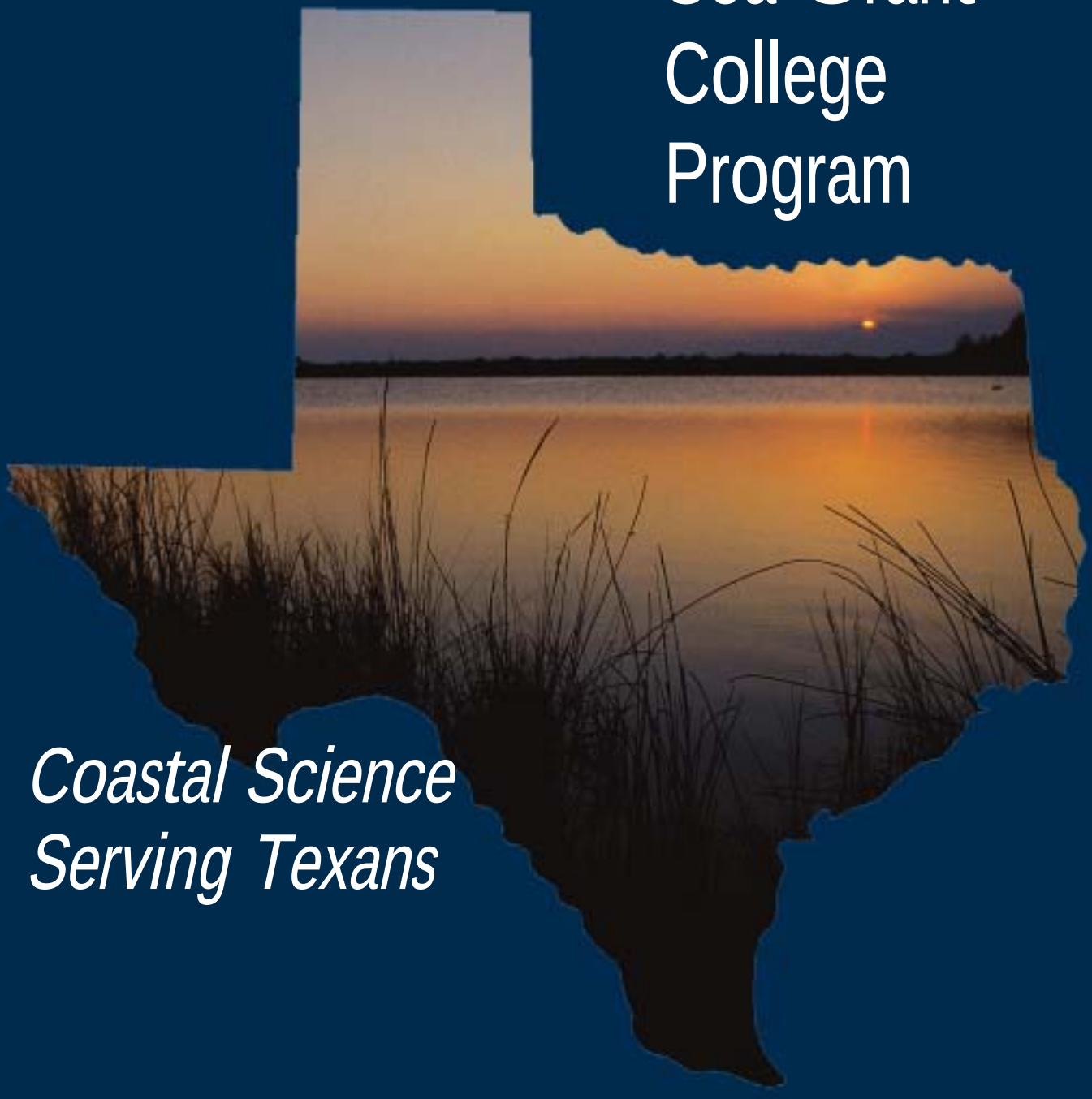
Texas Sea Grant College Program



Coastal Science Serving Texans

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From the Director

For most of the nearly 35 years of the Texas Sea Grant College Program's existence, our emphasis was largely focused on research that dealt with living marine resources and the environment in which they live. Little wonder that Sea Grant was often referred to as "fish grant." Those days and that reputation are changing rapidly, although the priorities for the 2004-2006 funding cycle have not changed – at least not significantly – from those of the 2001-2004 cycle: coastal ecosystem health and coastal ecosystem development. However, one word in the latter priority has changed to better reflect the types of research we are interested in supporting for the next two years, as coastal ecosystem development is now being called coastal economic development.

Dr. Robert R. Stickney

In recent years it has become increasingly clear that Sea Grant needs to encompass not only research that deals with the natural sciences, but we need to place a good deal more emphasis on the social sciences and cultivate new partnerships with faculty across the state who are involved in such disciplines as coastal engineering and policy and law, as well as architecture – in particular, landscape design and urban planning.

Why the need to expand our horizons? Primarily because it is becoming increasingly clear that virtually all of the studies in which Sea Grant has invested its time and dollars are related, in some way, to human activity along our coast.

The attraction of the Texas coast has led to rapid growth, particularly over the past 50 years. The result has been heavy impacts on marine commercial and recreational fisheries, dramatic increases in water and air pollution, consumptive water use leading to reductions in freshwater inflow to estuaries, wetland destruction and various other insults to the natural environment. One Texas Sea Grant outreach specialist estimates that if the city of Houston increases in population by four million people in the next 35 years, as some predict, and if the population density of the city remains at the current approximately 4,000 people per square mile, some 1,000 square miles of what is now open space will become populated! The pressures on the natural resources will be enormous.

Currently, Sea Grant is working with city planners, educators and others to begin developing new approaches to accommodate the influx of people to the coast without totally destroying those aspects of the environment that are the reason so many are drawn to our shoreline. To better determine what needs to be done and how those needs can be accomplished will require Sea Grant to branch out into some new arenas, as mentioned above. Currently, much of the activity associated with coastal community development exists within the communications and extension activities of Sea Grant. As we become more familiar with the challenges facing our coast and its resources, we will continue to cultivate relationships with social scientists and others who can provide the information required to develop the coastal communities of the future in a more responsible and sustainable manner.

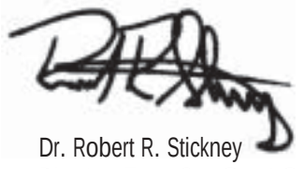
As you will see in this report, research in the 2001-2004 funding cycle is focused on some very important problems of local and regional interest, as well as at least one project with global implications that deals with climate change. Investigators funded for the 2004-2006 cycle that began on March 1, 2004, will be looking at the important issue of freshwater inflow, examining historical changes in our shoreline, producing maps of the continental shelf with remarkable resolution, trying to find better ways of producing red drum for enhancement of populations in our coastal waters, and addressing several other important topics. Each study, I would submit, ties in with coastal community development and the quality of life issues associated with a healthy coastal region.

Sea Grant extension specialists and agents are working with cities and other entities that support lifeguards to place warning signs about rip currents along our beaches. Table tents describing rip currents and what to do if you encounter one while swimming have been placed in several thousand motel rooms along our coast. Those table tents are in both English and Spanish. Sea Grant has funded a mini-grant research project that will attempt to determine the extent to which drownings along the Texas coast have occurred in conjunction with the presence of rip currents. Increasing population does not have to mean a concomitant increase in drownings if the public is educated about rip currents, and if the program saves even one life, the expenditures will have been well worth it.

Our educational programs have resulted in the establishment of the Floating Classroom Program, which takes middle- and high-school students out on a converted shrimp trawler so they can experience the wonders of Texas' coastal waters. Students also travel to a marsh and conduct some simple experiments on land as they develop a better understanding of marine science. A researcher funded by the program has produced a book of lesson plans – all of which have marine themes – aimed at middle-school students in a variety of classes, not just science and math. Teachers can use those lesson plans with marine-related examples that support the material they are teaching. Since most students, whether in Galveston or Lubbock, can relate to the ocean, the topic, whatever its nature, can be presented in a manner that peaks student interest. Also, each lesson is tied to the state's mandatory testing program.

It would be very easy to go on and on about the various activities with which Texas Sea Grant is involved. Suffice it to say that the program has an excellent staff of dedicated outreach, communications and education specialists, and we support our research universities' finest researchers and students who have an interest in the marine environment. I am extremely proud to have the opportunity to work with them and through them participate, at least vicariously, in their activities. Recent achievements and some that will come within the next year or two are the subject of this report.

For additional information, please pay a visit to our web site at http://texas-sea-grant.tamu.edu.



Dr. Robert R. Stickney
Director, Texas Sea Grant College Program
and Professor of Oceanography

Texas Sea Grant College Program:

Coastal Science Serving Texans

For more than 30 years, the Texas Sea Grant College Program has provided support, leadership and expertise for marine research, extension and education in coastal Texas. It serves and assists a wide range of organizations and individuals, including federal, state and local governments, environmental and industry trade organizations, colleges and universities, K-12 teachers and students, special interest groups focused on coastal issues, tourists and the public.

Texas Sea Grant is a component of the National Sea Grant College Program of the National Oceanic and Atmospheric Administration and also part of the College of Geosciences at Texas A&M University. It is one of a network of 31 university-based programs in coastal and Great Lakes states. Through a partnership of industry, government and higher education, Sea Grant sponsors and promotes programs aimed at the understanding, wise use and stewardship of the nation's coastal and marine resources to develop and maintain a sustainable economy and a healthy environment.

The national program, established by Congress in 1966, was modeled after the Land Grant Colleges. In 1971, Texas established one of the nation's first four Sea Grant Colleges.

Today, Texas Sea Grant helps to maintain the United States' position as a world leader in marine research and sustainable development of marine resources by supporting focused, competitive research projects by qualified investigators at universities throughout the state and promoting and engaging in significant marine education and outreach activities, ranging from the creation of public school curriculum materials to coordinating conferences that make new information available to coastal businesses, marine

The Texas coast is one of the state's leading recreation and tourist destinations. (Photo courtesy Texas Department of Transportation)

industries, governmental agencies, decisionmakers and the public. To support these endeavors, the program is organized into three main components: Program Administration, the Marine Advisory Service and the Marine Information Service.

The *Program Administration* oversees the program's daily operations and is responsible for awarding about $850,000 in grants annually to the best marine researchers in the state. The program currently focuses on three much-needed research areas: coastal ecosystem health, coastal economic development and marine education. The administration solicits and evaluates research, outreach and education proposals and ushers them through a rigorous peer review process to select and prioritize projects to be funded by the program.

Texas Sea Grant's research vessel KARMA hosts on-board educational programs for schoolchildren. (Photo by Jean O'Dette)

Texas Sea Grant also funds smaller research projects. These Mini-Grants are designed to take advantage of opportunities that are not anticipated during the two-year major research funding cycle, opportunities for which limited amounts of funding may have significant results. They may be used to test concepts that could lead to development of larger proposals submitted to Sea Grant or other funding agencies, to support new faculty at Texas colleges and universities who are trying to initiate research programs, or to fund research demonstration projects for Marine Advisory Service agents and specialists.

The *Marine Advisory Service* (MAS) is supported by the Texas Sea Grant College Program in cooperation with Texas Cooperative Extension, Texas A&M University, the Texas Transportation Institute and the county commissioners' courts. Its seven county agents serve the needs of coastal communities throughout the state, while its eight specialists, including a new National Sea Grant Ports and Harbors Specialist, support the county agents and carry out their own individual projects. Texas Sea Grant specialists also focus on the areas of aquaculture; marine

Texas is a major seafood producing state, generally ranking in the top five of all states based on the value of the catch. (Photo courtesy Texas Department of Transportation)

business; environmental quality; coastal community development; seafood quality, marketing and economics; marine fisheries; marine education; and marine policy.

Recent activities by the MAS include acquiring a vessel to support the Floating Classroom Program, developing the Texas Coastal Watershed Program, and coordinating the landmark international 2003 Summit for the Sustainability of the Gulf of Mexico Shrimp Industry. MAS's county agents also have been involved with developing aeration systems for marinas, teaching boaters how to use sewage pumpout facilities, developing live bait holding systems and a wide variety of other activities.

The *Marine Information Service* (MIS) communicates the results of Texas Sea Grant research projects and other important marine information to the people of Texas through media releases, brochures, posters, pamphlets, conference and workshop proceedings, books and its award-winning quarterly magazine, *Texas Shores*. MIS staff members support the administrative, research and advisory functions of Texas Sea Grant through the writing, editing, design, reproduction and distribution of publications, directing a concerted media relations effort, maintaining the program's Web site, preparing reports and proposals, and assisting with seminars, workshops and exhibits.

MIS publications are distributed across the country and internationally. *Texas Shores* is used in classes at three universities nationally and is distributed to high schools across the state. Recent

issues have focused on coastal erosion, development in coastal metropolitan areas, algal blooms, freshwater availability, biomass energy, shrimping, National Estuarine Research Reserve designation and the reflooding of the Bahia Grande. The magazine's "Coastal Legends" series also highlights the contributions of individuals who have played a pivotal role in the development of the marine sciences in Texas.

Other recent publications have included *Investigating the Marine Environment in the 21st Century*, an 818-page middle-school curriculum resulting from a research grant; a collection of publications – a guidebook, certificate, brochures, reference card and clean boating tips handout – to support the Clean Texas Marina initiative; books such as the *Texas Coastal Wetlands Guidebook*; and collaborative projects with the Texas Commission on Environmental Quality, Texas A&M University and the National Sea Grant College Program, to name a few. Texas Sea Grant also supported the National Sea Grant Program by hosting the Sea Grant Week 2003 national conference in Galveston, Texas.

In summary, Texas Sea Grant addresses practical problems through focused research, maintains close contact with coastal communities and other groups through a cadre of extension agents and specialists, and disseminates information in a wide variety of formats for a broad range of audiences. As the leading source of unbiased, state-of-the-art scientific information about the state's coastal region, the Texas Sea Grant College Program is dedicated to its motto: Coastal Science Serving Texans.

The coastal area is the most biologically rich and ecologically diverse region of the state — and also is home to chemical plants, oil refineries and gas processing plants that supply almost two-thirds of the nation's petrochemical needs and more than 20 percent of the United States' oil refining capacity.

Research Projects 2004-2006

The Texas Sea Grant College Program has three primary research priorities: coastal ecosystem health, coastal economic development and marine education. The projects approved for the 2004-2006 biennium focus on these areas, and also combine two or more of the priorities within the same project.

Bays and Estuaries

Five of the eight research projects focus on Texas estuaries and bays, and are expected to yield important information about coastal ecosystem health that will also have applications for coastal economic development. Two of the projects examine the importance of freshwater inflow, an increasingly critical issue as human population and corresponding development increase along the coast.

Quantifying Groundwater Inputs to South Texas Bays Using a Multiple Tracer Approach
Henrietta Edmonds,
The University of Texas Marine Science Institute

Henrietta Edmonds of The University of Texas Marine Science Institute is leading a regional study to measure groundwater inputs and the chemicals they contain to Nueces, Baffin and Mission-Copano bays, using naturally occurring geochemical tracers and direct measurement. Given the aridity of most of the Texas coast and the low amount of surface runoff, the effects of groundwater inflow may be particularly significant in this region, and the information gleaned through this project will be crucial to effective coastal management and to predicting the impacts of potential future changes in aquifer use or aquifer contamination.

Reduced Freshwater Inflows and Productivity in the Guadalupe Estuary: Use of High-resolution Spatial Mapping
Daniel Roelke,
Texas A&M University

A water diversion project being considered to provide additional freshwater for the growing population of San Antonio – and thus reducing the water available to the Guadalupe Estuary – has prompted Daniel Roelke and Stephen Davis of Texas A&M University to study the effects of reduced freshwater inflows on the estuary, which is the source of commercially important finfish and shellfish species and encompasses the wintering grounds of the only natural migratory population of whooping cranes in the world. The research team will take samples

The Guadalupe Estuary is the wintering grounds of the world's only natural migratory population of whooping cranes.

periodically and after major storms to record several water quality characteristics across the estuary. Using high-resolution spatial mapping, the researchers will plot changes in productivity as a result of pulses of freshwater inflow – pulses that would decrease in frequency and size if the flow of water to the estuary is decreased. Findings from the study will be valuable to water managers and state officials setting guidelines on diversion as they strive to balance human demands with the flows needed to maintain ecosystem health.

The shallow wave basin of the Reta and Bill Haynes '46 Coastal Engineering Laboratory at Texas A&M University is being used in research studying exchange processes between estuaries and the open Gulf.

A third research project examines the exchange processes between estuaries and the open Gulf Coast. Scott A. Socolofsky and Kuang-An Chang of Texas A&M University are using the new shallow wave basin of the Reta and Bill Haynes '46 Coastal Engineering Laboratory at Texas A&M to investigate large-scale eddy formation and the resulting mixing in tidal inlets as influenced by beach slope and inlet geography. The researchers will construct an artificial beach and simulate a long-shore current. They will conduct experiments under conditions that mimic two inlet types – flow from a river directly into open coastal ocean over a beach and flow into a bay protected from open water by a system of barrier islands. The analysis of the lab results will help coastal engineers and scientists understand the dominant mechanisms of exchange between open waters and estuaries and help them predict and control such exchanges.

Laboratory Studies of Exchange Processes through Tidal Inlets on the Texas Coast
Scott Socolofsky and Kuang-An Chang, Texas A&M University

Ayal Anis and Gary Gill of Texas A&M University at Galveston and James Pinckney of Texas A&M University will study the impact of physical forcings on nutrient fluxes in Galveston Bay. Although there are periodically high influxes of nutrients through the rivers entering the bay, Galveston Bay does not suffer from the large or persistent algal blooms commonly found in other estuaries. The key may be the shallowness of the bay, in which physical processes, such as winds, waves and tides, could have a greater impact. Researchers will conduct physical, biological and

Physical Control of Nutrient Fluxes in Galveston Bay
Ayal Anis and Gary Gill, Texas A&M University at Galveston
James Pinckney, Texas A&M University

One research project will attempt to determine why Galveston Bay is less affected by harmful algal blooms than other bays in Texas. (Photo courtesy Texas Department of Health)

chemical measurements during different seasons, during periods of high and low freshwater inflow and immediately after major storms, and combine the measurements to provide information about physical/biological/chemical interactions. The results of the research can be used to develop strategies for moderating the impact of harmful algal blooms and for evaluating the effectiveness of current EPA standards for maximum pollutant inflow levels.

Many beneficial use islands and marshes are now under development in Texas to mitigate ecosystem losses elsewhere and to provide a place to deposit dredged material. Marsh channels or creeks that allow the circulation of bay waters through and inundation of such marshes and that provide plenty of interface between land and water generate healthy and productive ecosystems. However, some preliminary marsh designs in the Galveston Bay area have had insufficient circulation and have been choked by siltation. In the fifth research project, Thomas Ravens and Vijay Panchang of TAMUG are using a circulation and sediment transport model to develop and test creek designs. Working in conjunction with the Beneficial Use Group at Galveston Bay, the researchers will validate their model at every step with measurements in the field. The project is expected to lead to better focused experiments and better quality models so the approach can be adopted in other areas and to provide an evaluation of creek construction techniques that maximize ecological functioning and sustainability at a minimum cost.

Design of Ecologically Rich and Sustainable Tidal Channels within Beneficial Use Marshes
Thomas Ravens and Vijay Panchang, Texas A&M University at Galveston

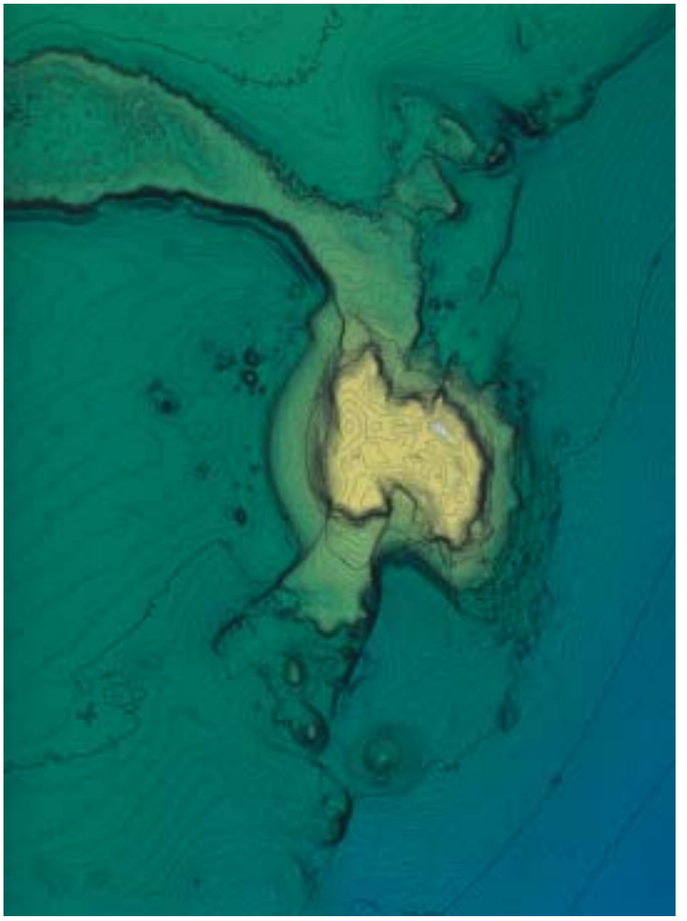
Mapping the Coast

Two research projects focus on mapping techniques to add to the body of knowledge about the physical characteristics of the Texas coast.

The first project has a marine education emphasis, but the information it will produce will also be valuable to scientists, engineers and decisionmakers. Troy Holcombe, William Bryant and

Sarah Bednarz of Texas A&M University will combine decades of digital bathymetric data and a smaller number of paper records to produce the first detailed, easily readable bathymetric maps of the Texas-Louisiana Continental Shelf and upper Continental Slope, including bays and estuaries and the shoreline. The completed bathymetry will be transitioned into the mainstream K-16 education in both Texas and Louisiana through the development of curriculum support materials and also made available on CD-ROM and on paper for applications in ocean engineering and construction, coastal zone planning, environmental decisionmaking, storm impact forecasting, the monitoring of transport/ deposition of toxic wastes and the regulation of fishing.

New Bathymetry of the Texas-Louisiana Continental Slope: Education, Research, Engineering, Decisionmaking
Troy Holcombe, William Bryant and Sarah Bednarz, Texas A&M University



The completed bathymetry of the Texas-Louisiana Continental Shelf and upper Continental Slope will have research, commercial, policymaking and educational applications.

The combined effect of sea level rise and coastward population migration has made the Texas coastal zone more vulnerable to coastal erosion, floods and frequent hurricanes and tropical storms. In the second mapping project, Hongxing Liu and Douglas Sherman of Texas A&M University are using high-resolution IKONOS satellite imagery and GIS techniques to analyze shoreline changes along the Texas coast. The researchers will examine the magnitude, patterns and causes of short-term (movement occurring over several seasons to five to 10 years), seasonal and episodic (caused by a single storm) changes along the upper Texas Gulf Coast during 2000-2005 using time series of high-resolution satellite images combined with tide gauge data and GPS-measured beach profiles. That information will be used to develop an innovative software package, freely available to coastal researchers, that will automatically delineate shoreline

Quantitative Analysis of Short-term Shoreline Changes Using High-resolution Satellite Imagery and GIS Techniques
Hongxing Liu and Douglas Sherman, Texas A&M University

Red drum hatcheries, including this one at Sea Center Texas, will benefit from research about hatchery-raised red drum growth and health. (Photo by Stephan Myers)

features from satellite imagery. The project will improve understanding of the magnitude and causes of short-term and episodic shoreline variations and provide a scientific basis for formulating coastal management policies.

Enhancing Hatchery Production

The final research project approved in 2004 focuses on better survival of hatchery-raised red drum in the wild by improving their growth and health before release. Annually since the mid-1980s, about 30 million juvenile red drum have been grown in hatcheries operated by the Texas Parks and Wildlife Department (TPWD) and released into Texas bays in an attempt to maintain the stock of this important sport and food fish. Among the most difficult problems of juvenile production is exhaustion of forage in the hatchery ponds, leading to the need for premature release of undersized fish that have relatively low survival rates. William Neill and Delbert Gatlin of Texas A&M University and Robert Vega of TPWD are studying the effects of environmental variation and feed quality on red drum growth and health. With lab and pond experiments, the researchers will test predictions from Ecophys.Fish, an ecophysiological simulation model developed in previous Sea Grant projects. The simulations predict that supplemental feeding could increase the average size of the red drum at release by 4.5 times, improving short-term survival and increasing the number that grow to fishable size. The results of this project will benefit state and federal agencies responsible for managing marine resources, commercial red drum producers, the scientific community and the public.

Effects of Environmental Variation and Feed Quality on Juvenile Red Drum Performance
William Neill and Delbert Gatlin, Texas A&M University
Robert Vega, Texas Parks and Wildlife Department

Research Projects 2001-2004

A dozen major research projects begun during the 2001-2004 funding cycle are in various stages of completion.

Red Drum Nurseries

Two of the projects examine ways to determine the nursery grounds of adult red drum, an important sport fish in Texas. Researchers Jay Rooker, Gary Gill and Thomas Minello of Texas A&M University at Galveston and Scott Holt of The University of Texas Marine Science Institute are doing the final analysis of data collected for a project designed to determine the birthplaces of adult red drum by comparing the chemical composition of adult fish otoliths or earstones with the composition of juvenile otoliths from several different nursery areas along the Texas coast and from hatcheries. The results will help determine the contributions of the different nursery areas to the adult numbers – information essential to understanding the health and importance of natural ecosystems – and the amount of mixing from the different nurseries that occurs among the adult population. Additionally, the otolith element "fingerprinting" techniques developed for this study – which included the mechanics of adult otolith core sampling, determining the trace elements most useful for differentiating locations, and sampling over several years to ensure that the chemical composition remains stable over time – will be tremendously useful for future coastal research on fish populations and their origins.

Recreational fishing for red drum is a vital resource for the economies of Gulf Coast communities. (Photo by Stephan Myers)

John Gold, William Neill and Delbert Gatlin of Texas A&M University and Timothy Mousseau of the University of South Carolina, working in conjunction with the Texas Parks and Wildlife Department, are combining their expertise in molecular and quantitative genetics, physiology and aquaculture to identify a set of genetic markers called microsatellites that can be used to determine the broodstock origins of hatchery-produced red drum collected in the wild. The researchers also are using the markers to assess any family basis for variations in growth rate, cold tolerance and the capacity for generalized physiological

Origins and Mixing Rates of Red Drum Stocks: Assessing the Contribution of Different Nursery Grounds Using Biogeochemical Fingerprints
Jay Rooker, Gary Gill and Thomas Minello, Texas A&M University at Galveston
Scott Holt, The University of Texas Marine Science Institute

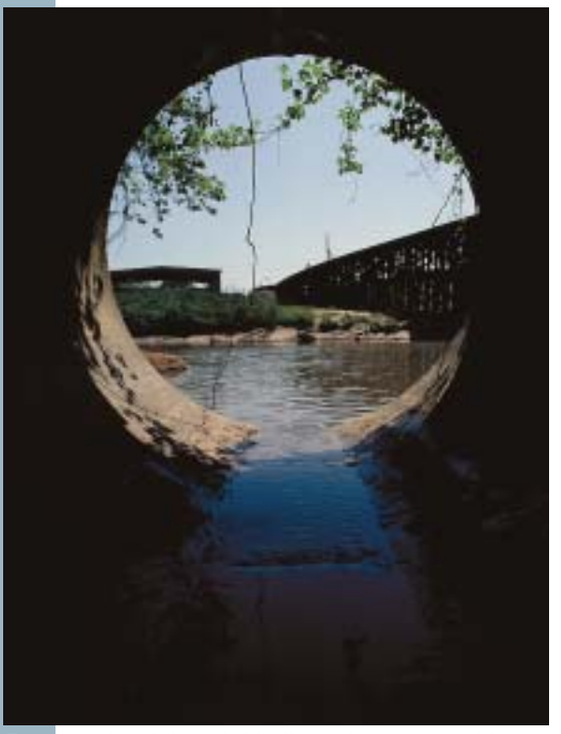
Development and Application of Hypervariable DNA Markers (Microsatellites) to Issues in Stock Enhancement and Culture of Red Drum
John Gold, William Neill and Delbert Gatlin, Texas A&M University
Timothy Mousseau, the University of South Carolina

performance. In addition to small-scale experiments to assess the performance in the wild of released fish and thus the hatchery broodstock that produced them, the project will include the first steps toward generating a red drum genetic map that will ultimately lead to a more technologically based selection of broodstock for red drum aquaculture. While the specific results of this project will primarily benefit red drum interests, the techniques developed can also serve those involved in the hatchery production and release of other game fish species.

Exposure to Contaminants

Contaminants in Texas Bays: Impairment of Red Drum Survival Skills and the Consequences for their Populations
Lee Fuiman, The University of Texas Marine Science Institute

Another project is studying the effects on red drum larvae from exposure to atrazine and malathion, two currently used pesticides present in measurable quantities in Texas coastal bays. Lee Fuiman of UTMSI is analyzing the data from behavioral and physiological tests used to determine the degree of impairment of larval survival skills, growth, development, condition and susceptibility to predators – and the consequences for larval survival – at environmentally realistic levels of exposure to each of the two pesticides. Marine fish larvae have an extremely high natural mortality rate, mainly from predation and starvation. Very small changes in larval mortality can have an enormous impact on the size of the adult population. The results of the project will contribute to a better understanding of fluctuations in wild fish stocks and to better strategies for determining the best locations and times for releasing hatchery-reared fish into Texas bays.



Three research projects are studying the effects of environmental contaminants on marine fauna. (Photo by Jamey Tidwell)

Two other research studies also focus on the effects of environmental contaminants on marine life. Peter Thomas of UTMSI is examining male Atlantic croaker collected in the Galveston and Corpus Christi bays for signs of feminization caused by exposure to environmental estrogens. In an earlier portion of the research project, he tested croaker exposure to xenoestrogens in the laboratory to find the best possible indicators of feminization to lay the groundwork for the next phase of the project, which involved testing of croaker collected from sites near sewage and industrial outfalls in the Galveston and Corpus Christi bays. Recent studies have indicated widespread feminization of male fish because of the presence of estrogenic contaminants in estuaries in Europe and Japan, but this is the first study of its kind in U.S. estuaries. Preliminary results for estrogen contamination of Texas estuaries are promising, as there has been no

evidence of feminization of croaker in the estuarine sites sampled to date in this project. Additional sites will be sampled in the final year. Recently, the genes for the three estrogen receptors in croaker have been expressed to enable researchers to examine their binding to these environmental estrogens. The results show that the binding to these receptors varies considerably, adding an additional level of complexity to the effects of these chemicals on reproductive systems.

Research studying how bivalves take up metals could affect the way filter feeders like oysters are used as pollution indicators.

Assessment of Feminization in Male Croaker and the Presence of Estrogenic Contaminants in Estuarine Environments
Peter Thomas, The University of Texas Marine Science Institute

Peter Santschi, Laodong Guo and Sammy Ray of TAMUG are synthesizing the data from their research project, which studies the role of natural dissolved organic matter in determining the quantity of potentially toxic metals absorbed by estuarine bivalves, such as oysters and mussels. The researchers theorize that bivalves can use certain dissolved organic matter compounds directly as a food source, and that because trace metals are often associated with potentially nutritious dissolved organic matter, the bivalves' absorption of the latter may greatly influence their uptake of trace metals and organic pollutants. Filter feeders such as oysters are frequently used as pollution indicators, so the study's conclusions about how bivalves take up metals, including the variables of minimum particle size and colloidal particle type and characteristics, will have significant applications for environmental assessment and monitoring programs.

Role of Natural Organic Matter in Governing the Bioavailability of Potentially Toxic Metals to Estuarine Bivalves
Peter Santschi, Laodong Guo and Sammy Ray, Texas A&M University at Galveston

Other Marine Wildlife

Three other projects also focus on marine fauna. Jaime Alvarado-Bremer of TAMUG and Jim Ditty of the National Oceanic and Atmospheric Administration Southeast Fisheries Science Center have developed an inexpensive, practical technique for identifying and verifying differences between post-larval brown shrimp and pink shrimp. Predictions of each generation's numbers, assessments of nursery habitats, and decisionmaking that affects coastal development and wetland and shrimp fishery management all depend on an accurate assessment of shrimp numbers at all life stages. While adult brown and pink shrimp are relatively easy to distinguish, they can be extremely difficult to identify in the post-larval and early juvenile stages. The two researchers have combined molecular genetics techniques with ontogenetic characters to provide a reliable method of species identification. By assaying the 16sRNA mitochondrial gene, they are

Identifying Species of Young Commercial Shrimp by Combining Developmental Morphology and Molecular Genetics
Jaime Alvarado-Bremer, Texas A&M University at Galveston
Jim Ditty, NOAA Southeast Fisheries Science Center

Survey and Inventory of the Fishes of the Gulf of Mexico
John McEachran, Texas A&M University

able to identify among all species of *penaeid* shrimp known to occur in the Gulf of Mexico, including exotic cultured species of Pacific white shrimp. In tandem with the validated molecular identification, an ontogenetic index of external biological features over the life cycle of each species, complete with digital images, will make it easier to correctly identify large numbers of specimens.

Another grant will result in the publication in 2005 of the second volume of *Fishes of the Gulf of Mexico* by John McEachran of Texas A&M University and his co-author, Janice Fechhelm. The text, which has been extensively peer reviewed, contains 689 species and 85 family descriptions, instructions on how to identify fishes, and a biogeography section that compares the diversity of fishes and species of the Gulf with other regions. The complete two-volume set represents the most complete survey and inventory of the fishes collected and recorded from the Gulf of Mexico during the past 200 years. In addition to its usefulness as a source for identifying fishes in the Gulf, the book's historical record also can be used as a yardstick against which to measure present and future changes in species distribution because of natural and human-caused changes in the Gulf of Mexico and to aid monitoring for non-native species.

Being able to differentiate between shrimp species at all stages during their life cycle is important for monitoring and assessment programs and for coastal development and fisheries management.

Assessing the Health of the Planktonic Food Web in Texas Coastal Bays Using RNA:DNA Ratios
Edward Buskey, The University of Texas Marine Science Institute

Edward Buskey and PhD student Christa Speekmann of UTMSI are developing a new method of determining coastal ecosystem health by extrapolating egg production rates from the RNA:DNA ratios of the female coastal copepod *Acartia tonsa*. Initial laboratory tests to determine the relationship between RNA:DNA ratios and egg production rates were repeated for variations in temperature and salinity and for the effects of natural and man-made disturbances such as harmful algal blooms and pollutants, and finally compared to results from field-collected zooplankton. Existing methods of surveying copepod population health involves time-consuming laboratory experiments and live sorting of zooplankton. Buskey and Speekmann's method can routinely assess the health of planktonic food chains by collecting animals from numerous locations and determining their condition using a relatively simple biochemical laboratory assay. Zooplankton like copepod larvae are an important link in the food web between phytoplankton and larval fish, and their adequate presence as a food supply is critical to the successful maturation of marine fish larvae.

Habitat Health

Coastal nursery habitats, such as Texas' approximately 235,000 acres of seagrass meadows, are critical for estuarine fisheries and wildlife. Two researchers are studying the impacts of environmental stressors on the photosynthetic efficiency of the seagrass *Thalassia testudinum* (turtle grass). Hudson DeYoe of The University of Texas-Pan American is examining the distribution, abundance and composition of drift algal beds that cover seagrass meadows in the lower Laguna Madre. In conjunction with his studies, Kenneth Dunton of UTMSI is in the process of developing a non-invasive technique to more rapidly and easily assess the health of such coastal plants in relation to invasions by drift macroalgae. Dunton is using pulse amplitude modulated fluorometry to estimate *Thalassia testudinum* production through photosynthesis at sites in the lower Laguna Madre and Redfish Bay, conducting laboratory tests on samples harvested from the sites, and doing on-site tests with submersible equipment. Both parts of the project will yield information on the impact of environmental stressors such as light, temperature and nitrogen levels on the health of Texas seagrass beds. In addition, the effects of drift macroalgae and algal epiphytes (algae that grow on the surface of aquatic plants) on seagrass populations will also be determined for grass beds in Redfish Bay and the Laguna Madre.

Innovative Tools for Seagrass Monitoring: Application of PAM Fluorometry to Measure Seagrass Stress and Primary Production
Kenneth Dunton, The University of Texas Marine Science Institute
Hudson DeYoe, The University of Texas-Pan American

Another team of oceanographers is finishing a re-evaluation of the factors responsible for the occurrence of hypoxia, dissolved oxygen concentrations low enough to threaten marine life, over the northern shelves of the Gulf of Mexico. Worth D. Nowlin Jr., Liela Belabbassi, Ann Jochens and Steven DiMarco of Texas A&M University and William Watson Schroeder of the University of Alabama have examined data collected in the 1990s over the Texas, Louisiana, Mississippi, Alabama and Florida continental shelves and also have examined historical databases for information about background conditions (winds, currents, heating, river discharge and

The Laguna Madre is one site for a research project testing the impact of environmental stressors on the health of seagrass.

Core samples from the Flower Garden Banks coral reefs may yield important insights about the climate patterns of the Gulf of Mexico during the past 250 to 400 years.

Processes Responsible for Hypoxia in the Gulf of Mexico: A Re-evaluation with New Data and Perspective
Worth D. Nowlin Jr. and Yongxiang Li, Texas A&M University
William Watson Schroeder, the University of Alabama

nutrient loading) and local factors (stratification, nutrient levels and light levels) as they relate to dissolved oxygen levels. Most studies of hypoxia in the Gulf of Mexico have attributed it primarily to excess nutrient levels, leading to pressure to decrease fertilizer use in middle America. This research is examining other local and regional factors that may contribute to hypoxia and attempting to quantify their relationships with each other and their relative importance in causing reduced dissolved oxygen concentrations. Completion of this project is expected in December 2004.

Corals at the Flower Garden Banks: Monitors of Environmental Change
Niall Slowey and Benjamin Giese, Texas A&M University

Other researchers are collecting core samples at Flower Garden Banks National Marine Sanctuary as part of a project to build records of environmental conditions spanning the past 250 to 400 years. Niall Slowey of Texas A&M University has calibrated the environmental record preserved in recent coral depositions with recorded temperature and salinity information from 1990-97. Preliminary results indicate that corals are reliable indicators of temperature change in the Gulf of Mexico. Slowey, Benjamin Giese and doctoral student Amy Bratcher will use the calibration on the Flower Garden Banks samples to create environmental histories, then use the histories to establish a baseline perspective of the health and vitality of the Flower Garden Banks reefs for evaluating the ecological significance of potential future changes. The data also will provide long-term insight into climate patterns in the region, including the El Niño/Southern Oscillation and Pacific/North America patterns, and how coral growth and marine conditions respond to climatic variability – useful in developing policies for protecting and managing marine resources and efforts to predict the effects of global climate change.

Beach Erosion

Sediment Transport Modeling and Assessment of Erosion Control Techniques on Galveston Island
Thomas Ravens, Texas A&M University at Galveston
Billy Edge, Texas A&M University

A final project focuses on an issue of major importance to coastal development interests. Thomas Ravens of TAMUG and Billy Edge of Texas A&M University are in the final stages of a detailed study of sediment transport and beach change on Galveston Island. The researchers have developed a sediment budget for the island based on shoreline position data from the past five decades. This analysis identified a recent, relatively quiet period (1990-2001) and a storm-dominated period (1956-1990), and determined the amount and direction of sediment transport for each. Focusing on the most recent quiet period and the emergence of an erosional hotspot at the end of the island's seawall, they employed a numerical model of shoreline change (GENESIS) and estimated that 100,000 cubic meters per year of nourishment (sand brought in from elsewhere) would be necessary to maintain the shoreline at the 2001 level at the hotspot. The study determined that hard structures such as an offshore breakwater or groin field would be ineffective, since sediment supply to the hotspot was restricted by up-drift shoreline structures. In addition, the researchers collected and analyzed bathymetric data from a 10-kilometer stretch of beach that included the erosional hotspot and a critical eroding beach in Jefferson County. The data from the 10-kilometer stretch is noteworthy due to the presence of geotubes on part of the beach and because the area has been subject to major nourishment and a hurricane in the past year. In Jefferson County, the bathymetric data has shown that the main cause of erosion is storm-induced over-washing, which occurs frequently because the dunes have disappeared. The results from the project – a more complete understanding of nearshore sediment flows and an evaluation of the efficacy of erosion control structures – will provide needed information for decisionmakers regarding multimillion dollar erosion control measures along the Texas coast.

Beach erosion is becoming an increasing concern all along the Texas coast. (Photo by Stephan Myers)

Mini-Grants

The Texas Sea Grant College Program uses Rapid-Response Mini-Grants and Marine Advisory Service Mini-Grants to fund smaller, short-term projects that cover topics that were not anticipated during the approval process for the two-year research funding cycle. They allow the program to respond quickly to problems or opportunities in which a small amount of funding can leverage significant results, including larger research studies in the future.

Texas Marine Managed Areas Inventory
Ralph Rayburn, Texas Sea Grant College Program

Recently completed and ongoing Mini-Grants include two survey projects. The first, an identification and inventory of Marine Managed Areas within the coastal waters of Texas, was completed in December 2003 and then submitted to NOAA's National Marine Protected Areas Center, which needs the information to develop a national inventory of MMAs in accordance with Presidential Executive Order 13158.

User Survey and Needs Assessment of Gulf of Mexico Coastal Ocean Observation Systems Products and Data
Jim Kruse, Texas Transportation Institute

The second project, still ongoing, supports a Gulf of Mexico Coastal Ocean Observing System (GCOOS) user survey and needs assessment that is part of a nationwide effort to implement a coordinated U.S. ocean and coastal observing system through a federation of regional systems. GCOOS integrates a broad variety of observational data from numerous sources, and provides information and observations to a wide range of users, including port and maritime transportation industries, fishing vessel operators, public health agencies, emergency management, the military, homeland security, researchers, petroleum and offshore industries, recreational boaters and beach-goers. The grant is assisting GCOOS in improving and maintaining an inventory of potential and current users of GCOOS' services, collecting user feedback and preparing the information from the inventory for inclusion on the GCOOS web site.

Bathymetry of the Texas-Louisiana Continental Shelf and Slope
Troy Holcombe and William Bryant, Texas A&M University

Another small Texas Sea Grant research grant laid the groundwork for a major project that is now under way in the current funding cycle. Under the grant, researchers acquired the best available digital bathymetry and topography files for the Texas-Louisiana coastal land area, Continental Shelf and upper Continental Slope. These data are currently being used by the same researchers to produce the first detailed bathymetric maps of the region, which will be used to create curriculum support materials for K-16 students and made available on CD-ROM and paper formats for researchers, industry, planners and decisionmakers.

Study of Sediment Transport Patterns near Galveston Beaches after Modification of Jetties
Billy Edge, Texas A&M University

One recent Mini-Grant was used to test the feasibility of changes to the shape of the jetties at the entrance to Galveston Harbor as a method of reducing suspended sediments, and thus perhaps increasing tourism, near the beaches of Galveston Island. Under the grant, seven alterations to the end of the jetties were tested using numerical models, and those modifications made no significant change, according to the models, in the concentrations of suspended sediment near the beaches.

Archaeological Oceanography Assistantship
Brett Phaneuf, Texas A&M University

Texas Sea Grant also funded an archaeological oceanography assistantship in 2003 that was used to establish inter-departmental, inter-university and governmental agency collaborations leading to the development of a program of deep-water archaeological research on shipwrecks in the Gulf of Mexico similar to the excavation of the shipwreck "Mica."

The most recently approved Texas Sea Grant-funded research project will attempt to determine if a relationship exists between meteorological and surf conditions and drownings and

near drownings over the past 20 years along the South Texas coast from Port O'Connor to the Mexican border. If strong correlations are found between these accidents and rip currents, strong longshore currents or large waves, the results of the study will be used to develop and implement a warning system about dangerous conditions and for other outreach and education efforts. The analysis will be conducted in collaboration with the Corpus Christi National Weather Service staff and beach managers.

Study of a Possible Link Between Drowning and Near-drowning Events and Surf Conditions in South Texas
Philippe Tissot, Texas A&M University at Corpus Christi

The "Mica" shipwreck, accidently discovered by a crew laying an oil pipeline, is just one of the many centuries-old wrecks waiting to be studied by deepwater nautical archaeologists in thousands of feet of water at the bottom of the Gulf of Mexico. (Sonar images courtesy U.S. Navy)

Fellowships

Texas Sea Grant College Program fellowships at both the state and national levels offer outstanding opportunities for graduate students to gain valuable experience while providing expertise to government agencies to aid their marine policy or natural resource efforts.

Texas Sea Grant Fellowship Program

Rubaba M. Ismayilova, the third recipient of the Texas Sea Grant Fellowship, is headquartered at the Texas Water Development Board in Austin, where she is using her background as an economist to evaluate the economic values of Texas' estuaries.

A native of Baku, Azerbaijan, and a doctoral candidate in the Urban and Regional Science Program at Texas A&M University, Ismayilova has a master's degree in economics and a background in international banking that includes experience with the Central Bank in Azerbaijan.

Her fellowship also involves field experiences. In addition to participating in two meetings of the advisory board of the Texas Corporate Wetlands Restoration Partnership (TCWRP), a partnership of federal, state and local government and private organizations, and meeting with scientists to discuss research opportunities on issues important to TWDB, Ismayilova joined volunteers in a TCWRP-sponsored restoration project at the San Jacinto Battleground State Historic Site, harvesting marsh grasses from the Buffalo Bayou shore and transplanting them to the San Jacinto River wetland edge, which has been severely eroded by barge and ship traffic.

Texas Sea Grant Fellow Rubaba M. Ismayilova is working with the Texas Water Development Board in Austin. She recently joined volunteers in a restoration project at the San Jacinto Battleground State Historic Site. (Photo by Ray Mathews Jr., Texas Water Development Board)

She says she plans to apply her coastal management experiences from the fellowship to problems in environmental policymaking, resource management and sustainable economic development.

Texas Sea Grant launched its statewide fellowship program in 2000. It is patterned after the highly successful Dean John A. Knauss Marine Policy Fellowship that is funded at the national level. The state program provides a one-year fellowship for a graduate student nearing the completion of a master's or doctoral degree to serve with one of the state's natural resource agencies. Other participating agencies include Texas Parks and Wildlife and the Texas General Land Office.

Dean John A. Knauss Marine Policy Fellowship

Nicolás G. Alvarado Quiroz, who recently received his PhD from Texas A&M University, is in Washington, D.C., working for the National Oceanic and Atmospheric Administration Science Advisory Board (SAB) under a Dean John A. Knauss Marine Policy Fellowship.

Nicolás G. Alvarado Quiroz, right, talks with his supervisor, Michael Uhart, executive director of NOAA's Science Advisory Board. Alvarado is in Washington, D.C., under a Dean John A. Knauss Marine Policy Fellowship. (Photo courtesy NOAA Public Affairs)

Alvarado is getting an inside look at the national development of marine and science policies as program analyst/assistant to the executive director of the SAB, where he is participating in meetings and hearings and working with SAB members, the NOAA Research Council and senior NOAA management on science policy. He has been assigned to develop policy in response to a newly adopted National Science Foundation definition of research. The guidelines created will standardize current research activities between the various NOAA line offices and potentially affect the allocation of funds and the characterization of surveys and observation projects. Alvarado also is updating the SAB Web site, following up on items from SAB meetings, providing background for the SAB and its members, and communicating with NOAA line offices and programs.

He holds a bachelor's degree in chemistry and a master's degree in earth sciences from the University of Ottawa in Ontario, Canada. Since beginning his doctoral studies at Texas A&M University at Galveston in 1999, Alvarado has been an NSF-funded graduate research assistant and a substitute lecturer/teaching assistant/dive master. He has been recognized by the Texas Institute of Oceanography, the Oceanography Graduate Council and the Texas A&M Department of Oceanography.

The Dean John A. Knauss Marine Policy Fellowship was established in 1979 to give a unique educational experience to graduate students enrolled in marine or Great Lakes studies. The program is named in honor of one of Sea Grant's founders and a former NOAA administrator. Students apply through the 31 state Sea Grant programs, which select candidates to sponsor, and the final decision is made by the National Sea Grant Office. While the number of fellowships offered varies with the availability of intern positions, Texas Sea Grant typically has at least one accepted each year.

Texas Sea Grant College Program
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Cindie Powell, writer/designer

Texas Sea Grant College Program

2700 Earl Rudder Freeway South, Suite 1800
College Station, Texas 77845
(979) 845-3854 • FAX (979) 845-7525
http://texas-sea-grant.tamu.edu

ADMINISTRATION

Dr. Robert R. Stickney
Director
(979) 845-3854
stickney@neo.tamu.edu

Peggy Foster
Assistant to the Director
(979) 845-1245
pfoster@neo.tamu.edu

Lynn Propes
Staff Assistant
(979) 845-3854
lpropes1@neo.tamu.edu

Terry Poehl
Fiscal Officer and Business Manager
(979) 845-3854
tlpoehl@neo.tamu.edu

Jennifer Channing
Financial Assistant
(979) 847-8978

Alan Bunn
Regional Manager
NOAA/NOS/Sea Grant
(979) 845-3855
alan.bunn@noaa.gov

MARINE INFORMATION SERVICE

Amy Broussard
Associate Director and MIS Director
(979) 845-3854
abrouss@neo.tamu.edu

Jim Hiney
Texas Shores Editor
(979) 862-3773
bohiney@neo.tamu.edu

Cindie M. Powell
Assistant Editor
(979) 862-3770
cpowell@neo.tamu.edu

Eric Graham
Webmaster and Computer Technician
(979) 862-3774
egraham@neo.tamu.edu

Crispin Morin
Distribution Manager
(979) 862-3767
sgpublications@neo.tamu.edu

MARINE ADVISORY SERVICE

Ralph Rayburn
Associate Director and MAS Leader
(Marine Policy Specialist)
(979) 845-7526
ralph-rayburn@tamu.edu

Marine Agents

Logan Respess
Aransas County
(361) 790-0103
301 North Live Oak
Rockport, Texas 78382
FAX (361) 729-3937
l-respess@tamu.edu

Richard Tillman
Brazoria County
(979) 864-1564
1800 County Road 171
Angleton, Texas 77515
FAX (979) 864-1566
r-tillman@tamu.edu

Vacant
(361) 552-9747
Calhoun County
P.O. Box 86
Port Lavaca, Texas 77979
FAX (979) 552-6727

Tony Reisinger
Cameron County
(956) 361-8236
650 East Highway 77
San Benito, Texas 78586
FAX (956) 361-8240
e-reisinger@tamu.edu

Julie Massey
Galveston County
(281) 534-3413, ext. 3
5115 Highway 3
Dickinson, Texas 77539
FAX (281) 534-4053
jk-massey@tamu.edu

Terrie Looney
Jefferson and Chambers Counties
(409) 835-8461
1295 Pearl Street
Beaumont, Texas 77701
FAX (409) 839-2310
tslooney@tamu.edu

John O'Connell
Matagorda County
(979) 245-4100
2200 7th St., 4th Floor
Bay City, Texas 77414
FAX (979) 245-5661
j-oconnell@tamu.edu

Marine Specialists

Granvil Treece
Aquaculture Specialist
(979) 845-7527
Texas Sea Grant College Program
2700 Earl Rudder Freeway South, Suite 1800
College Station, Texas 77845
FAX (979) 845-7525
g-treece@neo.tamu.edu

John Jacob
Environmental Quality/Coastal Communities Development Specialist
(281) 218-0565
17000 El Camino Real, Suite 301
Houston, Texas 77058
FAX (281) 218-6352
jjacob@tamu.edu

Russell Miget
Environmental Quality Specialist
(361) 825-3460
Natural Resource Center 2800
6300 Ocean Drive
Corpus Christi, Texas 78412
FAX (361) 825-3465
rmiget@falcon.tamucc.edu

Dewayne Hollin
Marine Business Management Specialist
(979) 845-3857
Texas Sea Grant College Program
2700 Earl Rudder Freeway South, Suite 1800
College Station, Texas 77845
FAX (979) 845-7525
dhollin@neo.tamu.edu

William Younger
Marine Education Specialist
(979) 863-2940
P.O. Box 18
Matagorda, Texas 77457
FAX (979) 863-2598
w-younger@tamu.edu

Gary L. Graham
Professor and Marine Fisheries Specialist
(979) 345-6131
Texas Sea Grant College Program
P.O. Box 1125
West Columbia, Texas 77486
FAX (979) 345-6131
taex-grahamg@wcnet.net

Jim Kruse
Ports and Harbors Specialist
(713) 686-2971
701 North Post Oak Boulevard,
Suite 430
Houston, Texas 77024
FAX (713) 686-5396
j-kruse@ttimail.tamu.edu

Michael Haby
Seafood Specialist
(361) 265-9203
Texas A&M Agricultural Research and Extension Center
10345 Agnes Street
Corpus Christi, Texas 78406
FAX (361) 265-9434
m-haby@tamu.edu

Texas Sea Grant College Program Researcher Directory

Contact information for the lead Principal Investigator of each major Texas Sea Grant-funded research project.

Texas A&M University

John Gold
979-847-8778
goldfish@tamu.edu

Troy Holcombe
979-845-3528
tholcombe@ocean.tamu.edu

Hongxing Liu
979-845-7998
honxing-liu@tamu.edu

John McEachran
979-847-9332
j-mceachran@neo.tamu.edu

William Neill
979-845-5759
w-neill@tamu.edu

Worth D. Nowlin Jr.
979-845-3900
wnowlin@tamu.edu

Daniel Roelke
979-845-0169
droelke@tamu.edu

Niall Slowey
979-845-8478
slowey@tamu.edu

Scott Socolofsky
979-845-4517
socolofs@tamu.edu

Texas A&M University at Corpus Christi

Philippe Tissot
361-825-3776
ptissot@cbi.tamucc.edu

Texas A&M University at Galveston

Jaime Alvarado-Bremer
409-740-4958
jaimeb@tamug.tamu.edu

Ayal Anis
409-740-4987
anisa@tamug.tamu.edu

Thomas Ravens
409-740-4919
ravenst@tamug.tamu.edu

Jay Rooker
409-740-4744
rookerj@tamug.tqaamu.edu

Peter Santschi
409-740-4476
santschip@tamug.tamu.edu

The University of Texas Marine Science Institute

Edward Buskey
361-749-6794
buskey@utmsi.utexas.edu

Kenneth Dunton
361-749-6744
dunton@utmsi.utexas.edu

Henrietta Edmonds
361-749-6772
edmonds@utmsi.utexas.edu

Lee Fuiman
361-749-6775
lee@utmsi.utexas.edu

Peter Thomas
361-749-6768
thomas@utmsi.utexas.edu

For additional copies, contact:

Texas Sea Grant College Program
2700 Earl Rudder Freeway South, Suite 1800
College Station, Texas 77845

or visit the web site http://texas-sea-grant.tamu.edu

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