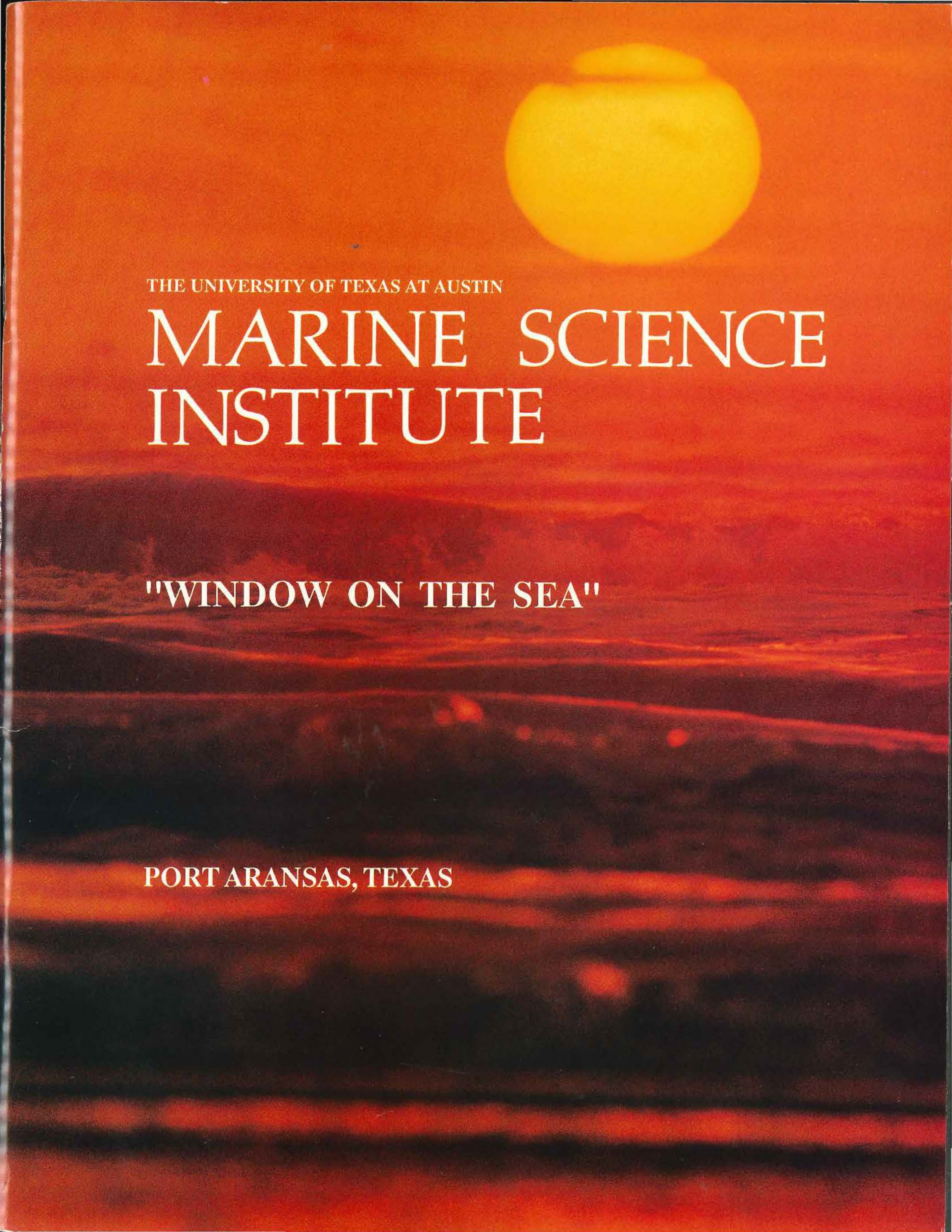


THE UNIVERSITY OF TEXAS AT AUSTIN

MARINE SCIENCE INSTITUTE

"WINDOW ON THE SEA"

PORT ARANSAS, TEXAS

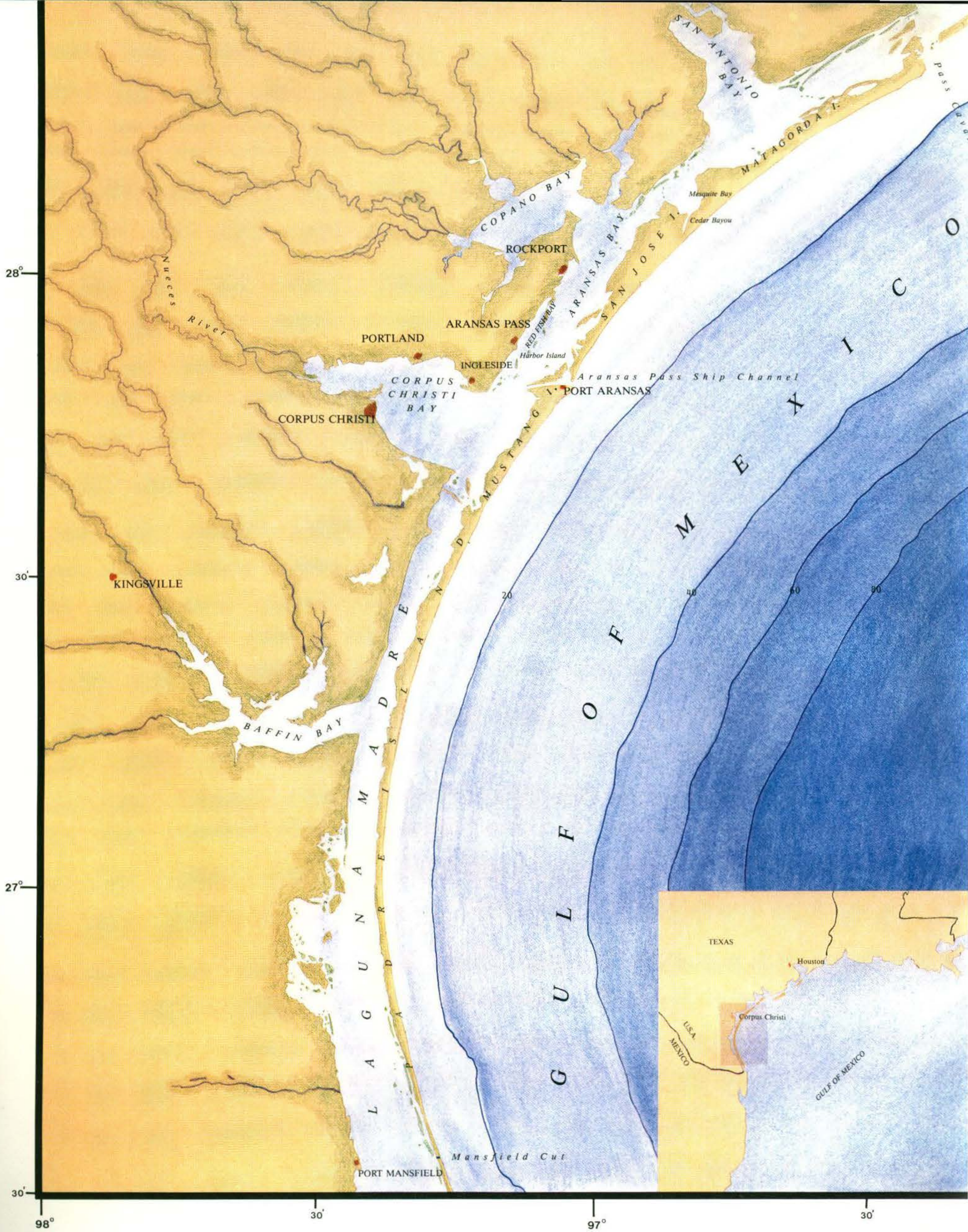

LONGHORN
THE UNIVERSITY of TEXAS

The University of Texas at Austin

MARINE SCIENCE INSTITUTE

Port Aransas, Texas

"Window on the Sea"


SAN ANTONIO BAY
MATAGORDA I.
Pass Cavallo
COPANO BAY
Mesquite Bay
Cedar Bayou
ROCKPORT
ARANSAS BAY
SAN JOSE I.
Nueces River
ARANSAS PASS
RED FISH BAY
PORTLAND
Harbor Island
INGLESIDE
Aransas Pass Ship Channel
CORPUS CHRISTI BAY
PORT ARANSAS
CORPUS CHRISTI
MUSTANG I.
GULF OF MEXICO
KINGSVILLE
20
40
60
80
PADRE ISLAND
LAGUNA MADRE
BAFFIN BAY
Mansfield Cut
PORT MANSFIELD
TEXAS
Houston
Corpus Christi
U.S.A.
MEXICO
GULF OF MEXICO
28°
30'
27°
30'
98°
30'
97°
30'

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A Message from the Director...

The Marine Science Institute, located on a coastal barrier island in the city of Port Aransas, Texas, is an organized research unit of The University of Texas at Austin. It serves as a *"window on the sea"* for the university and other cooperating institutions.

Our primary purpose is to provide both educational and research opportunities in the vital Texas coastal zone. It is an area that has thrived through the years on gas, oil, marine transportation and commercial fishing activities. In the coming decades, we expect to see the recreational tourist industry in the Coastal Bend develop into a major component of the State's economy. The health of the coastal zone ecosystem continues to be one of the major concerns of this laboratory and its scientists and graduate students. Through basic and applied research, we have the responsibility of providing an information base on the organisms and processes that comprise this valuable asset.

As the number of residents and visitors increases exponentially in the coastal zone, many questions arise and must be answered if we are to provide for wise use and management of our priceless resources. Our researchers seek answers through their projects on everything from fish-farming to the effects of toxins on the reproductive physiology of marine animals. Many questions arise in the strangest ways. A chef concocts a new recipe and suddenly one of our important commercial and recreational fish species is in a population decline. Mariculture may provide a way of relieving pressure on the natural populations of this species. On the other hand, a scientist working in his lab on the complex biochemistry of calcium deposition in the shells of crustaceans might make a discovery that leads to a way to induce moulting in an important crab species. As so often happens in science, something begins in the laboratory out of scientific curiosity and a strong urge to understand a process, and ends up as a commercial success.

There are also coastal problems that have state-wide implications. South Texas does not have an overabundance of surface freshwater. Much of our river runoff is managed in reservoirs and used for agriculture, manufacturing, and by our cities. This same water has flowed for many eons to the bays and estuaries. What are the consequences of restricting or denying that input to the coastal ecosystem? We often work with sister-agencies such as the Texas Water Development Board to answer these kind of questions.

The staff of the Institute includes faculty, research scientists, support personnel, and research vessel crews. Our funding comes from both State appropriations and numerous grants and contracts awarded to our scientists through a competitive process (for example, National Science Foundation, National Institutes of Health, Environmental Protection Agency, Minerals Management Service, and National Oceanic & Atmospheric Administration). The existence of the Marine Science Institute is made possible by the generous support of both the executive and legislative branches of our Texas State Government, The University of Texas System Board of Regents, The University of Texas at Austin, and you–the taxpayers of the State of Texas and our Nation. The outstanding physical plant and sophisticated equipment would not otherwise exist to make possible the conduct of important research work.

The "bottom line" of our work is represented by the publication of research results in peer-reviewed scientific journals. In this way our scientists and students of yesterday, today, and tomorrow provide a legacy for the Marine Science Institute that contributes in a meaningful way to mankind's knowledge and understanding of his environment.

The brochure will introduce you to the Institute, its facilities, some of its primary research initiatives, and the environmental setting. It is intended to reach both the scientist and the layman and to answer questions about the Institute. More detailed information on our scientists and their programs and publications, student theses and dissertations, and technical reports, are published periodically and available upon request.

If you have not already done so, visit the Marine Science Institute. It does not matter whether you are a student, a visiting scientist, or a vacationer, we want to share our facility and knowledge with all of you.

Robert S. Jones
Director

...RECOGNIZING A NEED

Nine years after the University of Texas opened its doors in 1883, the need for marine research and education was recognized. On December 23, 1892, the Board of Regents reported to Governor Jim Hogg that,

> *"The coast of the great State of Texas, washed by the tides and currents of the magnificent inland sea, the Gulf of Mexico, offers unrivaled opportunity for the establishment of a Marine Station. Strange animals and plants, a fauna and flora little known, invite the research of the student and investigator."*

The statement is as appropriate today as it was in 1892.

In May of 1900, the Board of Regents appropriated $300 for a marine laboratory in the University Medical School at Galveston, and the first "class" of five students began to study the littoral and shallow water fauna in the Galveston area. A few months later, the disastrous 1900 hurricane all but destroyed the marine laboratory's research vessel, a steam launch donated by Regent George W. Brackenridge. The launch's conversion had already consumed most of the $300.

Fifteen years later, Regent Brackenridge offered his 114-ft schooner, the NAVIDAD, to the University. It was to be the nucleus of a grand Gulf Biological Station. The gift of the NAVIDAD, together with $500 for its conversion to a working vessel, was accepted by the Board of Regents in April 1915. Before the NAVIDAD could go into service, a tropical storm in August caused such damage to the vessel that a decision was made to sell it.

Interest in setting up a marine station was at a low point when zoologist Dr. Elmer J. Lund came to Port Aransas to investigate a massive fish kill in 1935. He and an associate constructed a small, rough lumber one-room shack on the old Corps of Engineers dock at Port Aransas.

Dr. Elmer J. Lund, Director from 1941-1949

Dr. Lund recognized the uniqueness of the local environment and the need for public education about the natural resources of the Gulf of Mexico and gradually succeeded in rekindling interest in marine science at the University. Early in 1940 he discussed plans with the Mayor of Port Aransas, Boone Walker, who responded by offering the University a ten-acre tract of his own property as a site for the proposed Biological Laboratory. The land fronted on the pass at Port Aransas, immediately adjacent to the Government Reservation on the northern tip of Mustang Island.

The Marine Science Institute was founded by the University in 1941 with Dr. Lund as its first director. World War II postponed plans for a permanent facility, but research was begun in an old pier building. Among the Institute's first projects was an investigation of the distribution, life history and relative abundance of marine fishes of Texas, completed by Dr. Lund and Dr. Gordon Gunter, who undertook a study for the U.S. Navy on the problem of fouling on ship's bottoms. Dr. Lund also began an extensive collection of books on oceanography which became the basis of the Institute's library.

With the end of the war, the development of the Institute was resumed. Dr. Lund purchased approximately 12 acres of land from the Army Corps of Engineers and donated the property to the University. The property included a building constructed in the 1890's which had survived the 1919 hurricane. This building has been remodeled several times and still survives as a dormitory. Dr. Lund spent much of his own time hauling supplies, equipment and materials and supervising the construction of the Institute. By 1945, a graduate education program was underway. That year Dr. Lund accomplished another long-term goal by publishing the first issue of a scientific journal called *Publications of the Institute of Marine Science*. This journal, published on an occasional basis for several years before it was renamed *Contributions in Marine Science*, continues today as a yearly publication of the Institute.

After the war, two frame buildings (still in use as cafeteria and dormitory) were constructed, as well as a 200-foot dock extending into the Aransas Pass. A lab was built on the pier in 1948 with funding from the Texas A&M Research Foundation. In 1961, a major expansion phase was completed, including the first concrete-and-steel laboratory complex, as well as a boat house, boat docks, seawater ponds and other outdoor structures. With the acquisition in 1963 of another 49 acres of adjacent land, the Board of Regents authorized a further three-million dollar expansion, including additional laboratories and a 5.25 acre boat basin, finished in 1973.

When Hurricane Celia hit Port Aransas in August 1970 the Institute's primary research vessel at that time, the MARCIA K, was destroyed. The severely damaged 40-ft LORENE was rebuilt from the waterline up. Within a year the steel-hulled research vessel, LONGHORN, became the Institute's flagship. Originally an 80-ft vessel, she was lengthened to 105-ft in 1985-86 and substantially refitted. Laboratory and dormitory wings as well as an eight-unit apartment house for graduate students were added in 1974, followed by a physical plant maintenance complex. In 1975, the Institute became the Port Aransas Marine Laboratory and joined with the newly-formed Galveston Geophysical Laboratory to become the Marine Science Institute, affiliated with a Department of Marine Studies in Austin and with a central directorate on the main campus. In 1977, the Institute assumed operation of the National Marine Fisheries Service Laboratory also in Port Aransas.

The latest building complex, completed in 1983, comprises an auditorium, meeting rooms, library, and visitors center with indoor aquaria. Following the creation in 1984 of the Institute for Geophysics in Austin, which incorporated the Galveston Geophysical Laboratory, the Port Aransas facility once again became the sole location of the University's Marine Science Institute.

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In 1935, Dr. Lund was unaware that the fish-kill was caused by a "red tide", yet he stated, "Provision of an adequately equipped Marine Laboratory is the first and only effective means to an answer to this and all similar questions relating to animal and plant life in the Gulf." It took 50 years for another red tide to hit the area. This time, thanks to his pioneering work, there was a fully equipped Marine Science Institute from which researchers were able to study the culprit: the dinoflagellate, *Ptychodiscus brevis*.

...RESOURCES

Facilities

The Institute's 83,000 sq.ft. headquarters on 72 acres of beachfront land consists of a series of interconnected buildings containing laboratories, offices, library, museum, exhibit halls, classrooms, a visitors center, auditorium, seminar rooms, a student recreation room, and workshops. The two- and three-story buildings overlook the Gulf of Mexico and the Aransas Pass. Landscaped grounds border vegetated dunes leading to a popular sandy beach and the south jetty of the Aransas Pass. Tankers, freighters, shrimpboats, workboats and pleasure craft make this the busiest pass in South Texas. Fishermen use the stone jetty and campers use the nearby state park and beach.

All laboratories are air-conditioned and supplied with air, natural gas, deionized water and filtered seawater, and have approved chemical waste-disposal facilities. A 10,000 sq.ft. wet-laboratory is supplied with filtered running seawater and numerous large fiberglass tanks which can be configured for a variety of experiments on marine organisms. An additional 7,000 sq.ft. of wet lab, set up for fish studies, contains four 12-ft. diameter (4,000-gallon), four 10-ft. diameter (2,900-gallon), and eight 8-ft. diameter (1,800-gallon) tanks. Teaching and research laboratories have smaller tanks where specimens of locally collected plants and animals can be studied. Other buildings on the grounds of the Institute's headquarters include 9,500 sq.ft. of dormitories (70 beds), a cafeteria, physical plant complex, garages, greenhouses, walk-in freezer, and several outdoor and indoor pool/habitat tanks and 300-gallon raceways. One outdoor pool (44 x 20 x 4-ft. deep) is used to temporarily hold dolphins and small whales that periodically strand themselves on our beaches. The pools, laboratories and wet laboratory are supplied with seawater pumped in from the adjacent Aransas Pass and clarified in two large, covered stilling tanks. A five-acre boat basin/marina provides quick access for our research vessels to both the bay systems and the Gulf of Mexico, making day trips to both environments feasible and practical. Direct access to Gulf and bay waters is provided at the Pier Laboratory, a well-equipped facility at the end of a pier projecting 200 ft. into the Aransas Pass. A tide-trap at the pier lab and facilities for sampling the pass around the clock give researcher, student and visiting classes opportunities to study many aspects of tidal exchange processes.

A mile west of the main building complex, the mariculture facility occupies 26,000 sq.ft. of buildings on 10 acres next to the ship channel. This federal facility is operated by the Institute under a no-cost lease from the National Marine Fisheries Service.

Sharing the space with Texas A&M University, the mariculture program has created a center for this evolving field. Laboratories include four that can be controlled for temperature and photoperiod; others for stress-work in fish, larval and postlarval experiments, food-diet preparation and tropical fish rearing. Four closed system raceways, a 4,500 sq.ft. greenhouse and five indoor tanks, each 20 x 10 x 5 ft. holding 7,500 gallons of water, make up the spawning and rearing tanks. A 17,000-gallon square tank, 7,000-gallon circular tank, eight 4,000-gallon, four 2,500-gallon, five 300-gallon rectangular tanks, over two dozen 90-gallon, about thirty 50-gallon tanks and fifty 20-gallon aquaria complete the holding facilities. Water is pumped in from the ship channel, filtered and recirculated to create the controlled environment. The facility also has offices, computer terminals, a well equipped photographic darkroom with capabilities for color-processing and photocopying equipment.

Outlying buildings (within a mile of the main lab) provide an additional 16,000 sq.ft. and include houses and cottages (plus two tennis courts) as well as student apartments.

Year-round research on feeding and growth of red drum is done in a 4,464 sq.ft. greenhouse, a part of the mariculture facility. Eggs are hatched and raised to the juvenile stage in 20-ft. diameter tanks. Juveniles are then transferred to 50-ft. raceways for further study.

Laboratory Equipment

Laboratories are outfitted with balances, ovens, freezers, refrigerators, fume-hoods and the usual chemical glassware apparatus. There are microscopes ranging from simple binocular to large transmitted-light research microscopes with Nemarski and epifluorescence illumination systems and an scanning-electron microscope. There are two photographic darkrooms and two autoclave rooms. Controlled environment rooms and chambers are available for botanical and other experiments where temperature, humidity and light-levels must be varied.

Major equipment includes: atomic absorption spectrophotometer, spectrophotometers, mass spectrometers, infrared spectrophotometer, liquid scintillation spectrometers, emission spectrometer, spectrofluorometer; fluorometers; scintillation counters; CHN analyzer, 6-channel autoanalyzer system, 5-channel colorimeter, sample oxidizers; motion analysis system with dynamic video processor; radiation measuring system; gas chromatographs, HPLC systems, filter fluorometer for HPLC/LC; high vacuum glass lines for cryogenic manipulation of gaseous samples, laminar flow chamber; illuminated incubators, environmental shakers; centrifuges, direct-current blood centrifuge; glucose analyzer, and ultra-low freezers.

Computers

Remote-job-entry terminals in the Institute's computer laboratory provide direct access to the UT-Austin Computation Center's mainframe computer systems. A multipen graphics plotter and printer are for general use. The administrative offices, the library, and most individual laboratories have microcomputer systems, dot-matrix, letter-quality, and laser printers, for word-processing, instrument control, data acquisition, storage and analysis.

Library

The MSI library contains over 8,000 books and 37,000 bound volumes of journals. An on-line computer system provides access to bibliographic and abstract services nationwide. By interlibrary loan, books and journals can be obtained from major state and university libraries. The library is a member of the International Association of Marine Libraries & Information Centers and published the Proceedings for its first conference in 1984. The journal, *Contributions in Marine Science*, has been published since 1945. Through an exchange program with other marine research establishment libraries worldwide, the library regularly receives over 1,200 domestic and foreign journals, making this the most comprehensive collection of its kind on the Gulf coast.

Also housed in the library are historic collections of marine expedition reports, the Smithsonian Institution Bulletins, Fisheries Commission Bulletins, and a complete set of the 46-volume *Phycotheca Borealis Americana*, published from 1895-1919, containing pressed specimens of algae from around the continent. Only 10 complete sets are known to exist. Other items include maps, charts, aerial photographs of the region and a large reprint collection. A donated collection of local historical material (the Beasley Collection) is housed in a separate reading room.

Museum

A reference museum of cataloged specimens was established in the 1950's as a depository for local fauna. Collections made by MSI scientists and donations by individuals have resulted in the accumulation of over 5,000 specimens. The collection includes fishes, crustaceans, mollusks, polychaetes, and plants, all of which are made available for study by scientists upon request.

Research Vessels

The R/V LONGHORN (built 1971) is the largest of the Institute's research vessels. Modified in a major refit in 1986 to give her an overall length of 105 ft, LONGHORN is now 210 tons gross, has a beam of 26 ft and draws 7 ft. Designed specifically for Gulf of Mexico oceanographic research, the steel hulled vessel is modeled after a modern Gulf trawler with outriggers and paravanes ("flop-per stoppers") for added stability in choppy Gulf seas. She has a range of 2,000 nm or 14 days, accommodates up to 12 scientists and carries a crew of four. The LONGHORN has a wet lab, dry (electronics) lab, chartroom, a large fantail working deck area, and twin screws powered by two 12V-71 diesel engines.

Main equipment includes two 35-KW diesel generators; bowthruster; stern "U" frame; trawl-, hydro-, and conducting cable winches; hydraulic powered articulated crane; precision depth recorder; LORAN C navigation systems; gyro-compass; weather system; color radar; and radio-telecommunications gear. Navigation and weather equipment have repeaters in the electronics lab and computer interfaces for real-time data acquisition, using a variety of PC's compatible with those in the labs. Sampling equipment includes a piston corer; conductivity/salinity/depth profiling systems; transmissometer; profiling light sensor; rosette water sampler with 2.5, 5 and 30-liter water-sampling bottles; salinometer; reversing thermometers; various plankton nets; and a 33-ft otter trawl. On-deck incubators, live-boxes, a seawater profiling pump system, current meters and acoustic releases are among other available gear.

The KATY is a 57-ft fiberglass trawler with 16.5-ft beam and bunkspace for six. She is used mainly on day-trips when she can accommodate 25-30 people (usually class trips). KATY has a stern "A" frame and conventional trawl outriggers with stabilizers for roll-dampening. Powered by a single 671 diesel engine and screw, she has a 12-KW generator, a trawl-winch with 26-ft otter trawl, a hydro-winch and a variety of water quality, biological and sediment sampling gear, including a multiparameter profiling system. KATY's draft of 6 ft is ideal for conducting research in the bays, but huge areas of the estuarine systems are too shallow even for KATY. A fleet of smaller boats is used extensively in these waters: two Jefferson Skiffs (24-ft and 21-ft), several smaller Boston Whalers and flatbottomed Johnboats, open up the grass-beds, oyster reefs and shallow embayments to the researcher.

Finally, four-wheel-drive and other vehicles are available to provide access to remote beaches, mudflats, wind-tidal flats and *Spartina* marshes.

The area surrounding the Institute is a natural laboratory providing many opportunities for field research in a wide range of scientific disciplines. Some programs, however, rely heavily on laboratory experiments to investigate aspects of plant and animal biology, or require laboratory analysis of specimens and samples using sophisticated equipment.

Marine Botany

Research work at the Institute in marine botany has focussed on the seagrasses (macrophytes) and phytoplankton (called the "grass of the sea").

Marine Macrophytes

Ongoing research looks at the specialized physiological mechanisms which enable seagrasses and other halophilic (salt-loving) vascular plants to flourish in salt water and marine sediments. The distribution and production of seagrasses in our coastal zone is restricted by several biological, physical and chemical processes: the availability of the mineral nutrients nitrogen, sulphur and trace metals, the mutually beneficial associations between plant roots and microorganisms in the sediments, light availability, turbidity, and temperature and salinity variations.

Seagrass beds are important as nursery grounds for juveniles of many animal species, prompting extensive study of the food-web in this system. Using highly sensitive hydroacoustic equipment to record feeding activity, it has been found that organisms encrusting the seagrass blades (epiphytes), rather than the seagrasses themselves, constitute much of the food resource.

Studies on the carbon isotope ratios of

seagrasses and of the animals that forage amongst them has also increased our knowledge of the food chain in the seagrass community.

Cyanobacteria

The fixation of nitrogen by blue-green algae (Cyanobacteria) such as *Trichodesmium*, in marine environments is increasingly recognized as a major source of the combined nitrogen which is essential for algal photosynthesis and growth. Methods have been sought to develop laboratory cultivation of *Trichodesmium*. Strains of algae isolated at the Institute have been under study as a source of renewable hydrogen. Some researchers consider this common element might be the long-range successor to petroleum. The new strains of *Anabaena* species have high growth and metabolic rates, producing hydrogen at 10 to 20 percent of photosynthetic rates under normal aerobic growth conditions.

Phytoplankton Ecology

Insight into the complex processes in phytoplankton ecology is being gained by field measurements and laboratory experiments. Continuous fluorometry, chlorophyll determinations, carbon-14 primary production incubations and nutrient analyses are made in the field. Algal cultures are grown in laboratory simulations of water columns set up to observe the physiological adjustments phytoplankton make to changes during vertical migration. Also of interest is the role of vertical mixing and associated light-level variation in determining the photosynthesis of phytoplankton. One goal of this research is to mathematically model the processes to estimate rates of vertical mixing in the sea.

Marine Zoology

Animal physiological research is focussed on problems related to an aquatic existence.

Comparative Physiology

Research has centered on the exchange of gases, salts and water with the marine environment and the control of internal pH. Investigations have included studies of the transport and excretion of ammonia, the regulation of carbon dioxide levels in the blood and environmental aspects of oxygen exchange. Both fish and crabs have been subjects for this research. Recently, the process of moulting in the blue crab (*Callinectes sapidus*) has received extensive study. The

Periodic moults of the blue crab, *Callinectes sapidus*, are necessary for the animal to increase in size, and provide a fascinating range of biological problems. The crab in its new shell (top) has left empty the bottom shell. The moulting cycle is a complex process involving light cycle and temperature as well as moulting hormone systems and reproductive state. One recent finding is that while building the new shell after a moult, crabs appear to take up bicarbonate ions directly from seawater at a very high rate. Virtually all of the carbon dioxide produced from metabolism, as well as the bicarbonate from seawater, is put into calcium carbonate that hardens the new shell--a process that takes about two weeks.

formation of a new shell after moulting provides an interesting model for studies of biological calcification.

Along the Texas coast many fish populations experience a wide and variable range of salinities and temperatures in their natural habitats. Laboratory studies in specially designed chambers indicate that estuarine species such as seatrout and drum maintain optimal metabolic efficiencies when freshwater inflows produce estuarine salinities of about 20-25 ppt in the bays. Ideal metabolic conditions are not found during times of natural or man-induced stress. Assessments of optimum conditions are applied in the laboratory to such diverse questions as comparisons of fish size and swimming characteristics, energy efficiency of schooling, the biochemical nature of muscle development and the potential of a species (red drum, for example) as a candidate for mariculture.

Benthic Ecology

The shallow depths of windy Texas bays and estuaries mean that the water is often cloudy with resuspended sediments. This increases the overall importance of processes associated with the benthos. These processes include bacterial degradation of organic matter and nutrient regeneration. Invertebrates living in the sediments stimulate bacterial activity through a "gardening"-like process. Microorganisms are the primary food source for many invertebrates which, in turn, may be eaten by fish and other larger animals. Thus, bacteria are at the base of the benthic food-web. One aspect of research at MSI is aimed at understanding the complex interactions between microorganisms, invertebrates and the benthic environment.

Toxicology

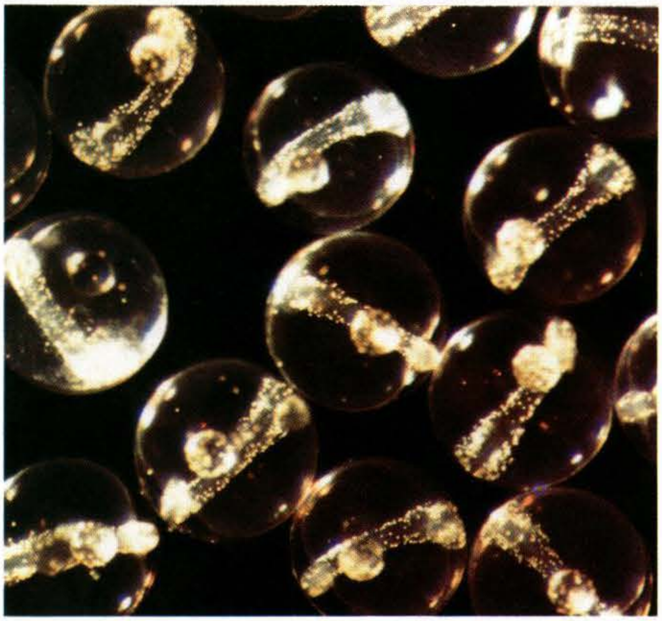
With the proximity of the refining industry and the huge Texas agribusiness surrounding the bay shores, it is important to learn how pollutants interfere with physiological and biochemical processes in marine organisms. The effects of pollution on fish reproduction and its physiological regulation--studies which are also vital to work in the mariculture program--are being investigated. Other research is focussed on detoxication systems in fishes.

Zooplankton Ecology

Bioluminescence, the production of light by living organisms, is rare among terrestrial organisms, but it can be a very common phenomenon in the marine environment. In coastal waters, the number of bioluminescent marine species is small, but they can often be quite abundant. In local waters, bioluminescence is most commonly associated with dinoflagellates such as *Noctiluca* and *Gonyaulax*, and with the comb jelly *Mnemiopsis*. In the deep waters of the Gulf of Mexico as well as throughout the oceans of the world, a majority of marine animals is often capable of bioluminescence. Species of fish, squid, shrimp and numerous small zooplankton species are capable of producing complex patterns of light. Laboratory experiments measure the amount and pattern of light production by these organisms and seek to determine how these animals use bioluminescence to increase their chances of survival in the sea. The behavior of bioluminescent organisms can be studied in darkness using infrared illumination and a computerized video-based system for motion analysis. Studies with bioluminescent zooplankton indicate that bioluminescence may often be used as a defense mechanism at night to startle or temporarily blind the sensitive eyes of their predators.

Mariculture

An approach to combatting over-exploitation of, and increased demand for, commercially harvested marine species is the idea of culturing fish, crustacea, or shellfish in a controlled environment -- mariculture, or the "farming of the sea." Whether this takes the form of rearing the animals to a marketable size or producing "seed stock" of juvenile stages to revive dwindling wild populations, a knowledge of the underlying biological processes which control reproduction, survival and growth are essential ingredients in mariculture.

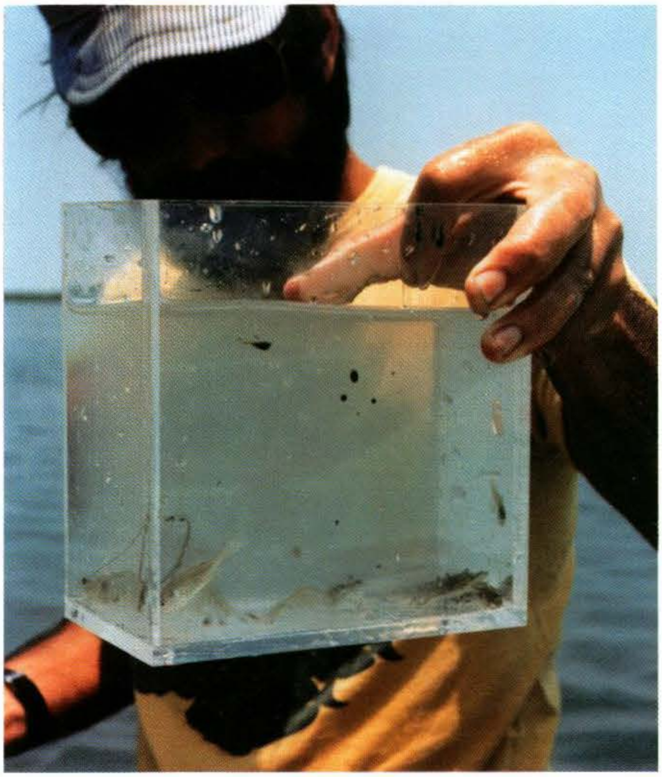


Atlantic croaker (*Micropogonias undulatus*) eggs with developing embryo. Croaker spawn near sunset and the eggs, which are buoyant and float at the ocean surface, hatch in about 24 hours.

Working in a variety of disciplines, both in the laboratory and in the field, research ranges from studies of physiology, genetics and endocrinology to investigations into the spawning cycles and larval fish development in locally occurring species and year-round spawning and rearing to adulthood of some species in captivity. Important finfish species such as the red drum (*Sciaenops ocellatus*), red snapper (*Lutjanus campechanus*) and spotted seatrout (*Cynoscion nebulosus*) are among those being studied and successfully cultivated here. Some of these are the subject of legislative restrictions on their harvesting in Texas waters, so the program is of great interest to sports- and commercial fishermen alike.

Much work remains to be done in this field, particularly on the understanding of environmental factors that trigger or inhibit reproduction in the wild. This information is also needed to enable maintenance of ideal conditions in the rearing tanks. Work is also being done on the problems of parasitic diseases that can cause rapid mass mortality of high-density tank populations.

Artificial diets are being developed to replace cultured plankton communities used to feed larval fish stages.



Eggs and juvenile fish collected in the field are identified in the lab to determine species population composition and density in natural habitats of bay and estuarine nursery areas.

At the biochemical level, the pituitary hormone that stimulates ovulation in fishes has been isolated and the environmental factors which influence its secretion are under investigation. A treatment using a synthetic luteinizing hypothalamic-releasing hormone combined with chemically blocking inhibitory neurons in the pituitary gland shows great promise in stimulating spawning in several warm-water marine fishes. The treatment causes a surge in the secretion of this pituitary hormone and should prove to be of great importance to progress in the mariculture program.

Taking a blood sample from one of the red drum broodstock. Researchers will analyze blood for several sex hormones to help determine the stage in the fish's reproductive cycle.

Marine Chemistry

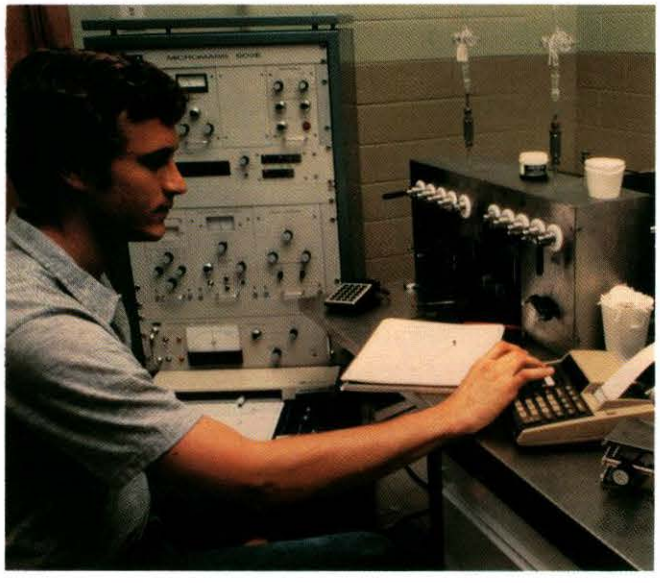
Ongoing research projects look at nutrients in the estuarine marine environments which are the basis of the food chain, study the geological fate of organic matter, especially in recent sediments of small ocean basins, and trace the food sources of various organisms by determining isotope ratios.

Nutrient Chemistry

Nutrients are essential for production in the oceans and can be directly related to phytoplankton biomass and productivity rates. Given sufficient light, nutrients, such as phosphate and nitrate, are a primary requirement for growth of phytoplankton which are the basis of nourishment for all animal life in the sea. The Texas rivers, bays and estuaries depend on freshwater inputs of nutrients to help sustain their biological populations, while in the Gulf, the major source of nutrients in the euphotic zone are the physical mixing processes that bring relatively high concentrations into the upper layers of the ocean (tides, storms), or biological recycling mechanisms. Nutrient distribution and dynamics are important in understanding the food environment of both pelagic and benthic organisms.

Organic Geochemistry

Organic geochemistry is the study of the remains of marine organisms which have become part of the sedimentary record. By studying organic matter in old sediments, we can learn about past life and past climates. Some organic matter in sediment eventually degrades to become petroleum, natural gas and coal. The organic matter in slope sediments of the Gulf of Mexico has been studied extensively at MSI, in cooperation with UT's Galveston Geophysical Laboratory. Recent discoveries have revealed the presence of gas hydrates and pockets of oil in the sediments. Such discoveries further our knowledge of hydrocarbon formation processes and may help



Stable isotope ratios of samples are determined on a special mass spectrometer.

us to understand the extent of natural seepage of oil and gas into the Gulf of Mexico.

A prime focus of geochemical research at the Institute has been the abundance of naturally occurring isotopes of carbon, nitrogen and sulphur in organisms. Many marine organisms "are what they eat", therefore the relative importance of their food sources can be determined if isotope ratios are different in, say, freshwater versus oceanic food supplies. Using isotope-ratio mass-spectrometers in the laboratory, it has been found, for example, that freshwater-derived plankton is more negative in ^{13}C ratio than open-ocean plankton. This has relevance in understanding the role that the bays and estuaries play in feeding animals that spend part of their life-cycle in those environments and part in the ocean, especially as freshwater supplies are being reduced or polluted by man's activities.

In shrimp mariculture, carbon ratios show the relative importance of formulated feeds versus natural pond biota. Nitrogen ratios determine how many trophic levels the food went through before the shrimp fed on it. In joint programs with Texas A&M University, studying mariculture ponds at a local power station, this research is helping to determine whether special expensive diets can be supplemented by pond productivity.

Further afield, using the nitrogen signal, the importance of salmon in the food ecology of Alaskan lakes is being studied.

Physical Oceanography

Studies on the Texas continental shelf and estuarine circulation and exchange of water between the two systems are the principal concerns of physical oceanography programs at the Institute. Direct measurement of currents over periods of up to one year are made with moored arrays to help understand such diverse processes as recent storm-sand deposits, the annual migration of juvenile shrimp, and currents in navigation channels.

A long-term study monitors the barrier island beaches and the oceanographic and meteorological processes that affect the deposition of debris and litter, tarballs, and the frequent stranding of marine mammals and sea turtles.

An array of current meters being launched from LONGHORN off the continental slope. Yellow "hardhats" protect glass flotation spheres and railroad wheels anchor the arrays to the ocean floor via acoustic releases.

...EDUCATION

One of the important functions of the Institute, in its role as an educational facility, is to share its resources by imparting to others its knowledge of marine science. This is accomplished in several ways through: formal university level teaching programs, dissemination of research results to the professional community, cooperative research with departments at UT and other universities, invitation of U.S. and international scientists to conduct research in our facility, scientific meetings and symposia, a marine education services program which introduces school-age students to the marine environment and provides practical workshops for their teachers, information to the general public through exhibits, open-house days, a newsletter, articles in the popular press, and response to public enquiries.

Teaching

The University's Department of Marine Studies, in association with the Departments of Botany, Chemistry, Geological Sciences, Microbiology, Zoology, and the Division of Biological Sciences, offers an interdisciplinary program leading to master's and doctorate degrees. Fifty-four Masters and fifty-two Ph.D. degrees have been earned at the Institute in the period 1954-1984.

Graduate students usually spend two semesters on the UT-Austin campus taking courses within their respective graduate programs. Further course work and the thesis or dissertation research then continues at the Marine Science Institute in Port Aransas. A generous bequest from the Estate of E.J. Lund enables the Institute to offer a number of graduate student and postdoctoral fellowships each year. Some students are supervised (or co-supervised) by a professor or research scientist at Port Aransas; others report to a professor located at the Austin or other UT campuses. Several faculty at the Institute hold positions in academic departments at UT Austin and teach an occasional course there.

In addition to the basic graduate study program during the regular session, a number of courses, offered only in the summer, are open to both upper division undergraduates and graduate students. Two six-week sessions include field, lab and lecture courses and cruises aboard the LONGHORN. Courses such as Marine Invertebrates, Ecology of Fishes, Marine Microbial Ecology, Marine Biology, Marine Chemistry, and Biological Oceanography are offered in summer sessions.

Publications, Meetings

Research programs, funded by federal and state agencies and private foundations, disseminate results through reports, compilations of data, and publications in professional journals. Since 1973, contribution numbers have been assigned to Institute papers published in refereed journals. More than 1000 papers (a list of which is available upon request) have been published since 1945.

Our own journal, *Contributions in Marine Science*, is in its 29th volume. Papers are generally, though not exclusively, on Gulf of Mexico subjects, but in a variety of disciplines and authored by scientists from around the country. A supplement to Volume 27 is devoted exclusively to papers given during the "Symposium on Migration and Its Adaptive Significance," held at the Institute in celebration of the University's centennial year, 1983.

The well-furnished auditorium, equipped with movie, slide, overhead and large-screen video projection equipment, has been the site of conferences, symposia and meetings attracting up to 250 participants per meeting from around the world. Notable among a growing number have been the American Fisheries Society 9th Larval Fish Conference, and a Conference on the Structure and Function of Ribsomes. The auditorium can be divided into modular rooms, each with audiovisual equipment, used for smaller meetings, talks and a regular Wednesday Night Seminar during the summer session.

Pygmy killer whale, *Feresa attenuata*, after stranding on Mustang Island beach in 1983. Four of these rare animals came ashore that year. While none was saved, valuable data was obtained, including the first recordings of this species' vocalization.

Cooperative Programs

Visiting scientists from the U.S., Mexico, Canada, Great Britain, Belgium, Venezuela, West Germany, People's Republic of China, Taiwan, Japan and India have spent up to two years at the Institute, collaborating with MSI scientists and exchanging research techniques. Other collaboration takes the form of joint research with scientists from other campuses or universities. R/V LONGHORN is frequently used by groups from other agencies (Florida State, Louisiana State, Texas A&M, Woods Hole, National Marine Fisheries Service).

A green turtle, *Chelonia mydas*, rescued from a shrimper's trawl and rehabilitated at the Institute, is wearing acorn barnacles (*Chelonibia testudinaria*) and two identification tags prior to its release in Redfish Bay.

Another area of public interaction is in answering the numerous questions from the public or news media: strange fish caught and curious objects found on the beach. The Institute staff cooperate with state and national data-banks that record information on animal populations, including the Stranded Marine Mammal and Sea-Turtle Networks, International Shorebird Survey, and Colonial Waterfowl Count.

Marine Education Services

The Marine Education Services program introduces students to marine science, especially through practical experience with methods of seagoing research. Since 1974 approximately 3,500 students per year have taken part in the visiting class program. In weekend workshops school science teachers participate in seagoing trips, attend lectures by MSI researchers on current research, and work first-hand with collecting and sampling equipment.

On a typical class trip aboard the KATY, students collect water samples and analyze

Students on a trip aboard the KATY examine the catch from a bottom trawl taken in the bay.

them for salinity, dissolved oxygen and nutrients; make plankton-tows and bottom-trawls and collect sediment samples. Half-day trips usually visit the bays and channels where thousands of birds and other animals can be seen while an understanding of the marine environment that supports such abundance is gained through measurement and sampling.

To make arrangements for classes to participate in these activities, write to the office of Marine Education Services at the Institute's address in Port Aransas.

Visitors Center

Interest in marine science is also stimulated by the Visitors Center, open daily to the public during working hours. Seven aquaria show typical Texas coastal habitats and the organisms that live there: mudflat, *Spartina* marsh, oyster reef, seagrass beds, mud-bottom, rock jetty, offshore oil platform. Films and video presentations are regularly shown in the auditorium to groups of visitors. Elsewhere in the main building, displays show current and past research projects and preserved specimens or photographs of local flora and fauna. Up to 15,000 visitors tour the facility annually. At periodic "Open House" days, researchers and students invite the public to view their current projects.

Wildlife Refuges

Near the Institute are several state and national wildlife refuges. Foremost of these is the Aransas National Wildlife Refuge, 55 miles by road but only 25 miles by water from Port Aransas. The refuge is the wintering ground for about 100 whooping cranes (*Grus americana*) that nest in Wood Buffalo National Park (Alberta and Northwest Territories, Canada). Padre Island National Seashore starts 25 miles by road from the Institute, and the Laguna Atascosa National Wildlife Refuge is 200 miles by road, but only 100 miles via the Intracoastal Waterway. The proximity of these refuges provides important opportunities for study of relatively undisturbed and diverse natural environments and their flora and fauna.

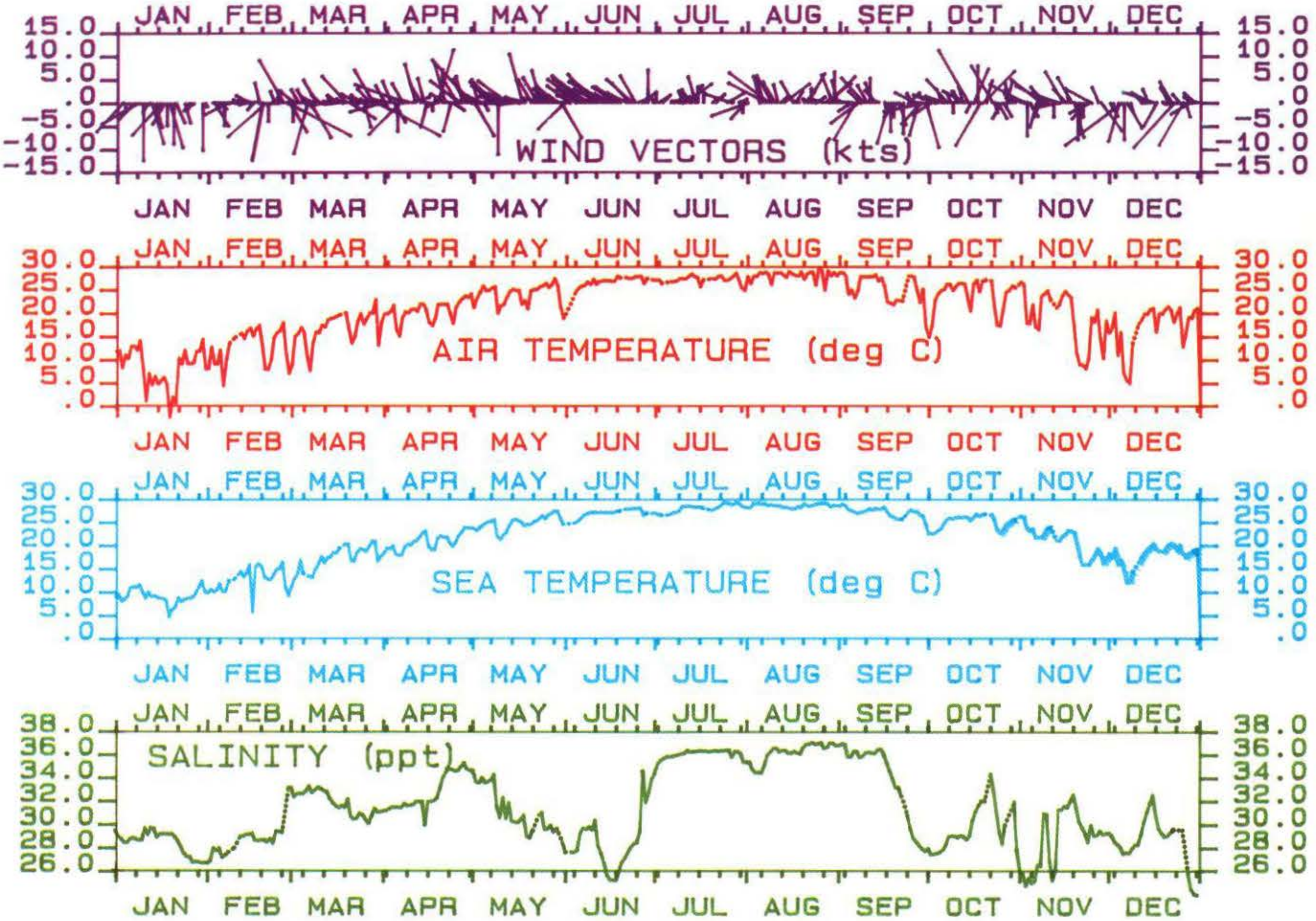
Javelina or collared pecary, *Dicotyles tajacu*, seen from the Gulf Intracoastal Waterway as it passes Blackjack Peninsula in the Aransas National Wildlife Refuge. The refuge's more famous inhabitants are the remaining wild population of whooping crane, *Grus americana*, that spend the winter here.

...ENVIRONMENTS

Within easy reach of the Institute are diverse marine and estuarine environments of interest to many fields of scientific research. These include the open Gulf of Mexico beyond the shelf-slope break, shallow waters of the continental shelf, bays, lagoons, wind-tidal flats and fresh- to brackish-water marshes. Wide ranges of temperature, salinity and turbidity characterize these waters both seasonally and geographically and consequently they support a diverse assemblage of plants and animals. The study of this varied flora and fauna and the physical, chemical and geological factors that control their environment challenges researchers in marine science.

Climate

Port Aransas is located at 27°50N and 97°03W. The climate is classified as dry subhumid with an average annual rainfall of 72 mm (28.5 inches) compared to Port Arthur's 141 mm (55.4 inches) to the north and Port Isabel's 65 mm (25.8 inches) to the south. Greatest yearly rainfall was 122 mm (48.2 inches) in 1888 and least was 14 mm (5.4 inches) in 1917. Snow is a rare event. Average annual temperature (measured at nearby Corpus Christi) is 22°C (72°F) with extremes seldom reaching 38°C (100°F) or falling below 0°C (32°F) on the coast. One of the most characteristic features of the climate is the bimodal wind regime. The prevailing wind is from ESE, blowing almost normal to the strike of the coastline, making Corpus Christi one of the nation's windiest port cities (behind Boston, Massachusetts). This wind is strongest from April-August but becomes variable in August-September and then, with the regular passage of cold fronts from late September-March, strong north- to northeasterly winds replace the southeasterlies. Polar air masses accompanying the fronts have a profound effect on the shallow bay waters and the adjacent Gulf coastal waters. Occasionally, the air temperature drops to below freezing and extensive fish kills have occurred as a result of abnormally low water temperatures. Normally, bay waters range from 10°C (50°F) to over 30°C (86°F). A vigorous outbreak of cold air can drop seawater temperatures to 4°C (38°F) along the Gulf coastline and down to freezing in the shallow bays. Water temperatures in isolated embayments can exceed 40°C (104°F).



Air and sea: the yearly cycle on Mustang Island. The stick diagram at top shows the magnitude and direction of the wind (north pointing up). Prevailing south- to southeasterlies are punctuated in fall, winter and spring by outbreaks of cold air ("blue northers"). Air temperature, shown at its predawn minimum, drops rapidly as each norther sweeps over the island. Some 30 northers can be seen in the 1984 record. Sea temperature responds more slowly and may be more than 10°C (18°F) warmer than the air temperature. Heat is lost from the sea to the atmosphere, cooling one and warming the other. In summer, early morning air and sea temperatures are in equilibrium, 29°C (86°F) or more, off the Gulf beaches. Salinity is highly variable, but a general pattern can be seen of fresh cool water in winter, Mississippi water in late spring and early summer and high salinity Gulf water in summer.

A Coastal Marine Automated Network (CMAN) weather station is located on the Horace Caldwell Pier near the Institute. This new facility, available on-line to MSI researchers, has already shown how different the coastal climate can be from stations like Corpus Christi, only a few miles inland. Air temperatures are warmer in winter and cooler in summer days (warmer at night). Rainfall can be exceptionally different, as can wind field.

Studies have been done at the Institute on the sea-breeze phenomenon, the coastal atmospheric boundary, and wind-stress over the ocean and its relationship to currents. An official U.S. Weather Bureau reporting station is now maintained at the Institute, providing air temperature and rainfall data. Two NOAA ocean data buoys are moored in the western Gulf and provide continuous data on meteorological and surface oceanographic conditions.

Gulf of Mexico

The Gulf of Mexico is classified as a mediterranean sea, 1,600,000 sq. km. (618,000 square miles) in area. In its northern part it has a wide continental shelf which progressively narrows as it curves south along the coast of Mexico. The continental shelf is approximately 200 km (108 nm) wide south of Cameron, Louisiana, 100 km (54 nm) opposite Port Aransas, Texas, and 20 km (11 nm) at its narrowest point, south of Vera Cruz, Mexico. The Gulf coast of Florida and the Yucatan Peninsula have shelves up to 300 km (162 nm) wide. In the western Gulf the shelf has numerous knolls and mounds which are salt domes and ancient reefs formed at lower stages of sea level. Beneath many of these structures are important oil deposits and numerous offshore oil and gas production platforms are located near them. The shelf break marks the border between the gently sloping shelf and the steep continental slope. Several canyons and other erosional features mark the upper slope, remnants of the Pleistocene low stand in sea level. The central basin is deeper than 3000 m (9840 ft) with the Sigsbee Deep (3871 m or 12,700 ft) being the deepest spot. The Sigsbee abyssal plain, 3600 m (11,800 ft) deep, may be the flatest of all seafloors, with gradients of only 1:8000, which translates into a change in depth of only three inches per nautical mile. The dominant feature of the Gulf Basin is the Mississippi cone, a vast accumulation of sedimentary detritus from the Pleistocene river.

Water flows into the Gulf of Mexico from the Caribbean via the Yucatan Straits and exits through the Florida Straits as the true "Gulf Stream". This current system is known as the Loop Current because it loops into the eastern Gulf before exiting. Bottom water of the Gulf is derived from the Caribbean and is similar to water at the sill depth of the Yucatan Channel. Remnants of Antarctic Intermediate Water are still identifiable by the salinity minimum that occurs between 850-1000 m (2800-3280 ft). The oceanography of the western Gulf has not been completely investigated, but a large gyre or eddy, thought by some to be "pinched off" from the

Loop Current, is a quasi-permanent feature. This warm water gyre circulates anticyclonically (clockwise in the northern hemisphere), giving rise to northerly setting currents along much of the coastline.

North of this a cyclonic gyre brings colder water down from the Mississippi region and the two currents converge and move offshore at a position somewhere along Padre Island. This position varies seasonally but Little and Big Shell beaches on Padre Island National Seashore were probably formed by sorting of sediments by the current system. Unlike gyres occurring off other coastlines (the Gulf Stream eddies, for example), ours are detected by subsurface temperature changes and are not generally seen by satellite imagery. This is especially true in summer when Gulf surface waters are uniformly 29-30°C (84-86°F), but in the winter, satellite pictures readily show the cool coastal currents contrasting with warm open Gulf waters.

Exchange of water between the shelf and slope is an important process along other continental margins and both warm and cold core eddies help to transport and mix water in both directions. Whether this happens in the western Gulf of Mexico is a question to be answered. Using arrays of bottom moored current meters on the shelf and slope, long-term measurements of up to a year are helping MSI researchers answer some of these questions.

Generally, the western Gulf of Mexico has been thought to be sparsely populated with pelagic animals, but as more observations are made, reports of whales, dolphins, sea turtles, and sea birds are increasing. Whales now known to occur in the western Gulf are sperm (*Physeter macrocephalus*), pygmy sperm, dwarf sperm (*Kogia* spp.), pilot (*Globicephala macrorhynchus*), killer (*Orcinus orca*), and the pygmy killer (*Feresa attenuata*). The dolphins include spotted, spinner, striped, and shortsnouted spinner (*Stenella* spp.). Five species of sea turtle occur: leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), green (*Chelonia mydas*), hawksbill (*Erectmochelys imbricata*), and the rare Kemp's Ridley (*Lepidochelys kempii*) turtles. Among the seabirds, shearwaters and petrels are present though not abundant. Cory's (*Calonectris diomedea*), greater, Audubon's and Manx (*Puffinus* spp.) shearwaters; Wilson's (*Oceanites oceanicus*) and Leach's (*Oceanodroma leucorhoa*) storm petrels occur offshore in late summer and early fall. Masked booby and northern gannet (*Sula* spp.) can be found in summer and winter, respectively, both straying close enough to shore to be seen from the beaches.

Bottle-nosed dolphin (*Tursiops truncatus*) in the Lydia Ann Channel.

Quite abundant and well-known are the Gulf's pelagic gamefish that draw deep-sea sportfishermen from around the country to compete in almost weekly summer fishing tournaments. Blue (*Makaira nigricans*) and white (*Tetrapturus albidus*) marlins, sailfish (*Istiophorus platypterus*), wahoo (*Acanthocybium solanderi*), and tuna (*Thunnus atlanticus*) are caught and several state records have been hooked in the offshore waters of Port Aransas. A fledgling long-line fishing industry harvests shark (*Carcharhinus* spp., *Sphyrna* spp., *Galeocerdo cuvieri*), swordfish (*Xiphias gladius*), and tilefish (*Lopholatilus chamaeleonticeps*), among others, in deep Gulf waters.

The beautiful Portugese man o'war (*Physalia physalis*) stuns its prey with stinging tentacles.

Warm, high-salinity "tropical" water supports an abundant assemblage of the floating weed *Sargassum* with its accompanying animal community including the sargassumfish (*Histrio histrio*), the carnivorous nudibranch (*Scyllaea pelagica*), sargassum crabs (*Portunus sayi*, *Callinectes marginatus*), and the shrimp *Latreutes fucorum*. A research vessel sailing the western Gulf will scatter schools of flying fish, attract fast-swimming *Stenella* dolphins to ride the bow, and encounter an occasional ocean sunfish (*Mola mola*), manta ray (*Manta birostris*) and whale shark (*Rhincodon typus*). On-station at night, schools of squid (*Lolliguncula brevis*) might gather under the deck-lights, attracted to juvenile flying fish (*Hirundichthys rondeleti*), pursued, in turn, by dolphin fish, or dorado (*Coryphaena hippurus*). The western Gulf of Mexico, even at the latitude of Port Aransas, is a tropical ocean.

A "blue fleet" of floating pelagic animals --Portugese man o'war (*Physalia physalis*), by-the-wind sailor (*Velella velella*), *Porpita porpita*, purple storm snail (*Janthina* spp.), and the nudibranch *Glaucus atlanticus*--is a remarkable community that periodically finds its way ashore. Some of the floating material originates in the Caribbean or in the northern reaches of the Gulf and eventually converges with the currents to wash ashore on the barrier island beaches. This includes terrestrial water hyacinth (*Piaropus crassipes*) and "sea beans" (large seeds of tropical shrubs) which

The nudibranch *Glaucus atlanticus* feeds on the stinging tentacles of the by-the-wind sailor and Portugese man o'war. The nudibranch is immune to the stinging cells, even utilizing them for its own defense in its fingerlike appendages. About 20 cm (3/4") long.

often wash ashore along Gulf beaches. Vast collections of driftwood, plant material and other riverine debris are brought onto the beaches in late April and May, delivered by the plume of fresh water from the outflow of the Mississippi-Achafalaya Rivers, which often extends hundreds of kilometers offshore and may persist until late July.

The transport of these assemblages of plants and animals to our back door creates an excellent opportunity for study.

Continental Shelf

The broad continental shelf has great importance commercially as a major merchant marine transportation route, a shrimping ground, sportfishing area and oil- and gas-producing region. Numerous offshore platforms are scattered along the continental shelf. Exploratory drilling is an everyday occurrence on the shelf, now divided into leases for sale to oil companies all the way out to the edge of the U.S. Exclusive Economic Zone (200 nm). During the 1970's the Marine Science Institute coordinated a multi-year survey of the Bureau of Land Management's leased "lands", the results of which form the basis of our present knowledge of the geology, oceanography, and biology of the western Gulf's continental shelf. Though generally flat, sedimentary outcrops of modest relief dot the shelf and provide important recreational fishing grounds. Because of numerous commercial seismic, magnetic and gravity surveys, the geologic structure of the shelf and slope is well-known. As exploration is now expanding into ever deeper waters, the outer shelf, shelf-break, and slope are coming under increasing scientific scrutiny.

Present-day sedimentary processes in relation to ancient deposits are of great contemporary interest, as is the role of currents and storms in transporting sediment and shaping the barrier islands.

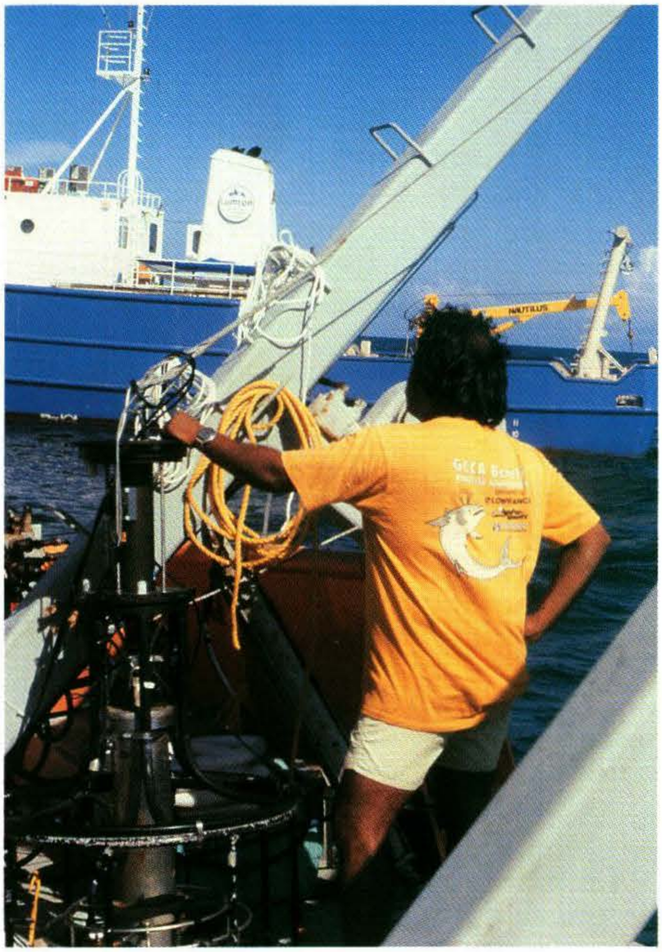
The shallow waters of the continental shelf are well mixed vertically during winter, spring and fall months but show a strong horizontal gradient from offshore warm waters to nearshore cool waters. Even during summer, inshore waters have only a small vertical temperature gradient. There is, however, a significant salinity gradient when fresh surface water overlays the deeper, more saline water due to river runoff or rain. By August of most years, surface water above 36 ppt salinity moves onshore. In some years the coastal water is much fresher and even far offshore the tropical water may be interleaved with Mississippi water well into the summer.

An often well-defined boundary separates the turbid coastal waters from the clear, blue, offshore water which sometimes enters the passes.

The seasonal change in the wind-field is responsible for controlling much of the shallow water shelf circulation. Southeasterlies drive coastal currents to the north, but when the first cold fronts push through in September they are replaced by northeasterly, north, and occasionally northwesterly winds which bring cold, dry air over the Gulf and promote rapid cooling of the surface waters, convective overturn, a southerly current and turbid coastal waters. In some years, in late summer, there is evidence for upwelling of cold, deep water but this phenomenon has been little studied and its effect on the productivity of continental shelf waters is unknown.

Photosynthesis by phytoplankton (primary production) is the base of the marine food web. Primary production varies in the water column, depending on the distribution of phytoplankton, the availability of nutrients, and the depth to which sunlight penetrates. These factors, in turn, are in large part dependent on physical processes in the water column (tides, currents, vertical mixing, turbulence, turbidity).

Blooms of phytoplankton including dinoflagellates and the blue-green algae *Trichodesmium* are not uncommon during the warmer months. *Trichodesmium* sometimes appears at the surface as a yellow or orange slick in calm weather, or as long, sinuous windrows at other times. Nearshore, under bloom conditions, it gives the water an orange-red color, leaving slippery deposits of "mud" on the beach when the tide recedes. Very occasionally, toxic conditions prevail following a bloom of dinoflagellates; it was the investigation of just such a bloom that boosted research here in the early days. The dinoflagellate *Noctiluca scintillans* also blooms on



occasion, producing spectacular bioluminescent displays in winter and spring of some years.

The shallow continental shelf supports an abundant zooplankton community of three basic types. The meroplankton is composed of animals that only spend part of their life-cycles as plankters. In our area, commonly found are crab larvae (zoea and megalops stages), shrimp larvae, barnacle larvae (nauplii and cypris stages), fish eggs and larvae. The holoplankton, those animals that are planktonic throughout their life, include numerous copepods of which *Acartia tonsa* is perhaps the most abundant in the region, arrow worms and the sergestid shrimps. Numerous jellyfish make up the larger zooplankton or megaloplankton and include cabbagehead (*Stomolophus meleagris*)--or as the shrimpers call them, "cannonballs"--sea nettles

(*Chrysaora quinquecirrha*), moon jellyfish or "four-leaf-clovers" (*Aurelia aurita*) and the phosphorus jellyfish (*Mnemiopsis mccradyi*).

Commonly found bottom-dwellers are the blue (*Callinectes sapidus*), stone (*Menippe mercenaria*) and frog crabs (*Raninoides louisianensis*) as well as the three commercially important species of shrimp, brown, white, and pink (*Penaeus* spp.). The infauna, or animals that live in the sediments on the shelf, have been one focus of study at the Institute for several years. Most abundant of these are the polychaete worms, but numerous other animals live in or on the sediment and reworking of the silt, mud and sand by their burrowing action is an important mechanism in the recycling of nutrients.

Red snapper (*Lutjanus campechanus*), grouper (*Epinephelus* spp.), mackerel (*Scomberomorus* spp.), red drum (*Sciaenops ocellatus*), speckled, and sand trout (*Cynoscion* spp.)--to name a few of the important fish species--abound on the shelf. The tarpon (*Megalops atlantica*), which is making a "comeback" in recent years, was once of such importance that it lent its name to the town now called Port Aransas.

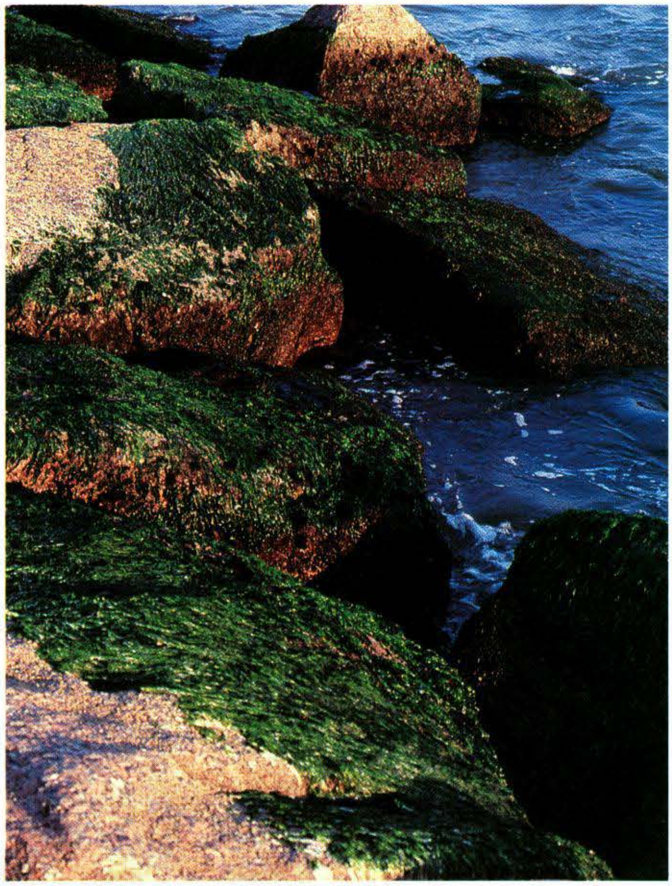
Nearshore, bottle-nosed dolphin (*Tursiops truncatus*) are common and, in summer, loggerhead turtles can often be seen, barnacle-encrusted, at the surface. Less frequent is the green turtle, now only seen as juveniles, but adults once were the basis of a major industry in Port Aransas.

Abundant numbers of gulls and terns range out to sea for several miles offshore. Most common are laughing gull (*Larus atricilla*) year-round; royal, sandwich, caspian, Forster's, least (*Sterna* spp.) and black (*Chlidonias niger*) terns in summer; ringbilled, herring and Bonaparte's (*Larus* spp.) gulls in winter. During spring and fall migrations many landbirds cross the open Gulf and individuals of a variety of species may alight on a vessel at sea, seeking shelter.

The offshore platforms and rock outcrops create isolated "hard bottom" environments in an otherwise flat plain of sand, silt or mud. Around the legs of the deeper platforms, almost tropical reeflike conditions exist as year-round temperature, salinity and turbidity are less changeable than on structures closer to shore. Damsel-, squirrel-, trigger- and pufferfish (*Pomacentrus variabilis, Holocentrus ascensionis, Balistes capriscus, Sphoeroides parvus*) share the habitat with blennies (*Hypsoblennius hentzi, Hypleurochilus geminatus*), groupers and snapper. Barnacles (*Balanus* spp.), sponges (*Haliclona* spp.), bryozoans (*Bugula* spp.), hydroids (*Tubularia* sp.), brittle stars (*Ophiactis* sp.), and many other invertebrates encrust the rig-legs. SCUBA-diving

around the rigs is a popular pastime and a useful method for conducting research on these unique communities.

More-adaptable, hard-bottom animals and plants flourish around the stone jetties lining the passes through the barrier islands. The granite rock-jetties of Aransas Pass are of particular interest because of the rich variety of animals and their proximity to the Institute.



The jetty community includes crabs (*Menippe mercenaria*, *Petrolisthes armatus*), sea hares (*Aplysia brasiliana*), sea urchins (*Arbacia punctulata*, *Echinometra lucunter*), hydroids (*Bougainvillia inaequalis*, *Obelia dichotoma*), soft corals (*Leptogorgia virgulata*), while at the waterline are found organisms which spend extended periods in air: acorn barnacles (*Chthamalus fragilis*, *Balanus* spp.), snails (*Littorina lineolata*, *Thais haemostoma*, *Anachis semiplicata*, *Cantharus cancellarius*, *Pisania tincta*, *Nerita fulgurans*), hermit crabs (*Clibanarius vittatus*), anemones (*Bunodosoma cavernata*, *Bunodactis texaensis*, *Aiptasiomorpha texaensis*), and the rock louse (*Ligia exotica*).

Barrier Islands & Gulf Beaches

Mustang Island is one of the barrier islands forming an almost continuous chain along the Texas coast. These islands attained their present form only a few thousand years ago, following the rise in sea level after the present-day coastline behind the barrier islands. Sediment carried by the rivers was deposited as sandbars on the shallow shelf, eventually emerging as islands to be further shaped by longshore currents. The islands are still dynamic, unstable structures with low relief (highest dunes less than 10 m or about 30 ft) and subject to breaching by storm tides.

Man has chosen to build residences, hotels, businesses (and laboratories) on the barrier islands, and has stabilized the passes between the islands with stone jetties to stop their typical southward migration. The Harbor Island Lighthouse was built in 1853 to mark the entrance to the natural tidal pass (Aransas Pass) separating Mustang and San Jose Islands. By the 1880's, when jetty construction began to stabilize the pass, the entrance had migrated 1.4 km (.8 nm) to the south, a rate of approximately 60 m (180 ft) per year. Aransas Pass was finally stabilized in the 1900's but the lighthouse is 2 km (1.1 nm) north of the pass it was built to guard.

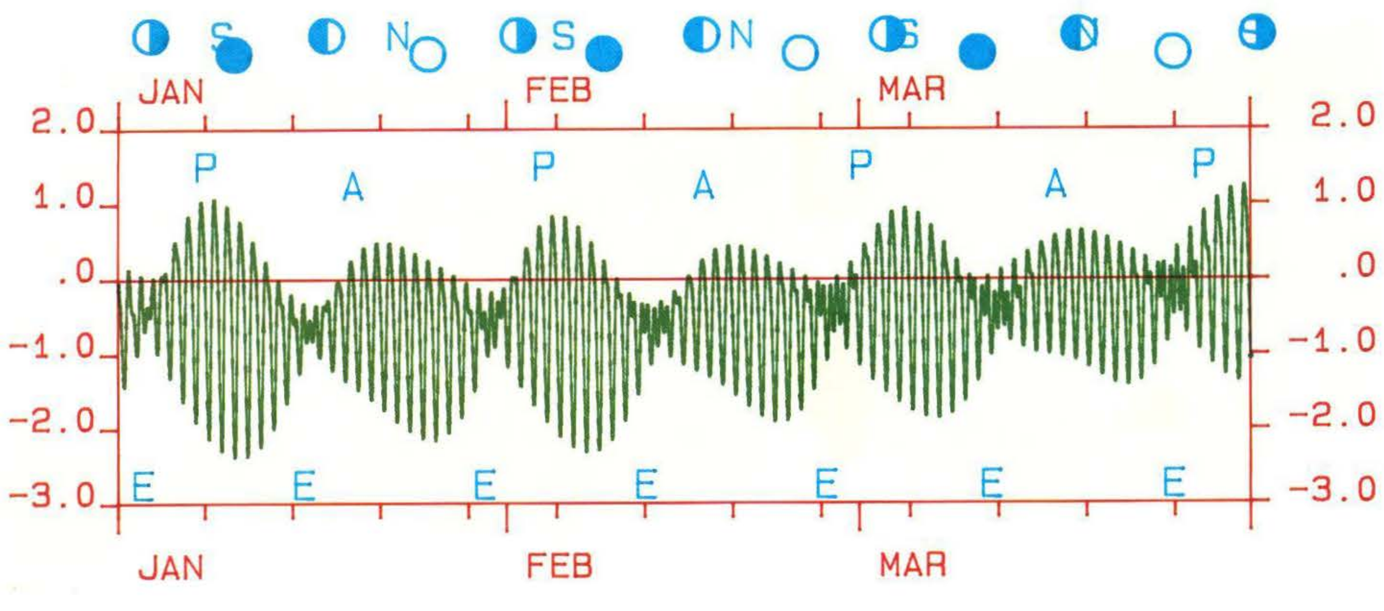
Aransas Pass is one of only two major shipping passes between barrier islands from the Mexican border to Freeport. Dredging is required to keep these passes open and some smaller, man-made passes have silted over in

only a few years. The extensive dredging projects since the 1940's have altered circulation patterns in the estuaries which, in turn, have affected sedimentation and island building processes. The dredging of the Gulf Intracoastal Waterway and deposition of spoil banks has been linked to the increase in salinity in Laguna Madre. Siltation of the smaller, natural passes has "welded" Mustang to Padre Islands, forming a continuous barrier island from Port Aransas to Port Mansfield, a distance of 167 km (90 nm). Padre Island, most of which is now National Seashore, has been split by the Mansfield Channel, dredged to allow shrimp boats access to the Gulf.

Astronomical tides at the Gulf shoreline have a yearly mean range of only 0.46 m (1.5 ft) with a normal maximum daily range of 1.1 m (3.5 ft) at Port Aransas, but are interesting in being primarily diurnal tides; one of few coastlines in the world where diurnal tides predominate. The semimonthly tropical /equatorial tidal cycle is the major factor controlling our tidal range. A tide gauge is maintained on the south jetty of the Aransas Pass, adjacent to the Institute. In the latter part of the hurricane season the tidal range may exceed 1.5 m (5 ft) when tropical depressions originating in the Gulf, creating high tides, are followed by cold fronts with northwesterly winds that push water out of the bays to lower the sea level at the coastline. At these times, the Gulf beaches may be 150 m (492 ft) wide on Mustang Island. Bay bottoms are exposed, revealing unusual organisms and sometimes long-buried bottles and artifacts of the past that bring out the "treasure" hunters. Prior to the passage of some northers, strong southeasterly winds push water up to the duneline, especially in spring, making the beaches impassable.

Hurricane and tropical-storm tides erode the dunes and can breach the islands, creating washover channels that may remain for months or years following a major storm. During Hurricane Celia, a direct hit in 1971, tides at Port Aransas were 2.9 m (9.4 ft) above normal while on the inland side of the

Astronomical tides at the Aransas Pass. Tides are diurnal except for a few days each fortnight. Tidal range is controlled by the declination of the moon and is greatest when the moon is over the tropics and least when over the equator. When other lunar phenomena coincide with the tropic tides, the greatest ranges of the year occur, such as in early January 1986, when the moon was full, near perigee, and at its southernmost declination. Heights are shown in feet. Datum is mean sea level. A = moon at apogee, P = at perigee; N = moon at northernmost declination, S = southernmost, E = over equator.

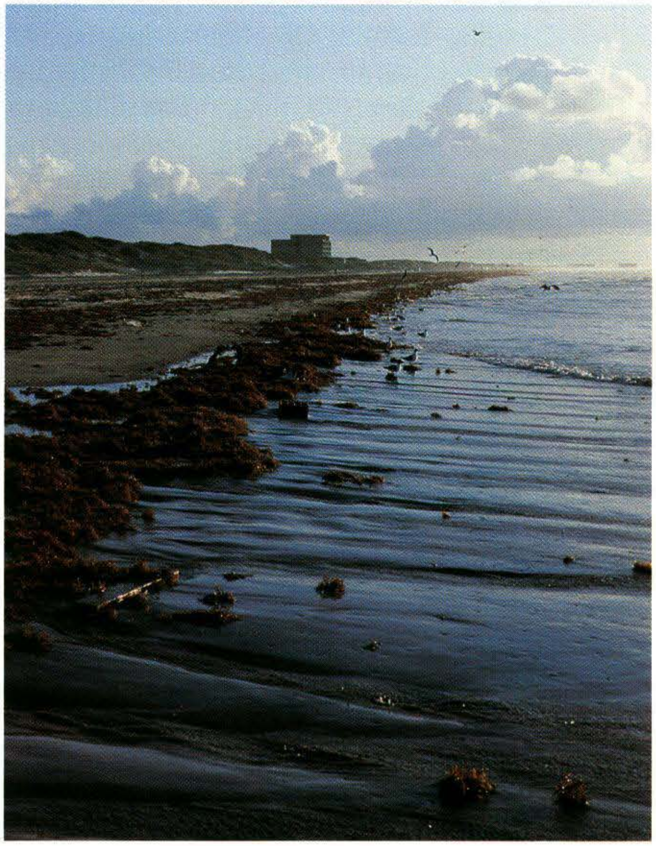


bay they exceeded 3.4 m (11 ft). In between extremes, low-profile, sandy beaches are characteristic of Mustang Island while steeper shell-beaches with permanent berms are typical of parts of the National Seashore.

Shallow waters and onshore winds sometimes take their toll of Gulf shrimpboats.

From one to three offshore sandbars, with corresponding rows of breaking waves, are typical of the shoreface. Breaker heights seldom exceed 1.5 m (5 ft) with wave periods generally less than eight seconds. The beaches are popular tourist attractions and the driving of automobiles is permitted from Mustang Island south to the Mexican border on all except a four-mile section of the National Seashore. San Jose Island to the north is privately owned with no access by road.

Striped mullet (*Mugil cephalus*), sand trout, red drum, hardhead catfish (*Arius felis*), and stingray (*Dasyatis* spp.) are fish typical of the surf zone. Dense schools of juvenile fish of several species including menhaden (*Brevoortia patronus*) and spot (*Leiostomus xanthurus*) attract pelicans, gulls and terns in summer and huge flocks of double-crested cormorant (*Phalacrocorax auritus*) in winter and spring. Bottle-nosed dolphin often feed in the surf over the sandbars. Littoral zone invertebrates include the lettered olive (*Oliva sayana*), sand dollar (*Mellita quinquiesperforata*), ghost shrimp (*Callianassa latispinna*), coquina clam (*Donax* spp.) and mole crab (*Emerita portoricensis*). Ghost crabs (*Ocypode quadrata*) abound on the midbeach area up to the dune vegetation line.



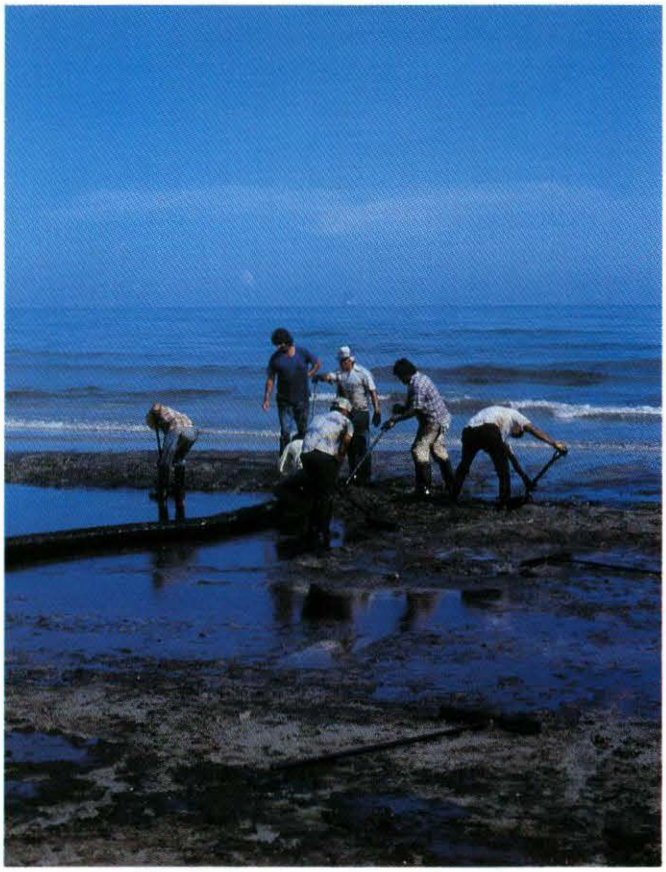
The receding tide leaves *Sargassum* weed on Mustang Island beach.

The barrier island beaches provide year-round roosting and feeding grounds for abundant numbers of gulls, terns, and shorebirds. Sanderling and red knot (*Calidris* spp.), willet (*Catoptrophorus semipalmatus*) and piping plover (*Charadrius melodus*) are common among the more than 30 species of shorebird found in the region. A long-term study done at MSI of the bird population on a 12-km (7.25-mile) stretch of Mustang Island beach recorded 1,200,000 individuals (average 1,000 birds per observation) of 216 species.

Ruddy turnstone, *Arenaria interpres*, feed on gooseneck barnacles, *Lepas* spp., growing on a stranded fishing float and line.

One of the most noticeable features of Gulf beaches is the debris left at the strandlines. Much of this is comprised of *Sargassum* weed, driftwood, seagrasses, jellyfish, penshells, seawhips and other plant and animal litter, but great amounts of man-made detritus are washed ashore. Ranging from tarballs to 55-gallon drums, the common items include plastic sheeting, hardhats, styrofoam, oil-pipe flotation collars, drilling mud containers, 5-gallon plastic pails, milk jugs and "household" garbage from supply boats, drilling platforms, tankers and fishing vessels.

Land-based debris enters the Gulf with the spring floods. Currents bring material south from Louisiana and north from Mexico and the Caribbean. Understanding the coastal wind and current regime in the western Gulf of Mexico is an important area of research towards learning the origin, fate and remedies for combatting this problem of the Texas coastal zone.



Clean-up crew removes oil spilled from the tanker ALVINAS on Galveston Island beaches in August 1984.

Bays & Estuaries

Between the barrier islands and the mainland are the elongated shallow bodies of water called lagunas and the flooded river valleys that have become bays. Together, the rivers, bays and lagoons make up seven recognized Texas estuaries. From north to south they are named (generally after their rivers) Sabine-Neches, Trinity-San Jacinto, Lavaca-Tres Palacios, Guadalupe, Mission-Aransas, Nueces and Laguna Madre. Port Aransas is within the Nueces estuary system.

The natural water depth seldom exceeds 3 m (10 ft) but numerous dredged channels are as deep as 14 m or 45 ft (the authorized depth of the Corpus Christi ship channel). A few "holes" scoured by currents are 20 m (65 ft) deep. Corpus Christi Bay is fed by the Nueces River with an annual average discharge of 771 million m^3 (628,000 acre-ft per year). A feature of this discharge is considerable variability: 97 million m^3 (76,000 acre-ft/year) to 3.25 billion m^3 (2,547,000 acre-ft/year).

Tidal exchange also takes place with Gulf of Mexico water through the few passes, but the variable streamflow, lack of any major rivers south of Nueces, brine discharge from drilling operations, excess evaporation and the alteration of the flow regime due to major dredging projects have created hypersaline conditions in Laguna Madre and the upper reaches of Baffin Bay. Yet, due to the shallowness of these estuaries, major storm events can replace the bay waters in a matter of hours with fresh or Gulf waters. A great diversity of estuarine environments can be found close to the Institute and opportunities abound to study the biology, physiology and ecology of a variety of organisms, some of which can tolerate salinities ranging from 0 to 140 ppt and temperatures from freezing to 40°C (32-105°F).

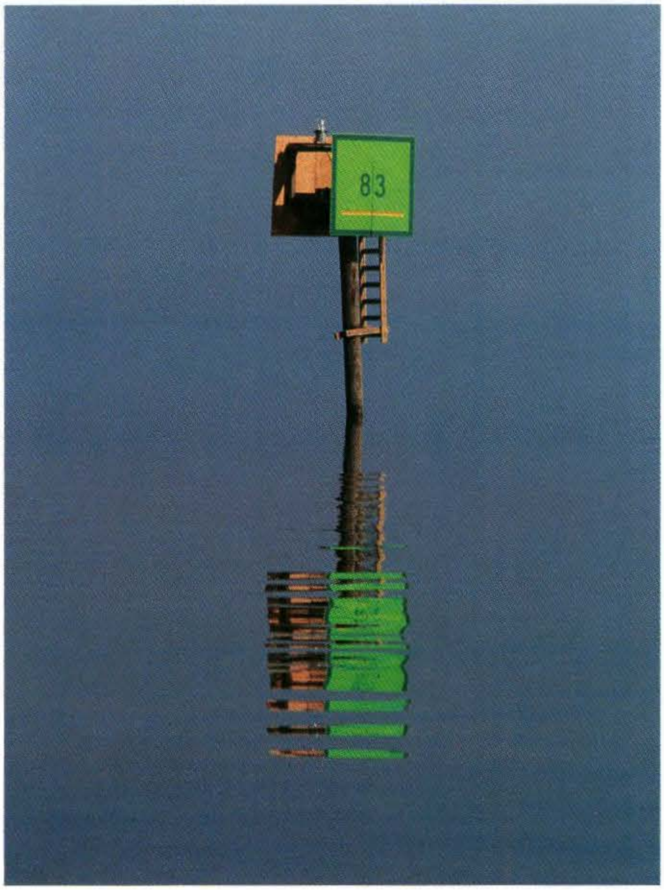
Open bay waters, seagrass beds, mangrove swamps, *Spartina* marshes, wind tidal flats and spoil-islands: these habitats contain many species of fauna and flora which spend all or part of their life cycles in the bays.

Open Bay Waters

Corpus Christi Bay overlies an important natural gas field and numerous platforms, "christmas-trees" and pipelines criss-cross the bay and adjacent waters. The Nueces drainage basin provides the great majority of the riverine input into the bay system, but two other drainage basins (Mission-Aransas and Nueces-Rio Grande) also provide freshwater inflow. In many years evaporation exceeds both precipitation and stream inflow and there is a net loss of freshwater through the system. Two major reservoirs (Lake Corpus Christi and Choke Canyon) upstream on the Nueces supply freshwater to an ever-expanding coastal population. The effects of the reduction of freshwater input projected in the future presents an interesting study to the estuarine scientist.

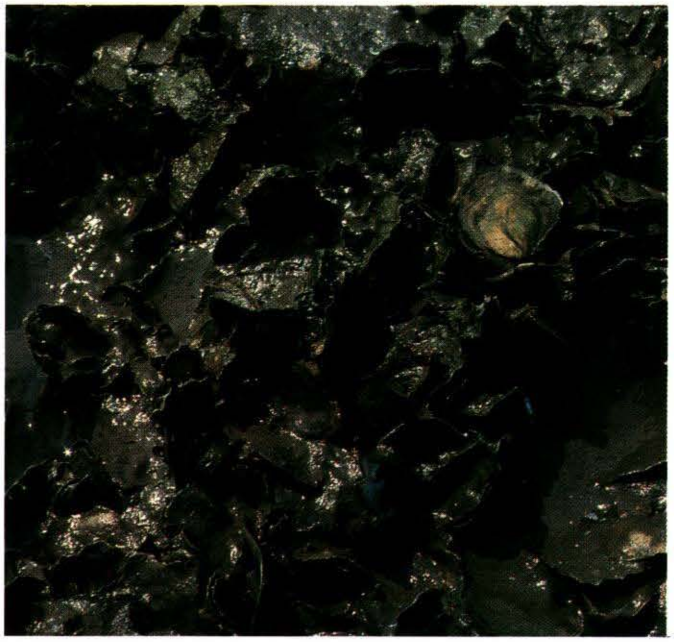
There is some water exchange between adjacent bays and the Laguna Madre but this is not significant compared to the input of the Nueces and exchange through the Aransas Pass to the Gulf of Mexico. The effects of freshwater inflows into such areas as the Lavaca-Tres Palacios Estuary and San Antonio Bay are of great interest. Teams of researchers have monitored phyto- and zooplankton, benthos, larval and juvenile fish populations. Temperature, salinity, oxygen, nutrient levels, primary production, organic carbon and chlorophyll-a have been determined and statistically analyzed to identify significant differences between locations and seasons. Food sources have been identified by examining the natural abundance ratios of stable carbon, nitrogen and sulphur isotopes in tissues of specimens collected in river, delta-marsh, bay bottoms and the water column.

Most open bay waters are less than 4 m (13 ft) deep. The ship channels (Corpus Christi, La Quinta, Aransas) and the Gulf Intracoastal Waterway provide the only "deep water" habitat in Corpus Christi Bay, creating at times a classic two-layered estuary. Bay waters are well-mixed and turbid due to the constant winds blowing across the surface.



Light penetration is limited by the suspended material and seagrasses do not grow well over much of the bay-system bottom. However, phytoplankters are common in the bay waters (*Rhizosolenia*, *Asterionella*, and *Cosinodiscus*, among many other more abundant forms), as are such zooplankton as

A shrimp (*Penaeus aztecus*), one of three species commercially harvested in the Gulf, forages at night among epiphytic algae on seagrasses.



A bed of the common eastern oyster, *Crassostrea virginica*.

Acartia tonsa, *Calanus* and barnacle nauplii. The larvae of many of the commercially important shellfish and finfish feed, in turn, on the rich zooplankton fauna, as do the jellyfish, and the ctenophore *Beroe ovata*. Squid, striped mullet, bay anchovy (*Anchoa mitchilli*) and menhaden may also be found feeding in open bay waters.

A commercial bay-shrimping industry flourishes and small, flat-bottomed shrimpboats of a variety of designs are a common sight. Southern flounder (*Paralichthys lethostigma*), black drum (*Pogonias cromis*), Atlantic (golden) croaker, red drum, and sand trout are caught by recreational fishermen from small boats and from the shore and fishing piers. The golden croaker makes a spawning run in the fall, attracting hoards of anglers to strategic points near the bay entrance.

Periodic changes in the bay water, brought about by climatic variability, have been shown to dramatically alter the benthic community structure, biomass production and nutrient regeneration.

In winter, the bays support immense flocks of double-crested cormorant, white pelican (*Pelecanus erythrorhynchos*) and ducks, including northern pintail, northern shoveler, american wigeon (*Anas* spp.) and redhead (*Aythya americana*). Duck-hunting is a popular winter sport. The bays are dotted with duck-blinds which can be used in summer as observation points.

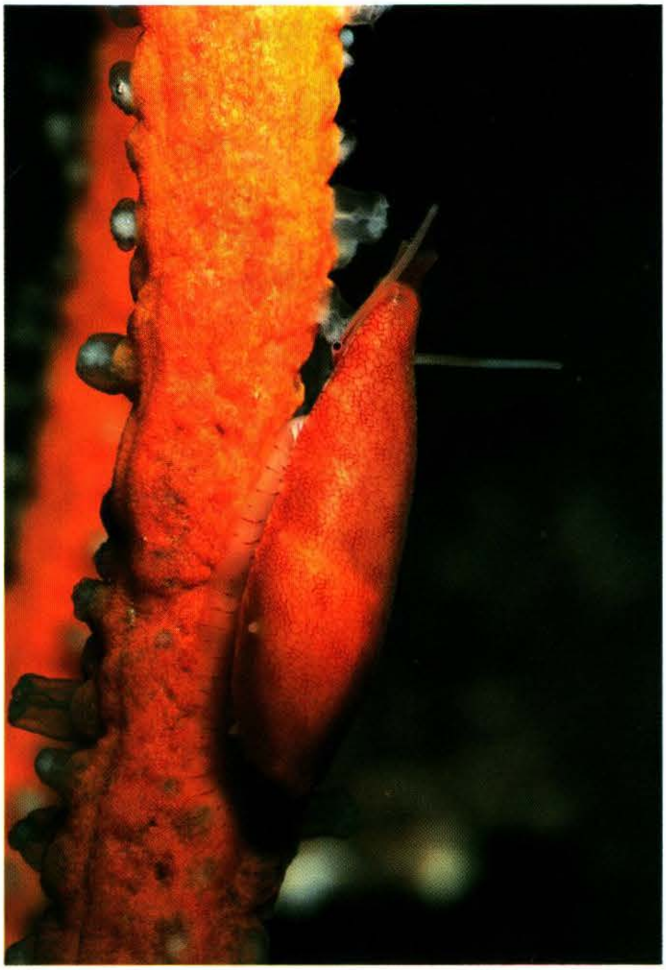
The role of the bay system as a nursery for many economically important fish and shellfish species is one aspect of research that has long been pursued at the Institute.

Much work remains to be done, especially as industry, agriculture, commerce, urbanization and the increased military use of the area threaten the natural environment with pollution, landfill and over-exploitation of resources.

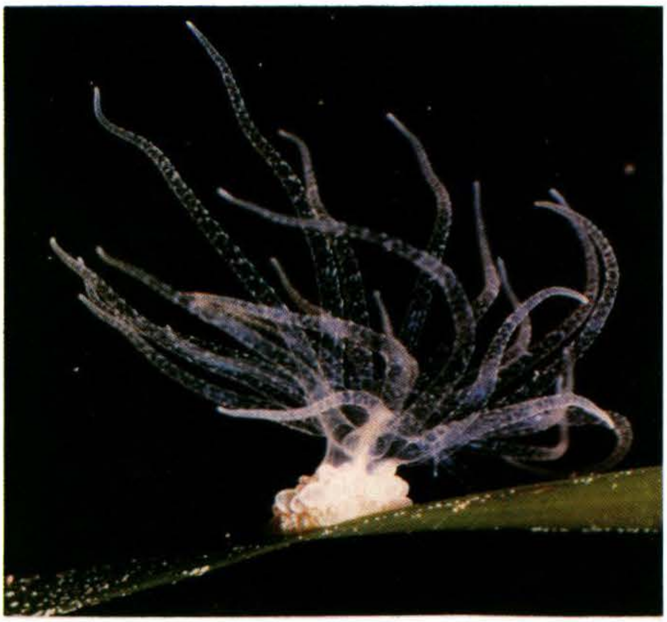
Oyster reefs develop in low salinity areas (between 10 and 30 ppt), perpendicular to the predominant current. Countless oysters serve as attachment points for other sedimentary animals such as hooked mussel (*Isachudium recurvum*), anemones and slipper shell limpets (*Crepidula* spp.). The reefs also attract numerous oyster predators including blister worm (*Polydora websteri*), boring sponges (*Cliona* spp.), oyster piddock (*Diplyothyra smythii*) and oyster drill (*Thais* spp.). Other inhabitants include stone (*Menippe*), blue (*Callinectes*) and mud (*Panopeus herbstii, Eurypanopeus depressus, Rithropanopeus harrisii*) crabs. The skilletfish (*Gobiosox robustum*) clings to the reefs with a sucker (formed jointly of the pectoral and ventrical fins) on the underside of the belly.

Seagrass Meadows

Seagrass beds provide one of the most diverse ecosystems in the world. These extremely productive areas are of direct interest to the nation's fisheries since they support a widely diverse community of fish and other organisms.



Color-mimicking provides camouflage for the 1 cm (0.4") parasitic snail, *Simnialena uniplicata*, feeding on the polyps of a gorgonian (the sea whip, *Leptogorgia setacea*). The sea whip feeds on plankton as it drifts past its filter-feeding polyps. Sea whips, resembling bundles of rusty-orange wire, often wash ashore on Gulf beaches.



A sea anemone (1 cm or 0.4") attached to a seagrass blade. White particles on the tentacles are batteries of stinging cells (nematocysts) peculiar to members of the Cnidaria phylum and are used for protection. The mechanisms by which the toxins are "fired" are of great interest to medical research.

In the Texas coastal region, extensive seagrass stands occur in the hypersaline Laguna Madre and smaller beds are found in Aransas, Redfish and Corpus Christi Bays. Among the plants found in these stands are turtle (*Thalassia testudinum*), widgeon (*Ruppia maritima*), shoal (*Halodule wrightii*), manatee (*Syringodium filaforme*) and clover (*Halophila engelmanni*) grasses. Shoal- and wigeongrass are the principal foods of the redhead and other ducks. The green turtle, for most of its life, feeds exclusively on seagrasses.

Two plants are widely distributed in the area: black mangrove, *Avicenna germinans*, which forms dense swamps and the smooth cordgrass, *Spartina alterniflora*, which grows in the shallow margins and at water's edge throughout bay areas. Both plant communities receive and retain nutrients washed from upstream waters and play important roles in the coastal food-web as feeding and refuge areas.

Epiphytic microalgae and serpulid polychaetes which attach to the seagrass blades are food for small gastropod mollusks (*Bittium varium*, *Anachis semiplacata*) and penaeid shrimp which, along with juvenile red drum and croaker, use the seagrass beds for refuge.

Mangrove Swamps

Black mangrove (*Avicenna germinans*) swamps are found in three major passes in South Texas: Pass Cavallo, Aransas Pass and Brazos-Santiago Pass. One of the largest swamps covers 600 hectares (about 1500 acres) on Harbor Island, a low barrier island at the confluence of Aransas Pass, Lydia Ann Channel, Aransas Shrimp Channel, and Corpus Christi Ship Channel. The swamp grows over the majority of the land area and lines many tidal channels that dissect the island, sharing the margins with *Spartina* cordgrass. These swamps are rich in species, offering a nursery area and refuge to such organisms as striped mullet, red drum, spotted sea (speckled) trout and blue crab, as well as to wading birds such as roseate spoonbill (*Ajaia ajaja*), reddish egret (*Egretta rufescens*), black-crowned night heron (*Nycticorax nycticorax*) and clapper rail (*Rallus longirostris*).

The rhizomes and aerial root system of the black mangroves trap silt and sediment and assist in the barrier-island building process. The limitation to the growth of mangrove swamps in this region appears to be temperature. Every few years a severe freeze kills up to 90 percent of the mangroves and it takes many more years for them to grow back to their former state. In normal years, seeds are carried out through the passes into the Gulf of Mexico and can often be found already germinating along Gulf beaches and on the back sides of the islands. The oldest surviving building in the area, the Aransas Lighthouse tower, built in 1857, stands in the Harbor Island mangrove swamp.

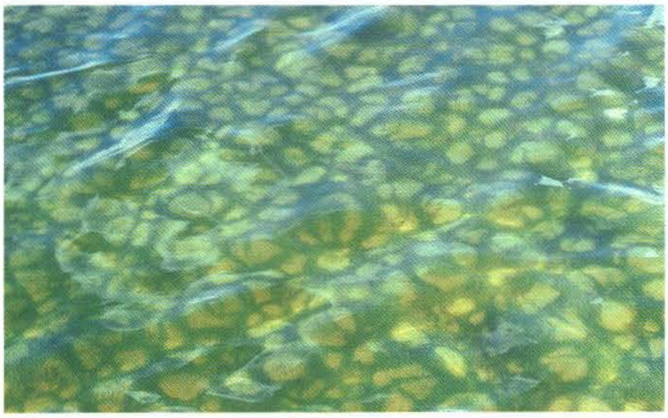
Spartina Marshes

Cordgrass (*Spartina alterniflora*) marshes are the major emergent vegetation of the shallow marginal areas in the bay system. The diurnal tides have little range on the back sides of the barrier islands and the *Spartina* does not experience the extremes typical of salt marshes in other coastal regions, where the grass is essentially submerged twice daily at high tide and completely exposed twice at low tide. In some areas, water levels are controlled mostly by wind and rainfall variations. The *Spartina* may dry completely in some regions by late summer.

The cordgrass itself is consumed by only a few animals--marsh crab (*Sesarma reticulatum*) and the snail *Melampus bidentatus*, for example. Numerous others find shelter, nest sites, refuge from predators and food in the surrounding mudflats and brackish ponds. Common invertebrates include the marsh periwinkle (*Littorina irrorata*), fiddler crabs (*Uca* spp.), ribbed mussel (*Geukensia demissa granosissima*) and the polychaete worm *Laeonereis culveri*. Most spectacular are the thousands of birds that use the *Spartina* marshes: grebes, pelicans, herons, egrets, spoonbills, ibises, rails, gallinules, ducks, gulls, terns, shorebirds, and many passerines. The long-legged waders often feed in large mixed flocks. Shorebirds range in size from tiny "peeps" to the large curlews, avocets, godwits and stilts. Coyote (*Canis latrans*), oppossum (*Didelphis virginiana*) and whitetailed deer (*Odocoileus virginianus*) during winter are common mammals using the marshes.

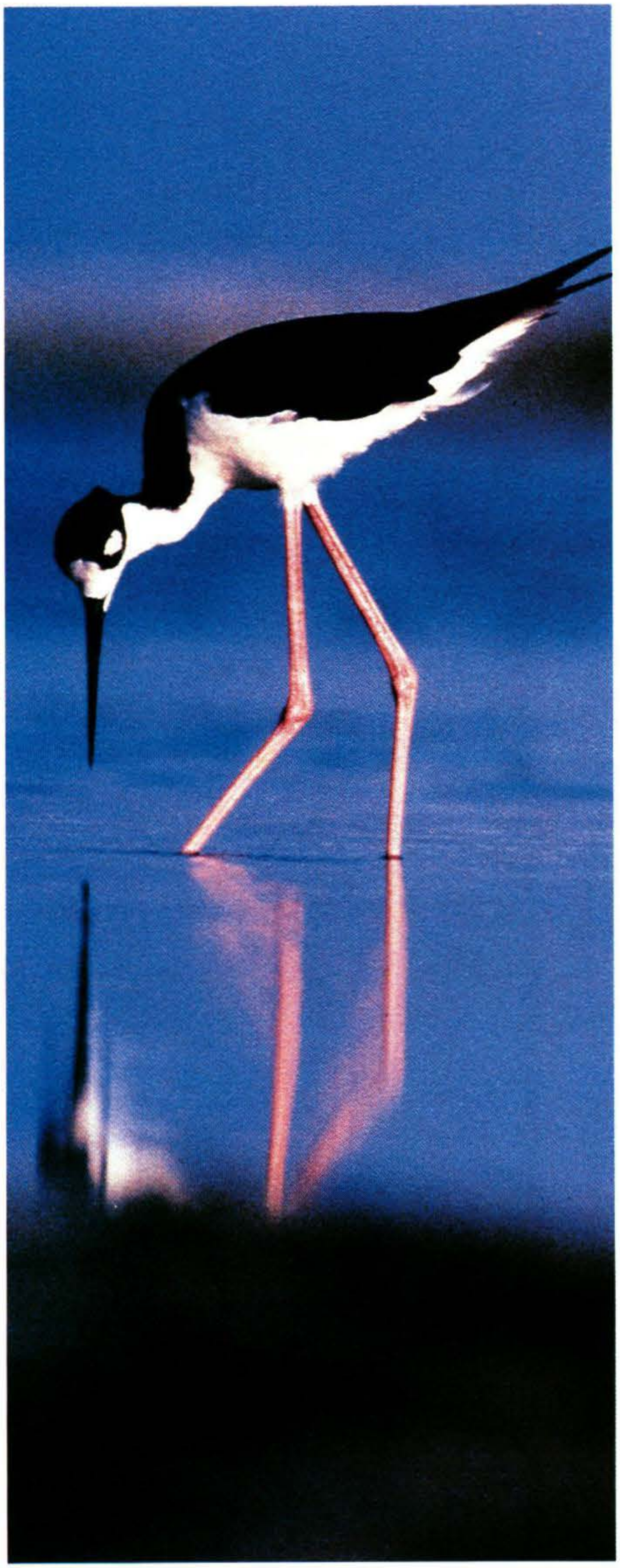
Wind-Tidal Flats

Extensive flat, sandy areas known as wind-tidal flats provide one of the region's harshest environments. In the "land-cut", where the Laguna Madre has become silted over, the Intracoastal Canal cuts through a flat that is nearly featureless from horizon to horizon. Wind-tidal flats periodically become inundated by sheets of water pushed up by prevailing winds or storm tides. Water may remain for weeks, months or years, before drying out. A filamentous bluegreen alga (*Lyngbya* spp.) thrives during wet periods and



Spartina marsh, algal flats: the cycle of drought and inundation typical of the everchanging face of the bayside barrier island environment.

forms a homogeneous sheet-like leathery mat over the sand. It provides food and shelter for microinvertebrates such as protozoans, nematodes and harpacticoid copepods as well as a variety of salt-tolerant insects including *Tachys pallidus* and *Diplochaetus lecontei*. Small fish such as *Cyprinodon variegatus* and



Fundulus spp. invade the flats during flooding. The system supports vast flocks of ducks, wading birds and shorebirds. When the waters recede, surviving fish retreat to deeper bay waters, the mats crack and curl up at the edges, halophilic bacteria multiply and give a reddish hue to the sediment, salt crystals fringe the pools, and the pickle weed (*Salicornia* spp.) plants turn brown, giving the flats a lifeless, dry and desolate appearance.

Spoil Islands

An unusual but important habitat has been created by the deposition of bay dredge-spoils to form islands which eventually become vegetated. Colonies of gulls, terns, the black skimmer, herons, ibises and egrets now nest on these islands. Some 40,000 pairs of 20 species nested on the spoil and other islands in 1980. The only salt-water nesting colony of white pelican is on spoil islands near South Bird Island in the Laguna Madre. The endangered brown pelican (*Pelecanus occidentalis*) has made a comeback after the Texas population "crashed" in the 1950's and 1960's due to pesticides. The largest colony is on Pelican Island, a spoil bank on the Corpus Christi ship channel. Emergence of vegetation on newly created islands provides an opportunity to study the stabilization of dune areas by naturally occurring and introduced plant species.

A black-necked stilt (*Himantopus mexicanus*) probes for invertebrates on Mustang Island's East Flats. The stilt is a summer resident and local breeder in the area. East Flats is an area of *Spartina* marshes, algal flats, scattered mangroves, shallow bay waters and ponds of varying salinity, vegetated islands and barren sand flats.

The Marine Science Institute has grown considerably since its beginnings in a small wooden building on the point. Researchers and students visiting the Institute for sampling trips in our varied environments often stay in that same building, now converted to a comfortable dormitory. While they might muse over the changes man has brought about in this coastal area in the past 100 years, their window overlooking the Aransas Pass provides a glimpse into a fascinating environment still shaped by the forces of nature. The larger "window on the sea" provided by the Institute allows researcher and student alike an opportunity to unravel the many mysteries remaining to be solved in this dynamic environment.

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