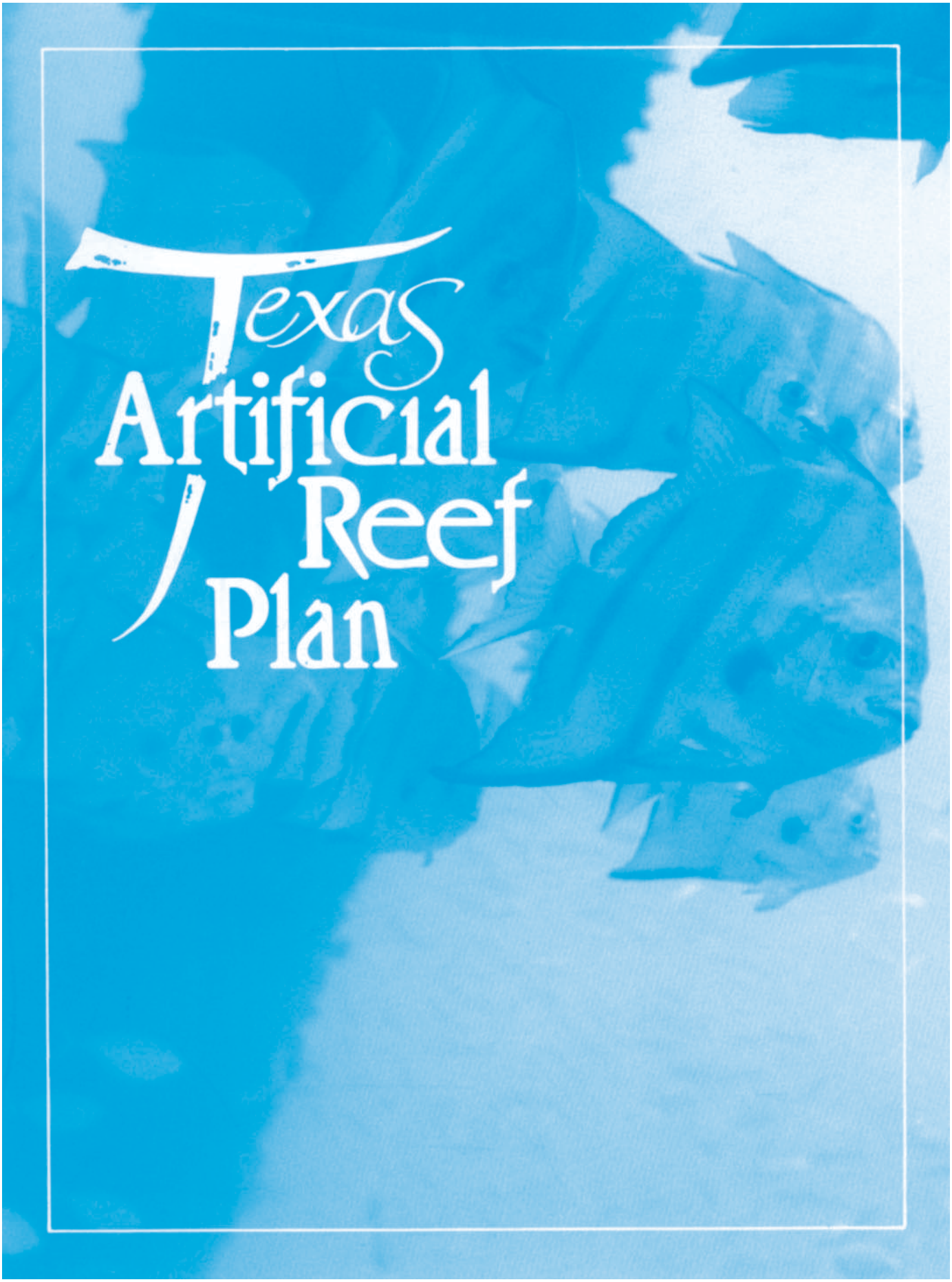
Texas
Artificial
Reef
Plan

Texas Artificial Reef Fishery Management Plan

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EXECUTIVE SUMMARY

Artificial reefs can be used with other fishery management techniques designed to achieve optimum yield from fisheries. The Texas legislature recognized this potential with the passage of the Artificial Reef Act of 1989, which directed the Texas Parks and Wildlife Department (Department) to promote, develop, maintain, monitor, and enhance the artificial reef potential in state waters and federal waters adjacent to Texas. The act defined an artificial reef as a structure or system of structures constructed, placed, or permitted in the navigable water of Texas or water of the federal exclusive economic zone adjacent to Texas for the purpose of enhancing fishery resources and commercial and recreational fishing opportunities. Enhancement of fishery resources is considered to be the restoration or creation of habitat to improve recruitment and spawning potential of reef associated species, while enhancement of fishing opportunities is the creation or improvement of fishing opportunities. To fulfill these purposes, the Department was directed to develop a state artificial reef plan in accordance with Chapter 89 of the Texas Parks and Wildlife code.

The Texas Artificial Reef Plan is a product of a process designed to maximize the input of those interest groups most affected by the placement of artificial reefs in salt waters. The Plan has been reviewed by the Texas Artificial Reef Advisory Committee, created to advise and make recommendations to the Department on details and specifications of the plan, in accordance with Chapter 89 of Texas Parks and Wildlife Code. Meetings with Department staff and the Committee were held in January, May, August, and October of 1990. These meetings were also open to and attended by members of the public and other state officials. Meetings were recorded and transcripts are available upon request.

All comments received were carefully considered. As directed by the Legislature, the Committee consisted of a representative of each of the following: (1) salt water sports fishing organization, (2) offshore oil and gas company, (3) Texas tourist industry, (4) General Land Office, (5) shrimping organization, (6) Texas diving club, (7) Attorney General's Office, (8) Texas university, and (9) environmental group.

The Artificial Reef Act of 1989 provided guidance for planning and developing artificial reefs in a cost effective manner to minimize conflicts and environmental risks.

The Artificial Reef Act of 1989 provided guidance for planning and developing artificial reefs in a cost effective manner to minimize conflicts and environmental risks. As directed by the legislature, an artificial reef covered under this Plan must be sited, constructed, maintained, monitored, and managed in a manner that:

(1) enhances and conserves fishery resources to the maximum extent practicable;

(2) facilitates access and use by Texas recreational and commercial fishermen;

(3) minimizes conflicts among competing uses of water and water resources;

(4) minimizes environmental risks and risks to personal and public health and property;

(5) is consistent with generally accepted principles of international law and national fishing law and does not create any unreasonable obstruction to navigation;

(6) uses the best scientific information available; and

(7) conforms to the state artificial reef plan.

Recommendations which have been developed in the Artificial Reef Plan to guide the Department's artificial reef program include the following:

- The Department should be made a permitting agency for artificial reef development in Texas and the adjacent Exclusive Economic Zone, with authority to deny any permit for proposed artificial reef construction which does not conform to the Texas Artificial Reef Plan.
- Subsequent to the adoption of the Artificial Reef Plan, an advisory committee consisting of persons from groups with interest in artificial reefs should be selected by the Chairman of the Texas Parks and Wildlife Commission for the purpose of advising the Department on implementation of the Plan.
- The specific locations for artificial reef development should be within the priority areas identified in the Plan.
- Artificial reefs should be constructed as benthic reefs using ships, oil platforms, or similarly constructed materials arranged in as complex a fashion as possible without jeopardizing structural integrity, and oriented in a fashion which maximizes effectiveness, durability and stability.
- The Department should actively pursue acquiring offshore platforms for use as artificial reefs in the Gulf of Mexico, in deference to other structures.
- The cost of the Department's artificial reef development, maintenance, and marking program should not exceed revenues accumulated in the Artificial Reef Fund. The cost of creating and maintaining artificial reefs

should be borne by the donor; however, the Department should minimize these costs to the maximum extent possible.

• The Artificial Reef Fund should be the sole source of funds for costs to the Department associated with artificial reefs. Any donation of artificial reef material should be accompanied by at least 50% of the realized savings to the donor. Costs associated with donation of an artificial reef should be included when calculating potential savings.

• Existing oil and gas platforms located in the priority areas for artificial reef development should be deployed as artificial reefs as near their current location and in a form as close to their current form as possible.

• Oil and gas platforms located within excluded areas at the time of removal should be placed as near as possible to artificial reefs located in priority areas.

• The specific location for materials not already present within the priority areas should be at sites that maximize enhancement of fishery resources and opportunities for recreational and commercial fishing to achieve optimum yield, minimize impacts on other users of the water column, and minimize environmental, property and health risks.

• The liability incurred by the Department through any donations of artificial reef material should be minimized to the maximum extent possible.

• The Department should continue to work with other groups to coordinate artificial reef development and management.

• Fishery resource harvest from artificial reefs should be regulated to satisfy fishery management objectives of the regulating entities within Texas and the adjacent Exclusive Economic Zone.

• The Department's present monitoring program should be enhanced to meet legislative mandates and to continue to determine trends in population abundance and stability, movement, growth, mortality and the impacts of environmental influences on reef associated species.

• The Department's present monitoring program should be enhanced to meet legislative mandates and to continue to determine fishery harvest trends, economics and impacts of sociological influences.

• Continued assessment and evaluation of the Department's activities by the Texas Parks and Wildlife Commission are necessary to meet legislative mandates and to address data needs reviewed in this Plan.

• The Department should continue to maintain a high level of interdepartmental and interagency communication to more fully benefit from the free flow of information concerning artificial reef research, adverse environmental conditions and changes in economic and societal goals.

• The Department should take advantage of the opportunities afforded by the creation of artificial reefs for scientific study and education of the public, including recreational spectators (e.g., nonconsumptive divers).

Implementation of the Texas Artificial Reef Plan should insure the continued enhancement of fishery resources and fishing opportunities for future Texans. By doing so, many other Texans and visitors to Texas will benefit directly and indirectly.

INTRODUCTION

Artificial reefs are any structures placed by man in the environment which alter the natural habitat. As such, artificial reefs represent a tool by which man can elicit changes in the ecosystem to achieve benefits. In general, the benefits sought through the use of artificial reefs have been the enhancement of fishery resources with a concomitant increase in fishing opportunities. As with any tool, however, artificial reefs can be used inappropriately, leading to detrimental effects such as loss of more valuable habitat, overfishing and destruction of property. Comprehensive planning strategies for the siting, deployment, maintenance, and management of artificial reefs is needed to maximize their assets, minimize their liabilities, and achieve desired purposes.

Artificial reefs represent a tool by which man can elicit changes in the ecosystem to achieve benefits.

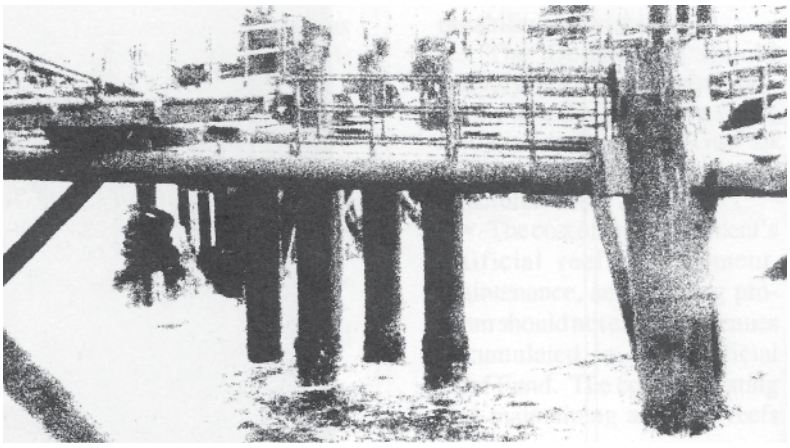
Artificial reefs can be used with other fishery management techniques designed to achieve optimum yield from fisheries. The Texas Legislature recognized this potential with the passage of the Artificial Reef Act of 1989. The act defined an artificial reef as a structure or system of structures constructed, placed, or permitted in the navigable water of Texas or water of the Federal Exclusive Economic Zone adjacent to Texas for the purpose of enhancing fishery resources and commercial and recreational fishing opportunities. The Act provided guidance for planning and developing artificial reefs in a cost effective manner to minimize conflicts and environmental risks. The Texas Parks and Wildlife Department (Department) was directed to develop an artificial reef plan (Plan) which meets these purposes, including the promotion, development, maintenance, monitoring and enhancement of the artificial reef potential in Texas and the adjacent Federal Fisheries Conservation Zone.

The Department manages the fisheries of the state to achieve optimum yield. For purposes of the Plan, optimum yield is defined as the amount of resources that the fisheries will produce on a continuing basis to achieve the maximum economic benefits to the fishing industries and the state as modified by any relevant social or ecological factors. Stated simply, fisheries should be managed by the State in a way that does not differ significantly from the way they would be managed by a privately-owned firm. This approach is consistent with that taken by the state in its management of other natural resources and the United States government in managing its natural resources, including fisheries.

Historical Perspective

Artificial reefs have been used for centuries to make fish available to fishermen. It is unclear how often this objective has been achieved, but other impacts have inevitably resulted from man's placement of structures and rigid materials in the aquatic environment. For example, the indiscriminate dumping of various materials of opportunity in the Gulf of Mexico (Gulf) has led to interference with navigation, expensive marking, and sites inaccessible to anglers. The specific goals to be achieved with artificial reef placement have seldom been clearly defined, leading to conflicts among competing interests as well as inefficient use of man-power and money. Further, artificial reefs have been created both intentionally and unintentionally. For example, jetties used to maintain navigational channels have also enhanced fishing opportunities. The United States (U.S.) Congress, recognizing the need for comprehensive planning to guide future artificial reef development in the U.S., passed the National Fishing Enhancement Act of 1984. That legislation mandated the development of a National Artificial Reef Plan.

Further impetus for the development of the National Artificial Reef Plan stemmed from the requirement by the U.S. Department of Interior that offshore oil and gas platforms must be removed completely when they are no longer producing and that the sea floor must be restored to its original condition. The use of offshore platforms for artificial reef development can be a practi-cal and economically attractive alternative to platform dismantling. The Gulf now has over



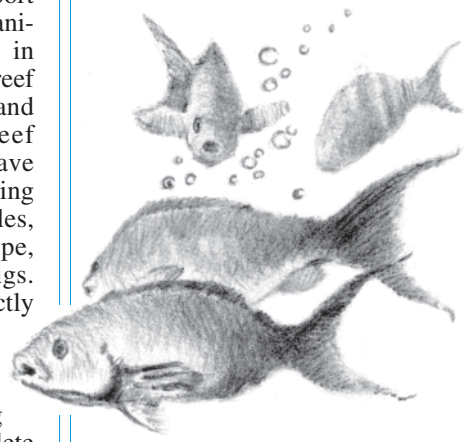
4,000 oil and gas platforms in State and Federal waters with forty percent of these offshore structures slated for removal by the year 2000. The removal of these structures will destroy the artificial reefs they represent, will be extremely expensive, and will preclude taking advantage of them in creating additional reefs. Indeed, "the size, shape, design, profile and density and openness of petroleum structures make them the most durable reusable material readily available for permanent artificial reef construction (1988 Interim Report of

the Texas Legislature's Subcommittee on Rigs-to-Reefs)." With this in mind, the Department of the Interior paved the way for a movement toward a national Rigs-to-Reefs Programs.

A host of states have carried forward this Federal initiative for a rigs-to-reefs program. In the Gulf, where offshore platforms are most prevalent, each of the bordering states has an artificial reef development program. Louisiana has an approved plan which facilitates the conversion of obsolete offshore platforms into artificial reefs. There have been at least 10 pre-planned rigs-to-reefs projects completed in the Gulf including one off Texas. This experience has stimulated new removal techniques and cost-saving technologies favoring reef development as a preferred disposal option.

Texas has been involved in artificial reef placement since the late 1940's. The Department has been authorized to conduct an artificial reef development program (Section 12.016, Parks and Wildlife Code) and Department staff have worked cooperatively with other state agencies, sport fishery and conservation organizations, and private industry in siting; obtaining permits and reef material; building, placing and maintaining reefs and reef markers. Artificial reefs have been created intentionally using oyster shell, tires, automobiles, construction rubble, clay pipe, barges, ships and drilling rigs. The Department has been directly involved in the construction of 23 artificial reefs. The largest initiative for artificial reefs in Texas occurred during the mid-1970's when 12 obsolete Liberty ships were sunk. Three each were placed off Freeport, Matagorda, Port Aransas, and South Padre Island. The most

recent artificial reef constructed was an offshore platform donated to the Department by Transco and deployed about 80 miles southeast of Galveston in January 1990. Reefs constructed from ships and offshore platforms have generally had much greater longevity than other materials used.



These intentionally-created artificial reefs are far exceeded by the over 2,000 de facto artificial reefs that exist in the form of piers, docks, jetties, and petroleum platforms in salt water in and adjacent to Texas. These structures perform the same function as any artificial reef, including enhancing fishery resources and commercial and recreational fishing opportunities, even though they may not have been built for that purpose.

The vast majority of unintentional artificial reefs are located in inland waters and coastal bays. The area benefitting least from decades of de facto artificial reef development has been the offshore saltwater zone. It was the needs of this area that the Texas Artificial Reef Act of 1989 apparently sought to address. Legislatively identified groups to be represented on the Artificial Reef Advisory Committee, created by the Act, reflect the emphasis placed on this area. Representatives of a saltwater sports fishing organization, an offshore oil and gas company, and a shrimping organization are included, but freshwater fishing interests and inshore oil and gas companies are not represented. Therefore, the Texas Artificial Reef Plan will focus on artificial reef development in the Gulf of Mexico off Texas unless otherwise noted.

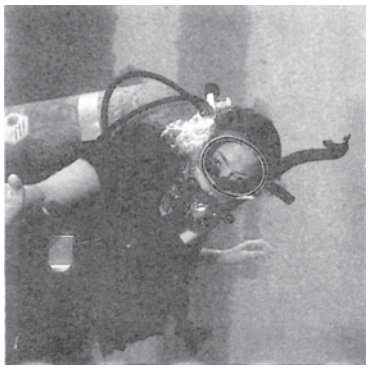
Goal and Objectives for the Artificial Reef Plan

In 1989, the Seventy-first Texas Legislature directed the Department to promote, develop, maintain, monitor, and enhance the artificial reef potential in state waters and federal waters adjacent to Texas to enhance fishery resources and commercial and recreational fishing opportunities. Enhancement of fishery resources is considered to be the restoration or creation of habitat to improve recruitment and spawning potential of reef associated species. If this goal is achieved, fishermen will not be the only beneficiaries. Divers engaged in recreational spectating will also benefit from increased access to additional reef structure and the ecological communities that result. To fulfill this purpose, the Department was directed to develop a state artificial reef plan in accordance with Chapter 89 of the Texas Parks and Wildlife Code. An advisory committee was created to advise and make recommendations to the Department on details and specifications of the Plan.

The Texas Artificial Reef Plan is a product of a process designed to maximize the input of those interest groups most affected by the placement of artificial reefs in salt waters. The Plan has been reviewed by the Texas Artificial Reef Advisory Committee. Meetings with Department staff and the Committee were held in January, May, August, and October of 1990. These meetings were also open to and attended by members of the public and other state officials. Meetings were recorded and transcripts are available upon request. All comments received were carefully considered. As directed by the Legislature, the Committee consisted of a representative of each of the following: (1) salt water sports fishing organization, (2) offshore oil and gas company, (3) Texas tourist industry, (4) General Land Office, (5) shrimping organization, (6) Texas diving club, (7) Attorney General's Office, (8) Texas university, and (9) environmental group.

The Plan is also a product of a process designed to gather and use the best scientific information available. This process included the contracting of Texas A&M University in 1988 to review all of the available scientific information concerning artificial reefs and prepare a report on artificial reefs. A synthesis of all applicable scientific research on which the Plan is based is contained in the Texas Artificial Reef Plan Source Document. It, too, has been reviewed by the Texas Artificial Reef Advisory Committee. Items required by the legislature that can be found in the Plan include:

- operational guidelines for the plan, including specific participant roles, and projected funding requirements for the plan;
- geographic, hydrographic, geological, biological, ecological, social, economic, and other criteria for permitting and siting artificial reefs;
- design, materials, and other criteria for establishing, constructing, and maintaining artificial reefs;
- mechanisms and methodologies for monitoring artificial reefs in compliance with the requirements of permits issued under the National Fishing Enhancement Act;



- mechanisms and methodologies for managing the use of artificial reefs;
- a map that depicts priority areas for artificial reef development consistent with the act and the National Fishing Enhancement Act; and
- provisions for managing the artificial reef fund in a manner that will assure successful implementation of the plan.

As directed by the legislature, an artificial reef covered under this Plan must be sited, constructed, maintained, monitored, and managed in a manner that:

- enhances and conserves fishery resources to the maximum extent practicable;
- facilitates access and use by Texas recreational and commercial fishermen;
- minimizes conflicts among competing uses of water and water resources;
- minimizes environmental risks and risks to personal and public health and property;
- is consistent with generally accepted principles of international law and national fishing law and does not create any unreasonable obstruction to navigation;
- uses the best scientific information available; and
- conforms to the state artificial plan.

Insomuch as the legislature desired that the Texas Artificial Reef Plan be consistent with the National Fishing Enhancement Act, the Plan and Source Document reference the National Artificial Reef Plan extensively.

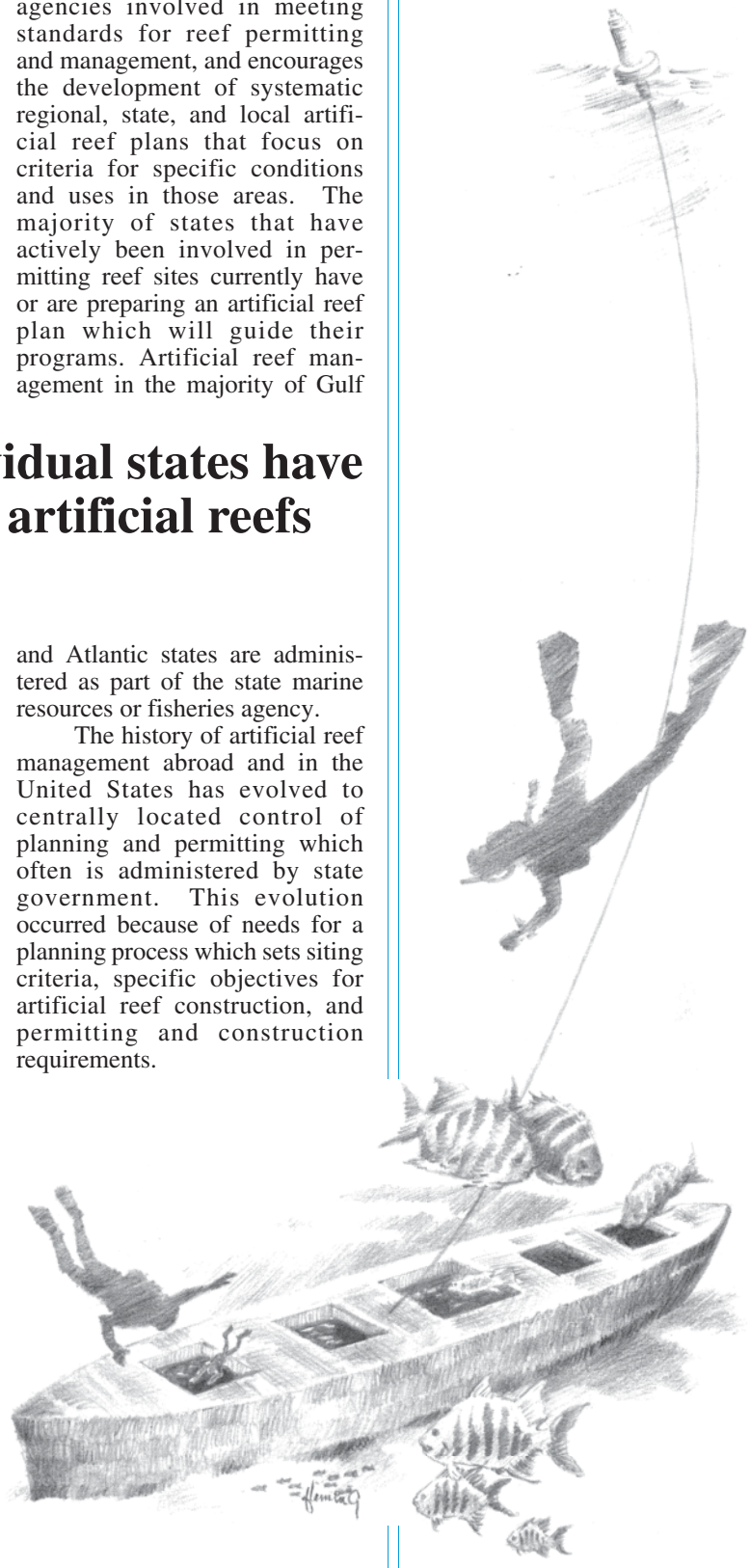
ARTIFICIAL REEF PROGRAMS AND PLANS

Artificial reefs have been constructed outside the United States for centuries. The United States and individual states have also been involved in developing artificial reefs for over 100 years. Abroad and overseas artificial reef planning has moved toward a more integrated program of research and development for resources enhancement, conservation, and management in order to attain both short and long term goals.

In the United States, national concern for artificial reef planning and management developed with the enactment of the National Fishing Enhancement Act of 1984. This legislation stressed the need for responsible and effective artificial reef development in United States waters, and mandated the development of the National Artificial Reef Plan. The National Artificial Reef Plan is a flexible working document designed to serve as a starting point for effective artificial reef development. Specifically the plan provides guidance on technical aspects of artificial reef development and management, serves as a technical reference for federal and state agencies involved in meeting standards for reef permitting and management, and encourages the development of systematic regional, state, and local artificial reef plans that focus on criteria for specific conditions and uses in those areas. The majority of states that have actively been involved in permitting reef sites currently have or are preparing an artificial reef plan which will guide their programs. Artificial reef management in the majority of Gulf and Atlantic states are administered as part of the state marine resources or fisheries agency.

The United States and individual states have been involved in developing artificial reefs for over 100 years.

The history of artificial reef management abroad and in the United States has evolved to centrally located control of planning and permitting which often is administered by state government. This evolution occurred because of needs for a planning process which sets siting criteria, specific objectives for artificial reef construction, and permitting and construction requirements.



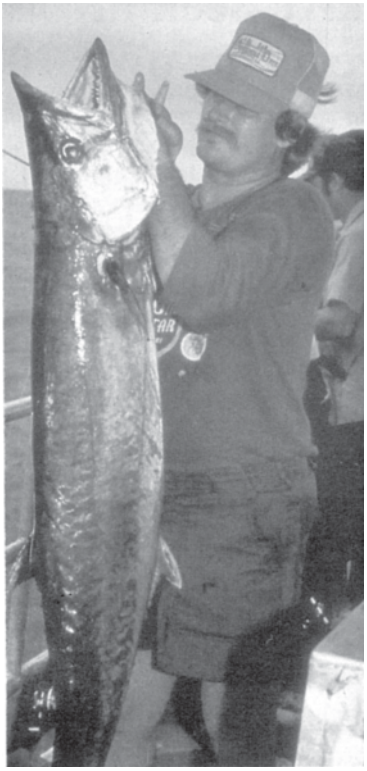
USE OF ARTIFICIAL REEFS TO ENHANCE FISHERY RESOURCES

Artificial reefs can be used to enhance reef fish and other organisms which comprise reef communities. However, artificial reef development displaces or otherwise impacts adjacent communities. Thus, it is important to define clearly the purpose of each proposed reef. For purposes of this document, an artificial reef is defined as a structure or system of structures constructed, placed or permitted in the Texas Territorial Sea and adjacent Exclusive Economic Zone waters for the purpose of enhancing fishery resources and commercial and recreational fishing opportunities. Enhancement of fishery resources is defined as an increase in the number of juveniles (recruits) and spawning potential per recruit. Oil and gas platforms, although not specifically constructed for fishery enhancement, serve this function; and the communities which develop are excellent examples of the communities and subsequent ecological interactions which occur on artificial reefs.

Offshore platforms in the Gulf of Mexico enhance fisheries by providing attachment substrate for habitat limited sessile invertebrates such as barnacles, oysters, mussels, bryozoans, hydroids, sponges, and corals. In addition to resident species, artificial reefs attract transient species, which may be present at a reef for periods of a few hours to a few days. Artificial reefs attract a variety of resident fish species. These species may be trophically dependent upon the sessile and motile invertebrates associated with a reef, attracted for cover and structure provided by the reef, or attracted as transient predators which feed on resident species.

As outlined above, artificial reefs have the ability to enhance reef associated assemblages. However, increases in the number of juveniles and spawning potential per recruit of reef associated species has not been documented for any artificial reef. Marine fishery professionals working with artificial reefs are well aware of the need for in depth ecological studies of the effects of artificial reefs on reef associated species, as well as the effects of artificial reefs on adjacent communities. For example, an increase in populations of trophically independent reef fish species such as red snapper must have some effect on the population of their prey species such as shrimp, which are also economically important. These questions must be addressed in order for fishery managers to understand the entire function of artificial reefs in fishery enhancement.

Artificial reefs can be used to enhance reef fish and other organisms which comprise reef communities.



USE OF ARTIFICIAL REEFS TO ENHANCE FISHERY OPPORTUNITIES

Artificial reefs can enhance the fishing opportunities for hook and line or spear fishermen targeting fish associated with the artificial reef. However, fishing opportunities for some other types of fishermen may be reduced. Opportunity is defined as an appropriate or favorable time or occasion. While not defined in the authorization statute for the artificial reef plan, the term "fishing opportunities" used herein means an appropriate or favorable fishing time or occasion. By definition, artificial reefs are structures that are placed by man in areas to enhance fishing opportunities. Enhancement of fishing opportunities through artificial reefs can occur by increasing the number or surface area of artificial reefs, increasing the accessibility of the sites to the fishermen, and ultimately increasing the potential for success of harvesting the desired species.

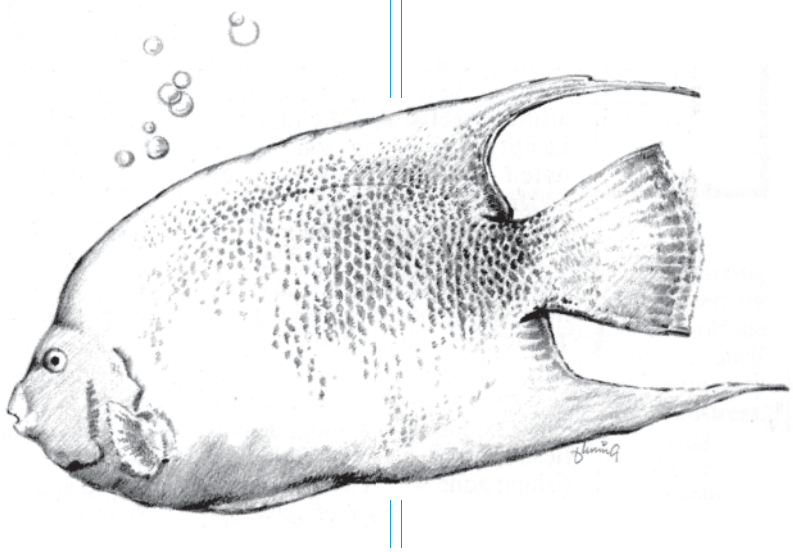
By definition, artificial reefs are structures that are placed by man in areas to enhance fishing opportunities.

Approximately 50-60% of the recreational fishermen operating in the Gulf off Texas used artificial reefs including oil and gas platforms for an estimated total of 300,000-400,000 anglers. Private sport boat saltwater fishermen on average took over 4 trips per year to the Gulf and spent over $100 per trip during the 1987-1988 and 1988-1989.

Partyboats (10 or fewer anglers) and headboats (more than 10 anglers) also operate in the Gulf of Mexico. Of the estimated 128 partyboats in Texas, 54% fished in the offshore area in 1987, while 86% of the 12 headboats in Texas fished offshore. During 1977-1978, 57% of interviewed offshore partyboat operators made at least one trip to an artificial reef and/or oil platform; 12% of all offshore partyboat trips to an artificial reef or oil platform were to a liberty ship site, and 23% were to an oil platform. In the South Padre Island/Port Isabel area, only 7% of partyboat trips were to artificial reefs. On average, partyboat reef users travel further offshore than non-reef users.

The species most often sought or landed by private sportboat anglers fishing in the Gulf include king mackerel, Spanish mackerel, cobia, red snapper, sand seatrout, silver seatrout, Atlantic spadefish, dolphin, vermilion snapper, Atlantic sharpnose shark, sheepshead, greater amberjack, and southern flounder. The mean annual private-boat landings in the Gulf (1982-1987) was dominated by sand seatrout (36,000 pounds), red snapper (35,000 pounds) and king mackerel (21,000 pounds).

A total of 782 Commercial Finfish Fishermen Licenses were sold in 1988, but only about 50 of these fishermen fished for fish in the Gulf. In Texas, snapper were the primary reef associated fish species landed by commercial fishermen with an average of nearly 600,000 pounds landed annually. Grouper were the second most dominant species landed with an average of over 200,000 pounds landed annually. Hook and line is the fishing gear most frequently used to harvest reef-fish. The use of longlines in the Gulf reef fish fishery began in 1980. Most recently, longlines account for 8% of red snapper harvest in the Gulf of Mexico, 34% of grouper harvest, and 24% of the total harvest of reef fish species landed. Other reef associated species landed commercially include grouper, greater amberjack, sheepshead, cobia, king mackerel, bluefish, dolphin, crevalle jack, Spanish mackerel, gray triggerfish and Atlantic spadefish.



SITING OF ARTIFICIAL REEFS

By Texas law, artificial reefs must be sited in a manner that enhances and conserves fishery resources, enhances fishing opportunities by recreational and commercial fishermen, minimizes conflicts among water users, minimizes environmental risks and risks to personal and public health and property, does not create any unreasonable obstruction to navigation and is consistent with generally accepted principles of international and national laws. Therefore, all these concerns must be taken into consideration when determining the location of prospective artificial reef development. Geographic, social, economic and environmental concerns have been incorporated into a resource planning framework developed by the Sport Fishing Institute, that can help in siting reefs designated for the enhancement of recreational fisheries. This framework can be modified to include the provisions mandated by the Parks and Wildlife Code (Chapter 89).

Three basic steps are included in the Sport Fishing Institute's framework for identification of artificial reef sites. The first is to identify the fishing zone designated for development using geographic, social, economic, and environmental information. For Texas, that area is defined by Chapter 89 of the Parks and Wildlife Code as the navigable water of Texas and water or the federal fisheries conservation zone adjacent to Texas waters. The second step, exclusion mapping, identifies and excludes areas within the fishing zone which should not be used for artificial reef development because of existing legislative or regulatory prohibitions, and potential user conflicts. In the final step, areas within the fishing zone that have specific positive attributes for artificial reef development are delineated and targeted for reef development. Areas within exclusion zones which were designated because of potential user conflicts may also be targeted for siting if those areas are already avoided by the traditional users. The following sections detail applicable criteria for the development of artificial reefs in Texas marine waters.

Parks and Wildlife Code, Chapter 89, requires that the National Artificial Reef Plan be followed as a guide and reference in the development of the Texas Artificial Reef Plan. The national plan gives general guidelines and some specific criteria for siting. For example, exclusion areas for artificial reefs to enhance fishing resources should include, but need not be limited to, shipping lanes, existing "live bottom" areas, restricted military areas, areas of poor water quality (e.g., hypoxic zones, sewage outfalls, toxic chemical dumps), traditional trawling grounds, unstable bottoms, existing rights-of-way (e.g., oil and gas pipelines and telecommunication cables), and sites used for other purposes which are incompatible with artificial reef development.

Parks and Wildlife Code, Chapter 89, further requires that a map be developed that depicts priority areas for artificial reef development consistent with the provisions of the Chapter and the National Fishing Enhancement Act. The technique described above and the criteria that follow were used to construct the required map (Figure 1). Specifically, the unshaded priority areas were identified by excluding existing fairways, clay and/or silt bottom substrate, historical shipwrecks, coral reefs, live bottom areas, oil and gas pipelines, industrial waste sites, and any other areas that might have safety considerations.

Areas within the fishing zone that have specific positive attributes for artificial reef development are delineated and targeted for reef development.

Geographic Criteria

Shipping fairways, anchorage areas, and historical shipwrecks should be avoided when siting artificial reefs. Shipping fairways and anchorages off Texas are critical to shipping commerce, and are non-negotiable for excluding as areas for artificial reef development. Historical shipwrecks may not be disturbed within the Texas Territorial Sea unless permitting has been acquired from the Texas Antiquities Committee.

Geographic areas which may be targeted for artificial reef construction because of obstructions in existence include all artificial reefs currently in place off the Texas coast. Permits for four of the five Liberty ship sites have allowed for the addition of petroleum platforms to those sites.

Hydrographic Criteria

The primary hydrographic factors to be considered in site selection include waves, water depth, currents, tides and water quality (Stone 1985). It has been suggested that since hydrographic effects are difficult to predict, the reef planners should anticipate the maximum effects possible, and compensate with appropriate reef shapes, composition, and siting prior to deployment to insure that the reef is not damaged, displaced or silted over.

The scientific literature provides little guidance for setting strict and discerning hydrographic criteria, thus a conservative

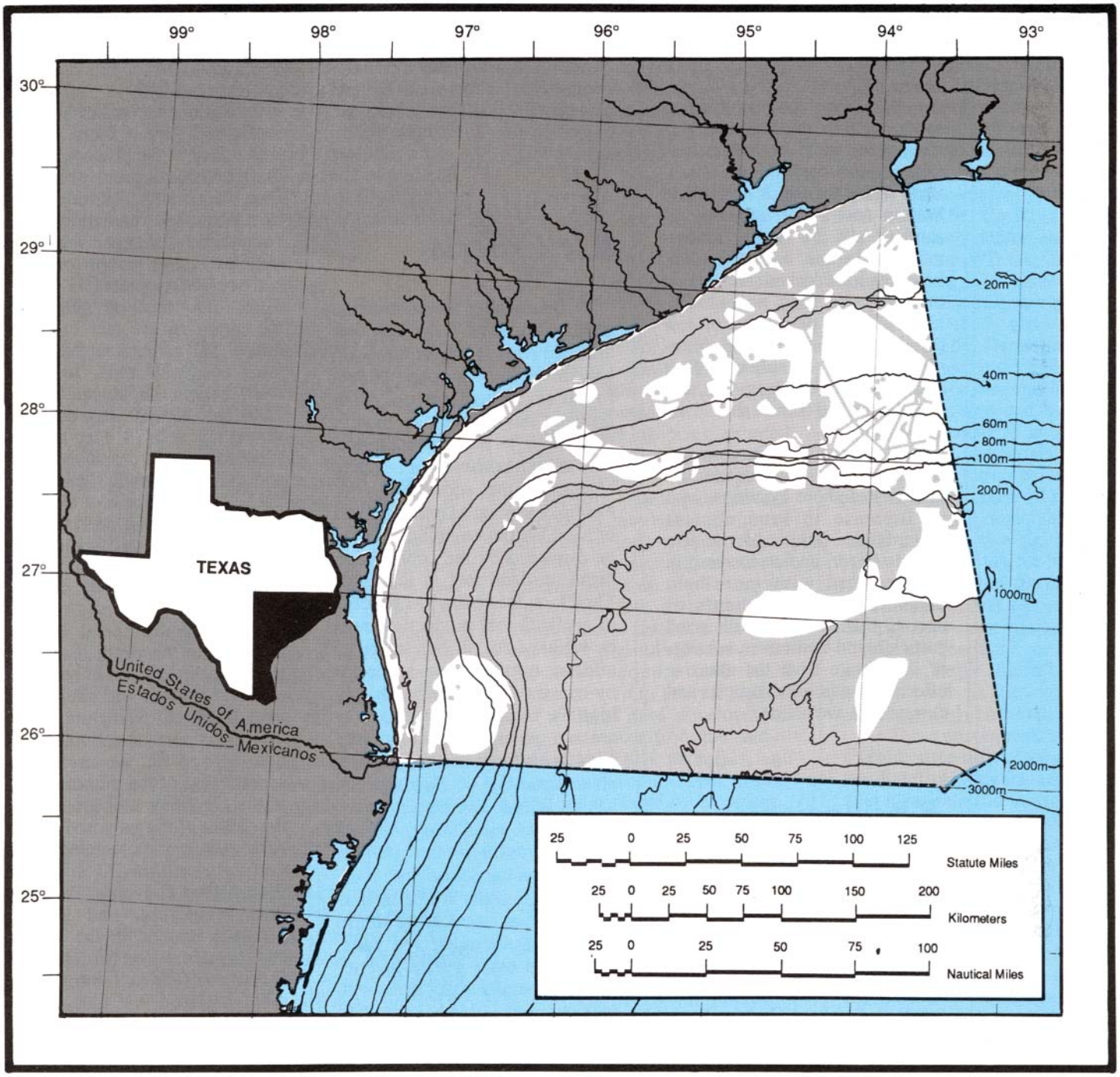


Figure 1.
Map of priority areas (blue) for artificial reef development in the Gulf of Mexico off Texas. Dashed line indicates boundary of water area covered by Plan.

approach should be taken under the general guidelines given in the literature. Reef stability depends on water depth and wave conditions. Water movement generated by currents or tides may affect siltation, material displacement, light penetration, and the fishability of the reef site. Water out to the 33 foot isobath is generally more turbid than beyond 33 feet due to the mixing of bottom sediments caused by wave interaction. Currents off the Texas-Louisiana continental shelf coastal region are primarily driven by longshore windstress. Water circulation associated with currents is dynamic, and each proposed reef site should be evaluated extensively for prevailing current patterns.

Geological Criteria

Substrate composition and sedimentation are the two primary geological considerations for artificial reef siting. Locations with a hard rock or hardpan bottom and a thin covering of sand or silt are highly recommended in the national plan; however, hard packed sand, gravel or shell are also acceptable, especially for placement of low density material such as fiberglass, plastic or rubber. Soft sediments such as clays, silts, and loosely packed sands should be avoided.

Bottom compositions range from sand and silt to hardpacked sand at nearshore locations, with an increase in sand content towards the mouth of the Rio Grande River, and an increase in mud content with movement offshore. Soft-sediments of unconsolidated clay or silt sized particles tend to silt over, subside, or degenerate from the abrasive effects of water born particles and current or wave action.

Biological Criteria

Artificial reef development may be either beneficial or detrimental to marine organisms in the affected area. Species which have been targeted for artificial reef development should be benefited, although literature regarding increases in actual production by artificial reef development for reef associated species is inconclusive. Determination of applicable biological considerations must be based upon the proposed purpose for artificial reef development, which dictates the species to be targeted. Siting criteria must be evaluated for each species or species groups, and include determination of species range and habitat requirements. In addition, existing and proposed fishery management plans and regulations for the targeted species must also be evaluated, as artificial reefs must be used to accomplish fishery management goals.

Ecological Criteria

Quantitative literature on the enhancement of fisheries with artificial reefs is vague; however, general ecosystem concepts lead to the conclusion that use of an artificial environment to modify food webs in an ecosystem will lead to both positive and negative changes in that ecosystem. For example, species adapted to a soft or sand bottom environment may be displaced by the construction of an artificial reef in that area. Therefore, the ecological benefits of artificial reef production must be weighed for all life stages of affected organisms on a species by species basis. Areas already high in biological productivity are not potential artificial reef sites according to the national plan. Examples of these types of habitat include live bottom areas, oyster reefs, coral reefs, beds of aquatic grasses or macroalgae, and scallop, mussel or clam beds. Live bottom areas are defined as marine areas supporting dense growth of sponges, sea fans, corals, and other sessile invertebrates generally associates with rock outcrops. Live bottom areas off of Texas are concentrated at depths greater than 197 feet. In the Gulf off Texas there are areas high in biological productivity other than those previously listed. These other areas support extensive infaunal and demersal stocks characterized principally by shrimp and groundfish communities which would be affected by the placement of artificial reefs. These communities are located primarily within depths less than 328 feet.

Social Criteria

Social concerns of artificial reef development focus on the safe utility of the proposed artificial reef to the targeted user group. The Parks and Wildlife Code mandates that recreational and commercial fishermen are to be targeted as user groups for artificial reef development in Texas. Thus, safety concerns, along with the utility of the reef to recreational and commercial fishermen must be considered. Artificial reefs cannot be placed within 1640 feet around oil production platforms or 774 feet around pipelines, nor in prohibited areas and danger zones designated by the U. S. Department of Defense. Polluted areas and area affected by treated sewage effluent should also be avoided to minimize resource exposure and risks to public health.

Additional social factors which must be evaluated when planning the location of an artificial reef include the amount of land based infrastructure available to support the activities of a user group in an area, the accessibility of the proposed reef to the identified user group, and the ability of the proposed site to attract the species targeted. The gulf area within 30 miles of Aransas Pass, Galveston, Freeport, Port Mansfield, and Brazos Santiago Pass serve the largest and broadest constituency of fishermen. The gulf access sites most utilized by party boat anglers seeking fish typically associated with reefs (e.g., snapper, grouper, mackerel) are Galveston, Freeport, Aransas Pass, and Brazos Santiago Pass.

User conflict at artificial reef sites in Texas was not identified as a problem in Texas waters; however, potential user conflicts may increase with the potential increase in artificial reef development. Since the primary purpose of this plan is to enhance fisheries, the siting of reefs must consider the impacts on all Texas

fisheries. A reef that may enhance the reef fishery might adversely impact the shrimp or menhaden fisheries. The shrimp trawling industry opposes artificial reef development in these productive areas because of the potential damage to equipment, but advocates the development of artificial reefs in areas historically avoided because of bottom obstructions or snags.

Economic Criteria

The costs associated with building, siting, maintaining, and managing artificial reefs in addition to opportunity costs of utilizing the water column for a reef should be weighed against benefits which will be derived from the reef. Opportunity costs represent costs to other user groups that are excluded because of the creation of the reef. Siting should consider all of the aspects aforementioned as they all are affected by the location and primary use of the reef.

Artificial reef development may be partitioned into six phases, each of which may require funding: 1) acquisition of reef material, 2) preparation of reef materials for deployment, 3) transportation and deployment of reef materials, 4) buoy purchase, 5) buoy maintenance, and 6) evaluation studies. Administrative costs are common to all six phases. Because many aspects of state artificial reef programs are interdependent, and may be integrated with other state programs, it is difficult to interpret funding of these programs, and even more difficult to partition funding into development phases. However, by considering the significant activities associated with each phase, approximate costs can be estimated.

The benefits or positive economic effects provided by artificial reefs include enhanced fishing opportunities for commercial and recreational fishermen, as well as the "non-use" benefits that are not related to immediate harvesting of the fishery stocks. Projected benefits can be compared to the costs of siting and maintaining the reef in specific locations.

Funding

Support for artificial reef development may take the form of money, material, or labor, and may be donated by private or governmental agencies, granted by federal, state, or local governments, provided in mitigation activities, or raised by the salvage of donated materials. Siting of artificial reefs is usually associated with the type and amount of funding available. In Texas, the Legislature has mandated that funding come from sources other than state general revenue funds. However, county and local governments may provide support for artificial reef development. Bonus revenues from the sale of salvageable reef materials, and mitigation have also been used to fund artificial reef development.

Liability

Liability is an important issue in artificial reef development and management, and may be incurred at all stages of the project, including permitting, siting, transportation, deployment, and maintenance. Section 205 of the National Fishing Enhancement Act mandates that proof of financial ability to assume liability must be presented to the Corps of Engineers by the permit applicant before a permit for artificial reef construction may be issued. As a result of this requirement, many artificial reef programs are administered by state agencies which hold all required permits for artificial reef development. Even so, potential liability for injuries, loss, or damage resulting from construction or maintenance of an artificial reef may involve numerous parties, and will be decided based upon the National Fishing Enhancement Act, Parks and Wildlife Code, federal admiralty law, and/or state tort law. The State of Texas, however, does not assume ownership (and liability) until the rigs are properly placed on the ocean floor. Specifically, the Department and its agents must be directed not to accept liability for, and it is not within the course and scope of their employment to accept liability for, incidents arising out of the dismantling, transportation, or placement of donated oil rigs.

All future donation agreements must absolve the State of Texas from liability for incidents arising out of the dismantling, transportation, and placement of the rigs and must designate the donor oil company, or a third party, as liable for all claims arising prior to the rigs being placed correctly on the ocean floor.

These provisions ensure that a future state official unaware of the liability dangers associated with dismantle and transportation will not inadvertently allow the state to be made the insurer for what is potentially the most dangerous phase of the project. The donation agreement for the Transco rig-to-reef project in early 1990 fulfills these requirements. It is essential that future donation agreements track the language of this agreement.

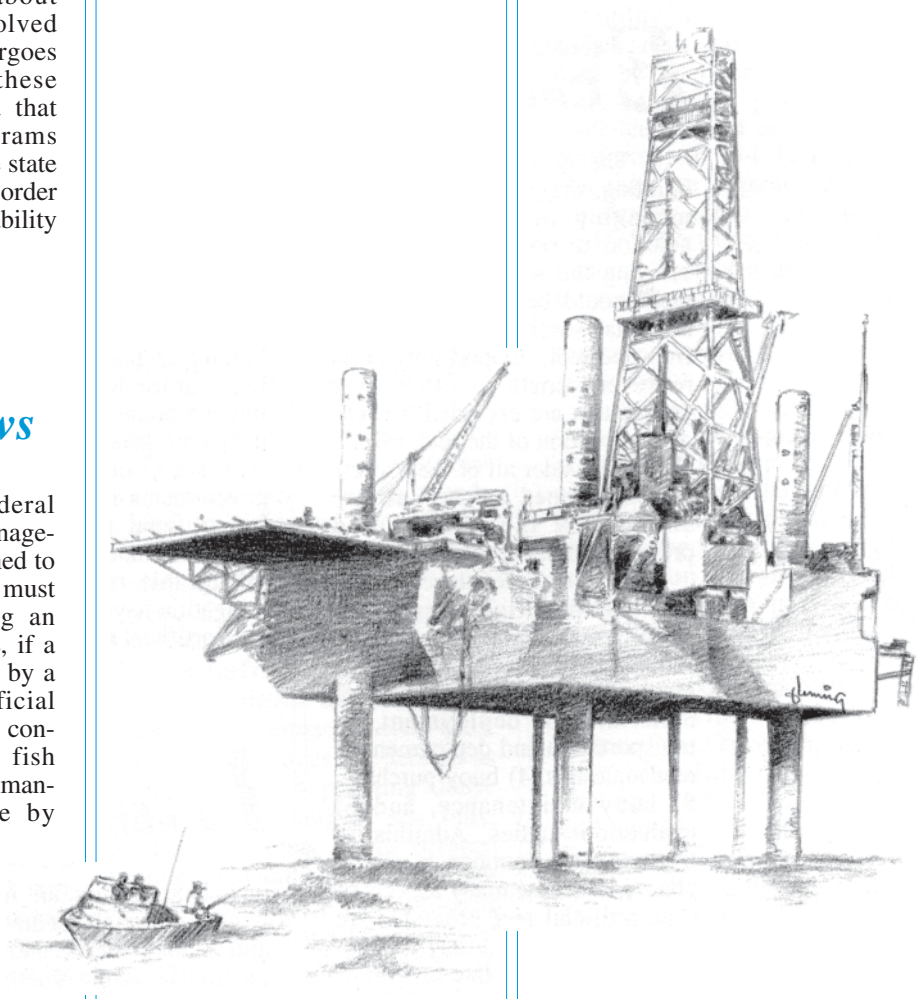
The Texas Tort Claims Act (Art. 6252-19) defines the liability of state government and state agencies in Texas. Sovereign immunity is eliminated in Section 4, but liability is limited in Section 3 to $250,000 per person, $500,000 for any single occurrence of bodily injury or death, and $100,000 for any single occurrence of injury to or loss of personal property.

Liability concerns have been addressed by administrators of

state artificial reef programs on the Gulf and Atlantic coasts. Some administrators feel comfortable with their protection under the National Fishing Enhancement Act, providing conditions of the permit are closely adhered to. Other administrators are quite concerned about liability, and each has tried to obtain a ruling from their state attorney general's office. In most cases, the ruling has not been of assistance, and it is felt that the ambiguity concerns about liability will not be resolved until a relevant suit undergoes litigation. However, these administrators recommend that state artificial reef programs should be reviewed with the state attorney general's office in order to clarify the program's liability exposure.

State and Federal Laws

Other State and Federal regulations and fishery management plans which are designed to protect or enhance species must be considered when siting an artificial reef. For example, if a targeted species is managed by a minimum size limit, artificial reefs that congregate large concentrations of undersized fish may compromise a fishery management plan's objective by increasing fishing mortality.



The creation of artificial reefs changes some aspect of an existing environment. Society, through its government, has required that before those changes can occur, the possible impacts must be evaluated through several permitting agencies. Before construction may begin on an artificial reef project in United States navigable waters, permits must be obtained from two federal agencies, the Corps of Engineers, and Coast Guard. In addition, a third permit from the Environmental Protection Agency may be necessary if materials are considered, by the Environmental Protection Agency, to be in violation of water quality standards. Each agencies' authority is highly decentralized, with regional decision making capabilities. Moreover, each permit is evaluated on a case-by-case basis within a region, and evaluation of permit requests are directly subject to interpretation by regional personnel.

Artificial reefs proposed for construction in Texas waters are also subject to permit requirements by three state agencies: the Texas General Land Office, the Texas Water Commission and the Texas Antiquities Committee. Procedures for permit application to the Texas Water Commission are initiated by the Corps of Engineers upon receipt of a Corps of Engineers application. Permit applications for the required coastal easement lease from the Texas General Land Office are the applicant's respon-sibility. The Antiquities Com-mittee is empowered to protect landmarks and thus may review applications for siting of reefs and may require a permit if a landmark might be affected.

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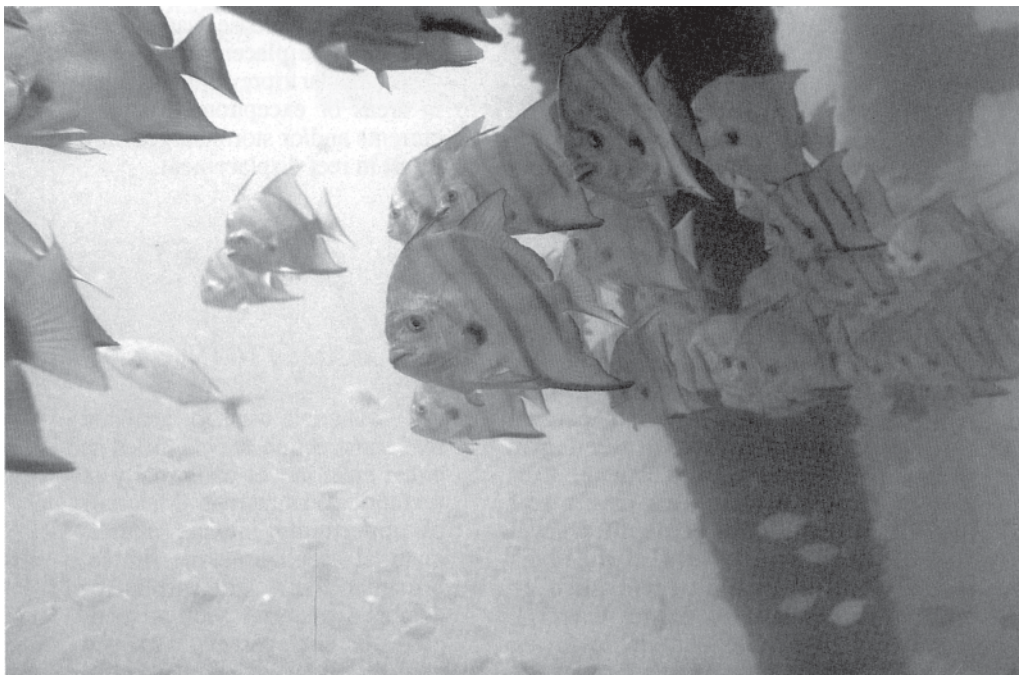

CRITERIA FOR ESTABLISHING, CONSTRUCTING AND MAINTAINING ARTIFICIAL REEFS

Material and design selection for an artificial reef should be based upon the overall purpose for artificial reef development. The purpose of artificial reefs in Texas is to enhance fisheries resources and commercial and recreational fishing opportunities for Texans. The efficacy of specific materials and designs can be evaluated on the basis of four standards, including function, compatibility, durability and stability, and availability. Evaluation of specific materials and designs using these standards may be accomplished regardless of the location of development.

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Design

The available scientific evidence is inconclusive on the best designs to enhance any species or species groups. How-ever, available information indi-cates that certain designs do affect the number of fish and species types attracted to an artificial reef. Artificial reefs can be characterized as either benthic reefs or fish aggregating devices; each of these groups can be further characterized, based upon height in the water column. Low profile benthic reefs have a reef height to water depth (aspect ratio) of less than 1/3, while high profile benthic reefs have an aspect ratio of greater than 1/3. High profile benthic reefs are thought to be more versatile than low profile reefs, since they have the potential to harbor a greater species diversity. However, conflicting reports exist con-cerning the importance of height to artificial reef design. Fish aggregating devises are moored structures which are either suspended in mid-water between surface and bottom, or float at the surface. Fish aggregating devises are designed to attract and temporarily hold fish, which are most often pelagic species.

Researchers disagree regarding the importance of vertical relief to artificial reef effectiveness. The steepness of the sides of a reef may actually be more important than reef height, however, the basis for this conclusion is not known. Enhancement of fisheries resources is correlated with the structural complexity of reefs. Reefs constructed perpendicular to general prevailing currents additionally increase water flow; however, the placement of reefs perpendicular to prevailing currents in areas of exceptionally strong currents and/or storm surges may result in reef displacement.

Materials

Materials used for artificial reef construction are classified as either materials of opportunity or prefabricated materials. Materials of opportunity include natural materials such as stone rubble, brush or trees, and surplus or damaged material such as concrete, derelict vessels, scrapped vehicles, tires, or oil platforms. Eighty percent of the reefs recorded in the Sport Fishing Institute's 'Reef Profiles' database are constructed of materials of opportunity. The most commonly used materials of opportunity are obsolete vessels, surplus concrete, tires, and various types of stone rubble. In addition, the availability of obsolete oil and gas platforms or rigs, which provided impetus for the Louisiana Artificial Reef Initiative promises to be important in future artificial reef development in the Gulf of Mexico. The available scientific information on the best materials to enhance any species or species groups is limited; however, some substances are better than others at obtaining desired effects. Moreover, stability and durability of artificial reefs depend on the type of material used.

Marking

Marking requirements, regulations and specifications regarding marking artificial reefs in the Gulf are stated in the policy statement 'Eighth U. S. Coast Guard District Policy For Marking Artificial Fishing Reefs In The Gulf Of Mexico', available from the Eighth District Commander and outlined below.

Depth (mean low tide): Type of buoy(s) required if the clearance from the water surface to the top of the reef is:

a. less than 85 feet – yellow special purpose buoy(s) with a flashing six second yellow light;

b. 85 to 200 feet – unlighted yellow special purpose buoy(s);

c. 200 feet or more – markings not required.

Size: Number of buoys required if the longest side of the reef is:

a. less than 1/2 nautical mile – one buoy positioned in the center of the reef;

b. 1/2 to 1 nautical mile – one buoy positioned at each corner of the reef;

c. over 1 nautical mile – one buoy set on each corner of the reef and additional buoys positioned on the reef's perimeter at 1 nautical mile intervals or as directed by the District Commander.

Location: If the reef is located within 1500 feet of a fairway, channel or anchorage area, a quick flashing (red or green) buoy between the edge of the reef and the navigational area is also required.

Waivers may be granted for the lighted buoy requirements on reefs with over 50 feet of water clearance provided:

a. the reef is over 2 nautical miles from fairways, channels or anchorage;

b. there is no history of deep draft traffic in the area;

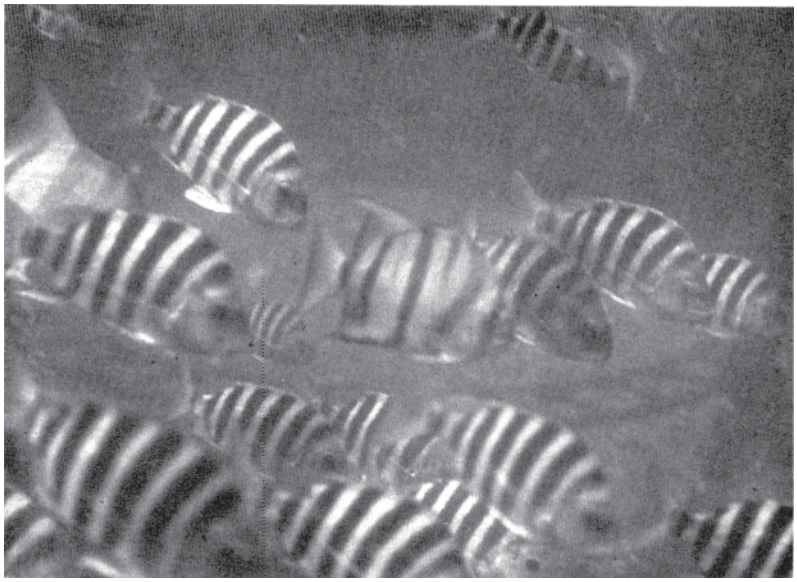
c. the entire reef complex is adequately marked.

Waivers may also be granted for the marking requirement on reefs with over 85 feet of water clearance provided:

a. the reef is included on updated National Ocean Service navigational charts;

b. the reef is over 2 nautical miles from fairways, channels or anchorage;

c. there is no history of deep draft traffic in the area.

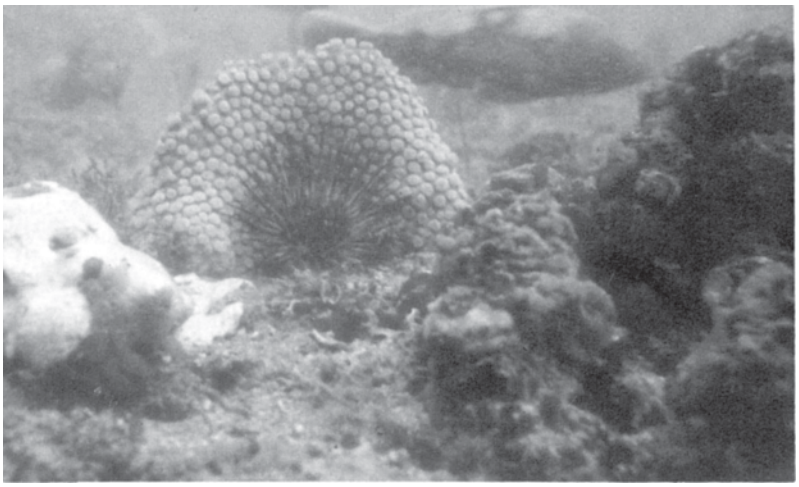


MECHANISMS AND METHODOLOGIES FOR MANAGEMENT

Texas legislators have delegated some authority to manage the fishery resources of Texas to the Texas Parks and Wildlife Commission, which is appointed by the Governor and approved by the Senate. The Texas Parks and Wildlife Commission establishes policy for the Department and adopts regulations. The Department administers the Commission's management programs, enforces statutes and regulations, conducts research and provides information and recommendations to the Commission, Legislature and Governor. The Department was granted authority to regulate the harvest of all wildlife resources, except shrimp and oysters, in all counties via the Wildlife Conservation Act of 1983 (Chapter 61, Parks and Wildlife Code), and has additional authority in certain other counties via Title 7 (Local and Special Laws) of the Parks and Wildlife Code. Authority to regulate shrimp and oyster harvest was provided in 1985 through amendments to Chapters 76 and 77, Parks and Wildlife Code. In addition, through Chapter 79 (Parks and Wildlife Code, Extended Fishery Jurisdiction), the Department is authorized to cooperate with the Gulf of Mexico Fishery Management Council for management of fishery resources in waters of the Gulf beyond state waters.

The Department's mission is to prevent depletion and waste of wildlife resources while maximizing the opportunity for harvest by regulating the means, methods, manners, and places in which it is lawful to take or possess wildlife resources. This mission parallels the goals of the Texas Artificial Reef Plan which calls for the enhancement of fishery resources and commercial and recreational fishing opportunities. To achieve this goal, the Department is mandated to; plan and review permit applications for artificial reefs; coordinate with relevant state and federal agencies; hold public hearings on proposed artificial reefs; oversee the maintenance and placement requirements of artificial reefs; and, develop rules and guidelines, in conjunction with the advisory committee, in the collection of fees, grants, and donations to the artificial reef fund. The twin goals of enhancing the resource as well as fishing opportunities may not necessarily compliment each other when the establishment of an artificial reef results in increased fishing mortality. Both commercial and recreational fishermen will concentrate their fishing efforts at artificial reefs when they target reef community species. High fishing mortality on an artificial reef can lead to overfishing, as witnessed on artificial reefs off South Carolina. Once fishing mortality exceeds the production of biomass attributed to enhancement by an artificial reef, there is a net loss in fishery resources. Although the biological attributes of artificial reefs have been verified in a number of observational studies, there are still only limited scientific studies relating to the management of artificial reefs. Few studies used quantitative experimental methods and many lacked scientifically valid controls. The importance of fish attraction versus fish production and the relationship between standing crop and fish catch have not been adequately addressed. Thus, as reef programs move forward, there needs to be increased attention on the questions regarding the impacts of artificial reefs on fish populations and fisheries, not just development of more reef sites. The debate among artificial reef authorities continues to center around the question of whether reefs actually increase predatory fish biomass or merely concentrate the already existing biomass. If artificial reefs merely attract fish then the placement of more of these structures could be detrimental in areas where fish stocks are already overfished. For example, red snapper in the Gulf are currently being over-fished. Management efforts that concentrate the species and thereby increase its vulnerability to fishing pressure may serve to harm the population further.

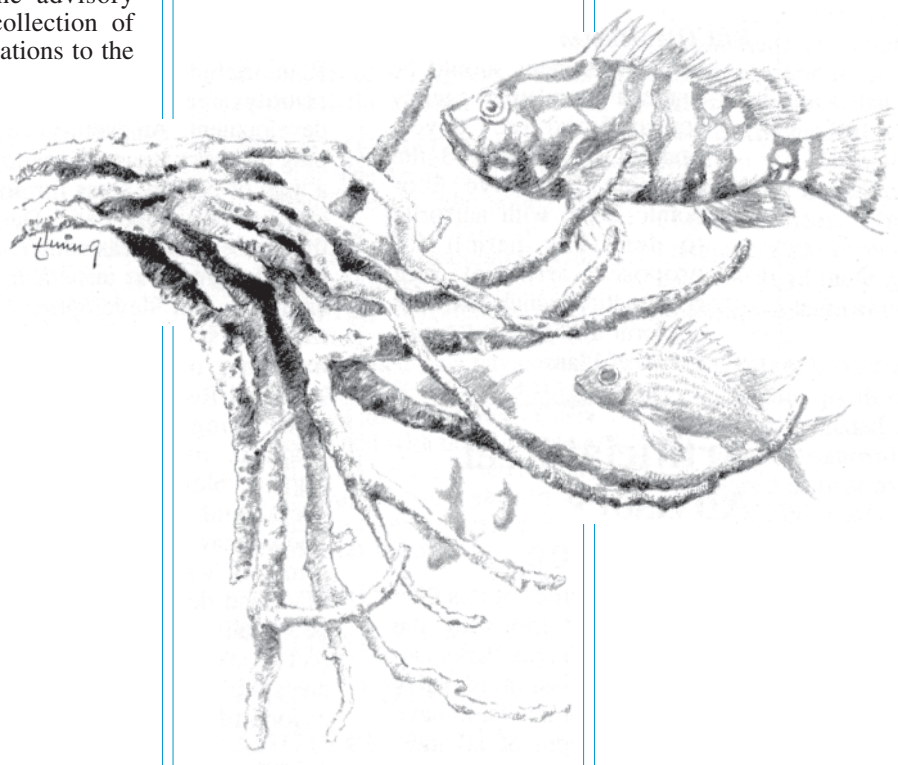
There needs to be increased attention on the questions regarding the impacts of artificial reefs on fish populations and fisheries.



MANAGEMENT OF THE ARTIFICIAL REEF FUND

The Legislature has created a fund designed to allow the Department to carry out artificial reef plan management independent of any other legislative funds or appropriations. Specifically, subchapter C, Section 89.041 of the Parks and Wildlife Code directs; (a) that the artificial reef fund be created in the State Treasury, (b) the fund be composed of all funds received by the state, including interest and earnings on the funds, and (c) no state general revenue funds shall be expended in the development or implementation of this plan. Additionally, Section 89.002(b)(5) of Parks and Wildlife Code directs the Department to develop rules and guidelines, in conjunction with the advisory committee, in the collection of fees, grants, and donations to the artificial reef fund.

The Legislature has created a fund designed to allow the Department to carry out artificial reef plan management.



CURRENT ACTIONS AND RECOMMENDATIONS

Permitting Authority

The legislature mandated the Texas Parks and Wildlife Department to promote, develop, maintain, monitor, and enhance the artificial reef potential in Texas waters and the Exclusive Economic Zone adjacent to Texas waters. Currently, the Department performs these functions by obtaining permits for artificial reef sites from other state and federal agencies, and by commenting upon permit applications submitted by other artificial reef builders to other state and federal agencies. Although the Department's comments are taken into consideration by the permitting agency, the Department does not have the authority to deny a permit when the goals of artificial reef construction proposed by another party conflict with the Departmental goals outlined in Chapter 89 of Texas Parks and Wildlife Code.

RECOMMENDATIONS

The Department should be made a permitting agency for artificial reef development in Texas and the adjacent Exclusive Economic Zone, with authority to deny any permit for proposed artificial reef construction which does not conform to the Texas Artificial Reef Plan.

Artificial Reef Advisory Committee

As the specifics of this Plan are implemented following the adoption by the Texas Parks and Wildlife Commission of rules and regulations, it is vital to have the continued input of all individuals and groups interested in artificial reefs and associated resources of Texas. Upon completion of this Artificial Reef Plan, which includes rules and guidelines governing the creation and management of the Artificial Reef Fund, the duties of the Artificial Reef Advisory Committee will be complete and its authorization will terminate.

RECOMMENDATIONS

Subsequent to the adoption of the Artificial Reef Plan, an advisory committee consisting of persons from groups with interest in artificial reefs should be selected by the Chairman of the Texas Parks and Wildlife Commission for the purpose of advising the Department on implementation of the Plan.

Map of Priority Areas For Artificial Reef Development

Chapter 89, Parks and Wildlife Code, requires that the Plan include a map depicting priority areas for artificial reef development. An exclusion mapping process was used to generate a map of priority areas for artificial reef development. During this process, all areas which have been designated as unsuitable for artificial reef development by the best scientific information available or by the National Artificial Reef Plan were identified, using appropriate geographic, hydrographic, geological, biological, ecological, social and economic criteria. These areas were then plotted on a map of waters covered by the Plan, and designated as areas to be initially excluded for artificial reef development. The remaining areas are designated priority are as for artificial reef development.

RECOMMENDATIONS

The specific locations for artificial reef development should be within the priority areas depicted in Figure 1.

Materials and Design

Benthic reefs are designed to enhance habitat for bottom dwelling organisms, whereas fish aggregating devices serve only to attract and temporarily hold pelagic fish species. Thus, benthic reefs serve all aspects of the Department's goal for artificial reef development, including the enhancement of fishery resources and opportunities for recreational and commercial fishing; however, fish aggregating devices serve only to enhance fishing opportunities. The National Artificial Reef Plan calls for artificial reef materials to be highly durable and stable to prevent displacement or breakup of the reef. The more complex the material or arrangement of the material comprising an artificial reef, the greater the number of chambers, openings and interstitial spaces. A moderate to high level of complexity is most beneficial for artificial reef success.

RECOMMENDATIONS

Artificial reefs should be constructed as benthic reefs using ships, oil platforms, or similarly constructed materials arranged in as complex a fashion as possible without jeopardizing structural integrity, and oriented in a fashion which maximizes effectiveness, durability and stability.

Acquisition of Reef Materials

A great deal of materials of opportunity which can be used for artificial reef construction are available. Offshore platforms presently located in the Gulf of Mexico are already fabricated and serving as artificial reefs. Offshore platforms are available at an increasing rate for use in artificial reef development programs. Their construction is consistent with recommendations

concerning materials and design, and their donation as artificial reefs to state agencies willing to assume the associated liability make them attractive from a cost efficiency standpoint.

RECOMMENDATIONS

The Department should actively pursue acquiring offshore platforms for use as artificial reefs in the Gulf of Mexico, in deference to other structures.

Funding of Reef Development and Maintenance

With the assistance of the Artificial Reef Advisory Committee, the Department has been directed to develop rules and guidelines for the establishment and management of an artificial reef fund. The legislature has required the Department's artificial reef program to be self-sustaining. With the construction of artificial reefs come costs associated with administration, deployment, maintenance (any action necessary to ensure continuous compliance with all artificial reef permit requirements) and marking. Therefore, as the donor benefits from the construction of an artificial reef with his donated material, he should be responsible for costs associated with its construction and management.

RECOMMENDATIONS

(a) The cost of the Department's artificial reef development, maintenance, and marking program should not exceed revenues accumulated in the Artificial Reef Fund.

(b) The cost of creating and maintaining and marking artificial reefs should be borne by the donor; however, the Department should minimize these costs to the maximum extent possible.

Funding of Additional Program Needs

Beyond the costs associated with the maintenance of artificial reefs come potential costs of liability. Once ownership of the materials on an artificial reef site is transferred to the Department, liability costs may be incurred for which state funds are insufficient or otherwise not available. In addition, numerous research needs associated with artificial reef development have been identified, such as determination of the best monitoring methods and best materials, designs, and locations for determining and subsequently maximizing the enhancement capabilities of artificial reefs. Currently, dedicated funding for these investigations is not available. As the donation of materials by an entity may result in substantial savings over alternative methods of material disposal, funding for artificial reef research projects and additional program needs should be offset by the savings accrued to the material donors.

RECOMMENDATIONS

(a) The Artificial Reef Fund should be the sole source of funding for costs to the Department associated with artificial reefs.

(b) Any donation of artificial reef material should be accompanied by a payment of at least 50% of the realized savings to the donor. Costs associated with donation of an artificial reef (under recommendation 6b) should be included when calculating potential savings.

Siting of Platforms Indigenous to Priority Areas

Existing oil and gas platforms serve as artificial reefs while still in use. These structures are stable and effective at supporting fish and invertebrate assemblages common to natural reef habitats. By minimizing movement and alteration of existing oil and gas platforms, artificial reef deployment costs as well as disturbance of the existing assemblages of organisms are minimized.

RECOMMENDATIONS

Existing oil and gas platforms located in the priority areas for artificial reef development should be deployed as artificial reefs as near their current location and in a form as close to their current form as possible.

Siting of Platforms Exogenous to Priority Areas

Use of existing permitted Department artificial reef sites for deployment of additional material ensures that new materials are located in areas already familiar to commercial and recreational fishermen as artificial reef sites. In addition, commercial shrimpers are historically aware of these sites as areas to avoid while trawling.

RECOMMENDATIONS

Offshore platforms located within excluded areas at the time of removal should be placed as near as possible to artificial reefs located in priority areas.

Siting of Other Materials Exogenous to Priority Areas

The Department is mandated to develop artificial reefs to enhance fishery resources and

fishing opportunities, while minimizing conflicts among users, and minimizing environmental, property, and health risks. The exclusion mapping process has designated priority areas for artificial reef development. Once these areas are identified, the final step in the exclusion mapping process of artificial reef siting includes the designation of areas which will provide as little conflict among users of the water column as possible. Examples of these areas include historical obstructions to trawling and previously constructed artificial reefs.

RECOMMENDATIONS

The specific location for materials not already present within the priority areas should be at sites that maximize enhancement of fishery resources and opportunities for recreational and commercial fishing to achieve optimum yield, minimize impacts on other users of the water column, and minimize environmental, property and health risks.

Liability

Liability may be incurred at all phases of artificial reef development, including permitting, siting, construction, and maintenance. Both the United States Congress and the Texas legislature, through the National Fishing Enhancement Act, and Chapter 89, Parks and Wildlife Code, respectively, sought to limit liability during artificial reef development. However, the success of these statutory efforts has yet to be tested in court.

RECOMMENDATIONS

The liability incurred by the Department through any donations of artificial reef material should be minimized to the maximum extent possible.

Joint Management

The Department is responsible for developing artificial reefs in the Texas Territorial Sea and adjacent Exclusive Economic Zone to enhance fishery resources and fishing opportunities. The Department is also responsible for the management of fish stocks and related research in the Texas Territorial Sea, and in conjunction with the National Marine Fisheries Service and Gulf of Mexico Fishery Management Council is responsible for fishery research and management in the Exclusive Economic Zone. Cooperation among these entities is mandatory for successful management of common fishery resources. This coordinated effort can provide for more effective development and management of artificial reefs and associated fishery resources.

RECOMMENDATIONS

The Department should continue to work with other groups to coordinate artificial reef development and management.

Regulation of Fishery Resource Harvest

The National Artificial Reef Plan directs artificial reef developers and managers to consider the objectives of fishery management entities involved in regulating organisms influenced by artificial reefs. For example, if a targeted species is managed by a minimum size limit, artificial reefs should not be constructed to aggregate large concentrations of undersized fish, or should facilitate maximum survival of released fish.

RECOMMENDATIONS

Fishery resource harvest from artificial reefs should be regulated to satisfy fishery management objectives of the regulating entities within Texas and the adjacent Exclusive Economic Zone.

Fishery Independent Monitoring

The objectives of fishery independent monitoring performed by the Department are to develop long-term trend information on fish population abundance and stability in Texas bays and offshore waters, and to monitor environmental conditions which may influence these factors. A monitoring program provides information about most life history stages of the resource and is capable of detecting changes in population structure.

RECOMMENDATIONS

The Department's present monitoring program should be enhanced to meet legislative mandates and to continue to determine trends in population abundance and stability, movement, growth, mortality and the impacts of environmental influences on reef associated species.

Fishery Dependent Monitoring

The objectives of fishery dependent monitoring programs are to determine size, catch per unit effort and value of reef associated species landed by commercial and recreational fishermen from Texas bays and offshore waters, and to determine monthly and annual purchases of edible seafood products by commercial dealers through Monthly Marine Products Reports. Daylight commercial landings and fishing activities are estimated from on-site surveys at seafood dealers, boat access sites and

commercial vessel docking structures. The landings and fishing activities of sport fishermen are monitored through on-site surveys at recreational boat access sites.

RECOMMENDATIONS

The Department's present monitoring program should be enhanced to meet legislative mandates and to continue to determine fishery harvest trends, economics and impacts of sociological influences.

Assessment and Evaluation

The Department is mandated (Sections 12.001, 61.051, and 89.021, Parks and Wildlife Code) to annually assess and publish the status of marine organisms of the state's saltwater fisheries and associated environmental variables. The Department is also responsible for making management recommendations regarding the state's fisheries.

RECOMMENDATIONS

Continued assessment and periodic evaluation of the Department's activities by the Texas Parks and Wildlife Commission are necessary to meet legislative mandates and to address data needs reviewed in this Plan.

Communication, Research, and Education

The Department is required to report on findings of fishery research, assessments and evaluations and to make recommendations for further actions when studies indicate they are appropriate to accomplish the objec- tives of this Plan.

The creation of artificial reefs provides valuable research opportunities. Many questions regarding the productivity, general ecology, and use of artificial reefs by fishermen and recreational spectators remain unanswered. New artificial reefs will provide educational opportunities, allowing for the study of reef communities.

RECOMMENDATIONS

(a) The Department should continue to maintain a high level of interdepartmental and interagency communication to more fully benefit from the free flow of information concerning artificial reef research, adverse environmental conditions and changes in economic and societal goals.

(b) The Department should take advantage of the opportunities afforded by the creation of artificial reefs for scientific study and education of the public, including recreational spectators (e.g., nonconsumptive divers).

The Texas Parks and Wildlife Department will periodically update data and information contained within the Texas Artificial Reef Plan.

~ NOTES ~

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