Istiophorus platypterus, Sailfish	summer
Katswonus pelamis, Skipjack tuna	summer
Leiostomus xanthurus, Spot	fall

TABLE 4.4. (CONTINUED).

Species	Season
Mugil cephalus, Striped mullet	winter
Mugil curema, White mullet	winter
Peprilus burti, Gulf butterfish	winter/spring
Peprilus paru, Harvestfish	summer/spring
Pomatomus saltatrix, Bluefish	summer/spring
Scomber japonicus, Chub mackerel	spring/winter
Scomberomorus cavalla, King mackerel	summer
Rachycentron canadum, Cobia	summer
Trachinotus carolinus, Florida pompano	spring/summer
Trachinotus falcatus, Permit	winter/summer/ spring
Xiphias gladius, Swordfish	spring/summer

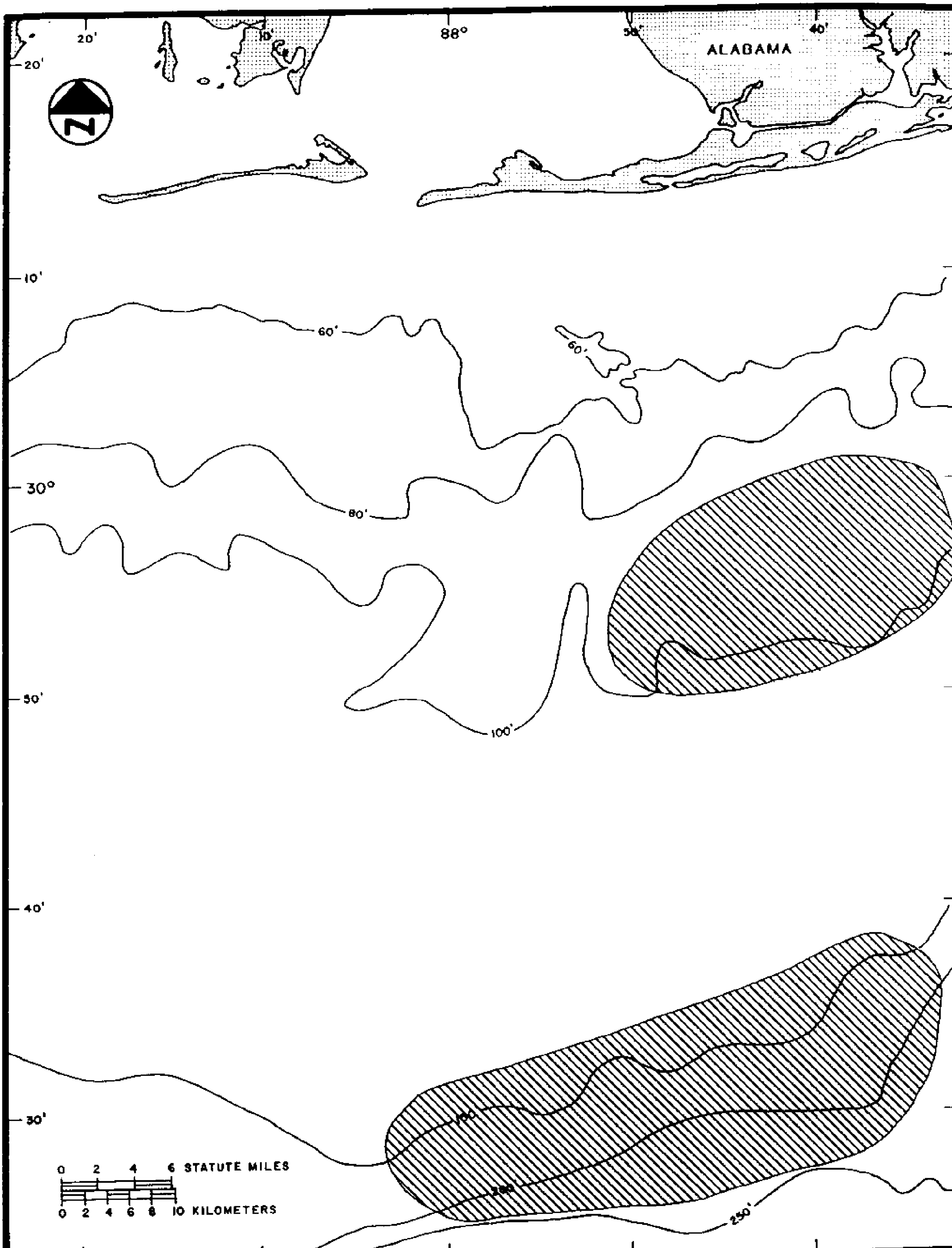

FIGURE 4.2. POTENTIAL ARTIFICIAL REEF SITES OFF ALABAMA.

The deepwater location is in approximately 150 to 250 ft (46 m to 76 m) of water approximately 43 mi (80 km) south-southeast of the main entrance to Mobile Bay (Figure 4.2). Coordinates of the center of the site are approximately 29°33'N Lat and 87°38'W Long. This site is well suited for the placement of an artificial reef that has a significant amount of vertical relief, such as an offshore petroleum platform. The substrate is reported as sand; however, a site-specific survey is recommended before reef placement. The site is located on the outer edge of the continental shelf off Florida bordering the De Soto Canyon. Placing an artificial reef with a significant amount of vertical relief offshore in deep water has several advantages. The nature of a structure providing both bottom structure and complexity provides habitat for the commercially and recreationally important species that are known to occur around irregular bottom (e.g., lutjanids and serranids). Secondly, the mid-water structure will serve as an attractant to large pelagic species such as tunas and billfishes. Local fishermen indicated that they will bottom fish for demersal species as well as troll for larger pelagic species when travelling this distance offshore. The specific site was selected at the shallow (landward) side of a relatively steep topographic slope where upwelling may occur. Large oceanic species sought by both commercial and recreational fishermen often occur in areas of upwelled waters. Pristas (1981), in a survey of big game fishing in the northern Gulf of Mexico, found this area had a relatively high number of billfishes raised during 1981. Placing an artificial reef structure nearby that offers mid-water structure is likely to make this area more attractive to large pelagic species as well as to demersal species.

Caution must be taken if a reef were to be sited along this shelf edge habitat to ensure that the reef was not placed on an existing hard-bottom area. Numerous rock outcroppings exists along the shelf edge and the specific site selected should be checked to ensure that the location is free from existing live bottom or outcroppings.

5.0 DISCUSSIONS AND CONCLUSIONS

5.1 FUTURE BIOLOGICAL CONSIDERATIONS

The coastal waters overlying the continental shelf off Alabama provide habitat for important commercial and recreational fishery resources. Proper implementation of artificial reef programs could greatly enhance the fishery resources available to all three States.

Biological data were reviewed prior to selecting the potential artificial reef sites. Very little site-specific information was available. It is recommended that further biological and environmental parameters be investigated at each site prior to the final placement of an artificial reef.

Following the review of the literature concerning the biological parameters that affect artificial reefs, it became apparent that there is a general lack of data concerning many of these parameters as related to specific species and geographic areas. Biological monitoring is strongly recommended before and after the placement of any artificial reef structure. Monitoring should include measurements and observations including substrate type, productivity, oceanographic and water quality conditions, species present, their life histories, and their utilization of the reef. Collection of this information will increase the relative cost of an artificial reef program, however, the increase in knowledge can significantly contribute to increasing the successfulness of future artificial reef programs.

Following the regional meetings with local fishermen it became apparent that most recreational fishermen will fish for nearly any species that they think it will be possible to catch. Although a majority prefer to fish for species that are edible, most recreational fishermen set off on a fishing trip planning to catch whatever they can. Few have species that they do not want to catch. Due to the non-specific target species it is probably difficult to build an artificial reef that will not benefit the recreational fishermen in some manner. Commercial fishermen are limited to seeking species that have some marketable quality and are therefore more difficult to please when constructing an artificial reef. These factors must be considered when designing an artifical reef from a biological perspective.

5.2 FUTURE ARTIFICIAL REEF PROGRAMS

Artificial reefs provide an innovative way to increase the potential catch of both recreational and commercial fishermen. Although the placement of artificial reef structures to increase habitat in the marine environment is not a new idea, research concerning the factors that can optimize the beneficial effects of artificial reefs has been limited. Significantly more data are necessary to realize the full potential and effects of artificial reefs.

Commercial and recreational fishermen benefit most from the placement of successful artificial reefs. Unfortunately, fishermen generally do not have significant amounts of capital to invest in artificial reef placement and research. As a result, although numerous artificial reefs have been placed by small localized fishing groups or interests, most of the data that exist concerning the parameters involved in creating a successful artificial reef have been collected by either local, State, or Federal governments or private industry, generally with some commercial interests in the project. It seems that this trend will continue in the future.

The largest sector of private industry with perhaps the most at stake economically is the oil and gas industry because of the problem of removing obsolete offshore petroleum platforms. Legal and economic considerations will probably be foremost in determining the future of artificial reefs, especially artificial reefs from offshore petroleum platforms. The oil and gas industry has been examining these problems and working closely with the Federal Government to determine the most mutually beneficial solutions. The Federal Government is developing a National Artificial Reef Plan to provide reef construction and placement guidelines and is continuing to fund research concerning various aspects of artificial reefs. Many of the existing platforms provide valuable fishery habitats and removal may have detrimental effects on fisheries and fishermen; however, maintenance and liability problems must be solved before any platforms are left in place. Several oil companies have already taken the lead by dismantling, transporting, and placing obsolete petroleum platforms as artificial reefs offshore Alabama and Florida. Very little monitoring has been conducted to determine the successfulness of these artificial reefs to optimize the success of future endeavors. Monitoring should be conducted in the future when additional offshore petroleum platforms are placed as artificial reefs.

One suggested method for promoting artificial reef endeavors is to develop regulatory policies whereby artificial reefs can be used as a form of mitigation or perhaps fine payment. Mitigation is a relatively new concept (e.g., see Soileau et al., 1985; Alevras and Edwards, 1985; Duffy, 1985) that could be used for developing artificial reef projects by industry involved in development of environmentally sensitive areas. Artificial reef programs could serve as mitigation measures to: (1) avoid or minimize impacts on organisms and habitats; or (2) compensate for unavoidable losses of those resources. Perhaps companies that have committed some type of environmental damage could be required to fund artificial reef projects in place of fine payments. These types of programs are potential suggestions that would provide more artificial reefs and data pertinent to artificial reefs, however, legal changes would be necessary to implement such actions. Government policy makers should investigate the feasibility of such policies.

A significant amount of information is still needed to optimize artificial reefs. Artificial reef decisionmakers should adopt comprehensive plans for artificial reef development and data acquisition in the future. With proper planning and data, artificial reefs could provide a useful tool for government, private industry, fishermen, and fishery managers.

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C S A

Continental Shelf Associates, Inc.

OPERATIONAL FACTORS AFFECTING
ARTIFICIAL REEF SITING OFF ALABAMA

28 FEBRUARY 1986

PREPARED FOR:

National Marine Fisheries Service
Southeast Region
9450 Koger Boulevard, Duval Building
St. Petersburg, Florida 33702

PREPARED BY:

Continental Shelf Associates, Inc.
759 Parkway Street
Jupiter, Florida 33477
Telephone: (305) 746-7946

"Applied Science and Technology"

ABSTRACT

Operational factors that influence the siting of artificial reefs include environmental conditions at the site, availability and suitability of different reef materials, transportation and logistics requirements, deployment techniques, optimum reef design, and marking requirements. Concrete blocks and rubble, steel ships and barges, obsolete petroleum platforms, and Japanese-designed structures are the most suitable materials for artificial reefs.

Alabama has established an artificial reef zone. Current reef development is concentrated primarily in a depth zone from approximately 60 to 100 ft (18 to 30 m). The creation of new reefs or the expansion of existing sites into reef complexes is recommended in this area. Two nearshore areas to provide access for small boat fisermen and divers exiting from Dauphin Island and Perdido Bay are recommended as potential sites. Establishment of reefs in waters deeper than 100 ft (30 m) is also recommended. Obsolete, high-profile ships and oil and gas platforms should be used at the deep sites.

The shelf drops off rapidly offshore from Pensacola, Florida. Deep water and firm substrates make much of the area suitable for reef development. An area of deep water near shore and with a sandy bottom is suggested for reef siting. Japanese-designed structures and obsolete ships, barges, and petroleum platforms are suitable materials for deployment in the area.

Technology exists for the transport of reef materials to the selected sites. Barges, heavy equipment, or flotation devices will be needed, depending on the material being used. Reef construction should incorporate a high degree of complexity into the reef structure. Reefs with less than 85 ft (26 m) minimum clearance will probably need a lighted buoy to mark the location.

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EXECUTIVE SUMMARY

This study was initiated as part of a multidisciplinary effort to identify potential artificial reef sites off Alabama on the basis of legal, social, economic, biological, and operational issues. This report designates sites on the basis of operational constraints.

Operational factors that influence reef siting include environmental conditions at the site, availability and suitability of different reef materials, transportation and logistics requirements, deployment techniques, optimum reef design, and marking requirements. A computerized literature search was undertaken to identify the available literature on these topics.

Numerous types of materials have been used in the past to construct artificial reefs. Based on availability and durability, concrete blocks and rubble, steel ships and barges, obsolete petroleum platforms, and Japanese-designed structures are the most suitable materials for reef construction. Blocks created from fly ash generated by power plants that burn coal may also have applications for artificial reef use. Although tires have been used extensively in the past, their tendency to drift or break apart makes their use questionable.

Environmental conditions that affect the success of artificial reefs include waves and currents, depth, substrate type, and topography. Areas subject to high-energy waves and currents should be avoided because these conditions limit the life-span of a reef. Depth is important for maintaining minimal navigational clearance, attracting the target fish species, and minimizing the effects of storms on reefs. Firm sand substrates are preferred to minimize the loss of a reef due to sinking or siltation. Topographies that are favorable for artificial reefs include flat and featureless bottom regions, near the shoreward edges of valleys or depressions, or areas on either side of ridges.

Alabama has an artificial reef program. Most existing reefs are located in a narrow band at water depths between 60 to 100 ft (18 to 31 m). Offshore sediments are primarily sand, providing a large area of suitable substrate. Proposed new reef sites are in an existing nearshore zone to provide greater opportunities for small boat fishermen and a deepwater zone that extends out from the 100-ft depth contour. A need is also indicated for expansion of existing reefs or creation of new reefs

within the 60-100 ft zone. Shallow depths in the nearshore zone necessitate construction of low-profile reefs. A combination of low and high profile materials are recommended for use in the deeper zones.

Transportation of recommended reef materials, including obsolete petroleum platforms, to a site is technically feasible. Barges and heavy equipment or flotation equipment for towing to a site will be required. Little information is available in the literature on deployment methods, however, it is important to anchor an offloading vessel to minimize spreading and to optimize placement of reef materials.

Reef size, complexity, spatial arrangement, location, orientation, and height are important factors to consider for a successful artificial reef. Optimum reef area ranges from 200 to 2,500 m^2 (cross section) or 2,500 to 130,000 m^3 (bulk volume). Reefs should consist of a hierarchical arrangement that includes blocks or units to form a set, sets clustered to form groups, and several groups to form a reef complex. Sets within a group should be spaced approximately 985 to 1,640 ft (300 to 500 m) apart. Reef complexes should be spaced at least 2 mi (3 km) apart. Reefs should be oriented perpendicular to currents. Reef height is probably most important for migratory fishes, and horizontal spread is probably most important for demersal fishes. Reef profile is more important than height, and vertical sides seem to be the best attractants. Vertical panels and horizontal and diagonal skeletal members are effective attractants because of the niches and shadows created. Large chambers and holes are avoided by fishes as are chambers with only one opening.

The U.S. Coast Guard determines the necessity for marking an artificial reef on the basis of:

1) physical characteristics of the obstruction;
2) depth of water in which the obstruction is located;
3) proximity of the obstruction to historic or designated vessel routes; and
4) type of vessel traffic at the obstruction site.

Marker buoys are generally not required if there is a 85-ft (26-m) minimum clearance above the reef.

1.0 INTRODUCTION

The United States has been one of the world's leaders, along with Japan, in using artificial reefs to enhance fishing activities in offshore waters. Many of the efforts in the United States have developed haphazardly as a result of low budget efforts by private groups or minimally-funded State agencies. One thing learned during trial and error endeavors is that knowledge and understanding of operational considerations are imperative to successful reef-building efforts.

Operational factors that need to be considered in planning artificial reef projects include environmental conditions at the site, availability and suitability of different reef materials, transportation and logistics requirements, deployment techniques, optimum reef design, and marking requirements. The objective of this report is to evaluate these factors as they affect reef-building operations and to select areas or sites suitable for the placement of artificial reefs.

It should be pointed out that this is one aspect of a multidisciplinary effort to select sites. Therefore, while legal, social, economic, and biological constraints influence successful artificial reef development, no attempt was made (except in a very general way) to incorporate these other issues into the present analysis. Hence, potential sites are recommended primarily on the basis of operational factors. Operational, legal, social, economic, and biological constraints must be evaluated in concert before final selections are made.

2.0 METHODS

The primary tasks conducted to achieve the objectives of this project involved collection and review of existing literature and data concerning the operational factors involved in constructing and siting artificial reefs. Data collection was accomplished by several different methods including: (1) computerized literature search and review; (2) review of in-house literature; (3) personal communication with researchers and persons involved with artificial reef projects; (4) input from the Advisory Group--a group of artificial reef knowledgeable persons selected to review and advise on the direction and nature of the project and products; (5) acquisition of information and advice compiled by persons at the Sport Fishing Institute's (SFI's) Artificial Reef Development Center; and (6) acquisition of information available from various State and Federal agencies.

A computerized literature search of numerous data bases from the DIALOG Information Retrieval Service was conducted using the key words "artificial reef." The search was conducted at Mississippi State University by Drs. Arthur Cosby and Bill Howard. Table 2.1 presents a list of data bases searched and the number of citations identified in each. A hard copy print-out of the citations was obtained and reviewed for pertinent literature. Copies of all pertinent literature were obtained and reviewed to identify additional information. An attempt was made to collect all pertinent information identified from the computer search and literature review.

Many in-house documents, including a significant amount of gray literature, were reviewed for pertinent information and additional references. Continental Shelf Associates, Inc. has a continuously expanding file concerning artificial reefs which provided a significant amount of information relevant to this study.

A number of persons at various universities, organizations, and private companies having experience with the construction and siting of artificial reefs were contacted for information. This information often assisted in identifying potential problems and solutions associated with implementing an artificial reef.

Numerous members of the Advisory Group provided valuable suggestions concerning literature and information sources to review and

TABLE 2.1. SUMMARY OF THE COMPUTER LITERATURE SEARCH OF VARIOUS DATA BASES FROM THE DIALOG INFORMATION RETRIEVAL SERVICE USING THE KEY WORDS "ARTIFICIAL REEF."

Data Bases Searched	Years	Citations
NTIS	1964-85	80
Dissertation Abstracts	1861 - Jan 1985	7
Sociological Abstracts	1963-84	0
PTS Defense Markets and Technology	1982-84	33
Conference Papers Index	1973 - Sep 1984	7
Federal Research in Progress	Sep 1984	1
Federal Research in Progress	(unabridged) Sep 1984	2
BIOSIS Previews	1981-85	31
BIOSIS Previews	1977-80	15
BIOSIS Previews	1969-76	17
COMPENDEX	1970 - Nov 1984	20
Oceanic Abstracts	1964 - Oct 1984	148
ENVIROLINE	1970 - Nov 1984	47
Aquatic Science Abstracts	1978 - Sep 1984	178
Environmental Bibliography	1974 - Oct 1984	8
Aquaculture	1970 - Jan 1984	0
Water Resources Abstracts	1968 - Nov 1984	28
	Total	622

offered the results of personal investigations. These individuals were also helpful by providing the views of various interest groups with whom they are associated.

The SFI in Washington, D.C. provided numerous publications concerning the design and siting of an artificial reef and exclusion maps for the specific areas of this study. Personnel at the SFI also helped by providing information that was requested for the study.

Literature and/or information was obtained from various State and Federal agencies. Many individuals associated with previous or ongoing artificial reef projects were most helpful in making recommendations for this project.

All of the compiled information was reviewed and a report synthesized in an attempt to identify the operational optimum artificial reef sites off Alabama.

3.0 LITERATURE REVIEW

Previous attempts at constructing artificial reefs have demonstrated that the type of material used as well as environmental factors affect the success of a reef-building operation. These factors are also important operational issues in selecting potential artificial reef sites. The following section presents a summary of findings from previous reef-building operations as related to these factors.

3.1 TYPES OF REEF MATERIALS

Although many types of materials have been used for artificial reef construction (Table 3.1), not all materials are suitable or recommended for use. Myatt (1981) suggested that persons involved in selection of materials for reef construction should consider the cost of preparing the materials, transportation requirements, suitability of the materials to reef objectives, and abundance of the materials. Hinman (1981) suggested that the reef program objectives (i.e., who will be the user groups) are important considerations in the selection of reef materials as well as the reef size and configuration.

Artificial reef-building efforts in the United States have primarily been directed toward recreational fishermen and have often resulted in large, haphazardly constructed reefs using scrap materials (Bohnsack and Sutherland, in press). Automobile tires and concrete blocks have been the most commonly used materials because of their availability, low cost, and ease of handling. Although tires have been widely used, specialized equipment is required to compress the tires into bales (Tolley, 1981). Ryder (1981) suggested that tire bales not be placed in waters less than 70 ft (21 m) deep because of their tendency to break apart and drift in high energy environments. Mathews (1984) reported that the U.S. Army Corps of Engineers (COE) stopped permitting tire reefs altogether. Other low density materials such as automobile bodies and appliances are not recommended because of their tendency to rust away and/or drift in shallow waters (Ryder, 1981). The use of wooden structures or vessels is also discouraged because of eventual navigational hazards or beach littering following disintegration during storms (Mathews, 1984).

Concrete materials are suitable for artificial reef construction because of their density, durability, low cost, and availability (Ryder,

TABLE 3.1. MATERIALS USED IN THE CONSTRUCTION OF ARTIFICIAL REEFS (FROM: RYDER, 1981).

Metal Material
Light Metal:
Automobiles
Boats
Appliances
Heavy Metal:
Oil platforms
Steel vessels
Rubber
Automobile tires
Truck and heavy equipment tires
Concrete
Culverts
Manholes
Blocks and bricks
Rubble
Rock
Other
Fiberglass
PVC
Wood
Coal waste combustion products
Electrodeposition

1981). Mathews (1983) considered concrete as one of the most effective materials in use in the country. He pointed out that concrete reefs require relatively limited amounts of labor, but do necessitate the use of heavy equipment for loading and unloading. Sheehy (1983) noted that concrete material requires a staging/storage area and that transportation costs from construction sites to staging areas can be considerable.

Ships and barges are the oldest type of artificial reef material (Mathews, 1983). Sunken vessels provide high profile and large surface areas which are advantageous in providing substrate for marine growth and attracting fishes (Bieling, 1981). Steel-hull barges and ships have been among the most successful materials used in Florida's reef-building projects (Dean, 1983). During the 1970s, obsolete Liberty Ships were made available by the Federal government to States interested in artificial reef construction. Mississippi and Alabama deployed five vessels each and Florida deployed six vessels before the supply diminished (Anonymous, 1985). Future sources of this type of material will likely be from private sources.

Recent interest has focused on the use of obsolete offshore oil and gas production platforms as artificial reefs. Six reefs have been created in waters off Alabama and Florida using obsolete structures donated by Exxon Company, U.S.A., Marathon Oil Company, Tenneco Oil Exploration and Production, and the Stage I and II platforms from the U.S. Navy. All but one of these have been created in Gulf of Mexico waters. The reef outside this area was constructed in the Atlantic off Broward County, Florida. McIntosh (1981) reported that the reef created from the Exxon structure is one of the most productive in Florida. Over 3,700 structures are located in the Gulf of Mexico and about 40 become obsolete every year (Dean, 1983). The fact that most of these structures are located off Louisiana and Texas results in significant operational and logistic costs for towing these structures to the eastern Gulf. In spite of the costs, it was estimated that Exxon's platform donation as a reef saved 5 million dollars over the costs of dismantling and disposal on shore (Dean, 1983). Costs and/or savings can be expected to vary depending on water depth at the platform site, platform size, and distance to the reef site. Shell Oil Company (1985), for example, estimated that use of a platform as an artificial reef (i.e., one towed to another location) would cost from approximately one half to one seventh of that required for dismantling and disposal on shore. This variation was largely dependent on water depth.

Carleton et al. (1982) and Woodhead et al. (1982) discussed the results of creating artificial reefs from wastes generated by burning coal in power plants. The need to dispose of these wastes and the shortage of sufficient land-fill capacity raised the potential for ocean disposal combined with reef construction. A conversion process that combines a sludge filtercake with fly ash is required to stabilize the wastes and protect the environment. Preliminary results seem to indicate that the waste product is nontoxic to marine life and the reefs attract fishes and invertebrates.

The Japanese government has ceased funding the construction of artificial reefs built from waste materials (Bohnsack and Sutherland, in press). The Japanese artificial reef program is directed toward commercial fishermen and uses special designs and materials including steel-reinforced or prestressed concrete, polyethylene concrete, rubber, and fiberglass-reinforced plastic (FRP). Sheehy (1981) suggested that the manufactured reefs used by the Japanese offer greater design flexibility, extended life spans, and better bottom stability than the materials commonly used in the United States. Sheehy (1983) compared a scrap culvert reef and a Japanese-designed FRP reef and found the latter to be superior in terms of attracting and sustaining desired target species of fishes and forage species in Florida waters. Major costs of FRP reefs are in materials and construction rather than in transportation, handling, and placement as with scrap material reefs (Sheehy, 1983).

The reefs described in the preceding discussion are all designed as bottom structures. Mid-water and surface structures are also available for use in attracting pelagic fish species. These types of fish attractors generally consist of a float, an attractor (e.g., discarded net material, synthetic-covered fiberglass frames and streamers, etc.), and an anchored mooring (McIntosh Marine, 1983). McIlwain and Lukens (1978) reported successful efforts in attracting pelagic species to two artificial reef sites off Mississippi using mid-water attraction devices. McIntosh Marine (1983) also found that it was possible to increase the number of fishes at artificial reef sites by the addition of mid-water attraction devices. Myatt (1978) described the use of mid-water devices to create a "trolling alley" adjacent to natural or artificial reefs and increase the catch rate of pelagic fishes.

Given the existing evidence, it is apparent that concrete materials, steel ships and barges, and obsolete petroleum platforms will most likely be used in constructing artificial reefs in the United States. Japanese-designed structures also present a significant potential for increasing artificial reef productivity in U.S. waters. Other materials are less suitable because of their lack of durability or availability. Therefore, the discussions which follow in selecting reef sites based on operational characteristics will focus only on the proposed use of these four types of materials.

3.2 ENVIRONMENTAL FACTORS

Bohnsack and Sutherland (in press) summarized the state-of-the-art in artificial reef design and placement and found that some investigators concluded that correct site selection was more important than reef design. Many artificial reef projects have been less than successful because reef planners have failed to consider substrate conditions and the energy environment at a site. Site selection should be based on optimum environmental conditions.

Important oceanographic considerations include wave direction and force and magnitude of tidal and ocean currents. Mathews (1985) suggested that areas with strong tidal currents should be avoided because these currents will cause erosion on alternate sides of the reef, causing it to sink. A relatively weak current could be beneficial to a reef situated at right angles to the current. Sheehy (1982) has developed stability calculation equations that use available oceanographic data and estimates of significant and maximum wave heights and periods, current velocities, and substrate data. These equations have been used to predict the stability of various Japanese-designed unit reef configurations under various conditions.

Depth is of prime importance in placing artificial reefs for several reasons. First, regulatory agencies require a certain minimum clearance for navigational purposes. In Florida, the COE prefers a minimum clearance of 50 ft (15 m) although more or less may be required depending on the location and type of reef (J. Winn, 1985, personal communication, COE). The Oil Industry International Exploration and Production Forum (1984) has taken the view that at least 130 ft (40 m) of clearance should exist when petroleum platforms are used as artificial reefs. Figure 3.1 shows bathymetric contours off Alabama. It is significant to note that the shelf in the area tends to be broad and shallow as compared to areas to the east off Pensacola, Florida.

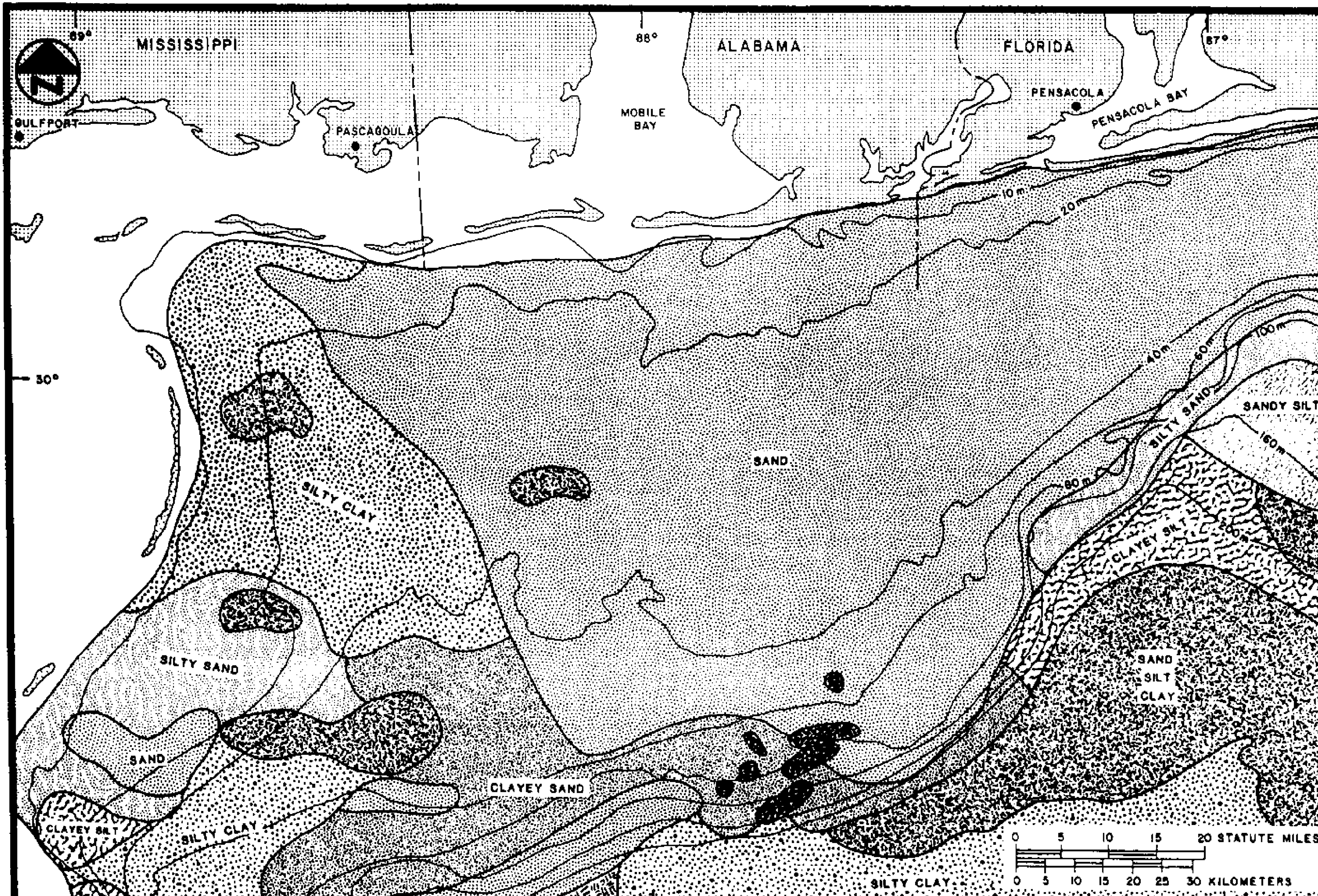

FIGURE 3.1. BATHYMETRIC CONTOURS AND SEDIMENT TYPES OFF MISSISSIPPI, ALABAMA, AND THE FLORIDA PANHANDLE (FROM: BROOKS, 1973).

Secondly, depth is important depending on the target fish species desired. Mathews (1981) suggested that the optimum reef depth is 90 to 120 ft (27 to 37 m). This is due to the fact that shallow reefs in 30 to 45 ft (9 to 14 m) depths do not attract the large benthic species common to reefs in 60 to 120 ft (18 to 37 m) depths. Shallow to intermediate depths may be desired if the reef is to serve a sizeable recreational diver population.

Finally, depth is an important factor when considering the potential impacts of severe storms on a reef. Reef materials in waters too shallow can be moved around or exposed to sedimentation during a storm. Mathews (1981) suggested that sites be chosen in water depths that are below the maximum affected depth during a 10-year storm event. This depth can be determined from the fact that a wave does not affect the bottom when the depth is greater than one half the wave length.

Substrate type is an important biological concern in the siting of artificial reefs. It is also a major operational consideration. Artificial reefs placed in areas of soft clay or silty sediments can sink into the bottom. Sand or sand/shell bottoms are the preferred substrate for siting reefs because of the greater support they provide (Mathews, 1981). Figure 3.1 shows the distribution of sediment types off Mississippi, Alabama, and the Florida Panhandle. Most of the bottom off Alabama consists of a sand substrate (Brooks, 1973).

Grove and Sonu (1985) identified three topographies that are favorable for artificial reef placement (Figure 3.2). These include placement in areas with gentle slopes and a relatively flat profile; in areas not far from the shoreward encroachment of a depression; and in areas on either side of a ridge which divides water masses or bottom topography. Most of the bottoms of concern can be classified under the first type of condition, given the general lack of topographic features and the parallel depth contours in the study area (Figure 3.1).

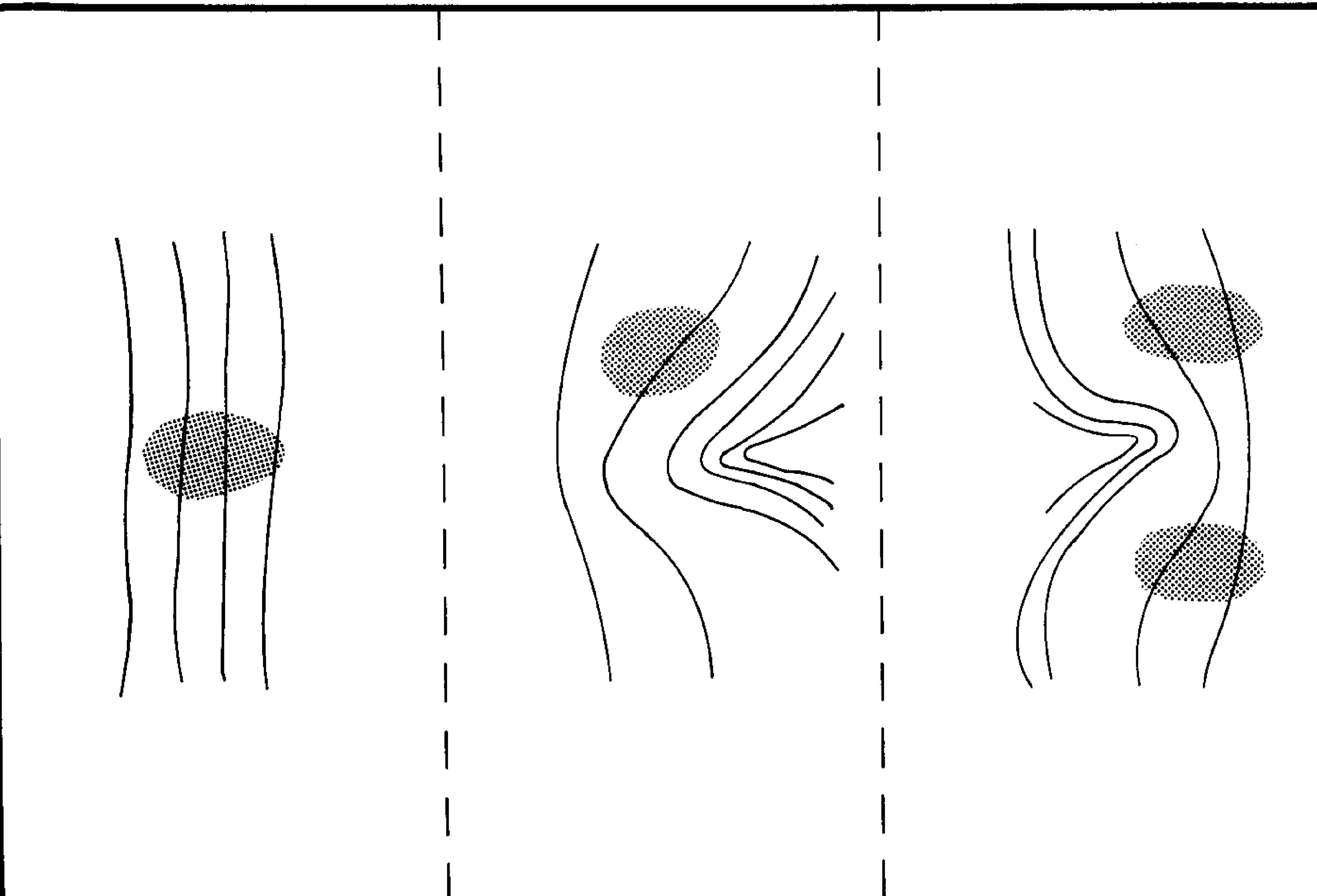

FIGURE 3.2. FAVORABLE TOPOGRAPHIES FOR REEF SITES (ADAPTED FROM: GROVE AND SONU, 1985).

4.0 ARTIFICIAL REEF SITE SELECTION

The previous section discussed the importance of considering the types of reef materials and environmental conditions in siting artificial reefs. Other data which are important in site selection include existing reef locations, navigational fairways, commercial trawl fishing areas, pipeline and communication cable routes, and military exclusion areas. All of these data are considered in the following description concerning the selection of potential reef sites. In the selection process, exclusion mapping techniques were used. With this technique, areas that are unsuitable on the basis of environmental conditions, navigational or military hazards, pipeline or cable routes, or interference with commercial fishing grounds were excluded from consideration. The remaining areas were selected as potential sites.

4.1 OPERATIONAL CONSIDERATIONS

The State of Alabama has been actively establishing artificial reef zones in conjunction with the Corps of Engineers. A nearshore reef zone approximately 3.7 mi (10 km) on a side extends from shore to a depth of about 50 ft (15 m) to the east of Mobile Point. An offshore reef zone has been established along the 60-ft (18 m) contour approximately between latitudes 88°04'30" and 88°11'30". However, a sizeable portion of this zone is in the navigational fairway, thereby limiting its use for artificial reef siting. A second zone along the 60-ft (18 m) contour and beyond extends from latitude 87°45'18" eastward to Florida waters. Most of the active, recorded reefs are located in this latter zone (Figure 4.1).

The primary factors excluding reefs from certain areas off Alabama are the navigational fairways and a commercial trawl zone inside the 60-ft (18 m) contour. Substrates throughout the area are generally hard, thereby providing optimum conditions for reef construction (Figure 4.2).

4.2 SITE SELECTION

Of the 44 commercial and recreational fishermen that responded to a questionnaire at a meeting in Mobile in January 1986, the vast majority fish in waters from 15 to 25 mi (24 to 40 km) from their point of launching (Table 4.1). This corresponds to a zone of artificial reefs established in the offshore waters as part of a State-sponsored program.

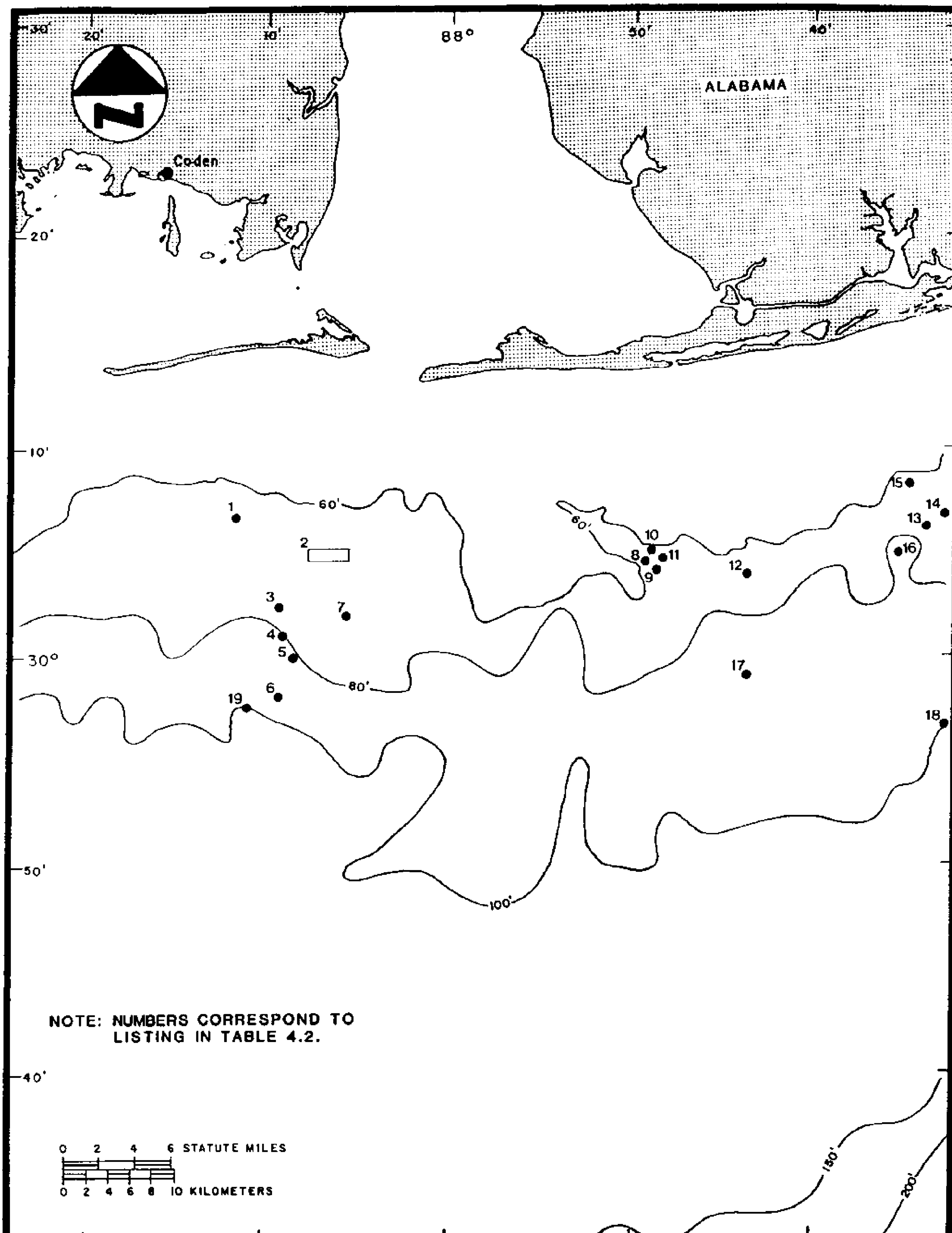

FIGURE 4.1. APPROXIMATE LOCATIONS OF EXISTING REEFS OFF ALABAMA.

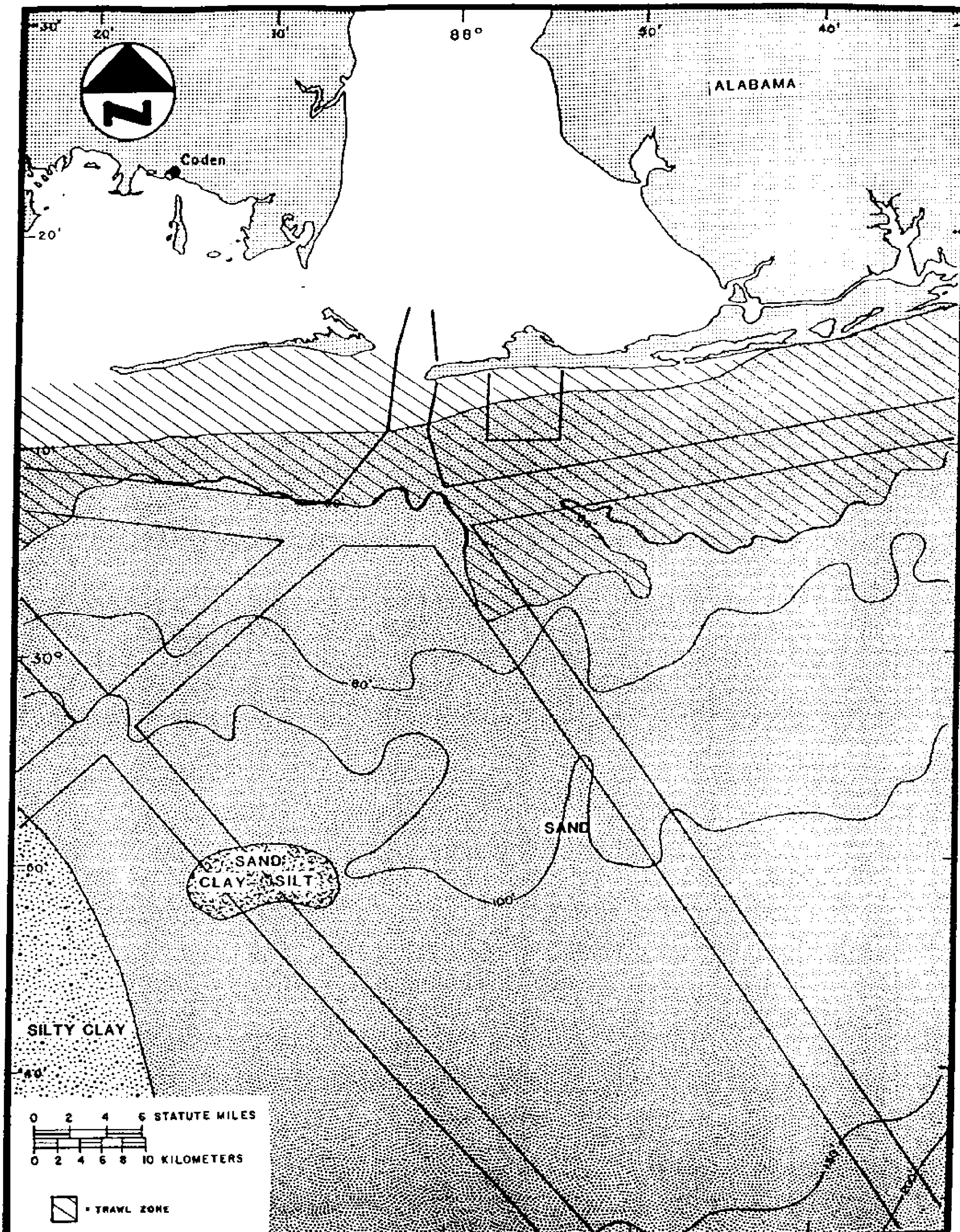

FIGURE 4.2. SEDIMENT TYPES AND LOCATIONS OF NAVIGATIONAL FAIRWAYS AND TRAWL ZONES OFF ALABAMA.

TABLE 4.1. RESULTS OF RESPONSES FROM ALABAMA FISHERMEN CONCERNING THE DISTANCES FROM SHORE CURRENTLY FISHED AND THE DISTANCES WILLING TO TRAVEL TO A PREFERRED SITE. RESULTS ARE EXPRESSED AS THE PROPORTION OF FISHERMEN USING EACH ZONE IN RELATION TO THE TOTAL NUMBER OF RESPONSES (=44). THE TOTAL PROPORTION IS GREATER THAN ONE BECAUSE SOME FISHERMEN REPORTED A MILEAGE RANGE (E.G., 10 TO 20 MILES).

Zone (miles)	Distance to Reach Current Fishing Areas	Distances Willing to Go to Reach a Preferred Spot
≤15	.56	.09
>15 ≤25	.72	.44
>25 ≤40	.21	.28
≥40	.09	.30

Alabama's artificial reef program has resulted in access to the reefs for boats exiting Mobile and Perdido Bays (Table 4.2). Most of the reefs are concentrated in a fairly narrow zone in waters from 54 to 102 ft (16 to 31 m) deep. No reefs are currently located in the nearshore zone. One reef was recently established 50 mi (80 km) from shore in 240 ft (73 m) of water. This reef was created from an obsolete petroleum platform donated by Marathon.

Three options are available for the establishment of additional reefs. These include construction of nearshore reefs for small boat fishermen, expansion of existing reefs, and construction of deepwater reefs for charter boat operators. The nearshore reefs would be located in an already charted zone (Area A1) off the peninsula to serve the needs of fishermen from the Dauphin Island and Gulf Shores/Orange Beach area (Figure 4.3). An area at A2 would provide nearshore reefs for the boats exiting Perdido Bay. Restricting reefs to these areas in the nearshore waters would still keep the largest portion of the coast open for trawlers.

One of the complaints of the fishermen at the Mobile meeting was the large numbers of boats which fish the existing reefs and the crowded conditions which are found on some holidays. One option to help alleviate this problem is to develop additional reef sites within the existing reef zone or to expand the existing sites. Particularly suitable for expansion from an operational point of view would be those sites in the deeper waters within the 80-100 ft (24 to 30 m) depth contour (these sites are located in Area B in Figure 4.3). Substrates in this area are conducive to reef siting, the sites are probably beyond most of the active trawling areas, and depths are sufficient to allow a mix of low and higher profile reefs for attracting a wider variety of fish species.

During the meetings in Mobile, it was also suggested that new reefs be established in deeper waters beyond the zone of existing reefs. The fishermen felt that this would help to disperse the fishing effort, and alleviate crowded conditions. The waters beyond the 80-ft (24 m) depth contour (i.e., Area B) is, for the most part, suitable for artificial reefs. As shown in Table 4.1, there is a willingness on the part of a large proportion of the fishermen present at the Mobile meeting to travel farther than 25 mi (40 km) to a preferred fishing spot to avoid crowds of fishermen. If this willingness to travel the necessary distances is prevalent among the fishing public in the area, then Area B

TABLE 4.2. ARTIFICIAL REEFS IN ALABAMA COASTAL WATERS.

Reef Name	Gulf Chain Loran-C Coordinates		Distance (mi) from Sand Island Light	Distance (mi) from Perdido Pass Sea Buoy	Water Depth (ft)
1) Southwest Banks	12655.4 47050.4		11.0	37.0	66
2) Dauphin Island Bridge	12706.0 47035.0	12735.0 47035.0	12.0 11.0	34.0 30.0	65
3) Drydock	12704.6 47028.7		10.6	32.1	72
4) Tulsa Wreck	12711.9 47027.4		11.0	32.5	84
5) Anderson (Liberty Ship)	12733.4 47018.6		10.3	30.9	82
6) Edwards (Liberty Ship)	12709.4 47013.6		13.8	34.4	84
7) Southeast Banks	12808.3 47027.0		11.6	27.8	75
8) Buffalo Barge II	12876.8 47044.3		12.3	17.7	66

TABLE 4.2. (CONTINUED).

Reef Name	Gulf Chain Loran-C Coordinates	Distance (mi) from Sand Island Light	Distance (mi) from Perdido Pass Sea Buoy	Water Depth (ft)
9) Fort Morgan Pipes	12883.1 47040.0	13.2	18.0	66
10) Buffalo Barge I	12881.9 47045.5	13.0	13.0	54
11) Lipscomb Tug	12900.9 47045.0	13.9	16.5	65
12) 105-ft Tug	12957.8 47039.9	19.0	19.5	64
13) Lillian Bridge II	13059.2 47054.9	27.5	9.0	92
14) Allen (Liberty Ship)	13069.2 47059.0	26.3	8.0	88
15) Kelley Pipes & Lillian Bridge I	13046.7 47062.8	25.5	9.7	60
16) Wallace (Liberty Ship)	13038.0 47046.0	25.3	10.5	90

TABLE 4.2. (CONTINUED).

	Reef Name	Gulf Chain Loran-C Coordinates		Distance (mi) from: Sand Island Light	Distance (mi) from: Perdido Pass Sea Buoy	Water Depth (ft)
17)	Sparkman (Liberty Ship)	12948.1 47020.2		20.3	17.7	93
18)	Trysler Ground	46990.0 13100.0	47000.0 13060.0	31.0	22.0	102
19)	Mail Ship	12678.1 47012.3		15.7	37.0	102

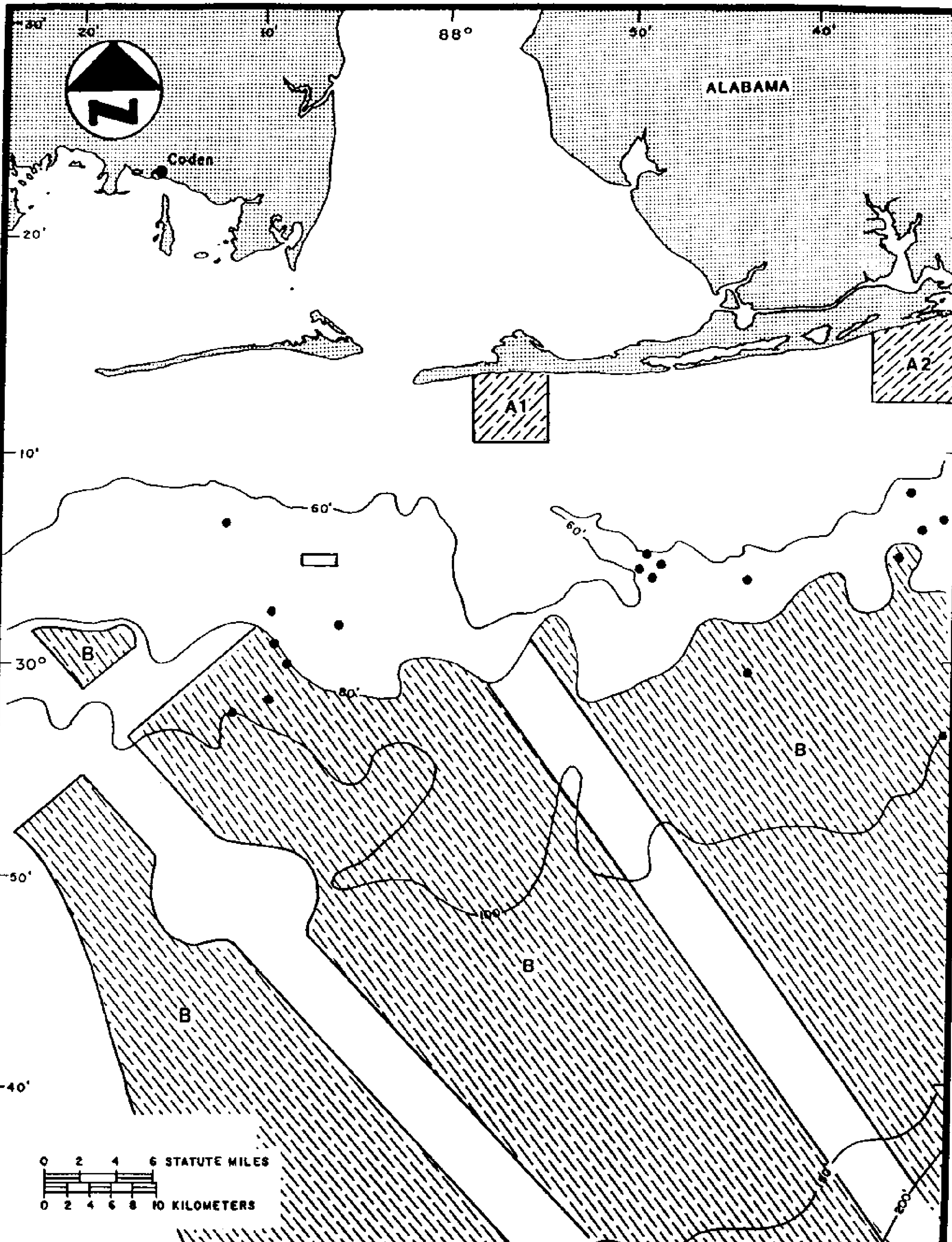

FIGURE 4.3. SUGGESTED NEARSHORE AND DEEPWATER ZONES FOR THE ESTABLISHMENT OF ARTIFICIAL REEFS OFF ALABAMA.

beyond the 100 ft depth is a prime area for establishing new reefs from an operational standpoint.

4.3 SUGGESTED REEF MATERIALS

Because of the relatively shallow waters [i.e., <50 ft (<15 m)] in the nearshore zones (Area A1 and A2), reefs in this area should be of low profile and dense material. Large concrete blocks or concrete rubble would probably be best. In deep waters (Area B) where a high profile is desired to attract pelagic species, intact ships or petroleum platforms would provide the best reef materials. In the existing artificial reef zone materials similar to those already used at these sites are probably suitable to expand existing sites or create new ones. However, it is recommended that the existing sites be expanded in a manner that develops reef complexes. These complexes are described in Section 5.0. A combination of low and high profile materials are used at these reef complexes.

5.0 DISCUSSIONS AND CONCLUSIONS

5.1 TRANSPORTATION OF REEF MATERIALS

Transportation of reef materials to the proposed site probably represents the largest single operation in terms of both effort and cost in the artificial reef construction process. Various types of methods are available to transport the materials to a site depending on the materials used.

Barges will generally be the preferred mode of transport for concrete materials because of the weight and volumes involved. Heavy equipment such as trucks or cranes will be required to load the materials onto the vessels. For unloading at the reef site, either "bottom dumping" or crane-equipped barges are necessary. It is significant to note that with barges, placement of materials on the bottom is generally scattered and it is difficult, if not impossible, to form the reef in a particular design. Marking the site with a buoy and anchoring during unloading can minimize the scatter of reef materials.

Sheehy (1983) used air bags to float Japanese-designed FRP reef units to a site off Panama City. These 5-m long by 1.0-m diameter units were towed to the site by small (i.e., 5-ton) boats. However, most Japanese-designed structures weigh on the order of several tons and require crane-equipped barges for transport, unloading, and placement.

To date, two obsolete petroleum platforms (Tenneco and Marathon) and a submerged production system (Exxon) have been moved from their locations off Louisiana and deployed as artificial reefs off Alabama and Florida. The submerged production system was a 2,200-ton structure towed 300 mi (483 km) to a location 35 mi (56 km) offshore Apalachicola, Florida in 110 ft (34 m) of water in 1980 (Sheehy and Vik, 1982). Two other obsolete platforms (Stages I and II) used by the U.S. Navy for scientific observations were sunk in place off Panama City, Florida.

Tenneco donated a platform to the State of Florida in 1982 for an artificial reef in 175 ft (53 m) of water 22 mi (35 km) southeast of Pensacola. The original structure was transported by barge in two sections. The deck section measures 72.5 ft (22 m) by 50 ft (15 m) and is 26 ft (8 m) tall. The 130-ft long steel jacket rests on its side and projects upward in the water column about 90 ft (27 m). Holes were cut in the deck section before deployment to permit light penetration and to attract more fishes (Johnke, 1984).

In 1983, Oceaneering International, Inc. engineered a new technique for moving petroleum structures. An obsolete Marathon platform jacket in 208 ft (63 m) of water off Louisiana was fitted with buoyancy tanks, toppled in place, and towed to a reef site 50 mi (80 km) off Alabama. The structure lies on its side in 240 ft (73 m) of water, leaving a clearance of 130 ft (40 m). The deck structure which had been removed from the jacket was also towed to the site on a barge and placed on the bottom near the jacket structure.

A variety of comments were received from oil companies, agencies, and others concerning the technical feasibility of transporting petroleum platforms in response to a Minerals Management Service (MMS) request for information on platform dispositions (Federal Register, 13 November 1984, p. 44925). These comments are summarized in Table 5.1. Overall, it appears that the technology is currently available to remove existing platforms from water depths of 300 ft (91 m) or less and to transport the structures to sites for use as artificial reefs. The weight of the jackets and the available technology may limit the use of platforms in water depths greater than 300 ft (91 m). However, economics, and not technology, will eventually dictate the fate of these structures.

5.2 DEPLOYMENT

Published literature that concerns descriptions of techniques used in deploying reef materials is generally lacking. It is assumed that in most cases, the reef materials are transported to a location above the reef site and allowed to drop from the surface. In shallow waters, a crane can be used to deposit materials and construct a reef to desired specifications. This may be less feasible in deep waters. In deep as well as shallow waters, currents could induce drifting which would result in scattering of the materials. It is important to mark the reef site and to anchor vessels unloading materials to ensure proper placement of the materials. Demoran (1981) reported that anchoring the bow and stern of an obsolete ship before sinking facilitated maintaining the desired position of the hull.

5.3 OPTIMUM REEF SIZE AND CONFIGURATION

The following discussion is summarized from Bohnsack and Sutherland (in press) who reviewed the literature on the optimum design and placement of artificial reefs. While much of the knowledge on this subject has come from U.S.-sponsored research, the vast majority of the

TABLE 5.1. SUMMARY OF RESPONSES TO AN MMS REQUEST FOR INFORMATION ON PLATFORM DISPOSITION AND TECHNICAL FEASIBILITY.

Company/Agency	Comments
Atlantic Richfield Company	a) Buoyancy tanks may be needed for towing a jacket to a disposal site.
Chevron U.S.A. Inc.	a) A major technical problem is providing buoyancy during transport. b) During towing of a refloated platform, operators must ensure control at all times, particularly in congested areas and during periods of adverse weather.
Cities Service	a) Size and bulk of many jackets exceed the capacity of existing equipment to remove in one piece. b) Refloating equipment is not currently available with sufficient capacity to transport large jackets. c) Technology and equipment are being developed to facilitate platform removal by refloating.
Conoco Inc.	a) Capability exists to salvage whole platform jackets in waters to 200 ft. b) In deep waters, platforms have to be dismantled.
Exxon Company, U.S.A.	a) Even in water up to 1,000 ft, it is feasible to cut platforms into pieces and to transport on barges. b) Primary problem in deep waters is to refloat and transport the jacket.
Marathon Oil Company	a) A jacket cannot simply be removed from deep water and placed in a shallow location because the structures are not designed to resist the large overturning moment.

TABLE 5.1. (CONTINUED).

Company/Agency	Comments
Minerals Management Service	a) Only economic and planning limitations restrict the potential utilization of oil and gas structures as artificial reefs. b) Transportation of a jacket by controlled flotation may be safer than transport by a conventional barge. c) Technology is available, but at high cost, to remove platforms from deep water by removing in sections.
National Ocean Industries Association	a) Technology exists for relocating most structures in water depths of 200 ft or less. b) Economics, not technology, is the limiting factor in the use of post production platforms.
Oceaneering International, Inc.	a) Technology exists to remove and dispose of all platforms currently in place. b) Technology has been limited in past by the lifting capacity of derrick barges. c) Oceaneering is investigating options to (1) tow jacket horizontally to a reef site; and (2) tow the entire structure either horizontal or vertically to a reef site.
Pennzoil Company	a) Most of platforms salvaged to date have been small structures in shallow water that could be loaded onto barges. b) Platforms to be salvaged in the future will be too heavy to load onto barges.
Phillips Petroleum Company	a) No technological problems exist in dismantling or transporting platforms. b) Supplemental buoyancy will be a consideration for large or deep platforms.
Shell Oil Company	a) There are no technical problems associated with dismantling and transporting platforms. b) Technological capabilities are limited by lifting capacities of derrick barges.

TABLE 5.1. (CONTINUED).

Company/Agency	Comments
Sohio	a) No technical problems associated with dismantling and transporting platforms in water out to 300-ft depths. b) In water depths from 300 to 600 ft, jacket weight is a serious technical limitation. Lift capacities for present derrick barges are not sufficient for these weights. c) Underwater technology is not currently available for salvage work for platforms in water deeper than 1,000 ft.
Tenneco Oil	a) Transporting an old platform depends on availability of an adequate capacity barge. b) Buoyancy tanks have several limitations.

literature has originated from Japanese scientists. Information is available on how reef size, height, complexity, spatial arrangement and orientation, and location affect reef success in attracting fishes.

The area of the reef (i.e., the amount of material deposited and the area of bottom covered) is one of the most important design considerations. Large reefs seem to be more productive than small reefs, although biological productivity reaches a peak at some optimum size (Grove and Sonu, 1985). In an analysis of Japanese artificial reef studies, Grove and Sonu (1985) found that the advantage of an artificial reef over a natural reef was at a maximum at a reef size of about 1,400 m^2 (cross section) or 50,000 m^3 (bulk volume). Overall, an artificial reef tended to be more attractive than a natural reef at sizes ranging from 200 to 2,500 m^2 (cross section) or 2,500 to 130,000 m^3 (bulk volume) (Figure 5.1). Various investigators have theorized as to what constitutes an optimum size depending on location. Japanese research has indicated that reefs should consist of a hierarchical arrangement; many blocks or units should form a set, sets should be clustered into groups, and several groups should form a reef complex (Figure 5.2). Reef sites within a group should be spaced about 984 to 1,641 ft (300 to 500 m) apart while reef complexes can be spaced at least 2 mi (3 km) apart (Grove and Sonu, 1985).

There seems to be no clear evidence regarding the importance of height or relief for attracting fishes. From the studies conducted, the effect of height depends on the species. Grove and Sonu (1985) concluded that height was more important to migratory fishes, and horizontal spread was more important to demersal fish species.

Of more importance to fish attraction than height is the profile of the reef. Vertical sides seem to be the best attractants (Grove and Sonu, 1985). Sheehy (1981) explained that this is due to the interaction of currents with the reef. Orientation of reefs should be perpendicular to currents to maximize this interaction. Prevailing currents tend to be alongshore in the northeastern Gulf.

Another important factor for artificial reef success is reef complexity. This includes design, spatial arrangement, number of chambers and openings, and the amount of interstitial space. Studies have shown that fishes may avoid chambers with only one opening. Large chambers and holes are also avoided by fishes. Vertical panels and horizontal and diagonal skeletal members may be more effective than

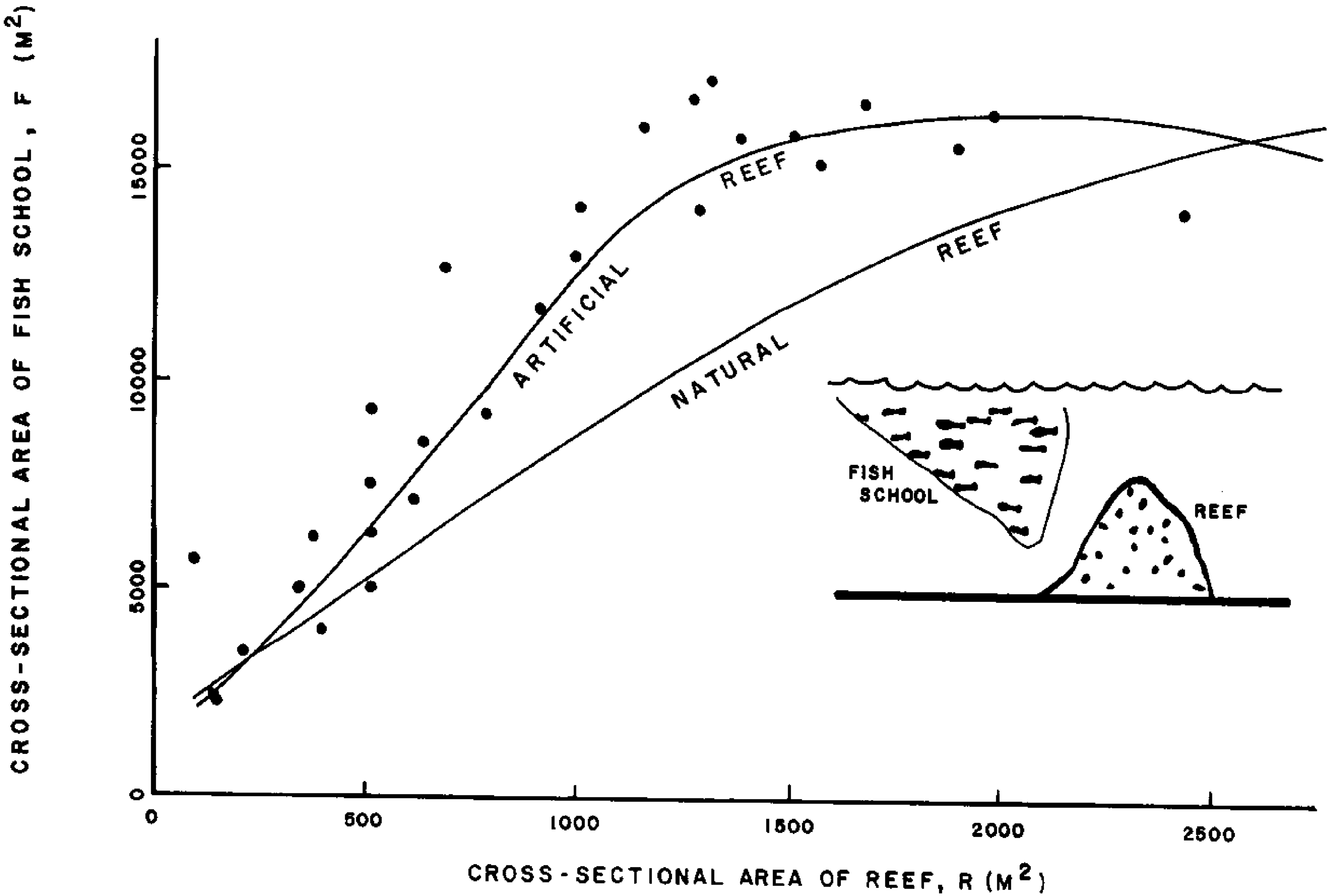

FIGURE 5.1. RELATIONSHIP BETWEEN REEF SIZE AND FISH CONGREGATION (ADAPTED FROM: GROVE AND SONU, 1985).

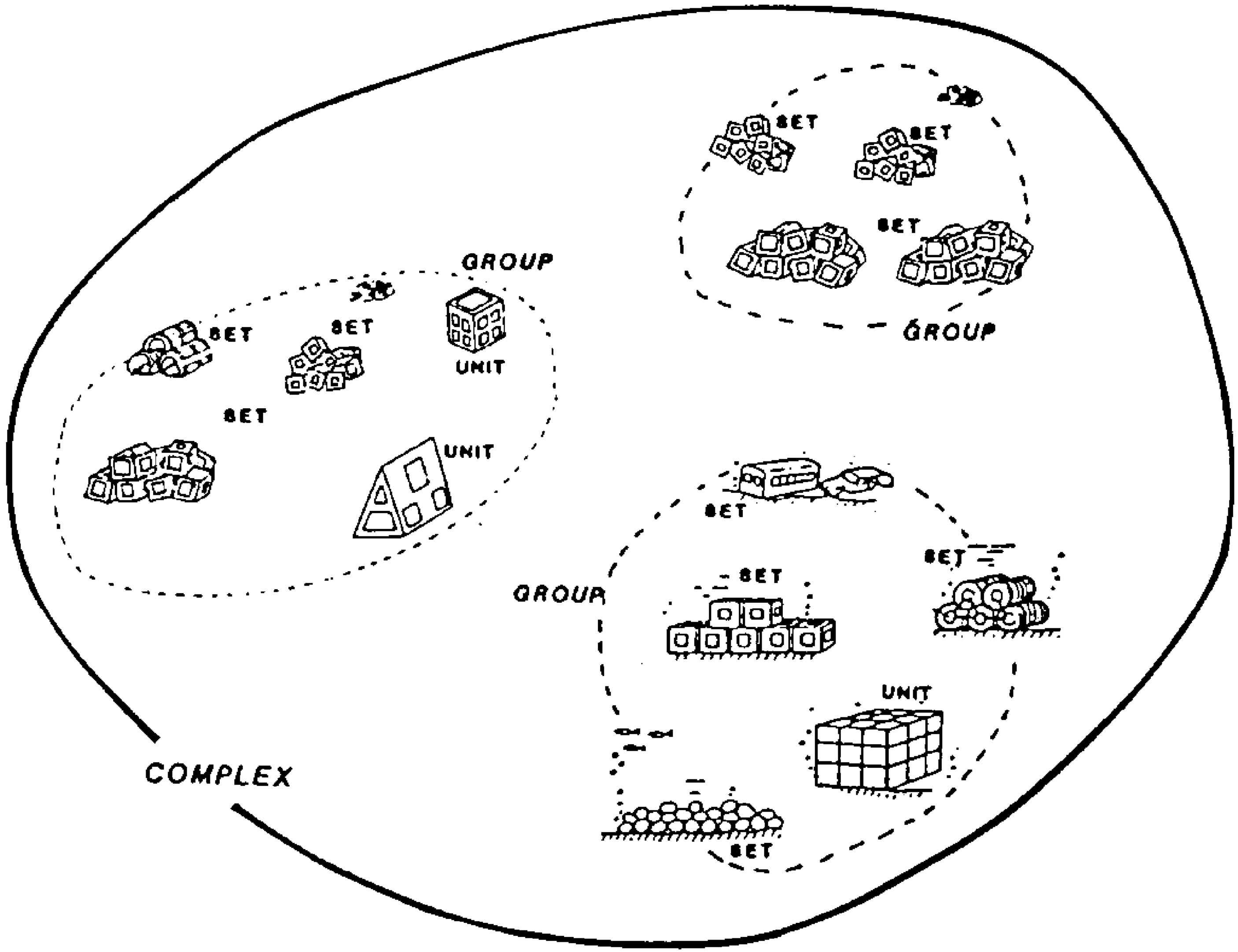

FIGURE 5.2. SCALES OF FISHING REEF (ADAPTED FROM: GROVE AND SONU, 1985).

vertical members because of the shadows created. Investigators have also found that artificial reefs made of different materials are superior to reefs of one material type.

5.4 MARKING REQUIREMENTS

In shallow waters, marking of a reef site is an important consideration for navigational safety reasons. This is of less concern in deep waters, but buoys assist fishermen in locating a reef. Marking also enables commercial trawl fishermen to avoid reefs where nets may become entangled.

The U.S. Coast Guard (USCG) has the legal responsibility to determine if a buoy is required on a reef. This determination is made on the basis of:

1) physical characteristics of the obstruction;
2) depth of water in which the obstruction is located;
3) proximity of the obstruction to historic or designated vessel routes; and
4) type of vessel traffic at the obstruction site.

Burgess (1974) stated that the USCG will not normally require marking of a reef if there is over 85 ft (26 m) of clearance. When marking is required, the owner of the artificial reef must maintain the buoy. At the Marathon platform reef, which has a minimum clearance of 80 ft (24 m), the oil company was required by the States of Florida and Alabama to purchase and place the first USCG-approved permanent buoy (Walters, 1985). Any further responsibility was assumed by the States. Exxon was able to avoid the need for a buoy at the reef created by its production template [minimum clearance of 40 ft (12 m)] by placing the structure near an existing lighted and buoyed U.S. Air Force tower (Ditton and Folk, 1982).

5.5 SUMMARY OF OPERATIONAL REQUIREMENTS

Various zones from shallow to deep waters have been established for potential artificial reef sites. The suitability of these sites can only be established after operational requirements are considered along with the legal, social, economic, and biological concerns associated with creation of reefs in these areas. As part of the analysis, it will be necessary to establish the objectives of the reef program (i.e., the target species desired and the user groups of the reef). These considerations will eventually dictate the final reef design.

In general, four types of materials are suitable for reef construction. These are concrete blocks or rubble, obsolete ships or barges, petroleum platforms, and Japanese-designed structures. High density, concrete material is probably most suitable in shallow areas where low profile structures will be required to comply with minimum clearance requirements. Ships, barges, and Japanese-designed structures are suitable for intermediate depths from 60 to 150 ft (18 to 46 m). Petroleum platforms will be effective in waters more than 150 ft (46 m) deep where the massive structures can attract large pelagic fishes.

Operational considerations should be major concerns in any reef-building effort. Proper siting and deployment of a reef are important not only to the success of the structure in attracting fishes, but also in complying with restrictions related to navigational issues. Finally, the quality of the reef construction is more important than the quantity of reef established. Therefore, reef designers should consider establishing reef complexes that provide diverse habitats. This is accomplished through planned development and careful deployment of materials.

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4. Recommendations for Specific Artificial Reef

Site Locations In

Alabama

Based on analyses of available data, there are two potential sites recommended for artificial reef placement off Alabama:

A) A shallow water site located approximately 20 miles southeast of the entrance to Mobile Bay in 80 to 100 feet of water (approximate coordinates are 29°58'N Latitude and 87°40'W Longitude). A low profile reef is probably best suited to this location due to the relatively shallow water.

This site is near existing artificial reefs but it is recommended that a new reef be placed at least 600 meters (1969 feet) from any existing reef. Because there are a number of successful existing artificial reefs in this area it is likely that conditions are suitable for a successful reef but a site-specific survey is recommended before reef placement.

B) A deep water site located 43 miles south-southeast of the entrance to Mobile Bay in 150 to 250 feet of water (approximate coordinates are 29°33'N Latitude and 87°38'W longitude). The water depth at this location is well suited to large, high profile reef. Such a structure would offer both bottom and mid-water habitats which increases the potential number of fishes that can utilize the reef.

Two additional very shallow water nearshore options include a site four miles square extending from the beach south of Little Point Clear and another four mile square site also extending from the shore just west of Alabama Point near Perdido Bay.

Site specific surveys are recommended in any of these areas prior to any reef emplacement to insure suitability of bottom type and that existing natural or artificial reefs do not occur on the proposed location. Care must also be taken to avoid navigational fairways.

SITING PLANS FOR THE ESTABLISHMENT OF ARTIFICIAL REEFS IN THE GULF OF MEXICO: A COOKBOOK PROCEDURE

[Florida]

by

Semoon Chang, Director
Center for Business and Economic Research
University of South Alabama
Mobile, Alabama 36688

July 1, 1986

Siting Plans for the Establishment of Artificial Reefs in the Gulf of Mexico: A Cookbook Procedure

Introduction

This report summarizes a cookbook procedure of making decisions as to whether a population center should attempt to have an artificial reef established in its waters. All technical arguments and presentations are deleted.

Step 1: Identify the population center.

A given community that considers establishing an artificial reef is the population center. If fishing waters are shared by another adjacent community, this neighboring community should also be included in the population center. Population centers are selected usually on the basis of social and demographic data.

Step 2: Develop an exclusion map.

An exclusion map should identify areas where artificial reefs may not be placed. These areas include shipping lanes, offshore ports, biologically sensitive areas, marine sanctuaries, military areas, and areas of particular shipping interests. An exclusion map shows areas that are most suitable for establishing artificial reefs in waters of the particular population center.

Step 3: Clarify the requirements and procedures of obtaining the permit to establish an artificial reef.

Early in the process, the population center may clarify the requirements and procedures of obtaining the permit to establish an artificial reef. This step is intended to make sure that no problems arise from the permit procedure after the decision is made to establish an artificial reef in the waters of the population center. This step requires personal interviews or telephone conversation with those who issue the permit.

Step 4: Obtain the numbers of commercial and recreational fishermen for the population center.

These numbers are necessary in estimating potential benefits from use of the artificial reef under consideration. The local fishermen's association, the U. S. Coast Guard, or a state office that issues fishing licenses may be able to provide information on these numbers. It is almost impossible to obtain accurate numbers of commercial and recreational fishermen. Since these numbers are the basis for the subsequent calculation, it is important to come up with reasonably accurate numbers. Saltwater divers should be counted as recreational fishermen.

Estimates by fishermen in the Pensacola area indicate that there are approximately 400 commercial fishermen and 12,500 recreational fishermen in the area.

Step 5: Estimate the dollar value of additional fish catch.

The dollar value is the sum of retail prices of different species of fish that both commercial and recreational fishermen are expected to catch off the artificial reef under consideration. Opinions of local fishermen and local marine biologists would be the source of this estimation. Since the fish catch off an artificial reef may vary with the type of the artificial reef, it may be necessary to presuppose the type of artificial reef the population may plan to have established.

Step 6: Obtain the numbers of resident and tourist recreational fishermen in the population center.

These numbers are necessary to estimate total fishing days of recreational fishermen in the population center. Rather than undertaking costly studies, it is suggested that fishing communities use the results of the 5-year interval national survey on fishing, hunting, and wildlife-associated recreation. The 1980 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation was published in 1982 by the U. S. Department of the Interior and the U. S. Department of Commerce. The 1985 survey may be made available in 1987.

The survey indicates the ratios of resident recreational fishermen and tourist recreational fishermen relative to an area's residence recreational fishermen. Residence fishermen refer to fishermen who live in the population center. Resident fishermen refer to residence fishermen who fish in waters of the population center. If a residence fisherman fishes in areas other than the population center, the residence fisherman is not a resident fisherman. Tourist fishermen refer to out-of-town fishermen who came to the population center for fishing. Since the ratios presented in the survey are different from one state to another, the method of obtaining resident and tourist fishermen is presented only for Florida. We already know the number of residence recreational fishermen and our assignment is to obtain the number of resident recreational fishermen and the number of tourist recreational fishermen on the basis of the number of residence recreational fishermen.

Population Centers in Florida

(A) [PC's residence recreational fishermen]

Multiplied by x 0.9535

Equals [Resident recreational fishermen]

(B) [Resident recreational fishermen]

Multiplied by x 0.6795

Equals [Tourist recreational fishermen]

Note that the number of tourist recreational fishermen may also be obtained by multiplying the PC's residence recreational fishermen by 0.6479 (which equals 0.9535 x 0.6795).

Step 7: Estimate the total annual fishing days of the population center's recreational fishermen.

The total annual fishing days of the population center are obtained by adding the total annual fishing days of the resident recreational fishermen and the total annual fishing days of the tourist fishermen. The total annual fishing days of recreational and tourist fishermen for the northwest Florida are available in, "The Economic Impact and Valuation of Saltwater Recreational Fisheries in Florida", a 1982 study by Bell, Sorenson, and Leeworthy. The annual fishing days per resident recreational fisherman are 17.5 days, while the annual fishing days per tourist recreational fisherman are 8.1 days. Since no comparable data are available in the national survey, these findings are applied for Alabama as well as northwest Florida. The estimation of the total annual fishing days of the population center's (resident and tourist) recreational fishermen is made as follows:

[Resident recreational fishermen x 17.5]

Plus [Tourist recreational fishermen x 8.1]

Equals [Total fishing days of recreational fishermen]

It is interesting to note that estimates by fishermen who attended the town meetings indicate that the fishing days of a typical recreational fisherman in the Pensacola area are 22 days (based on 3 responses) and the fishing days of a typical out-of-town fisherman is 5 days (based on 3 responses) in the Mobile area. Observations for commercial fishermen are excluded from these average figures.

Step 8: Estimate the total dollar value of recreational fishing.

To estimate the dollar value of recreational fishing, the total number of fishing days for recreational fishermen should be multiplied by how much each day is worth to each fisherman. Unless reliable studies are available for particular population centers that estimate the value of recreational fishing, it is suggested that population centers use the guidelines for assigning points for special recreation, developed by the Corps of Engineers. The unit-day value for saltwater recreational fishing in 1986 price is $14.73. Total dollar value of recreational fishing of the population center, therefore, is obtained as

	[Total fishing days of recreational fishermen]
Multiplied by	x $14.73
Equals	[Total dollar value of recreational fishing]

The $14.73 figure is the lowest estimate available in studies that estimated the daily value of recreational fishing. Based on estimates of fishermen who attended town meetings, however, even this figure may be an overestimation. Recreational fishermen in the Pensacola area were willing to pay about $83.50 (based on 3 responses) for use of artificial reefs for the entire year.

Step 9: Estimate the value of recreational fishing for the artificial reef under consideration.

The value of recreational fishing derived in step 8 is based on the assumption that all fishing days of all recreational fishermen are spent around the artificial reef. The value, therefore, should be multiplied by the percentage of fishing days spent on fishing around the artificial reef relative to total fishing days. The population center must make the best judgment for the percentage. That is,

	Total dollar value of recreational fishing]
Multiplied by	[Percent of fishing around artificial reef]
Equals	[Dollar value of recreational fishing around artificial reef]

The percent of fishing around artificial reef is approximately 40 percent (based on 3 responses) in the Pensacola area, according to the questionnaire survey at town meetings.

Step 10: Estimate the expenditure impact owing to the artificial reef.

The net economic development impact from expenditures by out-of-town fishermen (and additional local fishermen, if there are any) should be included in estimating the expenditure impact. Additional expenditures by only those fishermen who are attracted to the area due to the artificial reef should be considered. The annual expenditures per fisherman by state of activity are available in the 1980 national survey. These expenditure figures are adjusted to the 1986 price level. To obtain the expenditure impact, out-of-town (commercial and recreational) fishermen and local (commercial and recreational) fishermen who are newly attracted to the area due to the artificial reef under consideration need to be estimated. The procedure is described by state.

Expenditure Impact for Florida

(A) Estimate additional out-of-town and local fishermen due to the artificial reef under consideration.

(B) Multiply (A) by $234.48.

Step 11: Estimate the total annual benefit from the artificial reef.

The total annual benefit from the artificial reef under consideration is obtained by adding the following benefit categories:

(A) the dollar value of additional fish catch from the artificial reef [Step 5]

(B) the dollar value of recreational fishing for the artificial reef [Step 9]

(C) the expenditure impact of the artificial reef [Step 10].

Step 12: Convert the total annual benefit from the artificial reef to its present value.

Since total benefit figures are recurring each year, these figures should be converted to their present values so that benefits can be compared with costs for the same price level. To simplify the computational procedure, it is assumed that the discount rate is 10 percent and the life of an artificial reef is 25 years. The present value of the total annual benefit, then, is obtained as follows:

	[Total annual benefit]
Multiplied b	9.077040
Equals	[Present value of benefit]

Step 13: Estimate the total cost of establishing the artificial reef.

The total cost of establishing an artificial reef consists of (a) manufacturing or dismantling cost, (b) transportation cost that may include a liability insurance on shipment of an artificial reef, and the maintenance cost including an annual liability insurance premium. The maintenance cost should be discounted to the present value since it is recurring annually. Cost estimates are made usually after potential donors of artificial reefs are identified. The total cost is obtained by adding the following cost categories:

(A) Manufacturing or dismantling cost, if this cost is assumed by the population center.

(B) Transportation cost, unless this is assumed by the donor of the artificial reef.

(C) Present value of annual maintenance cost, which is Annual maintenance cost x 9.077040.

Step 14: Identify the sources of external funding and apply for funds.

The next step is to identify the sources of external funding and apply for funds needed to establish the artificial reef. Sources include the Wallop-Breaux fund at the federal level, state and local government, and local fishermen's groups. The fact that out-of-town fishermen would be attracted to the area may be presented as a basis for requesting a subsidy from the local government. Subtract the amount that can be acquired from these sources from the remaining cost to obtain the net cost of establishing an artificial reef to the population center. That is,

	Total cost obtained in Step 13
Minus	External funds
Equals	Net cost of establishing an artificial reef

Step 15: Make the decision.

The final decision on whether or not to establish an artificial reef in a given population center is made by comparing the present value of total annual benefit obtained in Step 12 with the net cost of establishing the artificial reef obtained in Step 14. If benefits are greater than costs, the population center may establish the artificial reef. If benefits are smaller than costs, the population center may not establish the artificial reef.

CSA

Continental Shelf Associates, Inc.

BIOLOGICAL FACTORS AFFECTING
ARTIFICIAL REEF SITING OFF FLORIDA

28 FEBRUARY 1986

PREPARED FOR:

National Marine Fisheries Service
Southeast Region
9450 Koger Boulevard, Duval Building
St. Petersburg, Florida 33702

PREPARED BY:

Continental Shelf Associates, Inc.
759 Parkway Street
Jupiter, Florida 33477
Telephone: (305) 746-7946

"Applied Science and Technology"

ABSTRACT

Available information concerning biological parameters that affect the success of an artificial reef was collected and reviewed. Sites off the Florida Panhandle were identified as biologically optimal potential artificial reef sites. Shallow water and deepwater sites were selected off each State and the advantages and disadvantages of each potential site were discussed. Biological parameters identified as important in artificial reef siting include substrate, benthic productivity, oceanographic and water quality conditions, reef structure, and the biology of target species. Shallow water sites were identified to be best suited for low-relief structures that would attract primarily demersal coastal species. Deepwater structures were identified to be best suited for high-profile structures that would attract pelagic as well as demersal species. There is a lack of information concerning the biological parameters important to artificial reef siting. Monitoring of all new artificial reefs is strongly recommended as a source of additional information to optimize future artificial reefs. Government policy makers should investigate the possibility of using artificial reefs as a form of mitigation or fine payment.

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EXECUTIVE SUMMARY

Available information concerning the biology of artificial reefs and potential artificial reef habitats off the Florida Panhandle was collected and reviewed. Numerous parameters were identified to be biologically important to the success of an artificial reef, including the productivity of the existing biota at a reef site, substrate type, oceanographic and water quality parameters, shape and profile of the structure, and the life history of target species. Although other parameters such as seasonality and reef size, structure, texture, and complexity are biologically important, they are probably less important to the success of an artificial reef than the previously described parameters.

Shallow water and deepwater sites were selected on the continental shelf off the Florida Panhandle. The shallow water sites are probably best suited for relatively low-relief structures such as concrete rubble or Liberty Ships. Due to their relative distance from shore, it is expected that the reefs would attract a significant number of estuarine-dependent species such as seatrouts, croakers, and drums. All of the species are commercially and recreationally important. Due to the relative closeness of the shallow water reef site off Florida to the edge of the continental shelf, it is likely that some of the more deepwater species such as snappers and groupers will also occupy the reef.

The deepwater sites are well suited for both high-relief and low-relief structures. High-relief structures offer potential habitat for a significantly larger number of species than low-relief structures. It is likely that many coastal and oceanic pelagic species will be attracted to a high-profile artificial reef that offers some type of mid-water structure. Species such as mackerels, cobia, bluefish, tunas, and billfishes which are recreationally and/or commercially important are likely to be attracted to such a structure. The lower portion of the structure would be similiar to a low-relief type artificial reef and would probably attract demersal fishes. Species such as snappers, groupers, and sea basses which are commercially and recreationally important would likely be attracted to the reef due to its location in deep water and close proximity to the shelf edge.

Researchers are just beginning to investigate the biological factors that are important to consider when siting and constructing an artificial reef. It is recommended that site-specific data for numerous

parameters such as substrate type and existing biota be investigated before final placement of an artificial reef. General information concerning the life histories of many commercially and recreationally important species is lacking and would be useful for artificial reef siting. Monitoring of biological and physical parameters should be conducted on any new artificial reef structure whenever possible.

Information concerning the biological parameters that affect artificial reefs is limited. Most of the data collected have been the result of funding from local, State, and Federal governments and from private industries that have economic interests in artificial reefs. Future funding for artificial reef research and monitoring will probably continue to originate primarily from these same groups. Additional potential funding may originate by using artificial reefs in mitigation or by committing the payment of fines to artificial reef endeavors.

1.0 INTRODUCTION

The use of artificial reefs as a habitat enhancement tool to expand recreational and commercial fishing opportunities has gained tremendous popularity during recent years. Many artificial reefs have been implemented by well intentioned and highly motivated persons who, unfortunately, constructed and sited their reefs with little or no scientific data (Bohnsack and Sutherland, 1985). Political persuasions, costs, available materials, and waste disposal have often been the major considerations for constructing and siting artificial reefs. Subsequently, numerous artificial reef efforts have been total failures resulting in a loss of money, labor, and occasionally already existing habitats (Stevens, 1963; Mathews, 1981). While the aforementioned considerations may continue to play a significant role in the construction and siting of artificial reefs, additional data (i.e., biological, operational, social, economical, and legal) and comprehensive plans are clearly necessary to fully profit from the many potential benefits offered by successful artificial reefs.

Biological considerations are of major importance for constructing and siting artificial reefs. Many parameters such as water depth and quality, reef profile and size, reef complexity, and spatial arrangement and orientation are important for optimizing the biological success of artificial reefs. All of these parameters must be considered along with specific habitat and environmental requirements of desired target species. Additionally, artificial reefs should be constructed and sited with fishery management goals and regulations in mind.

The purpose of this report is to review and evaluate the existing literature and data base concerning the biological parameters to be considered when constructing and siting artificial reefs. Using this existing information, biologically optimum locations will be selected for siting artificial reefs off the Florida Panhandle.

It should be pointed out that this is one aspect of a multidisciplinary effort to select sites. Therefore, while operational, social, economic, and legal constraints influence successful artificial reef development, no attempt was made (except in a very general way) to incorporate these other issues into the present analysis. Hence, potential sites are recommended primarily on the basis of biological factors. Biological, operational, social,

economic, and legal constraints must be evaluated in concert before final selections are made.

2.0 METHODS

The primary tasks conducted to achieve the objectives of this project involved collection and review of existing literature and data concerning the biological factors involved in constructing and siting artificial reefs. Data collection was accomplished by several different methods including: (1) computerized literature search and review; (2) review of in-house literature; (3) personal communications with researchers and persons involved with artificial reef projects; (4) input from the Advisory Group--a group of artificial reef knowledgeable persons selected to review and advise on the direction and nature of the project and products; (5) acquisition of information and advice compiled by persons at the Sport Fishing Institute's (SFI's) Artificial Reef Development Center; and (6) acquisition of information available from various State and Federal agencies.

A computerized literature search of numerous data bases from the DIALOG Information Retrieval Service was conducted using the key words "artificial reef." The search was conducted at Mississippi State University by Drs. Arthur Cosby and Bill Howard. Table 2.1 presents a list of data bases searched and the number of citations identified in each. A hard copy print-out of the citations was obtained and reviewed for pertinent literature. Copies of all pertinent literature were obtained and reviewed to identify additional information. An attempt was made to collect all pertinent information identified from the computer search and literature review.

Many in-house documents, including a significant amount of gray literature, were reviewed for pertinent information and additional references. Continental Shelf Associates, Inc. has a continuously expanding file concerning artificial reefs which provided a significant amount of information relevant to this study.

A number of persons at various universities, organizations, and private companies having experience with the construction and siting of artificial reefs were contacted for information. This information often assisted in identifying potential problems and solutions associated with implementing an artificial reef.

Numerous members of the Advisory Group provided valuable suggestions concerning literature and information sources to review and

TABLE 2.1. SUMMARY OF THE COMPUTER LITERATURE SEARCH OF VARIOUS DATA BASES FROM THE DIALOG INFORMATION RETRIEVAL SERVICE USING THE KEY WORDS "ARTIFICIAL REEF."

Data Bases Searched	Years	Citations
NTIS	1964-85	80
Dissertation Abstracts	1861 - Jan 1985	7
Sociological Abstracts	1963-84	0
PTS Defense Markets and Technology	1982-84	33
Conference Papers Index	1973 - Sep 1984	7
Federal Research in Progress	Sep 1984	1
Federal Research in Progress	(unabridged) Sep 1984	2
BIOSIS Previews	1981-85	31
BIOSIS Previews	1977-80	15
BIOSIS Previews	1969-76	17
COMPENDEX	1970 - Nov 1984	20
Oceanic Abstracts	1964 - Oct 1984	148
ENVIROLINE	1970 - Nov 1984	47
Aquatic Science Abstracts	1978 - Sep 1984	178
Environmental Bibliography	1974 - Oct 1984	8
Aquaculture	1970 - Jan 1984	0
Water Resources Abstracts	1968 - Nov 1984	28
	Total	622

offered the results of personal investigations. These individuals were also helpful by providing the views of various interest groups with whom they are associated.

The SFI in Washington, D.C. provided numerous publications concerning the design and siting of an artificial reef and exclusion maps for the specific areas of this study. Individuals at the SFI also helped by providing information that was requested for the study.

Individuals at various State and Federal agencies provided literature and/or information upon request. Many individuals associated with previous or ongoing artificial reef projects were most helpful in making recommendations for this project.

All of the compiled information was reviewed and a report synthesized in an attempt to identify the biologically optimum artificial reef sites off the Florida Panhandle.

3.0 LITERATURE REVIEW

The existing literature concerning biological parameters involved in siting a successful artificial reef can be classified into two general categories: (1) descriptive studies that provide biological and ecological observations made on artificial reefs; and (2) experimental studies designed to test and identify factors controlling recruitment, succession, fish attracting properties, and productivity of artificial reefs. Very few of these studies were conducted off the Florida Panhandle, however, much of the information is useful and can be applied to these specific study areas.

Bohnsack and Sutherland (1985) examined the artificial reef literature available through 1983. The report reviews the biology and ecology of artificial reefs and makes recommendations for future studies based on data gaps identified from the literature. The following discussions concerning the biological factors affecting artificial reef siting include summaries of information presented by Bohnsack and Sutherland (1985) and incorporate pertinent information made available after 1983.

Studies have shown that fishes use artificial reefs for feeding areas, shelter, spawning, orientation, and development (Klima and Wickham, 1971; Parker et al., 1979; Stone et al., 1979; Kakimoto, 1982). The parameters that attract fishes to artificial reefs have been extensively studied, but are not well understood. Studies attempting to determine the relative role of each parameter in attracting fishes to artificial reefs have been inconclusive and sometimes contradictory (Shinn, 1974; Russell, 1975; Prince and Gotshell, 1976; Prince et al., 1979; Hueckel and Slayton, 1982; Bohnsack and Sutherland, 1985). Although further research may prove otherwise, it seems that the parameters that are important in attracting fishes to artificial reefs are species-specific, and for most species, there is a combination of parameters which attract fishes to artificial reefs.

Studies have shown that several factors are biologically important for attracting fishes to artificial reefs and can be controlled to optimize the success of an artificial reef. These factors include substrate, oceanographic conditions, water quality parameters, productivity of surrounding water and substrate, proximity to other reefs/live-bottom areas, and vertical profile and relief. Although each

of these factors should be considered with respect to the desired target species, very few data are available concerning how these factors influence the recruitment of a particular species to an artificial reef.

The substrate on which an artificial reef is planned is critical to the success of a reef. Whenever possible, it is good practice to place a reef on a bottom where there is known to be underlying rock or hard pan. This will prevent the reef material from sinking into the substrate, and current action around the reef may scour the bottom and make additional reef habitat by exposing the rock (Mathews, 1981). Firm sand or sand/shell bottoms are the best substrate types to support a reef (Mathews, 1981). Substrate types that should be avoided are soft sediments, primarily comprised of clay or silt particles.

Oceanographic conditions should be considered when siting an artificial reef. Areas of upwelling, downwelling, ascending currents, and vortex currents have been suggested as good locations for artificial reef sites (Nakamura, 1982). Artificial reefs should be placed along the front line of internal waves and perpendicular to prevailing currents. Areas with strong tidal currents should be avoided (Mathews, 1981).

Water quality parameters such as temperature, turbidity, and anthropogenic pollutants should be considered when siting an artificial reef (Hueckel and Buckley, 1982; Sanders et al., 1985). Tolerances of desired target species to these parameters should be determined before siting an artificial reef. By comparing the water quality of areas with existing desirable fish populations to potential artificial reef sites, one can gain insight into the suitability of a potential site for colonization by desired species. A potential artificial reef site should be free from pollutants that may be biomagnified and potentially cause serious health problems for persons that eat the catch from the area.

Productivity of the water and benthic environments surrounding an artificial reef will affect artificial reef success (Randall, 1963; Russell, 1975; Hirose et al., 1977; Prince et al., 1979; Hueckel and Buckley, 1982; Steimle and Ogren, 1982). Considerable work is needed to fully understand the trophic pathways of artificial reef communities and the importance of productivity to the success of an artificial reef.

The effect of distance of an artificial reef site from a natural live-bottom area on the relative success of the artificial reef has been studied by numerous investigators. The results of these studies are

sometimes contradictory. Fast and Pagan (1974) observed that when an artificial reef was placed near a natural reef, fishes moved from the natural reef to the artificial reef, but not conversely. More recently, Matthews (1985) found that adult and subadult fishes moved from natural to artificial reefs up to a distance of 1.6 km. The author suggested that artificial reefs may increase fishing pressure that may be detrimental to the local fish population. Other investigators (Dewees and Gotshell, 1974; Stone et al., 1979) reported that artificial reefs in the immediate vicinity of live-bottom areas did not affect the fish community on the natural reef. Yoshimuda and Masuzawa (1982) suggested that artificial reefs should be placed at least 600 m (1,970 ft) from natural reefs so that each reef would not influence the other. Generally, it has been concluded that artificial reefs should be sited on barren sand bottoms where no existing live-bottom communities exist (Mathews, 1981; USDC, NMFS, 1985). It is better to add an additional productive habitat where one does not exist, rather than to make small improvements to an already productive live-bottom area.

Vertical profile and amount of relief offered by an artificial reef should be considered with respect to the target species. Study results concerning these factors are conflicting (Miyazaki and Sawada, 1978; Mottet, 1982; Grove and Sonu, 1983). Generally, it has been found that tall artificial reefs forming mid-water structures are best for attracting migratory pelagic species (i.e., mackerels, bluefish, and tunas). Low-relief structures with more horizontal structure on the seafloor are most suited for attracting demersal fishes (i.e., snappers, groupers, and sea basses) (Klima and Wickham, 1971; Matsumoto et al., 1981; Grove and Sonu, 1983). Other studies have shown that the shape of the reef may be more important than the height (Nakamura, 1982; Grove and Sonu, 1983). An artificial reef will best attract fishes if the sides are nearly vertical to increase turbulence and produce stagnation zones and lee waves.

Another biological factor that may affect artificial reef success may be the seasonality of spawning of target species. Many studies concerning the recruitment and succession of fishes on new artificial reefs indicate that juvenile fishes are often the first to inhabit an artificial reef and are often present in large numbers (Randall, 1963; Russell et al., 1974; Stone et al., 1979; Gascon and Miller, 1981; Walsh, 1985). Although there is little information to show that juveniles associated with artificial reefs survive and grow to adults, it seems that an artificial reef provides additional habitat for juvenile fishes

that may not normally survive. Placement of an artificial reef during the peak influx of juveniles of target species may significantly increase the number of juveniles that develop and mature (Carter et al., 1985). Considerably more research is needed to correlate the juveniles of a species settling on an artificial reef with peaks in spawning and larval availability.

The success of artificial reefs relative to natural reefs has been studied by numerous investigators (Randall, 1963; Buchanan, 1973, 1974; Russell, 1975; Molles, 1978; Smith et al., 1979; Gascon and Miller, 1981; Burchmore et al., 1985; Jessee et al., 1985). Generally, it has been found that the community structure of fishes colonizing an artificial reef is similar to the fish communities occupying nearby natural reefs. Although there are some conflicting reports, it seems that fish abundances on artificial reefs generally exceed those of nearby natural reefs. This is probably due to the greater complexity of artificial reefs compared to natural reefs, however, many factors are not well understood.

Whether artificial reefs actually increase fish productivity or simply aggregate existing individuals is not known (Mottet, 1982; Kuwatani, 1982; Grove and Sonu, 1983). Some investigators concluded that artificial reefs increase fish availability but not net productivity, while others suggest that artificial reefs allow secondary biomass production through increased survival and growth of new individuals due to the shelter and food resources provided by the reef (Manges, 1960; Beguery, 1974; Bohnsack and Sutherland, 1985). Considerable research is necessary before the productivity of fishes on artificial reefs is understood.

A review of existing information concerning artificial reefs has indicated that considerably more research is necessary to better understand the biological parameters that affect artificial reefs. Additionally, very little information is available from studies conducted offshore the Florida Panhandle.

4.0 ARTIFICIAL REEF SITE SELECTION

4.1 FLORIDA

4.1.1 Characterization of Potential Artificial Reef Environments

The temperature of surface waters overlying the continental shelf off northwestern Florida ranges from approximately 63 to 72°F (17 to 22°C) in winter to 82 to 88°F (28 to 31°C) in summer (Gaul and Boykin, 1964, 1965; Drennan, 1968; SUSIO, 1977; Dames & Moore, 1979). Variations in nearshore surface temperatures are closely related to air temperatures. Surface water temperatures farther offshore closely correspond with air temperatures in spring and summer, but deviate somewhat during fall and winter (Drennan, 1968; Huh et al., 1978). Mean bottom water temperatures, inclusive of summer and winter, range from approximately 57 to 68°F (14 to 20°C). Intrusions of the Loop Current onto the shelf may disrupt normal patterns and cause anomalous high temperatures during nearly any season (SUSIO, 1977; Molinari and Festa, 1978; Vukovich et al., 1979; Sturges and Evans, 1983).

The salinity of waters overlying the continental shelf off northwestern Florida generally range from approximately 28 to 37 ppt. During spring (January to May), there is a marked increase in freshwater discharges into coastal waters overlying the shelf causing a reduction in salinity (Schroeder, 1975). Other factors that influence salinity include evaporation, upwelling, and Loop Current intrusions. The major salinity changes due to freshwater discharges occur within the upper 33 to 66 ft (10 to 20 m) of the water column. Major salinity changes may affect water circulation in the area as a result of corresponding density changes.

Currents on the shelf off northwestern Florida are greatly influenced by bottom topography, primarily the De Soto Canyon. Currents which would normally follow a given direction due to wind stress or other forces can be diverted (Tolbert and Salsman, 1964; Gaul and Boykin, 1965; Gaul et al., 1966; Durham and Reid, 1967; Gaul, 1967; Drennan, 1968; Schroeder, 1976). Based on various data types (direct measurements, wind stress, drift bottles, and bottom and coastal configuration), the normal current flow is easterly or westerly, parallel to the coastline or isobaths. There is a slight bias toward flow to the west. Naturally occurring events such as cold-air outbreaks, tropical storms, and Loop

Current intrusions may drastically change these conditions during any season.

Sediments occurring on the continental shelf off the Florida Panhandle are typically sand. These sediments appear well-suited for supporting any type of artificial reef structure. Figure 4.1 shows the sediment types occurring off the Florida Panhandle.

The benthos off northwestern Florida has been studied by numerous investigators (Defenbaugh, 1976; SUSIO, 1977; Dames & Moore, 1979). The nearshore community to a depth of approximately 66 ft (20 m) has been described as the West Florida Inner Shelf Assemblage. Table 4.1 shows a list of benthic species characteristic of the West Florida Inner Shelf Assemblage. From approximately 66 to 197 ft (20 to 60 m), the benthos has been referred to as the West Florida Intermediate Shelf Assemblage. Table 4.2 presents a list of benthic species characteristic of the West Florida Intermediate Shelf Assemblage. From approximately 197 to 394 ft (60 to 120 m), the benthos has been described as the West Florida Outer Shelf Assemblage. Table 4.3 presents a list of benthic species characteristic of the West Florida Outer Shelf Assemblage.

Some areas along the edge of the De Soto Canyon exhibit high relief and live-bottom assemblages (Ludwick and Walton, 1957; Shipp and Hopkins, 1978). Outcrops and spire-like ledges attain 33 to 49 ft (10 to 15 m) of relief and have sponges, sea fans, sea whips, and tropical fishes associated with them. These areas are productive live-bottom areas and should be avoided as potential artificial reef sites.

SUSIO (1977) collected dredges and trawls along a transect off northwestern Florida. The macroepifauna and epiflora consisted of numerous species, including 58 molluscs, 59 decapods, 18 echinoderms, 16 algae, 5 scleractinian corals, and 1 octocoral.

Fishes that occur off northwestern Florida are similiar to the fishes that occur off Mississippi and Alabama. Coastal fishes that are commercially and economically important include sheepshead, red drum, black drum, seatrouts, whiting, spot, croakers, and mullets. Farther offshore, the fish fauna associated with outcroppings along the edge of the De Soto Canyon are numerically dominated by more tropical species. Serranids (sea basses) and pomacentrids (damselfishes) are the most conspicuous fishes present, however, numerous apogonids (cardinalfishes), chaetodonts (butterflyfishes), priacanthids (bigeyes), sciaenids (drums),

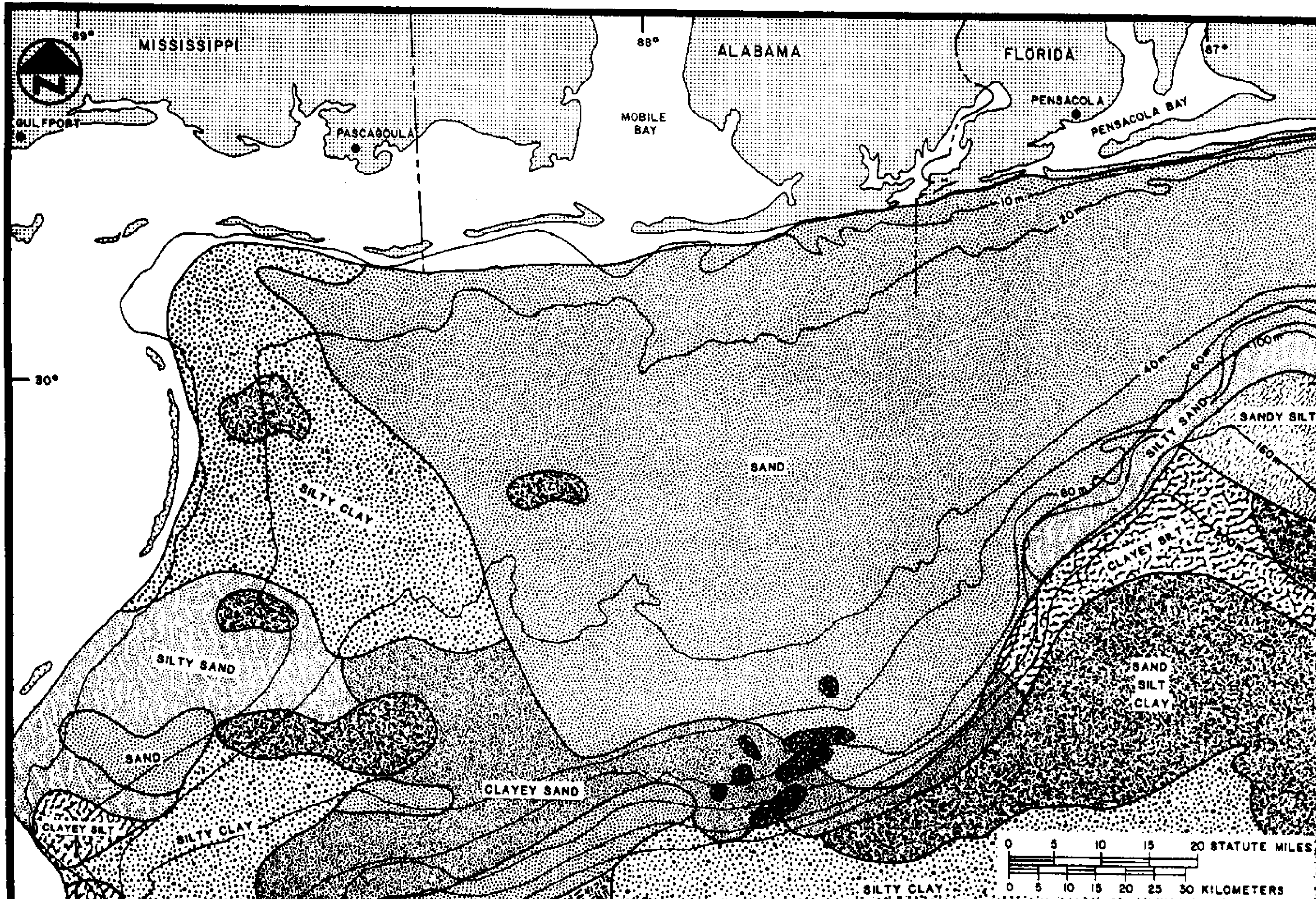

FIGURE 4.1. BATHYMETRIC CONTOURS AND SEDIMENT TYPES OFF MISSISSIPPI, ALABAMA, AND THE FLORIDA PANHANDLE (FROM: BROOKS, 1973).

TABLE 4.1. BENTHIC SPECIES CHARACTERISTIC OF THE WEST FLORIDA INNER SHELF ASSEMBLAGE (FROM: DEFENBAUGH, 1976).

Cnidaria	Natantia
Leptogorgia virgulata	*Penaeus duorarum*
Gastropoda	Reptantia
Anachis semiplicata	*Libinia dubia*
Mitrella lunata	*Metoporhaphis calcarata*
Fasciolaria l. hunteri	*Podochela riisei*
	Portunus gibbesii
Bivalvia	Echinodermata
Glycymeris pectinata	*Lytechinus variegatus*
Brachidontes exustus	*Mellita quinquiesperforata*
Musculus lateralis	*Echinaster spinulosus*
Argopecten i. concentricus	*Ophiothrix angulata*
Chione cancellata	*Luidia clathrata*
Pycnogonida	
Anoplodactylus insignis	

TABLE 4.2. BENTHIC SPECIES CHARACTERISTIC OF THE WEST FLORIDA INTERMEDIATE SHELF ASSEMBLAGE (FROM: DEFENBAUGH, 1976).

Porifera	Reptantia
Ircinia strobilina	*Portunus spinicarpus*
Haliclona viridis	*Stenorhynchus seticornis*
Speciospongia vesparia	*Parthenope serrata*
Gastropoda	Echinodermata
Fasciolaria lilium	*Luidia clathrata*
	Astropecten spp.
	Ophiolepis elegans
Bivalvia	*Encope michelini*
	Arbacia punctulata
Argopecten gibbus	*Eucidaris tribuloides*
Lyonsia beana	*Echinaster* sp.

TABLE 4.3. BENTHIC SPECIES CHARACTERISTIC OF THE WEST FLORIDA OUTER SHELF ASSEMBLAGE (FROM: DEFENBAUGH, 1976).

Bivalvia	Reptantia
Argopecten gibbus	*Raninoides louisianensis*
	Calappa sulcata
	Portunus spinicarpus
Natantia	*Anasimus latus*
Parapenaeus longirostris	

holocentrids (squirrelfishes), and lutjanids (snappers) are also present in large numbers (Shipp and Hopkins, 1978). The serranids and lutjanids are important species to both commercial and recreational fishermen.

In addition to resident fishes, numerous other fishes occur seasonally along the northwestern Florida coast. Pelagic fishes such as king and Spanish mackerels migrate and spawn off northwestern Florida during spring. Bluefin tuna migrate and spawn beyond the edge of the continental shelf during winter and spring. Billfishes such as black marlin, white marlin, sailfish, spearfish, and swordfish spawn along the edge and beyond the continental shelf. Other pelagic species such as cobia, dolphin, blackfin tuna, wahoo, and bluefish also migrate and spawn off northwestern Florida and are commercially and/or recreationally important at various times of the year.

4.1.2 Identification of Sites Selected for Artificial Reef Placement off Florida

Two potential artificial reef sites have been selected off northwestern Florida: a shallow water and a deepwater site. The shallow water site is located 21 mi (39 km) southeast of Pensacola in approximately 80 to 150 ft (24 to 46 m) of water. Coordinates of the site are approximately 30°10'N Lat and 87°05'W Long. Figure 4.2 shows the location of the site. Due to its close proximity to both the coastline [13 mi (24 km)] and the shelf edge [0.25 mi (0.5 km)], it is likely that a wide variety of species can utilize the artificial reef structure. The site is probably close enough to shore that numerous coastal species such as drums and seatrouts will be able to utilize the structure. At the same time, due to its close proximity to the shelf edge, some species (snappers and groupers) more commonly associated with the irregular shelf edge habitats will also be able to utilize the reef.

It is likely that a low-relief [≤50 ft (≤15 m)] structure is probably best suited for the shallow water site; however, a high-profile structure like an oil platform would likely act as an attractant for coastal pelagic species such as king mackerel, cobia, and bluefish. A high-profile structure would also provide habitat for demersal species (lutjanids and serranids) as would a low-profile structure. Local fishermen indicated that they presently fish for both demersal and pelagic species and are interested in an artificial reef to maximize their catch of both species types.

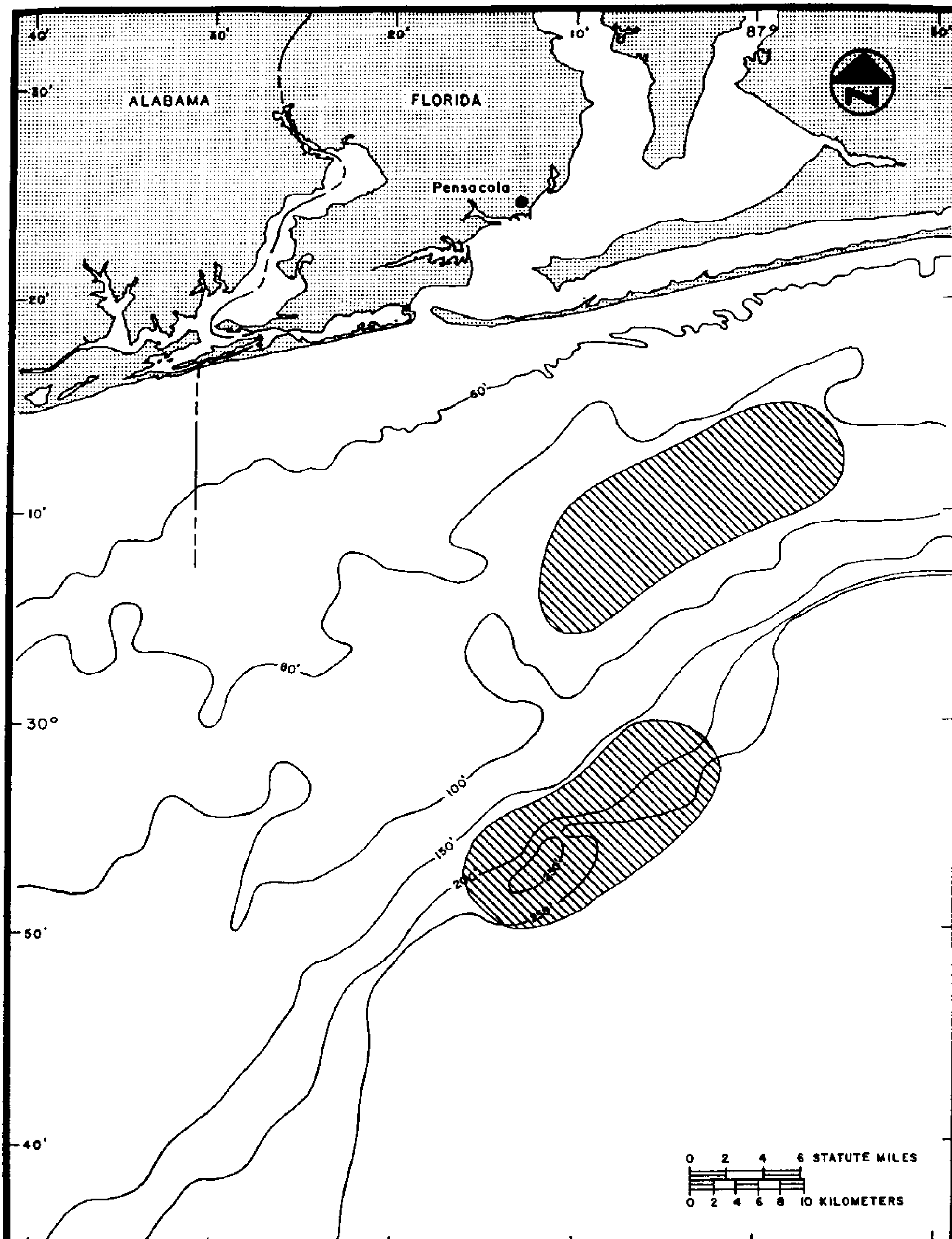

FIGURE 4.2. POTENTIAL ARTIFICIAL REEF SITES OFF FLORIDA.

The bottom substrate at the site is likely to be sand, although no site-specific data were identified. It is suggested that site-specific data for both substrate and productivity of the surrounding bottom be collected before final placement of the reef to optimize the successfulness of the reef.

One additional parameter that should be considered prior to reef placement is water clarity or turbidity. Due to the relatively shallow nature of the site, the reef will be within the depth limits of scuba divers. Meetings with local fishermen and divers indicated that scuba diving would likely occur on an artificial reef structure placed in the area. To best provide a structure that can be recreationally and commercially used by the largest number of people, the reef should be placed in relatively clear water. It is likely that water clarity is quite good at the shallow water site because the site is close to the shelf edge.

The deepwater site is located south of Pensacola in approximately 150 to 250 ft (46 to 76 m) of water. Figure 4.2 shows the deepwater site location. Coordinates of the site are approximately 29°52'N Lat and 87°13'W Long. The site is probably best suited for a high-profile reef that can provide a mid-water structure up to approximately 70 ft (21 m) from the surface without requiring a buoy. The structure is located at the edge of the shelf and would provide an excellent habitat for fish assemblages similiar to those that occur along the edge of the De Soto Canyon. Serranids and lutjanids would probably be the most important commercial and recreational species to occupy the reef. In addition to attracting the previously described demersal and coastal pelagic fishes, a mid-water structure in the area would likely attract numerous oceanic pelagic species such as tunas, swordfish, and billfishes. Pristas (1981, 1982) identified the area to be a location where a significant number of billfishes were raised relative to other areas in the De Soto Canyon area. Many of these fishes are attracted to high-profile and even floating structures. It is likely that an artificial reef with a significantly high profile could further serve to attract and congregate these species. The bottom substrate is most likely sand, however, a site-specific survey of both the substrate and productivity of the surrounding benthic habitat is suggested before final placement of the reef. The reef site is located on the shallow side of a steep topographic feature and may be in an area of upwelling. The upwelling would probably be beneficial for attracting both demersal and pelagic species.

5.0 DISCUSSIONS AND CONCLUSIONS

5.1 FUTURE BIOLOGICAL CONSIDERATIONS

The coastal waters overlying the continental shelf off Mississippi, Alabama, and the Florida Panhandle provide habitat for important commercial and recreational fishery resources. Proper implementation of artificial reef programs could greatly enhance the fishery resources available to all three States.

Biological data were reviewed prior to selecting the potential artificial reef sites off each State. In each case, very little site-specific information was available. It is recommended that further biological and environmental parameters be investigated at each site prior to the final placement of an artificial reef.

Following the review of the literature concerning the biological parameters that affect artificial reefs, it became apparent that there is a general lack of data concerning many of these parameters as related to specific species and geographic areas. Biological monitoring is strongly recommended before and after the placement of any artificial reef structure. Monitoring should include measurements and observations including substrate type, productivity, oceanographic and water quality conditions, species present, their life histories, and their utilization of the reef. Collection of this information will increase the relative cost of an artificial reef program, however, the increase in knowledge can significantly contribute to increasing the successfulness of future artificial reef programs.

Following the regional meetings with local fishermen it became apparent that most recreational fishermen will fish for nearly any species that they think it will be possible to catch. Although a majority prefer to fish for species that are edible, most recreational fishermen set off on a fishing trip planning to catch whatever they can. Few have species that they do not want to catch. Due to the non-specific target species it is probably difficult to build an artificial reef that will not benefit the recreational fishermen in some manner. Commercial fishermen are limited to seeking species that have some marketable quality and are therefore more difficult to please when constructing an artificial reef. These factors must be considered when designing an artifical reef from a biological perspective.

5.2 FUTURE ARTIFICIAL REEF PROGRAMS

Artificial reefs provide an innovative way to increase the potential catch of both recreational and commercial fishermen. Although the placement of artificial reef structures to increase habitat in the marine environment is not a new idea, research concerning the factors that can optimize the beneficial effects of artificial reefs has been limited. Significantly more data are necessary to realize the full potential and effects of artificial reefs.

Commercial and recreational fishermen benefit most from the placement of successful artificial reefs. Unfortunately, fishermen generally do not have significant amounts of capital to invest in artificial reef placement and research. As a result, although numerous artificial reefs have been placed by small localized fishing groups or interests, most of the data that exist concerning the parameters involved in creating a successful artificial reef have been collected by either local, State, or Federal governments or private industry, generally with some commercial interests in the project. It seems that this trend will continue in the future.

The largest sector of private industry with perhaps the most at stake economically is the oil and gas industry because of the problem of removing obsolete offshore petroleum platforms. Legal and economic considerations will probably be foremost in determining the future of artificial reefs, especially artificial reefs from offshore petroleum platforms. The oil and gas industry has been examining these problems and working closely with the Federal Government to determine the most mutually beneficial solutions. The Federal Government is developing a National Artificial Reef Plan to provide reef construction and placement guidelines and is continuing to fund research concerning various aspects of artificial reefs. Many of the existing platforms provide valuable fishery habitats and removal may have detrimental effects on fisheries and fishermen; however, maintenance and liability problems must be solved before any platforms are left in place. Several oil companies have already taken the lead by dismantling, transporting, and placing obsolete petroleum platforms as artificial reefs offshore Alabama and Florida. Very little monitoring has been conducted to determine the successfulness of these artificial reefs to optimize the success of future endeavors. Monitoring should be conducted in the future when additional offshore petroleum platforms are placed as artificial reefs.

One suggested method for promoting artificial reef endeavors is to develop regulatory policies whereby artificial reefs can be used as a form of mitigation or perhaps fine payment. Mitigation is a relatively new concept (e.g., see Soileau et al., 1985; Alevras and Edwards, 1985; Duffy, 1985) that could be used for developing artificial reef projects by industry involved in development of environmentally sensitive areas. Artificial reef programs could serve as mitigation measures to: (1) avoid or minimize impacts on organisms and habitats; or (2) compensate for unavoidable losses of those resources. Perhaps companies that have committed some type of environmental damage could be required to fund artificial reef projects in place of fine payments. These types of programs are potential suggestions that would provide more artificial reefs and data pertinent to artificial reefs, however, legal changes would be necessary to implement such actions. Government policy makers should investigate the feasibility of such policies.

A significant amount of information is still needed to optimize artificial reefs. Artificial reef decisionmakers should adopt comprehensive plans for artificial reef development and data acquisition in the future. With proper planning and data, artificial reefs could provide a useful tool for government, private industry, fishermen, and fishery managers.

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CSA

Continental Shelf Associates, Inc.

OPERATIONAL FACTORS AFFECTING
ARTIFICIAL REEF SITING OFF THE FLORIDA PANHANDLE

28 FEBRUARY 1986

PREPARED FOR:

National Marine Fisheries Service
Southeast Region
9450 Koger Boulevard, Duval Building
St. Petersburg, Florida 33702

PREPARED BY:

Continental Shelf Associates, Inc.
759 Parkway Street
Jupiter, Florida 33477
Telephone: (305) 746-7946

"Applied Science and Technology"

ABSTRACT

Operational factors that influence the siting of artificial reefs include environmental conditions at the site, availability and suitability of different reef materials, transportation and logistics requirements, deployment techniques, optimum reef design, and marking requirements. Concrete blocks and rubble, steel ships and barges, obsolete petroleum platforms, and Japanese-designed structures are the most suitable materials for artificial reefs.

The shelf drops off rapidly offshore from Pensacola, Florida. Deep water and firm substrates make much of the area suitable for reef development. An area of deep water near shore and with a sandy bottom is suggested for reef siting. Japanese-designed structures and obsolete ships, barges, and petroleum platforms are suitable materials for deployment in the area.

Technology exists for the transport of reef materials to the selected sites. Barges, heavy equipment, or flotation devices will be needed, depending on the material being used. Reef construction should incorporate a high degree of complexity into the reef structure. Reefs with less than 85 ft (26 m) minimum clearance will probably need a lighted buoy to mark the location.

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EXECUTIVE SUMMARY

This study was initiated as part of a multidisciplinary effort to identify potential artificial reef sites off the Florida Panhandle on the basis of legal, social, economic, biological, and operational issues. This report designates sites on the basis of operational constraints.

Operational factors that influence reef siting include environmental conditions at the site, availability and suitability of different reef materials, transportation and logistics requirements, deployment techniques, optimum reef design, and marking requirements. A computerized literature search was undertaken to identify the available literature on these topics.

Numerous types of materials have been used in the past to construct artificial reefs. Based on availability and durability, concrete blocks and rubble, steel ships and barges, obsolete petroleum platforms, and Japanese-designed structures are the most suitable materials for reef construction. Blocks created from fly ash generated by power plants that burn coal may also have applications for artificial reef use. Although tires have been used extensively in the past, their tendency to drift or break apart makes their use questionable.

Environmental conditions that affect the success of artificial reefs include waves and currents, depth, substrate type, and topography. Areas subject to high-energy waves and currents should be avoided because these conditions limit the life-span of a reef. Depth is important for maintaining minimal navigational clearance, attracting the target fish species, and minimizing the effects of storms on reefs. Firm sand substrates are preferred to minimize the loss of a reef due to sinking or siltation. Topographies that are favorable for artificial reefs include flat and featureless bottom regions, near the shoreward edges of valleys or depressions, or areas on either side of ridges.

The area off the Florida Panhandle is characterized by deep water in close to shore unlike most areas of the Gulf of Mexico. Sand bottoms cover a large portion of the area. Most of the existing reefs are located in nearshore waters of 67 ft (20 m) or less. The Escambia County Marine Recreation Committee has proposed 22 artificial reef sites in shallow (48 ft) (15 m) to deep (185 ft) (56 m) waters. A proposed reef zone extends seaward from the 80-ft contour and east of the existing navigational fairway to Pensacola Harbor. This area would include most of the sites proposed by the Escambia County Committee. This zone includes the site of the existing Tenneco reef at a depth of 175 ft (54 m). Expansion of the reef complex at this site is recommended as a priority.

Transportation of recommended reef materials, including obsolete petroleum platforms, to a site is technically feasible. Barges and heavy equipment or flotation equipment for towing to a site will be required. Little information is available in the literature on deployment methods, however, it is important to anchor an offloading vessel to minimize spreading and to optimize placement of reef materials.

Reef size, complexity, spatial arrangement, location, orientation, and height are important factors to consider for a successful artificial reef. Optimum reef area ranges from 200 to 2,500 m^2 (cross section) or 2,500 to 130,000 m^3 (bulk volume). Reefs should consist of a hierarchical arrangement that includes blocks or units to form a set, sets clustered to form groups, and several groups to form a reef complex. Sets within a group should be spaced approximately 985 to 1,640 ft (300 to 500 m) apart. Reef complexes should be spaced at least 2 mi (3 km) apart. Reefs should be oriented perpendicular to currents. Reef height is probably most important for migratory fishes, and horizontal spread is probably most important for demersal fishes. Reef profile is more important than height, and vertical sides seem to be the best attractants. Vertical panels and horizontal and diagonal skeletal members are effective attractants because of the niches and shadows created. Large chambers and holes are avoided by fishes as are chambers with only one opening.

The U.S. Coast Guard determines the necessity for marking an artificial reef on the basis of:

1) physical characteristics of the obstruction;
2) depth of water in which the obstruction is located;
3) proximity of the obstruction to historic or designated vessel routes; and
4) type of vessel traffic at the obstruction site.

Marker buoys are generally not required if there is a 85-ft (26-m) minimum clearance above the reef.

1.0 INTRODUCTION

The United States has been one of the world's leaders, along with Japan, in using artificial reefs to enhance fishing activities in offshore waters. Many of the efforts in the United States have developed haphazardly as a result of low budget efforts by private groups or minimally-funded State agencies. One thing learned during trial and error endeavors is that knowledge and understanding of operational considerations are imperative to successful reef-building efforts.

Operational factors that need to be considered in planning artificial reef projects include environmental conditions at the site, availability and suitability of different reef materials, transportation and logistics requirements, deployment techniques, optimum reef design, and marking requirements. The objective of this report is to evaluate these factors as they affect reef-building operations and to select areas or sites suitable for the placement of artificial reefs.

It should be pointed out that this is one aspect of a multidisciplinary effort to select sites. Therefore, while legal, social, economic, and biological constraints influence successful artificial reef development, no attempt was made (except in a very general way) to incorporate these other issues into the present analysis. Hence, potential sites are recommended primarily on the basis of operational factors. Operational, legal, social, economic, and biological constraints must be evaluated in concert before final selections are made.

2.0 METHODS

The primary tasks conducted to achieve the objectives of this project involved collection and review of existing literature and data concerning the operational factors involved in constructing and siting artificial reefs. Data collection was accomplished by several different methods including: (1) computerized literature search and review; (2) review of in-house literature; (3) personal communication with researchers and persons involved with artificial reef projects; (4) input from the Advisory Group--a group of artificial reef knowledgeable persons selected to review and advise on the direction and nature of the project and products; (5) acquisition of information and advice compiled by persons at the Sport Fishing Institute's (SFI's) Artificial Reef Development Center; and (6) acquisition of information available from various State and Federal agencies.

A computerized literature search of numerous data bases from the DIALOG Information Retrieval Service was conducted using the key words "artificial reef." The search was conducted at Mississippi State University by Drs. Arthur Cosby and Bill Howard. Table 2.1 presents a list of data bases searched and the number of citations identified in each. A hard copy print-out of the citations was obtained and reviewed for pertinent literature. Copies of all pertinent literature were obtained and reviewed to identify additional information. An attempt was made to collect all pertinent information identified from the computer search and literature review.

Many in-house documents, including a significant amount of gray literature, were reviewed for pertinent information and additional references. Continental Shelf Associates, Inc. has a continuously expanding file concerning artificial reefs which provided a significant amount of information relevant to this study.

A number of persons at various universities, organizations, and private companies having experience with the construction and siting of artificial reefs were contacted for information. This information often assisted in identifying potential problems and solutions associated with implementing an artificial reef.

Numerous members of the Advisory Group provided valuable suggestions concerning literature and information sources to review and

TABLE 2.1. SUMMARY OF THE COMPUTER LITERATURE SEARCH OF VARIOUS DATA BASES FROM THE DIALOG INFORMATION RETRIEVAL SERVICE USING THE KEY WORDS "ARTIFICIAL REEF."

Data Bases Searched	Years	Citations
NTIS	1964-85	80
Dissertation Abstracts	1861 - Jan 1985	7
Sociological Abstracts	1963-84	0
PTS Defense Markets and Technology	1982-84	33
Conference Papers Index	1973 - Sep 1984	7
Federal Research in Progress	Sep 1984	1
Federal Research in Progress	(unabridged) Sep 1984	2
BIOSIS Previews	1981-85	31
BIOSIS Previews	1977-80	15
BIOSIS Previews	1969-76	17
COMPENDEX	1970 - Nov 1984	20
Oceanic Abstracts	1964 - Oct 1984	148
ENVIROLINE	1970 - Nov 1984	47
Aquatic Science Abstracts	1978 - Sep 1984	178
Environmental Bibliography	1974 - Oct 1984	8
Aquaculture	1970 - Jan 1984	0
Water Resources Abstracts	1968 - Nov 1984	28
	Total	622

offered the results of personal investigations. These individuals were also helpful by providing the views of various interest groups with whom they are associated.

The SFI in Washington, D.C. provided numerous publications concerning the design and siting of an artificial reef and exclusion maps for the specific areas of this study. Personnel at the SFI also helped by providing information that was requested for the study.

Literature and/or information was obtained from various State and Federal agencies. Many individuals associated with previous or ongoing artificial reef projects were most helpful in making recommendations for this project.

All of the compiled information was reviewed and a report synthesized in an attempt to identify the operational optimum artificial reef sites off the Florida Panhandle.

3.0 LITERATURE REVIEW

Previous attempts at constructing artificial reefs have demonstrated that the type of material used as well as environmental factors affect the success of a reef-building operation. These factors are also important operational issues in selecting potential artificial reef sites. The following section presents a summary of findings from previous reef-building operations as related to these factors.

3.1 TYPES OF REEF MATERIALS

Although many types of materials have been used for artificial reef construction (Table 3.1), not all materials are suitable or recommended for use. Myatt (1981) suggested that persons involved in selection of materials for reef construction should consider the cost of preparing the materials, transportation requirements, suitability of the materials to reef objectives, and abundance of the materials. Hinman (1981) suggested that the reef program objectives (i.e., who will be the user groups) are important considerations in the selection of reef materials as well as the reef size and configuration.

Artificial reef-building efforts in the United States have primarily been directed toward recreational fishermen and have often resulted in large, haphazardly constructed reefs using scrap materials (Bohnsack and Sutherland, in press). Automobile tires and concrete blocks have been the most commonly used materials because of their availability, low cost, and ease of handling. Although tires have been widely used, specialized equipment is required to compress the tires into bales (Tolley, 1981). Ryder (1981) suggested that tire bales not be placed in waters less than 70 ft (21 m) deep because of their tendency to break apart and drift in high energy environments. Mathews (1984) reported that the U.S. Army Corps of Engineers (COE) stopped permitting tire reefs altogether. Other low density materials such as automobile bodies and appliances are not recommended because of their tendency to rust away and/or drift in shallow waters (Ryder, 1981). The use of wooden structures or vessels is also discouraged because of eventual navigational hazards or beach littering following disintegration during storms (Mathews, 1984).

Concrete materials are suitable for artificial reef construction because of their density, durability, low cost, and availability (Ryder,

TABLE 3.1. MATERIALS USED IN THE CONSTRUCTION OF ARTIFICIAL REEFS (FROM: RYDER, 1981).

Metal Material
Light Metal:
Automobiles
Boats
Appliances
Heavy Metal:
Oil platforms
Steel vessels
Rubber
Automobile tires
Truck and heavy equipment tires
Concrete
Culverts
Manholes
Blocks and bricks
Rubble
Rock
Other
Fiberglass
PVC
Wood
Coal waste combustion products
Electrodeposition

1981). Mathews (1983) considered concrete as one of the most effective materials in use in the country. He pointed out that concrete reefs require relatively limited amounts of labor, but do necessitate the use of heavy equipment for loading and unloading. Sheehy (1983) noted that concrete material requires a staging/storage area and that transportation costs from construction sites to staging areas can be considerable.

Ships and barges are the oldest type of artificial reef material (Mathews, 1983). Sunken vessels provide high profile and large surface areas which are advantageous in providing substrate for marine growth and attracting fishes (Bieling, 1981). Steel-hull barges and ships have been among the most successful materials used in Florida's reef-building projects (Dean, 1983). During the 1970s, obsolete Liberty Ships were made available by the Federal government to States interested in artificial reef construction. Mississippi and Alabama deployed five vessels each and Florida deployed six vessels before the supply diminished (Anonymous, 1985). Future sources of this type of material will likely be from private sources.

Recent interest has focused on the use of obsolete offshore oil and gas production platforms as artificial reefs. Six reefs have been created in waters off Alabama and Florida using obsolete structures donated by Exxon Company, U.S.A., Marathon Oil Company, Tenneco Oil Exploration and Production, and the Stage I and II platforms from the U.S. Navy. All but one of these reefs have been created in Gulf of Mexico waters. The reef outside this area was constructed in the Atlantic off Broward County, Florida. McIntosh (1981) reported that the reef created from the Exxon structure is one of the most productive in Florida. Over 3,700 structures are located in the Gulf of Mexico and about 40 become obsolete every year (Dean, 1983). The fact that most of these structures are located off Louisiana and Texas results in significant operational and logistic costs for towing these structures to the eastern Gulf. In spite of the costs, it was estimated that Exxon's platform donation as a reef saved 5 million dollars over the costs of dismantling and disposal on shore (Dean, 1983). Costs and/or savings can be expected to vary depending on water depth at the platform site, platform size, and distance to the reef site. Shell Oil Company (1985), for example, estimated that use of a platform as an artificial reef (i.e., one towed to another location) would cost from approximately one half to one seventh of that required for dismantling and disposal on shore. This variation was largely dependent on water depth.

Carleton et al. (1982) and Woodhead et al. (1982) discussed the results of creating artificial reefs from wastes generated by burning coal in power plants. The need to dispose of these wastes and the shortage of sufficient land-fill capacity raised the potential for ocean disposal combined with reef construction. A conversion process that combines a sludge filtercake with fly ash is required to stabilize the wastes and protect the environment. Preliminary results seem to indicate that the waste product is nontoxic to marine life and the reefs attract fishes and invertebrates.

The Japanese government has ceased funding the construction of artificial reefs built from waste materials (Bohnsack and Sutherland, in press). The Japanese artificial reef program is directed toward commercial fishermen and uses special designs and materials including steel-reinforced or prestressed concrete, polyethylene concrete, rubber, and fiberglass-reinforced plastic (FRP). Sheehy (1981) suggested that the manufactured reefs used by the Japanese offer greater design flexibility, extended life spans, and better bottom stability than the materials commonly used in the United States. Sheehy (1983) compared a scrap culvert reef and a Japanese-designed FRP reef and found the latter to be superior in terms of attracting and sustaining desired target species of fishes and forage species in Florida waters. Major costs of FRP reefs are in materials and construction rather than in transportation, handling, and placement as with scrap material reefs (Sheehy, 1983).

The reefs described in the preceding discussion are all designed as bottom structures. Mid-water and surface structures are also available for use in attracting pelagic fish species. These types of fish attractors generally consist of a float, an attractor (e.g., discarded net material, synthetic-covered fiberglass frames and streamers, etc.), and an anchored mooring (McIntosh Marine, 1983). McIlwain and Lukens (1978) reported successful efforts in attracting pelagic species to two artificial reef sites off Mississippi using mid-water attraction devices. McIntosh Marine (1983) also found that it was possible to increase the number of fishes at artificial reef sites by the addition of mid-water attraction devices. Myatt (1978) described the use of mid-water devices to create a "trolling alley" adjacent to natural or artificial reefs and increase the catch rate of pelagic fishes.

Given the existing evidence, it is apparent that concrete materials, steel ships and barges, and obsolete petroleum platforms will most likely be used in constructing artificial reefs in the United States. Japanese-designed structures also present a significant potential for increasing artificial reef productivity in U.S. waters. Other materials are less suitable because of their lack of durability or availability. Therefore, the discussions which follow in selecting reef sites based on operational characteristics will focus only on the proposed use of these four types of materials.

3.2 ENVIRONMENTAL FACTORS

Bohnsack and Sutherland (in press) summarized the state-of-the-art in artificial reef design and placement and found that some investigators concluded that correct site selection was more important than reef design. Many artificial reef projects have been less than successful because reef planners have failed to consider substrate conditions and the energy environment at a site. Site selection should be based on optimum environmental conditions.

Important oceanographic considerations include wave direction and force and magnitude of tidal and ocean currents. Mathews (1985) suggested that areas with strong tidal currents should be avoided because these currents will cause erosion on alternate sides of the reef, causing it to sink. A relatively weak current could be beneficial to a reef situated at right angles to the current. Sheehy (1982) has developed stability calculation equations that use available oceanographic data and estimates of significant and maximum wave heights and periods, current velocities, and substrate data. These equations have been used to predict the stability of various Japanese-designed unit reef configurations under various conditions.

Depth is of prime importance in placing artificial reefs for several reasons. First, regulatory agencies require a certain minimum clearance for navigational purposes. In Florida, the COE prefers a minimum clearance of 50 ft (15 m) although more or less may be required depending on the location and type of reef (J. Winn, 1985, personal communication, COE). The Oil Industry International Exploration and Production Forum (1984) has taken the view that at least 130 ft (40 m) of clearance should exist when petroleum platforms are used as artificial reefs. Figure 3.1 shows bathymetric contours off the Florida Panhandle. It is significant to note that the shelf off Pensacola, Florida tends to be among the narrowest in the Gulf of Mexico.

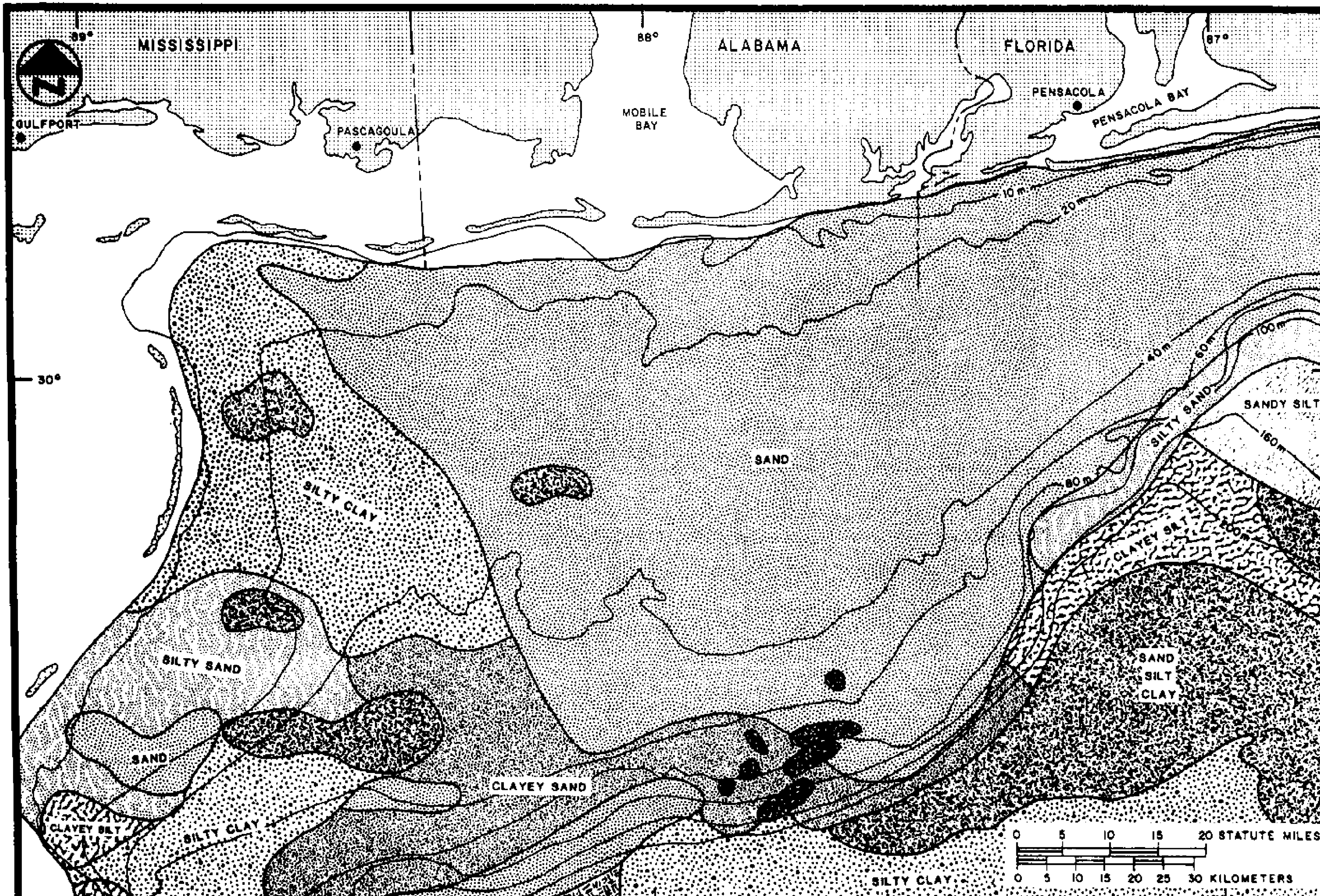

FIGURE 3.1 BATHYMETRIC CONTOURS AND SEDIMENT TYPES OFF MISSISSIPPI, ALABAMA, AND THE FLORIDA PANHANDLE (FROM: BROOKS, 1973).

Secondly, depth is important depending on the target fish species desired. Mathews (1981) suggested that the optimum reef depth is 90 to 120 ft (27 to 37 m). This is due to the fact that shallow reefs in 30 to 45 ft (9 to 14 m) depths do not attract the large benthic species common to reefs in 60 to 120 ft (18 to 37 m) depths. Shallow to intermediate depths may be desired if the reef is to serve a sizeable recreational diver population.

Finally, depth is an important factor when considering the potential impacts of severe storms on a reef. Reef materials in waters too shallow can be moved around or exposed to sedimentation during a storm. Mathews (1981) suggested that sites be chosen in water depths that are below the maximum affected depth during a 10-year storm event. This depth can be determined from the fact that a wave does not affect the bottom when the depth is greater than one half the wave length.

Substrate type is an important biological concern in the siting of artificial reefs. It is also a major operational consideration. Artificial reefs placed in areas of soft clay or silty sediments can sink into the bottom. Sand or sand/shell bottoms are the preferred substrate for siting reefs because of the greater support they provide (Mathews, 1981). Figure 3.1 shows the distribution of sediment types off the Florida Panhandle. Most of the bottom consists of a sand substrate (Brooks, 1973).

Grove and Sonu (1985) identified three topographies that are favorable for artificial reef placement (Figure 3.2). These include placement in areas with gentle slopes and a relatively flat profile; in areas not far from the shoreward encroachment of a depression; and in areas on either side of a ridge which divides water masses or bottom topography. Most of the bottoms of concern can be classified under the first type of condition, given the general lack of topographic features and the parallel depth contours in the study area (Figure 3.1).

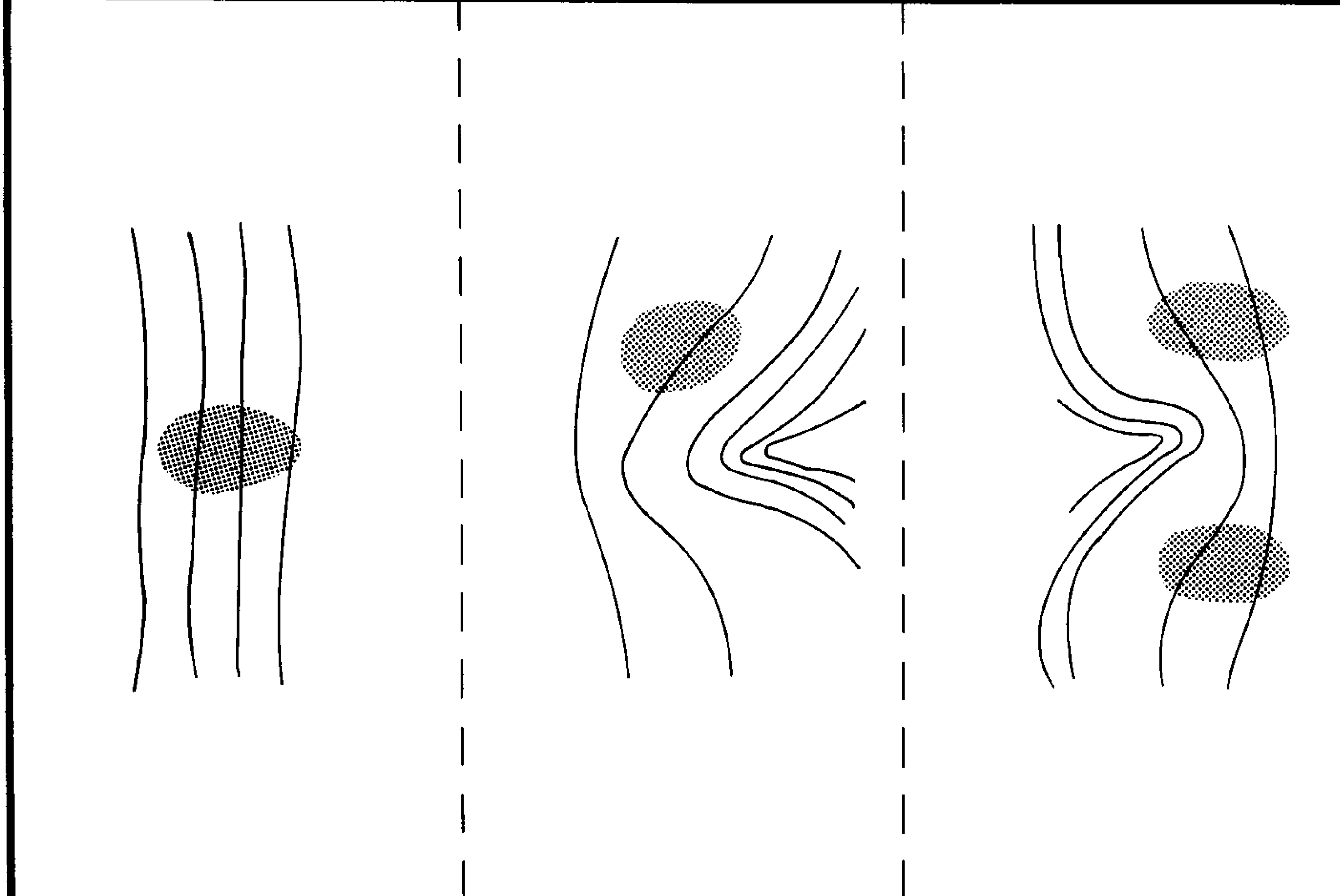

FIGURE 3.2. FAVORABLE TOPOGRAPHIES FOR REEF SITES (ADAPTED FROM: GROVE AND SONU, 1985).

4.0 ARTIFICIAL REEF SITE SELECTION

The previous section discussed the importance of considering the types of reef materials and environmental conditions in siting artificial reefs. Other data which are important in site selection include existing reef locations, navigational fairways, commercial trawl fishing areas, pipeline and communication cable routes, and military exclusion areas. All of these data are considered in the following description concerning the selection of potential reef sites. In the selection process, exclusion mapping techniques were used. With this technique, areas that are unsuitable on the basis of environmental conditions, navigational or military hazards, pipeline or cable routes, or interference with commercial fishing grounds were excluded from consideration. The remaining areas were selected as potential sites.

4.1 OPERATIONAL CONSIDERATIONS

Operational concerns are minimal for the Florida Panhandle coastal area. From an operational perspective, it is an excellent area for establishing artificial reefs. Depths increase rapidly from shore (Figure 4.1), providing for nearshore reefs with minimal opportunities for conflict with commercial trawlers. The bottom is generally hard or sandy which provides optimum substrate conditions. Navigational fairways and a military zone to the east eliminate some areas from consideration, but these concerns are minimal in light of other conditions.

4.2 SITE SELECTION

Existing artificial reef sites are depicted in Figure 4.2 and summarized in Table 4.1. Artificial reef sites proposed by the Escambia County Marine Recreation Committee and the suggested area for artificial reef siting are shown in Figure 4.3. The proposed zone was selected on the need to satisfy the requirments of both the nearshore and offshore fishermen. Although the areas west of the pass into Pensacola Bay satisfies the operational requirements for reef siting, the area east of the pass appears to be better suited for artificial reefs because of the deep water habitats near shore. This allows construction of reef habitats of various types (i.e, low profile, high profile) within minimum distances from shore thereby providing for a variety of users. However, it should be noted that sites 1, 16, 17, 18, and 19 would provide artificial reefs for the small boat fisherman wishing to stay close to shore. Operational conditions in this area are suitable for low profile reefs.

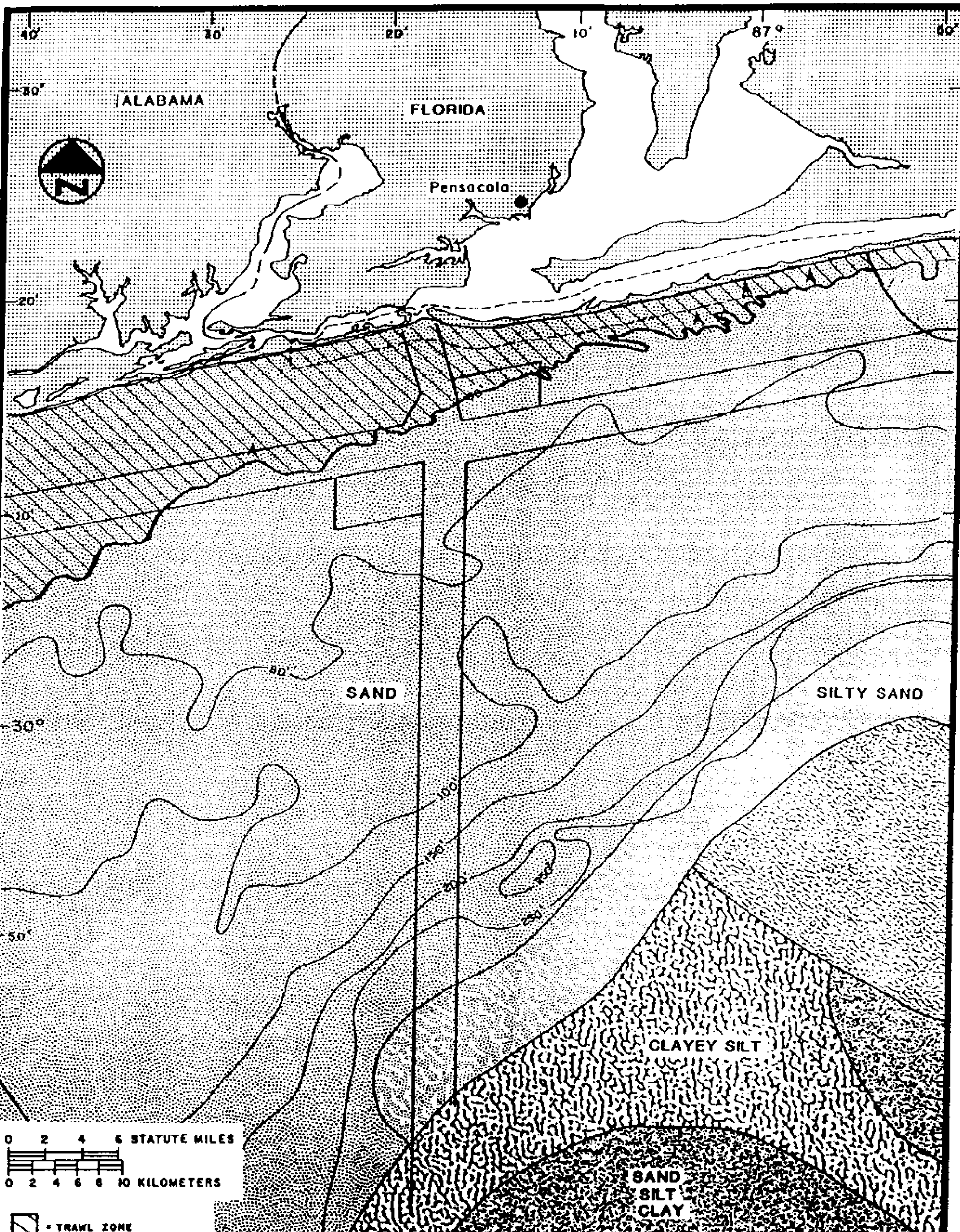

FIGURE 4.1. BATHYMETRY, SEDIMENT DISTRIBUTION, AND THE LOCATION OF NAVIGATIONAL FAIRWAYS OFF THE FLORIDA PANHANDLE.

TABLE 4.1. SUMMARY OF PERTINENT INFORMATION ON ARTIFICIAL REEFS OFF PENSACOLA, FLORIDA.

Reef Name	Latitude	Longitude	Depth (ft)	Distance (nmi)	Material
1) Tenneco Reef	30°00'00"	87°04'00"	175	22.0	Petroleum platform
2) PSM Reef	30°17'02"	87°07'06"	85	3.1	Airplane wreck, tires
3) Casino Fishing Reef	30°18'08"	87°07'30"	60	0.4	Concrete rubble
4) Liberty Ship Fishing Reef	30°16'03"	87°09'07"	67	3.0	Liberty Ship
5) Santa Rosa Barge Reef	30°17'25"	87°13'13"	45	1.0	Three barges, concrete rubble
6) Battleship Reef	30°17'42"	87°18'42"	Exposed	3.4	Battleship, concrete rubble
7) Unnamed	30°16'54"	87°25'36"	20	0.9	Polypropylene strips

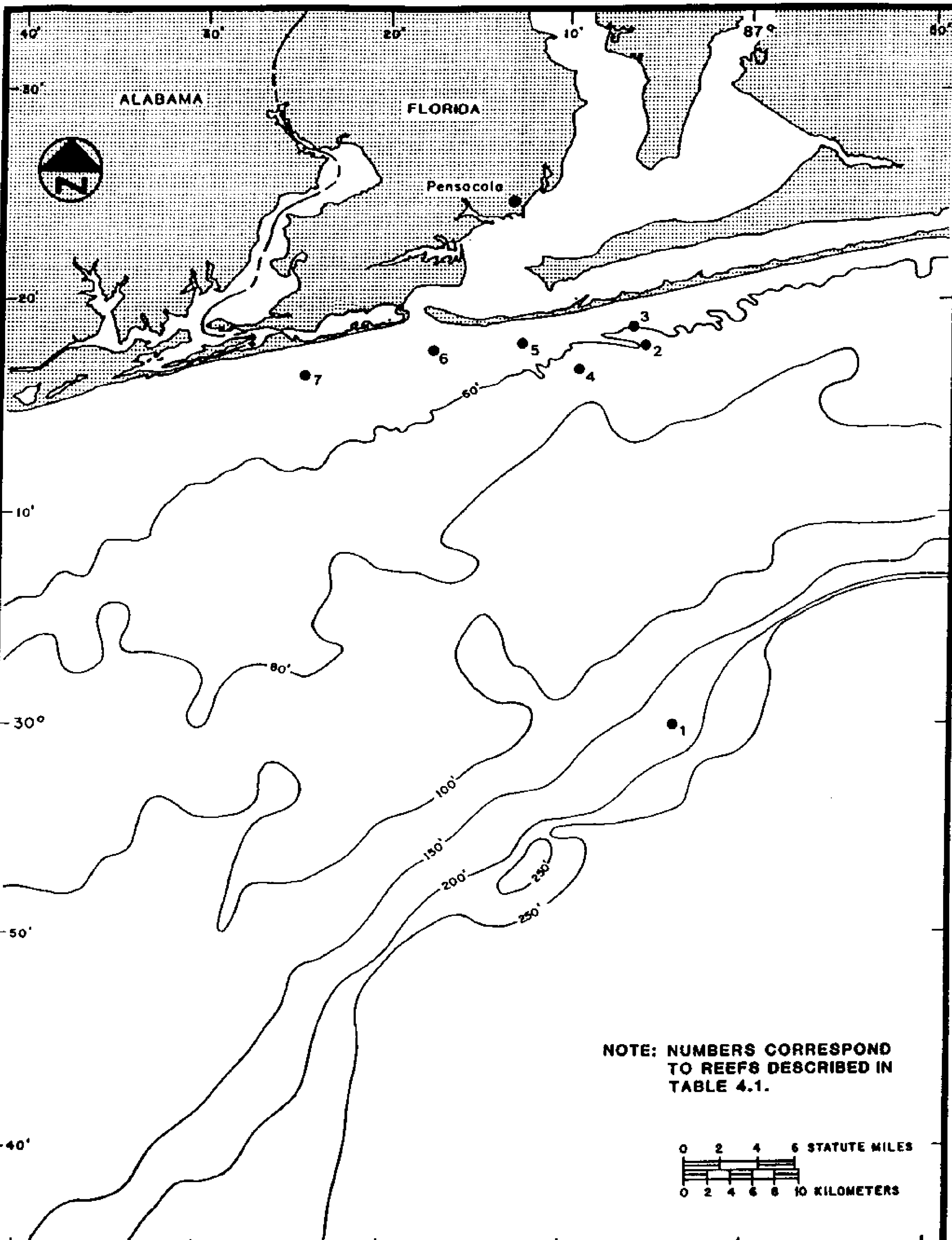

FIGURE 4.2. LOCATION OF EXISTING REEFS OFF THE FLORIDA PANHANDLE.

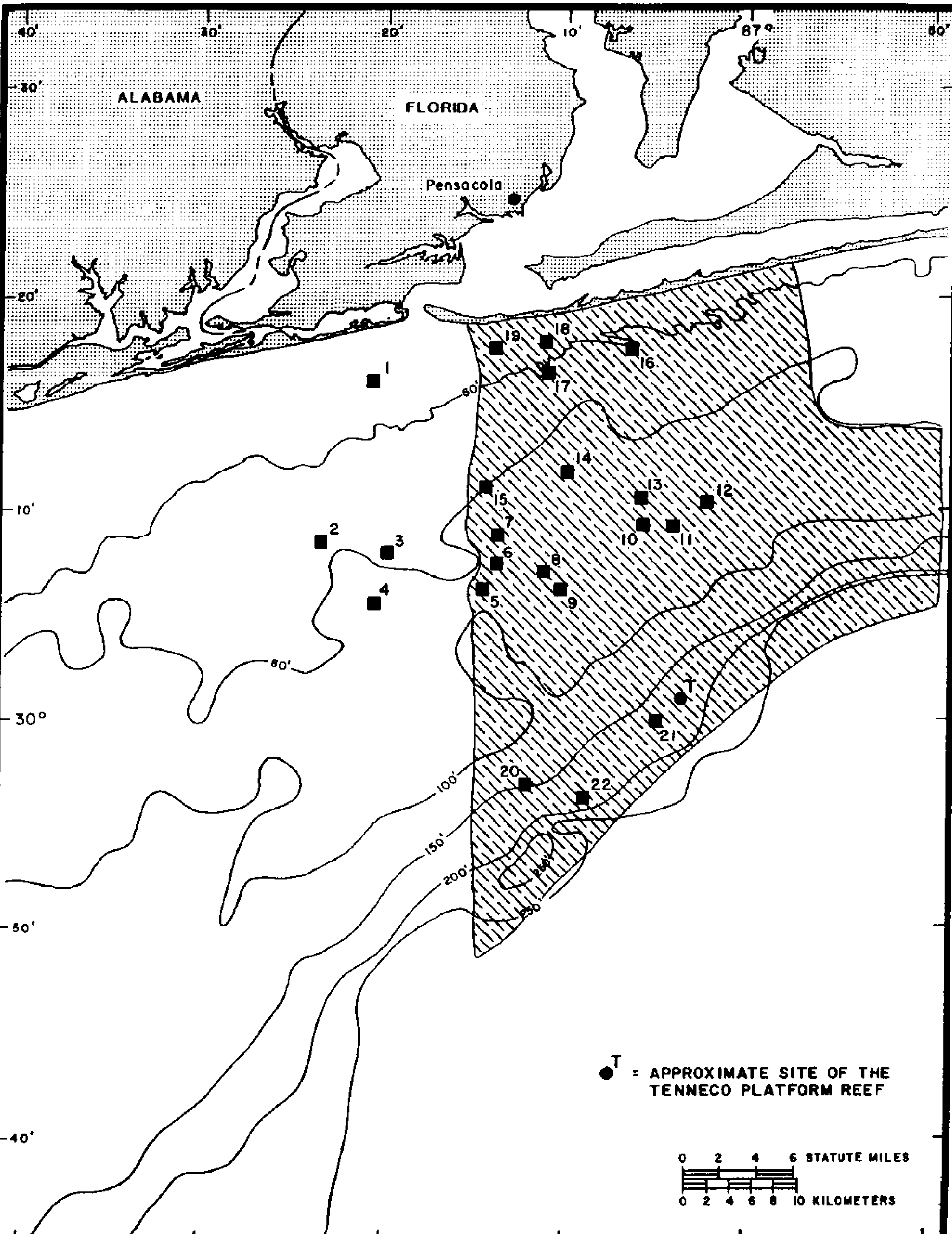

FIGURE 4.3. PROPOSED ARTIFICIAL REEF ZONE OFF THE FLORIDA PANHANDLE AND PROPOSED SITES OF THE ESCAMBIA COUNTY MARINE RECREATION COMMITTEE.

4.3 SUGGESTED REEF MATERIALS

Existing reefs in the area are constructed of an airplane wreck, tires, and a Liberty Ship. The ship and airplane wreck are particularly attractive to divers and, if left in tact, provide good habitat for fishes. The relatively deep water in the area of the existing reefs allows for high-profile reef structures while maintaining a 50-ft (15-m) clearance. It was mentioned at a meeting with fishermen in Pensacola in January, 1986 that Escambia County has developed plans for increasing the numbers of artificial reefs off Pensacola Bay. The plans call for creating reef complexes at new and existing reefs using old ships, concrete rubble, and Japanese-designed structures. All of these would provide excellent reef materials in the shallow to mid-depth ranges (i.e., 40 to 150 ft) (12 to 45 m) of the area. However, in the deeper parts of this zone, reefs should be constructed primarily of large materials for which design and placement can be more easily controlled. Intact ships and barges or Japanese-designed structures would satisfy this need. The design and construction of reefs made of concrete rubble are difficult, if not impossible, to control in deeper waters. During deployment this material is likely to spread over a large area and lose its effectiveness in attracting fish.

This area of Florida is one of the most suitable along the entire Gulf coast for artificial reefs constructed of intact, obsolete oil production platforms. The deep waters needed for this kind of reef are at their closest point to shore in this area of the Gulf. The Tenneco platform was sunk in 175 ft (53 m) of water just 22 mi (35 km) southeast of Pensacola. This is the average distance that the majority of the fishermen in Mississippi and Alabama have been traveling to reach reefs off their shores in waters 80 ft (24 m) deep or less. The existing Tenneco reef provides the opportunity to create a reef complex in this area using additional platform or large ships with their superstructures intact (as long as the minimum navigational clearance is maintained).

5.0 DISCUSSIONS AND CONCLUSIONS

5.1 TRANSPORTATION OF REEF MATERIALS

Transportation of reef materials to the proposed site probably represents the largest single operation in terms of both effort and cost in the artificial reef construction process. Various types of methods are available to transport the materials to a site depending on the materials used.

Barges will generally be the preferred mode of transport for concrete materials because of the weight and volumes involved. Heavy equipment such as trucks or cranes will be required to load the materials onto the vessels. For unloading at the reef site, either "bottom dumping" or crane-equipped barges are necessary. It is significant to note that with barges, placement of materials on the bottom is generally scattered and it is difficult, if not impossible, to form the reef in a particular design. Marking the site with a buoy and anchoring during unloading can minimize the scatter of reef materials.

Sheehy (1983) used air bags to float Japanese-designed FRP reef units to a site off Panama City. These 5-m long by 1.0-m diameter units were towed to the site by small (i.e., 5-ton) boats. However, most Japanese-designed structures weigh on the order of several tons and require crane-equipped barges for transport, unloading, and placement.

To date, two obsolete petroleum platforms (Tenneco and Marathon) and a submerged production system (Exxon) have been moved from their locations off Louisiana and deployed as artificial reefs off Alabama and Florida. The submerged production system was a 2,200-ton structure towed 300 mi (483 km) to a location 35 mi (56 km) offshore Apalachicola, Florida in 110 ft (34 m) of water in 1980 (Sheehy and Vik, 1982). Two other obsolete platforms (Stages I and II) used by the U.S. Navy for scientific observations were sunk in place off Panama City, Florida.

Tenneco donated a platform to the State of Florida in 1982 for an artificial reef in 175 ft (53 m) of water 22 mi (35 km) southeast of Pensacola. The original structure was transported by barge in two sections. The deck section measures 72.5 ft (22 m) by 50 ft (15 m) and is 26 ft (8 m) tall. The 130-ft long steel jacket rests on its side and projects upward in the water column about 90 ft (27 m). Holes were cut in the deck section before deployment to permit light penetration and to attract more fishes (Johnke, 1984).

In 1983, Oceaneering International, Inc. engineered a new technique for moving petroleum structures. An obsolete Marathon platform jacket in 208 ft (63 m) of water off Louisiana was fitted with buoyancy tanks, toppled in place, and towed to a reef site 50 mi (80 km) off Alabama. The structure lies on its side in 240 ft (73 m) of water, leaving a clearance of 130 ft (40 m). The deck structure which had been removed from the jacket was also towed to the site on a barge and placed on the bottom near the jacket structure.

A variety of comments were received from oil companies, agencies, and others concerning the technical feasibility of transporting petroleum platforms in response to a Minerals Management Service (MMS) request for information on platform dispositions (Federal Register, 13 November 1984, p. 44925). These comments are summarized in Table 5.1. Overall, it appears that the technology is currently available to remove existing platforms from water depths of 300 ft (91 m) or less and to transport the structures to sites for use as artificial reefs. The weight of the jackets and the available technology may limit the use of platforms in water depths greater than 300 ft (91 m). However, economics, and not technology, will eventually dictate the fate of these structures.

5.2 DEPLOYMENT

Published literature that concerns descriptions of techniques used in deploying reef materials is generally lacking. It is assumed that in most cases, the reef materials are transported to a location above the reef site and allowed to drop from the surface. In shallow waters, a crane can be used to deposit materials and construct a reef to desired specifications. This may be less feasible in deep waters. In deep as well as shallow waters, currents could induce drifting which would result in scattering of the materials. It is important to mark the reef site and to anchor vessels unloading materials to ensure proper placement of the materials. Demoran (1981) reported that anchoring the bow and stern of an obsolete ship before sinking facilitated maintaining the desired position of the hull.

5.3 OPTIMUM REEF SIZE AND CONFIGURATION

The following discussion is summarized from Bohnsack and Sutherland (in press) who reviewed the literature on the optimum design and placement of artificial reefs. While much of the knowledge on this subject has come from U.S.-sponsored research, the vast majority of the

TABLE 5.1. SUMMARY OF RESPONSES TO AN MMS REQUEST FOR INFORMATION ON PLATFORM DISPOSITION AND TECHNICAL FEASIBILITY.

Company/Agency	Comments
Atlantic Richfield Company	a) Buoyancy tanks may be needed for towing a jacket to a disposal site.
Chevron U.S.A. Inc.	a) A major technical problem is providing buoyancy during transport. b) During towing of a refloated platform, operators must ensure control at all times, particularly in congested areas and during periods of adverse weather.
Cities Service	a) Size and bulk of many jackets exceed the capacity of existing equipment to remove in one piece. b) Refloating equipment is not currently available with sufficient capacity to transport large jackets. c) Technology and equipment are being developed to facilitate platform removal by refloating.
Conoco Inc.	a) Capability exists to salvage whole platform jackets in waters to 200 ft. b) In deep waters, platforms have to be dismantled.
Exxon Company, U.S.A.	a) Even in water up to 1,000 ft, it is feasible to cut platforms into pieces and to transport on barges. b) Primary problem in deep waters is to refloat and transport the jacket.
Marathon Oil Company	a) A jacket cannot simply be removed from deep water and placed in a shallow location because the structures are not designed to resist the large overturning moment.

TABLE 5.1. (CONTINUED).

Company/Agency	Comments
Minerals Management Service	a) Only economic and planning limitations restrict the potential utilization of oil and gas structures as artificial reefs. b) Transportation of a jacket by controlled flotation may be safer than transport by a conventional barge. c) Technology is available, but at high cost, to remove platforms from deep water by removing in sections.
National Ocean Industries Association	a) Technology exists for relocating most structures in water depths of 200 ft or less. b) Economics, not technology, is the limiting factor in the use of post production platforms.
Oceaneering International, Inc.	a) Technology exists to remove and dispose of all platforms currently in place. b) Technology has been limited in past by the lifting capacity of derrick barges. c) Oceaneering is investigating options to (1) tow jacket horizontally to a reef site; and (2) tow the entire structure either horizontal or vertically to a reef site.
Pennzoil Company	a) Most of platforms salvaged to date have been small structures in shallow water that could be loaded onto barges. b) Platforms to be salvaged in the future will be too heavy to load onto barges.
Phillips Petroleum Company	a) No technological problems exist in dismantling or transporting platforms. b) Supplemental buoyancy will be a consideration for large or deep platforms.
Shell Oil Company	a) There are no technical problems associated with dismantling and transporting platforms. b) Technological capabilities are limited by lifting capacities of derrick barges.

TABLE 5.1. (CONTINUED).

Company/Agency	Comments
Sohio	a) No technical problems associated with dismantling and transporting platforms in water out to 300-ft depths. b) In water depths from 300 to 600 ft, jacket weight is a serious technical limitation. Lift capacities for present derrick barges are not sufficient for these weights. c) Underwater technology is not currently available for salvage work for platforms in water deeper than 1,000 ft.
Tenneco Oil	a) Transporting an old platform depends on availability of an adequate capacity barge. b) Buoyancy tanks have several limitations.

literature has originated from Japanese scientists. Information is available on how reef size, height, complexity, spatial arrangement and orientation, and location affect reef success in attracting fishes.

The area of the reef (i.e., the amount of material deposited and the area of bottom covered) is one of the most important design considerations. Large reefs seem to be more productive than small reefs, although biological productivity reaches a peak at some optimum size (Grove and Sonu, 1985). In an analysis of Japanese artificial reef studies, Grove and Sonu (1985) found that the advantage of an artificial reef over a natural reef was at a maximum at a reef size of about 1,400 m^2 (cross section) or 50,000 m^3 (bulk volume). Overall, an artificial reef tended to be more attractive than a natural reef at sizes ranging from 200 to 2,500 m^2 (cross section) or 2,500 to 130,000 m^3 (bulk volume) (Figure 5.1). Various investigators have theorized as to what constitutes an optimum size depending on location. Japanese research has indicated that reefs should consist of a hierarchical arrangement; many blocks or units should form a set, sets should be clustered into groups, and several groups should form a reef complex (Figure 5.2). Reef sites within a group should be spaced about 984 to 1,641 ft (300 to 500 m) apart while reef complexes can be spaced at least 2 mi (3 km) apart (Grove and Sonu, 1985).

There seems to be no clear evidence regarding the importance of height or relief for attracting fishes. From the studies conducted, the effect of height depends on the species. Grove and Sonu (1985) concluded that height was more important to migratory fishes, and horizontal spread was more important to demersal fish species.

Of more importance to fish attraction than height is the profile of the reef. Vertical sides seem to be the best attractants (Grove and Sonu, 1985). Sheehy (1981) explained that this is due to the interaction of currents with the reef. Orientation of reefs should be perpendicular to currents to maximize this interaction. Prevailing currents tend to be alongshore in the northeastern Gulf.

Another important factor for artificial reef success is reef complexity. This includes design, spatial arrangement, number of chambers and openings, and the amount of interstitial space. Studies have shown that fishes may avoid chambers with only one opening. Large chambers and holes are also avoided by fishes. Vertical panels and horizontal and diagonal skeletal members may be more effective than

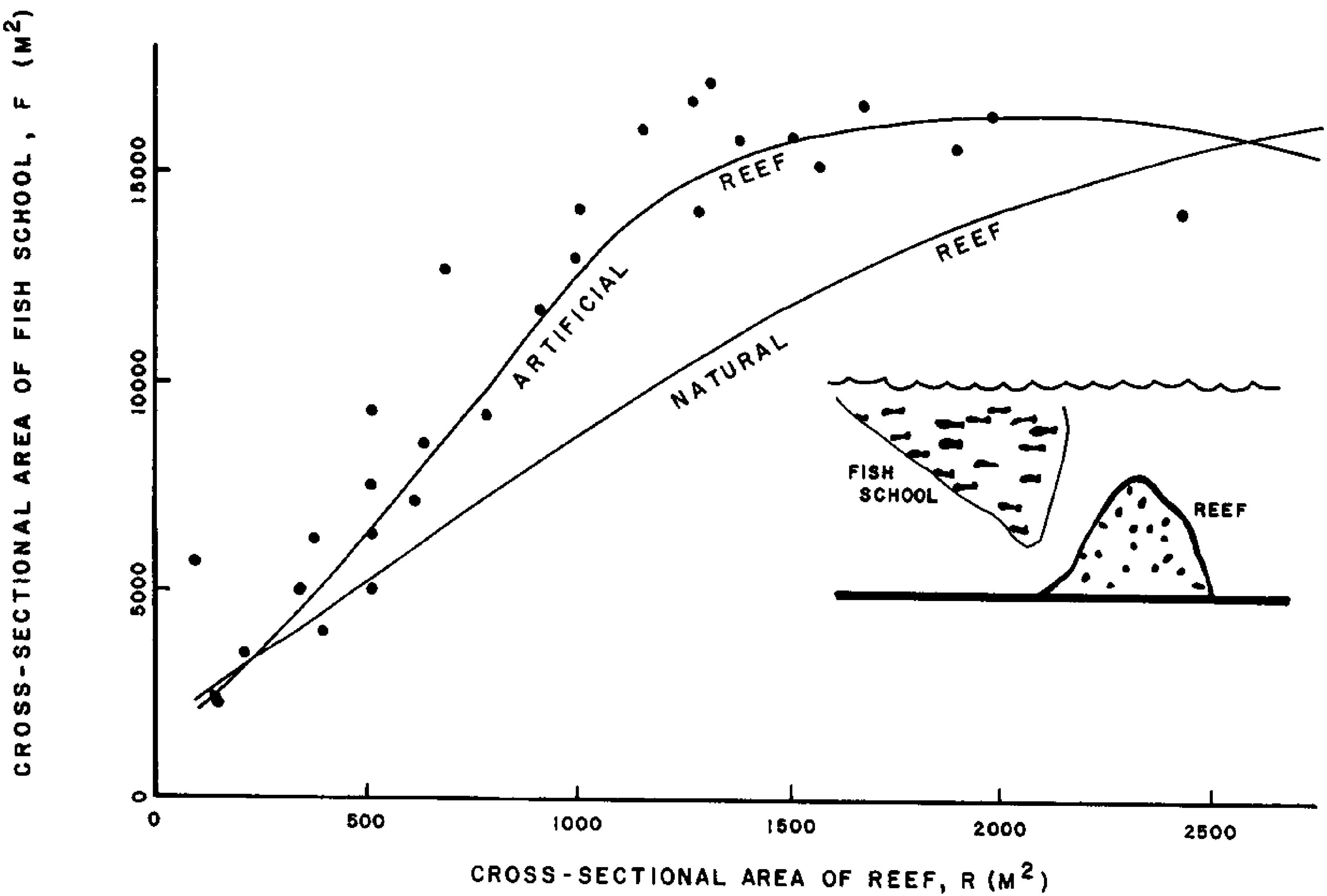

FIGURE 5.1. RELATIONSHIP BETWEEN REEF SIZE AND FISH CONGREGATION (ADAPTED FROM: GROVE AND SONU, 1985).

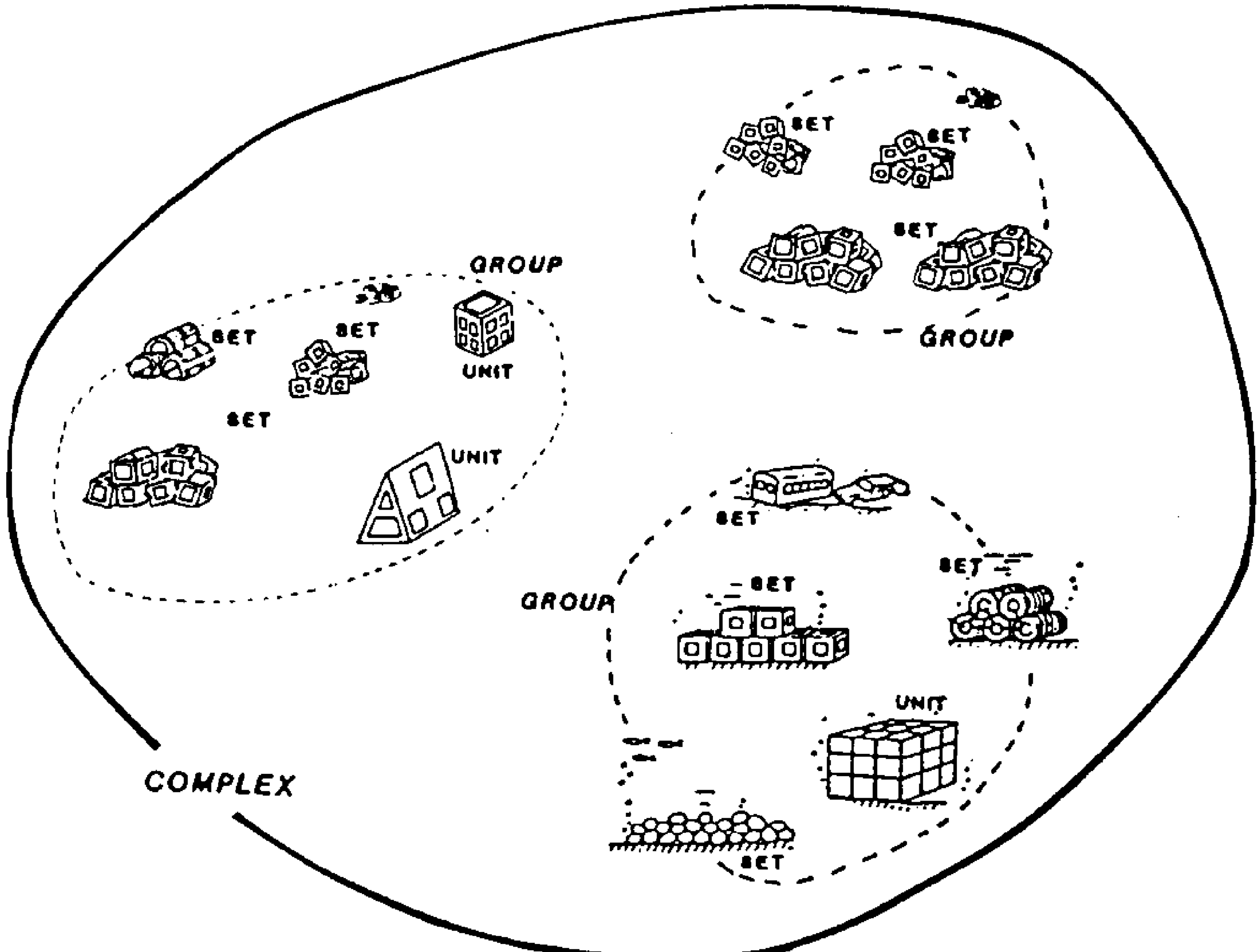

FIGURE 5.2. SCALES OF FISHING REEF (ADAPTED FROM: GROVE AND SONU, 1985).

vertical members because of the shadows created. Investigators have also found that artificial reefs made of different materials are superior to reefs of one material type.

5.4 MARKING REQUIREMENTS

In shallow waters, marking of a reef site is an important consideration for navigational safety reasons. This is of less concern in deep waters, but buoys assist fishermen in locating a reef. Marking also enables commercial trawl fishermen to avoid reefs where nets may become entangled.

The U.S. Coast Guard (USCG) has the legal responsibility to determine if a buoy is required on a reef. This determination is made on the basis of:

1) physical characteristics of the obstruction;
2) depth of water in which the obstruction is located;
3) proximity of the obstruction to historic or designated vessel routes; and
4) type of vessel traffic at the obstruction site.

Burgess (1974) stated that the USCG will not normally require marking of a reef if there is over 85 ft (26 m) of clearance. The U.S. Coast Guard requirements for proposed reefs off Escambia County, Florida include a permanent buoy if less than 50 ft (15 m) of clearance is maintained. Where greater than 50 ft (15 m) clearance is maintained, buoys are required only until the reef has been posted on navigation charts and a notice to mariners issued. The process would require 12 to 18 months before a permit request for removal could be made. When marking is required, the owner of the artificial reef must maintain the buoy. At the Marathon platform reef, which has a minimum clearance of 80 ft (24 m), the oil company was required by the States of Florida and Alabama to purchase and place the first USCG-approved permanent buoy (Walters, 1985). Any further responsibility was assumed by the States. Exxon was able to avoid the need for a buoy at the reef created by its production template [minimum clearance of 40 ft (12 m)] by placing the structure near an existing lighted and buoyed U.S. Air Force tower (Ditton and Folk, 1982).

5.5 SUMMARY OF OPERATIONAL REQUIREMENTS

Various zones from shallow to deep waters have been established for potential artificial reef sites. The suitability of these sites can only be established after operational requirements are considered along with the legal, social, economic, and biological concerns associated with creation of reefs in these areas. As part of the analysis, it will be necessary to establish the objectives of the reef program (i.e., the target species desired and the user groups of the reef). These considerations will eventually dictate the final reef design.

In general, four types of materials are suitable for reef construction. These are concrete blocks or rubble, obsolete ships or barges, petroleum platforms, and Japanese-designed structures. High density, concrete material is probably most suitable in shallow areas where low profile structures will be required to comply with minimum clearance requirements. Ships, barges, and Japanese-designed structures are suitable for intermediate depths from 60 to 150 ft (18 to 46 m). Petroleum platforms will be effective in waters more than 150 ft (46 m) deep where the massive structures can attract large pelagic fishes.

Operational considerations should be major concerns in any reef-building effort. Proper siting and deployment of a reef are important not only to the success of the structure in attracting fishes, but also in complying with restrictions related to navigational issues. Finally, the quality of the reef construction is more important than the quantity of reef established. Therefore, reef designers should consider establishing reef complexes that provide diverse habitats. This is accomplished through planned development and careful deployment of materials.

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4. Recommendations for Specific Artificial Reef Site Locations In Panhandle - Florida

Based on analyses of the available data, two potential locations for artificial reefs in the Florida panhandle are recommended:

A) A shallow water site located 21 miles southeast of Pensacola in approximately 80 to 150 feet of water (approximate coordinates 30°10'N Latitude and 87°05'W Longitude).

This location is probably best suited for a low profile reef due to the relatively shallow water, but because of its close proximity to the shelf edge, a higher profile structure would likely act as an attractant for coastal pelagic fishes such as cobia, king mackerel and bluefish as well as demersal species. This would increase the productivity of the reef as long as it does not interfere with navigation.

Since scuba diving would likely occur on the reef, water clarity should be considered in reef placement to provide the greatest use by the greatest number of people.

B) A deep water site located 35 miles south of Pensacola in approximately 150 to 250 feet of water (approximate coordinates are 29°52'N Latitude and 87°13'W Longitude).

This location would permit emplacement of a large, high profile reef.

Such a structure would offer both bottom and mid-water habitats as well as attracting coastal pelagics. As in the case of the high profile shallow water reef, this should increase the productivity of the reef.

Site specific surveys are recommended in all areas prior to reef emplacement to ensure that existing natural or artificial reefs do not occur on the proposed locations and to determine suitability of bottom type.

V. CONCLUSIONS

The purpose of this study was to develop a plan for siting artificial reefs in the northern Gulf of Mexico for the benefit of commercial and recreational fisheries. Specifically, it was to develop plans for three offshore localities: Biloxi-Pascagoula, Mississippi; Mobile-Dauphin Island, Alabama; and Pensacola, Florida. The information utilized in the study was acquired from existing data sources, with no new data collected. The study evaluates reef siting from the standpoint of biological, operational, sociological, economic, and legal criteria.

The ojectives of the study have been accomplished. The three site-specific artificial reef development plans have been completed, and a prescribed procedure developed which may be applied to the siting of artificial reefs in any geographic area. While the applicability of this procedure remains to be tested in areas other than the northern Gulf of Mexico, it is evident that the general characteristics of the siting-plan procedure remain valid whatever the geographic area. Specific decisions on reef siting will require site-specific information. The plan defines the scope, quality, and quantity of this information within each of the components evaluated. The three plans developed in this study may be used as models for the development of reef siting plans, as well as providing information necessary for definitive artificial reef siting in the three specified geographic areas. While the processes developed in this study are generally applicable, the results reported are not, and may only be applied uniquely to each of the three specific study areas.

In the course of this study it became apparent that much of the information required for definitive artificial reef siting-plan development is lacking or severely limited. Those data most wanting were in the sociologic component of the study. In other geographic areas it may be presumed that a similar lack of information could occur in any or all of the five components which are evaluated. The result of this lack of available information may require that substantial data gathering and collection efforts be conducted at some proposed artificial reef sites. The present study would have benefited from such an effort for the sociologic component, although definitive information was sufficient in the other areas. The circumstance of varying amounts of information and level of precision between the evaluative components should be expected. The result is a condition in which some of the components may be evaluated more precisely than others. This is unfortunate, but need not be a severely limiting factor so long as an adequate, though minimal amount of information is available. The "minimally adequate" information level is a subjective determination and will vary between regions and among investigators. In some cases it may prove essential to generate significant amounts of additional information to supplement that already available. It need be recognized that in most if not all cases there will be a significant lack of information within one or more of the evaluative components. New or additional data collection activities will be predicated by fiscal, temporal, legal, and political constraints. In extreme cases the lack of available data, coupled with the inability to generate new information, may prove a severe handicap to use of the reef siting procedure developed here.

The procedures developed in this study are generally straightforward and readily accomplished. The significance and utility of utilizing a local advisory committee and public meetings cannot be overemphasized. The advantages of having two levels and sources for local input and evaluation are myriad. On the one hand the mechanism provides sources and types of information generally impossible to obtain through conventional means, while at the same time allowing the public to participate directly in the reef-siting activity. The process involves political as well as other factors, and the early routine involvement of competing factions and interests allows for possible identificatiion and resolution of specific problems as they develop.

The siting of artificial reefs in the coastal areas of the United States will be accomplished whether or not definitive site specific plans are developed. It is hoped that the mechanisms and procedures defined in this study will provide the basis for rational, objective artificial reef siting evaluations and decisions. The social, economic, environmental, and other impacts coincident with the development of major artificial reef complexes off our shores will significantly effect those areas undergoing such development. Many decisions must be made and courses of action decided upon. It is believed that the information included in this study will provide a logical procedure for understanding and evaluating the courses of action to be taken, and to define and resolve the problems leading to optimal artificial reef development and siting decisions.

APPENDIX A

A PROPOSAL TO DEVELOP SITING
PLANS FOR THE ESTABLISHMENT OF
ARTIFICIAL REEFS IN
THE GULF OF MEXICO

SUBMITTED TO:
NATIONAL MARINE FISHERIES SERVICE
SOUTHEAST REGION
9450 KOGER BOULEVARD, DUVAL BUILDING
ST. PETERSBURG, FLORIDA 33702

SUBMITTED BY:

THE MISSISSIPPI-ALABAMA
SEA GRANT CONSORTIUM
P.O. DRAWER AG
OCEAN SPRINGS, MISSISSIPPI 39564

CONTINENTAL SHELF ASSOCIATES, INC.
P.O. BOX 3609
764 SATURN STREET
JUPITER/TEQUESTA, FLORIDA 33458

James I. Jones

Dr. James I. Jones, Director
Mississippi-Alabama
Sea Grant Consortium

08/20/84

DATE

Mr. Robert C. Stevens, Jr.
Continental Shelf Associates, Inc.

DATE

OMB Approval No. 29-R0218

FEDERAL ASSISTANCE

1. TYPE OF ACTION (Mark appropriate box)
- [ ] PREAPPLICATION
- [X] APPLICATION
- [ ] NOTIFICATION OF INTENT (Opt.)
- [ ] REPORT OF FEDERAL ACTION

2. APPLICANT'S APPLICATION
- a. NUMBER
- b. DATE Year month day: 19 ~~83~~ ~~3~~ ~~31~~ 84 8 17

Leave Blank

3. STATE APPLICATION IDENTIFIER
- a. NUMBER
- b. DATE ASSIGNED Year month day: 19

4. LEGAL APPLICANT/RECIPIENT
- a. Applicant Name: Mississippi-Alabama Sea Grant
- b. Organization Unit: Consortium
- c. Street/P.O. Box: Caylor Bldg. - G.C.R.L.
- d. City: Ocean Springs   e. County: Jackson
- f. State: Mississippi   g. ZIP Code: 39564
- h. Contact Person (Name & telephone No.): Dr. James I. Jones 601/875-9341

5. FEDERAL EMPLOYER IDENTIFICATION NO.

6. PROGRAM (From Federal Catalog)
- a. NUMBER
- b. TITLE: S-K Application

7. TITLE AND DESCRIPTION OF APPLICANT'S PROJECT

Deployment Plan for the Establishment of Artificial Reefs Using Obsolete Oil and Gas Production Platforms: Biological, Economic, Legal, Operational, and Social Perspectives

8. TYPE OF APPLICANT/RECIPIENT

A–State, B–Interstate, C–Substate District, D–County, E–City, F–School District, G–Special Purpose District, H–Community Action Agency, I–Higher Educational Institution, J–Indian Tribe, K–Other (Specify): Sea Grant Consortiu

Enter appropriate letter: K

9. TYPE OF ASSISTANCE

A–Basic Grant, B–Supplemental Grant, C–Loan, D–Insurance, E–Other

Enter appropriate letter(s): A

10. AREA OF PROJECT IMPACT (Names of cities, counties, States, etc.): Gulf of Mexico

11. ESTIMATED NUMBER OF PERSONS BENEFITING: Indeterminant

12. TYPE OF APPLICATION

A–New, B–Renewal, C–Revision, D–Continuation, E–Augmentation

Enter appropriate letter: A

13. PROPOSED FUNDING

a. FEDERAL	115,000 .00
b. APPLICANT	33,273 .00
c. STATE	.00
d. LOCAL	.00
e. OTHER	.00
f. TOTAL	$ 148,273 .00

14. CONGRESSIONAL DISTRICTS OF:
- a. APPLICANT: 5th
- b. PROJECT: Gulf of Mexico

15. TYPE OF CHANGE (For 12c or 12e)

A–Increase Dollars, B–Decrease Dollars, C–Increase Duration, D–Decrease Duration, E–Cancellation, F–Other (Specify):

Enter appropriate letter(s):

16. PROJECT START DATE Year month day: 19 84 9/0 1

17. PROJECT DURATION: 12 Months

18. ESTIMATED DATE TO BE SUBMITTED TO FEDERAL AGENCY Year month day: 19 ~~83~~ ~~3~~ ~~31~~ 84 8 17

19. EXISTING FEDERAL IDENTIFICATION NUMBER: ----

20. FEDERAL AGENCY TO RECEIVE REQUEST (Name, City, State, ZIP code): National Marine Fisheries Service, St. Petersburg, FL 33702

21. REMARKS ADDED: [ ] Yes [X] No

22. THE APPLICANT CERTIFIES THAT ▶

a. To the best of my knowledge and belief, data in this preapplication/application are true and correct, the document has been duly authorized by the governing body of the applicant and the applicant will comply with the attached assurances if the assistance is approved.

b. If required by OMB Circular A-95 this application was submitted, pursuant to instructions therein, to appropriate clearinghouses and all responses are attached: No response / Response attached

(1)
(2) N/A
(3)

23. CERTIFYING REPRESENTATIVE
- a. TYPED NAME AND TITLE: Dr. James I. Jones, Director
- b. SIGNATURE: James I. Jones
- c. DATE SIGNED Year month day: 19 ~~83~~ ~~3~~ ~~30~~ 84 8 17

24. AGENCY NAME

25. APPLICATION RECEIVED Year month day 19

26. ORGANIZATIONAL UNIT

27. ADMINISTRATIVE OFFICE

28. FEDERAL APPLICATION IDENTIFICATION

29. ADDRESS

30. FEDERAL GRANT IDENTIFICATION

31. ACTION TAKEN
- [ ] a. AWARDED
- [ ] b. REJECTED
- [ ] c. RETURNED FOR AMENDMENT
- [ ] d. DEFERRED
- [ ] e. WITHDRAWN

32. FUNDING

a. FEDERAL	$ .00
b. APPLICANT	.00
c. STATE	.00
d. LOCAL	.00
e. OTHER	.00
f. TOTAL	$ .00

33. ACTION DATE ▶ Year month day 19

34. STARTING DATE Year month day 19

35. CONTACT FOR ADDITIONAL INFORMATION (Name and telephone number)

36. ENDING DATE Year month day 19

37. REMARKS ADDED [ ] Yes [ ] No

38. FEDERAL AGENCY A-95 ACTION

a. In taking above action, any comments received from clearinghouses were considered. If agency response is due under provisions of Part I, OMB Circular A-95, it has been or is being made.

b. FEDERAL AGENCY A-95 OFFICIAL (Name and telephone no.)

SECTION I—APPLICANT/RECIPIENT DATA
SECTION II—CERTIFICATION
SECTION III—FEDERAL AGENCY ACTION

424-101

STANDARD FORM 424 PAGE 1 (10-75)
Prescribed by GSA, Federal Management Circular 74-7

PROJECT SUMMARY

a. Title: Siting Plans for the Establishment of Artificial Reefs in the Gulf of Mexico.

b. Co-Applicants: Mississippi-Alabama Sea Grant Consortium and Continental Shelf Associates, Inc.

c. Primary Objective: Develop a workable plan for siting artificial reefs in the Gulf of Mexico that would benefit recreational and commercial fisheries. Intended for a wide variety of potential user groups but most notable State fish and game agencies, fisheries commissions, and councils.

d. Summary of Work to be Performed: This study has two major objectives: 1) the organization of an Advisory Group composed of representatives of the co-applicants and interested parties from each of the affected Gulf Coast States, and 2) the development of three comprehensive site development plans covering the following demand centers: Gulfport/Biloxi, MS; Mobile Bay Area (Pascagoula, MS, Dauphin Island, AL; Gulf Shores, AL); and Florida Panhandle (Pensacola, Ft. Walton Beach, Destin). These plans which will follow the established Corps of Engineers, Environmental Assessment process. The latter objective will employ a multi-disciplinary approach to the complex web of biological, economic, legal, operational, and social issues associated with the establishment of artificial reefs. The end products will consist of three detailed siting plans for each affected Gulf Coast State which will identify and characterize specific artificial reef areas. These products can be immediately implemented by artificial reef sponsoring organizations.

e. Principal Geographic Impact of Project: Gulf of Mexico.

f. Total Federal Funds Requested; Total Amount and Percentage of Total Project Costs: $ 115,000 ; 77.5 %.

g. Project Costs to be Provided from Non-Federal Government Sources; Total Amount and Percentage of Total Project Cost: $ 33,273 ; 22.5 %.

h. Total Project Costs: $ 148,273 .

i. Principal Uses for Federal Funds and Amount Requested for Each Use:

MASGC		CSA	
Federal	Match	Federal	Match
$ 69,981	$ 17,728	$ 45,019	$ 15,545

Specific budgets for each component of the project are included as appendices.

A. IDENTIFICATION OF THE PROBLEM -

Several States bordering on the Gulf of Mexico, e.g., Alabama, Florida, Mississippi, and Texas, have developed artificial reefs using a variety of materials. However, to date no comprehensive plan has been established to systematically site artificial reefs throughout the Gulf.

This problem can be characterized by its legal, social, economic, biological, and operational facets. For example, if an artificial reef is to be established, where should it be located (biological, operational, and legal factors)? - What materials should be used (economic and operational factors)? - How should it be implemented to maximize benefits (sociological, economic, and biological)? The difficulty in establishing clearcut answers to such multi-disciplinary questions has been the limiting factor in the development of comprehensive artificial reef plans for the Gulf of Mexico. In other words, the interdependency of the above-named factors imposes real-world conflicts and complications.

B. PROJECT GOALS AND OBJECTIVES -

This proposed study will treat the five major disciplines holistically. The co-applicants have assembled a team of recognized experts in their respective fields who will work toward an identifiable goal, i.e., the development of artificial reef siting plans for three major areas within the Gulf of Mexico. The vehicle we propose to utilize to accomplish our objective does not represent "new" methodology. The technique we will employ will be described in detail shortly.

First, we present a description of the five major components and subcomponents of our plan. Our multi-disciplinary approach will analyze the following:

1. Legal

In order to develop comprehensive artificial reef siting plans, there are a myriad of State, Federal and local laws which must be considered.

The legal study will address the following:

(a) Obligations under the consistency provisions of the Coastal Zone Management Act;

(b) Federal tax incentives for entities willing to yield ownership of artificial reef materials;

(c) Federal and State law applicable to potential legal liability for injuries or damage to third parties throughout the artificial reef development process and once the reef is established;

(d) Appropriate international, Federal, State, and local laws governing obstruction to navigation as related to the establishment of artificial reefs; and

(e) Regulatory approval from Federal agencies under the Submerged Lands Act; Outer Continental Shelf Lands Act; Ocean Dumping Act; Endangered Species Act; Marine, Protection, Research and Sanctuaries Act; the National Environmental Policy Act; and the Marine Mammal Protection Act. Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act although applicable, will not be addressed here as the format of the total project is based upon EA requirements under these provisions.

While much of the work outlined in this section is being addressed by the Sport Fishing Institute through its 1983 SK grant, considerable interpretation and refinement of their products will be needed to produce site plans for the specific geographic areas targeted by this proposal. Details and nuances of state and local laws will have to be carefully analyzed and legal expertise will be needed on the site planning advisory committee.

2) Sociological

The sociological component of the study will evaluate, interpret and refine data emanating from the Sport Fishing Institute regarding sociological factors affecting the development of artificial reef site plans for the three target coast segments. In particular, sociologists will review and interpret recreational boat registration data, demographic information, recreational fishing characterization information, recreation access and facility information and other pertinent data in order to develop site plans that are responsive to the needs of the various user groups.

Further, sociologists will participate directly as part of the advisory group in order to provide effective consideration of user needs in the selection of specific artificial reef sites.

3) Economics

Economic analysis is concerned mainly with estimation and comparison of benefits and costs of establishing artificial reefs at various locations within each target coastal segment. Benefits and costs will be studied with special reference to how the siting plans will affect local fishery groups, local communities, and finally, the regional economy.

To develop effective site plans, it is necessary to collect and interpret data on numerous variables:

(a) Number, location, and ownership of existing platforms/reefs in each target area;

(b) Annual maintenance costs of platforms/reefs;

(c) Liability insurance premiums for platforms/reefs materials if left unchanged;

(d) Dismantling costs of platforms/reef materials;

(e) Transportation costs of dismantling;

(f) Salvage value of platforms/reef materials;

(g) Potential sites for (artificial) reefs;

(h) Transportation costs of platforms/reef materials to reef sites;

(i) Installation costs of reefs;

(j) Annual maintenance costs of reefs;

(k) Liability insurance premiums for reefs;

(l) Value of commercial fishing from reefs;

(m) Value of recreational fishing from reefs;

(n) Sources of funds for converting platforms/reef materials to reefs; and

(o) Itemized list of sunk costs.

In conducting economic analyses in this project, special attention will be given to economic research being conducted by the Sport Fishing Institute. Particular attention will be given to SFI's efforts to develop economic evaluation methodologies that will enable researchers to estimate the value of artificial reefs and to facilitate charitable donations of reef construction material.

To facilitate effective interpretation and application of economic variables and data, and to provide guidance on the effects of reef design and location factors on the economic soundness of reef siting alternatives, an economist will serve as a member of the reef siting advisory committee.

4) Biological

A number of diverse biological factors will be evaluated in the development of artificial reef siting plans. We assume that some pertinent data will be available from the Sport Fishing Institute; however, a variety of other data sources will be identified and utilized, as appropriate.

The biological component will address:

(a) Existing substrate and oceanographic conditions;

(b) Existing productivity and water quality;

(c) Biology of target species;

(d) Proximity to other productive fishing areas (live bottom areas, established trawling areas, etc.); and

(e) Reef utility as harvest areas/sanctuaries.

5. <u>Operational</u>

The operational component will assess and evaluate practical issues relevant to the establishment of artificial reef sites.

Factors which will be investigated include:

(a) Existing reefs/trawl "hangs";

(b) Available deployment techniques;

(c) Methods to transport artificial reef material to desired locations;

(d) Reef size and configuration optimization;

(e) Navigation clearance and marking requirements recommendations;

(f) Orientation of reef material on the substrate and within the water column; and

(g) Reef materials available/suitable for use.

Again, it is assumed by the co-applicants that some pertinent basic operational data will be available from the Sport Fishing Institute to support the investigation.

As mentioned previously, these disciplines will be treated in a holistic manner. To identify a vehicle or methodology for pursuing our interests we posed two questions.

1. Is there a well-established technique which readily adapts to the simultaneous treatment of seemingly diverse disciplines? and,

2. If such an approach exists, would its implementation maximize the ability to translate an artificial reef concept into reality?

A technique which satisfies both of these questions is the National Environmental Policy Act, Environmental Assessment (EA) process. Prior to describing the distinct advantages of using this procedure, we provide the following background information.

By definition, territorial waters within the Gulf of Mexico are considered "navigable waters" under the jurisdiction of the U.S. Army Corps of Engineers (COE). As such, any interested party which proposes to place structures and/or fill material for any purpose into Gulf waters, must first obtain COE approval. The EEZ is defined as the exclusive economic zone of the U.S. and extends 200 miles to sea. In the context of this S-K proposal, the creation of an artificial reef in the Gulf must receive approval from the COE prior to implementation.

All applications for COE approval (otherwise known as Section 10/404 permit) are subject to a "public interest review" process. The COE considers some twenty factors in their review of Section 10/404 permit applications including economics, safety (liability), general needs and welfare of the people (social), fish and wildlife values (biological), and energy, navigation and mineral needs (operational). No permit is granted by the COE unless its issuance is found to be in the public interest.

In cases where applicants intend to perform work of a significant nature, the COE requires the preparation of supporting documentation. One document which often satisfies these requirements is an EA.

We propose to develop EA´s which will be directed to the COE Districts (Jacksonville and Mobile) having jurisdiction over each of the three coastal segments. Each EA will be written so that it may later support Section 10/404 permit applications that will be keyed to specific artificial reef sites.

The distinct advantages of using the EA process as a siting plan for artificial reefs are that: 1) its format promotes and facilitates the incorporation of multi-disciplinary perspectives; 2) it is a recognized tool that would be readily accepted by the principal regulatory body, i.e., COE; and 3) the development of site-specific EA´s would enable artificial reef sponsoring organizations to immediately interface with the COE to obtain permitting approval.

C. APPROPRIATENESS AND NEED FOR GOVERNMENT FINANCIAL ASSISTANCE -

1. At this time, the fishing industry is engaged in intensifying its productivity. This, coupled with the present economic situation mitigates against obtaining funds from other public and private sources.

2. Austere times have caused a lack of noncommitted funds within the fishing industry which precludes the industry from undertaking a project of this nature.

3. Sources of funding which are or have been sought by Continental Shelf Associates, Inc. include several oil and gas companies.

D. PARTICIPATION BY PERSONS OR GROUPS OTHER THAN THE CO-APPLICANTS -

Although we believe the combined expertise of MASGC and CSA will enable us to produce the EA siting plans, we feel that several individuals representing related interests should be called on to advise in our effort to insure that the end products are sensitive to their needs. Therefore, we propose to organize an Advisory Group at the initiation of this effort. The Program Administrator will chair the Advisory Committee. The Program Administrator will be the final decision authority on all matters related to this effort. This group may be composed of the following elements.

- MASGC (for legal, economic, and sociological factors)
- CSA (for biological/regulatory and operational factors)
- Sea Grant Representatives
- Gulf of Mexico Marine Fishery Management Council
- Sport Fishing Institute Representative
- National Marine Fisheries Service
- Gulf States Marine Fisheries Commission
- Southeastern Fisheries Association

The co-applicants envision that this group will perform the function of a "scoping process" for the production of the EA's. The Sport Fishing Institute will provide a valuable link to this process as that organization is currently gathering basic artificial reef data under an approved S-K application.

The co-applicants have the flexibility to expand and modify the composition of the Advisory Group, as necessary, during the 12-month initial funding period.

E. FEDERAL, STATE, AND LOCAL GOVERNMENT ACTIVITIES WHICH MAY BE AFFECTED BY THIS PROJECT -

1. Coastal related State government agencies in the States of Florida, Alabama, and Mississippi.

2. The Gulf of Mexico Fisheries Management Council and the Gulf States Regional Fisheries Commission.

3. Federal agencies including but not limited to: National Marine Fisheries Service, Corps of Engineers, Minerals Management Service, Environmental Protection Agency, and Coast Guard.

F. PROJECT OUTLINE -

This effort will integrate the complex web of legal, social, economic, biological, and operational issues associated with establishing artificial reefs. The end products will serve as practical guides for implementing site specific artificial reef proposals by discussing the benefits and costs associated with available alternatives.

The specific tasks to accomplish the goals and objectives outlined in Section B of this proposal are enumerated below and in Figure 1.

Task I - Involves the formulation of the Advisory Group. This effort will be the responsibility of the co-applicants' Project Managers. Once formed, the group will: review the results of the Sport Fishing Institute's S-K artificial reef effort as it applies to targeted Demand Centers within each of the three coastal segments; and advise on EA format and the nature of accompanying documentation, e.g., maps, public information materials, etc.

Task II - The Principal Investigators from the co-applicants' organizations will conduct a literature search related to the five major study factors (as outlined in Section B).

Task III - Meetings will be held at appropriate locations within each targeted coastal segment to obtain local inputs regarding reef siting alternatives.

Task IV - Siting plans (EA's) will be drafted concurrently for each of the three coastal segments (Florida Panhandle, Mobile Bay area, Gulfport/Biloxi area) on a state- or zone-specific basis. The co-applicant's Project Managers will insure that all materials are assimilated in the format prescribed by the Advisory Group.

Task V - The Advisory Group and representatives from NMFS will be convened to review and comment on the draft products.

Task VI - All solicited comments will be used to make necessary adjustments to draft products.

Task VII - Three copies of each siting plan (EA) will be submitted to NMFS for final approval.

G. PROJECT MANAGEMENT -

The project will be organized as depicted in Figure 2. Project Management will be vested in two Co-Project Managers; one from MASGC and one from CSA. Consolidation of information from the participating Principal Investigators will be integrated by the two Project Managers. Final report preparation will be the responsibility of the MASGC Program Administrator.

H. MONITORING OF THE PROJECT -

1. Project progress monitoring will be the responsibility of the Co-Project Managers. the Project Managers will in turn be responsible to the Program Administrator via their parent organization.

2. Quarterly management reports will be required from each of the five component Principal Investigators. Those reports will be forwarded to the respective Project Manager for review. The Project Managers will then prepare a single composite report for delivery to the NMFS Technical Representative.

3. At this time, the specified project tasks appear to be attainable within the time frame indicated in Figure 1.

I. EVALUATION OF PROJECT RESULTS -

Upon completion of the first year's efforts, the artificial reef siting plans will be evaluated by NMFS. The co-applicants are interested in translating the developmental phase products into operational reality. We envision a second-year's efforts as having the following components:

1. The Advisory Group will identify Demand Center Management Teams (DCMT) to design and implement site-specific artificial reef proposals.

2. The Advisory Group will develop and provide the DCMTs with "how-to-guides" to advance their particular artificial reef proposals.

3. The Advisory Group will organize local public meetings, as appropriate, and assist the DCMTs in their development of individual Section 10/404 permit applications.

4. Once permits are issued to the DCMTs, the co-applicants will develop artificial reef site location maps and other public awareness documents through the auspices of Sea Grant Advisory Services.

J. PROJECT BENEFITS -

The first years' developmental effort will provide benefits to fishery interests in the Gulf of Mexico, by systematically identifying and documenting the rationale for the optimum artificial reef sites. The choice of preparing the siting plans in EA format will enable artificial reef sponsors to immediately interact with the principal regulatory agency, i.e. COE.

K. DISSEMINATION OF PROJECT RESULTS -

The results of this project will be delivered to a broad audience of the public and private sectors by Sea Grant Advisory Services throughout the Gulf Coast region. Delivery of project information will be through the various media such as brochures, handbooks, workshops, and general public awareness programs.

L and M. PROJECT COSTS -

A detailed breakdown of overall project and individual component costs, including cost sharing, is contained in the following budgets.

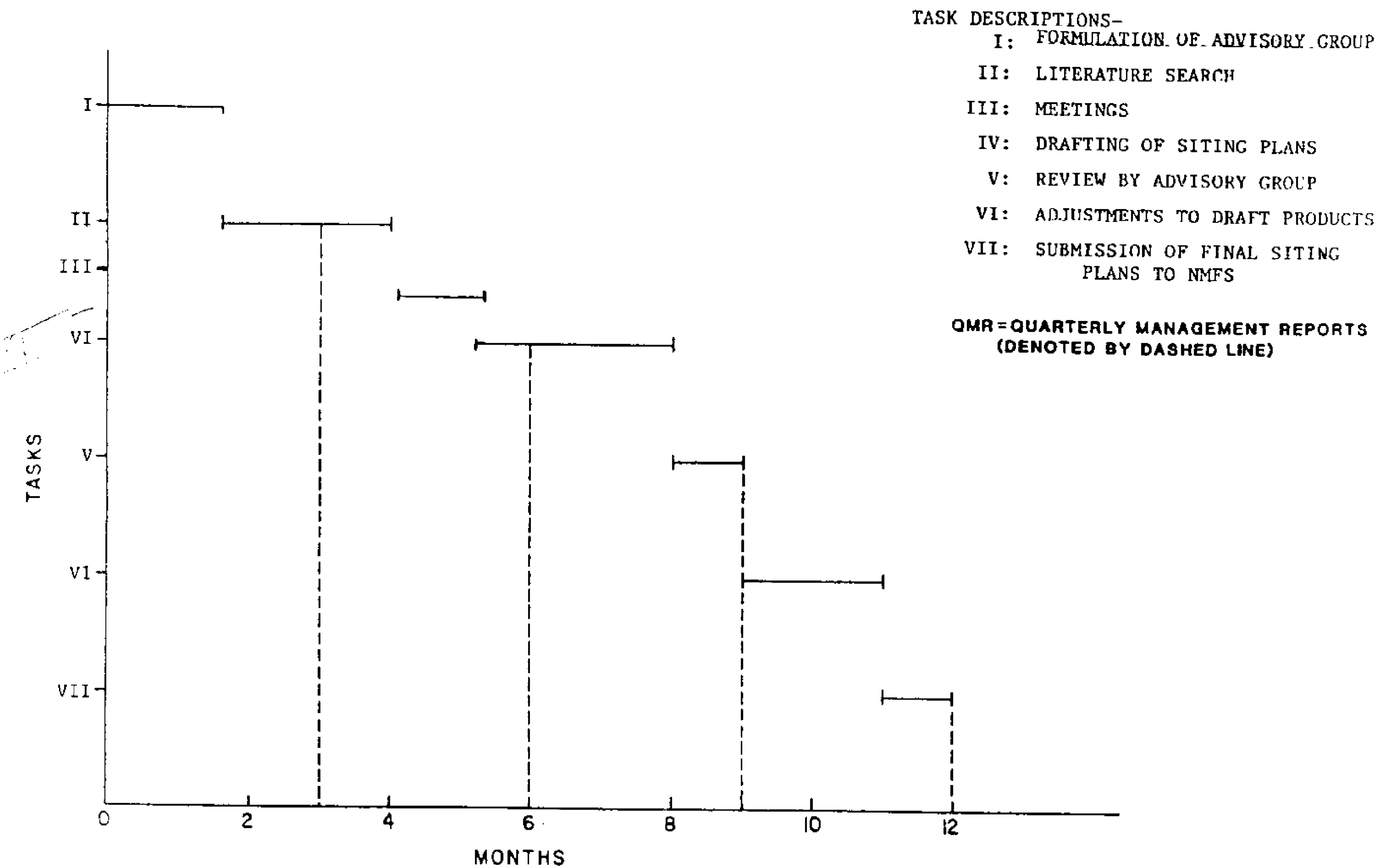

FIGURE 1. TASKS AND MAJOR MILESTONES.

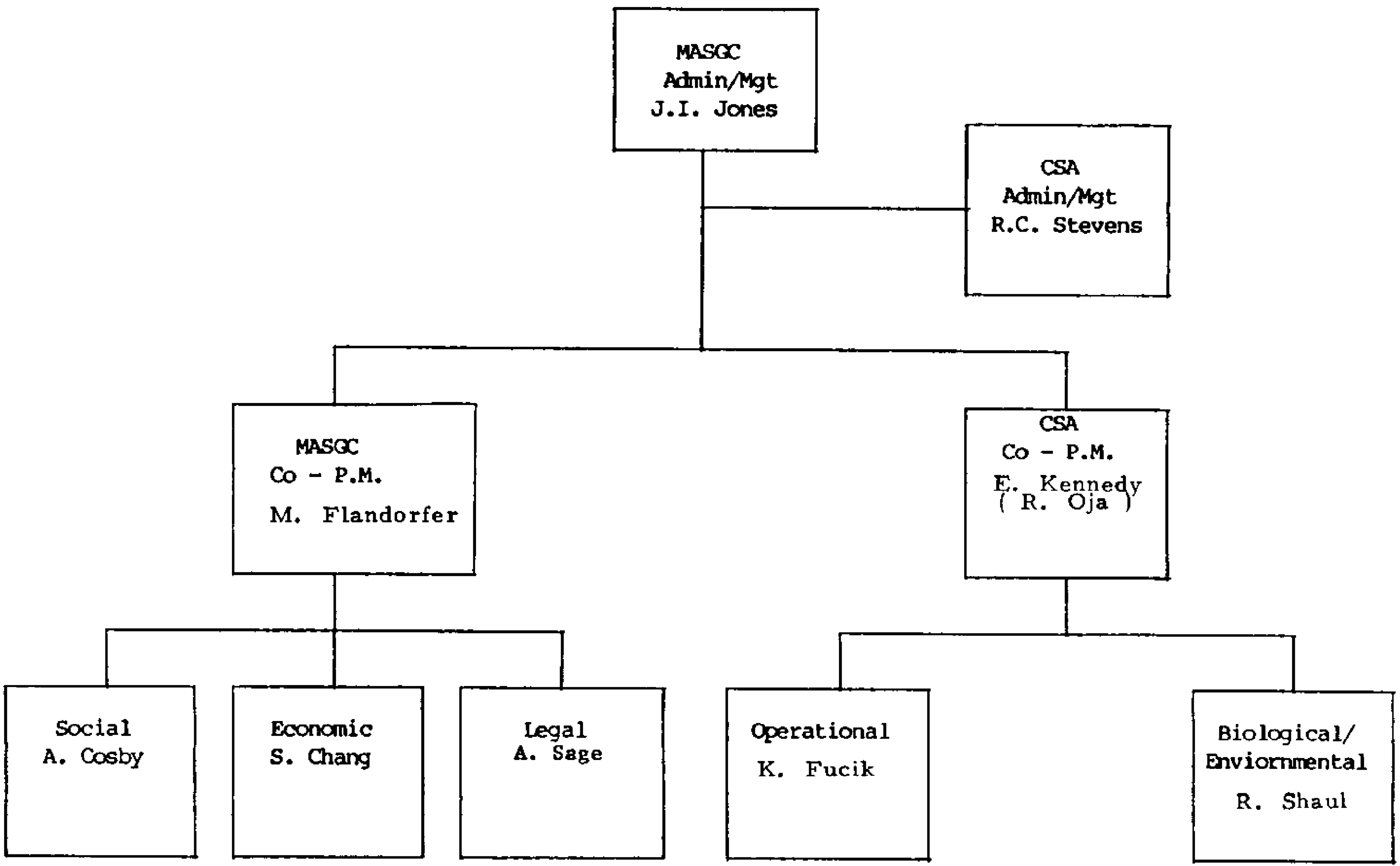

FIGURE 2 ORGANIZATION CHART.

APPENDIX B

DEVELOPMENT OF A SITING PLAN
FOR THE ESTABLISHMENT OF ARTIFICIAL
REEFS IN THE GULF OF MEXICO

PUBLIC REGIONAL MEETINGS

January 21, 1986	January 22, 1986	January 23, 1986
Marine Education Center	Mobile Gas Service Co. Auditorium	Holiday Inn
Gulf Coast Research Laboratory	Mobile, AL	University Mall
Biloxi, MS		Pensacola, FL

AGENDA

6:30 p.m. -Meeting opens. Introductions: Dr. James Jones, Director, Mississippi-Alabama Sea Grant Consortium

Economics Component -	Dr. Semoon Chang, University of South Alabama
Sociological Component -	Dr. Arthur Cosby, Mississippi State University
Legal Component -	Dr. Albert Sage III, University of Mississippi
Operational Component -	Kenneth Fucik, Continental Shelf Associates
Biological Component -	Richard Shaul, Continental Shelf Associates

Summary of presentations, Dr. James Jones

Discussions/recommendations/questions from the floor

ARTIFICIAL REEF SITING PLAN
REGIONAL MEETING
BILOXI, MISSISSIPPI
JANUARY 21, 1986

Adams, Glen
1621 Pollard Parkway
Baton Rouge, LA 20808
(504) 766-4429

Bitler, Richard
U. S. Air Force
Route 2, Box 298D
Biloxi, MS 39532

Boswell, Bunky
Gulf Fishing Banks
9364 Ridgeview Drive
Ocean Springs, MS 39564
(601) 875-9852

Brou, Eddie
Bel-Bru Marine Mart
621 E. Howard Avenue
Biloxi, MS 39530
(601) 432-2012

Cirino, John
Gulf Coast Research Laboratory
E. Beach Boulevard
Ocean Springs, MS 39564

Collins, Terese P.
City of Biloxi
P.O. Box 508
Biloxi, MS 39531
(601) 432-6280

David, Rusty
GCCA
15821 Albany Drive
N. Biloxi, MS 39532
(601) 392-6487 or 374-3611

Gallop, Jack
MS Fish
3307 Wall Avenue
Pascagoula, MS 39567
(601) 762-5157

Geller, Harry
Geller Investments
P.O. Drawer 920
Ocean Springs, MS 39564

Goff, Charles E.
12608 Walker Road
Ocean Springs, MS 39564
(601) 875-7984

Gusa, Miken C.
MS Gulf Fishing Banks
23 W. Echo Hills
Gulfport, MS 39503
(601) 832-3322

Haleth, R. D.
USMC (Ret)
5110 Courthouse Road
Gulfport, MS 39501
(601) 896-7969

Hatch, Barbara B.
5110 Courthouse Road
Gulfport, MS 39501
(601) 896-7969

Hobbs, Allen
GCCA
2726 Briarwood Drive
Moss Point, MS 39563

Howard, Susan
Jackson Co. Planning Comm.
600 Corvent Street
Pascagoula, MS 39567
(601) 769-3056

Lambeth, John
The Sun Herald
P.O. Box 4567
Biloxi, MS 39535-4567
(601) 896-2353

McArmally, Jim
Jackson Co. Planning Comm.
600 Corvent Street
Pascagoula, MS 39567
(601) 769-3065

Myers, Robert P.
GCCA
1515 Bayou Vista
Gautier, MS 39553
(601) 797-4408

Artificial Reef Siting Plan Regional Meeting
Biloxi, MS Continued

Patrick, Joe
2348 Parkview Drive
Gautier, MS 39553
(601) 497-3050

Pullis, E. R.
Ventura Charters
0702 E. Beach Boulevard
Gulfport, MS 39501
(601) 896-3469

Roberts, Lynn U Lysle
Rt. 5, 48 Ellis Drive
Gulfport, MS 39501
(601) 832-5602

Robertson, David B.
Sports Fisherman
519 Octave Street
Biloxi, MS 39532

Sepe, Mark R.
Charter Boats-GCCA
6676 Calanlus Circle
Ocean Springs, MS 39564
(601) 875-5151

Strickland George A.
Ms Gulf Fishing Bands
2819 Briarwood Circle
Mospoint, MS 39563
(601) 475-1470

Truax, N. W. and Jane (Cpt)
Truax Charter Service
1019 Legion Lane
Ocean Springs, MS 39564

Van Devender, Tom
Bureau of Marine Resources
P.O. Box 959
Long Beach, MS 39560
(601) 864-4602

Vile, DeWitt
4200 Dantelane Street
Moss Point, MS 39563
(601) 474-1915

Webb, David
3001 Graveline Road
Moss Point, MS 39563
(601) 497-3203

Wells, Douglas
124 Shiloh Circle
Ocean Springs, MS 39564
(601) 875-2609

Yeager, Paul
P.O. Box 223
Gautier, MS 39553
(601) 497-9505

Young, Glenn
Boat Builder
#7 Forest Hill
Ocean Springs, MS 39564
(601) 875-1229

Young, Jim
The Dive Shop
2819 Gulf Avenue
Gulfport, MS 39501
(601) 864-2321

ARTIFICIAL REEF SITING PLAN
REGIONAL MEETINGS
MOBILE, ALABAMA
JANUARY 22, 1986

Captain Jerry Alycucb
Rt. 2, box 2882
Orange Beach, AL 36561

Armand A. Annan III
P.O. Box 161
Point Clear, AL

Brian Annan
Rt. 2, Box 261
Fairhope, AL 36532

Donald Annan
Rt. 2, Box 261
Fairhope, AL 36532

David B. Ball
P.O. Box 130
Mobile, AL 36601

Claude T. Banger
P.O. Box 143
Route 1
Theodore, AL 36532

Ford Brackin
3614 Bayfront Road
Mobile, Al 36605

Micky Bullock
P.O. Box 505
Montrose, AL 36559

G. Marshall Burden
3762 So. Claindee
Mobile, AL 36608

Captain R. L. Burns
Rt. 2, Box 2440
Orange Beach, AL 36561

S. Chang
1100 Carolina Ct.
Mobile, AL 36609

Donnie & Jean Cochran
4154 Bacon Ct.
Mobile, AL 36609

Bob Cox
1284 Hatson Drive
Mobile, AL 36609

Edward Cunningham
Rt. 4, Box 254
Mobile, AL 36609

John Dindo
P.O. Box 130
Mobile, AL 36601

John & Brenda Doss
Rt. 4, Box 230-V
Theodore, AL 36582

W. C. Douglas
3354 Cahacee Drive
Mobile, AL 36609

Stuart P. Dowling
19 Mary Place
Mobile, AL 36604

Melvin E. Dunn
Rt. 1, Box 502B
Theodore, AL 36512

Art Dyas
P.O. Box 1029
Mobile, AL 36633

Rick Farver
6116 Smith Lane
Mobile, AL 36609

Captain Jack Flock
P.O. Box 162
Orange Beach, AL 36561

Angie Gleazer
Rt. 2, box 2440
Orange Beach, AL 36561

Larry Goldman
115 Rolling Hill Dr.
Daphne, AL 36582

Bill Gully
1809 Culkwood Ct.
Mobile, AL 36609

Judy & Robert Hardin
Rt. 2, Box 2497
Orange Beach, AL 36561

Artificial Reef Siting Plan Regional Meeting
Mobile, AL Continued

O. P. Harrison
Theodore, AL 36582

Steve Heath
P.O. Box 159
Dauphin Island, AL 36528

Robert Hodge
Rt. 1, Box 343
Theodore, AL 36582

Ross Hutchusson
821 W. Parkwood Drive
Mobile, AL 36608

Lee Ann & Ronnie Hyer
Box 18, Wateer Road
Magnolia Springs, AL 36555

Melvin L. Hyer
1910 Spanish Drive
Saraland, AL 36571

Tom Johnston
1012 15th Street
Mobile, AL 36615

Arlene F. Jones
P.O. Box 1420
Daphne, AL 36526

E. G. Jones
Rt. 4, Box 117
Mobile, AL 36605

Mark Jones
7249 Emerald Drive
Mobile, AL 36619

George Jordan
6133 Palomino Drive
Mobile, AL 36609

Allen Krusoe
3019 Palamino Drive
Mobile, AL 36609

Tom Littlepage
6209 Christopher Drive
Mobile, AL 36555

Daniel K. Lyski
8 Summer Oaks
Daphne, AL 36526

Greg Mann
Rt. 1, Box 181M
Mobile, AL 36605

Bill Matthews
3376 Laurel Drive
Gulf Breeze, FL 32561

Jerry & Karen McKean
5167 Norton Lane
Mobile, AL 36608

Dawn Meley
2121 Baker Road
Mobile, AL 36618

Joe Mosley
4678 Airport Blvd.
Mobile, AL 36608

Captain Rudolf Motley
Dedar Woods
Theodore, AL 36582

Rickey E. Namislo
201 Bayou Avenue
Saraland, AL 36571

C. Scott Overly
1409 Coltseum Boulevard
Montgomery, AL 36130

Wayne & Debbie Owens
663 Halifax Drive
Mobile, AL 36609

Romie Perez
156 West Collins St.
Mobile, AL 36608

Jerry Pittman
Rt. 1, Box 130
Mobile, AL 36605

Harry Shiram
3801 Ciaridge Rd.
Mobile, AL 36608

John & Mary Smallwood
Rt. 9, Box 72-F
Eight Mile, AL 36613

M. Staut
3651 Cedar Bend Drive #64-E
Mobile, AL 36608

Ellen Thomasson
400 Austell Place
Mobile, AL 36608

Joe. B. Van Valkenburgh
P.O. Box 1796
Gulf Shores, AL 35642

Jerry Walker
Orange Beach, AL 36561

Charles E. Willamor
Rt. 4, Box 654-A
Mobile, AL 36609

Gil C. Williamson
554 Quail Run
Theodore, AL 36582

ARTIFICIAL REEF SITING PLAN
REGIONAL MEETING
PENSACOLA, FLORIDA
JANUARY 23, 1986

Eilene Beard
Scuba Shack Inc.
Escambia Co. Marine Rec. Comm.
719 S. Palafox Street
Pensacola, FL 32501
904-433-4319

Steve Burton
University of West Florida
Pensacola, FL 32501
724-2000

Ken Davis
Escambia Co. Marine Rec. Comm.
1999 Mass Avenue
Pensacola, FL 32505
453-2111

Charles Hayes
349 Silver Road
Pensacola, FL 32505
432-2933

Scott B. Huggins
Charter Boat Captain
208 S. Sunset Blvd.
Pensacola, FL 32501
932-3824

Mike Knicklebine
Escambia Co. Marine Rec. Comm.
199 Mass Avenue
Pensacola, FL 32505
453-2111

Eddie Lively
Charter Boat Captain
13 Highpoint Drive
Gulf Breeze, FL 32561
932-5071

Ken Merritt
Escambia Co. Marine Rec. Comm.
405 Easter St.
Pace, FL 32570
434-3161 - Work
994-4623 - Home

James A. Newcome III
Charter Boat
5408 Rawson Lane
Pensacola, FL 32501
904-478-2543

Ed Perry
Destin Charter
718 Elise Lane
Destin, FL 32541
904-837-1648

Larry Wine
Escambia Co. Marine Rec. Comm.
P.O. Box 1613
Pensacola, FL 32597
904-433-0268

Krista Wismer
Armstrong
2079 Interstate Ct.
Pensacola, FL 32501
944-2475

ARTIFICIAL REEF QUESTIONNAIRE
FOR TOWN MEETINGS

1. Are you a recreational or commercial fisherman?

2. How often do you fish (# of trips/month)?

3. From what do you fish (i.e., private boat, charter boat, shore, etc.)?

4.a. If you fish from a boat, how far offshore do you typically travel to fish?

b. Does the boat from which you fish have Loran C navigation?

5. What is the farthest distance offshore you are willing to travel to fish?

6. What type of fishing gear do you use (hook & line, trawl, electric reel, etc.)?

7.a. For what species do you usually fish?

b. What species do you usually catch?

8. If possible, what additional species, if any, would you like to catch?

9. Do you presently own the equipment to fish for the species listed in question #8?

10. Do you typically keep what you catch or release it?

11. If kept, do you eat it?

12. Do you SCUBA dive (if no, go to question #17)?

13. How often do you SCUBA dive (# of trips/month)?

14. How far offshore will you travel to SCUBA dive?

15. When SCUBA diving, what is your primary activity (i.e., spearfish, photograph, etc.)?

16. What is the deepest water depth you feel comfortable with diving?

17.a. Do you fish or dive at any existing artificial reefs?

b. How often do you visit these sites (# trips/month)?

18. Where would you like to see additional artificial reefs placed?

19. What areas are most heavily fished by commercial trawl fishermen?

20. How far offshore do the commercial trawlers travel?

21. Are there nearshore areas (i.e., less than 60 ft. depth) with known snags that trawlers avoid?

22. Construction of artificial reefs will be a function of the availability of suitable reef material (i.e., concrete rubble, steel-hulled vessels, etc.) or funds to construct Japanese-type structures. Do the sources of these materials and/or funds now exist in the community?

23.a. What techniques are used by commercial fishermen (i.e., not bottom trawl fishermen): long-lines, gill-nets, mid-water trawls, traps, etc.?

b. Which areas are most commonly fished (such areas should be identified by type of technique listed in previous question)?

(Questions below do not require precise answers. Please make your best judgment and answer all questions.)

1. What is the name of your town? [ ]

2. How many fishermen live in your town?

   commercial fishermen [ ]
   recreational fishermen [ ]

3. On any given day, how many local fishermen fish in the waters of your town for recreation? [ ]

4. On any given day, how many out-of-town fishermen fish in the waters of your town? [ ]

5. Approximately how many days during a year does a typical recreational fisherman of your town fish in the waters of your town?

   [ ] 5 days
   [ ] 10 days
   [ ] 15 days
   [ ] 20 days
   [ ] 25 days
   [ ] 30 days

6. Approximately how many days during a year does a typical out-of-town recreational fisherman fish in the waters of your town?

   [ ] 1 day
   [ ] 5 days
   [ ] 10 days
   [ ] 15 days
   [ ] 20 days

7. According to your judgment, will artificial reefs increase fish catch in the waters of your town?

   [ ] Yes
   [ ] No

8. Would you be interested in having artificial reefs in the waters of your town?

   [ ] Yes Please continue only if your answer to No. 8 is Yes:
   [ ] No

9. Check the types of artificial reefs that you prefer to have in the waters of your town:

   [ ] oil/gas platforms
   [ ] sunken ships
   [ ] tires
   [ ] concrete rubbles
   [ ] others: specify____________________

10. If you have to pay for siting an artificial reef in the waters of your town, how much would you be willing to pay during a year for the right to use the artificial reef?

   [ ] zero
   [ ] 1 to 50 dollars
   [ ] 51 to 100 dollars
   [ ] 101 to 150 dollars
   [ ] 151 to 200 dollars
   [ ] 201 to 250 dollars
   [ ] 251 to 300 dollars
   [ ] more than 300 dollars

11. Are you a commercial fisherman or a recreational fisherman?

   [ ] commercial fisherman
   [ ] recreational fisherman

12. If you have an artificial reef sited in the waters of your town, what percent of your fishing time do you expect to spend around the reef for fishing?

   [ ] less than 10 percent
   [ ] 11 to 20 percent
   [ ] 21 to 30 percent
   [ ] 31 to 40 percent
   [ ] 41 to 50 percent
   [ ] more than 50 percent

13. Artificial reefs in your town may attract out-of-town fishermen and their dollars. Expenditures by these out-of-town fishermen on local goods and services are expected to be:

   [ ] substantial
   [ ] moderate
   [ ] little, if any.
   [ ] zero.

APPENDIX C

Development of Siting Plans for the Establishment of Artificial Reefs in the Gulf of Mexico

ADVISORY COMMITTEE MEETING AGENDA

DATE: 31 January 1985

TIME: 9:00 a.m.

LOCATION: Sheraton Mobile
301 Government Boulevard
Mobile, Alabama 36602
(205) 438-3431

I. Opening Remarks and Introduction of Participants

II. Background Information on the Development of the S-K Artificial Reef Siting Plan Study

III. Relationship of Mississippi-Alabama Sea Grant - Continental Shelf Associates, Inc. (CSA) Siting Plan Study to:

A. National Artificial Reef Planning Document
B. Proposed Platform Removal Standards
C. National Fishing Enhancement Act of 1984

IV. Goals of the Siting Study and Accomplishments To Date

A. Biological - CSA
B. Operational - CSA
C. Economic - MS/AL Sea Grant
D. Legal - MS/AL Sea Grant
E. Sociological - MS/AL Sea Grant

V. Refreshments Break

VI. Functions of the Advisory Committee

A. "Scoping Process" from a Regional Perspective
B. Review of Draft Products
C. Second Year's Effort
1. Identification of "Demand Center Management Teams"
2. Development of "How-to Guides"
3. Organization of Local Public Meetings

VII. Open Discussion Related to Items IV and VI

VIII. Lunch

IX. Continuation of Open Discussion

X. Closing Remarks

P A R T I C I P A N T S

Development of Siting Plans for the Establishment of Artifical
Reefs in the Gulf of Mexico

ADVISORY COMMITTEE MEETING
January 31, 1985

Name	Affiliation
Ronald Schmied	National Marine Fisheries Service St. Petersburg, FL
James I. Jones	Mississippi-Alabama Sea Grant Consortium
Max Flandorfer	Mississippi-Alabama Sea Grant Consortium
Stanley Hecker	Mississippi-Alabama Sea Grant Consortium
Robert Oja	Continental Shelf Associates, Inc.
Charles Futch	Florida Department of Natural Resources
Charles Blalock	Mississippi Department of Natural Resources
Robert Jones	South East Fisheries Association
Lynn Bonner Burke	Sport Fishing Institute
Lawrence Green	Corps of Engineers Mobile District
William Seaman	Florida Sea Grant College Program
Charles Wilson	Louisiana Sea Grant College Program
William DuBose	National Ocean Industries Association
Villere Reggio, Jr.	Minerals Management Service
B. J. Putnam	c/o Halfhitch Tackle Shop
Edwin J. Keppner	National Marine Fisheries Service Panama City Laboratory
John Burgbacher	Shell Offshore, Inc.
Robert Mulcahy	Continental Shelf Associates, Inc.
Richard Shaul	Continental Shelf Associates, Inc.
E. A. Kennedy	Continental Shelf Associates, Inc.
William Howard	Mississippi State University
Semoon Chang	University of South Alabama
Albert Sage	University of Mississippi

Development of Siting Plans for the Establishment of Artificial Reefs in the Gulf of Mexico

SECOND AVISORY COMMITTEE MEETING AGENDA

DATE: 17 September 1985

TIME: 9:00 a.m.

LOCATION: Quality Inn - Airport & I-65
3650 Airport Boulevard
Mobile, Alabama
(205) 344-3410

I. Opening Remarks and Introduction of (New) Participants

II. Recent Progress Concerning Artificial Reef Development

III. Principal Investigators' Preliminary Reports

A. Biological Aspects - CSA
Discussion

B. Operational Aspects - CSA
Discussion

C. Sociological Aspects - MASGC
Discussion

D. Economic Aspects - MASGC
Discussion

E. Legal Aspects - MASGC
Discussion

IV. Refreshment Break (*This will probably occur between B and C)

V. Continued Open Discussion Related to Item III

VI. Comments and Response of Advisory Committee

VII. Lunch

VIII. Proposed Meetings to Obtain Local Input

IX. Closing Remarks

X. Principal Invèstigators, Project Managers, and Project Director Meeting

P A R T I C I P A N T S

ARTIFICIAL REEF ADVISORY COMMITTEE MEETING
Reefs in the Gulf of Mexico

September 17, 1985
Mobile, Alabama

Name	Affiliation
James I. Jones	Mississippi-Alabama Sea Grant Consortium
Ronald Schmied	National Marine Fisheries Service, St. Petersburg, Florida
Stanley Hecker	Mississippi-Alabama Sea Grant Consortium
Max Flandorfer	Mississippi-Alabama Sea Grant Consortium
Nancy Marcellus	Mississippi-Alabama Sea Grant Consortium
Cheryl Noble	Mississippi-Alabama Sea Grant Consortium
Lynne Burke	Sport Fishing Institute
Ken Fucik	Continental Shelf Associates, Inc.
E.A. Kennedy	Continental Shelf Associates, Inc.
Albert Sage	University of Mississippi
Wayne Kewley	Conoco, Inc.
Richard Shaul	Continental Shelf Associates, Inc.
William Howard	Mississippi State University
Donald Pybas	Florida Sea Grant College Program
Edwin Keppner	National Marine Fisheries Service Panama City Laboratory
Ron Lukens	Mississippi Sea Grant Advisory Service
D.F. Withee	Eighth Coast Guard District
Rick Wallace	Alabama Sea Grant Advisory Service
Chuck Wilson	Louisiana Sea Grant College Program
Villere Reggio, Jr.	Minerals Management Service
James Hildreth	Corps of Engineers - Mobile District