

**Texas Sea Grant College Program
2010-2012 Funded Projects**

**Coastal Ecosystems and Habitats Role of Microzooplankton in Coastal Ecosystems:
Viewing Windows of Opportunity**

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Abstract

Harmful algal blooms (HABs) are a growing concern for human and ecosystem health, yet the mechanism of bloom initiation is not well known. Patterns in microzooplankton abundance will be examined to determine if “loopholes” in grazing pressure can be linked with HAB occurrences. Plankton cell abundances will be determined using the Imaging Flow Cytobot, a new instrument combining video and flowcytometric technology to capture high resolution (~1 μm) images. Subsequently, image processing developed for phytoplankton will be extended to microzooplankton taxa so that automated classification can be used to quantify individual categories. Grazing impact experiments will provide specific growth and grazing rates, which in combination with abundance data will provide basis for evaluating the opportunity for algal blooms. Deployment of the Imaging FlowCytobot at the University of Texas’ Pier Laboratory in Port Aransas, TX began in Sept. 2007 and will continue as part of the Mission-Aransas Estuarine Research Reserve to provide data for this project. Observed relationships between microzooplankton and HAB species together with the patterns in population dynamics will be employed in developing predictive indices for early warning of HAB events in the Gulf of Mexico. Dissemination of data will include developing a website for Texas plankton images and using this reference in hands-on training of stakeholders such as the volunteer groups “Red Tide Rangers” and Texas Master Naturalists, who participate in HAB monitoring for Texas.

Geological Controls on Submarine Groundwater Discharge Into an Upper Bay Estuary-Copano Bay

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Abstract

Submarine Groundwater Discharge (SGD) to estuaries and the ocean has long been recognized as an important component of the estuarine and coastal hydrological cycle, but has more recently been recognized as an important pathway for nutrients, contaminants, and dissolved organic matter from the regional and local aquifers to the estuaries and the ocean. The purpose of this study is to determine both the mechanisms and the relative importance of SGD in the delivery of nutrients, dissolved organic matter, and dissolved contaminants to the estuaries of the central Texas coast by using Copano Bay as an example. This bay is a relatively undisturbed and natural system, is typical of the upper-bay systems of Texas, and the rivers flowing into Copano Bay, including Aransas River, Mission River and Copano Creek, are natural rivers with no significant impoundments. During the summer of 2007 the Coastal Geology Lab at

Texas A&M University-Galveston (TAMUG) mapped all of Copano Bay with side scan sonar, single beam bathymetry and CHIRP high resolution seismics, running lines every 150 m for the entire bay, providing the most comprehensive subsurface data set for any bay in Texas. In addition, a series of cores were collected for additional subsurface control. As a result, there is a tremendous data set to draw from when designing and conducting this study.

This study will test three hypotheses: (1) Significant freshwater SGD is from aquifers consisting of Holocene filled incised channels; (2) Fringing marshes are a source of brackish SGD with high ammonia and phosphate; (3) Oyster reefs act as conduits, or are co-located within conduits.

These hypotheses will be tested using towed marine resistivity arrays, seismic CHIRP profiling, coring, groundwater sampling, and chemical analyses. Groundwater models will be used to verify the conceptual models of the flow rates, patterns, and pathways.

Investigating the Processes That Affect Texas Coastal Hypoxia

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Abstract

Hypoxia is a well studied and threatening condition in bottom coastal waters where dissolved oxygen concentrations fall below 1.4ml/l. In the northern Gulf of Mexico and south of Louisiana, hypoxia famously occurs seasonally and is principally caused by nutrient and freshwater flux onto the continental shelf by the Mississippi and Atchafalaya Rivers. However, preliminary analysis of historical water quality data over the last 25 years show that hypoxic events along the Texas coast can occur at anytime of the year, persist for weeks and are associated with the principal freshwater passes onto the continental shelf. Unlike the much larger Louisiana hypoxic region, there has not been an examination of the mechanisms and processes responsible for the formation, duration and breakdown of Texas coastal hypoxia. We propose implementing a multifaceted research plan to investigate the processes responsible for Texas hypoxia which includes a) forming a single database of historical federal, state and local water quality and hydrographic data, b) contributing state-of-the-art data from future concurrently funded federal and state projects and c). conduct spatial and temporal statistical analyses from the database. The last piece is to develop educational and outreach components for educating the coastal community on the implications of long-term hypoxia and to assist coastal management in developing strategies to mitigate the effect on the Texas coastal environment.

Promoting Larval Survival Through Broodstock Diet: Implications for Fish Stock Enhancement

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Abstract

The overall aim of the proposed research is to assess the influence of parental diet on egg fatty acid composition and the survival skills of red drum (*Sciaenops ocellatus*) larvae. Current research in our laboratory has shown superior antipredator performance of 3-week-old larvae from egg batches that had higher levels of two fatty acids: Arachidonic Acid (ARA) and Docosohexaenoic Acid (DHA). In a first step we will define the effects of broodstock nutrition on egg fatty acid content by manipulating the levels of ARA and DHA in the diets of captive adults during gonadal maturation and spawning. Secondly, we will assess the relationship between egg fatty acid content and larval survival skills. Finally, we will examine the importance of these findings to natural populations by assessing the variation in fatty acid content of eggs produced by wild females. The results of this research will be immediately useful for management of broodstock in stock enhancement programs for red drum and other important species by Texas Parks and Wildlife Department and other agencies. Successful stock enhancement helps maintain healthy coastal ecosystems that sustain the recreational fishing industry, a key component of the economy of Texas and other coastal states.

Genetic Effective Size in Hatchery-raised Spotted Seatrout, *Cynoscion nebulosus*, Released for Stock Enhancement in Texas Bays and Estuaries

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Abstract

Recreational fishing for the estuarine-dependent sciaenids *Cynoscion nebulosus* (spotted seatrout) and *Sciaenops ocellatus* (red drum) is a vital resource to economies of coastal communities in Texas, accounting in 2006 for roughly \$530 million in expenditures by over a million 'spenders.' Because of recent declines in abundance, the Texas Parks and Wildlife Department (TPWD) has initiated a program of stock enhancement of spotted seatrout, similar to the successful program for red drum initiated more than 20 years ago. A two-year project, utilizing molecular markers developed through current Texas Sea Grant funding, to address critical hatchery and hatchery-release aspects of the stock-enhancement program for spotted seatrout carried out by TPWD is proposed. Specific major accomplishments will include: (i) determination of the sex and productivity of individual brood fish at the two TPWD hatcheries; and (ii) assessment of the potential for a Ryman-Laikre effect (reduction in effective size and fitness of a 'wild' population stemming from small effective size of a hatchery-release population) on the seatrout fishery in Texas waters. Data from the project also will be used to determine if levels of genetic variation and allele/genotype distributions of hatchery broodfish differ from those of seatrout resident in the four Texas bays or estuaries where seatrout from TPWD hatcheries are released, and to identify the proportion of hatchery-released fish among samples of 100 fish from each bay or estuary. The TPWD is a full partner in the proposed research and will contribute significant matching funds to attain project objectives. A number of outreach activities also is proposed and will include personnel from Texas A&M University, TPWD, Sea Grant, and the Coastal Conservation Association-Texas. Targets of outreach activities include the 90,000 annual visitors to TPWD hatcheries, two chapters of the Texas Master Naturalists association, and tour groups (primarily primary- and secondary-schools) at Sea Center Texas. Results of the project will benefit multiple users and stakeholders, including fishers, coastal communities economically impacted by recreational fishing, TPWD, and other states in the Gulf Coast region planning to implement stock-enhancement of spotted seatrout. Results of the study also will be disseminated to the scientific community through publication in peer-reviewed journals.

Population Status and Demographics of the Texas Diamondback Terrapin (*Malaclemys terrapin littoralis*)

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Abstract

Diamondback terrapins (*Malaclemys terrapin*) are the only species of turtle that lives exclusively in brackish water. Due to their limited distribution and unique life history the Texas subspecies (*Malaclemys terrapin littoralis*) may be in danger of local extinction. Various sources of mortality have been identified including habitat loss, crab trap bycatch, power plant intakes, vehicular impacts and boating impacts. Little information has been gathered on the numbers or health of local Texas populations. In late September 2008, Hurricane Ike struck Galveston Bay. The exact impact on the terrapin population is unknown. However, numerous small live and dead juvenile turtles including 8-9 terrapin washed up on Port Aransas/Mustang Island beaches in late 2008 (T. Amos pers. Comm.). These terrapin were weak and two perished. This suggests that many younger terrapin may have been impacted by the hurricane. This proposed research will build upon the 2008-09 work by expanding the scope of the study to adjacent areas within Galveston Bay and adjacent sites to gather additional Texas diamondback terrapin population and demographic data. Our analysis will also include the Deer Island population and additional sites where terrapin have been sighted including the Anahuac National Wildlife Refuge, West Bay, Brazoria National Wildlife Refuge, Trinity Bay and Christmas Bay, which were not investigated in the previously mentioned study. This study will provide the first comprehensive population estimate of terrapin along the Texas coast and will provide a framework for future population studies.

An Experimental Test of The Effects of Beach Raking on Macroinvertebrate Communities of Texas Beaches.

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Abstract

Mechanical removal of beach-cast wrack is a highly debated issue within Texas' coastal counties. Central to the debate is the insufficient, often conflicting data available to natural resource managers and local governments necessary for objective decision making in regards to beach management practices. However, recent research indicates that beach-cast wrack accumulations (e.g., sargassum) are an important source of recycled nutrients and detrital material that form important trophic linkages between the food webs of oceanic, nearshore, intertidal, and terrestrial habitats. The objective of this study is to experimentally determine if the presence of beach-cast wrack influences the abundance, biomass, and trophic structure of swash zone macroinvertebrate communities through comparisons of mechanically raked and unraked beaches on South Padre and Brazos islands. The explicit objectives of this project are (1) to compare the swash zone communities in terms of trophic structure, similarity, diversity, and biomass among raked and unraked beaches; (2) to identify the species and/or trophic guilds principally responsible for recognized sample groupings [as potential stress indicators]; and (3) to frame results concerning wrack removal in the context of recommendations to coastal managers.

Wave Hydrodynamics in Segmented Wetlands with Application to Hurricane Damage Reduction and Wetlands Management and Preservation

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Hurricanes are the primary natural threat to coastal Texas communities, and fully understanding the risk of coastal damage by waves and surge is paramount for sustaining these communities and economies. This project addresses a critical need to quantify the benefit of coastal vegetation in coastal storm protection along the Texas coast, to not only better define hurricane hazard and risk, but also to demonstrate the value of preserving these rich coastal habitats. The goal of this proposed research is to quantify the impact of spatial variability in wetlands coverage on wave hydrodynamics, namely the impacts on wave attenuation and refraction and on the development of wave-induced currents along marsh fringes. To achieve this goal, we propose a combined experimental and numerical approach. First, a series of large-scale experiments will be conducted in the 3D Shallow-Water Wave Basin at Texas A&M University to investigate wave hydrodynamics in and around multiple idealized marsh segments. Second, a series of coupled, numerical hydrodynamic and wave model simulations will be used both to improve model skill, by integrating experimental findings into model numerics, and to quantify wave hydrodynamics in multi-segmented, field-scale wetlands management applications.

Post-Ike Recovery Of Upper Texas Coast Beaches And Their Status As Sea Turtle Nesting Habitat

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Recovery of upper Texas coast (UTC) beaches ravaged by Hurricane Ike will be evaluated long term in relation to repairing environmental damage to constituent beaches and strengthening the resiliency required for healthy coastal ecosystems to function. Post-Ike recovery of beach ecosystems from Bolivar Peninsula to Surfside will be characterized by coupling comparative assessments of habitat restoration efforts with those of an ecological function, sea turtle nesting, whose success depends on said recovery. Kemp's ridley nesting dynamics on UTC beaches during 2009-2011, when characterized as to type and quality of habitat (as determined by beach and sediment profiles) over which nesting occurs, will be used as an index of ecosystem recovery. Nesting, beach morphology and sediment data collected on UTC beaches during 2007-08 will provide a baseline on which to assess changes in nesting activity that may have resulted from Ike's impact and/or the success of habitat restoration. Satellite telemetry will determine intra-nesting season fidelity of pre-and post-Ike nesters to UTC beaches and habitat types on which repeated nesting occurs. Post-Ike nesting trends will be used to assess the UTC's potential to support a Kemp's ridley nesting colony complementing that on this species' primary nesting beach at Rancho Nuevo, Mexico.

Marine Education: Teaching High School Students the Scientific Method through Involvement in an Ongoing Field Experiment

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Abstract

Involving students in research has been shown to increase understanding of scientific concepts and improve student learning and retention. Funds are requested to develop an outreach program between Tulosso-Midway High School (TM) and Texas A&M - Corpus Christi (TAMU-CC). Both PIs, along with TAMU-CC graduate and undergraduate students, will create a Science Club at TM. TM students will learn scientific methodology and procedures as part of the science club. During their April break, they will attend a one week training session at TAMU-CC, which includes two field trips, to learn experiential procedures. TM students will then assist TAMU-CC researchers during the summer as they complete an ongoing field experiment designed to determine how predators affect oyster reef communities. TAMU-CC students will learn how to perform outreach activities, TM students will learn about how science is used as a process for discovery, and together, these students will complete a relevant research project. By involving TM students in research and demonstrating the usefulness of science and how the scientific method is used to solve problems, we will increase the scientific literacy of TM students and the probability that they will attend college and pursue a degree in science.

Evaluation of LISST instruments to monitor for harmful algal blooms (HABs) in Texas coastal waters

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Abstract

Harmful algal blooms (HABs) are an ongoing threat to coastal ecosystems, industry and leisure along the Texas coast. A challenge to bloom management is the early detection of HABs, which are patchy both in time and space. This research will evaluate the application of laser in situ scattering and transmissometry (LISST) as a tool to detect the presence and abundance of HAB species in the water column. LISST instruments have the potential to be a component of HAB monitoring systems as they are low-cost and easy to maintain, facilitating the deployment of multiple instruments at once and therefore the monitoring of a large area in real time. The research objectives are: 1.) To use the LISST-100X to determine the scattering signatures of HAB species that occur in Texas waters, and 2.) To conduct microcosm experiments to determine whether HAB species can be detected at concentrations representative of in situ bloom conditions against a background of naturally occurring particles. The research results will provide resource managers with the information they need to determine whether LISST instruments are a feasible tool for HAB detection in Texas waters.

Freshwater residence and habitat requirements of southern flounder determined by otolith chemistry

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Abstract

Southern flounder (*Paralichthys lethostigma*) is a broadly distributed and economically valuable species in the Gulf of Mexico, and the most sought-after flatfish on the Texas coast. Population sizes in Texas have declined dramatically over the past two decades, and the long-term sustainability of this fishery is at risk. A key uncertainty is the degree to which juvenile southern flounder require low salinity habitats for successful recruitment. The proposed work will directly assess freshwater residency patterns during juvenile life history stages using stable isotope ($^{87}\text{Sr}/^{86}\text{Sr}$) and trace element (Sr:Ca, Ba:Ca) ratios in ear bones, or otoliths, of southern flounder from coastal habitats in central Texas. Otolith chemical markers will also be compared to analyses of water samples from several freshwater sources in the region to determine residency patterns in specific tributaries. Residency patterns will then be compared to gauged stream flows to explore relationships between habitat use and outflow rates. This work will inform management strategies that require a comprehensive understanding of habitat requirements during critical juvenile life history stages and the impact of freshwater habitat and flow regimes on population dynamics of an important fishery species.