

TAMU-Q-01-001

# TEXAS SEA GRANT COLLEGE PROGRAM



Sea Grant

2001-2002

For additional copies, contact:

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

or visit the website <http://texas-sea-grant.tamu.edu>

TAMU-SG-01-601  
500 March 2001  
NA86RG0058

A/I-1

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Publication supported in part by Institutional Grant NA86RG0058 to Texas A&M University from the National Sea Grant Office, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.





Webster's Dictionary defines "odyssey" in part as an intellectual quest. When it comes to exploring Texas' marine environment, the word odyssey pretty well describes the Texas Sea Grant College Program's mission for the past 29 years.

In 2001 we will celebrate 30 years of studying the state's marine environment, taking what we learn and getting that information to the people who can use it most, be they legislators, regulators, business people, teachers or just plain folks.

The Texas Sea Grant College Program funds marine-related research, develops marine education curricula for school students at all levels, and reaches out to the people of our state through our network of county extension marine agents and extension marine specialists.

We are the link between those who study the marine environment and those who benefit most from the results. We are translators who take often complicated research results and turn them into useable solutions for the general public. Our goal is the wise use, management and conservation of Texas' coastal and marine resources.

During our 2001-2004 funding cycle, we'll support research addressing two priority themes: coastal ecosystem health and coastal economic development, both with emphasis on projects that take a multi-discipline approach.

The Texas Sea Grant College Program is part of a network of 31 similar programs across the nation. Every state that borders an ocean or the Great Lakes has a Sea Grant program of its own or shares one with another state. The Sea Grant concept was born out of the questioning mind of Athelstan Spilhaus, then dean of the Institute of Technology at the University of Minnesota, in the early 1960s. At the time, American fishermen needed help protecting U.S. fish populations from encroaching foreign fleets and they needed help improving fishing success.

"Why, to promote the relationship between academic, state, federal and industrial institutions in fisheries, do we not do what wise men had done for the better cultivation of the land a century ago?" Spilhaus asked during his 1963 keynote address to the American Fisheries Society, alluding to the Morrill Act of 1862 and the very successful Land Grant College Program. "Why not have Sea Grant Colleges?"

Congress passed The National Sea Grant College and Program Act in 1966. Within a decade, the National Sea Grant College Program was a reality and Texas became one of the first four state college programs designated by Congress. We've been leaders ever since.

The Texas Sea Grant College Program accomplishes its mission of research, education and outreach through its triad of administration, Marine Advisory Service (MAS) and Marine Information Service (MIS).

The **administration** oversees the program's daily operations and is responsible for awarding almost \$850,000 in grants annually to the best marine researchers in the state. Through the coastal ecosystem health and coastal economic development themes we have an opportunity to fund interesting, diverse and much-needed research projects.

More than half of Texas' population already lives within 100 miles of the coast and that percentage is expected to climb. More people means more development — homes, roads and businesses among other things — that put added pressure on the already-stressed coastal environment. Projects submitted under our coastal economic development theme will look at how development can continue on the coast with the least environmental impact.

**MAS** comprises seven extension marine specialists and six county extension marine agents spread along Texas' nearly 400 miles of coastline. They serve an area larger than many of the states that have Sea Grant Programs. The specialists are experts in fields of fisheries, environmental quality, aquaculture, marine business management, marine education, and seafood science, technology and marine policy. Marine agents function much as their well-known counterparts — county extension agricultural agents — but they turn their attention toward the marine-related needs of their coastal counties. Applications of research, technology transfer and education of coastal and marine users as well as youth are hallmark programs of MAS.

The **MIS** spreads the news of Sea Grant research to the people of Texas in many ways, including press releases, brochures, posters, pamphlets, conference and workshop proceedings, books and *Texas Shores* magazine, the flagship of MIS publications. Since the magazine's inception in 1984, *Texas Shores* has won more than 30 awards for writing and design. Each edition of the magazine focuses in-depth discussion on one important issue facing the state's marine environment. Past editions have covered topics such as bycatch, the return of the Kemp's ridley sea turtle, coastal zone management, seafood safety, hurricanes and water quality in Galveston Bay.

The MIS also regularly sends out press releases on breaking marine news stories, and MIS is responsible for putting together many education and technical publications.

The Texas Sea Grant College Program is dedicated to maintaining a healthy balance between business and the marine environment, because you can't do a live business in a dead environment.



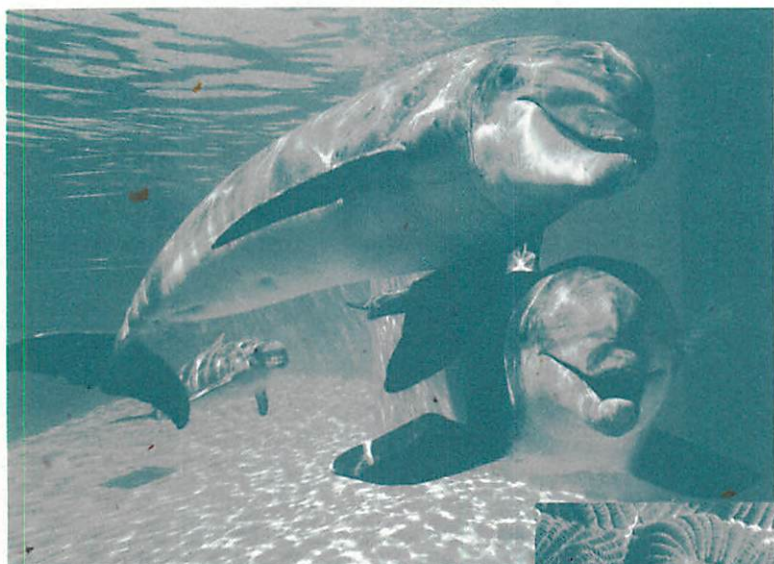
On Feb. 1, 2001 we officially opened our new office, located only a few miles from the one that has housed the program administrative offices for a decade. Over the past six years, we were split between two floors of an office building. The move provides us with space within the same suite of offices, thereby allowing us to consolidate certain activities and eliminate equipment that was duplicated because of the spatial separation that previously existed. While we have moved to a different city, the telephone, fax and e-mail contact information remains the same.

In this directory you will see summaries of the results obtained from research conducted during the March 1, 1998 through February 28, 2001 funding cycle and will find information on the latest round of research projects that have a March 1 start date. Also included are reports on mini-grants that were provided to some of our Marine Advisory Service agents and specialists, summaries of information gathered from rapid response research projects and a description of the recipients of Knauss and Texas Sea Grant Fellowships. Finally, you will find detailed contact information for all Texas Sea Grant College Program personnel.

This year will also see the launching of our floating classroom. A vessel has been obtained and will be placed in service after it has been appropriately retrofitted. The plan is to take middle school and high school students out on the water for half-day trips during which they will have the opportunity to collect samples and learn about the estuarine environment along the Texas coast. In addition to providing a program that is linked to the requirements of our state's educational program mandates, we hope to stimulate student interest in science and in the furtherance of their educational experiences by encouraging them to pursue college degrees in marine-related fields.

Please visit us on-line at <http://texas-sea-grant.tamu.edu> or come by in person to see our new office complex at 2700 Earl Rudder Freeway South, Suite 1800, College Station, TX 77845.

Dr. Robert R. Stickney  
Director, Texas Sea Grant College Program



# 2001-2004 RESEARCH PROJECTS





## Determining the health of small fry food

- Assessing the health of the planktonic food web in Texas coastal bays using RNA:DNA ratios

Zooplankton are an important link in the food web between phytoplankton and larval fish. It has long been known that an adequate food supply is critical to successful recruitment of marine fish. While a number of studies have looked at the effects of natural and man-made disturbances on fish and shellfish populations, few studies have focused on the lower levels of the food web, which can provide important insights into recruitment processes. Marine copepods are normally the dominant form of zooplankton, and their young are important food for larval fish. Assessing the health of copepod populations in nature can be attempted by measuring growth rates or egg production rates of females, but these methods involve tedious experiments with long incubation times. It would be a significant advance for routinely assessing the health of planktonic food chains if animals could be collected in the field and their condition reliably evaluated using a laboratory analysis such as an RNA:DNA ratio.

Dr. Edward J. Buskey  
Marine Science Institute  
The University of Texas at Austin  
Port Aransas, Texas 78373  
(361) 749-6794  
buskey@utmsi.utexas.edu

## Learning more about the Gulf of Mexico's sperm whales

- Stock assessment, movement patterns and habitat of endangered sperm whales in the northern Gulf of Mexico

The endangered sperm whale, the largest toothed whale on Earth, occurs as an apparently native population or populations in the northern Gulf of Mexico. A gathering of sperm whales of unknown sex, age, number and reproductive status occurs near coastal waters just south of the Mississippi delta in areas that could be affected by coastal and near-coastal toxins, fisheries, industrial traffic and oil and gas exploration and development. This project will attempt to shed light on the population status, habitat use patterns and relationship to human activities of these potentially important members of the Gulf of Mexico's diverse animal population. The study will use tools, such as photographic identification and photogrammetry studies, genetic analyses, satellite tracking and behavioral observations in consort with satellite remote sensing of oceanographic features.

Dr. Randall W. Davis  
Department of Marine Biology  
Texas A&M University at Galveston  
PO Box 1675  
Galveston, Texas 77553-1675  
(409) 740-4729  
davisr@tamug.tamu.edu

Dr. Bernd G. Würsig  
Department of Marine Biology  
Texas A&M University at Galveston  
PO Box 1675  
Galveston, Texas 77553-1675  
(409) 740-4729  
wursigb@tamug.tamu.edu

## Gauging the effects of pesticide run-off on redfish

- Contaminants in Texas Bays:  
Impairment of red drum survival skills and the consequences for their populations

The use of organophosphate pesticides, especially the herbicide Atrazine and the insecticide Malathion, for both agricultural and non-agricultural purposes is widespread in the state of Texas. These compounds are present in measurable amounts in Texas bays, but our knowledge of their effects on coastal animal life is negligible. However, the literature suggests both of these compounds will negatively affect behavioral and physiological processes. This project examines the effects of Atrazine and Malathion on the performance and growth of larval red drum, a major recreational fish species in Texas coastal waters. This will be achieved using behavioral and physiological tests to evaluate the survival skills and metabolic performance of larval red drum. This project will refine our understanding of coastal ecosystem health by gauging the effects of Atrazine and Malathion on the survival and growth of the highly sensitive red drum larvae.

Dr. Lee A. Fuiman  
Marine Science Institute  
The University of Texas  
Port Aransas, Texas 78373-5015  
(361) 749-6775  
lee@utmsi.utexas.edu



## Examining the factors that cause hypoxia

- Processes responsible for hypoxia in the Gulf of Mexico; A re-evaluation with new data and perspective

A team of three experienced oceanographers will re-evaluate the factors responsible for the occurrence of hypoxia (dissolved oxygen concentrations low enough to threaten living marine resources) over the northern shelves of the Gulf of Mexico. We will consider background conditions (wind, currents, river discharge, nutrient levels, heating) as well as local factors (nutrients, light levels, phytoplankton concentrations, vertical stratification) in relation to the occurrence of low dissolved oxygen concentration. We will seek quantitative relationships among the factors responsible for lowering oxygen concentrations. Our results will be combined with those in the literature and compared with those from waters off South Africa. New findings will be disseminated in refereed publications and via the Marine Information Service to improve general understanding of this sensitive marine environmental problem.

Dr. Worth D. Nowlin, Jr.  
Department of Oceanography  
Texas A&M University  
College Station, Texas 77843-3146  
(979) 845-3900  
wnowlin@tamu.edu



## Researchers use earstones to identify sources of red drum

- Origins of Red Drum stocks:  
Assessing the contribution  
of different nursery grounds  
using biogeochemical fingerprints

The study will examine the use of earstone trace element signatures of an estuarine-dependent finfish to quantify the contribution of different nursery areas to adult stocks. Earstones (otoliths) are formed as the adult grows and are made up of elements from the surrounding seawater. By examining the makeup of earstones from different fish, researchers hope to determine where these fish grew up. Researchers will use red drum as a "model" species and characterize trace element signatures of this economically important fish from several nursery habitats in Texas. Researchers also will look for major differences among the earstones of fish gathered from the same area. In addition, scientists plan to determine whether these "fingerprints" are stable over time. They will also use this technique to identify the source of adult red drum stocks in the northern Gulf of Mexico and assess the relative contribution of different nursery grounds. As a result, fundamental questions regarding the value and health of natural ecosystems will be addressed and explained with this novel technique.

Dr. Jay Rooker  
Department of Marine Biology  
Texas A&M University at Galveston  
PO Box 1675  
Galveston, Texas 77553  
(409) 740-4528  
rooker@tamug.tamu.edu

## Project examines pollutant uptake by oysters and mussels

- Role of natural organic matter in governing the bioavailability of potentially toxic metals to estuarine bivalves

Bivalves, especially oysters and mussels, have been extensively used as models and bio-indicator organisms in environmental assessment and monitoring programs to assess the bioavailable contaminant concentrations in coastal environments. Natural dissolved organic matter (DOM) is a potentially nutritious food source for bivalves. However, the presence of DOM may significantly alter the bioavailability and biogeochemical cycling pathways of many trace metals in aquatic environments. The role of natural DOM in governing the bioavailability of potentially toxic metals to bivalves is not well understood and has rarely been tested. In order to better use bivalves as pollution indicator organisms, a thorough understanding of metal uptake pathways and mechanisms, as a function of the quality and quantity of DOM, is sorely needed. The primary objectives of this research are to determine how DOM affects the bioavailability of metals to bivalves, including oysters and mussels, and whether DOM can be directly used as a food source by these bivalves. This will be determined using radiotracers and molecular probes in controlled laboratory experiments. The project will provide greater understanding of uptake pathways and mechanisms of potentially toxic and other representative metals in bioavailability and bioaccumulation, providing crucial information that can be used in environmental assessment and monitoring.

Dr. Peter H. Santschi  
Department of Oceanography  
Texas A&M University at Galveston  
Galveston, Texas 77551  
(409) 740-4476  
santschi@tamug.tamu.edu



## Learning about past climates, reef health by studying coral histories

- Corals at the Flower Garden Banks: Monitors of Environmental Change

Global-scale climate fluctuations affect the marine environment of the Gulf of Mexico. To anticipate future climate change and develop sensible policies for managing marine resources, we must understand climate variability and its effect on marine life. Our understanding would be greatly enhanced if we had better information about past climate changes and their effects. Such information is preserved in the skeletons of long-lived corals at the reefs of the Flower Garden Banks. In this project, researchers will construct long, high-resolution records of skeletal density bands and chemistry to determine histories of local environmental conditions and coral growth from them. Importantly, Flower Gardens corals also monitor the dominant pattern of winter climate variability in the extratropical Northern Hemisphere – the Pacific/North American pattern. We will verify coral-derived records with 20<sup>th</sup> century instrumental data, then use these records to characterize climate variability during the past two and a half to four centuries. Analysis of these results will contribute directly to our understanding of the temporal character of interannual and interdecadal variations of winter climate. The relationship between changes of coral growth and environmental conditions will indicate processes affecting the corals, and long coral records will provide an important baseline perspective on the overall health and vitality of reefs.

Dr. Niall C. Slowey  
Department of Oceanography  
Texas A&M University  
College Station, Texas 77843-3146  
(979) 845-8478  
slowey@ocean.tamu.edu

## Looking at the effects of estuary contamination on croakers

- Assessment of feminization in male croaker and the presence of estrogenic contaminants in estuarine environments

Recent studies indicate widespread feminization of male fish in polluted estuaries in both Europe and Japan because of the presence of estrogenic contaminants (xenoestrogens), which have potentially serious consequences for the reproductive success and long-term viability of fish populations. However, comparable information on male fish in U.S. estuaries is currently lacking. This project will develop and evaluate novel early warning indicators of feminization because of xenoestrogen exposure in Atlantic croaker. These indicators will include: testicular estrogen receptor protein, mRNA levels and androgen production. These indicators will be compared to established feminization biomarkers, plasma vitellogenin and testicular histology. Feminization indicators that are sensitive to xenoestrogens will subsequently be measured in croaker collected from contaminated sites, which are located near sewage and industrial outfalls in Galveston and Corpus Christi Bays. This study will provide an initial evaluation of the extent of xenoestrogen contamination and feminization of croaker populations in two major Texas estuaries. Thus, the research will provide the first information on feminization of male fish and the presence of xenoestrogens in U.S. estuaries and will be of widespread interest to marine resource protection agencies and managers throughout the country.

Dr. Peter Thomas  
Marine Science Institute  
The University of Texas at Austin  
Port Aransas, Texas 78373  
(361) 749-6768  
thomas@utmsi.utexas.edu



## Looking at the effectiveness of erosion prevention strategies

- Sediment transport modeling and assessment of erosion control techniques on Galveston Island

This project will be a detailed study of sediment transport and beach change on two critical, three-mile sections of the Galveston Island (Texas) shoreline – one subject to erosion control (geotubes) and one without erosion control. Researchers will adapt physically realistic sediment transport models for Galveston Island and make use of a novel, jet ski-based surveying system. This study will yield robust (measurement-verified) estimates of long-shore and cross-shore sediment flows and a sediment budget over a three-year period, will provide detailed and extensive baseline (bathymetric) data and will calculate (and/or measure) shoreline/beach change as a consequence of two erosion control measures currently under consideration (off-shore breakwater and onshore geotubes).

Dr. Thomas Ravens  
Department of Maritime Systems Engineering  
Texas A&M University at Galveston  
Galveston, Texas 77551  
(409) 740-4465  
ravenst@tamug.tamu.edu

## Developing more precise means of identifying shrimp

- Identifying species of young commercial shrimp by combining developmental morphology and molecular genetics

Prediction of year class strength, accurate assessment of important nursery habitat, the impact of water and wetland management strategies and decisions regarding the effect of coastal development on shrimp populations require correct identification of all life stages of shrimp. While separation of adult brown shrimp from pink shrimp is relatively easy, separation of their postlarval and early juvenile stages remains problematic. We propose a dual approach for identifying, assessing and verifying differences between species that minimizes the impact of morphological variability because of extrinsic factors yet provides confirmation of specimen identification (ID). This procedure combines ontogenetic scaling techniques with ID by molecular genetic testing. Our goals are two-fold: 1) develop an ontogenetic index that permits rapid and reliable separation of postlarval brown from pink shrimp yet allows screening of large numbers of specimens; and, 2) develop relatively inexpensive tests to verify the identity of these two closely related species of shrimp. Ultimately, information provided by this project will contribute to more accurate estimates of year class strength, improve predictive capabilities and provide fishery managers with better information upon which to base recommendations regarding potential annual yield and regulation of the shrimp fishery.

Dr. Jaime R. Alvarado Bremer  
Department of Marine Biology  
Texas A&M University at Galveston  
5007 Avenue U  
Galveston, Texas 77551  
(409) 740-4958  
jaimeab@tamug.tamu.edu

## Measuring the success of red drum stocking efforts

- Development and application of hypervariable DNA markers (microsatellites) to issues in stock enhancement and culture of red drum

The recreational fishery for red drum is a vital resource to economies of Gulf coast communities. In part because of this, Texas Parks and Wildlife operates a vigorous red drum stock enhancement program. This will be an interdisciplinary, interagency project that combines expertise in molecular and quantitative genetics, physiology and aquaculture to address critical issues impacting both stock enhancement and culture of red drum. We will develop the necessary genetic and analytical tools for large-scale efforts to measure success and efficiency of red drum stock enhancement, and we will carry out small-scale experiments to assess performance in the wild of released fish and the hatchery broodstock that produced them. We will use the same genetic tools to assess the genetic component of variation in three important performance traits: growth rate, cold tolerance and marginal metabolic scope (a measure of capacity for generalized physiological performance). Finally, we will take the initial steps towards generating a red drum genetic map. Results of the research will benefit a number of users and stakeholders, including state and federal government entities responsible for marine resources, private (commercial) red drum interests and the scientific and lay public.

Dr. John R. Gold  
Department of Wildlife and Fisheries Sciences  
Texas A&M University  
College Station, Texas 77843-2258  
(979) 847-8778  
goldfish@tamu.edu



## Creating a guide to Gulf of Mexico fish

- Survey and inventory of the fishes of the Gulf of Mexico

This project will complete a survey and inventory of the fishes of the Gulf of Mexico. The first half of the survey is complete and has been published in book form. About 80 percent of the second and final volume, covering the remainder of the fish fauna of the Gulf, has been completed. A total of 553 of about 700 species, 239 of about 280 genera, 62 of 82 families and two of four orders have been treated thus far. More than 200 species have been illustrated. To complete the inventory and write the remaining species descriptions, it will be necessary to revisit eight of the 11 largest natural history collections that have major holdings of fishes from the Gulf. During these visits the holdings of the fishes from the Gulf will be surveyed and descriptions written. The historical database summarized in this project will facilitate the monitoring of natural and human alterations of the Gulf. Changes in the historical species composition very likely will reflect natural or human alterations, such as weather patterns, habitats, pollution levels or fishing pressures. The historical database will also facilitate monitoring for the presence of non-native species in the Gulf.

Dr. John D. McEachran  
Department of Wildlife and Fisheries Sciences  
Texas A&M University  
College Station, Texas 77843-2258  
(979) 847-9332  
j-mceachran@tamu.edu



## Marine Education: A floating classroom

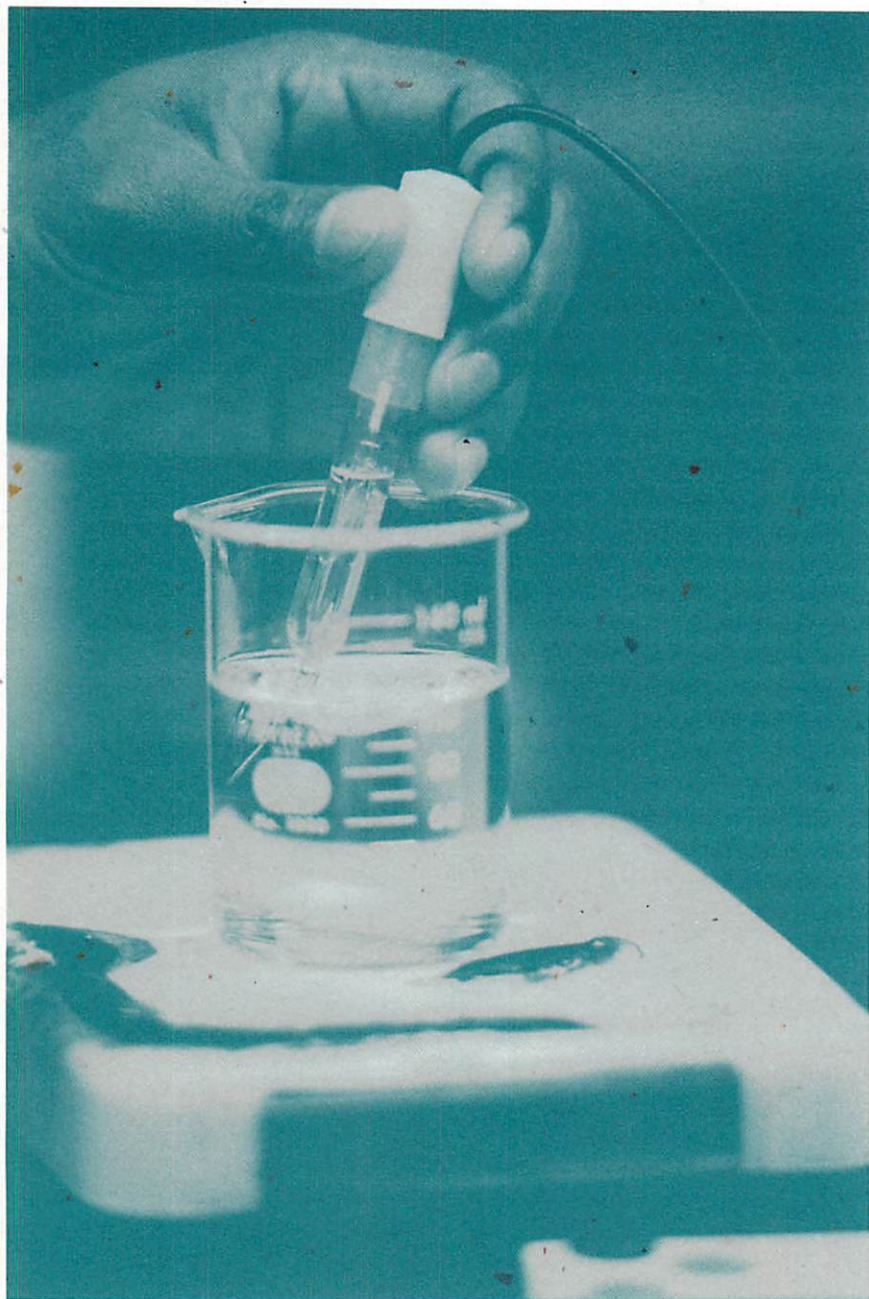
- Acquisition of a specialized vessel to advance marine literacy in Texas

Utilizing a grant from the Texas Coastal Management Program and the Matagorda County Navigation District #1 as well as a generous contribution from Mrs. Virginia Corn of Port Aransas, Texas, the Marine Education Program has acquired a 57 foot vessel to be used as a floating classroom. The vessel, to begin service in Spring, 2001, will be home ported in the central coast area and available for scheduling of school classes, science clubs, coastal education and adventure camps, youth sportsfishing clubs and other suitable groups. Scheduling inquiries should be made to the MAS Marine Education Office at the Texas State Marine Education Center in Palacios, 361-972-5370.

William Younger  
Texas State Marine Education Center  
100 Marine Center Drive  
P.O. Box 1283  
Palacios, Texas 77465  
(361) 972-5370  
w-younger@tamu.edu

Dr. Russell Miget  
Natural Resource Center  
Suite 2800  
6300 Ocean Drive  
Corpus Christi, Texas 78412  
(361) 825-3460  
rmiget@falcon.tamucc.edu

# REPORTS ON RESEARCH FUNDED 1998-2001





## Studying the effects of pollutants

- A reporter gene system for detecting and investigating marine pollutants with endocrine disruptive activities

Environmental pollutants that interact with cellular estrogen receptors to initiate or inhibit gene expression have been classified as xenoestrogens. Estrogenic activity has been found for a wide variety of chemicals, including pesticides, herbicides and detergents. These pollutants can adversely affect human hormones, impacting sex determination, reproduction and the immune system. Marine animals, particularly those living close to shore, may be regularly exposed to chemicals, used in industry and agriculture, as pollutants of water and sediment. In this project, scientists developed, tested and published a reporter gene for detecting estrogenic chemicals. Researchers also developed reporter genes for detecting chemicals that mimic the physiological activity of testosterone [ARE], thyroid hormone [TRE] or glucocorticoids [GRE]. These reporter genes were inserted into animal cells expressing the appropriate nuclear receptors and demonstrated that the estrogen reporter gene system is acutely sensitive to chemicals that exhibit the capacity to mimic estradiol activity. The most estrogenic chemical tested to date has been dioctylphthalate. It thought to be potentially at fault in altering estrogen-regulated physiology in humans. Development of the entire cassette of reporter genes for the steroid hormone family of nuclear hormones will allow the evaluation of drugs, chemicals, cosmetics, food additives and environmental contaminants to determine their endocrine disruptive capacity.

Dr. David Busbee  
Dept. of Veterinary Anatomy and Public Health  
Texas A&M University  
College Station, Texas, 77843-8981  
(979) 845-6463  
dbusbee@cvm.tamu.edu



## Developing cleaner, healthier diets for farm-raised fish

- Nutritional and environmental manipulations to reduce wastes in mariculture

Nutritional and environmental manipulations to minimize waste production and maximize nutrient uptake and growth efficiency are needed to enhance the economic competitiveness and environmental sustainability of commercial aquaculture. This project is examining ways to improve the food fed to red drum raised in aquaculture facilities. Based on findings from this project to date and previous research in this laboratory, the contribution of enriching nutrients such as nitrogen and phosphorus from the diet may be reduced without impairing growth of red drum. Researchers have shown the in-pond dissolved air flotation (DAF) system to be effective at reducing solids and biochemical oxygen demand from the water column. The system has a strong potential for reducing nitrogen, phosphorus, and organic carbon in the ponds, thus reducing the demand for high volumes of replacement water, and the load of these pollutants into the environment. The investigators have developed a mechanical system that will aerate water using very little energy with high efficiency. This portable eco-oxygenator was developed ancillary to the DAF system testing and development, and represents a breakthrough in design and management of water quality in mariculture systems. The device provides molecular oxygen to microbes in the system to enhance reduction of biochemical oxygen demand of organic carbon, uptake of phosphorus, and conversion of ammonia to nitrate. The system will be tested on the San Antonio River - Riverwalk segment in the summer of 2001.

Dr. Delbert M. Gatlin III  
 Dept. of Wildlife and Fisheries Sciences  
 Texas A&M University  
 College Station, Texas 77843-2258  
 (979) 845-9333  
 d-gatlin@tamu.edu

## Examining the effects of storms, shrimp trawling on bay sediments

- The importance of episodic events on turbidity and mobility of heavy metals in Texas estuaries

Episodic sediment resuspension events in estuaries, such as storms, shrimp trawling or dredging, can substantially alter biogeochemical characteristics of the sea bottom and also reintroduce sediment particles and pore fluids into the water. Such events prevent sediments from accumulating in the estuary and could allow the re-release of previously deposited contaminants. To determine the geological and geochemical impact of storms, shrimp trawling or dredging in shallow Texas estuaries, this project studied the effects of shrimp trawling and wind storms on sediment resuspension. A final deployment of an unattended bottom array is currently underway. The array was deployed at the sampling site in central Trinity Bay on Feb. 6, 2001 and is scheduled to be retrieved on Feb. 28, 2001. This will give researchers a full three weeks of monitoring for storm events. The array is equipped with sensors to monitor current speed and direction, wave height, salinity, temperature and suspended load. Researchers prepared and presented two posters on the Sea Grant project at the Galveston Bay Conference in January 2001. Finally, a manuscript is about to be submitted on the first phase of the project, dealing with sediment water-exchange impacts from shrimp trawling.

Dr. Gary A. Gill  
Department of Oceanography  
Texas A&M University at Galveston  
5007 Avenue U  
Galveston, Texas 77551  
(409) 740-4952  
gillg@tamug.tamu.edu



## Studying salinity's impact on seatrout

- The influence of salinity on reproduction, egg and larval development of spotted seatrout *Cynoscion nebulosus*

This study investigated the effect of changes in salinity on the reproduction and larval survival of spotted seatrout. Fish were collected from two different bays along the Texas coast with historically different salinity regimes. Adult fish were collected from each bay and transported to spawning tanks in Corpus Christi, Texas. Salinities in each tank were gradually adjusted to 20, 30 or 40 ppt, and fish were encouraged to spawn through manipulations of temperature and photoperiod. Over the course of this study, adult seatrout from both areas successfully spawned in each of the three salinities. In addition, the percent of viable larvae hatching from individual spawns was greater than 90 percent in all cases. Both egg diameter and wet weight increased significantly with decreasing spawning salinities. However, little difference was seen between dry weights indicating a difference in water content between spawning salinities. Increased water content of eggs spawned in lower salinities resulted in lower neutral buoyancies compared to eggs spawned in higher salinities. Maintaining neutral buoyancy is critical for these eggs because it prevents them from sinking to the bottom and being buried in the sediment. Acute salinity tolerance tests were used to estimate the vulnerability of seatrout larvae to sudden changes in salinity. In general, larvae spawned in 40 ppt were less tolerant of low salinities and more tolerant of high salinities than larvae spawned at 20 or 30 ppt regardless of where the brood stocks were collected. These results indicate that the salinity tolerance of larvae may depend more upon spawning salinity than adaptation to the predominant salinity regime of a particular bay system.

Dr. G. Joan Holt  
Marine Science Institute  
The University of Texas at Austin  
750 Channelview Drive  
Port Aransas, Texas 78373-5015  
(361) 749-6716  
joan@utmsi.utexas.edu



## Finding better foods for tropical fish

- Culture techniques for marine ornamental fish: A better larval diet?

The copepod *Centropages hamatus* was reared on a mixed diet of four dinoflagellates: *Gymnodinium nelsoni*, *Gonyaulax polyedra*, *Procentrum micans* and *Scripsiella trochoideum*. Approximately 10 million diapause eggs were produced during the project period by the co-investigator at Florida State University. Results show that hatching success remains high (generally >80 percent) for more than a year. To evaluate the value of copepods as fish food, copepod eggs were hatched and the nauplii fed to larvae of two ornamental fish species (jackknife fish, or *Equetus lanceolatus*, and comet, or *Callopleksiops altivelis*). The study found that copepod nauplii were superior to rotifers and *Artemia* as food. There were problems in the experimental design. Because of the number of copepod eggs that were produced in the lab (several million) compared to the number of live prey normally fed (hundreds of millions), it was necessary to reduce the size of the larval rearing tanks. The small volume enclosures designed to maintain a reasonable density of prey and provide adequate water quality for fish larvae were not tolerated by all species. If the number of copepod eggs could be increased, it would be possible to use the larger rearing chambers routinely used for feeding studies. The study found that nauplii hatched from *Centropages hamatus* diapause eggs hold promise as an alternative live food for tropical ornamental fish.

Dr. G. Joan Holt  
Marine Science Institute  
The University of Texas at Austin  
750 Channelview Drive  
Port Aransas, Texas 78373-5015  
(361) 749-6716  
joan@utmsi.utexas.edu

## Studying the factors affecting the supply of young fish to habitats

- The role of water level fluctuations in recruitment of red drum larvae: Stable isotopes as tracers

The red drum settlement project is essentially complete and has been quite successful. The objectives were two-fold. One was to develop an assay to determine the time since an individual red drum larva had settled into the seagrass nursery habitat from its earlier planktonic existence. The other was to use this knowledge of time-since-settlement to determine whether non-tidal water level changes were instrumental in the arrival of red drum larvae at the seagrass nursery sites. The first objective was fully accomplished. Stable isotopic composition of carbon and, to some extent, nitrogen in the fish reflect the isotopic composition of their food. Researchers showed that two to three days was required for the isotopic composition of small red drum larvae (4-6 mm in length) to reflect a change in isotopic composition of their diet. In studies with both caged and wild-caught larvae, researchers found that most red drum settle out of the plankton at a size of 5-8 mm and virtually all the new recruits are less than 10 mm. Completion of the second objective was severely hampered by the relatively poor recruitment of red drum larvae to the seagrass study sites, especially in the fall of 2000. The net result was that there were not enough larvae captured to make quantitative comparisons of settlement intensity among the study sites. The researchers did find that newly settled larvae were identified in the nursery sites on a daily basis through most of October and November, suggesting that factors controlling the abundance of planktonic larvae may have a substantial impact on settlement patterns in the seagrass meadows.

Scott A. Holt  
Marine Science Institute  
The University of Texas at Austin  
750 Channelview Drive  
Port Aransas, Texas 78373-5015  
(361) 749-6715  
sholt@utmsi.utexas.edu



## Factors affecting the movement of fish into bays

- Simulation of larval transport from the Texas coastal ocean to a bay

In this project, researchers are using a numerical model of water circulation coupled with a particle transport model to examine the role of various physical forcing factors including tides, non-tidal coastal sea level variations and wind stress on the transport of red drum larvae through Aransas Pass, Texas. Tidal forcing is effective at transporting passive particles a distance of approximately 15 km into the bays; however, there is limited dispersion of the particles into the bays. When acting alone, the tides are not effective at allowing particles to reach and stay in suitable estuarine habitat. The majority of the particles that enter Aransas Pass are transported in the Corpus Christi Ship Channel to regions that are not suitable for settlement. In addition, the dominance of the ebb tidal jet and the length of the pre-competent period of red drum larvae suggest that there may be substantial along-shelf transport of larvae. Fish larvae typically are present in the Aransas Pass at low concentrations intermingled with a few high magnitude events or pulses. This project's model reproduces the occurrence of the pulses and the arrival of settlement age larvae in seagrass beds. The researchers have found the pulses are associated with low-frequency variations in water level and local wind forcing in the Gulf of Mexico. The occurrence of pulses depends upon the time history of transport. Model simulations suggest that larvae have limited opportunities to settle, with the majority of the larvae entering the inlet only once or twice during the first 30 days of their lives. Simulations suggest the nearshore region, which is typically not sampled in larval studies, may be an important pathway for estuarine dependent larvae.

Dr. George Jackson  
Dept. of Oceanography  
Texas A&M University  
College Station, Texas 77843-3146  
(979) 845-0405  
gjackson@ocean.tamu.edu



## Keeping tabs on the Kemp's ridley

- Recruitment and population status of Kemp's ridley sea turtles in nearshore Gulf waters

Each month, from May through August 2000, researchers deployed 91.4-m long entanglement nets at jetty and beachfront habitats near Sabine Pass, Texas and Calcasieu Pass and Mermentau River, La. Weather permitting, entanglement nets were deployed for six to 12 hours/day across a two-week period in which all study sites were sampled. The 24 turtles that were captured represent the lowest annual total recorded by this study of sea turtle stocks along the upper Texas and Louisiana coast to date. This capture total included 21 Kemp's ridleys (including 2 recaptures) and three green sea turtles. In contrast, 1999 in-water captures, second only to those in 1993 (120 sea turtles), totaled 117 (116 ridleys and 1 green). These trends included a continued decline in sea turtle utilization of Sabine Pass initially observed in 1998. The 2000 netting season was characterized by elevated water temperatures and salinities associated with drought conditions prevalent throughout Texas. This environmental stress, along with a decline in blue crabs taken in trawl tows and incidental to entanglement netting, may have pushed sea turtles, especially Kemp's ridleys in search of food, to deeper and/or more eastern waters where foraging conditions may have been more favorable than those in the study area. Blood and carapace tissue samples used in determining sex ratio and heavy metal concentration were taken from 20 of the 24 sea turtles captured in 2000. Analysis of these samples is ongoing.

Dr. André Landry  
Dept. of Marine Biology  
Texas A&M University at Galveston  
Galveston, Texas 77553-1675  
(409) 740-4989  
landrya@tamug.tamu.edu

## Taking the coast into the classroom

- Field testing, revision, and dissemination of a marine education resource manual for middle schools

As part of this project, researchers are field testing, revising and disseminating an interdisciplinary marine education resource unit developed for middle schools to fill the void in the availability of marine education materials. The manual focuses on the marine environment and its resources and emphasizes the Texas coastal zone and the Gulf of Mexico in order to develop "marine literate" teachers and students. The unit is correlated to the Texas Essential Knowledge and Skills (TEKS) as well as to national standards in science, mathematics, social studies and language arts. The manual provides teachers with lessons that can be incorporated into existing courses or used as separate marine units. So far, several of the chapters have been finished. Once all of the chapters have been completed, they will be made available through the Texas Sea Grant College Program.

Dr. Violetta F. Lien  
 Science Education Center  
 The University of Texas at Austin  
 Austin, Texas 78712  
 (512) 471-7354  
 vflien@tenet.edu



## Comparing growth rates of caged vs. free-swimming fish

- Ecophysiology of marine fish stocks: Field test of an ecophysiological model to predict habitat value for recruitment of juvenile redfish

This project is part of a regional effort (Texas, North Carolina, and Florida) to improve the scientific basis for enhancement of marine fish stocks, by measuring and modeling effects of abiotic environment on aspects of juvenile fish performance important to their recruitment. In the project's first two years, the ecophysiological model's predictions of red drum (*Sciaenops ocellatus*) growth have compared very favorably with results of experimental enclosure studies for fish in environmentally variable habitat, both in Corpus Christi Bay and in hatchery ponds at CCA/CPL Marine Development Center in Corpus Christi, Texas. Agreement between model predictions and experimental results has given us increasing confidence in the model's structure and parameterization. Thus, we have begun to examine residuals between predicted and observed values for insight about relationships outside the bounds of the present model. In particular, discrepancies between growth rates both observed and simulated for red drum caged in ponds and those of free-swimming fish in the same ponds suggest the importance of microhabitat optimization via distributional responses to directive factors. Performance of red drum held individually for up to 13 months in 1-m-diameter cages in ponds, and fed daily to satiation on shrimp meat, indicated no cage constraint on growth: In 397 days, six fish grew from 4.4-15.5 g to 1,273-1,526 g, which far exceeds normal growth rates of red drum in Texas bays. However, such performance was consistent with simulation, under the ecophysiological model.

Dr. William H. Neill  
Department of Wildlife and Fisheries Sciences  
Texas A&M University  
College Station, Texas 77843-2258  
(979) 845-5759  
w-neill@tamu.edu



## How oysters and mussels absorb pollutants

- Bioavailability of colloid-associated metals to estuarine bivalves

Oysters and mussels, or bivalves, have been used as indicators of pollution for several decades. They are uniquely capable of concentrating pollutants from the large volumes of water that they filter. However, how these animals take up and accumulate these metals and other pollutants has not been thoroughly studied. The role of colloids, metals dissolved in water and often associated with organic, large molecules and tiny particles, has never been studied in relation to metal availability and toxicity to oysters and mussels. This research examined the extent to which oysters and mussels take up and accumulate colloid-associated metals and examine whether the presence of colloidal organic carbon alters the availability of metals to marine animals. During the third year of this project (March 1, 2000 to Feb. 28, 2001), the researchers continued to carry out bivalve exposure experiments and extended to marine plankton as well as comparative experiments. In addition, they focused their efforts on data interpretation, manuscript preparation and getting research results published. The major accomplishments during the third year include presentations at scientific meetings and 10 papers appearing in academic journals during the three-year project period. During this funding period, one of the principal investigators, Dr. Sammy Ray, has spent significant amounts of time with local oyster fishermen. The advancement of scientific knowledge on the use of bivalves as bioindicators of water pollution in environmental assessment programs was thus effectively communicated by the researchers funded by this project.

Dr. Peter Santschi  
Department of Oceanography  
Texas A&M University at Galveston  
PO Box 1675  
Galveston, Texas 77553-1675  
(409) 740-4476  
santschi@tamug.tamu.edu

## Texas Sea Grant Fellowship Program

In 2000, Texas Sea Grant launched a statewide fellowship program. The program is patterned after the highly successful Dean John A. Knauss Marine Policy Fellowship that is funded at the national level. The program provides one fellowship for a graduate student, who is nearing completion of a master's or doctorate, to serve with one of the state's natural resource agencies. The Texas Sea Grant Fellowship is seen as a capstone educational opportunity to students who are in the final stages of their graduate degree programs in either natural resource or marine policy studies. The one-year fellowship will usually begin on Sept. 1. Supporting agencies include Texas Parks and Wildlife, the Texas Water Development Board and the Texas General Land Office.

## Dean John A. Knauss Marine Policy Fellowship

The Dean John A. Knauss Marine Policy Fellowship was established by Congress in 1987 to give a unique educational experience to graduate students enrolled in marine or Great Lakes studies. Students apply to the program through the 29 state Sea Grant programs, which select candidates to sponsor. 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 one or two students accepted as fellows each year. The interns receive a monthly stipend to support themselves during the fellowship.

## Operation Neptune 5K

- Archaeological remote-sensing survey of Operation Neptune, the D-Day landings at the Omaha and Utah beachheads

This project is an effort to obtain additional information on U.S. Navy losses during Operation Neptune, the naval portion of Overlord, through remote-sensing data collection at the Utah and Omaha beachheads. Secondly, this project will create a planning document to assist in the management and preservation of the landing areas and associated cultural resources. The information assimilated into the Naval Historical Center's planning document will be used to provide future research baseline data for the evaluation of site significance and suitability for nomination to the National Register of Historic Places. The project is the first phase in a multi-year project planned to study United States' naval losses during Operation Neptune. In the summer of 2000, the first year of the project, researchers have already identified six to eight Sherman tanks and more than two dozen wrecks lying off the Normandy coast.

Brett Phaneuf  
Institute of Nautical Archaeology  
P.O. Drawer HG  
College Station, Texas 77841-5137  
(979) 845-6694  
brett.battelle@usa.net



## Dialects of the Texas coast

- Fishing for Life: An ethnodialectological examination of maritime communities

The coastal maritime communities of Texas were not surveyed as part of the Linguistic Atlas of the Gulf States, and these communities are now culturally and linguistically endangered as a result of globalizing economic and ideological shifts. This project will record local dialect and cultural practices for archival purposes as well as for the purpose of improving ethnodialectological methodology and developing an explanatory model of dialect change through long-term comparative fieldwork within Texas and across three countries sharing the North Atlantic (United States, Canada and Denmark). The Danish data have already been collected.

Dr. Lisa Ann Lane  
Department of English  
Texas A&M University  
College Station, Texas 77843-4227  
(979) 845-8338  
la-lane@tamu.edu

## Preserving an invertebrate collection

- Texas Cooperative Wildlife Collection Division of Marine Invertebrates

This collection, consisting of 15,000 lots of invertebrates, was placed under the curatorship of the staff of the Texas Cooperative Wildlife Collection in the Department of Wildlife and Fisheries Sciences in 1999. At that time, the Department of Oceanography made available limited funds to purchase critical supplies, including two drums of ethanol and a stock of various plastic lids for specimen storage jars, all desperately needed to control evaporation of ethanol solutions resulting from the backing-off tendencies of the old lids. Additional funds were made available to hire a half-time undergraduate for one semester to "top off" jars with ethanol and replace some of the old "bakelite" lids (the worst offenders of backing off tendencies) with the new polypropylene ones. Some cleaning and rearranging of the collection was also possible at that time. More than 25 percent of the collection is still below minimal curatorial standards. In order to continue curating the Marine Invertebrate Collection, minimal supplies and chemicals are needed.

Dr. R. Kathryn Vaughan  
Department of Wildlife and Fisheries Sciences  
Texas A&M University  
College Station, Texas 77843-2258  
(979) 845-5783  
rkvaughan@tamu.edu

## Studying the effects of a sewage plant

- Response of a tidal creek phytoplankton community to nutrient loading: Sensitivity regarding initial composition and mode of perturbation

The focus of this research is on variability of phytoplankton succession patterns and secondary productivity in response to nutrient loading from the Corpus Christi Allison sewage plant. It is also the intent of this research to continue to explain spatial and temporal trends of the community structure of the plankton in tidal creeks of the Rincon Delta. The project addresses how changes in current water management practices in Texas' lower Nueces River and Rincon Delta may influence current succession patterns in the plankton community found within the tidal creeks of the delta.

Dr. Daniel L. Roelke  
Department of Wildlife and Fisheries Sciences  
Texas A&M University  
College Station, Texas 787843-2258  
(979) 845-0169  
d-roelke@tamu.edu



## Establishing a low-power radio station at a coastal nature center

A low-power radio unit will be installed at the Matagorda County Birding Nature Center and be used to disseminate information on the birding center, the Texas Coastal Birding Trail, the surrounding environment and the Texas Sea Grant College Program. Visitors to the center can tune into the AM Broadcasts using a standard radio. At the site, signage will inform visitors of the broadcast and how to find it on their radios. Because these radios operate at a low frequency, they do not require FCC licensing. A new communication capability will result from this pilot project. The Texas Sea Grant College Program and the Matagorda County Birding Center will be able to communicate with all users of the center and provide information on the center and coastal issues/attractions. The project organizers can change the messages at any time and with any frequency they choose. This project also will demonstrate the effectiveness of localized, radio messages and hopefully serve as the first step in a larger effort by Texas Sea Grant to place low-power radio stations at other sites along the coast. These sites could provide a valuable tool for educating the public not only about Texas Sea Grant but also about the issues, and hazards, they will encounter along the Texas coast.

Mark Evans  
Suite 1800  
2700 Earl Rudder Fwy South  
College Station, Texas 77845  
(979) 862-3770  
mark-evans@tamu.edu

Dewayne Hollin  
Suite 1800  
2700 Earl Rudder Fwy South  
College Station, Texas 77845  
(979) 845-3857  
dhollin@neo.tamu.edu

Logan Respass  
220 7th Street, 4th Floor  
Bay City, Texas 77414  
(979) 245-4100  
l-respass@tamu.edu

## Matagorda Bay Bycatch Study

In 1997, commercial bay fishermen requested that Sea Grant conduct an independent study of the bay shrimp industry and the associated ratio of bycatch to shrimp in the bay shrimp fishery. To date, little data has been collected on bay shrimp trawl bycatch ratios. Since, data voids exist, it is assumed the ratio of bycatch to shrimp are similar to the ratios seen in the gulf shrimp fishery or higher. After two years of data were collected and analyzed, it was found the ratio approached 1:1 or less. It was determined that this study would be a long-term study in order to provide more complete scientific data.

John O'Connell  
PO Box 86  
Port Lavaca, Texas 77979  
(361) 552-9747  
j-oconnell@tamu.edu

## Handling Live Bait Video

Efforts to keep bait alive continues to be a topic of interest along the Texas coast. In 1997, work to modify live bait systems into recirculating systems was launched. Since that initiative was begun, a number of public workshops were conducted and one Sea Grant publication produced. The proposed project would enhance outreach efforts by providing a 20- to 25-minute video that would provide an overview of recirculating system operation, components needed and use of oxygen injection in bait systems at the dock and on the boat.

John O'Connell  
PO Box 86  
Port Lavaca, Texas 77979  
(361) 552-9747  
j-oconnell@tamu.edu

## Schools in Schools

In conjunction with this project, red drum fingerlings will be donated by the Texas Parks and Wildlife Department's Sea Center Texas and placed in 30- and 50-gallon aquariums located in two, sixth-grade classes. The fish will be raised by the students during the school year. The students will be taught math, science, reading and history using the fish to "hook" the students on learning. This will enable the teachers to have the students more involved through hands-on and entertaining learning experiences.

Richard E. Tillman  
1800 County Road 171  
Angleton, Texas 77515  
(409) 864-1564  
r-tillman@tamu.edu

## Marine education coordination and communications

The formation of an advisory group to identify information transfer and skill development needs of clients as well as institutional opportunities for cooperation/collaboration in marine education appears an imminent progression in the Marine Advisory Service's ongoing efforts to make its outreach efforts more relevant and effective. This "committee" will be comprised of representatives of a variety of state and national agencies and organizations keenly involved in marine and/or coastal education affairs. This initiative intends to: 1. Issue invitations to a well-rounded list of agencies and organizations to participate; 2. Host a minimum of two meetings per year of the MAS Marine Education Committee; 3. Develop a site on the Texas Sea Grant web page that will include a calendar of events of state marine education events.

William Younger  
Texas State Marine Education Center  
100 Marine Center Drive  
PO Box 1283  
Palacios, Texas 77465  
(361) 972-5370  
w-younger@tamu.edu



## Multi-state/multi-national watershed education expedition

This project will seek to develop a field study venture focusing on the Rio Grande, from its headwaters in New Mexico to its terminus at the Gulf of Mexico near Brownsville, Texas. This project would generate the following benefits:

- A notably enhanced understanding and appreciation for the social, environmental and economic importance of this river to the people of two nations by the students and educators participating in a Rio Grande River Run.
- Increased public visibility and recognition for each of the sponsoring entities.
- Expanded opportunities for grant funding from public and private sector sources at every level.
- A model for international/multi-state watershed education field studies with a readily transferable development strategy and delivery format.

William Younger  
Texas State Marine Education Center  
100 Marine Center Drive  
PO Box 1283  
Palacios, Texas 77465  
(361) 972-5370  
w-younger@tam.u.edu

Tony Reisinger  
650 East Hwy. 77  
San Benito, Texas 78586  
(956) 399-7757  
e-reisinger@tam.u.edu

## A comparison of knotless and knotted high-density polyethylene shrimp trawls in relation to fuel consumption

Diesel fuel prices have risen more than 40 percent during the last year while shrimp prices have remained relatively stable. This project will attempt to reduce fuel consumption by reducing the drag of shrimp trawls through constructing fishing trawls with knotless high-density polyethylene. Studies have previously shown significant fuel savings or production increases by using knotted high-density polyethylene (Spectra), compared to traditional nylon for trawls. Smaller twine diameters are used because of the increased strength of the high-density polyethylene, allowing drag reduction compared to bulkier nylon. With the introduction of knotless, high-density polyethylene, drag can be further reduced by the elimination of knots. An added advantage is the retention of 100 percent of the twine tensile strength, which is normally reduced 50-60 percent by knots. A disadvantage is the high cost, which is almost twice that of Spectra. With the cooperation of a local fleet owner, four, 60-foot flat trawls using UC Silver (knotless) will be constructed and compared to Spectra (knotted) trawls already being used.

Tony Reisinger  
650 East Hwy. 77  
San Benito, Texas 78586  
(956) 399-7757  
e-reisinger@tamu.edu

# TEXAS SEA GRANT COLLEGE PROGRAM

2700 Earl Rudder Fwy South, Suite 1800  
College Station, Texas 77845  
FAX (979) 845-7525

## ADMINISTRATION

Robert R. Stickney ..... (979) 845-3854  
Director  
Peggy Foster ..... (979) 845-1245  
Assistant to the Director  
Lynn Propes ..... (979) 845-3854  
Staff Assistant  
Terry Poehl ..... (979) 845-3854  
*Fiscal Officer and Business Manager*  
Stephanie Wilborn ..... (979) 847-8978  
*Financial assistant*

## MARINE INFORMATION SERVICE

Amy Broussard ..... (979) 845-3854  
*Associate Director and Publications Program Director*  
Jim Hiney ..... (979) 862-3773  
*Texas Shores Editor*  
Mark Evans ..... (979) 862-3770  
*Science Editor*  
Eric Graham ..... (979) 862-3774  
*Webmaster and Computer Technician*  
Jesse Rodriguez ..... (979) 862-3767  
*Distribution Manager*

## MARINE ADVISORY SERVICE

Ralph Rayburn ..... (979) 845-7526  
*Associate Director and Marine Advisory Service Leader*

## MARINE AGENTS

Richard Tillman ..... (979) 864-1564  
*Brazoria County*  
1800 County Road 171  
Angleton, Texas 77515  
FAX (979) 864-1566  
John O'Connell ..... (361) 552-6727  
*Calhoun County*  
P.O. Box 86  
Port Lavaca, Texas 77979  
FAX (361) 552-6727

Tony Reisinger ..... (956) 399-7757  
*Cameron County*  
650 E. Highway 77  
San Benito, Texas 78586  
FAX (956) 361-0034

Julie Massey ..... (281) 534-3413  
*Galveston County Marine Agent*  
5115 Highway 3  
Dickinson, Texas 77539  
FAX (281) 534-4053

Terrie Ling ..... (409) 835-8461  
*Jefferson County/Chambers County*  
1295 Pearl Street  
Beaumont, Texas 77701  
FAX (409) 839-2310

Logan Respass ..... (409) 245-4100  
*Matagorda County*  
2200 7th Street - 4th Floor  
Bay City, Texas 77414  
FAX (409) 245-5661

## MARINE SPECIALISTS

Granvil Treece ..... (979) 845-7527  
*Aquaculture Specialist*  
Texas Sea Grant College Program  
2700 Earl Rudder Fwy South, Suite 1800  
College Station, Texas 77845  
FAX (979) 845-7525

Dewayne Hollin ..... (979) 845-3857  
*Marine Business Management Specialist*  
Texas Sea Grant College Program  
2700 Earl Rudder Fwy South, Suite 1800  
College Station, Texas 77845  
FAX (979) 845-7525

William Younger ..... (361) 972-5370  
*Marine Education Specialist*  
Texas State Marine Education Center  
P.O. Box 1283  
100 Marine Center Drive  
Palacios, Texas 77465  
FAX (361) 972-3921

John Jacob ..... (281) 291-9252  
*Environmental Quality Specialist*  
c/o Armand Bayou Nature Center  
PO Box 58828  
8500 Bay Area Blvd. - 77507  
Houston, Texas 77258  
FAX (281) 291-0552



Younger, William ..... w-younger@tamu.edu

