The University & The Sea

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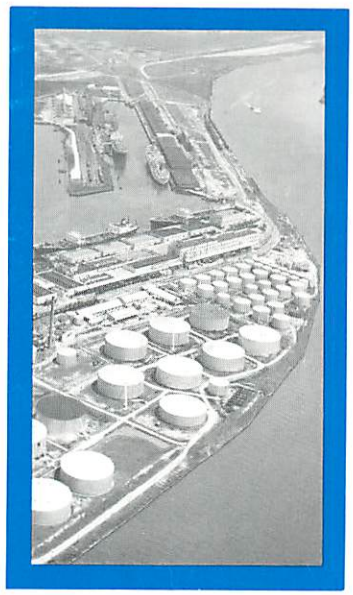
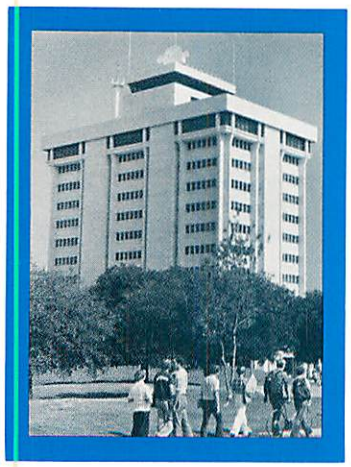
Special Issue

Sea Grant College Program Annual Report 1977-78





Sea Grant, now ten years old at Texas A&M, is housed on the eighth floor of the 15-story Oceanography/Meteorology Building on the main campus.

Contents

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This special issue was edited by Laura Colunga and written by KC Smith and Laura Colunga.

1977-78 marks tenth year of Sea Grant at Texas A&M

A decade has passed since the first Sea Grant funds were awarded to Texas A&M University in 1968. These ten years, ushered in by the landing of men on the moon in 1969, and the image of the "big blue marble", our planet as seen from space, have been accompanied by a new perspective and an acute awareness of the finite nature of our natural resources.

As we turned our attention to the environment, we became aware of how fragile and, at the same time, how bountiful a resource the oceans, Great Lakes and coastal areas are. We also realized how little we knew about the waters we had traveled and fished for so many centuries.

The U.S. Congress's purpose when it created the National Sea Grant Program in 1966 was to promote the development and wise use of the ocean's resources. This goal is being carried out through support of marine-related research, education and advisory services concerned with the conservation, proper management and social and economic use of marine resources.

The term "Sea Grant" was chosen to emphasize the program's similarity with the century-old Land Grant program, to point to the parallel between the present needs of the nation in the marine environment and the needs of the nation in the 1860's to develop its agricultural lands.

Texas A&M University was founded in 1876 as a Land Grant College. It was named one of the nation's first four Sea Grant Colleges in 1971. The Sea Grant College designation is made for sustained excellence in marine research, education and advisory services. There are now 13 Sea Grant Colleges.

Sea Grant at Texas A&M is a state-wide program involving researchers, educators and advisory personnel from many departments and campus units of Texas A&M, as well as other Texas institutions.

This special report summarizes the activities of the Texas A&M Sea Grant College Program in fiscal year 1977-78, in which more than 30 individual research and education projects were carried out in seven major program areas. Projects were supported in Texas A&M's Colleges of Agriculture, Education, Engineering, Geosciences, Liberal Arts and Science, and the Industrial Economics Research Division and Texas Agricultural Extension Service. Also receiving Sea Grant support in 1977-78 were projects at the Baylor College of Medicine, Houston; Brazosport College, Lake Jackson; the University of Houston; Sam Houston State University, Huntsville; and the University of Texas Marine Science Institute, Port Aransas.

Sea Grant is a matching-funds program, with approximately two-thirds of the total budget coming from the federal government and one-third from other sources. For the past nine years, a significant portion of the matching funds has come from the Texas Legislature in the form of a special item in the University's budget. Additionally, supporting funds are provided by local governments, other colleges and universities, private business and industry.

1977-78 was the tenth year of Sea Grant support at Texas A&M. Because of that, we are not only reporting on the activities of that year, but also pausing to reflect on the past ten years. Individuals associated with the program were asked to comment on the progress, discoveries, new directions and future possibilities for the program areas with which they have been associated. Summaries of the activities of the individual projects within each area during 1977-78 follow each discussion. The names and addresses of the project leaders appear with each summary, and details of their work may be obtained by writing to them directly.

Feenan D. Jennings
Director

Program Expenditures 1977-78

Program Area (National Office Categories)	**NOAA**	**Matching**	**Total**
Marine Resources Development	240,646	179,820	420,466
Socio-Economic and Legal Studies	104,548	48,179	152,727
Marine Technology Research and Development	167,256	95,599	262,855
Marine Environmental Research	469,000	123,505	592,505
Marine Education and Training	67,693	35,564	103,257
Marine Advisory Services	454,870	423,920	878,790
Program Management and Development	137,687	285,293	422,980
Totals	$1,641,700	$1,191,880	$2,833,580

Marine education — learning to appreciate the oceans

This exhibit from the Marine Resources Reference Center at Sam Houston State University has captured the attention of these youthful participants in the Children's Literature of the Sea Seminar.

The State of Texas has only one curriculum requirement for marine science education in elementary and secondary schools. A unit dealing with the sea must be included in the junior high earth science course; and, for high school students, the State provides only that an optional marine science course may be offered.

Indeed, some school districts and individual teachers, particularly those in coastal areas, exceed the minimum and provide course work in all aspects of marine awareness for students of all grades. However, many teachers may not yet realize the value and need for such study or have the academic or personal experience to teach it. Also, the overall low level of instruction in marine topics in Texas probably is due to a lack of available educational resources and teaching materials.

Helping to alter this trend, Texas A&M University, over the past few years, has expanded its marine education capabilities to provide materials for teachers and to make students and teachers alike more aware of the importance of marine resources.

The Sea Grant Program has supported this new focus by funding a variety of creative education and training projects with all age groups in mind. In 1977-78, these included projects to develop marine curriculum and resource materials, training programs for the study of humankind's ancient and modern seafaring traditions, instruction and research in the literature and arts of the ocean, and a hands-on experience in oceanographic research.

Sea Grant Deputy Director Lauriston King, who works closely with Texas A&M Sea Grant's education and training program, believes many Texans may not appreciate the marine environment because they do not understand it.

"Despite the size and complexity of the marine environment and its economic, recreational and demographic importance to the Texas Gulf Coast, I believe many citizens have not had the means to learn about the nature of their ties to the sea," King states.

"This has been especially true at the elementary, secondary and vocational school levels. Teachers have had little or no opportunity to study the ocean as part of their professional training. They have been limited further by the absence of materials and in-service training programs in marine affairs. Unfortunately, the sea has received scant attention in the classroom."

King says the goal of the Sea Grant marine education program is to increase awareness of the oceans as a critical part of the global environment, as a resource, and as an influence in history, art, economics and politics.

This goal is furthered through three kinds of marine education projects—curriculum development, vocational training and special program needs.

To nurture awareness of the oceans in their classrooms, King says, teachers must have materials that are readily-available and easy to use. They also should employ a creative complement of technique and tools—from beakers and aquaria to songs and games—to get marine information across to students.

Several Sea Grant researchers currently are developing materials, taking them into classrooms to test and assess, and working with the Texas Education Agency and individual teachers via workshops to make the availability of the new teaching aids known.

Vocational training in technical marine skills, a growing need with the proliferation of on- and offshore industries, also receives support, says King.

"Sea Grant's response has been to work with state vocational institutes and junior colleges in exploring the opportunities for new technical training programs, the development of classroom materials, the organization of existing materials, and the purchase of needed equipment."

Special programs—usually at the university level—give support to promising new areas of inquiry in marine-related fields and attract vibrant personnel capable of that inquiry to Texas A&M.

"Historically, Texans have looked to the land for sustenance and wealth, and in doing so, they have tended to overlook the contributions of the Gulf Coast to the prosperity and welfare of the state and the nation," states King.

"The Sea Grant Program is committed not only to teaching people about the sea, but also to making them realize the ways in which the ocean contributes to their well-being."

Marine Resources Reference Center, James DeShaw, College of Science, Sam Houston State University, Huntsville, TX 77340.

The lack of marine education resource and reference materials for use by Texas teachers was the impetus for this three-year project to develop and make available a materials resource center. Initial activities included the identification and gathering of existing marine instructional aids currently available to elementary and secondary teachers. Certain materials and curriculum packages then were reviewed, evaluated and described according to grade level and usefulness; these will be assembled into a series of bibliographies during a later phase of the project. The groundwork also was laid for establishment of a library or network of lending libraries on marine educational resources for Texas teachers, an objective which also will be completed during the second and third years.

Future-Oriented Marine Resources Teaching Unit (Mini-Semester) for Secondary Schools, Delmar Janke, Department of Educational Curriculum and Instruction, Texas A&M University, College Station, TX 77843.

The majesty of the sea can be conveyed to students in creative, scientific, lighthearted and sober terms, with myriad teaching aids. The marine resources educational module developed in this project capitalizes on that diversity as it promotes greater appreciation, understanding and future perspective of the marine environment to secondary level students. More than 50 conventional and innovative activities in 20 lesson clusters are included in the 440-page unit, which also includes two filmstrips and cassette tapes. Although filling a need for Texas and Gulf Coast marine resource teaching materials, the unit's creative approach is applicable by educators throughout the nation.

Children's Literature of the Sea, David Stewart, Department of English, Texas A&M University, College Station, TX 77843.

The research and resource base in marine-related children's literature and film has been strengthened through this three-part Sea Grant project that yielded several teaching aids. A carefully-researched anthology of folk and fairytales of the sea was produced which included representative selections from all over the world. In addition, elementary and secondary school teachers who want to introduce marine literature to students will have the benefit of a bibliography of selected books and resource materials relating to the sea. A bibliography of American and foreign feature films with the ocean as a theme also was completed as part of this project.

Training for Nautical Archaeology, George Bass, Department of Anthropology, Texas A&M University, College Station, TX 77843.

Texas A&M University is one of two places in the world where students can study the nascent scientific discipline of nautical archaeology. Established at the University in 1976, the graduate specialization used Sea Grant seed money for a three-part project designed to provide practical training for students and to raise public awareness of nautical archaeology and its possibilities in Texas. To this end, students surveyed the submerged site of a sidewheel steamboat in a Texas river, working closely with the local historical society. To aid classroom and public education, a unique collection was begun of films on underwater archaeological techniques. A potential educational experience also was investigated with the planning and cost analysis of construction of a full-scale replica of an ancient vessel, which students in the program would build and take on sea trials.

The Day on the Bay, Sarah Meyland, 408 E. 23rd St., Bryan, TX 77801.

Seed money was provided in 1977-78 for initiation of a unique seagoing educational program designed to expose high school and college students and their teachers to a "hands-on" marine science experience. During a seven-hour cruise of Texas coastal waters, students were involved in more than ten data-gathering activities, using oceanographic equipment and information provided in a marine science manual generated as part of the project. The Day on the Bay was designed to provide an educational link between classroom experience, where scientific principles are acquired, and the real, physical world, where the laws of nature are observed in action.

Development of Modular Instructional Units in Oceanic and Marine Technology, John Gunning, Oceanic and Marine Technology Program, Brazosport College, Freeport, TX 77566.

The loss during the year of most personnel associated with this project unfortunately stymied the attainment of many of its goals. Project objectives included the development of modular instruction units in oceanic and marine technology, generated in cooperation with other institutions having similar study programs. A small number of audio-visual materials were developed and used successfully in classrooms.

Advisory service provides answers, assistance, advice

Wallace Klussmann, Marine Advisory Service program leader, makes the point that "marine agents are Texas A&M at the local level."

It's a long process from the idea, through research and testing, to the answer, and even then, the work is not complete until results are in the hands of those who need them.

Knowledge and information generated through Sea Grant-funded studies belong as much to the public as to the investigator, and the Texas A&M Marine Advisory Service provides an important doorway through which information flows between scientists and consumers—the users of marine products and resources. The program's personnel—six county extension marine agents and nine marine specialists—are the gatekeepers of this two-way exchange.

The purpose of the Marine Advisory Service, says program leader Wallace Klussmann, is three-fold. In addition to providing a communication line between the University and the public, the program strives to organize, develop and transfer marine technology that improves the quality of life for people in Texas through the wise use of marine resources. Advisory personnel also are a focal point or contact that local citizens can go to for current information and technology.

Klussmann believes the Marine Advisory Service completes the total Sea Grant mission:

"The Sea Grant philosophy is to do applied research that has meaning to people. Unless we transfer that knowledge or research base to the public, the whole philosophy is not achieved."

"It is critical that we provide not only an assistance program to the person who makes a living from some marine resource, but also a good understanding of the resource itself to the entire population," says Klussmann.

By working at the local level in seven coastal counties, marine agents deliver useful and vital information to all segments of the population through workshops, educational programs, publications and face-to-face communication. Funding for their work is provided jointly by the Sea Grant College Program, the Texas Agricultural Extension Service and local county governments.

As contact points for marine advisory service activities, the agents not only integrate and interpret information from state and local agencies and institutions, but they also receive the questions, comments and complaints of people whose livelihood or enjoyment keeps them in touch with the sea. This constant contact with the public, says Klussmann, is helpful in identifying problems, setting long-range and immediate priorities, and informing decision-makers and researchers about the needs of coastal communities. Klussmann notes that an important part of the agents' role is their work with small, independent businesses which cannot afford the technical assistance or expertise that large industries employ.

"The marine agent is an organizer, educator and initiator. Most of all, he is a generalist because he must get along with and work effectively with commercial fishermen, recreationalists, industries, policy-makers, teachers and students. To do this, he has to be well-integrated into the community," Klussmann notes.

"Our marine agents are Texas A&M at the local level. They represent the University's capabilities in and understanding of our renewable and non-renewable marine resources."

County marine agents are backed up by a group of specialists, each an "expert" in a particular marine area. With joint support from Sea Grant and the Agricultural Extension Service, the advisory service currently includes specialists in marine recreation, fisheries, economics, business management, and seafood marketing, technology and consumer education.

Specialists locate, interpret, expand and disseminate technical information about marine resource development and utilization. Like the marine agents, they are in close contact with many segments of the population through workshops, meetings, short courses, individual contacts, advisory bulletins and newsletters

they generate. Working closely with the agents, they form a team, Klussmann notes.

"Our specialists are our most important link between the research community and the county agents. They are responsible for the two-way communication that is so essential to the success of both the research and advisory programs," he states.

The Marine Advisory Service traditionally has been an integral part of the Sea Grant Program at Texas A&M; it was among the first group of projects to receive funds ten years ago. Efforts initially were directed toward developing alternative economic uses for coastal marshes, particularly commercial development of wild crops. The Texas A&M mariculture project had its roots in these efforts, until it became a separate Sea Grant program area in 1974.

"For several years, we had only one agent on the coast," recalls Klussmann, "and his tracks would blow away before he could get back to an area again. Frankly, that wasn't enough to have any impact. However, as we became aware of more and more commercial and recreational interests, it was obvious that we had to add personnel if we wanted to serve the public effectively."

"We have six agents now, and I believe nine would be optimum. We also would like to add several specialists—a civil engineer and a marketing expert, for example—because we don't have the expertise we need in these areas."

In addition to the diverse activities which currently occupy advisory efforts, Klussmann believes two specific areas will require the attention of agents and specialists in the future. One of these, he says, is the "marine science opportunity for the general public".

"I feel very strongly about our commitment to educating the public about marine issues. It is important that adults, who can have a great influence on the use of our coastal resources through participation in special interest groups and through their votes on marine issues, make their decisions on the basis of information rather than emotion."

"Marine awareness is equally as important for young people, obviously because they some day will have the same decision-making responsibilities, but also because there is so much about the sea to know and enjoy."

Who to call

County Extension Marine Agents

Aransas and San Patricio Counties
Jeff Messinger
Aransas County Courthouse
Rockport, TX 78382
(512) 729-1211

Brazoria County
Charles G. Moss
Rt. 2, Armory Building
Angleton, TX 77515
(713) 849-5711, Ext. 327

Calhoun County
Joe T. Surovik
P. O. Box 86
Port Lavaca, TX 77979
(512) 552-9747

Cameron County
Jack A. Rickner
County Building
San Benito, TX 78586
(512) 399-2448

Galveston County
Bruce Cox
5115 Highway 3
Dickinson, TX 77539
(713) 337-2575, Ext. 296

Matagorda County
Willie Younger
Room 326, County Courthouse
Bay City, TX 77414
(713) 245-8415

Agent-In-Training
Jim Buckner
Department of Agricultural Economics
Texas A&M University
College Station, TX 77843
(713) 845-5221

Specialists

Marine Recreation Specialist
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Industrial Economics Research Division
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College Station, TX 77843
(713) 845-5711

Seafood Marketing Specialist
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College Station, TX 77843
(713) 845-6741

Marine Fisheries Specialist
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Sea Grant College Program
Texas A&M University
College Station, TX 77843
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Texas A&M Research and Extension Center
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(512) 265-9201

Seafood Technology Specialist
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Seafood Consumer Education Specialist
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Texas A&M University
College Station, TX 77843
(713) 845-3246

Marine Economics Specialist
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Department of Agricultural Economics
Texas A&M University
College Station, TX 77843
(713) 845-2333

'Shrimp farming' combines biology and agriculture

This specially-formulated feed was developed in earlier years of the Texas A&M shrimp mariculture research program. A major goal now is the breeding of shrimp in captivity.

Two decades ago, "sea farming" was the term used to describe the raising and harvesting of certain marine animals in captivity for commercial and food resource use. Although a well-established practice some places in the world—Japan and France, for example—in America, commercial mariculture is still in its infancy.

Persistent research on the biology, technology, economics and biochemistry of this developing science/industry has yielded several vigorous experimental mariculture programs in the nation, one of which is at Texas A&M University. During the last ten years, "sea farming" research, with Sea Grant support, has used a consortium of projects to develop a successful penaeid shrimp mariculture program. Two species currently are being raised and harvested experimentally at two facilities on the Texas coast, and information exists on the possible viability of three additional species.

Despite an interplay of many sciences, mariculture project leader Jack Parker describes this as basically a farming operation.

"We are at a point in our research where we can take a marine organism and farm it commercially. We've moved out of the scientific marine biological field and into the scientific agricultural field."

Improved culture technology as well as favorable market prices, expansion of a worldwide market and financial stress on the fishing industry have encouraged the mariculture effort, which Parker says has several beneficiaries.

"Ultimately, our purpose is to provide a quality food product to the consumer at an acceptable price in a way that is profitable to the producer."

"If we can do that, then we will have a new agricultural industry in Texas that could develop thousands of acres of land and have a significant impact on the state's economy," Parker states.

When mariculture was just a notion in Texas, research was geared toward determining whether land and water resources in the state were conducive to raising certain marine animals in open, constructed ponds. The environment was favorably assessed; a durable species was needed to study.

Texas Gulf waters have three native shrimp: *Penaeus setiferus* (white), *P. aztecus* (brown) and *P. duorarum* (pink), of which the first was judged the more likely candidate for successful mariculture.

Researchers then began to develop a food supply specifically for shrimp that would optimize growth and survival in captivity, Parker says. It took nearly three years to produce the ration, which contains 20 percent fish, shrimp and soy protein and 80 percent grain fillers—the latter being the accessible, inexpensive components.

"We have settled on a ration which, although probably not optimum, is assuring us bait and edible size shrimp at a reasonable price. At the time we did this, we wanted to direct our research efforts to other aspects of the program."

One of those "other aspects", Parker says, was refinement of the species stock used for mariculture. While the native species, *P. setiferus*, had fared well in the system, all shrimp varieties had to be considered to insure maximum results.

The Ralston Purina Company, in the mid-1970's, successfully was raising seed stock of two white penaeid shrimp from the Pacific coast of Panama, *P. vannamei* and *P. stylirostris*. These were proposed for testing in the Texas project. Their success in the system was good; and they are the species currently being raised at pond facilities in Angleton, donated by the Brazoria County Commissioner's Court, and at facilities in Corpus Christi, provided by Central Power and Light Company.

With basic components determined, Parker and his co-investigators since have approached the interrelated factors important to penaeid shrimp production. These have included studies of environmental conditions for optimum size and yield, nutritional requirements and feeding rates, engineering of cost- and

yield-efficient production systems, maturation and spawning in captivity, and variables that influence economic aspects.

"Two things are important to us now. We need to develop our maturation and reproduction technology to produce our own seed stocks in captivity and to develop improved genetic strains of shrimp. We also must understand more precisely how pond systems operate; that is, how to design and manage an ecosystem that maximizes production of each of the genetic strains."

Shrimp Mariculture System, Jack Parker, Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station TX 77843.

As the core of the Texas A&M mariculture program, this project was designed to assist the technology development needed to establish penaeid shrimp farming in Texas and to demonstrate that technology on a pilot basis.

Systems Analysis of Shrimp Mariculture, Vincent Sweat, Department of Agricultural Engineering, Texas A&M University, College Station, TX 77843.

A prime ingredient in successful commercial mariculture is the development of a production facility which optimizes survival and growth and minimizes the costs of construction and operation. This project sought to compile and model data about the chemical, physical and biological variables that influence the efficiency and economy of growth, or yield. Results of the first year of this project will enable a potential operator to estimate the cost of constructing and running a shrimp production system. They also can be used to set future research priorities and to identify factors which must be controlled to optimize shrimp production.

Studies on Larval Development and Growth in Penaeid Shrimp, John Wormuth, Department of Oceanography, Texas A&M University, College Station, TX 77843.

Two problems in the feeding and handling of larval penaeid shrimp were studied simultaneously to gain knowledge about food preference and efficiency during this critical stage of life. Methods were developed to culture shrimp through the first postlarval period and to test different growing conditions and food regimes. In addition, the effects of freezing on embryonic shrimp were studied to enable delayed development and storage of penaeid eggs, which thus can provide a back-up supply for research and, ultimately, commercial hatchery operations.

Nutritional and Biochemical Studies Concerned with Penaeid Maturation, Addison Lawrence, Department of Biology, University of Houston, Houston, TX 77004.

The successful growth and survival of captive shrimp depends on an understanding of nutritional and biochemical factors that enter into their development. Carbohydrate, protein and lipid levels in eggs of three penaeid species were studied for content comparisons between captive and wild populations. Investigation of certain fatty acids during five developmental stages also was conducted. In addition, nutritionally-important bacteria and dissolved organic matter were tested to assess their effects on growth and survival. The information obtained from this project will help to close the life cycle in captivity and to define the environmental conditions and dietary requirements which best support shrimp maturation.

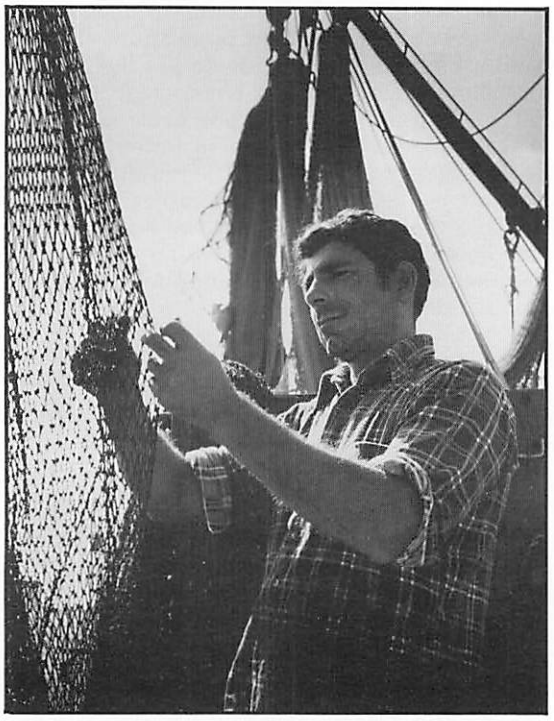
Natural and Induced Maturation in Penaeid Shrimp, Robert Brick, Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843.

A major step in the attempts to understand and accomplish reproduction in captive marine shrimp was taken with the successful maturing and spawning of a population of unmated female *Penaeus setiferus.* Several million eggs were spawned under carefully-researched environmental conditions and diet at the indoor facility of the National Marine Fisheries Service Galveston Laboratory. These efforts represent the first control of sexual maturation in this shrimp without surgical manipulation of endocrinological centers in the eyestalk.

Steroids and Fatty Acids in Crustacean Mariculture, Brian Middleditch, Department of Biophysical Sciences, University of Houston, Houston, TX 77004.

The efforts to control reproduction in captive penaeid shrimp were aided greatly by this project which determined certain nutritional requirements of the crustacea. Bioanalytical testing of adult male and female *Penaeus setiferus, P. stylirostris* and *P. vannamei* indicated a need for docosahexaenoic acid and other essential fatty acids for ovarian maturation. While algae contains these compounds, carnivorous shrimp will not feed on this, although they will consume small marine animals. Bloodworms were found to be capable of storing the nutritional products needed and, used as a dietary supplement, aided in the ovarian maturation and spawning.

Scientists and economists make seafood safe & salable



Ninety percent of Texas' commercial fishing industry is based on shrimp. Researchers at Texas A&M are looking at fish species in the Gulf of Mexico that fishermen could seek when the shrimping season is closed.

Research in the development of fisheries and seafood products responds to the worldwide realization that food sources needed now and for the future can be harvested from the ocean.

A number of alternatives have been proposed in various coastal states for improving the viability of commercial yields. In Texas, 90 percent of whose commercial fishing industry is based on shrimp, two plans have been considered. One is the harvest of certain finfish species, such as mackerel, mullet and sea trout, which are abundant in Gulf waters but which traditionally have not been sought by Texas fishermen. The other is using fish caught incidentally by shrimpers in their nets to make food products.

Sea Grant-funded researchers at Texas A&M University have investigated each of these possibilities from three perspectives. Biological studies by a number of scientists have sought to identify the populations, distributions and biological characteristics of several finfish which could be developed into alternative fisheries or alternative food resources.

Projects at the Seafood Quality and Safety Laboratory have emphasized quality control and consumer acceptance of seafood products by studying the chemical and physical properties that influence flavor, texture and wholesomeness of fish during handling and processing. Researchers also have worked to develop conventional and unconventional uses for fish and shellfish.

The relationship of economic factors to a commercial fishing industry also has been studied by Sea Grant researchers, such as John Nichols. A fisheries economist, Nichols believes that data generated in this area is important not only in helping to shape management policies, but also in determining the technology, yield and effort that is required to make a new or ongoing fishery a worthwhile enterprise.

Nichols was involved in the early 1970's with the first Texas A&M Sea Grant projects that focused on the potential of finding uses for fish taken unintentionally by shrimpers.

"Many scientists have believed that the finfish species caught incidentally in shrimp nets —sometimes as much as ten pounds of fish for every pound of shrimp—represent a tremendous biological waste, since most are thrown overboard," Nichols states.

While biologists concurrently were identifying the species being caught and seafood technologists were developing food products that could be made from these fish, Nichols and his associates were investigating the economic aspects of using the incidental catch.

"After analyzing both cost and market factors, we essentially confirmed the traditional wisdom of throwing the catch overboard. Given the harvesting systems and product utilization eight years ago, a shrimper couldn't hope to get at the dockside what it cost him to keep these fish on board," Nichols says.

"It was clear that if we wanted to expand the use of these species, we would have to improve the technology for harvesting and processing as well as product quality and consumer acceptance."

While progress has been made in these areas with the aid of Sea Grant research in fisheries biology and seafood technology, Nichols notes that fisheries researchers now are taking a broader look at development opportunities. Rather than tying efforts to the incidental catch, scientists are investigating five or six species that could be developed as a fishery that the current shrimp trawling fleet could seek on a seasonal basis when they were not harvesting shrimp.

As part of this work, fisheries economists, including Nichols, have formulated an integrated model for policy-makers to use to predict the outcome of various fishery plans.

The need for shrimpers to develop alternative harvests is the result of many factors, Nichols says—the increase in fuel prices, the growing number of shrimping vessels in the Gulf, and worldwide fluctuations in economy. However, a major contributor has been the gradual closing of Mexican fishing areas to U.S. shrimpers with the instigation of 200-mile, offshore fishing boundaries.

"I think we have got to get serious about developing alternative fisheries for the shrimpers and for new interests. The economic pressures on the Texas commercial fishing industry are going to continue such that we cannot dismiss this potential resource."

Economics of Production and Marketing in the Commercial Fish Industry, Wade Griffin and John Nichols, Department of Agricultural Economics, Texas A&M University, College Station, TX 77843.

Increased pressure within the industry, the potential for pond-reared crustacea, and the expanded resources available with new offshore fishing boundaries are factors which influence financial stability and long-range management plans for commercial shrimping in Texas. With a view toward future needs, which may include alternative harvests by shrimpers during at least some part of the year, a bio-economic simulation model was developed to assess the impacts of various management strategies for the state's fisheries. To build the model, researchers have analyzed current shrimp fishing catch, cost and market data, as well as information about successful alternative fisheries elsewhere on the Gulf coast. Although they model only one shrimp species and one small fishing area, research results already have been requested by a number of state, federal and international groups.

Economics of Commercial Shrimp Mariculture, Wade Griffin, Department of Agricultural Economics, Texas A&M University, College Station, TX 77843.

Potential investors and creditors in commercial mariculture enterprise will require accurate economic data with which to assess financial costs and returns of their investment. A bio-economic model was developed for shrimp grow-out ponds that is capable of budgetary and cash flow simulation and analysis. In developing the computer model, past and current production data generated through the Texas A&M mariculture project were used as a basis for assumptions. Based on these assumptions, large-scale penaeid shrimp culturing operations would be profitable in this state. However, because the analyses depended on certain generalities regarding biological, engineering and economic aspects of shrimp mariculture, the model also can be used to direct future research toward understanding factors that affect commercial feasibility.

Early Life Histories of Spanish and King Mackerel in the Gulf of Mexico, John McEachran, Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843.

King and possibly Spanish mackerel represent underexploited fishery resources in the northwestern Gulf of Mexico. However, efficient management plans for sport and commercial use cannot be developed without adequate biological information concerning distribution, seasonality and abundance. This project sought data on those factors. Analysis of plankton samples were used to determine the seasonal occurrence, location in the water column and abundance of eggs and larvae of Spanish and king mackerel off portions of the Texas coast. From this information, estimates were made concerning larval survival rates and probable biomass of adult populations.

Application of the Beverton-Holt Model for Assessing Fishing Effects on Demersal Fishes, Mark Chittenden, Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843.

A number of underutilized fish species exist in the Gulf of Mexico; among these are the demersals such as croaker, sea trout, sea catfish, kingfish, pinfish and sheepshead. Three of these species, the silver and sand sea trout and the Atlantic croaker, were the objects of an investigation to determine the potential biological effects of fishing these species. Data gained by yield-model simulations will aid in the development of management plans.

Wholesomeness and Safety of Fish and Shellfish, Carl Vanderzant, Department of Animal Science, Texas A&M University, College Station, TX 77843.

Seafood technology research at Texas A&M strives to improve the quality of existing fish and shellfish products and to develop methods to utilize fish species which currently are not commonly consumed by humans. Studies involve microbiological and biochemical analyses, since an understanding of influential bacterial and chemical mechanisms can reduce quality loss, spoilage and public health hazard as well as aid industry in commercial processing or packaging. Such studies were applied this year to minced fish flesh of several underutilized Gulf species which are being considered for marketing; certain shellfish suspected of hosting hazardous pathogens; quality control and determination of shrimp stored on ice; and controlled atmosphere packaging of fish with CO_2 to increase shelf-life during marketing.

Man and nature bring change to ever-shifting shoreline

John Herbich, Department of Civil Engineering, feels Sea Grant should continue to support studies of waves, currents and sediments so that this information will be available to planning groups and public agencies.

As people continue to live and work on, in or near the ocean, environmental concerns prompt the study of how this activity affects estuarine and offshore waters. Understanding the impacts means understanding the natural forces themselves since these provide the measures of change and also determine what technology can be used safely and efficiently in the coastal zone.

The group of Sea Grant projects concerned with shoreline processes and protection traditionally has sought data about the coastal environment that can be applied to the well-being of the environment and to the people who live and work there. Such data is necessary to balance growth and wise resource use, especially since over half of the nation's population lives within a 50-mile coastal strip that comprises only eight percent of the total U.S. land area.

One of the first researchers to receive Texas A&M Sea Grant support ten years ago, civil engineer John Herbich, each year since, has investigated different aspects of the relationship between natural coastal processes and human activity in this zone.

Herbich notes, "As more and more people move into the coastal zone, we have greater competition for space among the interests who use, need and enjoy the ocean. Unfortunately, this all is happening in an environmentally sensitive area."

"Unless we do some very careful planning —which Texas has the chance to do—we will end up with a coastline that is crowded, polluted and no longer useful or enjoyable. In order to plan, we need information about the marine environment itself."

Seeking some of this information, Herbich and four other scientists, during 1977-78, conducted individual projects that focused on wave characteristics of the Texas Gulf Coast, patterns of circulation in currents and the effect of these patterns on natural and pollutant chemicals, the effects of wind and wave action on offshore structures, and techniques for biologically stabilizing land claimed from the sea.

Herbich recalls that ten years ago research about shoreline processes and protection was focused on the danger of oil spills and the development of technology to contain and remove spilled oil from the surface of the ocean. A related concern involved the design and construction of oil tankers to prevent break up and loss of oil at sea in the event of a collision.

Rapid development along the Texas shoreline in the early 1970's also was creating concern about the effects of dredging and the dumping of dredged material offshore. Herbich cites this issue as an example of how research has responded to and clarified an environmental problem.

"There was a point during the development boom when many people decided that dredging was a bad idea and that it caused irreversible changes in the marine ecosystem. As a result, the amount of dredging permitted along the coast was reduced by about 40 percent, and the cost to do it nearly tripled because environmental regulations were enacted."

"However, based on a five-year study, we now know that dumping dredged material offshore affects the environment very little, and that any infringement on marine life is short-term. In fact, we may be doing ourselves an injustice by depositing dredged material on land because it increases the cost of the operation, and it also covers valuable land that could be grazed or cultivated."

Dredging and construction along the shoreline have created two other, related environmental problems which Herbich believes are pressing. One concerns the design and integrity of structures built on Texas' high-energy beachfront; the other involves sediment movement along the beach as a result of construction.

"We have thousands of examples of structural failure during hurricanes and severe storms, not just in the Gulf, but all over the world. Part of the problem is that we simply don't have enough information about coastal processes to incorporate into the design of fail-free structures," states Herbich.

"In addition, whenever we build along the shore, we interrupt the transfer of sediments by wind and water. This creates erosion and, ultimately, dredging problems. If we had better data about wave, current and sediment movement—basic oceanographic information —to combine with planning, we could avoid some of these difficulties."

Herbich notes that, in fact, a good deal of data does exist about the environmental forces of the Gulf of Mexico; the proof, he says, is in the level of technology applied by companies in the offshore industries. However, these individual entrepreneurs maintain exclusive access to "proprietary data" which they generate and do not make it readily available to scientists or the public.

"This is the reason I believe Sea Grant should sponsor work to understand shoreline processes. The information from such projects is available to the public as it plans the safe, efficient and wise use of the marine environment."

Wave Data Bank for the Texas Coast, John Herbich, Department of Civil Engineering, Texas A&M University, College Station, TX 77843.

A wave monitoring program was begun at Texas A&M in 1977, and initial efforts included an extensive search for recorded wave data. Because information is scarce about wave characteristics on the Texas Gulf Coast, several data-gathering devices—a pressure-type wave gauge, a "waverider" buoy and a receiving station—were purchased. These will be deployed on and near an offshore platform and will be monitored regularly with assistance from Mobil Oil Company.

Biological Application for Stabilization of Dredged Material—Corpus Christi Area, Carl Oppenheimer, Marine Science Institute, University of Texas, Port Aransas, TX 78373.

Maintenance and new dredging of coastal areas will continue in Texas as a part of economic and recreational activity and growth. Stabilization of dredged land with plant life, a slow process in nature, can be aided by the human hand, as this project testing growth and survival of different vegetation in dredged material is showing. Stabilization reduces wind and rain erosion and enhances the beauty and usability of the land. Knowledge about its processes adds to the information base upon which management plans for coastal and estuarine development and resource use are framed.

Wind/Wave Interactions and Their Effects on Offshore Structures, David Norton, Department of Aerospace Engineering, Texas A&M University, College Station, TX 77843.

Offshore platforms and other structures, important in the use or reclamation of marine oil, gas, mineral, recreation and food resources, constantly are subjected to wind, wave and spray action which must be acknowledged in their design. Seeking to ensure safer and more efficient construction, initial work has been completed on the development of an engineering model of the marine atmospheric boundary layer which is capable of predicting wind-related forces on ocean structures.

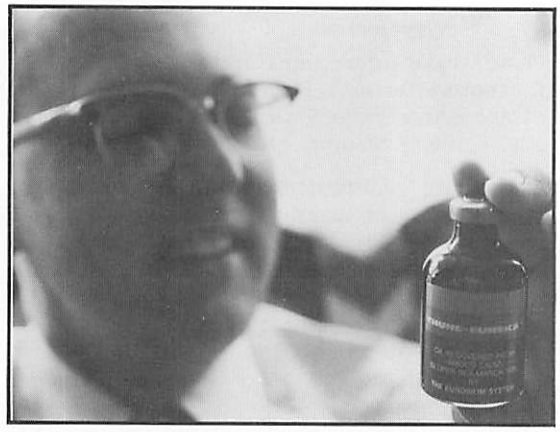
Developing New Techniques to Survey Chemical Variations in Coastal Waters, David Schink, Department of Oceanography, Texas A&M University, College Station, TX 77843.

The distribution of natural and pollutant chemicals in coastal waters—difficult to measure in this broad and rapidly-changing zone —is of economic importance because of the sizable portion of exploitable resources located there. This project sought a method of determining variability in the chemical composition of coastal marine waters by continuously collecting samples from various depths, analyzing them automatically and recording and digesting the collected data. A deep-towed pumping system already in use at Texas A&M was modified and refitted to accommodate new analytical equipment and techniques that permitted automatic sampling and assessing of specific chemical compounds in the water column.

Calculation of Gulf Coast Currents, J. C. Mungall, Department of Oceanography, Texas A&M University, College Station, TX 77843.

With the expansion of activity in coastal areas, detailed estimates of the vertical variation of horizontal water circulation are required to assess the impact of human-induced stresses. This project has responded to that need by providing the theory, development, sample applications and documented computer code for three models which provide estimates of the vertical profile of horizontal currents. These models already have been employed by various groups in the United States and Europe with satisfactory results.

Conflict in the coastal zone: utilization vs. protection



Roy Hann, Department of Civil Engineering, displays a container of oil recovered from the Amoco Cadiz spill off the coast of France in 1978. Sea Grant project researchers were called in to assist.

More than 300 miles of Texas' 600-mile coastline are beaches enjoyed by residents and tourists for their aesthetic and recreational values. Adjoining coastal marshes are delicate nursery areas that spawn many offshore species, which also are sought for commerce and for sport.

The highly-prized marine resources of Texas are finite, and they are in close proximity to activities which, without proper consideration, can degrade their quality and inhibit their productivity. In 1977-78, five Sea Grant researchers reviewed some of the effects of human activity in the coastal area through projects dealing with oil spills, organic and chemical pollution and marine pathogens.

Among these scientists is civil engineer Roy Hann, Jr., who has received Sea Grant funding since the program's inception at Texas A&M to study problems related to environmental quality and protection.

"Sometimes the problems we deal with in this area are not yet perceived as problems by most people, and I believe that demonstrating a reason for concern is an important function we perform. In almost every case, our Sea Grant-funded projects have resulted in major programs that now are being carried out nationally and internationally."

Since the early 1970's, awareness of the delicate yet abundant resources in the ocean has evolved and guided the thinking and actions of people toward their presence in the coastal zone, Hann says.

"People began to realize that we had the power to change the environment so that it no longer would be the same. In our quest to use the resources of the ocean, we were beginning to understand the difference between environmental modification and environmental pollution," he recalls.

As an example, Hann cites early studies of ocean dumping which helped to broaden the focus of concern for water quality from fresh water to include salt water resources. Industries previously had been relegated to coastal areas with the idea that this environment could handle their waste disposal. Research in the last ten years through Sea Grant and other programs, Hann says, has revealed that, in fact, some marine systems have been overloaded by 20 times their capacity.

These and similar realizations in such matters as oil spills, the transport of hazardous materials and the impacts of deep-water ports not only have led to legislation and management policies, but also to development of research and training programs, all of which reflect a new environmental attitude. The quality of the environment has become a design parameter in planning resource use, just as safety and energy conservation have, Hann notes.

Nonetheless, frontiers remain, he states, particularly in regard to sharing with other countries the policies and procedures that have been effective protectors of the environment in this nation.

"We're beginning to change things in the United States; we're fazing out ocean dumping and getting better oil spill control laws. However, we've got to realize that, with the sea, it's a worldwide situation, and that there are countries which are going to cycle through the same problems we are dealing with," Hann says.

Oil spill control exempifies the kind of problem that needs worldwide exchange, since few countries have developed the skills to prevent, respond to or correct these accidents, Hann states. Texas researchers, who have studied spills in light of the Gulf's offshore industries, believe that training in such techniques as tanker design, construction and operation is important because it represents a preventive rather than corrective approach.

Hann believes that, despite changes in attitude, policy and attention given to environmental matters in this country, some problems which appear to be resolved in fact remain unsolved. In many cases, he says, policymakers have assuaged environmental outcry by stemming the growth of a situation rather than actually correcting it.

"As our technology improves, the ramifications become more and more sophisticated, and I think it's going to turn out that there are problems which still exist, even though, in the public's eye, they have gone away.

"We are going to have to go back and recycle our solutions and refocus with a more reasonable approach," he suggests.

Review of solutions will be necessary, Hann says, because many alternatives developed in response to the ecology movement were formulated before the energy crisis of this decade, with the idea that energy was inexpensive. Future solutions will have to consider not only environmental quality and protection, but also the costs and resources required in securing these assets.

"We have a great potential in Texas for guarding the quality of the marine environment, and I believe much positive action can be taken. The objectives of Sea Grant-funded efforts in this area include a desire not only to develop ways to do this, but also to inspire environmental awareness in the citizens of the state."

Susceptibility of Texas Beaches to Spilled Oil, Roy Hann, Jr., Department of Civil Engineering, Texas A&M University, College Station, TX 77843.

The proliferation of offshore energy activities in the Gulf of Mexico presents a threat to the Texas coast in the form of oil spills and subsequent environment-fouling slicks. Several levels of investigation in this project collectively focused on the potential susceptibility of Texas beaches to oil spills. To evaluate the characteristics of Texas beach sands, a sampling program was carried out that examined sand size, distribution, trafficability, compaction and slope. In addition, oil/water emulsions were created in the laboratory in an effort to develop field methods for breaking down these mixtures. The techniques generated had immediate application when project members were asked to assist during the Amoco Cadiz oil spill off the coast of France.

Inventory, Movement and Behavior of Organic Pollutants in Commercial Fisheries Areas of the Texas Coast, C. S. Giam, Department of Chemistry, Texas A&M University, College Station, TX 77843.

One of the state's rich recreational and commercial fishery areas, Galveston Bay, is adjacent to the site of heavy industrial, chemical and petrochemical development. Little is known about certain effects of these activities on marine biota. By developing a systematic scheme for identifying and classifying organic contaminants in environmental samples, project researchers were able to inventory organic pollutants in different components of the Galveston Bay estuary. Analyses of water, sediment and biota samples also were used to study the distribution, behavior and fate of more abundant and persistent contaminants and led to the most detailed information currently available about the presence of pollutants in the Bay.

Accumulation and Transfer of Nutrients and Selenium in an Estuarine System, Jerry Neff, Department of Biology, Texas A&M University, College Station, TX 77843.

The chemical element selenium, extremely toxic to higher animals including humans, exists in Texas coastal and estuarine waters at higher than EPA-proposed levels. Little is known about its toxicity and sublethal biological effects to marine plants and animals, or about its potential for biomagnification in estuarine food chains to concentrations which ultimately could be hazardous to consumers of fishery products. The ground work was laid this year for the study of these interactions, from which the potential impact of selenium pollution on the Texas coastal ecosystem and on commercial fisheries species from this area can be assessed.

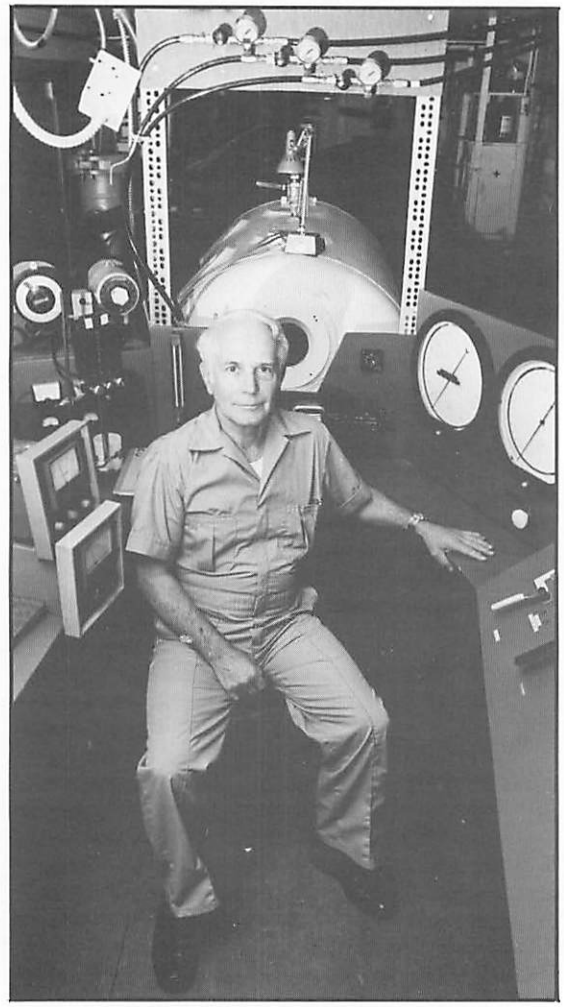
Accumulation, Transport and Environmental Aspects of Selenium in an Estuarine System, Frank Slowey, Department of Civil Engineering, Texas A&M University, College Station, TX 77843.

Efforts to understand the chemical behavior of selenium in an estuarine system are yielding data which ultimately can be used by local, state and federal agencies to assess the environmental consequences of selenium introduction into Texas coastal waters from sulphur mining and transportation. Laboratory studies during this project evaluated various analytical methods for determining Se in water and sediment samples. Field sampling along a 34-mile stretch of the San Bernard River provided information about the actual levels, locations and elemental forms of selenium in one estuarine system.

The Role of Sediments in the Distribution and Survival of Enteric Viruses in the Estuarine Environment, Joseph Melnick, Department of Virology and Epidemiology, Baylor College of Medicine, Houston, TX 77030.

Public health agencies and groups concerned with marine water quality management are among those who will benefit from new and improved techniques for quantitating viruses in marine and estuarine waters and sediments developed as part of this project. Such methodology is valuable due to the potential of water-borne and shellfish-transmitted hepatitis and gastroenteritis, caused by the presence of human enteric viral pollution in marine areas open to commercial and recreational use.

Research promotes health and safety in and near the sea



The University's Hyperbaric Facility takes on a futuristic appearance. William Fife heads Sea Grant-supported diving studies which are examining, among other things, the effects of diving on pregnant women.

Each year, several projects funded by the Texas A&M Sea Grant Program focus directly on the health and safety of people who live and work in the coastal zone.

The safety of those who dive—for recreation, for science or for a living—has been the subject of several studies over the last ten years in Sea Grant. The value of diving technology and research to marine understanding is recognized not only because of the growing number of all types of divers, but also because diving has become inextricably bound to the nation's future use and reclamation of marine resources.

Texas A&M physiologist William Fife has fathered most of the University's compressed air diving research, which has been directed toward understanding the effects of a high pressure (hyperbaric) environment on human physiology as well as determining procedures for working safely under water.

"As an important contributor to the offshore energy business, the commercial diving industry has needs for technology and human physiological data which are pressing and complex," Fife states. "In addition, scientists are using scuba in their research much more frequently now, and the number of recreational divers is growing anually."

"Our research has been geared to the problems—which are not always concentric—of each of these groups, in an attempt to make their diving operations safe and efficient."

Fife's work has been conducted primarily at the Texas A&M Hyperbaric Laboratory he established and maintains with support from Sea Grant and several other state and federal organizations. Equipped with a number of high-pressure chambers for animal and University-approved human tests, the facilities also are available for the treatment of scuba and commercial diving accidents as well as several non-diving maladies.

The Sea Grant Program became involved in diving concerns at Texas A&M ten years ago when Fife was asked by campus administrators to develop and oversee the University's sport diving program, which at that time was poorly-equipped and informally-administered. With Sea Grant support, he outfitted a diving locker and co-authored a scuba safety manual that set forth University policy and procedures for recreational training and scientific operations.

Since 1971, Fife has focused his Sea Grant-funded research on problems in scientific and commercial diving. His initial efforts were linked to the nationwide interest in underwater habitats, particularly the Hydrolab habitat, and one of the physiological effects, oxygen poisoning, on people who spend two and four weeks living on the seabed.

"Based on early studies of oxygen toxicity, which, in the habitat situation, manifests itself as pulmonary deterioration from breathing compressed air at higher-than-normal levels for long periods, the Hydrolab was limited in depth to 45 feet of sea water. People believed this was the maximum safe depth for human work and occupation, but, unfortunately, this was not deep enough for some scien-

tists to conduct the marine research they wanted to do," Fife recalls.

"I visited the project to conduct respiratory measurements on some of the scientists living in Hydrolab and found that people were having no long-term or irreversible deterioration of pulmonary function."

During the following year, Sea Grant supported Fife's additional research on animals, which ultimately demonstrated that 60 feet was an acceptable depth for habitat placement on the ocean floor. In 1973, he returned with his own crew to Hydrolab, which had been lowered to the deeper depth, to live for ten days in the habitat and conduct final tests.

Industry needs since the mid-1970's have evolved rapidly with the accelerated search for offshore energy resources. Most large commercial diving firms support their own hyperbaric research, a capability smaller companies usually cannot afford; and all firms are very covert about their individual diving procedures.

What companies lack, Fife says, is the ability to conduct long-term studies that often are needed to discern complex patterns of human response to the hyperbaric environment. He believes Sea Grant researchers nationwide can aid industry in such problems, and during the last five years, he has supported this aim by responding to specific needs of and requests from the commercial diving industry.

Among the projects he has fostered is the development of breathing mixtures for diving which are different from the normal gas composition of the air we breathe—78 percent nitrogen/21 percent oxygen. Hydrogen is supplanted as the primary component, which helps to allay nitrogen narcosis, a hazardous syndrome of deep diving on compressed air. Fife has logged over 6,000 hours of "hydrox" exposure in animals ranging from mice to man, at depths up to 1,000 feet. Sea Grant supported all of the human studies, he states.

The Texas A&M program also has supported Fife's efforts to improve decompression tables, which are the schedules that determine how long a diver must spend during his return to the surface, reversing the physiological effects of having been under water.

"Our development of decompression tables using deep decompression stops has opened up several new possibilities," Fife says. "Among other things, they permit shorter decompression from dives to around 400 feet. We also have developed tables for mixed gas breathing supplies to depths of 1,000 feet."

"Tables generated by our group are now in regular use by several diving companies operating in the Gulf and by at least one international company."

Sport diving compression tables have proved to be safe in most recreational situations. But, of greater interest and importance, Fife states, is the possibility that standard sport diving tables, which use as a prototype a young, lean, healthy male, may not be ideal when applied to female physiology.

The increasing number of women divers in the nation has prompted Fife to investigate several aspects of their involvement. He used Sea Grant support this year to investigate a particularly pressing problem concerning women divers: the potential susceptibility of an unborn infant to decompression sickness during or after a dive.

Preliminary findings of research conducted on pregnant sheep have indicated that at certain depths and durations which do not yield symptoms in the mother and which normally are safe for humans, the unborn infant appears to be more susceptible to decompression sickness than its diving mother.

"For various reasons, we can extrapolate sheep data to humans, and because adult sheep are known to be less susceptible than adult humans, these results are rather alarming. In my pinion, until we have additional information, a pregnant woman should not dive."

"In the next few years, I believe people are going to find out precisely what happens in the movement of gas into and out of body tissues, which is the crux of our understanding many problems of diving. With this information, we will be able to develop safer, more efficient procedures for all members of the diving community."

Development of New Concepts for Marine Diving, William Fife, Department of Biology, Texas A&M University, College Station, TX 77843.

The primary focus of this multi-faceted research program was fetal susceptibility to decompression sickness. Pregnant sheep were used as a model since ewes have a placenta which is similar in hemodynamics to that of humans, thus permitting extrapolation of research data to women. Findings indicated that an unborn child may be more susceptible to decompression sickness than its diving mother. Additional research was conducted to develop a technique for evaluating oxygen toxicity in animals and to determine the feasibility of developing air-diving tables with long bottom times.

Hurricane Response Model, Carlton Ruch, Industrial Economics Research Division, Texas A&M University, College Station, TX 77843.

Questionnaires, interviews, meetings and a literature and research review were among the data-gathering techniques used during the first year of this two-year project on the variables affecting human response to hurricane information and warnings. Researchers are developing information that can be used in public education programs to maximize safety and minimize loss of life during Gulf Coast hurricanes.

Marine Information Service helps bridge the gap

The Marine Information Service staff (l-r): KC Smith, Gisela Mahoney, Pat Sadberry, Laura Colunga and Dorothy Holtkamp (seated). MIS produces a variety of types of publications which result from Sea Grant-supported work.

Research projects usually result in reports; advisory agents distribute publications on a myriad of topics; teachers need curriculum guides and reference materials; scientists and specialists need publicity for workshops and programs. Who produces the reports, publications, educational materials, posters, brochures and other documents that are necessary to the research, education and advisory efforts of a Sea Grant program?

At Texas A&M, it is the Marine Information Service, a team of writers and editors, who provide these information and publication services. Not trained scientists, but rather professional communicators, the staff of the Marine Information Service (MIS) helps bridge the gap between researcher and user.

Originally called the Department of Marine Resources Information, MIS was formally organized within the Texas A&M Sea Grant College Program in 1970. Laura Colunga, managing editor, has been with the program for six of its eight years.

"Our primary job is to take the results of Sea Grant-supported research and make them understandable and available to the people who need the information," says Colunga. "Part of this process involves deciding on the form in which the information will be presented—a technical report, an advisory bulletin, a newspaper article, magazine feature story or fact sheet."

"This decision, and almost every other decision made about a publication as it is produced, is dependent on one question: 'Who is the audience?'," she says. "Scientists are accustomed to talking to other scientists; they have a language of their own. This language is not always understandable to the average person, like a fisherman or small businessman."

The job of the MIS editors, Colunga says, is to help the author of a publication identify the audience for his or her publication, and slant the language and appearance of the final product to that audience, or user group.

"Sea Grant is primarily a program of applied research, so it usually is not difficult to identify the group of people who need the results, be they seafood processors, marina operators, diving contractors, or just people who like to go to the beach."

The Marine Information Service regularly produces technical reports, conference proceedings, advisory bulletins, educational materials, feature articles and news releases, posters and brochures. Assistance is provided to Sea Grant project leaders and personnel in constructing exhibits and obtaining photographs and graphic materials for presentations.

The MIS staff constructs and helps run an exhibit about Texas A&M Sea Grant's marine advisory service to industry each year at the Offshore Technology Conference in Houston. Billed as the world's largest trade show, OTC last year attracted some 70,000 people from all over the world who are involved in some aspect of the offshore industry.

During 1977-78, MIS began handling the distribution of reprints of journal articles generated with Sea Grant support. Also, a system of peer review was initiated for technical reports submitted to the Sea Grant Office for publication.

"By encouraging the investigators to publish their results in professional journals, the information will be made known to other scientists in the field and will receive wider distribution than if it were published by our office," Colunga notes.

"However," she said, "we will continue to publish some manuscripts, such as long, detailed reports, which are not appropriate for journals. The new system of peer review will assure their accuracy and usefulness."

The Marine Information Service also publishes two periodicals—"The University and the Sea," and "Texas Trawler."

A bi-monthly, 8- to 12-page magazine, "The University and the Sea" is distributed free to approximately 7,000 persons, inside and out-

side of Texas. It is written for a general audience, and contains feature and news articles about Sea Grant-supported research and activities and other marine-related work at Texas A&M.

"Texas Trawler" is a bi-monthly newsletter for those involved in all aspects of the state's fishing industry—fishermen, seafood processors, retailers and wholesalers. It is sent without charge to approximately 5,000 people, mostly in Texas.

Tips, techniques and "how to do it" information are provided in advisory publications on topics ranging from "Fishing the Texas Coast" to "Protection for Small Craft Marinas" to "Maritime Law and the Small Boatowner."

A listing of selected publications produced during 1977-78 is included below. These, and all Texas A&M Sea Grant publications may be ordered from the Sea Grant College Program, Texas A&M University, College Station, Texas 77843. Checks should be made payable to Texas A&M University. When "no charge" is indicated, one to ten copies are free, 11 to 25 are $1 each, and more than 25 are 50 cents each.

Selected Publications

Advisory Services

Marine Advisory Service to Industry, TAMU-SG-78-109, no charge.

Maritime Law and the Small Boatowner, *Leonard C. Jacques*, TAMU-SG-78-501, no charge.

Education

Aquatic Science/Marine Biology 4-H Member Guide, *Debbie Lightfoot* and *James Davis*, TAMU-SG-78-402, no charge.

Day on the Bay Lab Book, *Sarah Meyland*, TAMU-SG-78-401, no longer available.

Fourth Student Conference on Marine Affairs, *KC Smith* (editor), TAMU-SG-78-502, no charge.

Environmental Quality

Environmental Considerations Relative to Operation and Maintenance of the Texas Gulf Intracoastal Waterway, *Wesley P. James, Steven Giesler, Robert DeOtte* and *Masamichi Inoue*, TAMU-SG-78-204, $5.

Environmental Management of a Ship Channel-Harbor Complex, *Marvin William Reavis* and *Roy W. Hann, Jr.*, TAMU-SG-78-202, $4.

Strategic Petroleum Reserve Project, *J. C. H. Mungal* and *W. P. James*, TAMU-SG-78-206, no charge.

Supplemental Aeration System Design for the Houston Ship Channel, *Thomas Wayne Hoskings, Tom D. Reynolds* and *Roy W. Hann, Jr.*, TAMU-SG-78-201, $5.

Technical and Philosophical Aspects of Ocean Disposal, *Marchi C. Zapatka* and *Roy W. Hann, Jr.*, TAMU-SG-78-203, $4.

Fisheries

Abstracts of the Third Annual Tropical and Subtropical Fisheries Technological Conference of the Americas, *Ranzell Nickelson II* (compiler), TAMU-SG-78-107, no charge.

Economic and Production Aspects of the Gulf of Mexico Shrimp Fishery, *John P. Nichols, Wade L. Griffin* and *Vito Blomo*, TAMU-SG-78-801, $1.

Proceedings of the Second Annual Tropical and Subtropical Fisheries Technological Conference of the Americas, *Ranzell Nickelson II* (compiler), TAMU-SG-78-101, $10.

Sea Grant Program

Publications Policies and Procedures/Sea Grant College Program, TAMU-SG-78-601, no charge.

Readership Study of Sea Grant '70s, *Samuel Gillespie*, TAMU-SG-78-205, no charge.

Sea Grant Publications/7, TAMU-SG-78-604, no charge.

Sea Grant Publications/8, TAMU-SG-78-605, no charge.

Texas A&M University Sea Grant College Program 1975-76 and 1976-77, *Laura Colunga* (editor), TAMU-SG-78-106, no charge.

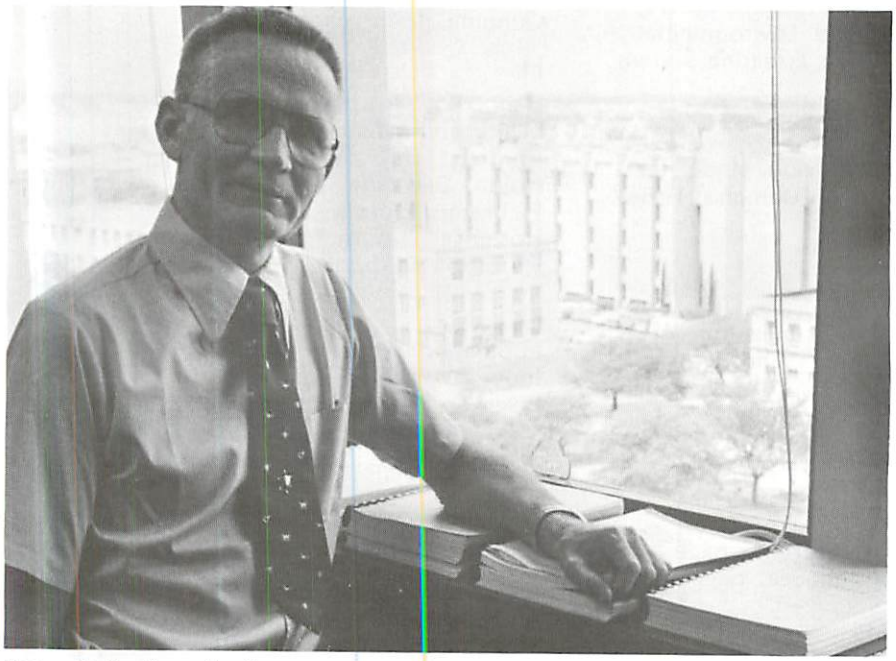
Shoreline Processes

Characteristics of Coral and Coral Dredging, *B. R. Schlapak* and *John B. Herbich*,TAMU-SG-78-207, $5.

Program summary

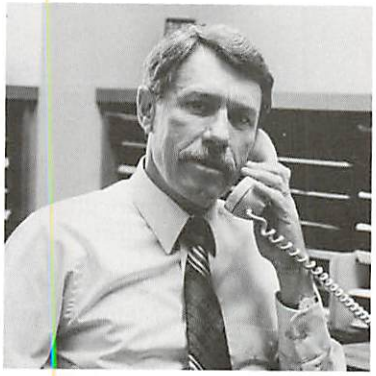
Education and Training	Year Begun	Year Completed
Training for Nautical Archaeology, *George F. Bass*	1977-78	1977-78
Development of Modular Instruction Units in Oceanic and Marine Technology, *John Gunning*	1977-78	1977-78
Marine Resources Reference Center, *James DeShaw*	1977-78	Continuing
Children's Literature of the Sea, *David Stewart*	1977-78	Continuing
Future-Oriented Marine Resources Mini-Semester for Secondary Schools, *Delmar Janke*	1977-78	Continuing
The Day on the Bay, *Sarah Meyland*	1977-78	1977-78
Marine Advisory Services		
Marine Fisheries and General Extension, *Wallace Klussmann*	1968-69	Continuing
Marine Information Services		
Marine Information Services, *Laura Colunga*	1969-70	Continuing
Mariculture Research		
Shrimp Mariculture Systems, *Jack Parker*	1968-69	Continuing
Natural and Induced Maturation in Penaeid Shrimp, *Robert Brick*	1977-78	1977-78
Steroid and Fatty Acids in Crustacean Mariculture, *Brian S. Middleditch*	1977-78	Continuing
Nutritional and Biochemical Studies Concerned With Penaeid Shrimp Mariculture, *Addison L. Lawrence*	1977-78	1978-79
Systems Analysis of Shrimp Mariculture, *Vincent Sweat*	1977-78	Continuing
Studies on Larval Development and Growth in Penaeid Shrimp, *John H. Wormuth*	1977-78	1977-78
Fisheries and Product Development Research		
Application of the Beverton-Holt Model for Assessing Fishing Effects on Demersal Fishes, *Mark Chittenden*	1977-78	1977-78
Early Life Histories of Spanish and King Mackerel in Gulf of Mexico, *John McEachran*	1977-78	1977-78
Economics of Production and Marketing in the Commercial Fish Industry, *Wade Griffin* and *John Nichols*	1977-78	Continuing
Wholesomeness and Safety of Fish and Shellfish, *Carl Vanderzant*	1977-78	Continuing
Economics of Commercial Shrimp Mariculture, *Wade Griffin*	1977-78	1978-79
Shoreline Processes and Protection Research		
Biological Application for Stabilization of Dredged Material—Corpus Christi Area, *Carl Oppenheimer*	1977-78	Continuing
Wave Data Bank for Texas Coast, *John Herbich*	1977-78	Continuing
Calculation of Gulf Coast Wind-Driven Currents, *Chris Mungall*	1977-78	1977-78
Developing New Techniques to Survey Chemical Variations in Coastal Waters, *David Schink*	1977-78	1977-78
Wind/Wave Interactions and Their Effects on Offshore Structures, *David J. Norton*	1977-78	1978-79
Environmental Quality and Protection Research		
Inventory, Movement and Behavior of Organic Pollutants in Commercial Fisheries Areas of the Texas Coast, *C. S. Giam*	1977-78	Continuing
Accumulation and Transfer of Nutrients and Selenium in an Estuarine System, *Jerry Neff*	1977-78	Continuing
Accumulation, Transport and Environmental Aspects of Selenium in an Estuarine System, *Frank Slowey*	1977-78	1977-78
The Role of Sediments in the Distribution and Survival of Enteric Viruses in the Estuarine Environment, *Joseph Melnick*	1977-78	1977-78
Susceptibility of Texas Beaches to Spilled Oil, *Roy W. Hann*	1977-78	1977-78
Health and Safety		
Development of New Concepts for Marine Diving, *William Fife*	1977-78	Continuing
Hurricane Response Model, *Carlton Ruch*	1977-78	1978-79

Program management



Feenan D. Jennings, director

Willis H. Clark
associate director



J. Allen Martin
fiscal officer

Lauriston R. King
deputy director

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