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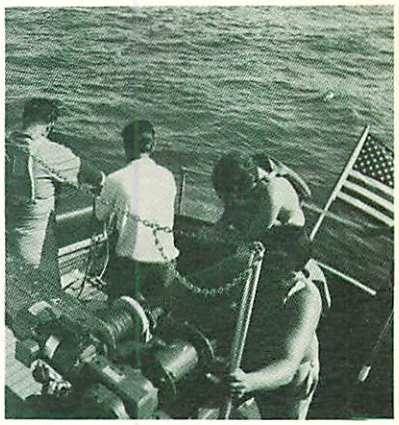
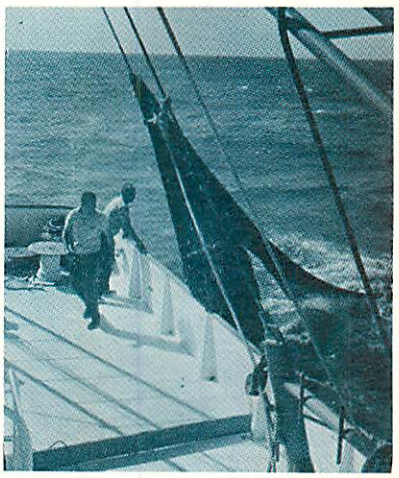
MARINE AFFAIRS IN TEXAS

A Report for 1968-69

TEXAS A&M UNIVERSITY SEA GRANT PROGRAM





This report is a resume of progress made under the Sea Grant Program in its first year of operation at Texas A&M University. The report is intended for a wide public audience as well as for the National Science Foundation, sponsor of the program. Greater detail concerning the program is available in a separate *Report of Sea Grant Project Activities, 1968-69.*

The Sea Grant Program has been initiated for you—the citizens of the State who are marine resource users, marine resource developers, or just persons interested in the conservation of a public asset. In order to make the program as responsive as possible to current problems and to resource opportunities, we need your advice and counsel.

Texas A&M invites you to give your opinion and judgement on what is needed, where the opportunities may lie, who should be sought out for counsel. Please send your comments to Office of Sea Grant Programs, Texas A&M University, College Station, Texas, 77843.

John C. Calhoun, Jr.
Director

MARINE AFFAIRS IN TEXAS

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TEXAS A&M UNIVERSITY SEA GRANT PROGRAM

Publication No. 103
Texas A&M University Sea Grant Program
Partially funded by the National Science Foundation
Institutional Grant GH-26

December 1969

Awakening The Giant

The technological advances necessary to claim the ocean's riches are progressing at a rapid rate. As Texas begins to awaken the sleeping giant that sprawls at the door to marine resource development, a coordinated effort among universities, industries, and government is required.

Zigzagging for 1,081 miles along the state, the Texas Gulf coastal zone is an area of intense concentrations; four and a half million people make their homes here; four hundred and seventy eight industries manufacture goods and provide services which are dependent upon a close association with the sea; fishermen plow the waters of the Gulf and oilmen search its bottom for vast reservoirs of energy. The use of the Texas coastal zone, including the waters, submerged lands, and adjacent shoreline is clearly multi-purpose. It is also clear that the use is multi-institutional; universities, research institutions, governments, and industry are deeply immersed in the state's marine activities.

And their future involvement will be even greater. In 1962 more than four million persons lived along the coast; by the year 2,000 this figure will increase by sixty five percent to more than seven million.

The Gulf provides the resources for a variety of diversified industries. Shipping, transportation, tourism, fisheries, offshore drilling, and mineral extraction are thriving industries of the area.

The future holds challenging promises for the state's coastal zone. In the shipping industry, plans must be laid now for ports and harbors which will be capable of handling the superships of tomorrow. Tankers that in 1956 averaged 16,000 deadweight tons, had increased in size to 150,000 tons or more by 1968. The problems to be faced by ports and harbors in accommodating these supertankers must be considered now.

In offshore areas, technological advances must keep pace with the nation's increasing energy demands.

Fishery resources of the sea are already big business on the Texas Gulf coast. In 1967, more than 4,000 commercial fishermen landed 138.1 million pounds of finfish and shellfish valuing $49.7 million at dockside. In 1966, 153 seafood wholesaling and processing establishments employed more than 4,000 persons. And the future will bring greater demands for food from the sea. Ways to make greater use of the ocean's food resources need to be developed. Techniques for harvesting finfish and shellfish in a reliable manner must be perfected.

One great potential of the Gulf lies in its untapped fresh water. More than $25 million worth of fresh water is produced worldwide from sea water annually in more than 200 desalination plants. One of these is located at Freeport, Texas, and produces one million gallons of fresh water a day.

Tourism and recreation, manufacturing and chemical industries, and services and building firms are also part of the growing Texas coastal zone. In order to serve the people of the state, each of these segments must be able to apply the research and technology derived from ocean studies. Basic research must be translated into practical applications. Statistical models must be transformed into working tools.

The Texas A&M University Sea Grant Program is built upon the premise that the marine environment can provide a bountiful harvest for the benefit of man. At the end of the first year of Sea Grant institutional support, the University has reviewed its activities with a view toward evaluation and future planning. The program seeks to develop the marine resources potential —to awaken the giant at the doorstep of the state—through education, research, advisory and information services, and program development.

The marine environment can provide a bountiful harvest for the citizens of Texas and the nation. Texas A&M University's Sea Grant Program seeks to develop the state's marine resources.

The University and the Sea

Anchored in a twenty-year tradition of ocean research, Texas A&M University combines research, education, extension and advisory services in a Sea Grant Program which applies imagination, resources, and professional manpower to the challenges of marine resource development in Texas.

Texas A&M University celebrated its 20th anniversary as the state's oceanographic leader in 1969. During its two-decade courtship with the sea, the University has become one of the outstanding ocean-oriented institutions in the nation and has firmly established itself in Texas' marine resource development activities. With the only sea-going research vessels in Texas, the University has conducted extensive research throughout the Gulf of Mexico and its scientists have participated in oceanographic research all over the world.

The University's coastal operations are headquartered in Galveston. The Marine Laboratory of Texas A&M concentrates on the exploration of the biological environment and student training. Also located in Galveston is the Texas Maritime Academy, the newest of the nation's six major accredited maritime academies and the only one located on the Gulf coast. Here also is the Marine Biomedical Institute, a joint Texas A&M University-University of Texas Medical Branch program to apply medical research to the oceans.

Plans for a multi-million dollar marine science campus to be located on the Mitchell Campus on Pelican Island, off Galveston, have recently been announced by the Texas A&M University Board of Directors. Named the Moody Marine Institute, it will eventually house the Marine Laboratory, the Maritime Academy, and other oceanographic installations and will provide dock and warehousing space for the University's vessels and equipment.

Supporting facilities for the University's diverse oceanographic activities are located on the main campus at College Station. A $7 million 12-story oceanography-meteorology complex will be completed in the early 1970's and a Remote Sensing Center and a Center for Dredging Studies have been established on the campus. Units within the College of Geosciences provide expert knowledge in a variety of areas. At the Research Annex, the University has joined with industry to begin operation of a fish protein concentrate pilot plant and the civil engineering department has begun work on a bold plan to construct scale models simulating 80 percent of the Texas Gulf Coast in the Hydromechanics Laboratory.

Add to its history of ocean research Texas A&M's reputation as a land grant institution specializing in extension services, and the result is a program which capitalizes on many capabilities—a program aptly named the Texas A&M University Sea Grant Program.

The Sea Grant Program: Application & Experimentation

The idea of creating a national program in marine resource development is patterned after the land grant college concept of 1862. More than 100 years later, the land grant principle of resource development has been applied to the oceans. Administered by the National Science Foundation, the Sea Grant Program makes it possible to apply the University's competence and knowledge in ocean science to the practical needs of marine resource development.

Texas A&M University was one of six universities in the nation to receive institutional support under the Sea Grant Program for 1968-69. For 1969-70, the national program has been expanded, increasing the university institutional support from $2,545,600 to $4,807,000 and adding two universities to the list.

As announced by the National Science Foundation, the first two years' institutional awards and the funded support levels are:

	1968-69	1969-70
Oregon State University	$553,000	792,000
Texas A&M University	475,000	750,000
University of Rhode Island	477,200	685,000
University of Wisconsin	376,000	620,000
University of Washington	229,000	500,000
University of Hawaii	435,400	474,900
University of Miami		600,000
University of Michigan		380,000

In addition to the institutional awards for 1968-69, the National Science Foundation awarded project funds amounting to $2,454,300 for 27 individual projects.

The National Science Foundation provides two-thirds of the funds required for Sea Grant Programs with the remaining one-third coming from the institution. For Texas A&M University, therefore, the total Sea Grant effort amounted to $750,000 for the first year, $475,000 of which was provided by the National Science Foundation. For the second year, the total University Sea Grant effort involves more than $1 million.

As specified by the National Sea Grant College and Program Act of 1966, Texas A&M University's institutional support is directed toward Education, Advisory Services, and Research. In addition, the University program has designated funds for Program Development which gives the Program Office an opportunity to search out innovative ideas, plan for long-term projects, and provide direction and guidance for the total Sea Grant effort.

Twenty projects were funded under the Research category during the first year; Advisory Services operated through two individual projects; and

five projects were initiated under the Education category, including two devoted to technician training. Program Development funds were used for seminars, conferences, planning workshops, publication of a newsletter, and other program efforts. The accompanying graph shows the distribution of Sea Grant funds by category.

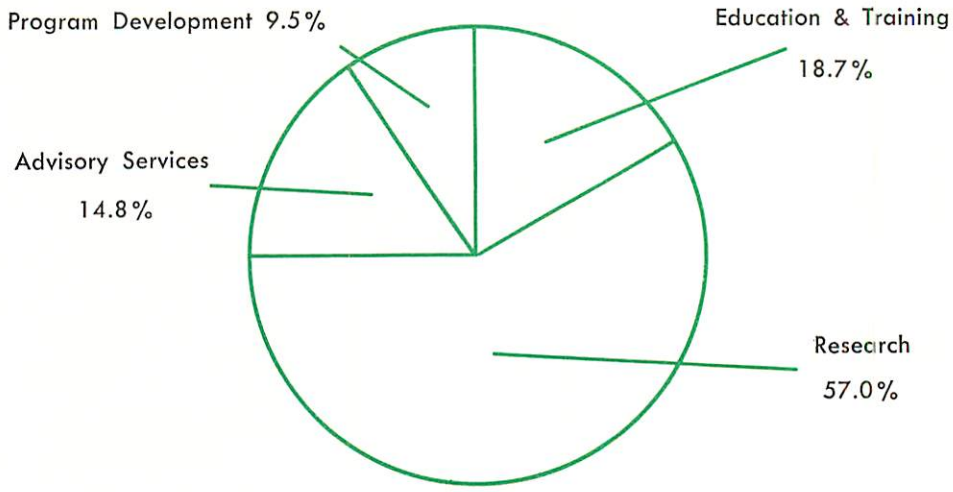
A Partnership in Progress

Texas A&M University draws heavily on its history as a land grant institution in its approach to the sea. But where land grant emphasizes food, sea grant looks toward transportation, mineral extraction, recreation and ocean engineering as well as food.

The Texas A&M Sea Grant Program has five points of action for resource development in Texas:

- To draw together the separate programs of the university concerned with marine resource development;
- To work with industry, government, other universities, and other users of marine resources to identify the needs of the states and the region toward which academic competency should be directed;
- To establish and administer projects and programs that will serve the needs which have been identified;
- To stimulate the interests of academic personnel in applying their disciplinary knowledge to marine resource problems;
- To build working relationships with industry, state agencies, other universities, municipalities and individuals for advancing the total educational and research effort related to marine resources.

To carry out this ambitious plan, the first year's activities involved 72 professional university staff members and 58 graduate students who partici-



pated in 27 Sea Grant projects. In addition, 27 non-professional technicians assisted in Sea Grant work. The table illustrates the extent of the University's Sea Grant involvement.

Most of the program's activities are carried out through existing academic departments and established organizational units of the university. During the first year, staff members from 18 departments and divisions from 6 colleges of the University were involved in the program, as well as personnel from Texas State Technical Institute and Galveston College. Some future projects will be carried out through other universities also where competencies are appropriate.

The objective of Texas A&M University is to develop an educational program in marine resources to qualify for designation as a Sea Grant College on behalf of the State of Texas and the Gulf Region. To accomplish this, the needs of the state for marine resources activities in education, research, extension, and advisory services must be identified. The University has established liaison with industry, governmental units and other users of marine resources and has begun to work with other regional institutions. The total talent available to work on marine resources development is being identified and the economic impact of existing marine resource industries in the coastal and near-inland cities and counties is being studied.

UNIVERSITY INVOLVEMENT TEXAS A&M UNIVERSITY
SEA GRANT PROGRAM 1968-69

Activity	Number of Projects	Professional Staff	Man-months Prof. Staff	FTE* Prof. Staff	Student Participation
EDUCATION & TRAINING	5	13	44.0	3.66	3
ADVISORY SERVICES	2	7	29.3	2.44	2
RESEARCH					
Fishery Science & Marine Biology	4	10	33.9	2.83	12
Resource Management	3	14	31.0	2.58	8
Pollution	3	6	15.8	1.31	6
Coastal Engineering	3	6	22.0	1.83	5
Aquaculture	1	2	7.9	.66	6
Seafood Technology	2	5	13.6	1.13	9
Water & Sediment Analyses	3	8	9.4	.78	3
Acoustics	1	1	3.0	.25	4
TOTALS	27	72	209.9	17.47	58

*FTE—Staff Full-Time Equivalents

Harvesting the Resources of the Sea

A vast reservoir of vitally important resources . . . ranging from seafood to offshore minerals . . . lies in our ocean, waiting to be wisely used and managed for the benefit of man.

Living along an extensive ocean coastline, Texans have traditionally turned to the Gulf as an important source of food and other resources. A $46 million shrimp industry hauls in 100 million pounds of shrimp a year. A healthy offshore oil and gas industry reaches the bottom structures of the Gulf for vitally needed power sources. Along its more than 1,000 miles of recretional shoreline and 300 miles of beaches, Texas has the potential for all types of recreational activities. More than 170 million tons of goods are passed through Texas ports each year.

The Texas A&M University Sea Grant Program seeks to assist these giant industries and to aid in the development of other important resources from the sea. Thirteen projects in fishery development, aquaculture, offshore technology, and extension services are now underway.

Sea Grant extension agents, modeled after the successful agricultural county agents, have already begun work in the coastal counties of Texas, demonstrating the practical application of research information in the development of seafood farming. The commercially valuable shellfish—shrimp, crab and oysters—have been the objects of field demonstrations. In bringing research information to the fishermen of the Texas Gulf coast, the Texas A&M Sea Grant Program is designed to bring about a rapid transition from the "hunting" technique that has served fishermen for centuries, to a profitable "harvesting" technique that will bring new knowledge and information to industrial and individual users.

● ● Fisheries related projects received nine percent of the first year's funds. An embryonic aquaculture program is also a part of the Texas A&M University Sea Grant Program. Fisheries scientists are developing techniques for "planting" fish and shellfish in ponds, caring for them much like a farmer tends his crops, and harvesting the seafood for commercial purposes. Already it has been found that shrimp may complete the maturation cycle—from a ¼ inch larvae to a 4 inch shrimp weighing 30-50 grams—25 percent earlier in ponds than in the open Gulf. Aquaculture techniques are also being applied to oysters, blue crabs, pompano, and striped mullet.

To catch and raise the fish is only half the job, however. The marketing problems associated with delivering a fresh, wholesome product to the consumer is the other side of the Texas A&M Sea Grant Program fishery coin.

The effects of handling fish and shellfish in the catching and storing process are being evaluated by animal scientists. Certain microorganisms interfere with the quality of seafoods and bring about rapid spoilage. In order to prolong shelf life, investigators are identifying the organisms which cause deterioration and are tracing the source of the contamination. Remedies for the problem may result from these studies. It is becoming evident that personnel

trained in proper seafood handling are needed and a proposed course and laboratory to acquaint students with these problems are being developed.

Diseases of fish and shellfish are also being investigated through the Sea Grant Program. When coastal area fishermen began to notice massive menhaden kills in Texas waters in 1968, Sea Grant project leaders in the University's School of Veterinary Medicine were called in to aid in isolating the disease and its cause. Virtually no work had been done on what constituted the normal healthy cells of menhaden. The researchers set to work to catalog normal and pathogenic cells in an effort to establish a reference point for the appearance of normal menhaden tissue. The end result is intended to be a diagnostic system for identifying diseases which destroy our fisheries stock. Through correct diagnosis, treatment methods can then be developed, not only for menhaden but other fish and shellfish also.

Investigation into the fungi which attack commercial molluscs, creating a virtual stand-still in oyster production, is also being conducted with a view toward the possible control of such epidemic diseases. Certain parasitic fungi have already been classified along with the optimum temperature and salinity levels in which they flourish. When the conditions can be controlled—such as in commercial oyster ponds—the killing parasite can be eliminated.

● ● As oil companies spread their search for oil into deeper and deeper waters, the need increases for large deep-water structures capable of withstanding high winds and heavy seas. The development of analytical tools and models which will assist in new design and construction techniques is carried on through the University's Civil Engineering Department under the Sea Grant Program. Information derived from two ocean engineering projects will contribute to the growing offshore technology field through the development of greater information on pilings used in offshore work. Other Sea Grant research is directed toward learning more about how large submerged oil storage tanks will behave under various wave forces and pressures.

To further assist the offshore mineral industry, Sea Grant projects are applying sophisticated geochemical analysis techniques to the ocean environment. At the Texas A&M Activation Analysis Research Laboratory, cores brought up from the ocean floor are bombarded with nuclear particles which help reveal the composition of the cores. In another study, investigators are analyzing ocean water at various depths to help oil men differentiate between hydrocarbon deposits which are produced from decaying sea life and hydrocarbon seeps which indicate the presence of oil deposits.

Members of the Texas A&M Oceanography Department are developing ways to apply the electrical logging techniques used successfully in various land-based operations to the marine environment under a Sea Grant project. Immediate applications are anticipated in offshore platform foundation engineering, pipe line and cable surveys, estuarine pollution studies, mineral surveys, and sediment transport and deposition studies. The use of electrical logging equipment should significantly reduce the cost of oceanographic work.

Work in underwater communication systems is also being carried out in the program. These systems have the potential of providing the oceanographer, fisherman, and others interested in the development of marine resources with a new dimension in the area of data collection. The ultimate goal of this work will be a prototype system which will be able to transmit reliable signals to surface receivers.

Planning for the Coastal Zone

With the increasing concentration, of people along the Texas coastal margin, answers must be sought to the environmental problems associated with pollution and to the engineering problems brought about by industrial and recreational expansion.

Planning for efficient use and development of the coastal zone has received a high priority rating among the many ocean programs of our nation and in our state. In this area of conflicting uses where industries and communities challenge each other for supremacy of use, many environmental problems must be resolved with speed and efficiency.

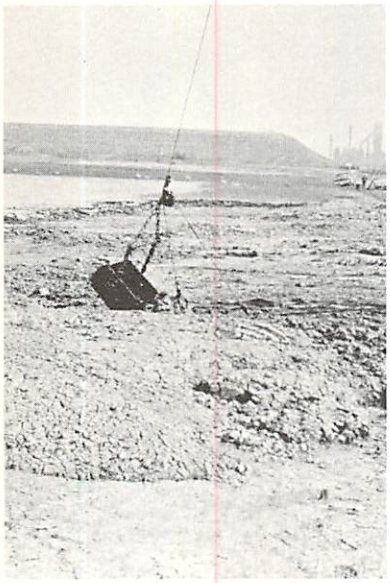
Many land-based industries discharge waste materials into rivers and streams which eventually find their way to the estuaries and bay systems along the Gulf coast. The degree to which pollution can be tolerated without damage to these important nursery and fishery areas is of critical importance to Texas marine resource development. To improve our knowledge of pollution and its related areas, the Sea Grant Program directed six projects toward pollution, coastal engineering and estuarine work.

Under the Sea Grant Program research is being conducted to find out what happens to the marine life when varying amounts of organic chemicals are discharged and to establish optimum water quality standards in the estuaries. Major components in the determination of water quality in estuaries include the rate at which pollutants are removed from the water by the normal settling process and the resulting oxygen demand of these deposits on the bottom. Engineers in the Civil Engineering Department are attempting to analyze these processes in the Houston Ship Channel and to construct a computer model to duplicate these events.

Not all of the effluent which reaches the estuarine areas can be attributed to industrial wastes. Agricultural and commercial pesticides can cause massive fish kills and other biological damage. Through a Sea Grant project, a technique to determine the amount of pesticide pollution present in fish by examining the brains of fish has been developed. A periodic surveillance of fish populations using this method could result in early detection of dangerous levels of pesticide pollution so that remedial action could be taken before the estuarine environment is severely damaged or destroyed.

Among the engineering problems associated with the Texas coastal zone are those of sand, shell, and mineral recovery. Because of the large dredging activity along the Gulf coast, Texas A&M engineers are searching for more efficient dredge pumps. During the first year of a three-year study, a facility for testing pumps was initiated. During the coming years various fluids will be tested. The objective of the study is to improve dredging equipment and reduce the costs of dredging operations due to cavitation problems.

The erosion of sand beaches by wave action is a problem found along many miles of the Texas coast. When the beach is fronted by a seawall sup-



As the Texas coast is developed for industry, recreation, and other uses, planning must be based on sound scientific and engineering research of the type conducted through the Sea Grant Program.

ported on spread foundations or by dune barriers, the erosion problem becomes acute. The stability of naturally protected or artificially protected beaches is of great importance along the Gulf Coast whether it is a beach used for recreation, such as Padre Island National Seashore, or whether the beach protects a city, such as Galveston, or whether the beach protects industrial complexes, such as Freeport. As the Texas coast is developed for industry, recreation, and other uses, the planner will be faced with many decisions involving the coastline and beaches. A three-year study in the Civil Engineering Department will develop greater understanding of beach processes and beach scour to help planners make economical decisions. During the first year, laboratory work using the wave channel and wave basin models in the University's Hydromechanics Laboratory will be conducted. Collection and analyses of field data will be made in the following years.

A bio-engineering study of the numerous micro-organisms of the sea—some of which produce edible proteins and carbohydrates or useful enzymes and some of which are capable of degrading community and industrial waste material—also is being conducted. Not enough is known about these tiny creatures to make beneficial use of them in marine resource planning. An intensive investigation will help determine their possible use in breaking down unwanted waste materials in bays and estuaries and other applications.

Putting Knowledge to Work

Applied research, which answers the need for fruitful returns on the ocean investment, can only be achieved through sound basic research programs and the dissemination of useful information to those who work in the coastal areas of Texas.

The application of principles and techniques to the ocean environment takes many forms. Before applied research can be effective, it must be based on sound principles and laboratory techniques. It must also be organized and recorded in such a way as to make the findings readily available to users.

Putting knowledge to work in marine affairs also includes the accumulation and dissemination of scientific, technical and economic information. As results from the various Sea Grant projects are obtained, a system of information and documentation is developing. An information handling system is being created to make marine resource information easily available to user groups. Over seven hundred reports and articles have been stored on microfiche film which can be easily retrieved with reader-printer equipment. Because the Sea Grant concept is built around the idea of useful tools and data, how information is disseminated receives high priority.

One way to let others know what Sea Grant is and how it can be used in the state, is through conferences and meetings. In January, 1969, more than 200 persons from all over the state met for the First Annual Texas A&M University Sea Grant Conference. The meeting helped provide a focus on the needs of the state in marine resource development. Proceedings of the conference presentations are being published and a second conference is already being planned.

Seminars and short courses also provide a mechanism for sharing ideas. In August, 1969, thirty engineers from industry, government, and universities participated in Texas A&M University's first "Coastal and Hydrodynamics Short Course." The two-week course was sponsored by the Sea Grant Program and the Coastal and Ocean Engineering Division of the University's Civil Engineering Department. In November, 1968, the first annual Dredging Seminar was held by the University's Dredging Center. Fifty-three participants from industry, government, and universities attended.

Extension advisory services, patterned after the agricultural county agent services, are another means of disseminating useful information. Under the Sea Grant Program, marine extension agents will become key elements in marine resource development. The goal of the program is to provide personnel to assist commercial fishermen and other users of marine resources. The program has already begun to identify people who will use the marine extension agent's services and to pinpoint the kind of information and assistance needed.

A newsletter, *The University and the Sea*, is published by the Sea Grant Program Office. Through the newsletter, 2,000 students, businessmen, indus-

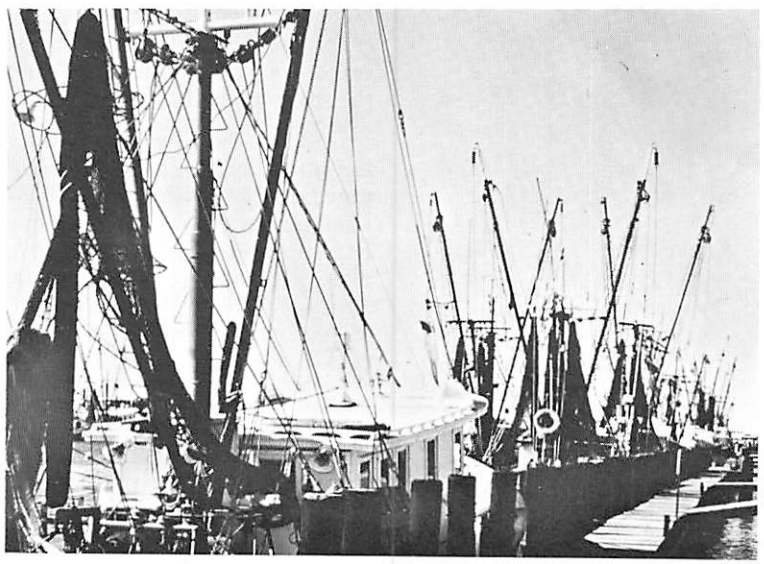
trialists, scientists, engineers, and others are kept informed on Sea Grant projects and other marine resource development news.

A comprehensive inventory of marine related activities has recently been compiled by the University's Industrial Economics Research Division under Sea Grant sponsorship. The 72-county area which serves as Texas' apron on the Gulf of Mexico provided the background for the report. The study documents a $94 million Federal investment in the state, cites 15 colleges and universities that carry on more than $5 million of work in 200 marine research projects annually, quotes fishery and offshore production figures, and lists 11 Texas ports and their annual tonnage and facilities. More than 400 industries that are involved in marine related business are listed. A companion study which will indicate trends in the state's marine resource development effort is supported by the Sea Grant Program for next year.

Other projects, too, are directed toward expanding the knowledge base and putting ideas into action. One project will produce a model for the management of comprehensive all-university programs, such as the Sea Grant Program. As university-level programs begin to take on the breadth needed to solve the resource development of the nation, such a plan will help in providing guidelines for those who must manage the program.

Another project is directed toward helping management, also. A descriptive economic study of the U.S. shrimp industry, with emphasis on Texas' role, will be combined with production-investment-inventory systems of a shrimp fishing complex in a two-year study by members of the university's economics department. When completed the study will serve as an important guide to managers and owners of shrimping businesses.

A cooperative project between the Texas Interagency Natural Resources Council and the Sea Grant Program has produced a comprehensive annotated bibliography with more than 2,200 citations to publications concerning Texas' bays, estuaries, and adjacent land areas. To facilitate literature survey work, the bibliography has a key-word index and cross-reference headings.



Texas' $46 million shrimping industry is the target for a Sea Grant project which will produce production-investment-inventory systems as management guides.

Training for Careers in Ocean Work

The manpower needs for oceanography cover a broad spectrum of abilities—from technicians trained in the use of fishery equipment, electronic devices, and general maritime gear, to engineers prepared to face the construction problems of the marine environment.

One of the basic goals of the National Science Foundation Sea Grant Program is to initiate and support programs for the education of personnel in various fields relating to marine resource development. It is not surprising, then, that the first projects to come from the Texas A&M Sea Grant Program dealt with education and training. During the first year's program five projects were concerned with education and training utilizing 18.7 percent of the total program funds.

Two projects were put into action for technician-training—one in cooperation with Galveston College, and the other with Texas State Technical Institute (formerly James Connally Technical Institute) in Waco.

At Galveston the program is a cooperative effort with the Texas A&M Marine Laboratory, Texas Maritime Academy, the University's Department of Oceanography, and Galveston College. During its first semester of operation, 14 students participated in the program and 9 more are now enrolled. Two curricula have been set up: (1) a two-year oceanographic instrument instruction; and (2) a one-year deck and fisheries training program which provides instruction to marine oriented mechanics, welders, and riggers. Technicians are trained in actual ship-board operations where they learn to make emergency repairs and to assist scientists and engineers in operating instruments and in recording meaningful data.

At Texas State Technical Institute a course in underwater welding was begun and continues for the second year. Plans are now being made for an oceanographic instrumentation technology course. A diving tank and suitable underwater and surface gear will be added to the program this year. During the first year 12 students were enrolled in underwater welding.

At the University level, many academic subject areas are being studied for possible development into marine resource oriented subjects. A course in maritime geography was developed by the Texas A&M University Geography Department and is expected to be offered in 1970 at the undergraduate level. It will include instruction in maritime economic, political, and cultural geography. A course in seafood technology is being developed in the University's Animal Science Department which will acquaint students with the problems of seafood production and treatment.

The Galveston Marine Laboratory's Sea Grant project is primarily concerned with instruction and student research in areas related to exploitation and utilization of marine biological resources. The graduate program is being expanded so that students may complete all or part of the course work and thesis research required for the Master's of Science degree in marine biological

areas in Galveston. Two new courses were developed under the 1968-69 Sea Grant Program. The Marine Laboratory is also providing offices, classroom, and laboratories for other Sea Grant projects centered in Galveston.

The Sea Grant Program partially supports three faculty members of the coastal and ocean engineering division of the Civil Engineering Department who are relieved from some of their normal duties to prepare new graduate courses in coastal and ocean engineering. Six new courses are now being developed: coastal engineering I and II, ocean engineering, coastal sediment processes, estuarine hydrodynamics, deep ocean and continental shelf dredging. Graduate students who perform study and research in coastal or ocean engineering on a half-time basis are partially supported from Sea Grant funds.

Documenting the Program

To some extent the measure of research—
both applied and basic—lies in the dissemination
of findings through the information media.
The Sea Grant Program has made a significant contribution
to the literature related to marine development.

As set out in the National Sea Grant College and Program Act of 1966, the National Science Foundation shall encourage and develop "programs consisting of instruction, practical demonstrations, publications, and otherwise, by sea grant colleges and other suitable institutes, laboratories and public or private agencies through marine advisory programs with the object of imparting useful information . . ."

Through its research, education, and advisory services projects, the Texas A&M University Sea Grant Program has originated nineteen technical reports, contributed seven articles to professional and trade journals, and has contributed to the preparation of eleven theses by graduate students within various University departments. In addition, proceedings of conferences and meetings have been published, bibliographies have been compiled, and newsletters and media releases have been prepared to disseminate marine resource information to the general public.

Through the mass media, hundreds of column inches of newspaper copy have carried the story of the Sea Grant Program to the people of the state and radio and television broadcasts have created greater public awareness of the problems and promises of marine resources. Visual presentations, using 35 mm color slides and 16 mm color film, have been prepared for use by project leaders and others.

The following bibliography includes technical reports, journal articles, participation in professional meetings, theses, general information publications, films and other media devices which have been developed from the first year's Sea Grant activities at Texas A&M University.

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